Strengthening European Food Chain Sustainability by Quality and Procurement Policy

Deliverable No: D6.3

EVALUATION OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF DIFFERENT MODELS OF PSFP IN A SCHOOL CONTEXT:

FINAL REPORT

February 2019

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Author(s)	Angela Tregear, Maysara Sayed, Mary Brennan (UNED); Ružica Brečić, Irena Colić Barić, Andrea Lučić, Martina Bituh, Ana Ilić, Dubravka Sinčić Ćorić (ZAG); Efthimia Tsakiridou, Konstadinos Mattas, Christos Karelakis, Alexandros Gkatsikos, Ioannis Papadopoulos (AUTH); Filippo Arfini, Beatrice Biasani, Daniele Del Rio, Michele Donati, Francesca Giopp, Gianluca Lanza, Alice Rosi, Francesca Scazzina (UNIPR); Jelena Filipovic, Zorica Anicic (BEL) Steve Quarrie (EUTA)
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EVALUATION OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACT OF DIFFERENT MODELS OF PSFP IN A SCHOOL CONTEXT:

PART 1: SYNTHESIS

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EXTENDED ABSTRACT

This report presents a summary and synthesis of the methods and results of WP6.3, evaluating the environmental, economic and social impacts of different models of Public Sector Food Procurement (PSFP) in a school context (more details are provided in each of the Country Reports comprising D6.3). The report builds on insights gained from D6.1 (report on contract tendering and award procedures for PSFP in European countries), and also integrates key findings from D6.2 (nutritional impact of PSFP models, including the role of plate waste). Significant resources are spent in public procurement, and there are on-going debates as to how the sustainability outcomes of this sector may be enhanced, including for rural territories. EU Procurement Directive 2016/24 (EC, 2014) makes provisions to encourage more flexible, open and transparent contract tendering processes, to promote economic and social benefits from public procurement, as well as positive environmental outcomes (also covered by Green Public Procurement (GPP) advice (EC, 2016). Such policies respond to calls for PSFP to adopt alternative models (e.g greater use of local sourcing and/or organic produce), as these may be linked to enhanced sustainability outcomes. To date, however, the environmental, economic and social outcomes of different models of PSFP have yet to be examined systematically. The WP6.3 research reported here aimed to fill this gap.

In each of five countries (Croatia, Greece, Italy, Serbia, UK), a pair of case studies was undertaken, each case study representing a contrasting model of PSFP. Each case model consisted of the supply chain providing meals to a sample of five schools in the case (four schools in the Serbian cases). Primary and secondary data were then collected to evaluate the sustainability impacts of these meals services. In four countries (Croatia, Greece, Serbia, UK), the paired cases comprised one 'LOW' model, where contract awards were made mostly or entirely on the basis of lowest price, and one 'LOC' model, where either the contract award criteria referred to local sourcing, or in practice the chain consisted of a proportion of local suppliers. In Italy, where by regional law a minimum of 70% of food procured for school meals must come from organic agriculture, integrated production, or typical and traditional products, the two cases were LOC-ORG (a model operating according to this law) and ORG (a model in which the contract primarily referred to organic sourcing).

In terms of the contexts of the paired cases, building on the insights from D6.1 (report on contract tendering and award procedures for PSFP in European countries), we identified many interesting variations across the five countries. For example, differences were found in terms of who is responsible for contracting and managing school meals services (in Greece, Italy and UK, it is municipalities/Local Authorities (LAs), but in Serbia and Croatia it is handled by individual schools); the length of the contract renewal cycle (from up to nine years in one Italian region, to one year in Serbia and Croatia); and the mode of meals service delivery (high use of private central caterers in Italy and Greece vs. in-house provision in Croatia and Serbia). We also found considerable differences in the typical number of suppliers contracted per model, the prices of meals, and the staffing levels in kitchens. Although our main focus was on examining the differences between models within each case pair, these contextual insights across the countries added to our understanding and interpretation of the main results, and also informed our conclusions/recommendations.

To evaluate environmental impacts, we devised a method based on the approach of Lancaster and Durie (2008), which involved estimating the total carbon emissions (in kgs $C0_2$eq) generated by a school meals service, following the principles of Life Cycle Analysis. Specifically, for the meals service to the featured schools in each case model, we estimated the total emissions based on (i) the types of foods procured by the schools/catering units, and their

quantities, over one school year, (ii) the kms travelled by first tier suppliers to deliver the foods, taking into account vehicle types, loads and numbers of customers in the rounds, and (iii) the quantities of plate waste generated and the disposal method. Overall, the analysis found that across all cases, the greatest contributor to total carbon footprint was the <u>production, processing and upstream transportation of the food items.</u> This was in contrast to downstream transportation (from first tier suppliers to caterer/schools), which generally contributed only a modest proportion of total emissions. In particular, the rate of emissions was affected by the quantities in the average meal of (especially red) meat and other animal products such as hard cheeses, which have a high carbon burden, vs. fruits and vegetables, which have a low burden. Hence, our results showed that <u>the carbon footprints of the PSFP models here depended more on the composition of the meals rather than where the foods came from</u>. A further important finding from the environmental analysis was the <u>important role of food waste disposal method to total carbon footprint</u>. In countries where low carbon disposal methods such as anaerobic digestion, composting and animal feed are practiced (Croatia, Italy, UK), waste disposal comprised a very small part of total emissions for all cases (even when plate waste rates were high, as in Italy). However, in Greece and Serbia, where landfill is a common disposal method, waste contributed much higher proportions of total emissions. In terms of within-pair differences between the case models, we found that in four out of the five pairs (Greece, Italy, Serbia, UK), the LOC model had a lower carbon footprint than the LOW model. However, our analysis shows that the differences were <u>not</u> due to the localisation profile of the model, as transport emissions comprised only a modest part of total emissions in all cases. Instead, the differences were explained by the composition of the meals, i.e. the average meals in LOC models exhibited less meat and animal products, and more fruits and vegetables, compared with LOW models. This explanation also held true for the Croatian case pair, where LOW model meals had a smaller carbon intensity than LOC.

To evaluate <u>economic impacts</u>, we gathered data on the flows of expenditures from meals service budgets, and staff/supplier locations, in order to estimate the local economic multiplier (LM3) effect of the meals services. Across the cases, the highest LM3 ratio calculated was 2.46 (Serbia LOC), and the lowest 1.59 (Greece LOW). The ratios indicated that in the highest case, every 1.00 spent from the school meals budgets generates an additional 1.46 for the local economy, whereas the additional value is only 0.59 in the lowest case. In terms of within-case pair differences, the results were as expected for three case pairs (Greece, Serbia and UK), whereby ratios for LOC cases exceeded those of their counterparts, due to their proportionately higher expenditures on local suppliers. In Italy and Croatia, LOC models gave smaller LM3 ratios than their counterparts. For Italy, the explanation is that despite the municipal ambition to encourage local sourcing in the LOC-ORG case, there was a *de facto* low budget spend on local suppliers in this case. The result highlights how important it is for contracting authorities to translate sustainability goals into specific and measurable contract criteria, in order to truly influence procurement practices and economic multiplier effects. In Croatia, the smaller LM3 ratio in LOC case was due to a lower proportion of total budget spend on payroll, and also a slightly smaller proportion of locally resident staff, comparied with LOW case. The result highlights the important contribution of payroll expenditures to local economic impact in public procurement, particularly in services which involve high labour intensity and reliance on a workforce located conveniently for locally dispersed sites (as is the case with school meals services). In these kinds of services, payroll can have an uplift effect on overall economic multiplier. This effect was evidence in three out of the five case pairs.

We also gathered data from secondary sources, and from supplier interviews, to estimate the <u>economic value of the contracts to suppliers</u>. Overall, it was found that suppliers to the PSFP cases were a mix of large and small firms, indeed ranging in extremes from local microbusinesses (2 employees, turnover of €40,000) to very large national/international enterprises (2,000 employees turnovers of >€200million). However, in the vast majority of instances, the school meals contracts of the case models represented only very small, or negligible proportions of suppliers' total businesses, and these had not contributed directly to the winning of new business for those suppliers. The exceptions to this were two of the private catering firms (UK LOC caterer, Italy ORG caterer), and a handful of smaller firms in other cases. Nevertheless, in interviews, suppliers rated their involvement in the PSFP contracts positively, as a steady and complementary area of business. Also, the results possibly underestimate the value of PSFP contracts, as a whole, to the suppliers in the chains, as many were engaged in fulfilling multiple contracts. There were no notable differences found in the economic value indicators between the cases in each pair.

To evaluate social impacts, we gathered data (mainly from interviews with suppliers and school leaders) on the employment profiles of individuals working in the case meal services/supply chains, and their levels of training/qualifications. We also gathered information about the working environments and levels of connectedness between members of the chain.

In terms of the profiles of employees in the PSFP cases, the main finding was that, regardless of case, the profiles reflected those found in wider catering and distribution sectors. Therefore, the majority of jobs in supplier firms were taken by male employees, and were mostly full-time, whilst in the catering firms, the majority of the workforces were female, with a higher proportion of part-time jobs. Ethnic minority representation was generally very small. The main exception to these profiles came from the Serbian cases, where several suppliers had higher female and ethnic minority representation, a fact that was attributed to the population profiles of the local areas, rather than the features of the procurement models of the cases. In terms of staff training and skills development, the main differences observed in the cases were linked to national variations (much higher engagement in formal qualifications and training in Italy, Greece and UK; greater reliance on informal, peer-to-peer training in Serbia), and firm size (larger firms, particularly in UK and Italy, engaged in multiple development activities including their own 'academies'), rather than the procurement models.

In terms of working environment and connectedness, the research found that relations between supply chain members, and between suppliers and schools, tended to be stronger in the LOC case models than the LOW case models. Interactions were based on a wider set of social connections, whereas in LOW models they tended to be more functional and limited to specific functions/tasks to be performed in the chain. In both LOC and LOW cases, across most countries, examples were given of how suppliers and catering firms had become involved in community events and engagements, although the greatest potential for developing these seemed to be in the cases where there was an abundance of supply chain members headquartered close to each other. In terms of the links between the PSFP cases and rural communities, we found limited examples of such developments, however the potential to create them would seem to be dependent on the case context, specifically, the presence of mixed agriculture and agrifood processing within the case region.

The report concludes with a range of recommendations to key authorities and decision-makers on how to enhance the sustainability outcomes of PSFP models. Although adoption of a localised procurement model can promote positive local economic multiplier effects and greater social connectedness between supply chain members, to enhance the economic value of PSFP contracts to suppliers, and promote positive employment and training outcomes, other actions are recommended. To reduce carbon emissions of PSFP, the recommended priority sequence is adjustment of waste disposal method, then menu composition, then transportation arrangements. Finally, the report summarises key findings of D6.2 on nutritional impacts of

PSFP and the role of plate waste, and offers some integrated conclusions and recommendations based on both parts of WP6.

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List of Abbreviations and Acronyms

LA – Local Authority

LOC Model – a procurement model where the procurement contract encourages local sourcing and/or a proportion of local suppliers is present in the supply chain

LOC-ORG Model – a procurement model where the procurement contract encourages local sourcing, and sourcing of organic produce

LOW Model – a procurement model in which contract awards are based heavily, or entirely, on lowest price bids from suppliers

GPP – Green Public Procurement

LM3 – Local Multiplier 3

MEAT – Most Economically Advantageous Tender

ORG Model – a procurement model where contracts encourage sourcing of organic produce

PSFP – Public Sector Food Procurement

1. INTRODUCTION & METHODS

1.1. Objectives and Research Approach

This synthesis report presents the methods and results of WP6.3, evaluating the environmental, economic and social impacts of different models of Public Sector Food Procurement (PSFP) in a school context. Significant resources are spent in public procurement, and there are on-going debates as to how the sustainability outcomes of this sector may be enhanced. EU Procurement Directive 2016/24 (EC, 2014) makes provisions to encourage more flexible, open and transparent contract tendering processes and also to promote economic and social outcomes from public procurement, as well as environmental outcomes (also covered by Green Public Procurement (GPP) advice (EC, 2016). Such policies respond to calls for PSFP to adopt alternative models (e.g greater use of local sourcing and/or organic produce), as these may be linked to enhanced sustainability outcomes (e.g. Le Veilly and Bréchet, 2011; Morgan and Sonnino, 2006; Nielsen et al, 2009; Sonnino, 2009; Tikkanen, 2014; Triches and Schneider, 2010). To date, however, few studies have systematically examined the environmental, economic and social outcomes of different models of PSFP. The research reported here aimed to fill this gap.

In each of five countries (Croatia, Greece, Italy, Serbia, UK), a pair of case studies was undertaken, each case representing a specific model of PSFP, contrasting with the other case in the pair. In terms of scope, each case model consisted of the supply chain organised around the catering firm/unit(s) providing meals to a sample of five schools in the case (four schools in Serbian cases). Primary and secondary data were collected to evaluate the sustainability impacts of these meals services. Full accounts of the methods and techniques employed in the analysis are given in the relevant sections of this report, and in each Country Report, however in brief they were as follows:

To evaluate environmental impacts, we devised a method based on the approach of Lancaster and Durie (2008), which involves estimating the total carbon emissions (in kgs C02eq) generated by a school meals service. Specifically, for the meals service to the 4-5 featured schools in each case model, we estimated the total emissions based on (i) the types of foods procured by the catering firms/units, and their quantities, over one school year, (ii) the kms travelled by first tier suppliers to deliver the foods, taking into account vehicle types, loads and numbers of customers in the rounds, and (iii) the quantities of plate waste generated and the disposal method. In each case, we then summed the emissions from (i) to (iii) to estimate the total carbon footprint of the meals service.

To evaluate economic impacts, we investigated the local economic multiplier effect of the school meals budget and the economic value of the school meals contract to suppliers. To estimate local multiplier effect, we used LM3 methodology[1], which involved tracking the expenditures of the case school meals budget through three rounds of spending, to identify what proportions of the budget were retained in/leaked out of the local area. To investigate economic value, in each case we gathered data on the sizes and growth rates of suppliers, the contribution of the school meals contract to their total business, and the importance of the contract to operations and winning of new business. For both sets of measure, we drew from a combination of secondary sources and interview data provided by suppliers and catering firm/unit managers.

[1] Full explanation of the method is available at www.lm3online.com.

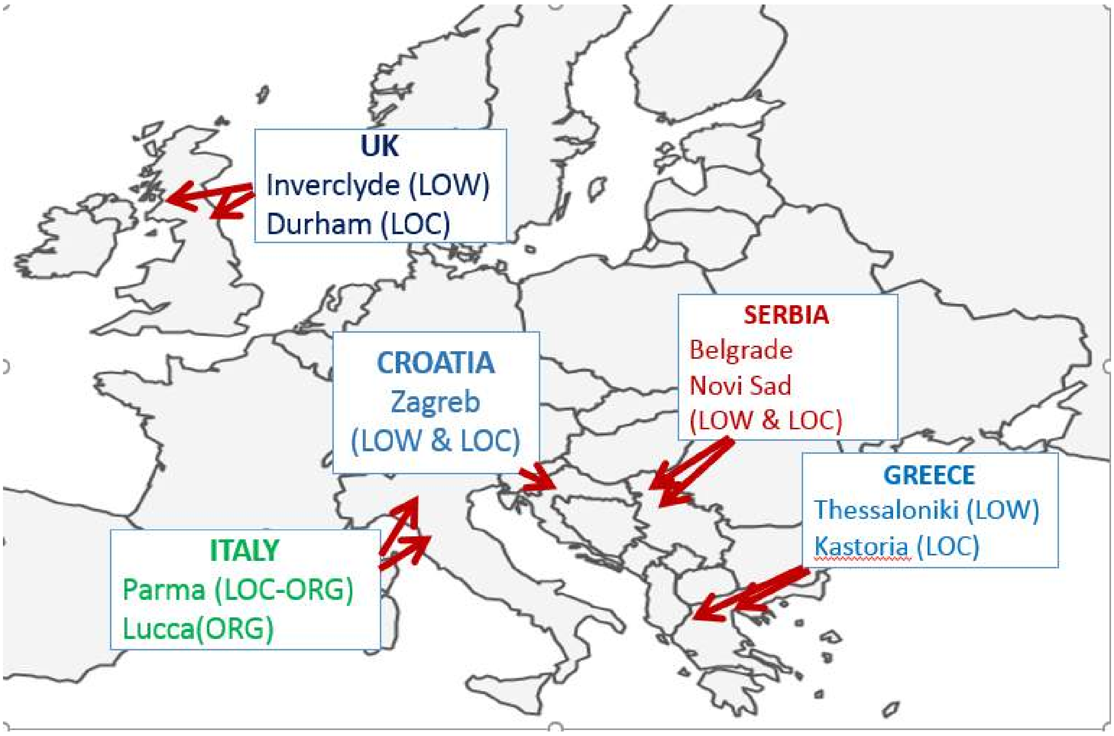
To evaluate social impacts, we investigated the employment and training profiles of the workforces involved in each case, as well as the working environments and levels of connectedness between members of the supply chain. For these measures, we drew heavily on data provided by informants in interview.

As indicated above, research teams gathered a mixture of quantitative and qualitative data from both secondary and primary sources. The main secondary sources included national/regional policy documents, contract tendering/award documents, certification scheme literature, emissions factors databases, business statistics databases, and websites/brochures of suppliers, catering firms and schools in each case. Primary data collection involved depth interviews with 10-15 informants per case, including typically 1-2 policy/municipality representatives, 4-5 suppliers, 1 representative per catering firm/unit, and 1 head teacher/representative per school.

1.2. The Case PSFP Models

The location of the case PSFP models included in this research are shown in Figure 1, followed by an explanation of the selection of the cases, and how they were defined, in each country.

Figure 1. Location of Case PSFP Models



Croatia

Both case studies are located in Zagreb City, the capital of Croatia. In Croatia, procurement contracts are normally tendered and managed by individual schools, not municipalities, and the first criterion for contract award is safety (pass/fail), and the second is price. Therefore, the dataset for one case model in this research (LOW) consists of five primary schools who each undertake their own procurement according to this typical context and contracting criteria. The other case model is based on a hub school with a big central kitchen, which prepares meals for 12 other schools in Zagreb City, in addition to its own pupils. Due to its large budget and bargaining power in the supply chain, the hub school has more flexibility to contract additional, usually local, organic and/or family-owned suppliers, at least some of whom supply healthier products. This model is therefore described as a LOC model, and the dataset consists of the hub school plus four out of the 12 schools it distributes meals to.

Greece

School meals were introduced in Greece for the first time in 2016-17 by the Ministry of Labour, Social Insurance and Social Solidarity, and the Ministry of Education, in a fully funded program ("School Meals") to address social inequality risks. Within this context, the PSFP models selected were one LOW and one LOC model. The LOW case was the implementation of the School Meals programme in the urban municipality of Evosmos – Kordelio, Thessaloniki. The contract was awarded according to the Most Economically Advantageous Tender (MEAT) framework, and most of the catering firm's first tier suppliers were located outside the municipality or abroad. Hence, this case was defined as a LOW PSFP model. The LOC case was the implementation of the School Meals programme in the rural municipality of Kastoria, northwestern Greece. Although in this case the contract was also awarded according to the MEAT framework, a larger proportion of first tier suppliers, and also upstream producers, were located in the prefecture of Kastoria. Hence, this case was defined as a LOC PSFP model.

Italy

In Italy, school meals are normally organised at the municipal level. The research was conducted in two municipalities, which are also administrative centres of their provinces: Parma, located in Emilia-Romagna Region in the North of Italy, and Lucca in Tuscany Region, in the Centre of Italy. The two case procurement models were (i) a local-organic (LOC-ORG) model (Parma), in which the procurement contract encouraged sourcing of foods from within a local/regional area, and a minimum amount from organic agriculture, integrated production, typical or traditional products (in total to comprise at least 70% of all foods employed for meal preparation); (ii) an organic (ORG) model (Lucca), in which the procurement contract specified that the majority of foods used in meal preparation must be of organic origin.

Serbia

The Serbian context for school meals provision is similar to Croatia, to the extent that individual schools are normally responsible for contracting and managing their own food supplies/meals, and are obliged to accept lowest cost tenders. In practice however, there is some variation in the geographical distances between schools and the first tier suppliers they contract with, which formed the basis of the case model definitions. Specifically, the first PSFP model was defined as a LOC model, and consisted of schools which procured more than 70% of their food (by value) from suppliers less than 15 km distant from the school. The second PSFP model was a LOW model, in which at least 30% of food (by value) was procured from suppliers at least 15 km distant from the schools. In reality, the procurement decisions of schools in Serbia take place in a fluid manner on an annual basis, which means the stability of models over time is rather weak. For the purposes of this study, both LOC and LOW models were defined according to the suppliers contracted at the commencement of data collection, early during the 2017-18 school year. In terms of location, the dataset for the LOC case consisted of the supply chains to two Belgrade and two Novi Sad primary schools, respectively, whilst the dataset for the LOW case comprised the supply chains to an additional three Belgrade primary schools and one Novi Sad primary school.

UK

The research was conducted in two regions: County Durham in north east England and Inverclyde in west central Scotland. In both these areas, as elsewhere in the UK, school meals are generally organised at municipal or Local Authority (LA) scale. In Durham, the PSFP model was defined as LOC, because the procurement contract specifies a number of sustainability criteria as part of the award, including encouragement of local sourcing. Inverclyde was defined as a LOW PSFP model, as the procurement contracts are awarded primarily on the basis of lowest price bids, with no specific reference to local sourcing.

2. PSFP MODELS: DESCRIPTION OF THE CASE STUDIES

In this section, we draw together some material relating to the school meals context in each country, as well as some key features of the supply chains and schools in each case study.

2.1. Croatia

Both case PSFP models are located in Zagreb city, which is the capital city of Croatia. There are 144 primary schools in total, with an average pupil roll of 414 per school. All schools must offer meals (breakfast, lunch and snack), and the price to parents set by Zagreb City Council is €1.20, although there are subsidies available for those on restricted incomes/hardship. In Zagreb, as in Croatia more widely, food procurement contracts are tendered and managed by individual schools, not municipalities, and the process is undertaken on an annual basis. Meal preparation and cooking is most often undertaken on-site in schools. Lunch menus are normally a single-option hot main meal, plus a dessert.

The Croatian LOC case is a cluster of five schools centred on a hub school (LOCSchool A) which procures food and cooks and distributes lunches for 12 other schools in addition to its own pupils. Six to seven staff work in the central kitchen. It contracts with 11 suppliers, of which six have their bases within Zagreb City. Typically, these suppliers are large (e.g. turnovers of €174m-€340m). In addition, LOCSchool A contracts with three small, family-owned suppliers. The remaining LOC Schools receive lunches daily by delivery from LOCSchool A, and then also contract directly with suppliers for their breakfast and snack items. The kitchens of the other LOC schools are small and operated by 1-2 non-specialist staff. The 5 LOCSchools have an average pupil roll of 562, and average meal uptake of 50%.

The Croatian LOW case is a set of five regular Zagreb primary schools, who contract food procurement individually according to normal legal requirements. On average, each school contracts with eight suppliers, four of whom are large (in fact some are the same suppliers as was found in LOC case). Data collection also revealed that LOW schools contracted with an additional 2-3 suppliers each, most of whom were local and in some cases small family firms This was somewhat against expectations. LOW schools have average pupil roll of 474, and average meal uptake of 51%. Typically, 1-2 specialist catering staff work in the school kitchen - teaching staff are often closely involved too. The five LOWSchools were also found to be active in pursuing food and health-related projects and initiatives with pupils.

2.2. Greece

The Greek case studies are located in different regions, but have the same context regarding school meals provision. Until very recently, there were no meals provided in state schools in Greece. They were introduced for the first time in 2016-17, when the Greek government launched the 'School Meals' program, as part of a social security measure. The program first targeted only 38 schools, then extended funding in 2017-18 to cover 798 schools nationwide. Private catering firms are contracted to provide the meals in different regions. Menus comprise a daily single-option hot main meal, plus bread and salad. As no schools in Greece have any on-site kitchen or canteen facilities, the catering firms prepare and pack the meals off-site in single-serving containers then transport them in insulated carriers to schools where they are eaten in classrooms or halls.

The Greek LOW case is the implementation of the School Meals programme to five schools in Evosmos-Kordelio district in Thessaloniki. Although Thessaloniki is the second largest city in Greece and is prosperous in terms of socio-economic indicators, Evosmos-Kordelio is a more deprived suburb with a high immigrant population, and all 33 primary schools in the district participated in the School Meals program. The set price of meals is €2.23. The private catering firm contracts with 9 suppliers, of which two are local. Approximately one staff member is allocated to prepare the meals for each school. The five featured LOW schools are medium-sized (average roll = 232 pupils), with good uptake (average = 78%). One school undertakes a recycling project with pupils involving the plastic waste from the meals, but otherwise there are no other health/sustainability initiatives at LOW schools.

The Greek LOC case is the implementation of the School Meals programme in five schools in Kastoria municipality in north west Greece, in rural, mountainous landscape bordering Albania. The wider region of Western Macedonia in which Kastoria sits is medium in terms of socio-economic indictors. There are 29 primary schools in the municipality of which 15 take part in School Meals program. The set meal price is €2.22. At the time of being awarded the contract, the catering firm had pre-existing agreements with local suppliers in connection with another catering contract, and so the firm used these to build its procurement for the school meals contract. Overall, the firm contracts with 9 suppliers, of which five are local (three out of the four non-local suppliers are in fact the same as LOW case). The five featured schools, all based in Kastoria town, are much smaller than LOW case (average roll = 73) and uptake is higher (average = 84%). All schools undertook recycling projects but no other health or food initiatives.

2.3. Italy

The LOC-ORG case model is based in Parma, a wealthy municipality in Italy. The area has 33 primary schools in total, each with an average of 200 pupils, and an average meal uptake of >90%. All schools are obliged to offer meals, and the full price to parents is €6.18. Menus typically comprise a daily single-option hot main meal, comprised of a cereals or starch-based first course (e.g. pasta, rice), a meat or fish based second course, side vegetables, bread, and fruit. Desserts are served only on special occasions. A private catering firm prepares and cooks the meals off-site in a central kitchen, and then transports them to most schools in the municipality (a few schools have the ingredients delivered directly and cook on-site). The staffing levels equate to 5-6 kitchen staff per school. The meals contract is renewed on a 6 year cycle, and the current catering firm, part of a large cooperative enterprise, has held it since 1995. The caterer subcontracts to 29 suppliers (of which 10 are the main ones), and many of these are large-scale enterprises, with turnovers of >€100m. Although the PSFP contract in LOC-ORG case encourages local sourcing, the definition of local in the contract is broad, and there is no minimum threshold specified. 24 of the 29 suppliers are based >100km from Parma. As will be seen, this has implications for the sustainability outcomes of LOC-ORG case. The five featured schools in the case are medium to large sized (average pupil roll = 371) and have high meal uptakes (71-95%). Several food and health-related initiatives have been organised for all schools in the municipality.

Lucca is also a relatively wealthy municipality in Italy. The area has 29 primary schools in total, each with an average of 100 pupils. All schools are obliged to offer meals, and the full price to parents is €5.00. Menus are designed according to the same guidelines as Parma municipality, and therefore comprise the same elements as LOC-ORG case, although dessert can be served more often (substituting for fruit). A private catering firm prepares and cooks all the meals in a central kitchen, and then transports them to school sites. The staffing levels equate to 3-4 staff per school. The meals contract is renewed on a 9 year cycle, and the current caterer, part of a regional corporate enterprise, has held it since 2002. The caterer subcontracts to 9 suppliers, around half of which are large enterprises with turnovers >€100m. Around half of the suppliers are located inside the region. The five featured schools have an average pupil roll of 182, which means they are larger than the municipal average, but smaller than the LOC-ORG schools. Meal uptake is very high in four schools (88-90%), and much lower in one school (46%). At least one major food-related educational project has been organised for schools in the municipality by the catering firm, as part of the specifications of the contract.

2.4. Serbia

The dataset for the Serbian LOC and LOW cases comprised a selection of four schools, in each case, located either in the city of Belgrade or Novi Sad. Belgrade has a total population of 1.23million, and a population density of 521 persons per km^2. There are 130 primary schools. Novi Sad is a city and municipality to north west of Belgrade, with a population of 319,000, and population density of 87 persons per km^2. There are 22 primary schools in Novi Sad city (37 in the municipality). All the schools, in both cases, are located in quite affluent districts, and Belgrade and Novi Sad are themselves more wealthy parts of Serbia.

Throughout Serbia, the provision of school meals is normally organised and managed at the individual school level, without any intervention from a central authority. All schools that provide all-day stay to pupils are required to provide meals (c.36% of all primary schools). There is no standard set price for school lunches, although a Strength2Food survey found the average price to parents nationwide is 143 RSD (€1.19, range €0.33-2.08). Lunches in Belgrade schools average 173 RSD (€1.45), whilst in Novi Sad the average price is 74 RSD (€0.62). (Novi Sad municipality has imposed a price freeze over the last 12yrs, which explains why those lunch prices are very low.) Around 75% of schools outsource catering to private firms, with the remainder preparing and cooking meals in-house and on-site in school. Menus are designed by the catering firms or in-house cooks, and typically comprise a single-option hot meal of soup and/or meat/fish dish with side vegetables and bread, plus dessert (fruit or cake/cookie). All the schools in both LOC and LOW cases undertake their catering in-house. LOC case schools only contract with 1-2 suppliers each, whereas LOW schools typically contract with 3-6. The sizes of the schools in both LOC and LOW cases are large (average pupil rolls = 932 and 1176, respectively).

2.5. UK

LOC case is situated in County Durham, a large, rural region in north east England (population 519,700), with relatively high levels of deprivation and quite low levels of agricultural production. There are 230 primary schools in the region, with an average pupil roll of 135 and average meal uptake of 65%. All schools are obliged to provide meals, and the LA (Durham County Council) manages a single PSFP contract which covers c.200 schools (the remainder undertake their own catering arrangements). Provision of the meals is outsourced to a private catering firm, although all its staff are located in the schools, and therefore all meal preparation and cooking is undertaken on-site. The set price to parents is £2.00 (€2.28), and the daily menu typically comprises a choice of two hot meal options (of which one is vegetarian), cold sandwich options, a choice of side vegetables/salad, plus dessert. The catering firm contracts with three main suppliers, all of whom deliver food items directly to schools, plus two small organic farms who supply two schools with organic meat and milk. For the three main suppliers, two are local (<40km radius), while the third is non-local. The price of a school meal is set at £2.00 (€2.28). The five featured schools in LOC case are all small-sized (average pupil roll = 175), albeit this average is slightly higher than the regional average, with mixed uptake (average = 60%). Food and health projects have been pursued actively in all the schools (e.g. growing and cooking projects, pupil and parent cookery classes), albeit to different breadths and extents.

LOW case is situated in Inverclyde, a small, relatively deprived region in west central Scotland (population 78,800), featuring very little agricultural production. There are 20 primary schools, with an average pupil roll of 266, and an average meal uptake of 73%. All schools are obliged to offer meals and this provision is undertaken in-house by the Facilities Management unit of the LA (Inverclyde Council). This unit employs all the catering staff who cook the meals daily on-site in 18 schools, the remaining two being supplied with meals from the kitchens of their neighbouring school. The price of a meal is set between £1.95 (€2.11) and £2.00 (€2.28). Facilities Management issues a set menu, although in practice catering staff have autonomy to make small adjustments to it. Typically therefore, daily menus can involve multiple options, including soup, two hot main options, cold sandwich options, choice of side vegetables, and/or dessert. Facilities Management contracts with four suppliers, two of whom are local (<40km radius). The five schools in LOW case are larger than the regional average (average pupil roll = 300), and with slightly higher uptake (average = 75%). Food, health and/or sustainability issues have been pursued actively in some schools, (e.g. 'growing, cooking, eating' programmes), whereas other schools have placed more priority on addressing hunger and well-being issues amongst more deprived pupils through breakfast and holiday hunger clubs.

2.6. Cross-case Summary

Table 1 draws together some of the key features of the case PSFP models and how they contrast with each other, as well as across countries.

Table 1. summary of key features of case PSFP models

	Croatia	Greece	Italy	Serbia	UK
Full price of lunch	LOC €1.20 LOW €1.20	LOC €2.23 LOW €2.22	LOC-ORG €6.18 ORG €5.00	LOC €1.02 LOW €1.21	LOC = £2.00 (€2.28) LOW= £1.95-£2.00 (€2.21-€2.27)
No. of suppliers	LOC = 11 LOC = 6-10	LOC = 11 LOW = 8	LOC-ORG = >200 (10 out of 29 main ones featured here) ORG = 9	LOC = 1-2 LOW = 3-6	LOC = 3 LOW = 4
Catering arrangements	In both cases, catering is in-house and meals are cooked on-site in schools	In both cases, catering is outsourced to private catering firm, and meals are cooked in central kitchen	In both cases, catering is outsourced to private catering firm. In LOC-ORG case, most meals are cooked in central kitchen, in ORG case, all meals are	In both cases, catering is in-house and meals are cooked on-site in schools (although nationwide, the majority of schools outsource catering to private firms)	In LOC case, catering is outsourced to private caterer, but meals are cooked on-site in schools In LOW case, catering is in-house and meals are cooked on-site in schools
Contract renewal cycle	Annual	60-120 days (the duration of School Meals programme for one school year, to date)	LOC-ORG = 6yrs ORG = 9 yrs	Annual	LOC = 5 yrs LOW = 5 yrs

3. ENVIRONMENTAL IMPACTS OF PSFP MODELS

3.1. Methodology to measure environmental impact

Our core measure of environmental impact was carbon footprint, expressed as the kgs $C0_2$eq emitted from the production, processing, transportation and waste of food items purchased by the featured schools in each case, over a school year. To calculate these emissions, we devised an approach inspired by the method of Lancaster and Durie (2008).

For the PSFP case models in Croatia, Greece, Serbia and UK, to estimate the emissions from the production and processing of food items supplied to the schools, we used three common sets of emissions factors. For fresh items, we used the factors proposed by Audsley et al. (2009). For processed items, we used the factors of the Rowett Institute of Nutrition and Health Database (2017), as these include emissions for processing activities. Finally, for cases featuring organic items, we adopted Williams et al's (2006) factors, because these encompass estimates for both conventional and organic meat and dairy products. All sets of factors encompass the emissions caused by all the activities arising from the production of food items up to and including transport to the regional distribution centre (RDC) level. In our study, the RDC level equates to wholesalers (i.e. the first-tier suppliers).

For Italy, there are well-established and reliable databases which provide emissions factors more specific to the Italian context, hence to estimate the emissions from the agricultural production of food items supplied to the Italian case schools, we used emissions factors provided by Italian literature, BCFN Double Pyramid database, the Environmental Product Declaration (EPD) database, LCA-Food database, and Ecoinvent database. The combination of these different sources of information allowed identification of the most accurate emissions factors for the Italian context, in terms of food origin and agricultural practices adopted (e.g. organic or conventional production).

Across all cases and countries, the emissions factors used accorded with a Life Cycle Assessment (LCA) approach, and included the emissions along the food supply chain, from agricultural phase to agri-food processing phase (if relevant), and upstream transportation to RDC level. The emissions factors were also all attributional rather than consequential in nature, which is regarded as appropriate when the purpose of the research is to present an initial scope of responsibility for emissions within a system (Brander et al, 2019). For any food items which lacked a specific emissions factor, we substituted the average emission factor for the corresponding food category.

To estimate the emissions relating to the transportation of food items from wholesalers/suppliers to schools, we used the calculation method recommended by Defra (2013). This is based on estimating suppliers' delivery round distances and frequencies, taking account of the types of vehicles and fuel used, the number of drops to other customers in the rounds, and the proportion of the loads comprised by the food items to the schools featured in the case[2]. According to Kellner & Otto (2011), the formula below assumes 89% weighted average allocated to the distance of the delivery round and 11% for the vehicle load.

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[2]The formula we used was:

$$\textbf{Total CO2 Emissions From Transportation Process per Week} = \left(\textbf{Total Delivery Rounds CO2} \times \frac{\textbf{School Drops}}{\textbf{Total Drops}} \times \textbf{89\%}\right) + \left(\textbf{Total Delivery Rounds CO2} \times \frac{\textbf{School Load}}{\textbf{Vehicle Load}} \times \textbf{11\%}\right)$$

To estimate the emissions relating to waste, we applied the emissions factors for waste handling proposed by Moult et al (2018). These capture the emissions from transportation of waste from schools to waste disposal sites, and from the processing of the waste itself, for five different food categories (fruit and vegetables, bread, cheese, fish, and meat).

In practice, the data collection and analysis steps in each of the cases was as follows. First, we collected the delivery invoices sent by all the suppliers to the featured schools, over at least one 6 week time period (often more) in the 2017-18 school year, to reflect seasonal changes in the menu[3]. From these invoices, we generated a list of the total quantities of foods purchased by these schools in those periods. We included all types of food item (fresh fruit and vegetables, fresh meat, milk and dairy, eggs, ambient goods (e.g. bread, pasta, rice, flour), and processed and frozen items (including canned goods and ready made foods). The only items excluded were those purchased in very small quantities (e.g. certain spices, sauces) and bottled water. From these data we estimated the average weekly quantities (in kgs) of all foods purchased by the schools, then multiplied these quantities by the number of weeks in the school calendar to estimate total quantities (kgs) of the food items purchased over one school year.

Next, we calculated emissions (kgs $C0_2$eq) from the agricultural production and processing of the foods, multiplying the per kg emissions factors mentioned earlier by the total quantities calculated in the above step. To select the most appropriate factor from the range of food origin options, we used information given by suppliers in interviews as to the origin of the foods supplied to schools. We also recorded when origins switched over the course of the year, which was the case for some fresh fruit and vegetables.

Then, we calculated the emissions (kgs $C0_2$eq) relating to the transportation of the food items from the suppliers to the featured schools for all the weeks in the school year, using information on delivery round distances and frequencies given by suppliers in interview, and applying the estimation method of Defra (2013).

Finally, we calculated the emissions (kgs $C0_2$eq) relating to the handling of waste by taking the data on volumes (in kgs) of plate waste generated at two case schools over a one or two week period per school (as collected in WP6.2 and reported in D6.2), and aggregating these pro rata to all 4-5 featured schools in the case, for the whole school year. We then multiplied these aggregate plate waste volumes by Moult et al's (2018) waste handling emissions factors, taking account of the emissions attached to different categories of waste.

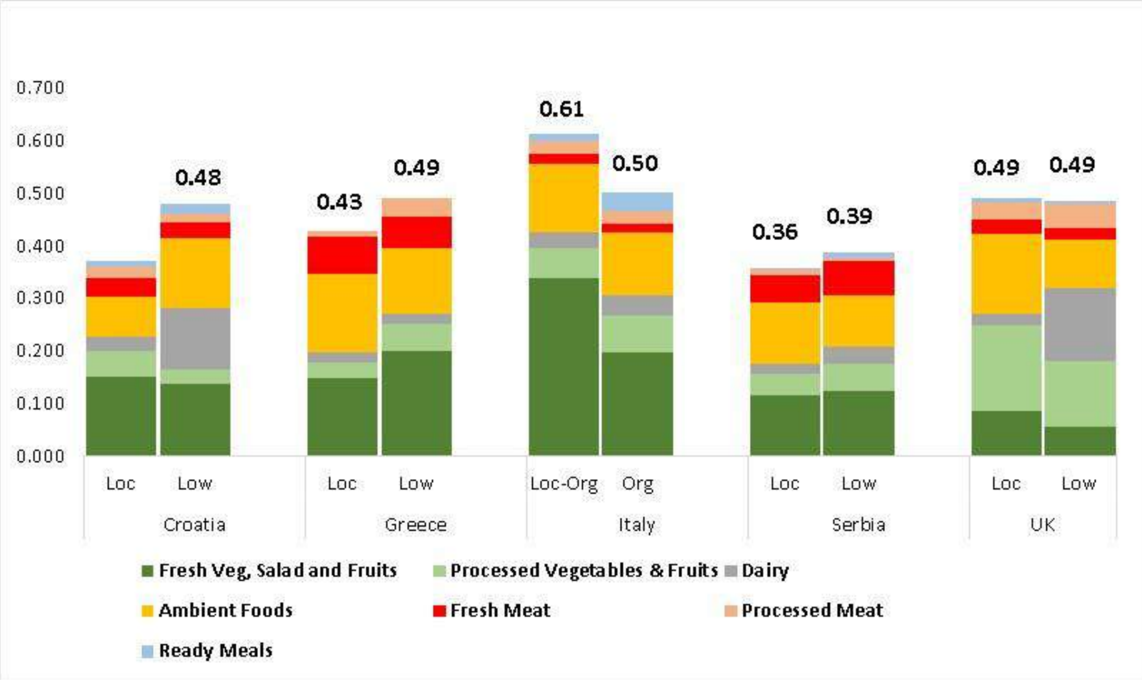
The total carbon footprint for each case PSFP model was therefore the sum (in kgs $C0_2$eq) of the above sets of emissions applied to the total aggregate food volumes purchased by the featured schools, as described above.

3.2. Which foods are procured in the case school meal services?

Figure 2 summarises the types of foods procured in each of the case models, and total weights per average meal. In all the cases below, the weights of meals refer to the total volumes of foods procured over one school year, for the four to five schools in each case, divided by the number of meals served. Hence, they refer to the raw weights of the foods procured for the average meal (i.e. pre-preparation and cooking).

[3] The exceptions were the Italian cases, where it was not possible to obtain invoices. Instead, food quantities were estimated from documents supplied by the municipalities and catering firms.

Figure 2. Weights and proportions of foods procured for the average meal in each case PSFP model



As Figure 2 shows, there was considerable variation between the paired cases, and across countries, in the total weights of foods procured for the average meal. Italy cases show the highest weights (0.61 kg and 0.5 kg), while Serbian cases show the lowest weights of food procured per meal (0.36 kg and 0.39 kg). Figure 2 also shows interesting variations in the types of foods comprising these weights. Although in most cases, fruit and vegetables (fresh and processed combined) represent the largest category, it can be seen that the proportion varies from almost two thirds of total weight (Italy LOC-ORG) to around one third (Croatia LOW). There are also large differences in the amount of dairy products procured for the average meal, representing around one quarter of total weight in UK LOW and Croatia LOW cases, but much less in the other cases. There are also smaller, though notable, variations in the proportions of fresh meat and total meat across the cases, with the Greek and Serbian cases procured more meat in the average meal than the other cases. The Country Reports give full description of the composition of the meals case by case, however some brief features are as follows:

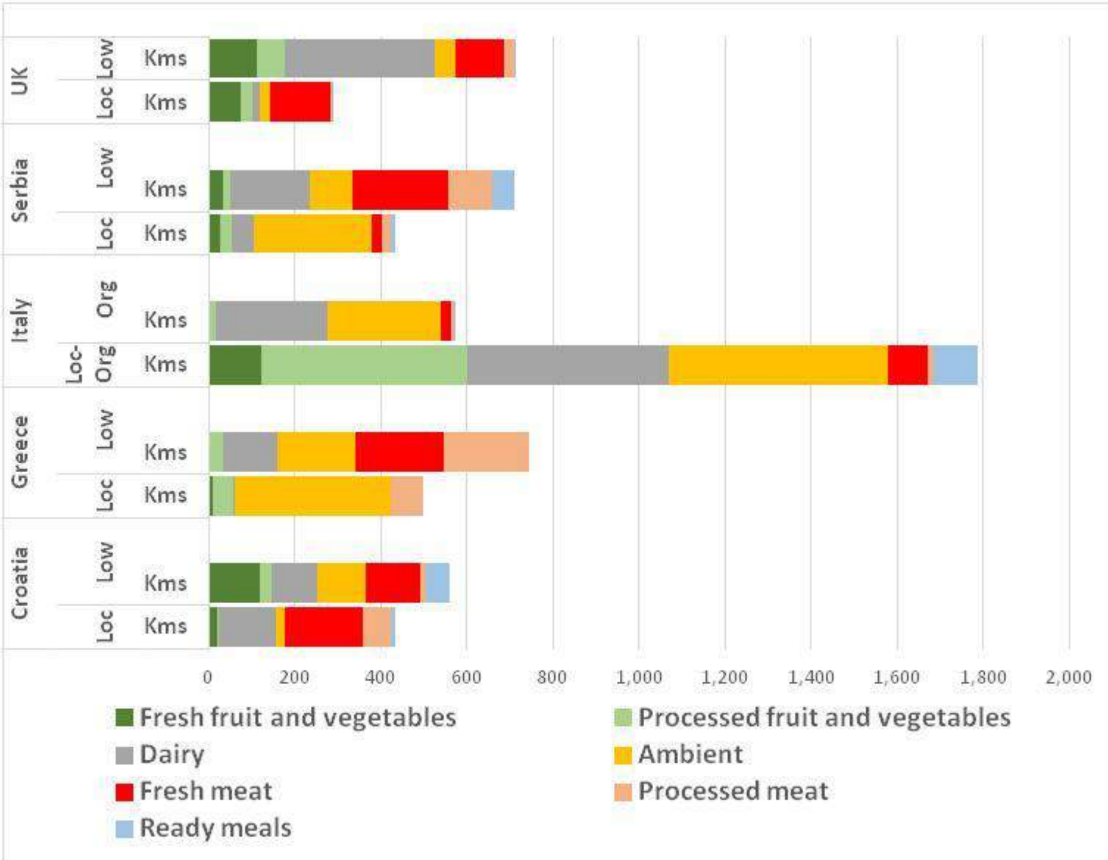
- **Croatian cases** considerably more food was procured for the average meal in the LOW case schools compared with the LOC case schools. In LOW case schools, there was a smaller proportion of fruit and vegetables, a much greater proportion of dairy and ambient products, but a smaller proportion of meat. In both cases, procurement consisted of a relatively narrow range of food items, e.g. the vegetables category comprised potatoes plus 3-4 other types, of which lettuce was the only notable salad, whilst bananas, apples and oranges represented the vast majority of fruits. Bread dominated the ambient category.

- **Greece cases** – more food was purchased for Thessaloniki (LOW) meals compared with Kastoria (LOC) meals. In both cases, procurement was characterised by a narrow range of items, for example, meals contained no fruit or ready made items; the vegetable selections were drawn from a quite limited and simple range; fresh meat was beef or chicken only; processed meat was 100% frozen fish, and dairy was 100% cheese (mainly feta). Comparing the two average meals, Figure 2 shows that although the LOW case meal has a greater proportion of vegetables compared with LOC meal, it contained the same proportion of meat and within this, a greater proportion of beef vs chicken.
- **Italian cases** – both Italian cases procured large quantities of food for the average meal, with Parma LOC-ORG meal showing the largest quantities. Within this, the LOC-ORG meal had a very healthy composition: almost two thirds of the meal was fruit and vegetables drawn from a broad range, and the vast majority of this was fresh, with canned tomatoes dominating the processed items. Just under one quarter of the LOC-ORG average meal was ambient foods (of which around half was bread and a quarter was pasta), followed by small amounts of dairy (of which a third was Parmigiano-Reggiano cheese), fresh and processed meats (dominated by poultry and fish, respectively). The ORG average meal followed a similar general pattern, albeit with a slightly smaller proportion of fruit and vegetables and very slightly higher proportions of dairy and ready made food (mainly fresh pasta and pizza dough).
- **Serbian cases** – As Figure 2 shows, a slightly smaller quantity of food was procured per average meal in LOC case schools compared with LOW case, however in terms of composition, the meals in both cases had almost identical proportions of fruit and vegetables, both fresh and processed. The fresh category in both cases was dominated by potatoes and apples, followed by cabbage, haricot beans and small amounts of salad. Processed vegetable items included various frozen vegetables, tinned and pureed tomatoes and pickled vegetables. The LOC case average meal had slightly smaller proportions of dairy products and fresh meat than the LOW case meal, and beef also featured less prominently relative to pork and chicken. In both cases, the ambient food category was dominated by bread, with smaller proportions of oil, pasta and flour.
- **UK Cases** – whilst the same quantities of food were procured for the UK LOC and LOW case average meals, perhaps the most striking feature of the meal compositions in both cases was the high proportions of processed fruits and vegetables relative to fresh, which were almost the inverse of the proportions found in the other cases. In both UK cases, potatoes dominated the fresh veg category, followed by modest to small amounts of carrots, broccoli and then very small amounts of salad vegetables. Processed vegetables were dominated by processed potatoes (chips/mash) and a wide range of frozen veg. Thereafter, the most notable difference between LOC and LOW cases is the much higher proportion of dairy products in LOW case, which was largely accounted for by the use of cartoned drinking milk (including chocolate and strawberry flavoured milk), whereas water was the only beverage in LOC case schools. Both LOC and LOW case meals contained similar proportions of meat (both fresh and processed), although there was a slightly greater representation of beef in LOW case meals. In both cases, the schools' purchase inventories included quite a lot of labour-saving ingredients, e.g. sponge mixes, bottled sauces, and prepared frozen vegetables, which were not found in other cases.

3.3. How far do foods travel in the case school meals services?

Next in terms of environmental impact, we report the distances travelled by foods, from first tier suppliers to the featured schools, for all the case PSFP models over one school year (Figure 3). For the case models that did not involve a central kitchen, the distances travelled by foods were calculated as the totals of round trips from the locations of the first tier suppliers to the relevant featured school(s) in the case. For the case models that incorporated a central kitchen, distances travelled were the sum of the kms travelled between first tier suppliers' headquarters and central kitchens, and then from central kitchens to schools. In order to compare across cases, we divided the total kms by the number of weeks of delivery operations in a school year, and also by the number of featured schools in the case, to give the average kms travelled, per school, per week. It should be emphasised that the estimates are the raw kms travelled for food items in each category, based on the round-trip distances from suppliers to the featured central kitchens/schools, and the frequencies of the suppliers' deliveries. The kms have not been moderated to take into account other customers in the delivery rounds, nor shared loads or backhauling.

Figure 3. Average kms travelled by suppliers to deliver foods to PSFP case models (per school, per week)

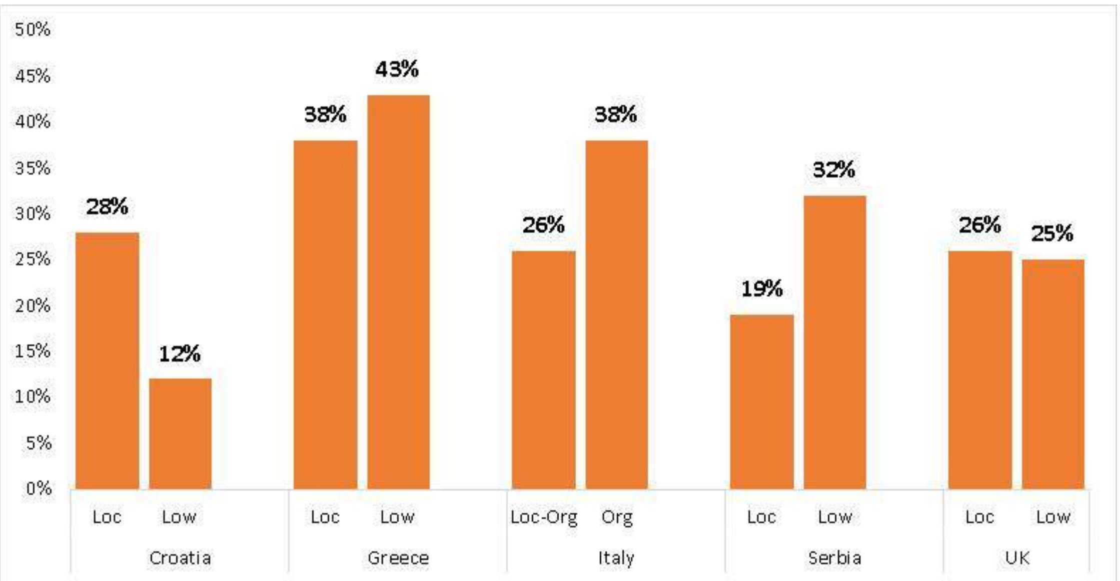


As Figure 3 shows, in four out of the five case pairs, the kms travelled in the LOC model were smaller than in the contrasting case. This accords with expectations, given the shorter distances between schools and suppliers in the LOC models. Italy LOC-ORG case is the exception, and the reason lies in the presence of 1-2 key suppliers of specific items which were located at great distance from the catering firm (e.g. canned tomatoes were transported from Calabria, in southern Italy). The distance between suppliers and the catering firm also explains the high kms travelled by suppliers in Geek LOW case, which was second highest average. Other factors which influenced the kms travelled, beyond the basic distance between suppliers and catering location, were the number of suppliers (Serbia LOW case average was fourth highest, due largely to the quite high numbers of individual suppliers making trips to the schools, in an uncoordinated way) and the frequency of deliveries (UK LOW case was third highest average, due to the daily deliveries of fresh cartoned milk to schools).

3.4. What are waste levels in the case school meals services?

In this section, we report the plate waste levels for the featured schools in each of the paired case models. Plate waste was defined as the uneaten food left on plates after pupils had finished their meal. A full breakdown of plate waste volumes per food category for two schools in each case is reported in D6.2 Country Reports, and is summarised in the D6.2 Synthesis. These volumes were collected via two week-long periods per school (one week-long period per school in the Greece cases). For each case, we present here the plate waste as a percentage of the total food served during all weeks of plate waste data collection in the participating schools.

Figure 4. Plate waste rates in PSFP case models (as proportion of total food served)



As Figure 4 shows, there was considerable variation within case pairs, and across countries, in terms of the percentages of served food that were wasted. The highest rate of waste was in the Greece LOW case (43%), whilst the smallest rate was in the Croatia LOW case (12%). In three out of the five case pairs, the waste rates in the LOC models were smaller than in the LOW models. D6.2 Synthesis and D6.2 Country Reports give detailed reporting of the compositions of these waste percentages, and also the implications for nutritional loss, financial loss, and the embodied carbon in the waste. For D6.3, the core interest is in estimating the carbon emissions associated with the transportation and disposal of these quantities of waste. This is reported within the next section.

3.5. Carbon footprint of case school meals services

We now report the core environmental impact results for the school meals services in the case procurement models. Figure 5 shows the carbon emissions of the average meal in each case, as delivered to the four or five featured schools, over one school year. This Figure also shows the contribution of the main activities of the supply chain (production/processing, local transportation and waste) to the emissions in each case. Figure 6 shows the carbon intensity of the average meal in each case, that is, the kgs $C0_2$eq per kg of food in the average meal. This latter measure is important for comparison purposes within and across the case pairs, because it eliminates the variations in the total weights of average meals across the cases.

Figure 5. Carbon emissions per average meal in the case PSFP models (kgs $C0_2$eq)

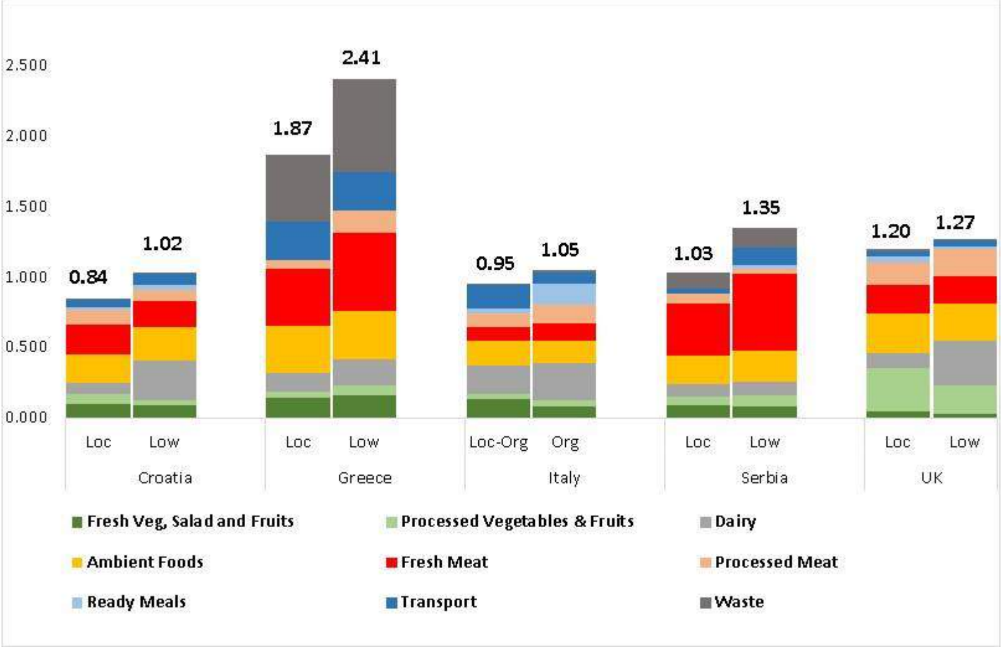
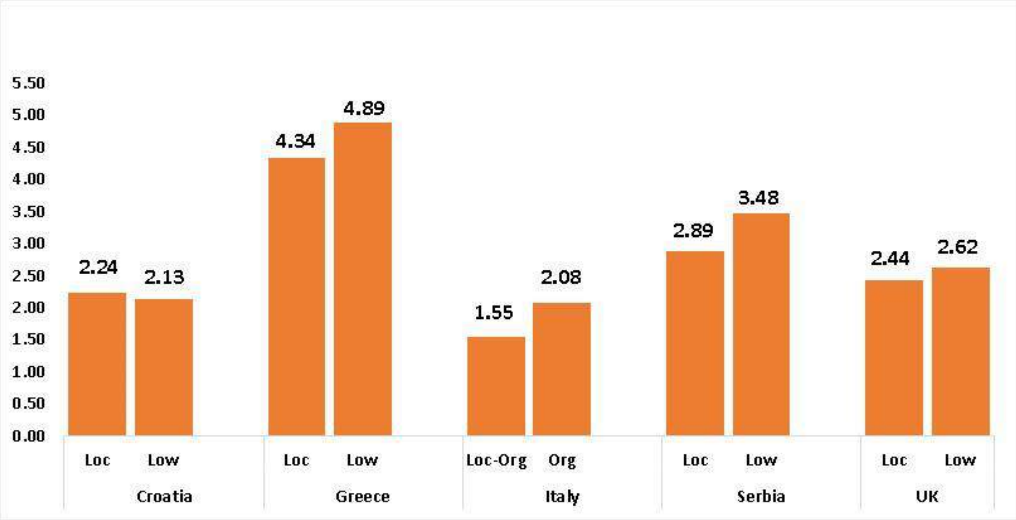


Figure 6. Carbon intensity of average meal in the case PSFP models (kgs $C0_2eq$ per kg of meal)



Figures 5 and 6 show that the two Greece cases had the highest carbon footprints per average meal, and per kg of meal. Indeed, it can be seen that the emissions of these cases were considerably higher than the second largest case emissions (Serbia), and more than double the lowest case emissions (Italy), on a pure carbon intensity measure. The main contributors to emissions in the Greece cases were waste (due to a combination of high waste levels plus the use of landfill as the disposal method) and fresh meat (which was a relatively high proportion of the weight of the average meal). Waste disposal and meat were also high contributors in the Serbia cases, as landfill was the disposal method used by half of the schools in each case, and the proportions of meat in both Serbian cases, by weight, were also relatively high. At the lower end, Italy and Croatia cases showed the smallest carbon footprints. On a per meal basis, Croatia cases were lower, however recall that in Italy, a much higher quantity of food was procured per average meal. When this variation is eliminated (Figure 6), Italy cases are confirmed as having the lowest emissions per kg. Even on a per meal basis, the Italy result is striking, and demonstrates how the composition of the meals, in terms of the proportions of food types, affects carbon footprints significantly. The other key highlight from Figure 5 is the relatively small contribution of transport emissions to total carbon footprint in all cases, even those which were found to have relatively high kms travelled by first tier suppliers. In particular, despite having a much higher average kms travelled than all other cases, the Italy LOC-ORG case nevertheless showed the lowest carbon intensity of all cases. The result reinforces the point that carbon emissions in PSFP are more dependent on the composition of meals on the plate, rather than how far foods have travelled to reach the plate. Finally, Figure 5 highlights the overlooked importance of waste disposal method to the total carbon footprint of school meals.

In terms of within case-pair comparisions, Figure 6 shows that in four out of the five case pairs, the LOC model carbon footprint was smaller than the LOW model one. However, our analysis shows that this outcome was not due to the localisation of the procurement model, as transport emissions represented only a modest contribution to total carbon footprint across all cases. Instead, the difference was explained by meal composition variations, with the average meal in LOC cases containing less (red) meat and animal products, and more fruits and vegetables, compared with LOW cases. This explanation also holds true for the Croatian case pair, where LOW case meals had a smaller carbon intensity than LOC case meals.

4. ECONOMIC IMPACTS OF PSFP MODELS

4.1 Methodology to measure economic impacts

In this section, we report the results relating to the economic impacts of the case PSFP models. The measures of economic impact examined were (i) local economic multiplier effects of the case meals supply chains, and (ii) the economic value of the PSFP contracts to suppliers.

4.1.1 Methodology to measure local economic multiplier effects

The aim of the local multiplier analysis was to trace the expenditures of the organisations/firms in the case school meals supply chains, to identify what proportions of the monies from the meals contracts in each case were retained within (or leaked out of) the local area. To calculate this, we used the 'Local Multiplier 3' (LM3) methodology[4], which involves tracking the expenditures of a starting budget (i.e. the total budget gathered from parental/state contributions to fund a school meals service), through three rounds of spending (LM1, LM2, LM3).

In practice, this involved first defining the geographic dimensions of the local area of the case. In accordance with best practice, each research team in WP6.3 defined the local area radius of the paired cases in their country using their knowledge of the case contexts. The definition of the radius was also guided by the views of informants in interviews, which again follows good practice. To allow comparability between the case pairs, the same radius distance was set for both cases. Therefore, from this process, the local area radiuses defined in each country were as follows:

- Croatia - 10km radius from Zagreb city centre (applied for schools in both cases)
- Greece – 50km radius from location of LOC and LOW Caterers, respectively
- Italy – 50km radius from location of LOC-ORG and ORG Caterers, respectively
- Serbia – 15km radius from the location of each featured school in both cases
- UK – 40km radius from headquarters of LOC and LOW catering units, respectively

Thereafter, for each case, research teams tracked the expenditures of the school meals service starting budget through the following three rounds:

- <u>From the holders of the starting budget to the immediate budget recipients (LM1)</u>. In this research, the LM1 stage comprised the budget transfer from the municipal or school contract awarder to the case meals service provider (either private catering firm or in-house municipal/school unit responsible for actually providing the meals). Retention/leakage of values from the local area was determined by the geographic location of the budget recipient's registered HQ, as given for accounting purposes, relative to the defined local area radius.
- <u>From the budget recipients to their staff and first tier suppliers/wholesalers (LM2)</u>. In this research, this stage involved tracking the meal provider's expenditures on their own

[4] Full explanation of the method is available at www.lm3online.com.

staff (i.e. catering staff), their first tier suppliers (i.e. all the contracted first tier suppliers), and other costs. Retention/leakage was determined by the geographic residence of staff, first tier suppliers and recipients of direct cost expenditures, relative to the defined local area radius.

- From the first tier suppliers to their staff and upstream suppliers, and the private spend of meal provider staff (LM3). In this research, this involved estimating the proportions of the private spend of the catering employees that were retained in the local area, and the proportion of expenditures of first tier suppliers on their staff and upstream suppliers, retained in the local area.

In terms of calculation outcome, LM3 is expressed as a ratio between 1 (indicating no value has been retained within the local area) and 3 (indicating that 100% of values have been retained).

For countries where meals provision is organised at the municipal level (Greece, Italy, UK), the above steps were followed once per case, such that a single LM3 ratio was generated for the total meals budget serving all schools in the municipality. For countries where meals provision is handled at individual school level (Croatia, Serbia), a separate budget tracking calculation was made for each school in each case, and then the totals from these calculations were summed for analysis, to arrive at an aggregate LM3 estimation for each case.

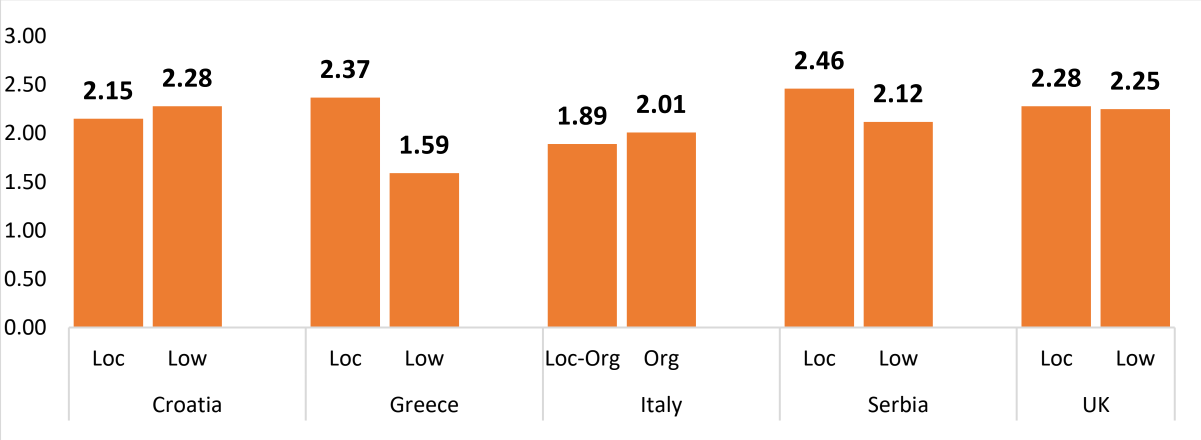
4.1.2. Methodology to measure the economic value of PSFP contracts to suppliers

In each case, we explored what the economic values were to the members of the supply chain as a result of their involvement in the school meals contract. Via depth interviews with a sample of suppliers in each case, research teams obtained data relating to these suppliers' current employee numbers and turnovers (thereby generating an estimate of the size of their businesses), and an estimate of their growth rates over the preceding 5 years. Research teams also asked suppliers to estimate the proportion of their business dependent on the school meals contract, and the size of any new business won as a direct result of the contract. As the absolute number of supply chain members in all cases was small, results are reported descriptively.

4.2. Local economic multipliers of case school supply chains

In this section, we report the local economic multiplier ratios of the PSFP cases, generated from the analytical process previously described. Figure 7 summarises the results. The higher the ratio, the greater the local economic multiplier effect.

Figure 7. Local economic multiplier (LM3) ratios for PSFP case models



As Figure 7 shows, overall, the highest LM3 ratio calculated was for Serbia LOC case, at 2.46. This means that for every 1.00 spent from the meals budgets of the schools in this case, an additional 1.46 was generated for the local economy (defined as 15km radius from each school). In contrast, the smallest LM3 ratio estimated was for Greece LOW case, at 1.59. This result means that for every 1.00 spent from the meals budget in this municipality, only 0.59 of additional value was generated for the local economy (defined as 40km radius from LOW Caterer headquarters). When it is considered that the smallest starting budget in the case dataset was €80,000, and the largest was €8.8million, it can be appreciated how the magnitude of the local multiplier ratio can translate into significant differences in total monetary flows to local areas.

Turning to the within-case pair differences, our expectation was that the LOC PSFP models would show higher LM3 ratios than their counterparts, given the way in which the case models had been defined for this research. Figure 7 reveals ratios were indeed as expected for three case pairs: Greece, Serbia and UK. Inspection of budget flows in these cases confirmed that the results are due to a greater proportion of supplier budgets being spent on local firms. However, for the case pairs in Croatia and Italy, a contrary result was found, with the LOC case models having a smaller LM3 ratio than their counterparts.

In Italy cases, the reason relates to the *de facto* degree of localisation in Parma LOC-ORG case, as observed in Section 2. Specifically, it was noted that although Parma municipality had the ambition to encourage local sourcing, the broad definition of local in the contract, and lack of minimum threshold, placed little obligation on the Caterer to do so in practice. In fact, it was found that only 18% of the LOC-ORG supplier budget was spent on local firms, compared with 68% of ORG supplier budget. Hence the reason for the smaller LOC-ORG ratio. The result highlights an important point about the gap between ambition and reality of sustainability outcomes in PSFP, when contract criteria are not specified in the strongest way.

In Croatia cases, there is a different reason to explain why the LM3 ratio of LOW case schools was higher, in aggregate, than that of LOC schools. As explained in the methodology, LM3 analysis involves tracking expenditures on staff/payroll as well as suppliers (and other direct costs). In the Croatia cases, the difference in ratios was due to the features of catering staff expenditure, specifically, a greater proportion of the LOW total meals budget was spent on staff compared with LOC case, and a greater proportion (100%) of LOW school staff were resident in the local area compared with LOC staff. The result highlights the important contribution of payroll expenditures to local economic impact in public procurement, particularly in services which involve high labour intensity and reliance on a workforce located conveniently for locally dispersed sites (as is applicable to school meals services). In these kinds of services, payroll can have an uplift effect on overall economic multiplier (an effect also observed in the UK LOW and Italy LOC-ORG cases). Indeed, it can be argued that the LM3 ratios for most of the cases in this research are relatively high for the food and drink sector, as a consequence of the high labour intensity of PSFP services, and the typical geographic location of workforces.

The Croatia LM3 result also highlights an important point about the distinction between the number of local suppliers in a PSFP model, and the proportion of budget expenditure on such suppliers, and the consequent effects on local economic multiplier. In Croatia, LOC case schools on average contracted with a larger number of local suppliers compared with LOW case, but the aggregate proportions of budget expenditures were almost identical between the two cases. The result emphasises that it is the proportion of budget spend on local suppliers which determines the multiplier effect, not the number of suppliers. It highlights the risk of contracting authorities allocating small amounts of budget to local suppliers, as a token gesture. Such strategies are unlikely to generate significant multiplier effects.

4.3. Economic values of the case school meals services

The next set of results we report are the findings related to the economic value of the PSFP contracts to members of the supply chain in each case. Most of the data for this part of the study was gathered from interviews with the suppliers and catering firms/units. The research teams asked these interviewees about their employee numbers, turnovers, the contribution of the case school meals contract to total business, and future growth prospects. As only a small number of suppliers was interviewed per case, the D6.3 Country Reports present the findings in narrative form. In the following sections are some highlights from each of the case studies.

Overall, it was found that suppliers to the PSFP cases were a mix of large and small firms, indeed ranging in extremes from local microbusinesses (2 employees and turnover of €40,000) to very large national/international enterprises (2,000 employees and turnovers of >€200million). However, in the vast majority of instances, the school meals contracts of the case models represented only very small, or negligible proportions of suppliers' total businesses, and these had not contributed directly to the winning of new business for those suppliers. The exceptions to this were two of the private catering firms (UK LOC caterer, Italy ORG caterer), and a handful of smaller firms in other cases. Nevertheless, in interviews, suppliers rated their involvement in the PSFP contracts positively, as a steady and complementary area of business. Also, the results possibly underestimate the value of PSFP contracts, as a whole, to the suppliers in the chains, as many were engaged in fulfilling multiple contracts. There were no notable differences found in the economic value indicators between the cases in each pair.

Croatian cases – Overall, there were no notable differences between the economic value indicators of suppliers in LOC and LOW model cases. Hence, in both, suppliers were a quite extreme mix of large and small firms. For example, LOC case suppliers had turnovers of between €55,000 and €340m, and employed between 2 and 1409 staff, while in LOW case, firm size went from €40,000 to €289m, and from 2 to 3296 employees. Business growth rates in both cases also varied considerably from those who were experiencing very high levels of growth, to those who had experienced reductions. For all the suppliers in both cases (even the small firms), the school meals contracts represented only a very small part of their businesses, with all but 1-2 suppliers estimating the value to be <1%. However, it should be remembered that the Croatia case studies are based on only 5 schools, and suppliers would typically deliver to more than that, so these figures likely underestimate the value of school meals contracts (and other PSFP contracts) more generally to the suppliers. Moreover, in interviews almost all suppliers spoke positively of their involvement in the meals contracts and how these fitted in well with other contracts and activities, in a complementary way.

Greece cases – As in Croatia, there were no notable differences between Greece LOC and LOW cases in the economic value indicators. The members of the supply chains in both cases were a mix of large and small firms. While both of the catering firms were large businesses (LOW Caterer had 645 staff, LOC had 700+), suppliers ranged from large businesses to small firms of 30 employees or less. Based on a small number of informants (1 caterer + large 2 suppliers per case, due to lack of cooperation from the other, especially smaller, suppliers), it was found in interviews that the meals contracts represented negligible proportions of turnover for the firms. However, it could be that the contract was economically more important to the smaller supply chain members. It is also worth noting that as state funding of school meals is likely to grow in future, the meals contracts could become more economically attractive for caterers and suppliers. In both cases, firms reported very mixed growth rates, some very negative over last 5 yrs due to the general economic situation in Greece.

Italian cases – In Italy, some differences were found between the cases in terms of the size and economic profile of supply chain members. In particular, although several suppliers in the Parma LOC-ORG chain had very large turnovers (e.g. >€200million), and tended to be producers of the goods they sold, the catering firm was also a very large enterprise with national reach. With its size, the catering firm could exert bargaining power on other chain members, as well as exerting its own quality coordination through ISO and other certification, in a 'channel captain' role. The LOC-ORG school meals contract represented only a very small part of the business for all supply chain members (all but one estimated <1%). In ORG case, suppliers were more a mix of large multiproduct wholesalers and smaller firms (<€14million turnovers), and as the catering firm was smaller in size also, it enjoyed less bargaining power in the chain compared to the LOC-ORG catering firm. The meals contract in ORG case represented a higher proportion of total business for two chain members (one third for the catering firm and 9% for a fresh produce supplier), though negligible proportions for the remaining members.

Serbian cases - Like Croatia and Greece, supply chain members in both LOC and LOW cases were a mix of small and large firms, this mix being notably extreme in LOC case, where four of the six suppliers used were almost microbusinesses, whereas the other two employed 915 and 2000 people, respectively. Compared with other countries, there were more examples of firms in both Serbian cases for whom the meals contract represented a reasonable proportion of total business (e.g. for one LOC supplier the contract was worth 6% of business, for two LOW suppliers, the contracts were worth 10-15% and 33%, respectively). It is worth noting also that, like Croatia, the contracts examined here relate to individual schools, and so PSFP contracts, more generally, could be worth more to suppliers in the Serbian cases. Moreover, in

LOC case, suppliers evaluated cooperation with schools very positively, due to familiarity with contract servicing and payment terms, and good relationships developed with schools.

UK Cases - There were many similarities between LOC and LOW cases in terms of economic value. In both cases, with the exception of the LOC catering firm, the school meals contract represented only very small proportions of suppliers' total turnovers, and had contributed a negligible direct impact on winning new business. This was the situation even for the smaller firms in each case. Nevertheless, suppliers in both cases spoke positively about their involvement in the LOC and LOW school meals contracts, as contributions to a portfolio of public sector supply contracts. Therefore, in both cases, the school meals services were strategically important to suppliers rather than of high, direct, economic value.

5. SOCIAL IMPACTS OF PSFP MODELS

5.1. Methodology to measure social impacts

The goal of the social impact analysis was to assess what social values were generated by the operation of the case school meals services. The indicators we took into account to measure social impact were:

(i) employment-related criteria. Under this heading, we gathered data on the number and types of jobs linked to the school meals service in each of the PSFP cases, and the diversity profile of staff and levels of training/skills development in place within the businesses participating in the supply chain.

(ii) criteria relating to the working environment of the service chain and connectedness of people within it, including rural communities. Under this heading, we gathered data on the well-being and job satisfaction of interviewees, and their testimonies relating to how much they engaged with others in the supply chain, and what kinds of activities/occasions such engagement represented. Within this, we explored the extent to which the school meals procurement in each case brought caterers and schools into contact with rural and farming communities that produce food items.

Given the small sample sizes of informants in the research, the D6.3 Country Reports give a narrative presentation of the results relating to the above indicators. Here below are some highlights from each of the case studies.

5.2.What are the employment-related impacts of school meals supply chains?

Croatian cases – The main finding in both LOC and LOW cases was that employee status and profiles seemed to be typical of wider catering/distribution sectors as regards male/female employment, and ethnic minority representation. There did appear to be a high proportion of full-time employees in the supply chain, and amongst suppliers in both cases, there was evidence of commitment to training and skills development. However an important finding in both Croatian cases was that in schools, there was under-staffing of kitchens/canteens, a situation not helped by the fact that in Croatia, kitchen staff are centrally appointed government employees, so it can be hard for schools to fit staffing according to need, as school leaders perceive it.

Greece cases - For employment impact, the main finding was that the number of jobs due to the school meals contract in both areas was very small for both catering firms, and negligible for first tier suppliers, for both LOW and LOC cases. However, it must be noted that these findings were based on data provided only from larger suppliers in both cases (due to lack of cooperation from smaller firms). It is possible that the employment impact may have been greater for smaller firms in both cases. In terms of skills and training, again there was no notable difference between practices in LOW and LOC cases – firms in both models followed mandatory processes and also gave examples of additional training and skills development for employees.

Italian cases – In terms of employment profile, like cases in other countries, the Italy cases showed employment patterns that reflect the wider catering and distribution sectors. Therefore, the majority of jobs in supplier firms were taken by male employees, mostly full-time, whilst in the catering firms, the majority of the workforce was female, with a higher proportion of part-time work. In terms of staff training, members in both the Italian cases, specifically the larger firms, exhibited a strong commitment to staff training and development beyond mandatory levels. Thus, both LOC-ORG and ORG catering firms applied many training certifications and quality standards to their own businesses as well as their supply chain partners (HACCP, ISO, BRC, IFS), in addition to multiple examples of bespoke codes of practice on processing quality, etc. Amongst the suppliers in both cases, there was also much evidence of investments in staff development. Firms organised specific training programmes for improving knowledge and skills in voluntary certification schemes, and gave financial support for workers' families, cultural events, and sustainability projects. Gender equality had also been the focus for some firms, with some being the recipients of awards for having promoted female qualification. Some firms also had specific internship programmes for students in collaboration with schools and universities. A final highlight was the fact that very large suppliers like the LOC-ORG wholesaler BigMover had developed their own advanced programmes in career development ('BigMover Academy'). Generally speaking however, smaller firms showed less activity in staff development beyond law compliance. The difference between large and small firm engagement in these actions was more notable than any difference between the PSFP models.

Serbia cases – In terms of employee profile, the research found a slightly higher female and ethnic minority representation in the workforces of the suppliers in both LOC and LOW cases compared to the rates in other countries, however there was much variation from firm to firm. In LOC case, suppliers were, with one exception, trade companies with slightly more educated workforces, whereas in the LOW case, suppliers were a mix of production and trade companies with more manual jobs. In terms of staff development and training, the strongest finding across chains in both cases was that although staff absence and turnover rates were low amongst supplier firms, there was very little formal training or development – informal, peer-to-peer training on the job was commonplace. The other key finding was that training and development amongst catering staff (i.e. in school kitchens) was also informal and basic, and overall the financial and working conditions were very harsh for employees in this part of the chain. This was true for both LOC and LOW cases.

UK cases - Overall, the employment profile and staff training activities in LOC and LOW supply chains were very similar, with gender balances and ethnic minority representations that reflected sectoral norms. In both cases, suppliers demonstrated considerable commitment to staff development, with a range of activities and support given to employees for upskilling and obtaining qualifications. Rather than differences being observed between the cases, the main difference was between the large and small firms in both cases. Specifically, the larger suppliers in both cases, in addition to supporting employees to gain recognised third party qualifications, also offered their own study and training programmes, linked to internal career progression. Meanwhile, although the smaller firms had less elaborate training programmes, they gave examples of flexible and bespoke training/qualifications created specifically to fit the needs of certain employees and roles.

5.3. What is the working environment and connectedness in school meals supply chains?

<u>Croatian cases</u> - In terms of supply chain connectedness, the research found evidence of stronger relations in LOC case, compared with LOW case. Specifically, examples of good collaborations were found between LOCSchool A (the hub school) and its suppliers (e.g. the dairy supplier "school milk day" involved organising a gathering of school children and conducting a tour for headteachers of the factory; the multiproduct supplier also undertook healthy meal promotions). Engagement with local schools was a key part of such activities, including giving presentations and talks to schoolchildren about their businesses and taking part in educational activities to improve understanding of different foods and where they come from. Overall, stable procurement relations were found to have developed between LOCSchool A and its suppliers. However, even though supply chain relations were better in LOC case, development of rural connectedness was limited by only a relatively limited number of small suppliers being currently contracted in the chain, and none of these were family farming firms (directly). Meanwhile, relations between supply chain members in the LOW case were found to be weaker than LOC case. Although some LOW case schools did use family farming firms and smaller suppliers in procurement, these suppliers did not have any links with schools for educational or social goals. So in both cases, there was room for improvement in terms of supply chain connectedness.

<u>Greece cases</u> – In terms of working environment and connectedness, the research found that staff absence rates were low in both LOW and LOC cases, and the general relations between supply chain members were characterised as good by interviewees. However, in LOW case it was found that interactions between supply chain member were more limited in nature, i.e. based on the interactions between specific individuals necessary for tasks to be performed (e.g. delivery drivers and school kitchen staff). These kinds of interactions are typical for the more impersonal context of a large city environment (LOW case is set in Thessaloniki), and were exacerbated by the Greek financial crisis which has created a more strained social environment. In LOC case, which was set in the rural, mountainous region of Kastoria, the relations between supply chain members were characterised by interviewees as more warm, informal, and going beyond the dyadic interactions of personnel fulfilling their roles. Local supply chain members also had service-based relations (e.g. LOC Baker ran a retail shop visited by staff from other LOC case suppliers, while LOC Caterer ran a kitchen/restaurant where employees could socialise after work). A greater community ethos was therefore found to exist in Kastoria, which was linked to the procurement model. However, in neither LOC nor LOW cases did suppliers engage directly with schools, or in community activities related to schools.

<u>Italian cases</u> - In LOC-ORG case, good relations were found between the catering firm and its suppliers over menu development, food quality and origin assurance, and examples were found of educational initiatives in which the catering firm and its suppliers had been involved (e.g. farm visits, food culture and health classes for parents and children). In ORG case, the research identified a high potential for suppliers to connect with the local community, but currently this was done only indirectly, at best. However, the ORG catering firm itself was found to be very active in social connectedness, e.g. by spearheading an initiative to bring local trout to the school menu, alongside many other examples of bringing tastes/cultural knowledge of the region to children. Overall therefore, some unexploited links with suppliers were found in both cases. Moreover, in LOC-ORG case, the main way that rural connections were made was by featuring products such as Parma Ham and Parmigiano-Reggiano on the school menus, which could be considered an easy way for the catering firm to claim a commitment to rural development. Beyond such 'easy wins' in LOC-ORG case, the key barrier to more rural/territorial connections in this case was found to be the presence of mainly non-local suppliers in the chain (as highlighted in LM3 results section). In ORG case, the finding was that it would be easier to initiate more social connectedness, as a greater proportion of suppliers were local, and already engaged in social-community activities.

Serbia cases - In LOC case, supplier and school relations were rated highly by interviewees and there were several examples of joint activities/initiatives beyond pure supply of physical goods. One large wholesaler (supplying one LOC and one LOW school) conveyed that relations with the schools were good. In addition, this firm engaged with schools' charitable activities, donating food and providing educational packages for 1st graders. It also ran its own charitable foundation which financed educational projects that local schools participated in. Another LOC supplier was also identified as a good-performing, well-managed business that commanded the trust of its customers. In general, the LOC schools indicated that when they found a supplier they could trust, they preferred to keep that relationship in future contracts. In LOW case, supply chain members seemed to have quite good relations and staff satisfaction, but experienced slightly less supplier-school engagement, beyond the actual supply of goods, compared with LOC case.

UK cases - In the LOC school meals chain, strong relations existed between key supply chain members, which facilitated positive community outcomes in this case. All the smaller suppliers in the chain exhibited flexibility and good communications in dealing with the catering firm and individual schools, while all suppliers except one were actively engaged in school and/or community-related projects in the region. Relations between the catering firm and school headteachers were also good. In terms of the links between the schools and rural communities supplying foods, the research indicated that the LOC school meals service promoted strengthening of these links, particularly for the most rural schools in the sample, and promoted awareness-raising of these links within other schools. The local supply orientation of one supplier, and the presence of mixed farming in the region (albeit not extensive), helped to facilitate the links between schools and rural communities supplying foods. In LOW case, the relations between the members of the school meals supply chain appeared less strong. First, no interactive or coordinating activity appeared to exist between the suppliers. Second, and most strikingly, there was no joined up activity between the LOW suppliers and the schools they provided food to, beyond the functional transfer of goods between delivery drivers and catering staff. This was despite suppliers having ready access to educational materials and resources, and at least some schools placing priority on food-related issues in the curriculum. The links between the school catering service and other food and health activities in the schools were also quite weak. The analysis indicated a big opportunity for the LOW authority to promote better integration between suppliers, the meals service, and the schools. In terms of supporting links to rural communities, the LOW meals service did not promote strengthening of such links. However, the lack of farming and absence of suppliers currently within the LOC region were two factors inhibiting the development of these links.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. PSFP models and sustainability impacts: what we learn from this research

This research has investigated different models of PSFP in a school meals context, to measure and explain their environmental, economic and social impacts. Within this, the research had the particular aim of comparing 'alternative' PSFP models (i.e. those characterised by local/organic sourcing) against mainstream counterparts (i.e. where little or no emphasis is placed on organic and/or local sourcing). This section draws together the main findings on these questions.

First, in terms of environmental impact, the research found that in four out of five case pairs, the LOC (or LOC-ORG) procurement model had a lower carbon footprint than the LOW (or ORG) counterpart. Moreover, for the remaining case pair (in Croatia), the model with the greater *de facto* use of local suppliers exhibited a lower carbon intensity. To this extent, the results appear to support claims that alternative PSFP models are more environmentally friendly than manstream ones. Importantly however, our results show that the difference between the cases was not due to the degree of localisation of the model itself, as transport emissions were, at most, a relatively modest contribution to total emissions across all cases. Instead, the composition of the case menus was the more important feature, in particular the proportion of (high carbon) red meat and other processed animal products relative to lower carbon items such as fruit and vegetables. Similarly, although the two organic sourcing cases in the research (LOC-ORG and ORG, in Italy) exhibited the lowest carbon footprints of all cases, this was again due to their menus featuring high proportions of fruit and vegetables and only small amounts of meat, rather than the feature of organic sourcing itself. For environmental impact, the research revealed a further significant factor in the carbon footprint of a PSFP case: waste disposal method. Specifically, the research found that for cases where landfill is the disposal method, waste disposal has a dramatic impact on emissions. Again, waste disposal is a feature that impacts on the carbon footprint of a PSFP model, but is unrelated to degree of localisation or organic sourcing.

In terms of economic impact, the research examined the local economic multiplier effects of the case models and found that in three out of five case pairs, LOC models had greater LM3 ratios than their counterparts. Moreover, for the remaining two pairs (in Croatia and Italy), the *de facto* supply arrangements revealed by the fieldwork confirm that greater expenditures on local suppliers give greater retention of values in the local area. Indeed, these results relating to economic multiplier effects are probably the most compelling evidence of the positive impacts of alternative (i.e. localised) PSFP models of all the measures we examined. However, the LM3 analysis did also show that multiplier effects can be moderated by case payroll expenditure, a feature which is determined more by the labour intensity/dispersal profile of the catering service than the type of procurement model used. The research also investigated the economic value of the case contracts to suppliers and the contribution of these contracts to their future business growth, but found no notable differences between the case pairs on these.

In terms of social impact, the research found no notable employment or training/development differences within the case pairs that could be attributed to the type of procurement model. Instead, all notable differences were related to factors such as variations in national/regional context, and/or size of supplier. However, the research did find differences between the PSFP case models in terms of supply chain connectedness, with a greater strength and abundance of social relations exhibited in LOC cases relative to their counterparts. Indeed, this result ranks alongside local multiplier effect as the most compelling evidence of the positive impact of alternative PSFP models. Nevertheless, even within LOC cases, the research found quite weak relationships between suppliers and schools, and also in the role of the meals service as a vehicle for stimulating rural development activity. Our analysis indicates that progress in the latter is dependent on the contextual circumstances of the case chains, specifically the extent of mixed farming and agrifood processing, and related infrastructures/supports, in the region.

These conclusions are summarised in Table 2.

Table 2. Effects of alternative PSFP models (LOC/ORG) on three sustainability indicators: a summary

		Effect of Alternative PSFP Model (LOC/ORG)
Environmental Impact	Carbon emissions	Other factors have greater effect (e.g. menu composition, waste disposal method)
Economic Impact	Local economic multiplier effect	Positive for LOC model (if a high percentage of budget is spent on local suppliers)
	Economic value of contract	Other factors have greater effect (e.g. supply chain strategies of suppliers, size of suppliers)
Social impact	Employment/training	Other factors have greater effect (e.g. size of firm, national/regional context)
	Working environment and connectedness	Positive for LOC model (although further actions needed specifically to connect supply chains and schools, and promote rural development)

6.2. How to enhance the sustainability outcomes of PSFP models?

EU procurement policies such as Procurement Directive 2016/24 and the GPP make provisions to encourage more flexible, open and transparent contract tendering processes, as well as promoting new entrants into PSFP (including SMEs, social enterprises and other nontraditional suppliers) and encouraging the inclusion of environmental, economic and social outcomes into contract award critiera. Although these provisions are helpful, their adoption is largely voluntary, and most contracting authorities are very budget conscious and focused on short-term costs and benefits which means a continued heavy reliance on price-based decision-making in PSFP. The situation has been exacerbated by uncertainty over which actions to prioritise in order to achieve the greatest benefits. The present research has sought to shed light on this point. Based on the findings, we offer the following recommendations for regulators, municipalities, contracting authorities and other key decision-makers in PSFP services, as to how the sustainability outcomes of these services can be enhanced. Subsequent work in Strength2Food (WP10) will develop and elaborate the recommendations from WP6, therefore we offer these recommendations as immediate reflections as to how stakeholders may take positive actions to enhance sustainability outcomes of PSFP models.

6.2.1 How to enhance the environmental impacts of PSFP models?

In terms of reductions in carbon emissions, the research found that although transport emissions play a part in the total carbon footprint of a PSFP case, the contribution is a relatively modest one, at most. Instead, the composition of the menu and waste disposal method are more significant contributors to total footprint. Therefore, where reduction of carbon emissions is the key objective of authorities, we propose that the priority order of action should be as depicted in Figure 8.

Figure 8. Priority order of actions to reduce carbon emissions of PSFP

As Figure 8 shows, our recommendation is that the first priority action should be for the PSFP case to focus on its waste disposal method, and if that method is landfill, to switch to a more environmentally friendly alternative where possible (e.g. anaerobic digestion, composting, animal feed). As highlighted by the case results in Greece and Serbia, landfill disposal method can contribute up to one third of total carbon emissions of a PSFP chain, therefore by this one adjustment, the most dramatic reduction effects can be experienced. The second priority action should be focusing on menu adjustments, specifically, exploring ways in which the proportions of red meat can be reduced, e.g. by substituting with more white meat or fish, or by introducing more 'meat-free' days in menu cycles. Increases in the proportions of fruits and vegetables used, as well as less carbon intensive animal proteins such as milk and eggs, would also give reductions. In other words, we recommend that menus adopt more the principles of the traditional Mediterranean diet. Such menu adjustments do of course have to be balanced against the nutritional requirements of the meals, which is a particular concern in a school meals context. Third, the PSFP case can usefully focus on transportation arrangements as a means to reduce carbon emissions. Adjustments to those arrangements could involve sourcing items more locally (recall the emissions burden due to a single, very distant, supplier of canned tomatoes in the Italy LOC-ORG case, and also the burdens linked to distant suppliers in the Greece cases), but in making such adjustments, authorities need to ensure that supply chains do not become inefficient, with a multiplication of short journeys at the local level. Equal, or even greater, reductions in transport emissions may be possible by switching to electric, or more fuel efficient vehicles, by encouraging suppliers to share or backhaul deliveries, by creating better coordinated local/regional transportation hubs or warehouses, and/or by reducing the number of individual suppliers in the contract. Increasing storage capacities within schools (especially chilled and frozen storage) can also have a carbon reduction effect, as this would allow for reduced frequency of deliveries. However, such investments should be partnered with information and training, so kitchen staff are confident about food safety implications of such storage.

In summary, our recommendations to authorities and decision-makers to reduce carbon emissions of PSFP chains are:

- Improve infrastructural provision of anaerobic digestion/composting facilities where these do not currently exist, and where they do, mandate or at least encourage their use in contract award criteria
- Launch food waste awareness and minimisation programmes amongst supply chain member associations and user groups (catering firms, school leaders, public information campaigns), which could include study tours and discussion forums to exchange experiences about minimising waste in school canteens
- Invest in research on nutritionally sound low-carbon diets and menus, and undertake information and knowledge exchange programmes amongst nutritionists, menu designers, catering staff and pupils/parents, to adjust menus to a more local carbon profile
- Encourage better transport coordination between suppliers (including local suppliers) by allocating points to sharing, backhaul and 'distribution only' services of bidders in contract awards
- Encourage more environmentally friendly vehicle and fuel use by specifying these, or allocating points to these, in contract awards
- Explore potential for creation of local/regional transportation hubs/warehouses that could reduce the contact points and individual journeys in the distribution of foods (particularly in PSFP cases where meals provision is disaggregated to individual school level (as in Serbia and Croatia), and/or schools tend to contract with a large number of suppliers (e.g. >5)

6.2.2 How to enhance the economic impacts of PSFP models?

In terms of economic impacts, the research found quite compelling evidence that local economic multiplier effects of school meals services can be enhanced by adopting localised PSFP models, specifically, by ensuring that a good proportion of the total budget expenditure from the service is allocated to local first tier suppliers. Such suppliers are more likely to source from local upstream suppliers (a dynamic that was illustrated well in the UK LOC case), and also to employ local staff, who respend a greater proportion of their incomes within local areas. For authorities that seek to enhance the economic multiplier effects of their catering services, our recommendation is therefore to allocate a greater proportion of supplier expenditure to first tier local firms, and also to encourage first tier suppliers of any location to source from upstream suppliers located in the local area/region. (The contracting of one to two small local suppliers, with minimal budget allocation, has little economic multiplier effect.) However, the research also found that the economic multiplier effects of the case chains were heavily influenced by expenditures on catering staff wages: the requirement for large, locally dispersed workforces to provide the school meals services meant that staff wages were often a significant proportion of the total service budget. In most cases, the vast majority of staff did live in the local area, although in Serbia it was noted that the low-pay, low-status nature of catering employment meant that a proportion of staff could not afford to live in the districts where they worked. Therefore, to maximise the economic multiplier effects from payroll expenditures, authorities could explore ways of making it easier/viable for staff to live more locally, either by expanding provision of more affordable housing, or indeed revising pay grades/levels.

In connection with economic multiplier effects, the research also found that in Italy and Croatia, the PSFP models which had been defined as 'local' in the case selection process (LOC in Croatia, LOC-ORG in Italy) were revealed through the fieldwork to have supply chain arrangements that made them less local than their counterparts. As a result, their economic multiplier effects were smaller than those counterparts. The result highlighted that ambitions and outward commitments to local sourcing do not necessarily translate into tangible returns to local economies, if they are not accompanied by meaningful definitions of local areas (Italian case) and specific criteria and/or minimum thresholds for local sourcing (both cases). Therefore, our recommendation is that authorities make full use of the provisions in EU Directive 2016/24 to incorporate local sourcing criteria into contract awards in ways that combine appropriate and meaningful boundaries for what is 'local', with meaningful minimum thresholds for percentages of local sourcing.

Also in relation to economic multiplier effects, the research found that the contribution of firms to local economies was linked to their supply chain orientation and procurement strategies. The contrasting orientations of the catering firms in the Italian case pair, and the Greece case pair, illustrate this point well. The caterers in the *de facto* non-local cases (Parma in Italy, Thessaloniki in Greece) were part of large enterprises whose procurement strategies were based on national distribution networks and an efficiency logic, whereas the caterers in the *de facto* local cases (Lucca in Italy, Kastoria in Greece) were more embedded in regional distribution networks and a localisation logic. As the catering firms played the role of channel captains in these cases, their orientations/logics were important for determining the configuration of the whole supply chains. Therefore, to improve local economic multiplier effects of PSFP, our recommendation is that authorities find ways to encourage more local/regional caterers or suppliers to bid for contracts, and where successful bidders are part of large, nationally networked enterprises, encouragement is given for them to engage more with local supply networks. This could be achieved, for example, by incorporating a minimum threshold for local sourcing into contract award criteria (as mentioned above), or by encouraging such firms to engage in sharing, backhaul or 'distribution only' services in partnership with local supply networks as part of the contracting arrangement.

In relation to economic value of the PSFP contracts, the research found that for the vast majority of firms, contract value was very low. Nevertheless, firms were generally positive about their involvement in PSFP contracts, arguing that these fitted in well with their portfolio of activities. Moreover, the case study approach of this research, which focused on firms' involvement in only one or two school meals services, possibly underplays the value of PSFP, as a whole, to the suppliers studied. No notable differences were identified within the case pairs on the economic value measures examined. Instead, the value of contracts to firms' businesses was more related to the size of the firm (more small firms reported a higher percentage of contract value compared with large firms). However, the sample was very small and so conclusions should be treated with caution. To this extent, the research findings tentatively endorse recommendations to encourage more contracting of small firms in PSFP, for reasons of economic value.

A further conclusion is that the contributions of firms to local economies is also context dependent. Strategies to encourage contracted firms to engage with local supply bases depend on the extent to which local supply networks are already established within the local area/region. For example, this was identified as a limitation in the UK and Greece LOW cases (Inverclyde and Thessaloniki), both of which are situated in areas lacking in a critical mass of agrifood producers. In these kinds of contexts, the recommendation is for PSFP authorities to work with authorities and agencies involved in economic development and regional growth to identify how support and investments can be made in ways that meet their mutual goals. PSFP strategies that complement the development strategies of other regional authorities will achieve more than those which operate in isolation.

6.2.3 How to enhance the social impacts of PSFP models?

In terms of employment profile and staff training/development, the research found no notable differences within the case pairs that could be attributed to the type of procurement model followed. The profile of jobs, gender balance and ethnic minority representations in the cases were reflective of the profiles of the distribution/catering sectors more generally, whilst the type and extent of training/development opportunities were explained more by other factors (e.g. firm size, national/regional context). To encourage equal opportunities and upskilling of workforces in PSFP therefore, our recommendation is that, regardless of the procurement model pursued, authorities work with regulators, qualifications bodies and trade associations to identify standards and practices which can be incorporated into contract award criteria, either as mandatory standards or as items for points allocation (this is particularly encouraged in Serbia, where currently almost all training is undertaken informally, on the job). Authorities should also make full use of the provisions in Directive 2016/24 which encourage greater involvement of social enterprises and employers of marginalised groups (e.g. disabled persons) in PSFP contracts. Although within specific firms across most cases, an impression was given of relatively good employee relations with low levels of staff absence, there was also an acknowledgement that many front-line jobs in wholesaling, distribution and catering are low-paid and undervalued. As a result, the working environment can be very stressful and unrewarding, a point emphasised in relation to on-site school catering staff in Serbia and Croatia, where staff/pupil ratios are often very high and yet payroll expenditures are low. Investments in these staff would not only improve their working conditions, but also bring other social connectedness benefits (see below) and economic multiplier effects (as described above). Giving authorities more power to manage their own capacities and staffing levels in school kitchens could be another way to initiate change. For example, some schools could increase their revenues by providing meals for neighbouring schools, thereby allowing more staff to be hired and/or pay to be increased (a point illustrated well in the hub school model of Croatia LOC case).

In terms of supply chain connectedness, the research found compelling evidence that localised models of PSFP are linked to greater breadth and depth of social networks and relations in case supply chains. Thus for example, in Kastoria (Greek LOC case), Durham (UK LOC case), and Lucca (Italy ORG but *de facto* local case) evidence was revealed of flexible collaborations and strong relations between suppliers and catering firms, and of at least some engagement of suppliers in community events/activities. Therefore, we recommend adoption of localised procurement models to achieve greater social connectedness. Nevertheless, even amongst the more localised cases in this research, we found that the specific connections between supply chain members and schools were less frequent, with relatively few examples of school visits, field trips and joint educational projects/initiatives. There were almost no examples of supplier involvement in menu design or in the meals service itself beyond the contracted deliveries of goods. This was despite evidence in some cases (e.g. UK, Croatia) that suppliers had both the materials and the willingness to make connections with schools, and indeed these had formed part of the suppliers' successful contract bids. Therefore, to maximise social impacts from PSFP, our recommendation is that authorities not only encourage local sourcing, but also incorporate aspects of community and school engagement into contract award criteria, preferably in the form of targets which can then be monitored/reported throughout the duration of the contract. Meanwhile, on the school side, the research identified a vital role for school catering staff in the development of food and health-related initiatives linked to the meals service, for example by fostering better menu designs and canteen practices that minimise waste (e.g. Croatia LOW case schools), liaising with teaching staff to create a positive food and health learning environment (e.g. the taste tests and parent-child cookery classes of UK LOC case), and as well as liaising with suppliers, with whom they often have daily contact. For this role to be fully realised however, catering managers and kitchen staff jobs need to be valorised more. Our recommendation therefore is that authorities review catering staff training, grades and pay to reflect and reward this shift in their roles. Other ways of valorising kitchen staff would be to develop award schemes, prizes and competitions, as well as develop discussion forums, and events where experiences and good practice can be shared between individuals and across schools/municipalities.

Finally in terms of connectedness, the research found that whilst the localised case models (e.g. Kastoria, Durham, Serbia LOC) contributed more to their local economies than non-local ones, farmers and upstream producers in those areas were generally not visible in the meals services, and not connected to downstream actors/schools. To this extent, the cases reveal that PSFP is not reaching its potential as a driver of rural community development, even where supply chain connectedness is good. Moreover, although certain examples were found of farmer/grower relations being initiated with schools, these tended to be stimulated either by producer associations (e.g. initiatives promoting beekeeping/honey production as a traditional rural practice in Croatia and Serbia), or motivated by one specific actor in the chain (e.g. the head teacher in UK LOC case having a personal determination to source local organic meat for her school), rather than emerging as a result of formal PSFP processes. The one clear exception to this pattern was in Italy ORG case, where for example the catering firm initiated a food and growing educational project, bringing together schools and producers, as part of the specifications of the PSFP contract in this case. Our recommendation would therefore be to invite contracting authorities, catering firm/unit managers and school leaders to work more actively with local/regional producer associations, farmers groups and other representative bodies to identify ways in which they can develop initiatives for enhanced social (and local economic) outcomes. Working with producer associations may also be a route to getting more small farmers/growers into PSFP, as associations may have the supply scale and flexibility to meet the needs of larger PSFP contracts (a problem raised by small scale apple growers in Croatia).

Of course, the potential for PSFP to contribute to rural development is heavily dependent on the context of the local area/region in which the service is located, which leads to different recommendations according to circumstances. For example, it was noted that in the LOC-ORG case in Parma, where there is an abundance of territorial products, the sourcing of one or two emblematic products is an easy way for a catering firm to claim contribution to rural development. In such cases, the recommendation is for PSFP to seek more creative ways to pursue rural development goals, for example by engaging with nontraditional producer groups, or taking further the nature of the collaboration with existing producer groups. In contrast, in areas like Inverclyde and Thessaloniki, which have very little agricultural production on their doorsteps, the recommendation is for authorities to work actively with local development agencies and/or producer groups in neighboring regions to stimulate new initiatives (similar to the economic development recommendations described above).

6.3. Final Reflections for Policy and Practice

The preceding sections have offered recommendations relating to the enhancement of environmental, economic and social impacts of PSFP, respectively. However, there are some fundamental aspects of PSFP contracting policies and practices which were found to be relevant to an authority's effort to enhance any aspect of sustainability. We conclude by reflecting on these processes.

Improvements to contract specifications and award criteria. A common theme in the recommendations across almost all 6.3 Country Reports is the encouragement of authorities to make more reference to specific standards/thresholds in contract award criteria, and to include more quality and sustainability-related measures. This recommendation held true for countries with already well elaborated procurement policies and rules for school food (e.g. Italy) as well as countries where lowest price remains the foremost, if not the only, award criterion (e.g. Serbia and Croatia). In Italy, more clearly specified criteria/thresholds (e.g. tighter definition of 'local') can have the effect of turning sustainability ambitions into more concrete action, whilst in Serbia, qualitative criteria can be the means to liberate schools (i.e. the contracting authorities) from a very restricted pool of suppliers, who sometimes turn out to be unreliable or unsafe, because of their very low-cost oriented business models.

Flexible contracting practices. Across the case studies, greater use is also encouraged of flexible contracting practices, such as breaking larger contracts into smaller lots to encourage bids from small firms (recommended widely across countries), using joint tenders or buying groups to consolidate very small contracts into larger ones in order to attract a different set of bidders (proposed in Serbia, where individual schools can find it hard to attract larger or more professional suppliers because the value of individual contracts is too low), or using dynamic purchasing agreements to allow new entrants the possibility to join the supply chain mid-contract (proposed in Italy, where contract renewal cycles are very long).

Simplification of contract tendering and award processes. In countries such as Croatia and Serbia, where school meals are organised at the individual school level, each school has to bear the costs of these processes, which is a heavy burden exacerbated by the fact that the renewal cycle is annual. This encourages habitual practices by the schools in order to minimise effort, which are obstructive to radical change. On the supplier side, it also discourages new entrants. Therefore in these countries there is a particular recommendation to streamline and simplify the processes, to reduce the administrative burden for schools, and make it easier for new entrants to participate. One way in which this could be achieved is by introducing a simplified standard tender procedure, including a standard list of mandatory criteria, at national level. A second way is by shifting reponsibility for some or all of the meals contracts to the municipal level: e.g. in Croatia, Zagreb City Council currently handles contracts for some food categories on behalf of all schools in the city, this responsibility could be extended to other categories.

Trust in contracting processes and public institutions. Across the countries, the research found that sustainability outcomes were facilitated by the existence of good relations in supply chains, and also goodwill and trust between public and private bodies. These aspects are particularly highlighted in Serbia, where currently there exists a lack of trust between supply chain members and public authorities. Neutral or well-respected bodies or institutions, which have the trust of both sides, could be called upon to mediate between the public and private organisations, as a way forward to build trust within PSFP systems.

7. INTEGRATION OF D6.2 FINDINGS ON NUTRITIONAL IMPACTS OF PSFPS AND ROLE OF PLATE WASTE

7.1. Summary of main D6.2 findings on nutritional impacts and plate waste

The aim of WP6.2 was to investigate the nutritional impacts of models of PSFP, focusing on primary school meals. In each of the same paired cases as studied in WP6.3 (in Croatia, Greece, Italy, Serbia and UK), a sample of daily lunch menus from two out of the five featured schools was selected and nutritionally analysed against referent standards (either national or World Health Organisation). In this way, WP6.2 assessed the planned nutritive value of the meals in each case model. In addition, recognising that children do not always eat as intended, samples of daily plate waste were collected from the lunch services of the same two schools in each case, and their weights and compositions analysed. In this way, WP6.2 assessed childrens' actual nutritional intake from the meals, as well as the losses (nutritional, economic and embodied carbon) due to plate waste. To provide context and explanation for the results, WP6.2 research teams also undertook observations of canteen environments and lunchtime services, conducted interviews with kitchen and school staff, and gathered secondary data on schools' involvement in food and sustainability initiatives. In practice, large variations were revealed across the cases in terms of menu design, lunch period organisation, canteen seating arrangement and staff-student interaction. Several of these features were identified as important to explaining the observed levels of plate waste.

In terms of nutritional composition of menus, the vast majority of Italian menus (both LOC-ORG and ORG cases) met all macronutrient standards, though they were deficient in some micronutrients. In UK, Serbia and Greece, menus met some nutritional standards (e.g. for protein), but large proportions were either too high or too low in other nutrients (e.g. many UK and Greek menus were too high in fat and saturated fatty acids). Large proportions of the Croatian menus were deficient in both macro and micronutrients. Overall, the results showed that even in terms of planned nutritive value (i.e. if children eat everything served to them), the case sample menus often did not provide what is recommended by national or WHO standards. No consistent nutritive value differences were identified between the menus in each case pair. Instead, factors other than procurement model were more important to explaining these differences, for example, the presence in the case of a robust regime for benchmarking the nutritional composition of menus.

Large variations across cases were also found in terms of plate waste quantities, from 12% and 19% of average meals served in Croatia LOW and Serbia LOC cases, respectively, to 38% in Italy ORG and Greece LOC cases, and as much as 43% in Greece LOW case. Starchy carbs and vegetables were the largest contributors to total waste in most cases, with proportions of 30-40% each being common. Proportions of meat and fish waste tended to be smaller (c.9%-17%). Unsurprisingly, these plate waste quantities and compositions translated into considerable nutritional losses compared with the planned intakes, from a third to almost half of many macro and micronutrients lost in the higher waste cases (i.e. Greece LOC and LOW, Italy ORG), to at least 10-20% of nutrients in the lower waste cases (i.e. Croatia LOW, Serbia

LOC). Bearing in mind the deficiencies in the planned nutritive value of many case menus, it can be concluded that the actual nutritional intake of children from the sample lunches often fell well below national/WHO recommendations. High levels of plate waste also represented a considerable economic loss for case meals services (as much as 54% of the total supply budget in Greece LOC case, compared with only 3% in the low-waste Croatia LOW case), as well as a considerable embodied carbon burden (63% of total emissions in Greece LOW case, compared with only 5% in Croatia LOW case). We conclude from this that waste reduction is a highly desirable goal, not only to minimise nutritional losses, but also cost and unnecessary carbon emissions.

Apart from a possible link between the location of meal preparation (whether on-site or central kitchen) and the freshness and flavour of the food, the levels of plate waste found in the cases appeared to be unaffected by the procurement model. Factors such as canteen environment and staff-pupil interactions were identified as more influential. The quantity of food in a served portion was also highlighted as an influential feature, as large variations in average meal weights were found across cases, from 252g (UK LOW) to 527g (Italy LOC-ORG).

7.2. PSFP models and four sustainability indicators

Based on the findings of both D6.2 and D6.3, we present below (Table 3) a summary of the effect of different PSFP models on all sustainability indicators considered by both parts of WP6: environmental, economic, social and nutritional. The conclusions relating to the first three indicators have been described in Section 6.1. For nutritional impacts, it can be seen that both in terms of the nutritional composition of menus, and plate waste, we conclude that factors other than the type of PSFP model are more important to determining positive outcomes. For strong nutritional profiles in menus, we found that having a robust set of national referent standards is important, as is the involvement of professional nutritionists in menu planning and design. Similarly, although WP6.2 research revealed a possible link between an on-site cooking model and the resulting freshness/flavour of the meals served, we conclude that many other factors are more significant to the reduction of plate waste in school meals services, including the canteen and service environment, and the level and quality of interaction between kitchen staff and pupils.

Table 3. Effects of alternative PSFP models (LOC/ORG) on four sustainability indicators: a summary

		Effect of Alternative PSFP Model (LOC/ORG)
Environmental Impact	Carbon emissions	Other factors have greater effect (e.g. menu composition, waste disposal method)
Economic Impact	Local economic multiplier effect	Positive for LOC model

		(if a high percentage of budget is spent on local suppliers)
	Economic value of contract	Other factors have greater effect (e.g. supply chain strategies of suppliers, size of suppliers)
Social impact	Employment/training	Other factors have greater effect (e.g. size of firm, national/regional context)
	Working environment and connectedness	Positive for LOC model (although further actions needed specifically to connect supply chains and schools, and promote rural development)
Nutritional Impact	Nutritional composition of menus	Other factors have greater effect (e.g. presence of national standards for school food, involvement of nutritionists in menu design)
	Plate waste	Other factors have greater effect (e.g. canteen environment, staff-pupil interaction)

7.3. Enhancing the sustainability of PSFP models across four sustainability indicators: recommendations

In this Section, we draw together all the areas of learning we have made in both WP6.2 and WP6.3 to propose initial recommendations for how those involved in PSFP (contracting authorities, catering firms, school leaders, family and community groups) may enhance the sustainability outcomes of the services they have input into. Many of our recommendations are complementary, in other words to pursue one course of action to address one sustainability goal (e.g. nutritional) does not detract from or conflict with positive outcomes for another sustainability goal (e.g. social). Some actions may indeed serve to enhance other outcomes in a synergistic way. However, we note and discuss where possible tensions/conflicts in actions could arise. Subsequent work in Strength2Food (WP10) will develop and elaborate the recommendations from WP6, therefore we offer these recommendations as immediate reflections as to how stakeholders may take positive actions to enhance sustainability outcomes of PSFP models.

First, we recommend that PSFP stakeholders have well-defined standards/criteria at procurement contract phase, or service planning phase, and that these criteria are used actively in the implementation of the meals service. For example, to enhance environmental, economic and social sustainability outcomes, we recommend that stakeholders refer to specific standards/targets in contract tenders and, where possible, put in place reporting/monitoring processes within the duration of contracts to verify good practice. For nutritional outcomes, we encourage relevant authorities to introduce national nutritional standards (if these do not yet exist), and recommend that contracting authorities refer to these standards as part of contract award processes. Moreover, we recommend that stakeholders involve professional nutritionists in the planning and evaluation of menus to meet these standards.

Second, there are many actions PSFP stakeholders can take to reduce plate waste, high levels of which are very undesirable from a nutritional perspective, as well as economic and environmental perspectives. In menu design, it is recommended that stakeholders (i) tailor portion sizes better to the needs/appetite of children, (ii) increase the appeal of menus by simplifying /rationalising meal components, and (iii) allow space in menus for familiar/appealing foods/dishes. Meanwhile, in canteens, we advise stakeholders to adjust lunch periods and environments to give children more time and space to eat and, perhaps most importantly, encourage high quality interactions between kitchen staff and pupils. Part of these recommendations involves greater valorisation of the role/status of kitchen staff, including their training and development, to integrate these staff better into the school 'family'. In terms of wider school life, we endorse initiatives which bring food and health issues to life for students, including activities linked to local producers/suppliers. Such activities help create interest and knowledge about foods, which helps acceptability. Initiatives that involve parents/families can be particularly valuable in this regard.

To enhance environmental outcomes of PSFP, actions to reduce waste (see above) are very helpful, as is attention to waste disposal method. In addition, we recommend exploration of low carbon menus, aspects of which can be compatible with nutritional goals (e.g. encouragement of large proportions of fruit, vegetables, cereals and grains in menus, and modest proportions of meat). However, efforts to pursue low carbon menus should pay heed to potential conflicts with nutritional standards. For example, many menus in the PSFP cases studied in this research already contained low proportions of meat, and to reduce these further could compromise intakes of key macro and micronutrients, such as proteins and iron. Moreover, low carbon menus need careful consideration when they involve introduction of novel/unfamiliar foods, as without context/introduction, these are likely to result in high rates of refusal/plate waste.

Positive local economic outcomes of PSFP can be gained from authorities engaging more actively with local suppliers (i.e. adoption of localised procurement models). However, there can be risks of negative environmental impact if localisation is pursued in an unplanned way, as the consequence can be a multiplication of individual journeys and contact points between suppliers and schools, which can increase transport emissions even for relatively short distances. In order to minimise this risk, we recommend that authorities encourage suppliers to collaborate for efficient supply chain management, and explore support for such management e.g. through development of regional warehouses or transportation hubs. At a more extreme level, authorities should also ensure that localised procurement models do not compromise nutritional goals by effectively restricting access to a variety of nutritionally important foods, when these may not be available locally/in season. (There are also environmental consequences for sourcing unseasonal, local produce in preference for produce grown further away, but in conditions that require less energy intensive inputs).

Positive social outcomes of PSFP can also be gained from authorities engaging more actively with local suppliers and encouraging members of the PSFP chain to connect with each other (i.e. adoption of localised procurement models). We see actions in this area as highly synergistic and beneficial to all four sustainability outcomes. Better interaction between members of the PSFP supply chain implies transport efficiencies which can reduce carbon emissions (as described above). Such interactions can also reinforce and promote development of local supply networks within local areas/regions, which can be a platform to economic growth/prosperity. Moreover, greater involvement of suppliers and producers amongst the users of PSFP (i.e. schools here) offers an opportunity for positive educational outcomes (as part of food/health related initiatives in the classroom) and, where supply chain members take a more active role in the meals service itself, there is the potential for beneficial contributions to menu design and service improvements, which can bring positive nutritional outcomes.

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The Strength2Food project in a nutshell

Strength2Food is a five-year, €6.9 million project to improve the effectiveness of EU food quality schemes (FQS), public sector food procurement (PSFP) and to stimulate Short Food Supply Chains (SFSC) through research, innovation and demonstration activities. The 30-partner consortium representing 11 EU and four non-EU countries combines academic, communication, SMEs and stakeholder organisations to ensure a multi-actor approach. It will undertake case study-based quantitative research to measure economic, environmental and social impacts of FQS, PSFP and SFSC. The impact of PSFP policies on nutrition in school meals will also be assessed. Primary research will be complemented by econometric analysis of existing datasets to determine impacts of FQS and SFSC participation on farm performance, as well as understand price transmission and trade patterns. Consumer knowledge, confidence in, valuation and use of FQS labels and products will be assessed via survey, ethnographic and virtual supermarket-based research. Lessons from the research will be applied and verified in 6 pilot initiatives which bring together academic and non-academic partners. Impact will be maximised through a knowledge exchange platform, hybrid forums, educational resources and a Massive Open Online Course.

HORIZON 2020

Strengthening European Food Chain Sustainability by Quality and Procurement Policy

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EVALUATION OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACT OF DIFFERENT MODELS OF PSFP IN A SCHOOL CONTEXT:

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COUNTRY REPORTS

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Academic Partners

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2. **UNIPR**, University of Parma (Italy)
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EXTENDED ABSTRACT

This report presents the WP6.3 research into the sustainability outcomes of two models of primary school meals procurement in Croatia. Both case procurement models are located in Zagreb City. All primary schools in Zagreb City are required to provide meals for pupils and to procure safe food based on the lowest price. Individual schools are normally responsible for contracting and managing their own food supplies, and cooking meals onsite for their pupils. Therefore, the dataset for one case model (LOW) consists of five primary schools who each undertake their own procurement according to this typical context. The other case model is based on a hub school that, unusually, procures food and prepares lunches for 12 other schools as well as its own pupils. Since this hub school has at its disposal a larger budget for food, it has more bargaining power in the supply chain, and opportunity for improvement in its menus. Therefore, it has more flexibility to procure from alternative suppliers, such as small, local firms. This case model is therefore described as a LOC model, and the dataset consists of the hub school plus four of the 12 schools it distributes meals to.

In terms of supply chain and meals service organisation, in LOC case, the hub school (LOCSchool A) contracts with 11 first tier suppliers, three of these are via Zagreb City Council (for dairy and meat), while the others are a mix of larger and smaller, family-owned firms. These suppliers deliver foods directly to LOCSchool A, which then prepares meals for its own pupils, as well as the lunches for the other four LOC schools (which are transported daily from LOCSchool by van). Schools in LOC case serve 788 meals per day on average. In LOW case, the five schools (LOWSchools A-E) contract directly with an average of eight first tier suppliers each, again these comprise a mix of larger and smaller family-owned firms. All meals in LOW case are cooked and served on-site in the schools. Schools in LOW case serve an average of 1202 meals per day.

For <u>environmental impact</u>, we analysed, for both cases, the volumes of the different foods procured, the kms travelled by first tier suppliers, and the plate waste rates. We then used these data to estimate the total carbon footprints for the case meal services. From the food procurement data, we found that the average meal in LOC case is comprised of 54% fruit and vegetables, 20% ambient, 16% meat, 7% dairy and 3% ready meals. 370g of food is procured per meal. The average meal in LOW case has a smaller proportion of fruit and vegetables (34%) and meat (10%), and larger proportions of ambient (28%) and dairy (25%). A larger volume of food (480g) is procured per meal in LOW case. We calculated that the total kms travelled annually by first tier suppliers in LOC case (81,540 kms) were lower than in LOW case (100,962 kms), mainly because the presence of LOCSchool A, as a hub school, increases the efficiency of the chain and lowers the total number of contact points. In terms of plate waste, we found that the volumes in LOC case (130g per average meal, 27% of full weight) were higher than in LOW case (30g per average meal, 12% of full weight). In terms of carbon footprint, we found that the total emissions of the meals service in LOC case were 119,089 kgC02eq, equivalent to 0.84 kgC02eq per average meal, or 2.24 kgC02eq per kg. In LOW case, although total emissions by purchase volumes and emissions per average meal were higher (221,395 kgC02eq and 1.02kgC02eq, respectively), LOW case emissions per kg (2.13 kgC02eq) were smaller. The higher purchase volume and per meal emissions for LOW case can be explained by the larger volume of food these schools procure per average meal. When that difference is taken account of in the per gram calculation, we find that <u>LOW case emissions are smaller than LOC</u>. The main explanation lies in the differences in average meal composition between the cases, in particular, the smaller proportion of meat in LOW average meal. Also, it is interesting to note that although the more efficient hub structure of the LOC case reduces

kms travelled by suppliers, this translates into only a modest emissions saving compared with the LOW case. This is because the impact of transport on total emissions is very small (6-8%) compared with upstream production and processing activities (92-94%) in each case.

In terms of economic impact, we analysed, for both cases, the local economic multiplier (LM3) effect of the school meals supply chain, and the economic values generated for the first tier suppliers. For local multiplier effect, we found that the LM3 ratio for LOC case (2.15) was in fact smaller than LOW case (2.28). Therefore, for every €1 spent by the LOC meals service an additional €1.15 is generated for the local economy, whereas for every €1 spent in LOW meals service, and additional €1.28 is spent in the local economy. Although in LOC case, as expected, a larger proportion of the total number of first tier suppliers used were situated in the local area (defined as 10km or less from Zagreb city centre), in practice 60% of LOC case total budget was spent on local suppliers, compared with 61% of LOW case budget. Moreover, it was found that not all catering staff in LOC case resided within the 10km radius, whereas 100% of staff in LOW case did. These differences explain why the LM3 ratio for LOW case was higher. In terms of economic values, in both LOC and LOW cases we found that the majority of suppliers were large firms, for whom the school meals contract was only a tiny proportion of their overall business (<1%). There was little evidence that being contract holders had won these firms any new business, as public procurement formed only part of their business portfolio. Nevertheless, as the LOC and LOW cases here comprised only five schools each, and in reality suppliers contract with numerous other Zagreb (and other) schools, the results here are likely to be an underestimate of the true value of school meals contracts to these suppliers.

In terms of social impact, we found that suppliers typically employ full-time staff, and their gender and ethnic profiles follow those of the wider catering/distribution sectors. In both LOC and LOW cases, suppliers appeared to show a commitment to staff training and skills development. However, in both LOC and LOW cases we found a lack of workforce in the school kitchens, including specialist, trained staff. That is a significant obstacle in the development of more sustainable school meals, as for example, the role of kitchen and canteen staff is highlighted as important to improved quality of meals, the reduction of plate waste, as well as to development of food and health related initiatives in schools. In terms of supply chain connectedness, there appeared to be weaker links between schools and suppliers in LOW case compared with LOC case, despite the fact that some suppliers had developed good resources, and undertook activities and events with schools in other regions. There is an opportunity for schools in LOW case to build better links with suppliers therefore, and this could be made more feasible by coordinating events/activities across a number of schools.

A key learning from this research is that a school meals service which has a high proportion of local suppliers and efficient supply chain structure (like LOC case here) does not, in itself, necessarily give the strongest environmental or even local economic multiplier outcomes. A focus on the composition of the meals (in particular levels of meat content) and school budget expenditures (split between local vs non-local suppliers and staff) are more important factors for these outcomes.

In terms of recommendations, we propose to organise the body core who will be responsible for providing school meals in Zagreb Town. Zagreb Local Authority could be responsible for procurement of not only for fresh fruit and milk, but also for Fresh Vegetables, Meat, Eggs, Fish, etc. In that case, Zagreb LA would have higher bargaining power with suppliers and could support procurement of locally produced food. Locally produced and supplied food could help to improve environmental, economic and social impacts.

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List of Abbreviations and Acronyms

LOC MODEL – School with Alternative model of public food procurement

LOW MODEL – School with model of LOW cost public food procurement

1. INTRODUCTION & METHODS

This report presents the methods and results of the WP6.3 Croatia study into the environmental, economic and social impacts of public sector food procurement, focusing on primary school meals. The study was conducted in Zagreb City, the Capital of Croatia. This area was chosen because the local authority (LA) was known to be actively engaged in addressing sustainability issues, including in relation to its procurement practices for school food. As a result, it was felt that stakeholders would be generally open and enthusiastic about the subject matter of the study, therefore giving an opportunity to gather rich data and detailed insight into sustainability issues and how to address them. Furthermore, Zagreb was a good choice for analysis because of the possibility of finding an Alternative case of school procurement model.

The methodological approach of WP6.3 is to identify and compare a LOC/ALTERNATIVE procurement model with a LOW model in terms of environmental, economic and social impacts. All primary schools in Zagreb City are required to provide meals for pupils and to procure food based on the lowest price. Individual schools are normally responsible for contracting and managing their own food supplies, and cooking meals onsite for their pupils. Therefore, the dataset for one case model (LOW) consists of five primary schools who each undertake their own procurement according to this typical context. The other case model is based on a cluster of schools centred on a hub school. This hub school was chosen because it has a big central kitchen that prepares meals for 12 other schools in Zagreb City. The school presents a true exception in the school meal supply scheme. It is a large school (both in terms of premises and the number of pupils) and is located in the heart of the western part of the city. Due to its infrastructure and location it is running a true and efficient small business. It functions completely within the public procurement framework and uses the same suppliers as everyone else (that won the tenders). However, due to the surplus in the budget, the hub school has enough room to enrich the standard meals with other, usually local, organic and family-owned suppliers and their healthier products. They have large bargaining power and run their kitchen in a very efficient way – not only in terms of food processing but also in terms of logistics (optimisation of routes and operations). This model is therefore described as a LOC model, and the dataset consists of the hub school plus four of the 12 schools it distributes meals to.

The fieldwork for the LOC case study commenced in autumn 2016 with telephone interviews and desk research. Thereafter, the bulk of the primary data collection was conducted in May, June, and September 2017 and January, June and September 2018. There were two main components. First, we undertook face-to-face interviews with a total of 18 informants, including supplier managers, farmer/processors, school head teachers and kitchen staff (Table 1). These interviews provided the main sources of information about economic and social impacts of the school meals chains, and, to some extent, environmental impacts. Interviews also allowed us to better understand the relationships between actors in the chains and how the systems generally worked.

We undertook considerable secondary data research, including scrutiny of school and supplier websites, the hub school's contract tender documents, school menu information, company databases, and ordering records and logistics data supplied by interviewees. These sources provided us with much information to perform the environmental and economic impact assessments.

Table 1: Profile of interviewees in Case 1: Alternative model (LOC)

	Identity	**Interview Date & Duration**
1.	LOCSchool A (hub school) Procurement Officer and Catering Responsible	21-9-2018, 1 hrs 4-05-2018, 1hrs 14-01-2018, 1hrs 10-5-2017, 2hrs 3-10-2016, 2hrs
2.	Manager “KLARA” (producer and distributer of bread and bakery products)	9-5-2018, 1 hrs
3.	Manager, ‘NASE KLASJE’ (producer and wholesaler - currently supplying pasta to schools)	6-10-2017, 2 hours
4.	Manager “VELPRO” (wholesaler and distributer of “other” food categories to Primary Schools)	9-10-2017 45 minutes
5.	Manager “VINDIJA” (producer, wholesaler and distributer of “dairy products” food categories to Primary Schools)	11-10-2017 40 minutes
6.	Manager “AGRODALM” (wholesaler and distributer of “fruit and vegetables” food categories to Primary Schools)	13-10-2017 1hour
7.	Manager, ‘VAJDA’ (meet producer)	12-04-2018 1hour
8.	Manager of Family farm “MANDARINKO” - producer of tangerines	5-10-2017 1hour
9.	Head of the LOCSchool A / Accountant of the LOCSchool A	5-02-2018, 1hour 17-9-18 1hour
10.	Head of the LOCSchool B / Accountant of the LOCSchool B	1-02-2018, 1hour 19-9-2018 1hour
11.	Head of the LOCSchool C/ Accountant of the LOCSchool C	14-11-2017, 1hour 24-9-2018 1hour
12.	Head of the LOCSchool D/ Accountant of the LOCSchool D	12-02-2018, 1hour 26-9-2018 1hour
13.	Head of the LOCSchool E/ Accountant of the LOCSchool E	14-02-2018, 1hour 9-10-2018 1hour

The fieldwork for the (LOW) case study commenced in autumn 2016 with a depth interview with members of the Local authority (LA) which in this case was Zagreb City Council and desk research. Thereafter, the bulk of the primary data collection was conducted in January, June and October 2017, as well as in February, March and October 2018. We undertook 9 face-to-face interviews with a total of 14 informants, including the managers of selected suppliers, and the head teachers and accountants of the five selected schools (Table 2). As with the Alternative (LOC) case, we also undertook considerable secondary data research, including scrutiny of school and supplier websites, schools' contract tender documents, school menu information, company databases, and ordering records and logistics data supplied by interviewees. These sources provided us with much information to perform the environmental and economic impact assessments.

Table 2: Profile of interviewees in Case 2: (LOW) case model

	Identity	**Interview Date & Duration**
1.	Head of the LOWSchool A / Accountant of the LOWSchool A	15-11-16, 2hrs & 22-10-18, 2hrs
2.	Head of the LOWSchool B / Accountant of the LOWSchool B	22-1-17, 1 hrs 18-6-2018, 30minutes
3.	Head of the LOWSchool C / Accountant of the LOWSchool C	24-1-17, 1 hrs 18-6-2018, 30minutes
4.	Head of the LOWSchool D / Accountant of the LOWSchool D	18-01-17, 1hr 19-06-17, 30minutes
5.	Head of the LOWSchool E / Accountant of the LOWSchool E	19-01-17, 1hr 20-6-17, 30minutes
6.	Manager "KLARA" (producer and distributer of bread and bakery products)	9-5-2018, 1 hrs
7.	Manager "VELPRO" (wholesaler and distributer of "other" food categories to Primary Schools)	9-10-2017 45 minutes
8.	Manager "VINDIJA" (producer, wholesaler and distributer of "dairy products" food categories to Primary Schools)	11-10-2017 40 minutes
9.	Manager "PODRAVKA" (producer, wholesaler and distributer of "other" food categories to Primary Schools)	16-10-2018 1 hour

2. ZAGREB CONTEXT AND CASE 1 (LOC) & CASE 2 (LOW) MONOGRAPHS

2.1. Profile of the city of Zagreb

The city of Zagreb is the biggest city in the Republic of Croatia and the capital (Figure 1). It comprises an area of 641,355km2, 64,000.00ha and population of 790,017 (largest in Croatia). The city of Zagreb is territorially organised into 70 areas.

City of Zagreb is the cultural, scientific, economic, political and administrative centre of the Republic of Croatia with seat of Parliament, President and Government of the Republic of Croatia.

Zagreb is situated in the continental middle of Croatia, on the southern mountain foothills of Medvednica and on the banks of river Sava. The favourable geographical location in the south-western corner of Pannonian plain between Alpine, Dinaric, Adriatic and Pannonian regions is the main cause of it being situated on a traffic intersection between Central and Southeastern Europe and the Adriatic sea. Population density: 1,245.6 inhabitants/km² (http://stanovnistvo.population.city/hrvatska/adm/grad-zagreb/)

Almost 2/3 of its surface is made of woods and farmland, and 34 rural and subrural areas are situated outside of construction areas of the urban centre.

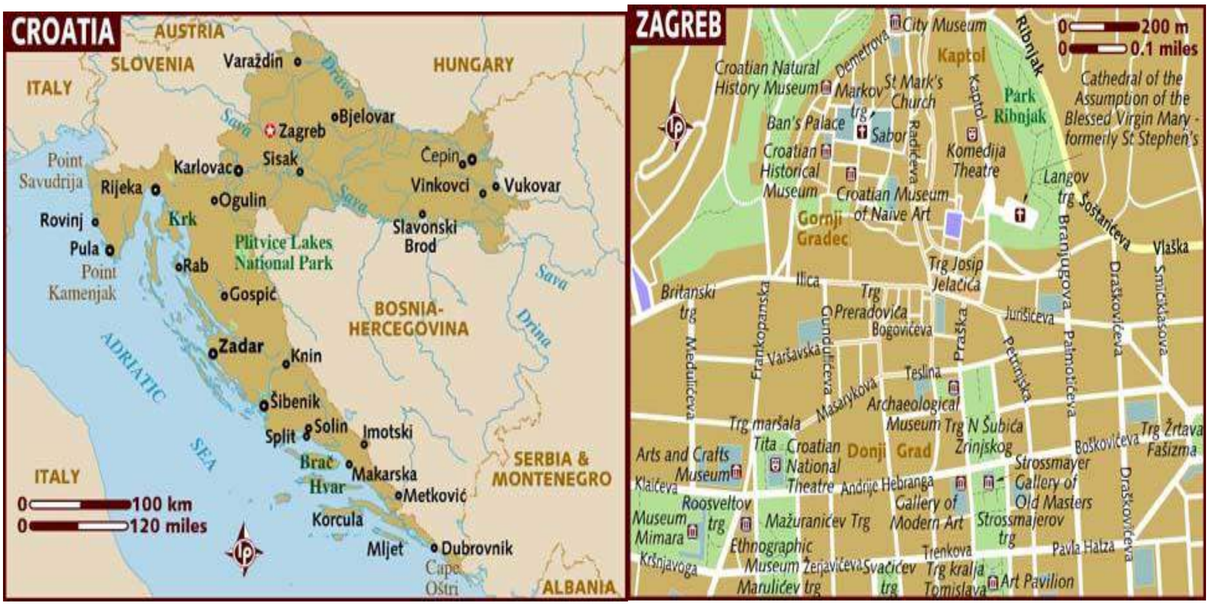
Farmland makes up 1/3 of the surface area of the city of Zagreb or almost 23,000.00 ha.

The area in which the majority of agricultural production takes place in the city of Zagreb is different from rural areas in the strict sense of the word, not only in relation to its role, but also in relation to its importance.

The city of Zagreb implements the local agricultural policy of sustainable development of agriculture and rural areas in its surroundings, which takes into account the importance of Zagreb as a trade centre and all of its natural conditions, which determine priority areas for agricultural production. The main objectives of the policy are as follows: farmland protection, modernization of primary agricultural production and starting processing of agricultural products, agrotourism development, opening of thematic routes, and labelling and branding of agricultural products.

It can be established that 25.0% or 3,562.0 ha of the total farmland is suitable for vegetable farming. For cattle breeding only 12.6 % or about 1,803.8 ha of farmland is suitable, and 39.6% is suitable for arable crops in the function of cattle breeding. A similar surface area relates also to wine growing (1,570.0 ha or 11.0%) (map 6) and fruit growing (1,682.5 ha or 11.8%). (http://www1.zagreb.hr/zagreb/slglasnik.nsf/7ffe63e8e69827b5c1257e1900276647/7883e70240402bafc1257f61004ef2f0/$FILE/Program%20odr%C5%BEivog%20razvoja%20poljoprivrede%20%C5%A1umarstva%20i%20ruralnog%20prostora%202016-2020.pdf) .

Figure 1: Map of Croatia / City of Zagreb*



Source: https://www.lonelyplanet.com/maps/europe/croatia/zagreb/

- In the area of the city of Zagreb, there are 32.9% of the total number of active Croatian entrepreneurs. The entrepreneurs of the city of Zagreb employ 40% of the total number of employees in Croatian entrepreneurship. They also earn 52.8% of the total earned revenues of the Croatian entrepreneurship and 54.7% of after-tax profits as well as 53.6% of the total investments into new fixed assets (https://www.hgk.hr/documents/kzstrukturnekarakteristike57cfebc3bff9e.pdf)

- 90.3% of the total number of entrepreneurs of the city of Zagreb – according to the most recent data of the Financial agency FINA there were 34,336 of them registered – operate in nine industries, whose shares in this segment amount to more than three percent; most of them operate in trade industry (27.1%), professional, scientific and technical industries (22.1%), construction industry (9.2%), processing industry (8.9%), information and communication industry (7.8%), accommodation and food preparation and serving industry (5.0%), real estate business (3.9%); administrative and ancillary service business (3.7%), transport and storage industry (2.6%).

- According to the data of the Croatian Bureau of Statistics, GDP per capita for Zagreb in 2013 amounted to €18,132, which is 77.3 percent higher than the national average. National GDP per capita in 2013 amounted to €10,228. (http://www.poslovni.hr/hrvatska/bdp-po-stanovniku-77465-kuna-308762)

- Of the total number of inhabitants of Croatia, based on 2011 Census, 1,107,623 or 25.8% of them lived in the greater metropolitan area, which includes the city of Zagreb and Zagreb county. 2011 Census showed that there are 790,017 inhabitants in the city of Zagreb (369,339 males and 420,678 females) or 18.4% of the total number of inhabitants of Croatia. The average age of the inhabitants of the city of Zagreb was 41.6 years (aging index 118.9) https://www.hgk.hr/documents/kzdemografskakretanja57cfeb9f56ba7.pdf

In terms of ethnicity, only 5,26% of the population is ethnic minority.http://www.zagreb.hr/nacionalne-manjine-u-gradu-zagrebu/676

2.2. Primary school meals provision and policies in Zagreb City

Zagreb City has 144 primary schools in total, with a total of 59,756 pupils (in 2017/2018), giving an average pupil roll of 414[5], considerably higher than the Croatian national average of 150. [6]

In Zagreb, there is a significant deviation from the above mean due to population density; because of that it is becoming a more efficient school network.[7]

All primary schools are required to provide meals for pupils. For students with daily stay, schools are obliged to organize the possibility of children consuming three meals per day (milk meal, lunch and snack). The City of Zagreb subsidies meal for 44, 300 pupils[8], which means that around 74,13% of children in Zagreb are taking at least one meal (usually breakfast) in the school.

Meals are usually paid by parents and The City of Zagreb. The price of a milk meal is 5.00 HRK (€0.67), lunch is 9.00 HRK (€1.20) and snacks are 2.50 HRK (€0.34). These prices are fixed by City of Zagreb across all public schools.

According to the established criteria and standards of the program "Food subsidies in Croatia", some pupils have the right to subsidized meals. The price difference between the subsidy and the full price is financed from the school budgets. Pupils who are entitled to have free meals: milk meal, lunch and snacks are those:
- Whose family is recipient of social support;
- Whose parents (applies to both parents or a single parent) are unemployed and regularly registered at the Employment Bureau or haven't received a salary in the last two months
- Children of the Homeland War Veterans with disabilities.

The difference in funds between the subsidized price and the established full price of free and subsidized meals is made payable to the schools from the budgetary funds. In Zagreb elementary schools, meals are co-financed for about 44,300 pupils in 2017/2018. The budget earmarked for this year was: 26,000,000.00 Kuna. Pupils' parents pay the monthly food price based on the records of the school of the number of consumed meals and payment slips issued by the school. Breakfasts normally consist of bread with cheese/ham, cereals or pastries, yoghurt/dried fruit. Lunches normally consist of a hot main meal and dessert. For snack, children are normally served fruit, yoghurt and/or bread, or a sweet or savoury pastry. Milk is often served either with breakfast or snack.

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[5] https://www.dzs.hr/Hrv_Eng/publication/2018/08-01-02_01_2018.htm
[6] https://eclectica.hr/2015/07/13/hrvatsko-skolsto-u-brojkama
[7] http://nastavnici.org/2015/07/15/na-putu-prema-dolje-skolska-statistika/
[8]http://www1.zagreb.hr/slglasnik/index.html#/akt?godina=2017&broj=250&akt=875FFD7FC6605D30C125820 5003D1F23

In order to increase the intake of fresh fruit and vegetables, and milk and dairy products, as well as to increase the awareness of the importance of healthy diet of primary school children, from the school year 2017/2018, Croatia commenced the implementation of the European Union School Fruit and Vegetables Scheme – free meals of fruit, vegetables, milk, and dairy products for school children. The main goals are:

- increasing the intake of fresh fruit, vegetables and dairy products which will consequently reducing the intake of foods high in salt, added sugar and fat.
- raising the level of knowledge about the importance of healthy eating and nutritional value of fresh fruit and vegetables as well as milk and dairy products;
- education of students in order to reduce food waste.

Schools can choose local suppliers, who sign up for delivering the groceries, and groceries between preferred options:

- fruit - apples, pears, citrus fruits, peaches, nectarines, plumbs, apricots, cherries and berry fruits
- vegetables - carrot, beetroot, beet, celery, tomato, radishes, and other root vegetables
- dairy products – milk, lactose free milk, yogurt, fermented dairy products without added sugar, fruits, flavours, walnuts and cocoa.

The School scheme incorporates the existing School fruit and vegetables scheme and the Milk program in schools, and for its implementation a total of €3 mln (23 million Kuna) has been earmarked to enable Croatian school children to have an additional meal of fresh fruit and vegetables as well as milk and dairy products. For the School scheme implementation funding, the European Commission allocated €1,720,946 to Croatia for fruit and vegetables and €800,354 for milk and dairy products. In the past (2017/2018) school year, 1,060 schools, 401,800 students and 104 suppliers participated in the school scheme, and €2.5 million were made available, according to the Ministry. http://www.mps.hr/hr/novosti/krece-skolska-shema

A second novelty in Croatian school meal provision from the school year 2017/18 is the fact that schools have become designated competent authorities, unlike previous years when that role was assigned to suppliers. Every school that wishes to participate in the School scheme selects a supplier to supply fruit and vegetables (100-150 g per a child and a week) and milk and dairy products (0.15-0.25 l per a child and a week). Fruit and vegetables are delivered and distributed at least once a week, and milk and dairy products also at least once a week, for the duration of a minimum of 12 weeks on school days in accordance with the school calendar during the whole school year. The target groups for delivery and distribution of fruit and vegetables are primary and secondary school pupils of all ages, and for delivery and distribution of milk and dairy products the target groups are primary school pupils from grade 1 to grade 4.

A forthcoming novelty in Zagreb is the Annual Action Plan for sustainable production This plan is currently a policy document that has not been implemented yet, however it aims to connect students with agriculture and learning about healthy eating habits, local food supply chains, organic production, sustainable production. The Annual Action Plan for accompanying educational measures includes:

- Fruit and vegetable courses
- Maintaining school gardens
- Visiting local farms

2.3. School meals service contracts in Zagreb City

In Zagreb City, as in the rest of Croatia, food supply contracts are tendered, awarded and managed by individual schools, rather than handled at the municipal level. Schools must conduct their procurement activities to comply with the Public Procurement Law (PPL). In accordance with Article 20 of the PPL (official gazette no. 90 / 11, 83 / 13,143 / 13 and 13/14), contracting authorities (i.e. the school managers) are obliged to make an annual Procurement Plan which, among other things, contains information about the objects of procurement, estimated value of the procurement, and the type of procedure that is intended to be implemented for individual item purchases. According to pg. 2 of Article 20 of the PPL, the client (school manager) is obliged to enter data on procurement items whose estimated value is less than 200.000,00 HRK (€27,052) (goods and services) /500.000,00 HRK (€67,630) (works), and according to the Article 18 pg. 3 of the PPL is not applicable.

Procurement items are determined by clients in accordance with Article 79 of the PPL. Having determined the subject of procurement, it is necessary to estimate its value (in accordance with the required amount), so if the value of each of the procurement is within the range from 200,000.00 to 500.000,00 HRK, the client must specify the implementation of one of the public procurement procedures. If this value is below the specified thresholds, client is not obliged to specify the procedure that will be implemented. When procuring goods, works, and services of the estimated value from 20,000.00 to 200,000.00 Kuna, the contracting authority sends a minimum of three Calls for tenders with the aim of market research.

The responsible person representing the contracting authority or an authorized person (i.e. school manager) decides on appointing the commission for implementation of procurement of goods, works, and services of bargain value. Commissions should comprise of at least 3 members, of which one is the chairman. Commissions are established depending on the procurement subject for which the procedure of selecting tenders is conducted.

For example: Each primary school writes its own annual Procurement Plan, in which, among other things, it defines the procurement items - goods - i.e. food items. After examining the procurement plans of more primary schools, it can be recognized that certain food items are in accordance with the provisions of the PPL and that their estimated value does not exceed 200,000.00 HRK.

An example of the procurement plan for LOCSchool A (LOC model) for 2017 is in Appendix 1. For this school, categories of Bread, Milk, Fruit and Vegetables and Other Foodstuffs have to go through the procedure of Public Procurement because annual expenditures are above 200,000HRK. Food categories such as fish and pasta are valued less than 200,000 HRK per year, and so for these items LOCSchool A is just required to invite 3 suppliers to send their tenders. In terms of contract award criteria, the first criterion for the food evaluation is the safety of the food (pass/fail), and the second is price.

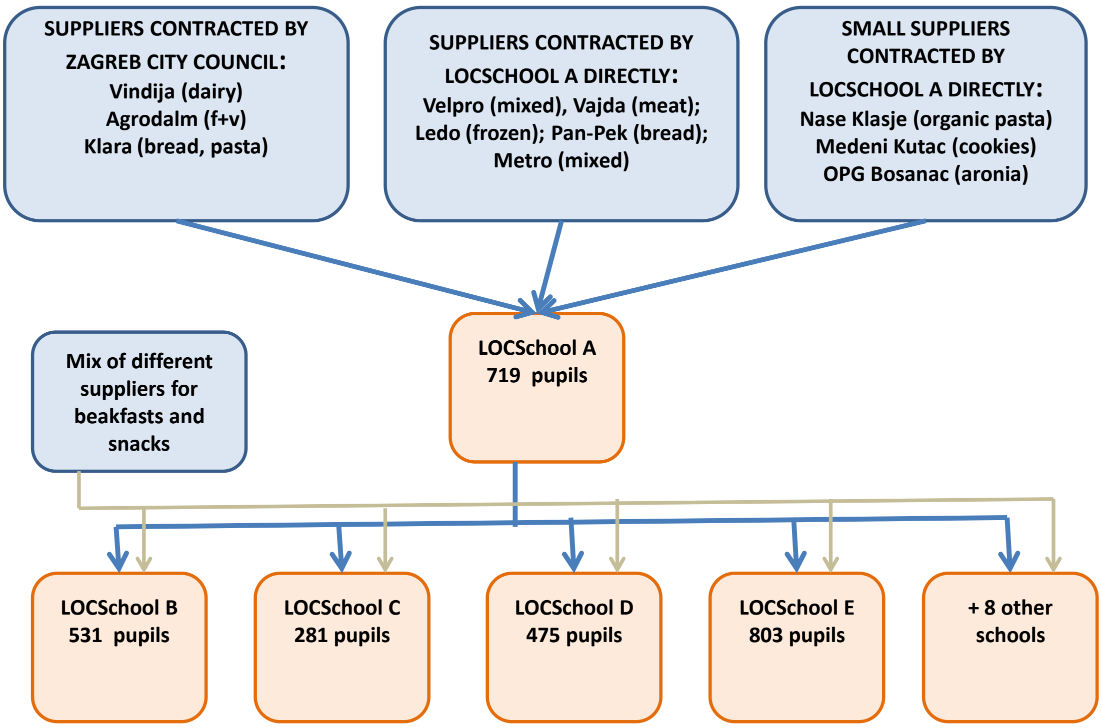
Every supplier delivers food to each primary school separately.

- Meat and bread are delivered every day at 6 a.m.
- Milk (depends on the school storage space)
- Pasta once a month (depends on the school storage space)

2.4. Case 1 (LOC) supply chain organisation and description of members

As described previously, the LOC case is based on a hub school (LOCSchool A), which cooks meals not only for its own children, but also cooks and delivers lunches to 12 other schools. Figure 2 presents the organisation of the LOC case supply chain, showing which suppliers were contracted by LOCSchool A to supply food items in the 2017-18 school year.

Figure 2: Organisation of Case 1 (LOC) school meals supply chain



As can be seen, the organisation of the LOC case supply chain is moderately complex, with the presence of LOCSchool A, as the hub for lunches, playing a key role in increasing the efficiency of the chain. Figure 2 shows that each supplier operates in a specific food category, and that there are three main types of supplier in this case. First, is Agrodalm (fresh fruit and vegetables), Vindija (milk and dairy products) and Klara (bread, pasta). All these suppliers are large firms in their category supplying Zagreb schools, and they are contracted to do so by City of Zagreb itself. Second is a set of suppliers which LOCSchool A contracts with directly, and which are popular with many Zagreb schools: Velpro (mixed), Vajda (meat), Ledo (frozen), Pan-Pek (bread) and Metro (mixed). Third, is a set of small and/or local firms that LOCSchool A contracts with directly: Nase Klasje, Medeni Kutak and OPG Bosanac. LOCSchool A is able to contract these suppliers because of the larger budget at its disposal linked to its unusual position as catering provider to other schools. It is this part of the LOC case supply chain, in particular, which makes it different from the typical arrangements for school food procurement in Croatia. These small family owned producers provide LOCSchool A with specialty products such as aronia. Moreover, they enable LOCSchool A to enrich its meals with organic fresh pasta (e.g. from Nase Klasje) and not just the low cost one that is being delivered within the overall public procurement contracts that provide regular pasta. Furthermore, due to its "business like" approach to school meals, LOCSchool A manages to have a very efficient process of food processing and delivery, as well as much stronger personal and business ties with suppliers.

Figure 2 also shows that LOCSchools B-E, besides receiving lunches from LOCSchool A, also contract specific suppliers to provide them with food items for breakfast, milk and snack meals.

The next sections describe the main members of the LOC case supply chain: suppliers and schools.

2.4.1. LOC case fresh fruit and vegetables suppliers

AGRODALM d.o.o. is the largest fresh fruit and vegetable supplier in Zagreb. The company has been in business since 1994. Since its establishment, the company has been constantly growing, and it currently employs 24 employees, three of which with a college degree. The company specializes in supplying restaurants, state and public institutions, chain stores, and others in the area of Zagreb county and its surroundings with fresh fruit, vegetables, and other food products. The company is located at Veletržnica i hladnjača Zagreb, it has its own storage warehouse of 300 m2, which complies with all conditions for keeping and storing fruit, vegetables, and other food products. It deploys its own fleet of 6 delivery vehicles for the distribution of the mentioned products.

The company offers products of domestic and foreign origin. It mainly offers products of domestic origin from all parts of Croatia. Besides trading, it also has its own farmland in Dalmatia, in the area of Ravni Kotari, where it produces high quality fruit and vegetables. Beside its own production, the company participates also in the cooperation with long-time subcontractors in the territory of the whole of Republic of Croatia. The quality of fresh fruit and vegetables is controlled by an inspection authority which daily conducts controls and determines food safety of the products in the storage. Agrodalm has a turnover of €6,004,000, and employees 24 staff.

2.4.2. LOC Case fresh meat suppliers

VAJDA is a company that is part of PIVAC group. In everyday cooperation with over 650 employees in meat processing industry, Braća Pivac in Pivac group make up one of the most respectable and largest family meat industries in this part of Europe, and they base their growth and development on the sound foundation of quality and tradition. Apart from the company Mesna industrija Braća Pivac, the Pivac group is made up of companies Vajda d.d., PPK-Karlovačka mesna industrija d.d. and Dalmesso d.o.o. Vajda is located in Cakovec 110 kilomenters from Zagreb. Vajda has a turnover of €25,078,666 and employs 251 staff.

2.4.3. LOC Case dairy products suppliers

VINDIJA - At present, the Vindija group encompasses 14 companies, 8 of which are located in Croatia while 6 of them are located in the countries neighbouring Croatia. It employs over 4,000 employees, and has an average annual turnover of €400 million. In its range, Vindija offers over 1,000 different products of seventeen brands, the best-known of which are 'z bregov, Cekin, and Vindon.

Vindija has commercial centres in all larger Croatian towns, and in Bosnia and Herzegovina, Serbia, and Macedonia, it distributes its products through member companies of Vindija stores. Being strongly present domestically and regionally, Vindija exports its products into EU member states.

Annually, 200 million litres of milk are bought and processed, placing Vindija as the second largest milk producer in Croatia. It has modern processing plants, where international quality standards ISO 9001, HACCP, HALAL, KOŠER, IFS, and BRC are implemented in all production facilities. Healthy food products of premium quality are produced.

Vindija’s programme encompasses over a thousand well-known and recognised parent brands: milk and dairy products 'z bregov, soft drinks and fruit juices Vindi, chicken meat and chicken meat products Cekin, turkey meat and turkey meat products Vindon, bovine cattle meat products Rozeto, as well as bread, pastries, and cakes Latica. Vindija is located in Varaždin, 81 kilometer from Zagreb. In total, Vindija has a turnover of €340,298,667 and employs 1070 staff.

2.4.4. LOC Case ambient food suppliers

KLARA - Zagrebačke pekarne Klara is a Croatian company undertaking industrial production of bread, pastries, and other related food products. In its central production plant in Zagreb, over 150,000 pieces of bakery products are produced on a daily basis, and distributed, also daily, to over 2,500 delivery locations. The company has been formally present on the Croatian market since 1909, but as a private joint-stock company, whereas in its present organizational form, the company operates since 1994. Although Zagrebačke pekarne Klara is primarily oriented towards the greater Zagreb area, it operates nowadays throughout Croatia. Aside from its centralized production plant in Zagreb, it also has a centralized logistic-distribution centre, as well as the administrative headquarters of the company at the same address. Hence, a high-quality contact with the market is achieved through separate regional logistic centres in Split (Kaštel Sućurac) and Rijeka (Kukuljanovo), as well as through the placement of own bakery products into the market of Slavonija region. From the Zagreb distribution centre, fresh, long-life, and frozen products are distributed on a daily basis while the regional centres are exclusively in charge of the distribution of long-life and frozen products. The business has a current turnover of €22,578,160 and employs 710 staff.

NAŠE KLASJE – Naše klasje was founded in Zagreb in 2001 as a greenfield investment into the creation, development, and sales of innovative food products. Today, there are two factories producing two different product groups – fresh pasta and bakery commodities. The company takes a leading place in the production of fresh pasta in the domestic market. For its own needs, the company imports the primary commodity, hard grains of durum wheat, which are not produced in Croatia. It provides pasta made of durum wheat to LOCSchool A**.** Naše klasje is a small private family owned company. It has an annual turnover of €4,417,333 and it employs 17 staff.

2.4.5. LOC Case processed fruit and vegetables suppliers

LEDO – At present, Ledo is the largest domestic producer of industrial ice-cream and the largest distributer of frozen food (fruit and vegetables, fish, pastries, ready-made food and meat). The company prides itself on its innovation and has very recognisable products. The Ledo factory is located in Zagreb, has a turnover of €173,992,000 and employs 1076 staff.

2.4.6. LOCSchool other food suppliers

METRO - METRO Cash & Carry d.o.o. commenced business in Croatia in 2001. Today, the company operates a total of nine wholesale centres in the country. METRO Cash & Carry is present in 25 countries with over 750 self-service wholesale centres. With over 100,000 employees all over the world, this wholesale company achieved sales results in the fiscal year 2016/17 of ca. €29 billion. METRO Cash & Carry is part of the METRO AG group. The company offers customized solutions matching the regional and international needs of its wholesale and retail customers. Some of the products the company offers are as follows : cosmetics and toiletries, meat, dairy products, vegetables, fish, frozen products, pasta and seasonings, office supplies, and fruit. Metro has a distribution centre located in Zagreb with a turnover of €24,296,933 and employs 1066 staff.

VELPRO - a partner to professionals, is designed primarily to satisfy the needs of retailers, hotel businesses, hospitality and catering industry, and public sector, i.e. companies and small business owners who can get all the supplies they need for their businesses in one place. VELPRO operates all over Croatia, with over 200 vehicles, which meet the most modern international distribution standards. Besides premium quality services, the customers are offered a wide range of 12,000 products, which consists of over 800 products of its own brands: Rial, Profiline and Profiline Exclusive. VELPRO sells and distributes fresh food, fruit and vegetables, fresh meat, packaged food, beverages, cosmetics and chemistry, seasonal products, office supplies, technical goods, and a professional range for hospitality and catering, as well as hotel businesses, which make out a significant segment of its wholesale operations. High-quality services of the largest Croatian wholesaler implies a modern goods ordering online system. Besides online orders, the customers have at their disposal also specialized wholesale centres at certain locations. The turnover of Velpro is €296,361,333 and it employs 1409 staff and its distribution centre is located in Zagreb.

2.5. The featured schools in Case 1 (LOC)

Table 3 summarises the pupil roll and meal uptake in LOCSchools A-E. The next sections give a description of each of the schools.

Table 3: Pupil roll and meal uptake in (LOC) featured schools (2017-18)

	Pupil roll	% free meals	Daily average meals	Daily average all meals	Daily average uptake (%)
LOCSchool A	719	5%	530 (breakfast) 360 (lunch) 165 (snack)	351	48%
LOCSchool B	531	8.5%	531 (breakfast) 290 (lunch) 266 (snack)	362	68%
LOCSchool C	281	1%	188 (breakfast) 105 (lunch) 188 (snack)	160	56%
LOCSchool D	475	4%	253 (breakfast) 190 (lunch) 158 (snack)	200	42%
LOCSchool E	803	1%	478 (breakfast) 233 (lunch) 180 (snack)	297	36%

2.5.1 LOCSchool A

LOCSchool A is located in a heart of the western part of the city Zagreb. It is one of the largest schools in this City area, having 719 pupils. All pupils have the right to have school meals, but usually they are taken by younger grades (1^{st}-4^{th}), who stay in the school in day-care (48%

uptake). A relatively low percentage of children (c.5%) are eligible for free school meals (children of disabled parents, unemployed parents, children from families that receive social welfare). The current administrator for food procurement, who has been in post for 3 years, has initiated a range of projects and activities on food, health and growing, which reflect a personal interest and commitment to these issues. This school presents a true exception in the school meal supply scheme. Due to its infrastructure and location LOCSchool A provides meals for 12 other schools as well as its own pupils, therefore it runs a true and efficient "small business". As mentioned before, due to the surplus in the budget LOCSchool A has enough room to enrich the standard meals with other, usually local, organic and family-owned suppliers and their healthier products. The School has large bargaining power and runs its kitchen in a very efficient way – not only in terms of food processing but also in terms of logistics (optimisation of routes and operations). Approximately 6-7 staff work in the LOCSchool kitchens.

2.5.2 LOCSchool B

LOCSchool B is located in the Tresnjevka-north area. Close to the school are the following facilities: Ericsson-Tesla factory, Church of St. Marko Križevčanin, kindergarten "Bajka" and the city theater "Trešnja". The school has 531 pupils, which places it slightly below average size for the schools in this case. Although LOCSchool B procures lunches from LOCSchool A and other food (for breakfast and dairy meals) from the same suppliers used by most schools in the Zagreb, the head teacher has a personal commitment to pursuing food and health issues in the curriculum and in wider school life. This means LOCSchool B has undertaken various projects not typical of most schools, for example, a workshop on healthy diets. Uptake of school meals is 68%, which is the highest uptake in this sample. 1-2 staff work in the kitchen/canteen, to take responsibility for unpacking and serving the lunches, and monitoring the children.

2.5.3 LOCSchool C

LOCSchool C is located in the north of the City. The school surroundings belong to the historical urban complex which has been, based on a Decision of the Ministry of Culture, entered into a Register of Cultural Heritage of the Republic of Croatia. In the school surroundings, there are ca. 4,000 m2 of green space, a hedged school playground, and an open space for playing and learning. Two classrooms lead to the garden, which is used by students during classes and daycare. The school was awarded with a status of a European eco-school in 2001, has realized a number of activities and projects so far, and in 2011 it was awarded with a GOLDEN STATUS OF AN INTERNATIONAL ECO-SCHOOL. The school has 281 pupils, which is the smallest pupil roll in this case, and 56% of pupils take school meals. The lunch is delivered from LOCSchool A, while breakfast and snacks are planned by the cook in cooperation with the biology teacher. In the last couple of years, there were no initiatives related to healthy diet and healthy food. But, the head teacher is very active in promotion of learning in nature (for example – educational path - determining and listing plant species in the school environment). The school is located in a more affluent district, therefore only a very small number of children are eligible for free meals. 1-2 staff work in the kitchen/canteen, to take responsibility for unpacking and serving the lunches, and monitoring the children.

2.5.4 LOCSchool D

LOCSchool D is located in an older blue-collar district, full of poor families, which are welfare and/or child support recipients. Also, there is an exceptionally high number of dysfunctional families – divorced parents, single parents, etc. The school has 475 pupils, slightly above average for this case , of which 4% are eligible for free school meals. The school has pursued several food and health related initiatives in the past, including gardening and cooking clubs. The head teacher expressed enthusiasm for health projects, for example – within a joint project conducted in cooperation with the Faculty of food technology and biotechnology, the school entered into a project of Kaufland's VIP school, which in 2017/2018 enabled a weekly donation of fruit and vegetables of 100kg - for every pupil of the school. Also, in 2017, the Croatian Academy of Applied Nutrition in cooperation with the Scout Unit Plamen-Trešnjevka organized an interesting event in the school yard - FOOD REVOLUTION DAY – whose initiator was famous Jamie Oliver. Educational workshops for parents and children were organized, as well as scout games and preparation of healthy meals in order to promote healthy nutrition and physical activity as important health factors. Also, in cooperation with the associations «Vestigium» and "Zeleni klik", they organized a green eco-market. That day, both teachers and parents had a very demanding task of planting spice plants, medicinal herbs, and decorative plants. Uptake of school meals is 42%, which is lower than average for schools in this case. 1-2 staff work in the kitchen/canteen, to take responsibility for unpacking and serving the lunches, and monitoring the children.

2.5.5 LOCSchool E

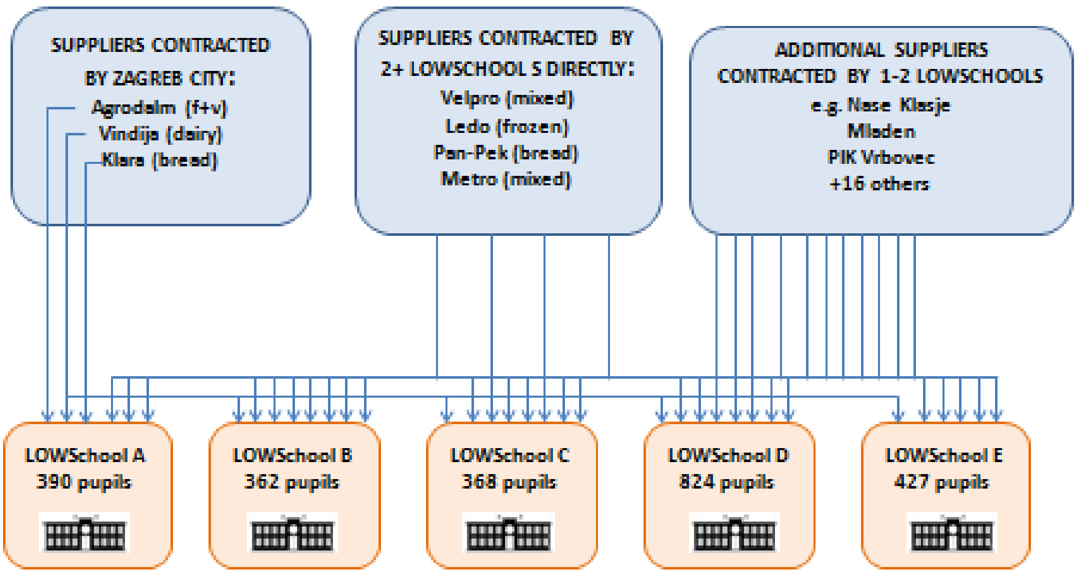
LOCSchool E is the biggest school located in the western area of Zagreb. The statistics of the future pupils of the 1st grade: out of the total of 108 pupils, 15 of them live in single-parent families, 93 of them live with both parents. The majority of parents, 72 of them, estimated to have average income, 27 of them estimated to have an above-average income, and 4 of them below average (single-parent families with one child). By the principal's decision and due to socially threatened circumstances, 4 pupils receive free food (a milk meal and a lunch), which is 1% of the pupil roll. The head teacher actively pursues a healthy packed lunch policy and encourages children to make healthier choices. In the school year 2017/2018, LOCSchool E started a healthy diet project under the name Child Diet Optimization. At the school, a milk meal and snack are prepared according to the menu. The menu is planned in accordance with the report of the Dietary Team, which keeps track of wishes, critiques of pupils, parents and form masters. The menu for breakfast and snack is planned seasonally and LOCSchool E very actively follows the general rules and guidance for elementary school pupils' diet of the Croatian Ministry for Health. 1-2 staff work in the kitchen/canteen, to take responsibility for unpacking and serving the lunches, and monitoring the children. However, the uptake of school meals is 36%, which is the lowest uptake in this case.

2.6 CASE 2 (LOW) Supply Chain Organisation and Description of Members

The LOW model study was, like LOC case, conducted in Zagreb City and consisted of five primary schools situated in an average but densely populated city area that mainly consists of middle class families. They represent regular schools that invest a lot of effort to produce highest quality meals within the given legal framework. They pay special attention to the food preferences of children and try to serve them what they will actually eat. The schools have extremely typical supply chains that consist of suppliers that have won the annual public procurement tenders. Each LOW school undertakes its own procurement contracts with suppliers, independent of the other schools. The schools also participate in the EU Milk and Fruit school schemes. Due to their procurement being undertaken on an individual school basis, each LOW school has medium to low power and ties with its suppliers. What is important to mention is that the financing of the school meals goes through the school finances – consisting of the city of Zagreb subsidy and the part that pupils pay. There are, on average, 20 families per school that do not cover the cost of the school meal, in spite of the fact that their pupils eat. Such cases present a challenge for school budget and the management since the school does not want to deny the food to the children.

Figure 3 presents the organisation of the LOW case supply chain, showing which suppliers were contracted by each of the LOWSchools to supply food items in the 2017-18 school year.

Figure 3: Organisation of Case 2 (LOW) school meals supply chain



As can be seen, the organisation of the LOC case supply chain is complex, with many individual suppliers being contracted, and delivering goods to different mixes of schools. For ease of depiction, suppliers are categorised into three types in this case. First, is Agrodalm (fresh fruit and vegetables), which supplies LOWSchool A, and Vindija (milk and dairy products), which supplies all five LOWSchools. Both of these are the largest firms in their category in Zagreb, and they are contracted to supply schools by City of Zagreb itself. Second are large firms which two or more LOWSchools contract with directly - these include: Klara (bread, pasta) which supplies Schools A, B, C and E; Velpro (mixed) which supplies Schools A, C and E; Ledo (dairy) which supplies Schools A, C, D and E, and Pan-Pek (bakery) which supplies Schools A, B, C and D. It can be noted that some of these suppliers also hold contracts in the LOCSchool case, and indeed they are known to supply many schools across city of Zagreb. The third type of supplier in LOW case, which was revealed through the research, is an additional set, typically contracted by one school only in the case, and usually for only small proportions of the school's budget. These suppliers are sometimes local, and in some cases (Nase Klasje, Mladan) are also family firms (although the set also includes non-local, larger firms). The presence of these suppliers in the LOW case supply chain demonstrates the willingness of regular schools in City of Zagreb to contract with additional firms beyond the main large suppliers.

The next sections describe some of the key suppliers in the LOW case. (Descriptions for Agrodalm, Vindija, Klara Ledo and Velpro have already been given in sections 2.4.1 to 2.4.6.)

2.6.1. LOW case fresh fruit suppliers

OPG Mlađan - The family farm Mlađan was founded in 2002 with the aim of growing different sorts of apples and pears. At the very beginning, the plantations covered 2 ha, but today they extend to 7 ha of surface. The estate is located in the village of Ladina (municipality Dubrava - Zagrebačka County), a distance of 54 km from Zagreb. At first, OPG Mlađan competed only for the delivery of apples. Since then, it is one of 34 suppliers who signed the contract in 2018 to deliver produce to 91 schools in Zagreb and in Zagrebačka and Karlovačka counties (38,894 children). At least once per week for the school year, 100 to 150 grams of fruit or vegetables per student are delivered – peaches, apples, nectarines, plums, tangerines, pears, strawberries, cherries, carrots, and tomatoes. This is equivalent to 5.5 tonnes of fruit weekly, for a payment of around two million Kuna (€270,500).

The owner commented: "We're overwhelmed. Although some heads of schools wouldn't even talk to us because they are not familiar with the scheme, others accepted us eagerly because they trust their producers". He further explained that strawberries are somewhat debatable in the whole scheme because some children are allergic to that fruit, while it is also difficult to imagine carrots or tomatoes as a stand-alone meal for children. Last year, they also organized children's outings on their estate of 7 hectares of orchard, and every school they did business with planted its own plant. The company aims to keep working with children in future years, based on growing a good reputation.

https://www.vecernji.hr/zagreb/socnim-jabukama-hrane-38894-daka-971763 - www.vecernji.hr

2.6.2. LOW case fresh meat suppliers

PIK VRBOVEC - was founded in 1961, based on the meat company owned by Đuro Predović, which was founded in the 1938. The part of Prigorje, where the meat industry PIK Vrbovec is located, was traditionally famous for cattle farming, especially hogs, forming a good starting point for this kind of industry. The meat industry PIK Vrbovec is a leading meat producing company in Croatia and in the region, and with its products, it satisfies almost 40% of the needs of the Croatian market for red meat and products from red meat, placing the company in the leading position in the Croatian market. Besides the products under the PIK brand, a selected range of products under the Sljeme brand is also produced, and its quality is well-known to many Croatian consumers. PIK products are also exported to foreign markets, whereby export makes out 10 percent of the total annual sales. However, many Croatian origin products are more expensive, in particular meat. PIK Vrbovec is located in Vrbovec - Zagreb region (30kilometers from Centre). The company has a turnover of €288 740,88 and employs 19,625 staff.

2.6.3. LOW case ambient food suppliers

PAN-PEK d.o.o. is a leading company in the production of bakery and confectionary products. Years-long experience, persevering product quality, along with the know-how of experts, enabled Pan-pek to occupy the leading position on the market. They have built a new, most-modern, completely automatized, and computer-controlled factory of bakery and confectionary products in Croatia, which is located in the broader centre of the City of Zagreb. PAN-PEK offers to the market a very wide range of products – from the basic to the special kinds of bread and pastry, fresh and packed cakes and biscuits, to the products custom-made only on order. They supply about two hundred small and medium companies daily, as well as all larger hypermarkets, schools, hospitals, kindergartens, nursing homes, and a number of individual customers. Pan Pek has a turnover of €28,635,333 and employs 585 staff.

MLINAR – The history of Mlinar dates back to 1903 and Križevci, where and when a company „Prvi križevački paromlin i paropila Hinko Švarc i sinovi“ was founded (the company built a mill for wheat grinding). Today, Mlinar has over 230 retail stores in its possession in four European countries, and in the form of wholesale, it additionaly places products onto 19 world markets. So far, they have placed their franchise in eight world countries on three continents. The production is organized in five large bakery plants, two of them in Osijek, and one in Poreč, Šibenik and Zagreb. Those are mainly most-modernly equipped bakery plants in this part of Europe, and the Osijek plant is one of technologically most sophisticated bakery production units in the world. The turnover of Mlinar is €70,529,333 and it employs 1491 staff.

2.6.4. LOW case other food suppliers

***PODRAVKA* -** is one of the leading companies in South-Eastern, Central, and Eastern Europe, and was founded in 1947 on the basis of a former jam production and fruit processing factory of the brothers Wolf. Later on, it became known worldwide for its production of a universal food supplement - Vegeta, which has been exported for over half a century into over 40 countries in the world on all five continents. Podravka is today recognized by its consumers not only for its brand Vegeta, but also for a number of other brands: Dolcela, Lino, Eva, Fant, Kviki, etc. With headquarters in Koprivnica,90 kilometers from Zagreb Centre, it operates today in two main business segments: nutrition and pharmeceuticals. Today, it is the leading food brand in the region.

In 2012 and in cooperation with the town of Koprivnica, Podravka initiated the project of unique “Healthy menus” aimed at primary school students. Podravka’s *School menus project* is aimed at improving eating habits of primary school children in Croatia through the use of "school kitchen healthy menus". The primary aim of this Project is for Podravka to promote - through free nutrition education of children, their parents, primary school teachers, and cooks related to new, nutritionally high-valued meals (less sugar, fat, salt, and more vitamins and minerals) in school kitchens – a healthy and balanced nutrition of primary school students aimed at their wellbeing in the future. Due to its quality, the project received acknowledgment from the Ministry of Health and Ministry of Ministry of Science, Education, and Sports. The Project involved participating schools from Zagreb, however not any in the current LOW case sample.

In 2013 together with the Institute Ruđer Bošković, Podravka initiated the Food Innovations Centre. According to the strategic objective of the Agriculture Division, Podravka is planning to achieve a proportion of 100% of domestically grown primary raw materials in the ready-made product of tomatoes by 2022, and in order to achieve that, it continually improves its cooperation with domestic subcontractors, invests into its agricultural production, soil quality improvement, purchase of special equipment and machinery. Podravka has a turnover of €275,072,000 and employs 3296 staff.

2.7 The featured schools in Case 2 (LOW)

Table 4 summarises the pupil roll and meal uptake in LOWSchools A-E.

Table 4: Pupil roll and meal uptake in (LOW) featured schools (2017-18)

	Pupil roll	% free meals	Daily average meals	Daily average all meals	Daily average uptake (%)
LOWSchool A	390	3%	278 (breakfast) 85 (lunch) 69 (snack)	144	37%
LOWSchool B	362	3%	254 (breakfast) 244 (lunch) 129 (snack)	209	58%
LOWSchool C	368	5%	296 (breakfast) 222 (lunch) 127 (snack)	215	58%
LOWSchool D	824	2%	695 (breakfast) 86 (lunch) 86 (snack)	390	35%*
LOWSchool E	439	6%	325 (breakfast) 64 (lunch) 40 (snack)	244	33%*

*These percentages have been adjusted to reflect the low proportion of lunches taken relative to other meals.

2.7.1. LOWSchool A

LOWSchool A is a primary school located in the western part of the city of Zagreb. It has 390 pupils, which makes it a medium-sized school for this case. In in-class teaching, a total of 200 pupils are schooled, 105 of which are girls and 95 boys. In subject teaching, there is a total of 170 pupils (80 girls and 90 boys). The pupils come from different family types and are of different socio-economic status. Their admission area covers objects in which war veterans, disabled veterans, and socially threatened families are accommodated as a result of which a certain number of pupils come from such families. Also, their settlement is close to to mosque, so that there are pupils strictly adhering to Islamic customs. A part of their pupil roll comes from families which bought their flat in market conditions. Therefore, the sociologic structure of their pupils is diverse. Extended stay is organized for the pupils of the first and second grade, so that in the school year 2017/2018 the school had a total of 73 pupils in the extended stay programme. The school took part in the project "the healthier the happier" (Erasmus + 2014 – 2016: an EU funded project promoting the healthy lifestyle: campaigns related to development of healthy diet habits, public discussions, tasting of healthy, locally grown foodstuffs, setting up a billboard promoting seasonal and healthy foodstuffs, drafting of a healthy cookbook). One other project important to this school is "Hidden Calories" – workshops for 3rd grade pupils conducted by the students of the Medical faculty in Zagreb in cooperation with the Public health institute "Dr. Andrija Štampar" on a healthy diet and hidden calories in industrially processed food. Uptake of school meals is 37%, which is slightly lower than the average.

2.7.2. LOWSchool B

LOWSchool B is a primary school located in the centre of Zagreb Town. It has 362 pupils, which makes it the smallest school in this sample. In the past few years there have been little extraordinary activities related to healthy food and eating (just household maintenance as extracurricular activity). An interesting event in this school is role substitution -- students assume the role of the staff and help out in the preparation and serving of meals. There are regulated meal portions for students at this school – students from the 1st and 2nd grade receive smaller portions than the ones from the 3rd and 4th grade. Uptake of school meals is 58%, which is joint highest in this case.

2.7.3. LOWSchool C

LOWSchool C is a primary school serving an eastern part of Zagreb City. It was opened on 1st October 1964 in the district Borongaj-North, on vegetable farmers land. It has 368 pupils, which makes it a medium-sized school for the region. In the past two years, an increasing number of pupils have been registered at this school. The reasons for this is the moving of families to LOWSchool C's admission area, and earlier admission of older siblings. Most of the parents have secondary education qualifications. 5% of pupils are eligible for free meals, which is the joint highest in this case. LOWSchool C has pursued a number of health and food-related initiatives in recent years, reflecting a personal enthusiasm and commitment of the head of the school. These include a School scheme (fruit) Association and a youth programme initiative: **Association Udruga O.A.ZA. – Održiva Alternativa Zajednici** (a Sustainable Community Alternative). This initiative was founded in January 2013 in Zagreb. Its aim is to organize various youth programmes, during which students can – in a pleasant and motivating atmosphere – develop their own potential and become responsible and exemplary leaders of a sustainable social change. This school possesses urban gardens.

2.7.4. LOW School D

LOWSchool D is a primary school serving a wide region of Zagreb. The socio-demographic profile of this school is mainly from blue-collar class, with numerous families with three or more children. LOWSchool D's admission area includes a part of the city area stretching 10 km from northwest to southeast and encompassing 9 districts. The school area is of predominantly rural character and – aside from this school, a kindergarten, and Grad mladih (Youth town) – there are no other educational or cultural institutions. The districts are expanded through individual housing construction, therefore the number of students in each class unit is increasing yearly. A large number of students take city buses, and for some students, the transportation is organized by a school bus. The local community is agricultural.

It has 824 pupils, which makes it the largest primary school in the sample, and 2% of LOWSchool D's pupils are eligible for free meals. The school has not actively pursued food and health-related initiatives. Uptake of school meals is 35%, which is around average for a school in this case.

2.7.5. LOWSchool E

LOWSchool E was founded based on a Decision of the City Council from 17th May 2007. In school year 2018, LOWSchool E had 439 pupils. The school is located in a suburban area. A part of the admission area is in the district of Donja Dubrava, and another part is the district of Sesvete. This is a neighbourhood full of family houses. The majority of families moved here and built family houses during the Croatian war of independence and post-war period. From the outset (2007), the number of pupils has decreased due to families moving abroad. 10% of the total pupil roll is of Roma nationality. Most of them live in good socio-economic conditions. However, they are absent from classes a lot (both excused and unexcused absence). 6% of pupils have a free school meal (lunch and/or school milk meal).

The current head teacher has a personal enthusiasm for food and health issues, and several additional projects about food and healthy eating are ongoing. Within the school prevention programmes, the following topics are covered: Healthy diet – the first grade obesity prevention; Child obesity prevention – the second and third grade; Food and drink – the fifth grade; Proper diet – the seventh grade. They are also involved in the School fruit scheme and they are Kaufland's VIP school (once a week Kaufland donates fruit for all pupils and a certain amount of vegetables).

Uptake of school meals is 33%, which is in the lowest uptake in this case.

3. ENVIRONMENTAL IMPACT OF SCHOOL MEALS SERVICES

3.1 Methodology to measure environmental impact

Our core measure of environmental impact was carbon footprint, expressed as the kgsC0$_2$e emitted from the production, processing, transportation and waste of food items purchased by the five featured schools in Case 1 (LOC) (i.e. LOCSchools A-E) and Case 2 (LOW) (i.e. LOWSchools A-E), respectively, over a school year.

To estimate the emissions from the production and processing of food items supplied to the schools, we used two sets of emissions factors. For fresh items, we used the factors proposed by Audsley et al. (2009). For processed items, we used the factors of the Rowett Institute of Nutrition and Health Database (2017), as these include emissions related to the activity of processing. Both sets of factors encompass the emissions caused by all the activities arising from the production of food items up to and including transport to the regional distribution centre (RDC) level. In our study, the RDC level equates to wholesalers (i.e. the first-tier suppliers described in Sections 2.4 and 2.6).

To estimate the emissions relating to the transportation of food items from wholesalers/suppliers to schools (i.e. 'local' transportation), we used the calculation method recommended by Defra (2013), which is based on estimating suppliers' delivery round distances and frequencies, taking account of the types of vehicles and fuel used, the number of drops to other customers in the rounds, and the proportion of the loads comprised by the food items to the schools featured in the case[9]. According to Kellner & Otto (2011), the formula below assumes 89% weighted average allocated to the distance of the delivery round and 11% for the vehicle load.

To estimate the emissions relating to waste, we applied the emissions factors for waste handling proposed by Moult et al (2018). These capture the emissions from transportation of waste from schools to waste disposal sites, and from the processing of the waste itself, for five different food categories (fruit and vegetables, bread, cheese, fish, and meat).

3.1.1 Measurement method for Case 1 (LOC)

The measurement process for Case 1 (LOC) was as follows:

First, we collected the delivery invoices sent by all the suppliers (including Agrodalm, Vajda, Vindija, Klara, Naše klasje, Ledo, Metro and Velpro) to LOCSchool A over the whole school year 2016-17: from September 2016 until mid of June 2017, to reflect the seasonal change in menu. From these invoices, we generated a list of the total volumes of foods purchased by LOCSchool A in those periods. We included all types of food item (fresh fruit and vegetables, fresh meat, milk and dairy, eggs, ambient goods (e.g. bread, pasta, rice, flour), and processed and frozen items (including canned goods and ready meals). The only items excluded were those purchased in very small quantities (e.g. certain spices, sauces) and bottled water. From these data we estimated the average weekly volumes (in kgs) of all foods purchased by

[9] The formula we used was: $\text{Total CO2 Emissions From Transportation Process per Week} = \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Drops}}{\text{Total Drops}} \times 89\%\right) + \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Load}}{\text{Vehicle Load}} \times 11\%\right)$

LOCSchool A, then multiplied these volumes by 36 weeks to estimate the total volumes (kgs) of the food items purchased over one school year. Then, in order to isolate the volumes of foods destined for lunches in LOCSchools A to E (recall that LOCSchool A cooks lunches for 12 schools in addition to its own pupils), we gathered data on the average number of lunches served daily in all 12 schools, and identified the proportion comprised by LOCSchools A-E (this was 37%). We then multiplied the total volumes of foods purchased by LOCSchool A by this percentage. A final point to note about the estimation of food purchase volumes in LOC case is that LOCSchool A procures food items for breakfast and snack for its own pupils, in addition to lunch items for 12 schools. As it was not possible to identify these specific foods from within the invoice lists, they have been included in the food volume estimations. Hence, the total food purchase volumes in the LOC case are likely to be a slight over-estimate of true volumes. As all other LOCSchools procure breakfast and snack foods directly from suppliers, not LOCSchool A, these items were excluded from the food volume estimates in this case.

Having estimated total food purchase volumes in LOC case, next we calculated emissions (kgs$C0_2$e) from the agricultural production and processing of these foods, using Audsley et al's (2009) and Rowatt Institute's (2017) per kg emissions factors multiplied by the total volumes calculated in the first step. To select the most appropriate factor from the origin options (EU, rest of world), we used information given by the suppliers in interview as to the origin of the foods they supplied to schools in Zagreb City (and also where origin changed over the course of the year, in the case of fresh fruit and vegetables).

Then, we calculated the emissions (kgs$C0_2$e) relating to the transportation of the food items from the suppliers to LOCSchools A-E for the 36 week school year, applying the measurement method of Defra (2013) to the information given by suppliers in interviews on their delivery round distances and frequencies, types of vehicles, fuel and the number of drops to other customers in the rounds.

Finally, we calculated the emissions (kgs$C0_2$eq) relating to the handling of waste by taking the data on volumes (in kgs) of plate waste generated at two LOCSchools over four weeks (as collected in WP6.2 and reported in D6.2), and aggregating these to the five LOCSchools, for the 36 week school year. We then multiplied the aggregate plate waste volume of all five LOCSchools by Moult et al's (2018) waste handling emissions factors, taking account of the emissions attached to different categories of waste.

The total carbon footprint for LOC case was therefore the sum (in kgs$C0_2$eq) of the above sets of emissions applied to the total aggregate food volumes purchased by LOCSchool A, as described above.

3.1.2. Measurement method for Case 2 (LOW)

The measurement method for Case 2 (LOW) was different from Case 1 because each of the five LOWSchools procures food supplies independently of the other schools. Therefore, for each LOWSchool (A to E), we collected food purchase invoices from all the relevant suppliers for the 36 week school year (autumn 2016-summer 2017). Like in Case 1, this time period captured seasonal shifts in fresh vegetable procurement. Like LOCSchool A, it was not possible to isolate breakfast and snack foods from other foods in the procurement invoices for

LOWSchools A to E, therefore the total food volumes for these schools are likely to be a modest over-estimate of the true volumes for lunches.

To calculate carbon footprint, we applied the same emissions factors as Case 1 to capture the agricultural production and processing emissions from the foods procured to LOWSchools A to E (again assumed to cover all activities to the wholesaler/supplier level). To calculate the 'local' transport emissions (i.e. from suppliers to schools), the measurement method recommended by Defra (2013) was again used. Finally, waste emissions were calculated by applying the emissions factors of Moult et al (2018) to LOW case plate waste data (as collected in WP6.2 and reported in D6.2), again taking account of emissions attached to different waste categories.

The total carbon footprint for the LOW case was the sum (in kgs$C0_2$eq) of the above sets of emissions applied to the total aggregated food volumes purchased by LOCSchools A to E.

3.2 Which foods are supplied in the school meals services?

To begin, this section reports the total volumes of foods supplied to the featured schools in Zagreb City over one school year, and the weight and composition of the average meal (pre-preparation and cooking) in both Cases.

3.2.1 Foods supplied in Case 1 (LOC) service

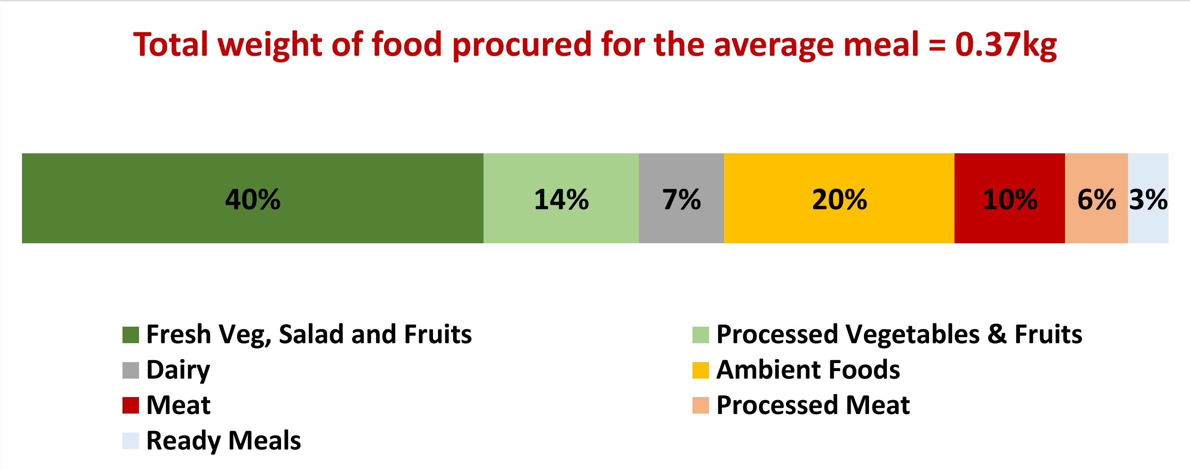
Table 5: Annual volumes of foods supplied to (LOC) schools (n=5)

Food Category	Volume (kg/ltr)
Fresh fruit and vegetables	21,282
Processed fruit and vegetables	7,158
Dairy	3,951
Ambient	10,610
Fresh meat	5,109
Processed meat	2,912
Ready meals	1,838
Total	**52,860**

As Table 5 shows, the total volume of food items purchased by LOCSchools A-E was 52,860 kgs, of which 21,282 kgs was fresh fruit and vegetables, 7,158 kgs processed fruit and vegetables, 3,951 kgs/l dairy, 10,610 kgs ambient, 5,109 kgs fresh meat, 2,912 kgs processed meat and 1,838 kgs ready meals. Of these amounts, it is noteworthy that (9,257) kgs of fresh vegetables was comprised of potatoes, lettuce (962kg), carrots (925kg) and onions (888kg). The majority of fresh fruit included bananas (1,665kg), oranges/tangerines (1,554kg) and apples (740kg) and pears (1,110kg). Dairy foods included mainly milk (1,860l), yogurt (810l), pudding and cream (573l) and eggs. Ambient foods were mainly comprised of bread (2,275kg), pasta (2,281kg) and rice (2,174kg). The composition of meat categories included chicken (2,260kg), beef (1,472kg) and pork (892kg).

We took the above yearly purchase volumes and divided them by the total number of meals served at LOCSchools A-E, in order to calculate the total weight (pre-preparation and cooking) and composition of an average meal at these schools. Figure 4 shows the results. It is emphasised that the total weight refers to the amounts of food procured for the average meal, rather than the weight of the served meal on the plate.

Figure 4: Composition of average meal in (LOC) schools (n=5)



As Figure 4 shows, the average meal at LOCSchools A-E is 370 g in total weight, and is comprised of 40% fresh fruit and vegetables, 14% processed vegetables, 7% dairy, 20% ambient, 10% fresh meat, 6% processed meat, and 3% ready meals, So the average meal contains just over half fruit and vegetables (of which two thirds is fresh fruit and vegetables, and then 43% of fresh vegetables is potatoes), one fifth ambient, and relatively small amounts of meat and dairy.

3.2.2 Foods supplied in Case 2 (LOW) service

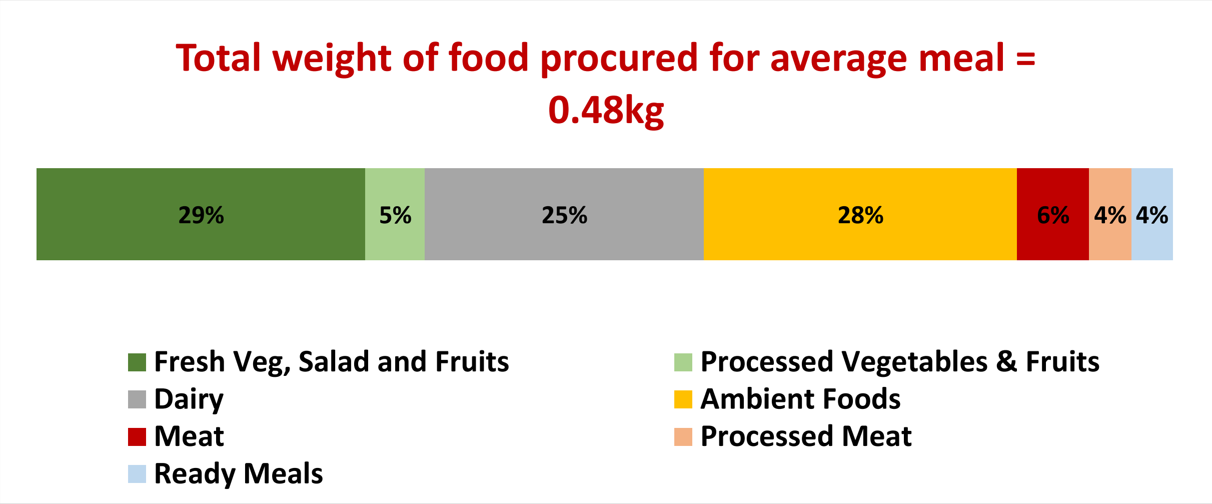
Table 6: Annual volumes of foods supplied to (LOW) schools (n=5)

Food Category	**Volume (kg/ltr)**
Fresh fruit and vegetables	30,056
Processed fruit and vegetables	5,435
Dairy	25,502
Ambient	28,623
Fresh meat	6,581
Processed meat	3,867
Ready meals	3,772
Total	**103,838**

As Table 6 shows, the total volume of food items purchased by LOWSchools A-E was 103,838 kgs, of which 30,056 kgs was fresh fruit and vegetables (fruits dominated by bananas, apples and oranges, vegetables dominated by potatoes, then onions and carrots), ambient food (28,623 kg) (dominated by bread then small amounts of pasta), dairy (25,502 kg) (dominated by milk then small amounts of yoghurt), fresh meat (6,581 kg) (comprised equally of poultry, pork and beef), processed fruit and vegetables (5,435kg), processed meat (3,867kg) and ready meals (3,772kg) (mainly sweet and savoury pastries).

We took the above yearly purchase volumes and divided them by the total number of meals served at LOWSchools A-E, in order to calculate the total weight (pre-preparation and cooking) and composition of an average meal at these schools. Figure 5 shows the results. Again it is emphasised that the total weight refers to the amounts of food procured for the average meal, rather than the weight of the served meal on the plate.

Figure 5: Composition of average meal in (LOW) schools (n=5)



As Figure 5 shows, the average meal at LOWSchools A-E is 480g in total weight, and is comprised of fresh vegetables, salad and fruits (29%) dairy (25%) ambient food (28%), fresh meat (6%), processed vegetables (5%), processed meat (4%) and ready meals (4%). So the largest component of the average meal in LOW case is fruit and vegetables, although at just over one third of the total meal, this component is much smaller than in LOC case (where it was over half). However, in both cases, the vegetables procurement is dominated by potatoes, then carrots, onions, cabbage and lettuce, and in the fruit procurement, bananas, apples and oranges dominate. The average LOW case meal also contains a much higher proportion of dairy than in LOW case (25% compared with 7%), this is made up largely of cartoned milk for drinking, and plain yoghurt. The LOW average meal contains a lower proportion of meat (10% compared with 16%), with a similar amount of beef. Both LOW and LOC cases have similar proportions of ambient foods (dominated by bread), and ready meals (dominated by sweet and savoury pastries).

3.3 How far do foods travel in school meals services?

Next for environmental impact, we report the distances travelled by foods to reach the schools in the LOC and LOW cases. Specifically, using data gathered from first tier suppliers (i.e.the wholesalers and producers listed in the Monographs) relating to their geographical distances from the schools, and also their delivery volumes and frequencies, we estimated the annual kms travelled by these suppliers to deliver to schools the volumes of foods reported in the preceding section. Using this method, in LOC case, we summed the kms travelled from suppliers to LOCSchool A (the hub school) and then added the estimated kms travelled by LOCSchool A vans to deliver prepared meals to the other four schools in the case. In LOW case, as each school operates its own procurement independently of the other schools, we simply summed the estimated kms travelled by each supplier to each of the five LOW schools. Note that the results in this section indicate the distances travelled by foods only in the last 'local' phase of transportation, rather than from the foods' origins in terms of farm or place of production. It should be emphasised that the estimations are the raw kms travelled for food items in each category, based on the round-trip distances from suppliers to central kitchens/schools, and the frequencies of the suppliers' deliveries. The kms have not been moderated to take into account other customers in the delivery rounds. Nevertheless, the estimates here help interpretation of subsequent results relating to transport emissions from both LOC and LOW cases, as part of the carbon footprint calculation.

Table 7: Annual kms travelled by foods, from suppliers to schools, in (LOC) case

Food Category	**Kms**
Fresh fruit and vegetables	3,600km
Processed fruit and vegetables	648km
Dairy	23,760km
Ambient	3,672km
Fresh meat	32,832km
Processed meat	11,808km
Ready meals	1,440km
Transport from LOCSchool A to other schools	3,780km
Total	**81,540 km**

As Table 7 shows, first tier suppliers travelled a total of 81,540 km to deliver foods to LOCSchool A, the hub school for the LOC case. Fresh meat and dairy suppliers contributed the greatest kms to this total, at 40% and 29%, respectively. These high proportions are partly explained by the geographical distance of both suppliers to LOCSchool A (102 km and 85 km, respectively), plus the need for frequent deliveries for these perishable items (minimum 3 times per week). Despite the delivery frequency for fruit and vegetables also being high, the small contribution of these items to the total can be explained by the proximate location of the fruit and vegetable supplier in this case (<10km). It is also worth highlighting that the transportation undertaken by LOCSchool A to deliver the prepared meals to the other schools in this case is a very small contribution to the total kms travelled. The organisation of the LOC case supply chain, with LOCSchool A acting as a hub, therefore reduces the kms travelled by first tier suppliers in this case.

Table 8: Annual kms travelled by foods, from suppliers to schools, in (LOW) case

Food Category	**Kms**
Fresh fruit and vegetables	21,384 km
Processed fruit and vegetables	4,608 km

Dairy	19,476 km
Ambient	20,286 km
Fresh meat	22,752 km
Processed meat	2,484 km
Ready meals	9,972 km
Total	**100,962 km**

Table 8 shows that first tier suppliers travelled a total of 100,962 km to deliver foods to LOW schools A-E, a sum 20% higher than the total kms travelled in LOC case. The main contributors to kms travelled in LOW case were suppliers of fresh meat (23%), fresh fruit and vegetables (21%) and dairy (19%). All these items are associated with frequent deliveries (at least three times per week). Moreover, as the schools in LOW case procure independently, and many suppliers deliver to 1-2 schools only in the case, the distribution chain is fragmented with many contact points. This increases the total kms travelled, even though more than half of all suppliers in LOW case (13/25) are based within 10 kms of the schools.

3.4 What are waste levels in school meals services?

In this section, we report the waste levels for schools in both Cases. A full breakdown of plate waste volumes per food category is reported in D6.2 Croatia Country Report, for two LOC schools (LOCSchools A and E), and two LOW schools (LOWSchools A and C). These volumes were collected via two week-long periods per school. Here, we present estimates of total plate waste for all five LOC and five LOW model schools. To arrive at these estimates, we first calculated the average plate waste per week at each of the two schools per case, then multiplied these by 36 wks to estimate the total annual plate waste at those schools. We then used these results to estimate the annual plate wastes at the remaining three schools in each case, based pro-rata on the total number of meals served at those schools. Finally, we summed the annual totals for each school to arrive at the annual totals of plate waste per case.

Table 9: Annual plate waste in (LOC) schools

	Total Waste (kgs)
LOCSchool A	5,548
LOCSchool B	3,109
LOCSchool C	1,828
LOCSchool D	2,412
LOCSchool E	4,260
Total	**17,157**

Average plate waste per meal (g)	**130g**
Average plate waste per meal (%)	**27%**

Table 10: Annual plate waste in (LOW) schools

	Total Waste (kgs)
School A	649
School B	1,032
School C	776
School D	1,328
School E	896
Total	**4,681**
Average plate waste per meal (g)	**30g**
Average plate waste per meal (%)	**12%**

Tables 9 and 10 show that the amount of annual plate waste in the case of LOC model schools is 17,571 kg compared to LOW model schools where it is 4,681kg. In LOC case, the average plate waste per meal is 130g (27% of meal), while in LOW case it is 30g (12% of meal). Therefore, the level of plate waste in LOW schools is much lower, on average, than LOC schools. This is despite the fact that the amount of food procured per meal in LOW case (480g) is considerably higher than LOC case (370g). In fact, the total waste percentage of LOC case is in line with other case studies in WP6, whereas LOW case waste rate is amongst the lowest in all case studies. Given the fact that in both cases, schools have similar menus and meals like soups, stews, pasta and risotto, there are three possible reasons for the differences in the proportions of waste. First, based on observation during WP6.2 data collection it is possible that pupils in LOW schools are given more supervision and encouragement by staff to eat up compared with LOC schools. In fact, the relationship between staff and pupils in LOW schools is very good. Second, pupils in LOW schools may have more time for lunch, on average (for example in LOWSchool A pupils had a 45 minute time period, compared with the more typical 15-20 minutes). Finally, it is possible that the waste rates in LOC case are affected by the central kitchen arrangements. As those meals are packed, transported and unpacked again before serving, the freshness and flavour may be less good, at least for schools other than LOCSchool A. By contrast, LOW schools always prepare and serve their meals on-site to only their own pupils, which may encourage children to eat more.

3.5 What is the carbon footprint of school meals services?

We now report the core environmental impact results for the school meals services in Croatia LOC and LOW cases. Below we present the total carbon footprints of the services in each Case, and the contribution of the main activities of the supply chain (production/processing, local transportation and waste) to the totals. The descriptions in the preceding sections of meal compositions, kms travelled from first tier suppliers, and waste volumes, are used to help interpret the results in each case.

3.5.1 Carbon footprint of Case 1 (LOC) service

Based on the measurement method described in 3.1.1, we calculated the total carbon footprint of the school meals service for the five schools in LOC case (i.e. LOCSchools A-E). Hence we calculated and summed the total emissions associated with the production, processing, transportation and waste of food items purchased by these five schools over one school year. Table 11 shows the results.

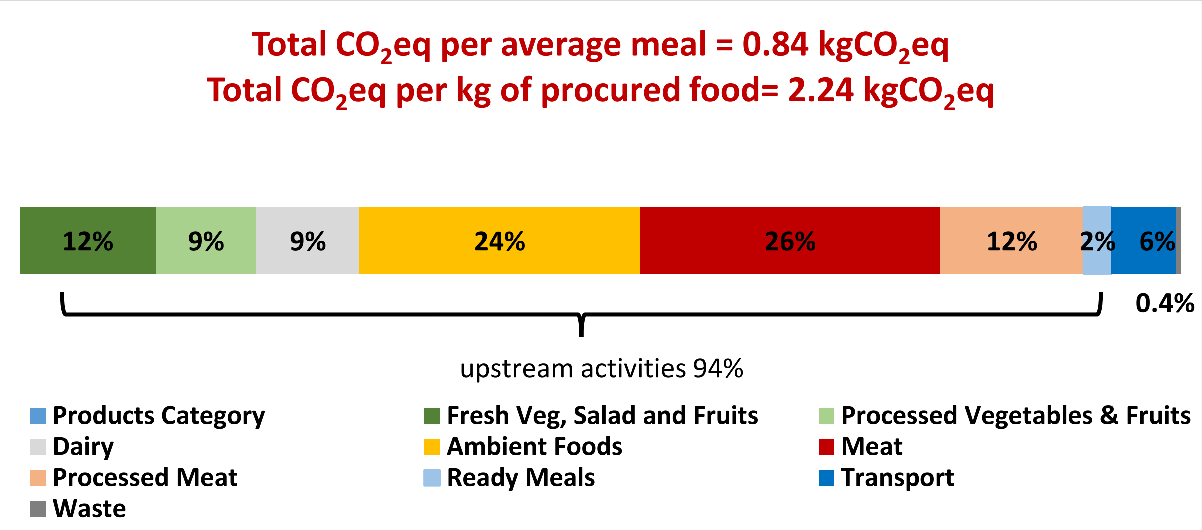
Table 11: Carbon footprint of school meals service in (LOC) case

	kgs$C0_2$eq
Production, processing, upstream transport emissions, of which:	111,920
Fresh fruit and vegetables	13,920
Processed fruit and vegetables	10,313
Dairy	10,562
Ambient	28,793
Fresh meat	30,784
Processed meat	14,680
Ready meals	2,868
Local transportation emissions (from first tier suppliers to LOCSchool A central kitchen)	4,640
Local transportation emissions (from LOCSchool A central kitchen to LOCSchools B-E)	2,024
Handling and disposal of plate waste	504
Total	**119,089**

As Table 11 shows, the total emissions from the foods purchased by LOCSchools A-E was 119,089 kg$C0_2$eq. Of the main supply chain activities, production/processing/upstream transportation contributes the vast majority (94%) of these emissions. In turn, the main contributors within this category are fresh meat and ambient foods, followed by processed meat, then fresh and processed fruit and vegetables, and then dairy foods. Local transportation (both from first tier suppliers to LOCSchool A, and from LOCSchool A to the other four schools) contributes a very small proportion of total emissions, whilst the contribution of plate waste handling is tiny.

In order to facilitate interpretation and comparison, we next express the total carbon emissions at LOCSchools A-E on a per average meal, and per kg of meal, basis. To derive emissions per meal, we divided the total emissions from the foods purchased by the schools in one year (119,089kg$C0_2$eq) by the total number of meals served (788 daily meals*5days*36weeks = 141,840 meals). By this calculation, the average meal at LOCSchools A-E generates 0.84 kgs$C0_2$eq. Figure 6 shows the breakdown of these emissions, by type of food and stage of supply chain activity. To derive emissions per kg of meal, we divided the total emissions figure (119,089kg$C0_2$eq) by the total volume of foods procured (pre-preparation and cooking) (52,860kgs). By this calculation, emissions for every 1kg of average meal at LOCSchools A-E are 2.24 g of $C0_2$eq.

Figure 6: Carbon footprint of school meals service in (LOC) case



As Figure 6 confirms, 94% of the total carbon emissions from the average meal in LOC case are attributable to production/processing/upstream transportation of the food items. Within this, it can be seen that fresh meat contributes the greatest single emissions burden (26%). With the addition of processed meat, total meat comprises over a third of total emissions. This is despite fresh meat representing only 10%, and total meat only 16% of the volume of the average meal. Ambient food (which was mainly bread and pasta, and comprised just under a quarter of the volume of the average meal) is the next largest emissions contributor (24%). Fruit and vegetables, whilst constituting over half of the average meal by volume, contributes only 21% of total emissions. Local transport (including both first tier supplier deliveries to LOCSchool A, and then meals transport from LOCSchool A to the other schools), contributes a modest 6% of total emissions, whilst the burden from waste handling is tiny at 0.4%. Overall, these LOC case results demonstrate the high emissions burden from meat, and the modest burden from downstream transportation, in school meals supply chains.

3.5.2 Carbon footprint of Case 2 (LOW) service

Based on the measurement method described in 3.1.2, we calculated the total carbon footprint of the school meals service for the five LOW model schools (i.e. LOWSchools A-E). Hence we calculated and summed the total emissions associated with the production, processing, transportation and waste of food items purchased by these five schools over one school year. Table 12 shows the results.

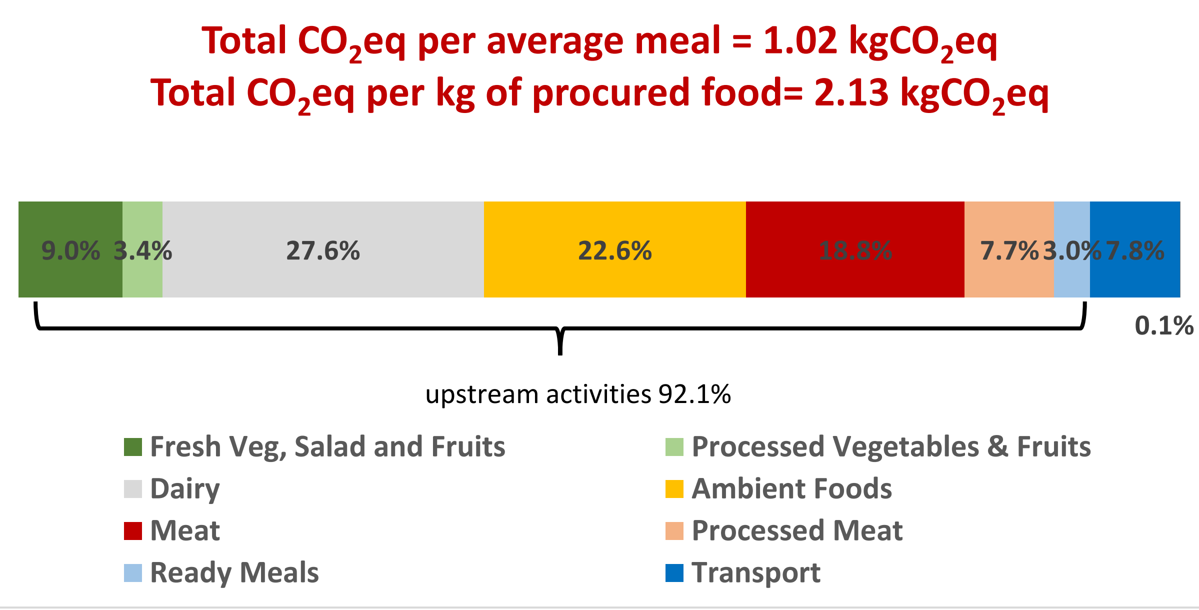
Table 12: Carbon footprint of school meals service in (LOW) service

	kgs$C0_2$eq
Production, processing, upstream transport emissions, of which	204,131
Fresh fruit and vegetables	19,858
Processed fruit and vegetables	7,651
Dairy	61,204
Ambient	49,969
Fresh meat	41,585
Processed meat	17,116
Ready meals	6,747
Local transportation emissions	17,177
Waste	87
Total	**221,395**

As Table 12 shows, the total emissions from the foods purchased by LOWSchools A-E is 221,395 kg$C0_2$eq. Of the main supply chain activities, production/processing/upstream transportation contributes the vast majority (92%) of these emissions. The main contributors within this category are dairy foods, then ambient, then meat and then fruit and vegetables. Local transportation emissions are slightly higher than in LOC case, but still contribute only a modest amount to total emissions. The waste handling burden in LOW case is very small.

In order to facilitate interpretation and comparison, we next express the total carbon emissions at LOWSchools A-E on a per average meal, and per gram of meal, basis. To derive emissions per meal, we divided the total emissions from the foods purchased by the five schools in one year (221,395 kg$C0_2$eq) by the total number of meals served (1202 daily meals*5days*36weeks = 216,360 meals). By this calculation, the average meal at LOWSchools A-E generates 1.02 kgs$C0_2$eq. Figure 7 shows the breakdown of these emissions, by type of food and stage of supply chain activity. To derive emissions per kg of meal, we divided the total emissions figure (221,395 kg$C0_2$eq) by the total volume of foods procured (pre-preparation and cooking) (103,838 kgs). By this calculation, emissions for every 1kg of meal at LOWSchools A-E are 2.13kg of $C0_2$eq.

Figure 7: Carbon footprint of school meals service in (LOW) case



As Figure 7 shows, 92% of total carbon emissions from the meals service to LOWSchools A-E is attributable to production/processing/upstream transportation of the food items. These upstream activities are therefore by far the most significant environmental impact of the chain. Of these emissions, the greatest single contributor (28%) is dairy (which was dominated by drinking milk and smaller amounts of yoghurt), and then total meat. It is noteworthy that meat comprised only 10% of the volume of the LOW case average meal, but contributes more than a quarter of total emissions. The next emissions contributor (23%) is ambient food (heavily dominated by bread, with small amounts of pasta), and then fruit and vegetables (12% in total). Despite the fragmented nature of the distribution system in LOW case, local transportation contributes a modest 8% of total emissions, whilst ready meals and waste handling are very small contributors.

3.5.3 Comparison of carbon footprint of LOC and LOW meal services

To compare the carbon footprints of LOC and LOW cases, it is important to place the results in the context of the size and scale of the meals services in each case, and the related procurements. In the five schools of LOC case, fewer meals are served per year (141,840) and less food is purchased per meal (370g) than in the five schools of LOW case (216,360 and 480g, respectively). With these differences, it is not surprising that total emissions in LOC case are smaller than LOW case (119,089 vs 221,395kg$C0_2$eq). It is also logical that emissions per average meal in LOC case are smaller than in LOW case (0.84 vs 1.02 kg$C0_2$eq). However, when the differences in meal numbers and food volumes purchased are taken account of - by calculating emissions on a per gram basis - LOC case meals are found to have higher emissions than LOW case meals (2.24 vs 2.13 $gC0_2eq$ per gram of average meal). The main explanation is that although the LOC average meal contains more fruit and vegetables, it also contains more meat (16% of total volume vs 10% in LOW case). The LOC average meal also contains a higher proportion of processed fruit and vegetables than the LOW meal (14% vs 5%). Also, although the LOW average meal does contain a lot of dairy (25% vs 7%), the vast majority of this is drinking milk, which has a low emissions burden. Finally, it is also interesting to note in this comparison that although the more efficient hub distribution structure of the LOC case reduces kms travelled by suppliers, this translates into only a very modest emissions saving compared with the LOW case. This is because the impact of transport on total emissions is very small compared with upstream production and processing activities.

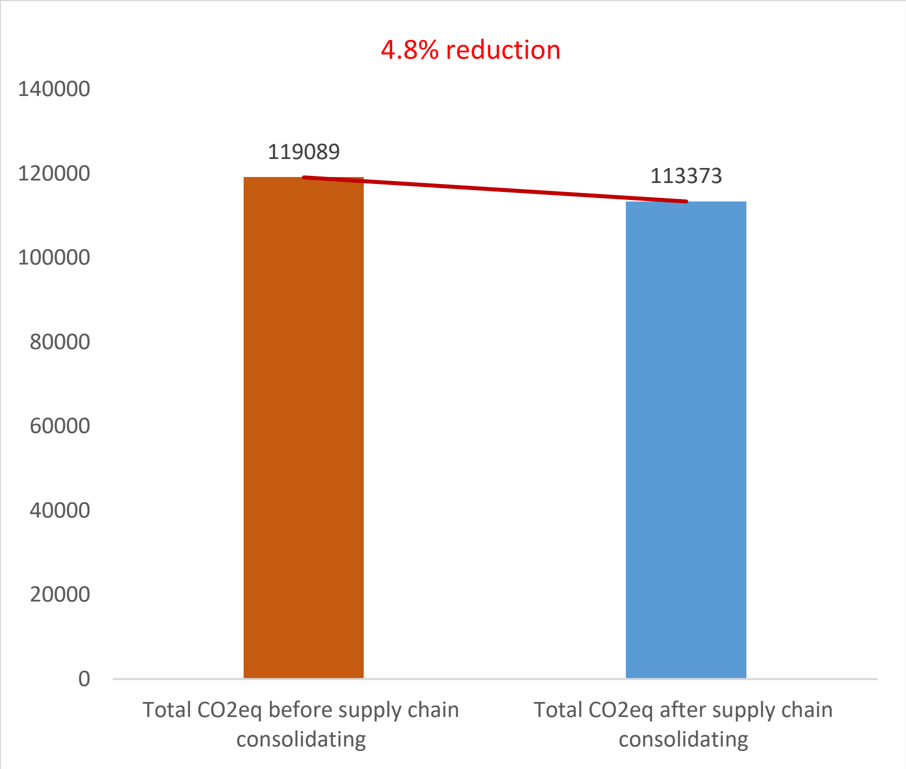
3.6. Procurement management scenarios to reduce carbon footprint

The preceding sections have shown how different activities in the supply chain contribute to the carbon footprint of the (LOC) and (LOW) meals services. To conclude our analysis of the environmental impact of the services, we report results of our exploration of different procurement management scenarios and their effects on carbon emissions in both Cases.

3.6.1 Carbon footprint management scenarios in (LOC) case

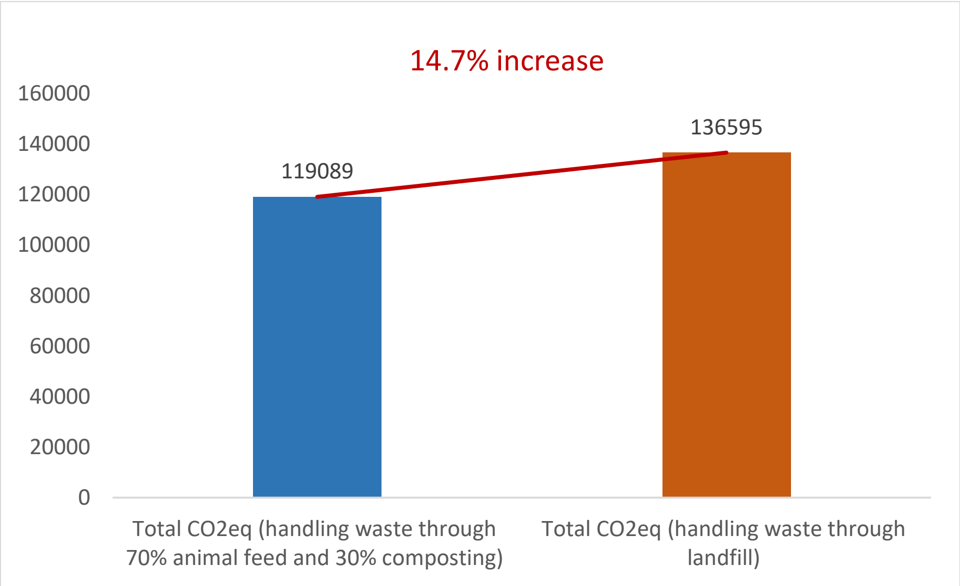
The first scenario we analysed was the possibility that LOCSchool A could consolidate its transportation process, to reduce the number of suppliers for the same food category. For example, the dairy supplier Vindija (located 110 km from Zagreb), the meat supplier Vajda (114km from Zagreb) and pasta supplier Pik Rijeka (159km) could all be replaced by more local suppliers near Zagreb (<10 km). This scenario will reduce the total carbon emission by 4.8% and will reduce the transportation emission alone by around 80% (Figure 8).

Figure 8: Carbon emissions effect under transportation consolidation scenario in LOC case



The second scenario we explored was the possibility that in LOC case, the schools switched from current waste destinations to landfill destination. If the current situation (70% of waste destined for animal feed, 30% destined for composing) were changed and all waste was sent to landfill, this would cause an increase of total carbon footprint of LOC case by 14.7% (Figure 9). This is a significant change.

Figure 9: Carbon emissions effect under alternative waste disposal scenario in LOC case

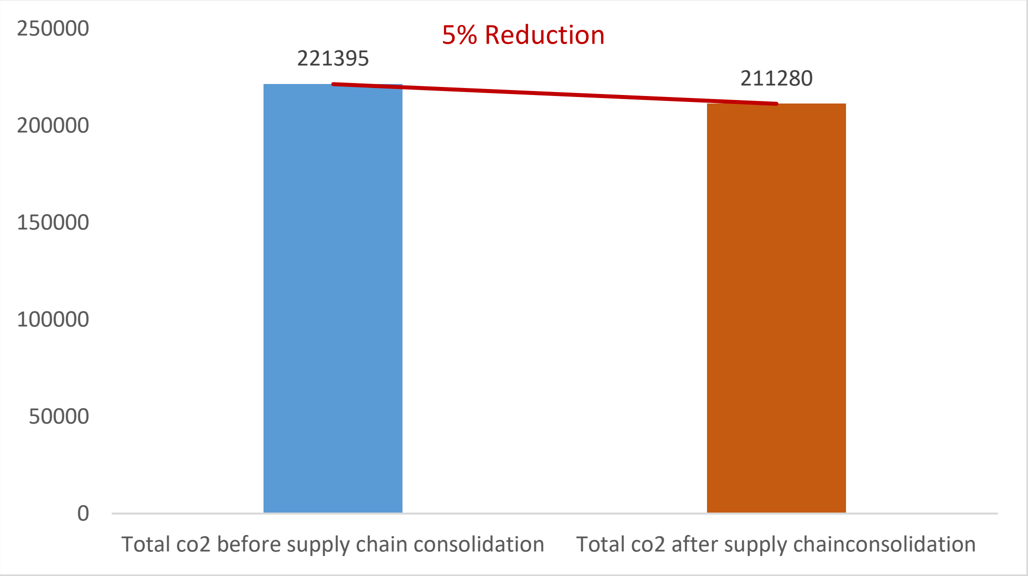


3.6.2. Carbon footprint reduction scenarios in (LOW)case

We explored two carbon footprint reduction scenarios for LOW case: (i) assuming a greater proportion of LOW case suppliers are located 10kms from the schools (ii) assuming current waste destination is replaced by landfill.

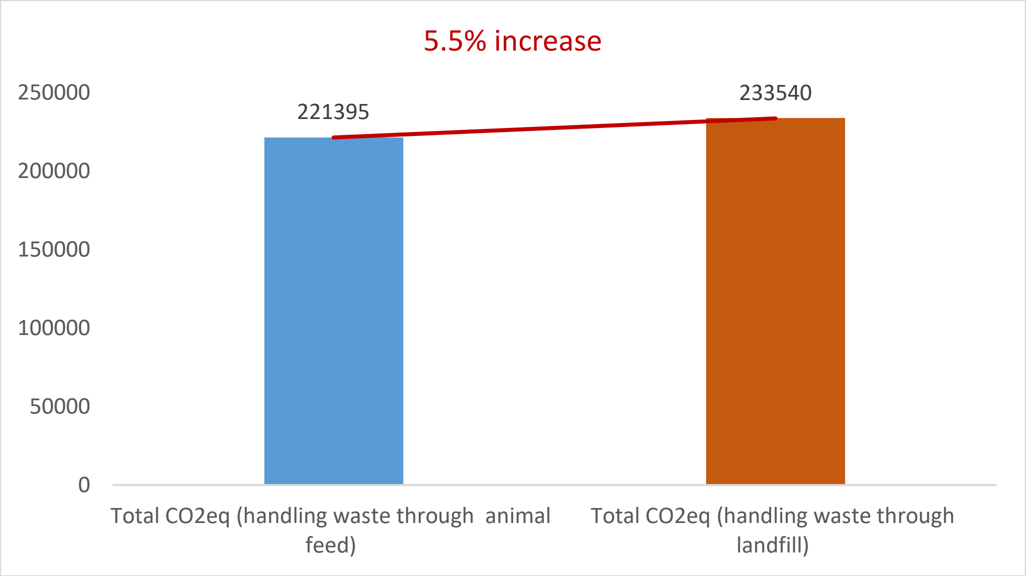
In the first scenario, we assumed that LOW SchoolS A-E could consolidate their transportation process, to reduce the number of suppliers for the same food category. For example, the dairy supplier Vindija (located 110 km from Zagreb) could be replaced by a local milk factory near Zagreb (<10 km). This scenario will reduce the total carbon emission by 5% and will reduce the transportation emission alone by around 41% (Figure 10).

Figure 10: Carbon emissions effect under alternative waste disposal scenario in LOW case



The second scenario we explored was the possibility that in LOW case, the schools switched from current waste destinations to landfill destination. In the LOW case, if waste destination is changed from composting to landfill there would be an increase of 5.5% of total carbon foot print (Figure 11). It can be concluded that these schools use the better method for waste handling.

Figure 11: Carbon emissions effect under alternative waste disposal scenario in LOW case



4. ECONOMIC IMPACT OF SCHOOL MEALS SERVICES

In this section, we report the results of the economic impact of the school meals services in the LOC and LOW cases. The measures of economic impact used in both cases were (i) local economic multiplier effect, and (ii) the economic value of the contract to suppliers.

4.1 Methodology to measure local economic multiplier effect

The aim of the local multiplier analysis was to trace the expenditures of the schools in the LOC and LOW cases, to identify what proportions of the monies from the meals contracts in each case were retained within (or leaked out of) the local area. To calculate this, we used the 'Local Multiplier 3' (LM3) methodology[10], which involves tracking the expenditures of a starting budget (i.e. the total budget gathered from parental/state contributions to fund a school meals service), through three rounds of spending. In Croatia, each school organizes its own procurement independently, therefore within each case, the budget expenditures were recorded for each of the five schools individually, and then these values were aggregated to estimate a case level LM3 result.

In practice, the analytical steps were as follows. First, we set the geographic dimensions of the local area. For both LOC and LOW cases, we defined this as a 10km radius from the geographic centre of the City of Zagreb. This radius takes in all Zagreb City area plus parts of the neighbouring County. In interviews, informants felt this represented the local area for Zagreb. Using this radius, several of the popular suppliers described in the Monographs (e.g. Agrodalm, Klara, Ledo, Velpro, Pan-Pek) are classed as 'local', although two common suppliers (Vindija for dairy and Vajda for meat) fall well outside this boundary and are therefore classed as non-local. This distinction also accorded with the views of interviewees as to which suppliers were considered local or not. Then, for each of the five schools in the case, we tracked the budget expenditures as follows:

1. <u>from the holders of the starting budget to the immediate budget recipients</u>. In our Cases, this stage comprised the transfer of funds from Zagreb City Council and parents to schools (the budget recipients), to cover the cost of meals provision. Budget retention/leakage was determined by the geographic location of the schools, relative to the 10km local area radius.
    - <u>from the budget recipients to their staff and first tier suppliers/wholesalers</u>. In our Cases, this stage involved tracking schools' expenditures on their catering staff, on their first tier food suppliers (i.e. the relevant contracted suppliers described earlier in the Monographs), and their other direct costs. Retention/leakage at this stage was determined by the geographic residence of staff, first tier suppliers and recipients of direct cost expenditures, relative to the 10km local area radius.
    - <u>from the first tier suppliers to their staff and upstream suppliers, and budget recipient's staff personal expenditures (LM3)</u>. In our Cases, this stage involved estimating the proportions of the expenditures of the schools' first tier suppliers on their staff and upstream suppliers, that were retained in the local area. It also involved estimating the

[10] Full explanation of the method is available at www.lm3online.com.

proportion of personal expenditures of the schools' catering staff, that were retained in the local area.

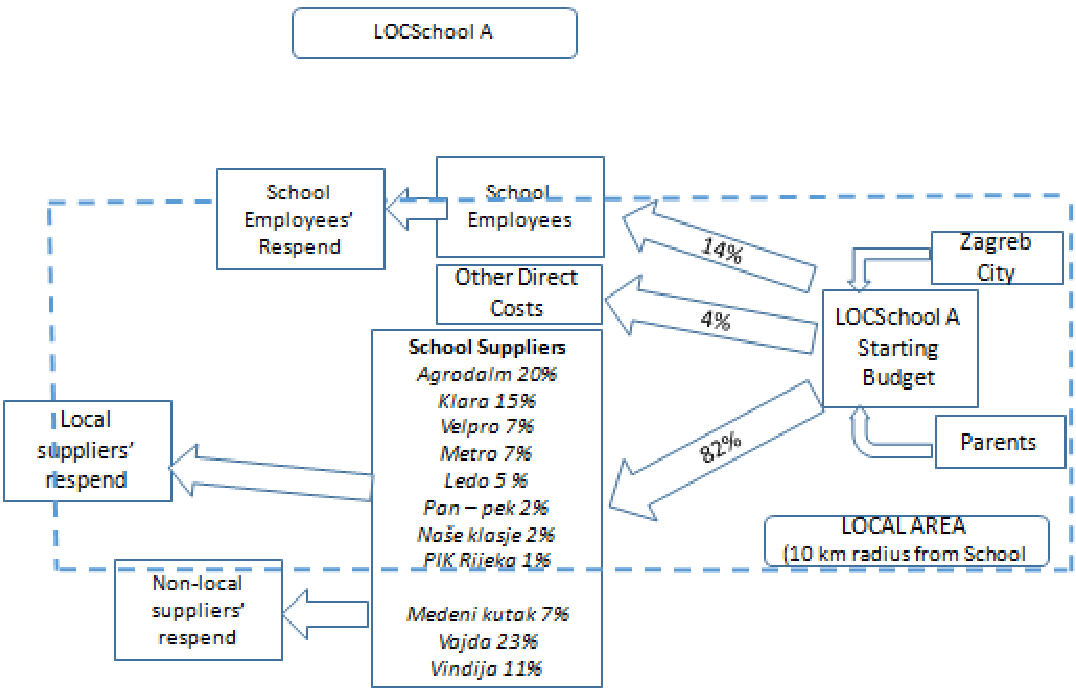
In terms of calculation outcome, LM3 is expressed as a ratio between 1 (indicating no value has been retained within the local area) and 3 (indicating that 100% of values have been retained). The following sections present the budget expenditures for the individual schools, and aggregated LM3 results, for the LOC and LOW cases respectively.

4.2 What are local economic multipliers of the school meals services?

4.2.1 Local economic multiplier of LOC case schools

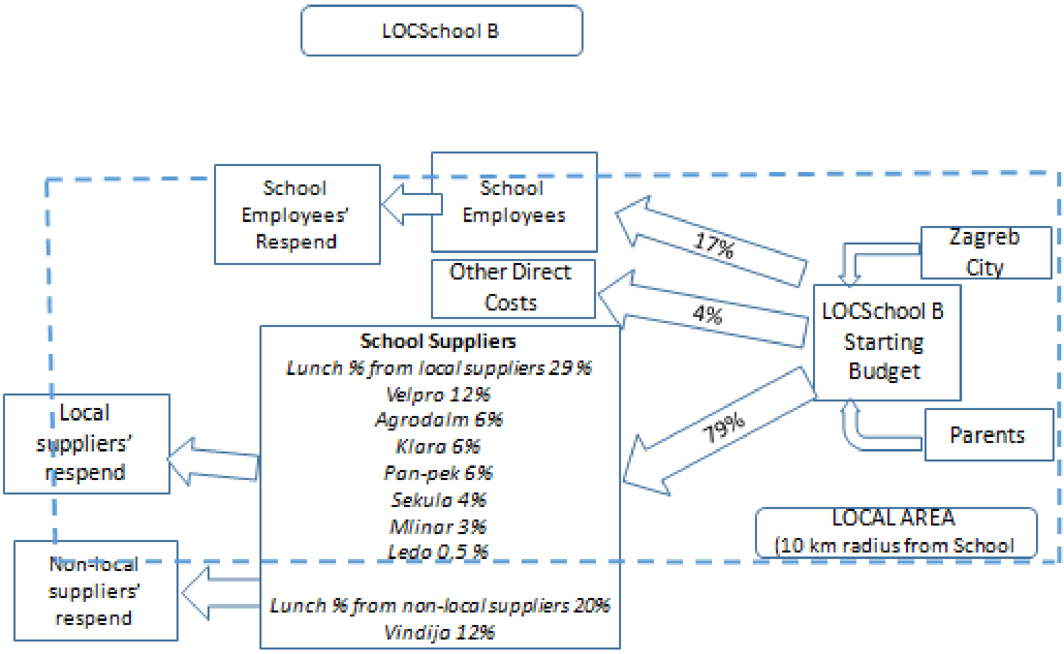
First we report the budget expenditures of the schools in the LOC case and the results of the LM3 analysis. Figures 12-16 show the budget expenditures on staff, direct costs and food suppliers for LOCSchools A-E, respectively. For LOCSchool A, all suppliers are contracted directly by this school. For LOCSchools B-E, recall that all lunches are cooked and delivered by LOCSchool A, using the same ingredients, from the same suppliers, as LOCSchool A. Hence, the supplier expenditures for LOCSchools B-E include the % split in lunch ingredients (local vs non), according to the procurement pattern of LOCSchool A. All other suppliers listed for LOCSchools B-E relate to non-lunch supplies (i.e. breakfasts, snacks, etc), which are arranged through direct contracts.

Figure 12: Flow of budget expenditures of LOCSchool A meals service



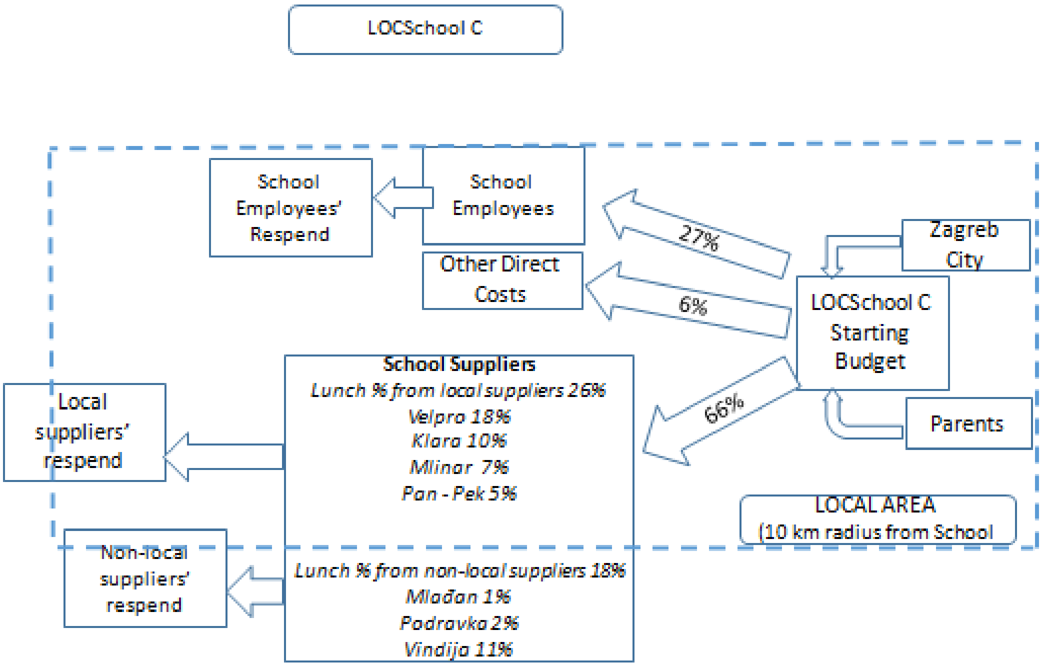
As Figure 12 shows, a small proportion (14%) of the school meals budget for LOCSchool A is spent on catering staff, with just over half of this spend on employees residing within the local area. The vast majority of the budget (82%) is spent on food supplies, from a total of 11 different suppliers. Eight of these suppliers have headquarters in the local area (59% of food supply spend), and three are non-local (41% of spend).

Figure 13: Flow of budget expenditures of LOCSchool B meals service



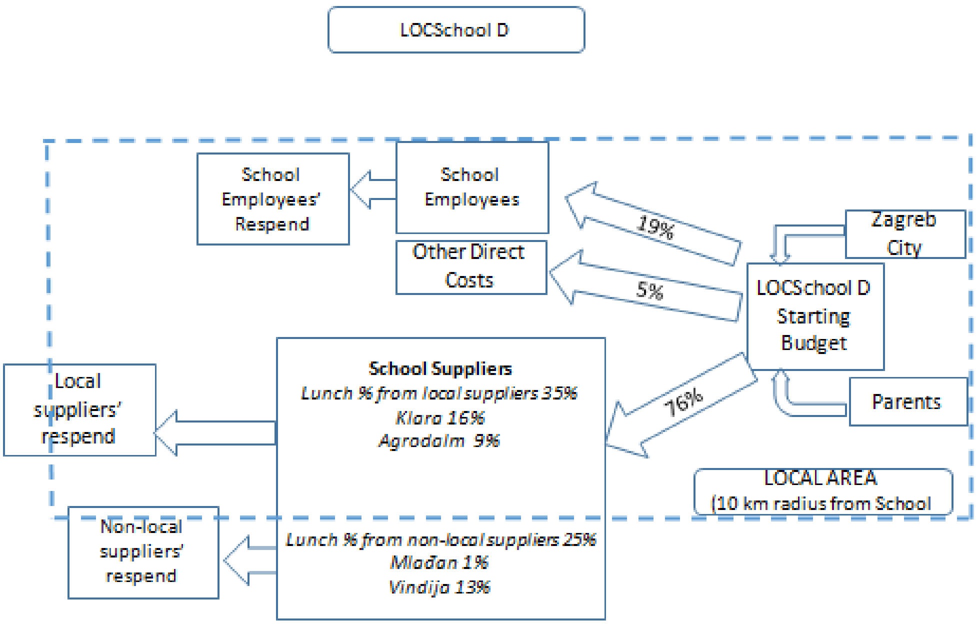
As Figure 13 shows, a small proportion (17%) of the school meals budget for LOCSchool B is spent on catering staff, with almost three quarters of this spend on employees residing within the local area. The vast majority of the budget (79%) is spent on food suppliers. The biggest single recipient of this spend is LOCSchool A, which provides all the lunches for LOCSchool B. As was shown earlier (Figure 12), the majority of the ingredients for these lunches come from local suppliers. Beyond lunches, LOCSchool B procures food from a further eight suppliers (to cover breakfasts, snacks, etc), all but one of which have headquarters in the local area. In total, 68% of LOCSchool B's food supplies budget is spent on suppliers within the local area, and 32% on non-local suppliers.

Figure 14: Flow of budget expenditures of LOCSchool C meals service



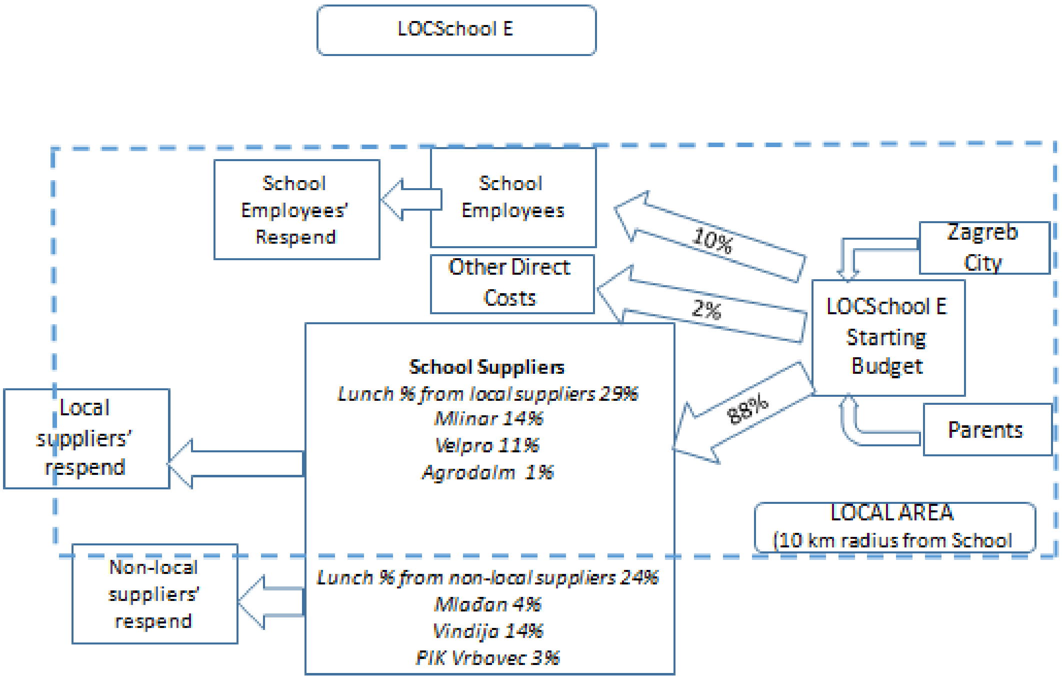
As Figure 14 shows, just over a quarter (27%) of the school meals budget for LOCSchool C is spent on catering staff, all of whom reside within the local area. The majority of the budget (66%) is spent on food suppliers. The biggest single recipient of this spend is LOCSchool A, which provides all the lunches for LOCSchool C. As was shown earlier (Figure 12), the majority of the ingredients for these lunches come from local suppliers. Beyond lunches, LOCSchool C procures food from a further seven suppliers (to cover breakfasts, snacks, etc). Four of these have headquarters in the local area. In total, 67% of LOCSchool C's food supplies budget is spent on suppliers within the local area, and 33% on non-local suppliers.

Figure 15: Flow of budget expenditures of LOCSchool D meals service



As Figure 15 shows, a small proportion (19%) of the school meals budget for LOCSchool D is spent on catering staff, all of whom reside within the local area. Over three quarters of the budget (76%) is spent on food suppliers. The biggest single recipient of this spend is LOCSchool A, which provides all the lunches for LOCSchool D. As was shown earlier (Figure 12), the majority of the ingredients for these lunches come from local suppliers. Beyond lunches, LOCSchool D procures food from a further four suppliers (to cover breakfasts, snacks, etc). Two of these have headquarters in the local area. In total, 60% of LOCSchool D's food supplies budget is spent on suppliers within the local area, and 40% on non-local suppliers.

Figure 16: Flow of budget expenditures of LOCSchool E meals service



As Figure 16 shows, a small proportion (10%) of the school meals budget for LOCSchool D is spent on catering staff, all of whom reside within the local area. The vast majority of the budget (88%) is spent on food suppliers. The biggest single recipient of this spend is LOCSchool A, which provides all the lunches for LOCSchool E. As was shown earlier (Figure 12), the majority of the ingredients for these lunches come from local suppliers. Beyond lunches, LOCSchool E procures food from a further six suppliers (to cover breakfasts, snacks, etc). Three of these have headquarters in the local area. In total, 55% of LOCSchool E's food supplies budget is spent on suppliers within the local area, and 45% on non-local suppliers.

Overall, Figures 12-16 reveal the general pattern of expenditures of schools in the LOC case. Expenditures on catering staff by these schools range from 10-27% of total meals budgets, giving an average of 17%. Mainly, catering employees in these schools are a mix of local and non-local residents, using the 10km radius threshold. In terms of suppliers, perhaps unsurprisingly given its status as a central kitchen, LOCSchool A contracts with the largest number of suppliers (11), although the other schools contract with between four and eight suppliers each, in addition to their procurement of lunches from LOCSchool A. The most popular supplier, used by all LOC schools, is Vindija (for dairy), although this is a non-local company. Klara, Agrodalm, Pan-Pek and Velpro are used by four LOCSchools, and all of these are local. On average, LOCSchools spend 60% of their supplies budgets on local firms Finally, it can be noted that as LOCSchools B-E source their lunches from LOCSchool A, which comprises a large share of their supplies budget, it means the procurement decisions of LOCSchool A, and the proportions it spends on local vs non-local suppliers, have a transfer impact on all the other schools.

The expenditure values and proportions above were entered into the LM3 online tool for analysis. The calculation revealed the Project LM3 ratio for the LOC case school meals chain is 2.15. This means that for every €1 spent by the initial budget generators (i.e. Zagreb City Council, and parents/carers), an additional €1.15 is generated within the local area. Table 13 presents the result, together with estimates of Local and Non-Local LM3s.

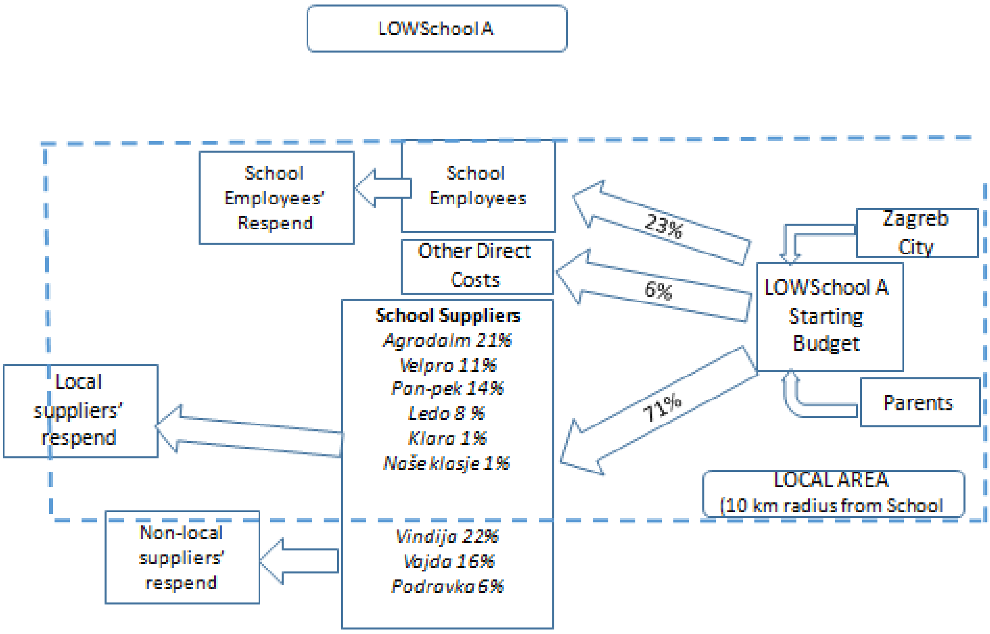
Table 13: Project, local, and non-local LM3 estimates for (LOC) meals service

		Explanation
Project LM3	2.15	For every €1 spent in the LOC case school meals service, an additional €1.15 is generated in the local economy
Local LM3	2.64	If only local suppliers were used in LOC case meals service, then for every €1 spent an additional €1.64 would be generated in the local economy
Non-Local LM3	1.32	If only non local suppliers were used then for every €1 spent an additional €0.32 would be generated in the local economy

4.2.2 Local economic multiplier of LOW case schools

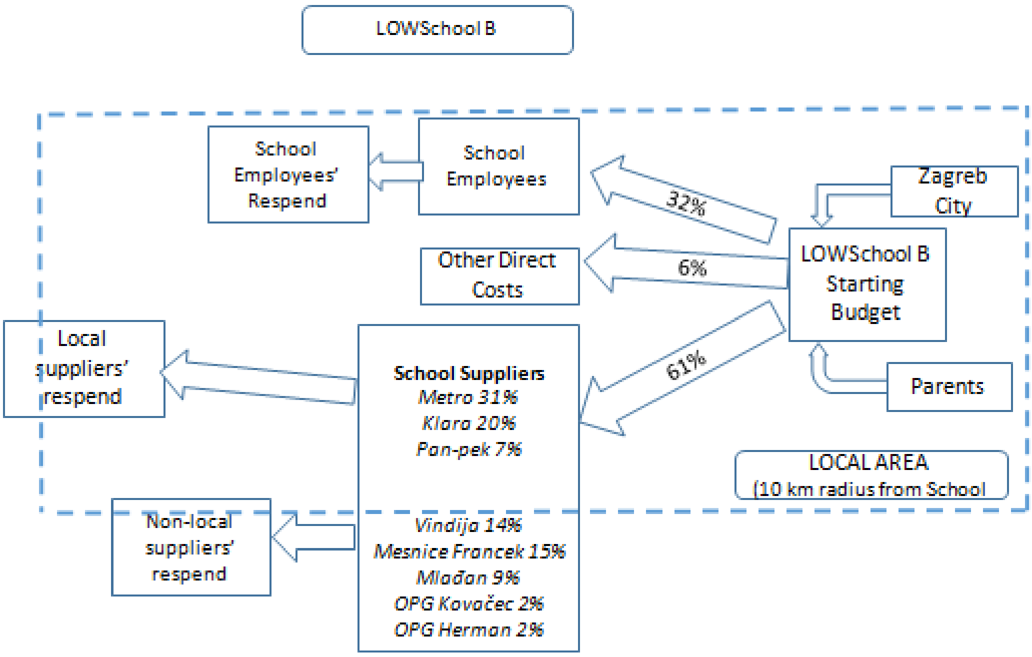
Next we report the budget flows and LM3 results for the LOW case (i.e. LOWSchools A-E). In terms of local area, the same local boundary was defined as for the LOC case, i.e. a 10km radius from the geographic centre of Zagreb City. Therefore, all classifications of suppliers as 'local' or 'non-local' in the LOC case also hold true for the LOW case. A sizable number of suppliers were found to be common to both LOC and LOW cases, although LOW schools did also procure from some different suppliers. It is noteworthy that all the expenditures on catering staff in LOW schools were to staff residing within the local area. Figures 17-21 show the budget expenditures on staff, direct costs and food suppliers for LOWSchools A-E, respectively. As all procurements are handled independently by the five LOWSchools, all suppliers are contracted directly by the individual schools.

Figure 18: Flow of budget expenditures of LOWSchool A meals service



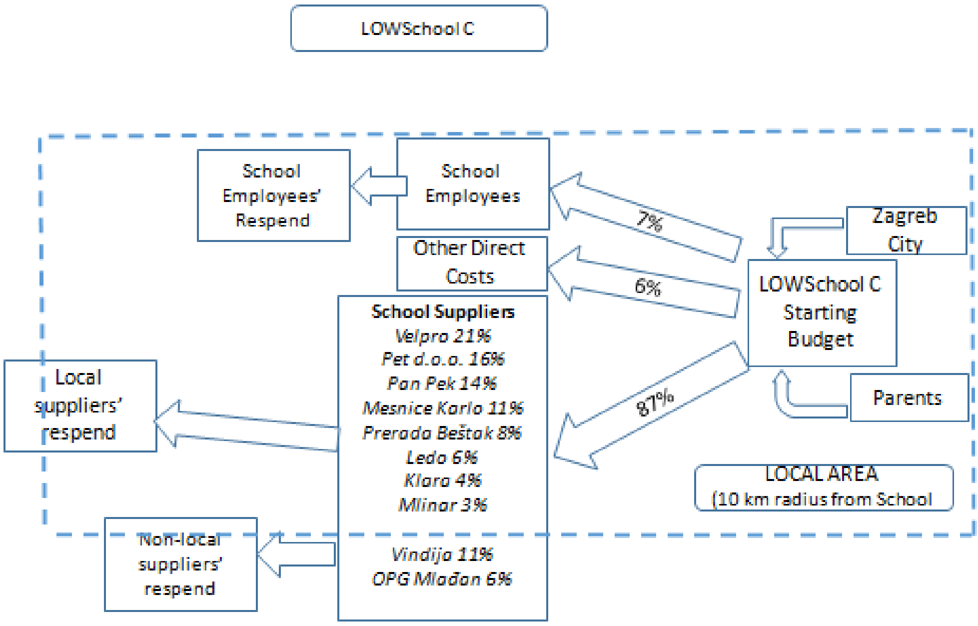
As Figure 17 shows, almost a quarter (23%) of the school meals budget for LOWSchool A is spent on catering staff, all of whom reside within the local area. The majority of the budget (71%) is spent on food supplies, from a total of nine different suppliers. Six of these suppliers have headquarters in the local area, and three are non-local. In total, 56% of LOWSchool A's food supplies budget is spent on suppliers within the local area, and 44% on non-local suppliers.

Figure 9: Flow of budget expenditures of LOWSchool B meals service



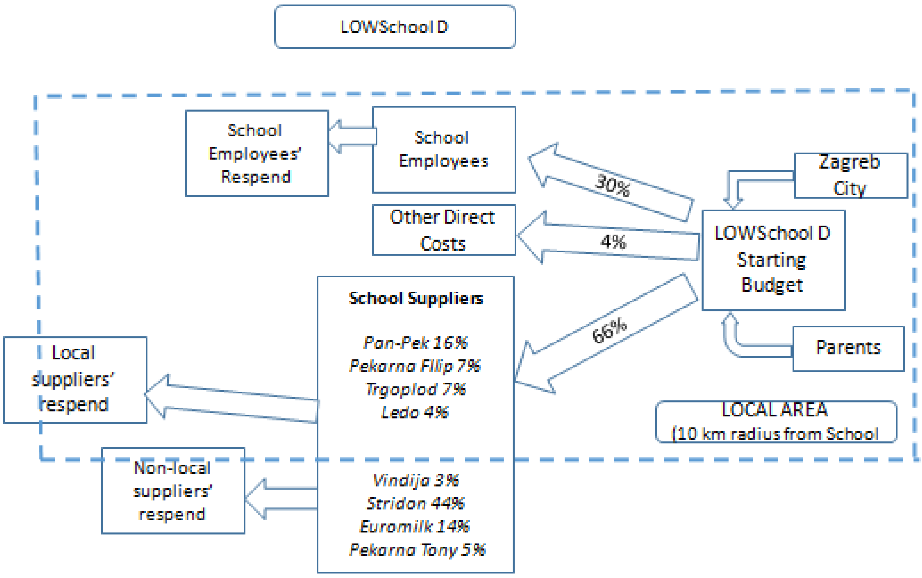
As Figure 18 shows, almost a third (32%) of the school meals budget for LOWSchool B is spent on catering staff, all of whom reside within the local area. The majority of the budget (61%) is spent on food supplies, from a total of eight different suppliers. Three of these suppliers have headquarters in the local area, and five are non-local. In total, 58% of LOWSchool B's food supplies budget is spent on suppliers within the local area, and 42% on non-local suppliers.

Figure 19: Flow of budget expenditures of LOWSchool C meals service



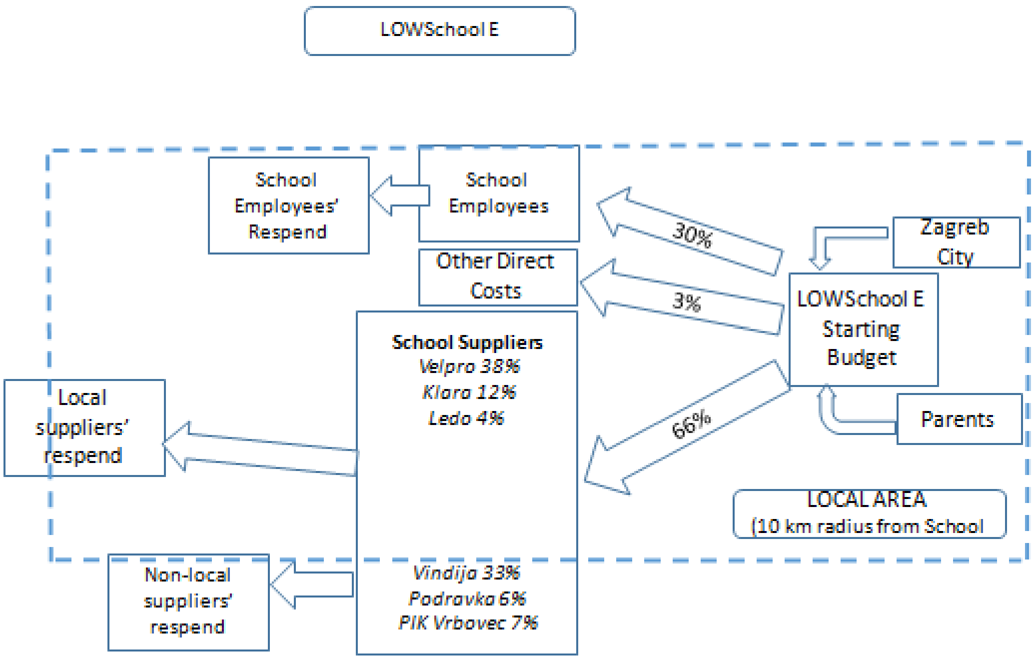
As Figure 19 shows, a very small proportion (7%) of the school meals budget for LOWSchool C is spent on catering staff, all of whom reside within the local area. The vast majority of the budget (87%) is spent on food supplies, from a total of 10 different suppliers. Eight of these suppliers have headquarters in the local area, and two are non-local. In total, 83% of LOWSchool C's food supplies budget is spent on suppliers within the local area, and 17% on non-local suppliers. Of all schools in both LOC and LOW cases, this school spent the largest budget proportion on local suppliers.

Figure 20: Flow of budget expenditures of LOWSchool D meals service



As Figure 20 shows, a sizable proportion (30%) of the school meals budget for LOWSchool D is spent on catering staff, all of whom reside within the local area. The majority of the budget (66%) is spent on food supplies, from a total of eight different suppliers. Half of these suppliers have headquarters in the local area, and half are non-local. In total, 34% of LOWSchool D's food supplies budget is spent on suppliers within the local area, and 66% on non-local suppliers. Of all schools in both LOC and LOW cases, this school spent the smallest budget proportion on local suppliers.

Figure 21: Flow of budget expenditures of LOWSchool E meals service



As Figure 21 shows, a sizable proportion (30%) of the school meals budget for LOWSchool E is spent on catering staff, all of whom reside within the local area. The majority of the budget (66%) is spent on food supplies, from a total of six different suppliers. Half of these suppliers have headquarters in the local area, and half are non-local. In total, 54% of LOWSchool E's food supplies budget is spent on suppliers within the local area, and 46% on non-local suppliers.

Figures 17-21 have revealed the overall pattern of expenditures of schools in the LOW case. Expenditures on catering staff by these schools is typically between a quarter and a third of total meals budget, and on average 24%. This average is higher than LOC schools (17%), which is logical given that all LOW schools prepare their own lunches on-site, in addition to other meals. LOWSchool C is an outlier, with only 7% of its meals budget spent on catering staff. In contrast to LOCschools, all LOWSchool catering staff reside locally. This can be expected to boost the LM3 ratio for the LOW case, especially as the average proportion of budget spent on catering staff by LOW schools is larger than LOC schools. In terms of suppliers, there are several similarities between LOW and LOC cases. All LOW schools use the non-local Vindija (for dairy), and four use Ledo and Pan-Pek, both of which are local. On average, LOW schools spend 61% of their supplies budgets on local firms, which is slightly smaller than LOC schools (60%).

The LOW case expenditure values and proportions were entered into the LM3 online tool for analysis. The calculation revealed a Project LM3 ratio for the LOW school meals chain of 2.28. This means that for every €1 spent by the initial budget generators, an additional €1.28 is generated within the local area. Table 14 presents the result, together with estimates of Local and Non-Local LM3s.

Table 14: Project, local, and non-local LM3 estimates for (LOW) meals service

		Explanation
Project LM3	2.28	For every €1 spent by the LOW school meals service, an additional €1.28 is generated in the local economy
Local LM3	2.65	If only local suppliers were used then an additional €1.65 would be generated in the local economy
Non-Local LM3	1.32	If only non local suppliers were used, then an additional €0.32 would be generated in the local economy

Overall, the LOW school meals service has a higher LM3 ratio (2.28) compared with the LOC service (2.15). Both of these ratios are slightly above average in the context of the food sector, and reflect the fact that in both cases the majority of the supply budget is spent on local suppliers. The slightly higher ratio in LOW is due to the fact that all catering staff in LOWSchools are resident in the local area, compared with only a portion of staff in the LOC case.

4.3 Economic value of the school meals service

To explore what economic values are experienced by members of the school meals supply chains from their involvement in a contract, we asked all suppliers in both Cases to give their current employee numbers and turnovers, in order to obtain an estimate of the size of their businesses, and an estimation of their growth rates over the last 5 years. We also asked suppliers to estimate the proportion of their business dependent on the school meals contract, and the size of any new business won as a direct result of the contract. As the absolute number of supply chain members in both Cases was relatively small, we report the results descriptively.

4.3.1 Economic value in Case 1 (LOC) service

In terms of business size, we found the members of the supply chain each had turnovers of between €340,298,667 and €55,000, and employed between 2 and 1409 staff. Growth rates varied considerably from those who were experiencing very high levels of growth, to those who had experienced a reduction in growth. For all the suppliers, the LOC model school meals contract represented only a small part of their business, and the amount of new business won as a result of holding the contract was also estimated to be very modest. Nevertheless, almost all interviewees spoke very positively of their involvement in the contract and how it fitted in well with other contracts and activities, in a complementary way. Table 15 summarises the data.

Table 15: Economic value of school meals contract in (LOC) case

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 yrs	New business won as result of contract
	Employees (n)	Turnover (€)			
Vindija	1070	340,298,667	0.1%	-9.16%	Negligible
Velpro	1409	269,361,333	0.09%	Negligible	Negligible
Metro	1066	242,969,333	Negligible	-1.29%	Negligible
Ledo	1076	173,992,000	0.1%	6.08%	Negligible
PanPek	585	28,365,333	0.021%	26.65%	Negligible
Klara	710	22,578,160	0.23%	-7.74%	Negligible
Vajda	251	25,078,666	0.313%	-9.90%	Negligible
PIK Rijeka	369	17,369,333	0.012%	-28.70%	Negligible
Agrodalm	24	6,004,000	1.17%	32.56%	
Naše klasje	17	4,417,333	0.156%	19.99%	
Medeni kutak	2	55,385	41.27%	65.12%	

As Table 15 shows, eight of the 11 suppliers in the LOC model are large enterprises, with more than 250 employees. Of these, four suppliers (Vindija, Velpro, Metro and Ledo) are very large, with more than 1000 employees and turnovers more than €100million. Unsurprisingly, for these firms, the LOC school meals contract is worth only a tiny proportion of their total business (less than 1%). For the remaining large firms (PanPek, Klara, Vajda and PIK Rijeka), and for all but one of the smaller firms, the situation is the same. Only for one supplier (Medeni Kutak) is the LOC meals contract a significant contributor to total turnover (41%). This supplier is a small, family-owned firm.

For Vindija as dairy producer and supplier, the LOC school meals contract comprises a very small % of turnover, although the firm services several contracts for all other schools in the region. It can be argued that the LOC schools contract therefore has a value in terms of being a complementary part of the firms operations. In terms of growth rate, Vindija went through a period of large expansion. Given that such a small proportion of business is due to the LOC model school meals contract, it is not possible to attribute any new business specifically to this contract. However, the main reason for supplying all schools is the corporate social responsibility: the business has an orientation towards encouraging children to consume their milk and dairy products. Their goal is to set up some habits in the early stage of children lives and later when they become consumers, they will look for their products.

For Velpro and Metro, suppliers of other food products, the LOC model schools contract comprises neglible turnover, and like Vindija, represents one contract in a portfolio of public sector contracts operated in the region. The contract is not likely to lead to large amounts of new business.

For Ledo, the LOC schools contract comprises 0.1% of turnover, and represents one contract in many public sector contracts operated in the region.

For PanPek and Klara (producers of bread and bakery products), the contract comprises a very small % of turnovers, although the fact that the contract represents regular income is appreciated. Both of these suppliers do have lots of small shops all around the country, where children, with their parents, could look for the products they are used to eating in the school.

4.3.2 Economic value in Case 2 (LOW) service

In terms of business size, we found the members of the LOW model schools supply chain had turnovers of between €40,000 and €289m, and employed between 2 and 3296 staff. Growth rates of suppliers varied considerably from those who were experiencing high levels of growth, to those who had experienced negative growth. For all the suppliers, the Zagreb school meals contract represented only a small part of their business, and the amount of new business won directly as a result of holding the contract was also estimated to be very small. Nevertheless, all interviewees spoke very positively of their involvement in the contract. Table 16 summarises the data.

Table 16: Economic value of school meals contract in Case 2 (LOW)

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 yrs	New business won as result of contract
	Employees (n)	Turnover (€)			
PIK Vrbovec	1962	288,740,000	0.001%	15.95%	Negligible
Podravka	3296	275,072,000	0.001%	5.67%	Negligible
Stridon	312	49,896,000	0.044%	5.87%	Negligible
Euromilk	37	4,248,000	0.165%	25.04%	Negligible
Bionatura	29	3,330,666	0.033%	28.04%	
Mesnice Francek	28	1,384,592	0.496%	-25.53%	
TER	10	1,347,569	0.100%	14%	
Bakery Filip	2	39,624	8.75%		

As Table 16 shows, in the case of 2 small firms, the LOW school meals contract comprised from 8.3% to 50% of turnover. Furthermore, although very little new business could be attributed to holding the LOW meals contract, most of suppliers explained that every customer is regarded as important, and having the children in the schools fits with the firm’s bigger strategy.

For the Meat Producer PIK VRBOVEC, the LOW school meals contract also comprised a very small % of turnover. Like in LOC model - also serviced contracts for other LAs, amounting to 0.5% of turnover. Therefore, the School meals contract had strategic importance to the business. PIK VRBOVEC Meat Company had exhibited relatively significant growth in past 5 years. Nevertheless, directors also argued that having already won school contracts did help with future bids, as it showed that the firm could meet standards and do the job, which acted as a reassurance to the tenderer.

Podravka is a large enterprise, and is part of a parent company with several other food and pharmacy companies. It holds many public sector contracts in Croatia, hence although the LOW model contract represented a tiny proportion of total business, as a whole the public sector contracts were regarded as economic valuable. The management conveyed that no new business had been won directly as result of the LOW model contract. However, at the time of interview, PODRAVKA was working on the innovation process of development of ready-meals for schools.

5. SOCIAL IMPACT OF SCHOOL MEALS SERVICES

5.1 Methodology to measure social impact

The goal of the social impact analysis was to assess what social values were generated by the operation of the (LOC) and (LOW) school meals services. The indicators we took into account to measure social impact were:

(i) employment-related criteria. Under this heading, we gathered data on the number and types of jobs linked to the school meals service, and the diversity profile of staff and levels of training/skills development in place within the businesses participating in the supply chain.

(ii) criteria relating to the working environment of the service chain and connectedness of people within it, including rural communities. Under this heading, we gathered data on the well-being and job satisfaction of interviewees, and their testimonies relating to how much they engaged with others in the supply chain, and what kinds of activities/occasions such engagement represented. Within this, we explored the extent to which the school meals procurement brought caterers and schools into contact with rural and farming communities that produce food items.

Given the small sample sizes of informants in both Cases, we give a descriptive reporting of the results relating to the above indicators.

5.2 What are the employment-related impacts of school meals services?

In terms of the types of employment offered by suppliers, we found a substantial proportion of full-time positions, in primarily medium or relatively low skilled work. The ethnic profile of suppliers' workforces tended to reflect the wider profile of the region, with the vast majority of staff being of white Croatian ethnicity. The gender split was representative of the food supply/catering sector more generally. Almost all depot and delivery jobs were filled by male employees, and almost all staff working in school kitchens were female. Office staff were also predominantly female. Regarding the types/levels of qualifications held by staff, in most cases the mandatory qualifications for all staff were: food safety, health and safety, manual handling, safeguarding, allergen training; customer care; health and safety.

Additional qualifications for all staff were: nutrition awareness, first aid, sustainability, customer care, MSC training; food safety, machine operations, driver training

Optional for cooks: professional cookery, NCFE Nutrition and Health,

Additional for some staff: HACCP training, administrative training,

Mandatory for food staff: hygiene training.

Tables 17 and 18 summarise the employee profiles of the suppliers who were willing to share information in LOC and LOW cases respectively. It also contains information about the numbers and profile of catering staff in LOC and LOW cases.

Table 17: Employment related impact of school meals service in LOC case

	Job Type		Employee profile	Skills/Training Development
	FT	PT	Ethnic minority	% staff on training/with qualifications
Vindija	97%	3%		100%
Ledo	97%	3%	1-2%	100%
PanPek	100%	0%	1%	100%
Klara	100%	0%	0%	100%
Vajda	50%	50%	0%	100%
LOCSchool A	3	4		100%
LOCSchool B	3	0		100%
LOCSchool C	1	0		100%
LOCSchool D	2	0		100%
LOCSchool E	2	0		100%

Table 18: Employment related impact of school meals service in LOW case

	Job Type		Employee profile	Skills/Training Development
	FT	PT	Ethnic minority	% staff on training/with qualifications
Vindija	97%	3%		100%
Ledo	97%	3%	1-2%	100%
Pan_Pek	100%	0%	1%	100%
Klara	100%	0%	0%	100%
Vajda	50%	50%	0%	100%
PIK Vrbovec	100%	0%	0%	100%

Podravka	100%	0%	0%	100%
Stridon	100%	0%	0%	100%
Euromilk	100%	0%	0%	100%
LOWSchool A	3	0		100%
LOWSchool B	3	0		100%
LOWSchool C	2	1		100%
LOWSchool D	2	1		100%
LOWSchool E	3	0		100%

As Tables 17 and 18 show there is significant lack of kitchen staff in LOC school models. For example in the case of LOC model – there are 7 employees in the kitchen and they prepare 2139 hot meals in total (for 13 schools in total) which means that each cook is responsible for more than 300 hot meals (recommendations for one cook is 70 hot meals and 270 dairy meals).

In the case of LOW model, usually there are 3 cooks for around 396 dairy meals in average, which means that each cook is responsible for more than 123 dairy meals. Compared with LOC model, LOW model is in a better position regarding workforce and hot meals – cooks are responsible for 80 to 20 hot meals per school.

5.3 What is the working environment and connectedness in school meals services?

5.3.1 Working environment and connectedness in (LOC) meals service

To explore how the LOC school meals contract impacts on working environment and suppliers' sense of connectedness to others in the chain, we explored the experiences of suppliers and schools of working in the supply chain and to describe any events or occasions which brought them into contact with other members of the chain. A finding from the suppliers' testimonies was a strong sense of commitment to their positions in the region. The interviewees spoke positively about the working relationships they had developed in the local supply chain. These were linked to commercial benefits (e.g. improved flexibility of service, more tailored customer response, better ability to negotiate ways through problems or crises, development of trust), as well as civic outcomes.

In interview, supply chain members also conveyed involvement in voluntary and outreach activities, in the form of giving their time and resources to support council or public agency-run initiatives, such as hosting site visits and tours for community groups (e.g. Vindija's "school milk day" involved organising a gathering of school children on the big event and conducting a tour for headteachers in their own factory; Podravka also undertook healthy meal promotion). Engagement with local schools was a key part of such activities, including giving presentations and talks to schoolchildren about their businesses and taking part in educational activities to improve understanding of different foods and where they come from. The following sections offer more illustrative detail about working environment and connectedness for key supply chain members.

Vindija is the main supplier of dairy items to both LOC and LOW schools, and it employs 1070 staff. The firm is based in Varaždin, which is >100km distant from Zagreb. On the World School Milk Day in 2018, Vindija 2018 organized a social gathering with children in the Zagreb park Bundek. The event was aimed at drawing the attention to the importance of milk consumption in schools, but also to the wellbeing that milk offers in the upbringing of children. Students from many Zagreb primary schools participated in the event, followed by their younger friends from numerous Zagreb kindergartens, singing songs of milk and enjoying delicious Vindino cheese desserts. Since this project is not only of nutritional, but also of educational character, and focused on the awareness raising of the importance of healthy nutrition from the earliest age, Vindija is proud to participate in it according to its business mission. The celebration of the World School Milk day was initiated by the Food and Agriculture Organisation of the United Nations, which recognized the importance of milk in children's nutrition, but also the value that milk has as a nutritionally high-valued foodstuff. That was the reason why Vindija played an active part in the event, offering support to the adoption of healthier eating habits and ensuring necessary nutrients to school children.

Vindija also engages in events close to its factory base. In the autumn 2018 Varaždin food industry celebrated a good cooperation with educational institutions by entertaining heads of primary schools and kindergartens and their staff in the area of northern Croatia. Vindija – supplying with its products almost five hundreds of schools and kindergartens throughout Croatia – used this opportunity to introduce novelties in its wide range to heads of schools, such as Vivis fresh cream cheeses and dairy desserts produced in most-modern plants of Vindija's Vivis factory.

During the presentation of its product offer, Varaždin food industry laid a special emphasis on foodstuffs that are especially custom-made for children due to their quality, quantity, and nutrition values. Evidently exceptionally pleased with what they saw in Vindija's production plants, as well as during the presentation of its product offer organized at the company's headquarters, the school staff thanked the employees of commercial management for proverbially pleasant, high-quality cooperation. Although this event did not take place in Zagreb, it nevertheless brought together groups of teachers from Zagreb primary schools to observe the production processes behind the milk and cheeses which their students consume every day.

PODRAVKA - Podravka products are supplied to LOC schools via wholesalers Velpro and Metro. Podravka is also a direct supplier to two LOW schools (LOWSchools A and E). In 2015, this supplier implemented"Zdravi odmor" (Healthy break) project in cooperation with schools throughout Croatia. All the activities of the "Healthy break" project were related to the preparation of healthy meals in schools and providing useful information on proper nutrition. That encourages the adoption of proper eating habits during growing up, which can be permanently used in adulthood too. The debate about healthy and proper nutrition was joined by a famous singer who presented meal preparation using healthy foodstuffs to the students. Healthy meal can also be a tasty meal, that is one of the objectives of the Healthy Break Project, which Podravka is using to raise awareness of the importance of a school meal, its compatibility with the rules of proper nutrition, as well as to improve eating habits of the students.

With the aim of improving the living quality of the society in which it operates, Podravka has been investing – since its founding - into science and education, sustainable development, culture, arts, sports, and charitable projects. It can pride itself especially on the organization of the manifestation Lino Višebojac, introducing true sports values to primary school students throughout Croatia.

Lino višebojac is one of the most distinguished sports manifestations, in which children – through sports competitions – acquire a winning mindset, learn how to deal with defeat, and adopt true sports and human values through spending time together.

The primary aims of this sports Project is for Podravka to promote – through a free nutrition education of children, their parents, primary schools teachers, and cooks related to new, nutritionally high-valued meals in schools kitchens – proper and balanced nutrition of primary school students, to their wellbeing in the future. Due to its quality, the Project received an acknowledgement of the Ministry of Health and Ministry of Science, Education, and Sports.

From 2014 – 2024 Podravka formed a nutrition strategy – it's aimed at harmonisation of nutrition profile in accordance with the recommendations, and it also started producing baby food. From 2014 - 2017 it cut down the amount of sugar used by 300 tonnes.

At LOCSchool A, the manager explained that the school firm did a lot of work on health and nutrition awareness raising amongst school pupils. A specific example involved undertaking sessions in schools to explain the dietary reasons for a new government policy limiting the serving of fish.

The campaign „Today we're having fish" was aimed at raising awareness of the importance of domestic fishery and aquaculture products in order for such products to be more widely used in the nutrition of school children and thus become a part of their healthy meals. Good eating habits are adopted at the earliest age, so this campaign speaks to the 1st grade students by offering them packages containing: a can of Adriatic sardine in olive oil, sardines pâté, and a picture book "Today, we're having fish". LOCSchool A accepted the initiative and got involved in the project, in which a total of about 40,000 packages in 2,000 Croatian schools was dispensed. The campaign was initiated by the Ministry of Agriculture in cooperation with educational institutions at national level.

Also, in 2018, LOCschool A participated in the programme *School Honey Day* and the promotion of Croatian apiaries. The programme is aimed at the promotion of domestic honey, and each student of the 1st grade of primary schools received a 370 mL jar of honey and an educational picture book. The programme is aimed at the promotion of local producers - users of the marking Med hrvatskih pčelinjaka (Honey from Croatian apiaries) – to increase honey intake in children's nutrition, raising awareness of the importance of healthy nutrition and nutritional values of honey, and educating students about the importance of beekeeping for the whole agricultural production and biodiversity. The programme was initiated by the Ministry of Agriculture, Croatian Agricultural Agency, and Paying Agency for Agriculture, Fisheries, and Rural Development and is focused on the 1st grades of primary schools on the territory of the whole Republic of Croatia.

The LOCSchool A manager also spoke very positively about the relationships developed with local suppliers, which were conveyed as extremely helpful to the smooth running of the service. Strong relationships were characterised as allowing for greater flexibility and the development of trust. For example, Vajda, Agrodalm and Klara were described as willing to adjust their delivery schedules in the event of bad weather, to ensure schools did not run short of items. Another example was the sharing of information by Agrodalm about forthcoming shortages in the harvest, which would likely cause problems in sourcing pears or tangerines in spring/summer 2017. As a result of this information, LOCSchool A adjusted its forthcoming menu to reduce reliance on pears or tangerines, substituting these with other fruits.

In LOCSchool B - A workshop on a healthy diet (ongoing food related project) – this school take care about waste management – plastic is recycled, waste food is donated. They use just plastic pudding spoons and plastic juice cups.

At Agrodalm, managers explained in interview that they try to include local producers of fruit and vegetables wherever it is possible. In terms of links with others in supply chain, the Agrodalm manager conveyed a strong, community-minded orientation. For example, he spoke enthusiastically about sourcing locally, to help suppliers grow their businesses. The managers explained that they could mix produce from the local growers with produce from other origins to achieve the correct volumes and continuity of supply to meet the needs of the schools

At KLARA; LEDO and PAN PEK, the managers conveyed a very strong commitment to local community and sustainability issues. Although it was clear that the orders to LOC and LOW model Schools were a very small part of their overall turnover, the contract mattered to those suppliers because of children and parents future eating and consumer habits.

5.3.2. Working environment and connectedness in (LOW) meals service

To explore how the LOW school meals contract impacts on working environment and suppliers' sense of connectedness to others in the chain, we asked suppliers and schools to talk about their experiences working in the supply chain and to describe any events or occasions which brought them into contact with other members of the chain. The finding was that although suppliers reported had resources available for community benefits, including educational/school visits (Vindija), none had undertaken any of these activities within schools in LOW model. Hence, a missed opportunity existed to develop more connectedness in the chain, particularly as suppliers and schools, at the time of interview, had little to no contact/exchange with one another, beyond physical deliveries. The following sections offer more illustrative detail about working environment and connectedness for key supply chain members in LOW school models.

At PIK VRBOVEC, the directors conveyed some types of community engagement activity the firm got involved with. For example, they produced a ham with a low fat and salt content. But, neither of their initiatives had been followed by LOW case schools, nor had the LOW schools asked PIK Vrbovec to engage in any community/social benefit projects post- contract award.

KUFLAND is not registered supplier LOW or LOC schools but they are trying to set up relationships with some of them them by project – They organized a competition in which they sought public primary schools to donate fresh fruit and vegetables throughout the school year 2018/2019. They selected 38 partner schools from all over Croatia, which would have an additional healthy meal for their students during the next school year - and by the end of the next school year Kaufland will donate almost 150 tons of fresh fruit and vegetables. The task of the school is to collect as many environmental tips and at least one of them present creatively.

At LOW Schools, head teachers explained that they had no liaison activity with any current suppliers of school food, and in general they explained they lacked knowledge about who suppliers were and where food for meals came from. Therefore, despite the fact that most of LOWSchools A-E were active in pursuing projects in healthy eating and diets, and some engaged in 'growing, cooking, eating' projects which explored food provenance, current suppliers were not part of these initiatives.

***LOWSchool A* –** ongoing food related project:

1. the healthier, the happier, Erasmus+- an EU funded project promoting the healthy lifestyle; campaigns related to development of healthy diet habits, public discussions, tasting of healthy; locally grown foodstuffs, setting up a billboard promoting seasonal and healthy foodstuffs, drafting of a healthy cookbook. At the beginning of the project, and initial state evaluation was conducted, and at the end a final one.
2. School scheme of school fruits and school milk – a national/European project promoting availability of one fruit and one milk meal once a week to every school child. Although it is a national scheme, not all schools have participated, so LOWSchools are examples of schools which have been proactive in applying.
3. Hidden calories – workshops for the pupils of the third grade conducted by the students of Medical faculty in Zagreb in cooperation with the Public health institute to learn what is a healthy diet, and the hidden calories in industrially processed food.

5.3.3 Comparison of environment and connectedness in LOC and LOW model schools

In LOC model schools, there appeared to be stronger relations between supply chain members than in LOW case. LOCSchool A, as the hub school, plays a key role in coordinating sourcing of items from suppliers. Supply chain members exhibited strong connections to LOC School A, and also were involved in working directly with other schools in the City County, to arrange visits, talks, and to participate in educational and community projects. However, in LOC model, although some small suppliers are used for procurement, there were no direct links to family farming firms. This creates a limitation on the level of connectedness between LOCschools and the rural areas and communities around them.

In LOW model schools, the relations between suppliers and schools appeared to be weaker than in LOC model. No interactive or coordinating activity was identified between LOW model school suppliers, and overall, there was a lack of joined up activity between supply chain members of the LOW school meals service and the schools they provide food to, despite suppliers having ready access to educational materials and resources, and at least some schools placing priority on food-related issues in the curriculum. Our analysis reveals an opportunity for LOW model schools and Zagreb city council to promote better integration between suppliers and schools. Finally, although LOW Schools did use some family farming firms and smaller suppliers in procurement, these suppliers did not have any links with schools for educational or social goals.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 What do we learn from this research?

In the design of this research for WP6.3 in Croatia, a LOC and a LOW case were selected. The LOC case was defined according to its feature of having a hub kitchen (LOCSchool A), and known sourcing of food items from local suppliers. The LOW case was defined by five 'regular' primary schools, unconnected to each other, which procured food items following typical, low cost, conditions. From the research, some expectations for the LOC case were borne out - for example, there was a greater proportion of local suppliers used, there were less kms travelled, and there were better supplier relationships, than was found in LOW case. However, there were also results that went against expectations - carbon emissions per gram of meal in LOC case were higher than LOW (due to more meat in average meal), and LM3 ratio in LOC case was smaller than LOW (due to slightly smaller budget spend on local suppliers, and a smaller proportion of kitchen staff residing in the local area).

What we learn from this research is that a school meals service which has a high proportion of local suppliers and efficient supply chain structure does not, in itself, necessarily give the strongest environmental or even local economic multiplier outcomes. A focus on the composition of the meals (in particular levels of meat content) and school budget expenditures (split between local vs non-local suppliers and staff) are more important factors for these outcomes.

We have also learned from this research that even though Croatian procurement law does not specify any minimum thresholds for local sourcing, or other sustainability criteria, a surprisingly high proportion of local suppliers appears to be used by 'regular' schools, at least in Zagreb context. Therefore, the expectation that 'low cost' procurement model gives weaker environmental and economic outcomes is challenged by our results. We emphasise that these results and conclusions may be different in other parts of Croatia where there may be less ready availability of suppliers within a small geographic area.

6.2 How could environmental, economic and social impacts of the meals services be improved?

For environmental impact, we found that the carbon emissions per kg of average meal in LOC model schools were slightly higher than LOW model schools. The main way to reduce emissions in LOC model would be to reduce the amount of meat in the menus, or to substitute a proportion of red meat for white meat,. However, such adjustments need to be considered also from a nutritional point of view - reductions in meat proportions on the menus may have negative impact on nutritional profile of the meals. In LOC case, LOCSchool A operates as a hub school which improves the efficiency of the supply chain. This feature should be retained as it reduces the kms travelled by first tier suppliers in this case. The supply chain could be made more efficient by decreasing the number of suppliers to LOCSchool for the same food category. For LOW model schools, where the menus give lower emissions per kg of average meal, the main opportunity for emissions reduction would be through more consolidation of suppliers, and better coordination between them. For example, some larger suppliers could distribute items on behalf of other, particularly smaller, suppliers, in order to reduce total kms travelled.

In terms of economic impact, the local multiplier effect of the LOC model meals service is slightly smaller than LOW model. To increase local multiplier effect, schools in both LOC and LOW models could contract with more local suppliers, particularly for categories of high budgetary spend. In terms of economic value, we found that suppliers are a mix of large and small firms, but that overall, the value of the LOC and LOW case contracts is a very small proportion of their total businesses, and often <1% of turnover. It should be noted, however, that the LOC and LOW cases here comprise only 5 schools, and in reality, many of the suppliers studied here have contracts with many other Zagreb (and other) schools. From that perspective, the composition of the case studies here likely underestimates the true value of school meals contracts for Zagreb suppliers. It can also be emphasised how the typical context of contracts being managed by individual schools, on an annual basis, adds a time and cost burden to suppliers. LOC case, with its hub school model, reduces this time and cost burden.

In terms of social impact, we found that suppliers typically employ full-time staff, and their gender and ethnic profiles follow those of the wider catering/distribution sectors. In both LOC and LOW cases, suppliers show a commitment to staff training and skills development. However in schools in both cases we found a lack of workforce in the school kitchens, including specialist, trained staff. That is a significant obstacle in the development of more sustainable school meals, as for example, the role of kitchen and canteen staff is highlighted as important to improved quality of meals, the reduction of plate waste, as well as to development of food and health related initiatives in schools. Also, particularly in LOW case, there appeared to be weaker links between schools and suppliers compared with LOC case, despite the fact that some suppliers had developed good resources, and undertook activities and event with schools in other regions. There is an opportunity for schools in LOW case to build better links with suppliers therefore, and this could be made more feasible by coordinating events/activities across a number of schools.

6.3 What policy interventions would help?

EU Regulation 2014/26 is expected to have an impact on public procurement practice in Croatia. It is expected that the new law will make public procurement procedures in the future more flexible and easier, with reduction of costs for businesses and an increase in competition. It also means that some qualitative criteria should be in the description of procurement (until this Regulation, in Croatia procurement had to follow the rule of lowest price). However, implementation is the critical factor, there is a need to go beyond just a formal measure in Croatia. To improve sustainability of school meals, our recommendation is to follow the best practice of other EU countries and to insist on the evaluation of qualitative criteria during award process for procurement contracts. This can include specifying thresholds for certain criteria such as local sourcing or organic food (like is partially the case in Italy).

One option could be that public procurement should be organised at the Govermental level, through a central service for public procurement.

6.4 What local/practice interventions would help?

In terms of recommendations, we propose to organise the core body who will be responsible for providing school meals in Zagreb City. Zagreb Local Authority could be responsible for procurement of not only fresh fruit and milk, but also Fresh Vegetables, Meat, Eggs, Fish, etc. In that case, Zagreb LA would have higher bargaining power with suppliers and could support procurement of locally produced food. Zagreb Council could also encourage larger suppliers to act as distributors for other small suppliers. Furthermore, better coordination and communication between schools could be developed (both in terms of their procurement and pursuit of health/food projects), as well as forums or idea exchanges where good practice can be shared. Intervention such as awards/competitions for schools / cooks / suppliers could also be helpful. Finally, within this research we found "good practice" between some suppliers and some schools, even without legal requirements. Those "light examples" could serve as a directions for way forward. Locally produced and supplied food could help to improve environmental, economic and social impacts

The EU funded "School Scheme" has been a great intervention for all participating primary schools in Croatia. This project has helped children to get free fruits, vegetables and dairy products in school and therefore has encouraged them to adopt healthy eating habits. The aim of that project was also to help local and domestic producers. In this regard, there are some problems with implementation. Some schools sometimes get imported products, and there is no control body that determines which apples should be local vs imported. Neither is it written on the apples themselves. The only specification is that apples should be from 100 to 150 grams in weight. This makes it hard competition for local manufacturers. Two years ago when the scheme was launched, the local apple harvest was weak and then the commercial companies were involved in the delivery of F&V for schools. Now schools are not motivated to change suppliers. There should be some control of who the producers and vendors should be in that Scheme. This could be via formation of a control body at the Ministry or City level, who can help local producers to deliver their products to schools.

Another challenge to local farmers' participation in the School Scheme is the requirement for them to have resources to keep fruit for the whole year for delivery. It requires that little family farms have chilled storage, which many do not have. It makes it hard for them to compete in that market. Also, when the prescribed size of the apples is 150 grams, and the family (local) producer does not have enough products of that size, it is another reason why they can't participate. The solution could be in setting up trading companies for small producers, where individual farmers who do not have enough apples or other fruits can sell them to those companies. The real competition are producers in other EU countries who, unlike Croatian producers, are associated with producer organizations through which they reduce production costs, have cheaper prices and can buy cheaper raw materials, negotiate with suppliers and simply sell their products. In the focus of the Ministry of Agriculture's work for the next year are tenders for primary production and the construction of chilled storaged spaces for fruit and vegetables, which will also operate as regional distribution centers (not just storage space). These actions will facilitate the positioning of local fruit and vegetables on the market, primarily towards public suppliers - schools, kindergartens, dormitories, hospitals etc. The Ministry of Agriculture grants support for the establishment of producer organizations - €500,000 for 5 years of operations. Around 15 manufacturing organizations have been established.

In the practice, this project could be much more helpful to small producers. But, schools are not capable of dealing with the administration and it is difficult for them to handle so many small suppliers and take care of payments and delivery process. This task could be handled by the Minsitry or LA.

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APPENDICES

Appendix 1

Food Procurement Plan for school A (LOC)

PLAN NABAVE za 2017. godinu **KUHINJA**

Red. broj	NAZIV	Jed. mjere	Količina	IZNOS (neto)	PDV	UKUPNO
1.	MESO					
1.1.	JUNETINA b.k.(komad, odrezak, na kocke)	kg	3800	175.500	43.875	219.375
1.2.	PILETINA (batak, prsa)		4000	110.000	27.500	137.500
1.3.	PURETINA b. k. - odrezak, kocke		2000	100.000	25.000	125.000
1.4.	SVINJETINA b. k. - narezana na kocke		2300	56.000	14.000	70.000
	UKUPNO I		12100	441.500	110.375	551.875
2.	PROIZVODI OD MESA					
2.1.	SALAMA (pileća i pureća, ostala)	kg	150	7.000	1.750	8.750
2.2.	ŠUNKA (puretina)		300	11.000	2.750	13.750
2.3.	HRENOVKA pureća		900	13.000	3.250	16.250
2.4.	KOBASICE ZA KUHANJE		250	7.000	1.750	8.750
2.5.	ŠUNKA (suha rolana)		800	29.600	7.400	37.000
2.6.	ZIMSKA SALAMA	kg	300	13.000	3.250	16.250
	UKUPNO II		2700	80.600	20.150	100.750
3.	RIBA					
3.1.	LIGNJA (cijela i kolutići)	kg	200	6.000	1.500	7.500
3.2.	PLODOVI MORA	kg	200	5.000	1.250	6.250
3.3.	Panirani kolutići lignje	kg	1200	3.000	750	3.750
3.4.	OSLIĆ FILE smrz.	kg	200	6.000	1.500	7.500
3.5.	PANIRANA RIBA - razno	kg	2200	50.000	12.500	62.500
	UKUPNO III		4000	70.000	17.500	87.500
4.	PEKARSKI PROIZVODI					
4.1.	KRUH crni i razne druge vrste	kom.	40000	115.000	5.750	120.750
4.2.	PECIVA razne vrste	kom.	50050	65.000	3.250	68.250
4.3.	PEKARSKI PROIZVODI druge vrste	kom.	6000	20.000	5.000	25.000
4.5.	ŠTRUKLI SIR rinfuza	kom.	5000	18.500	4.625	23.125
4.6.	OKRUGLICE (marelica, šljiva)	kg.	200	3.800	950	4.750
4.7.	OSTALO (pizza, burek)	kg.	4400	50.000	12.500	62.500
	UKUPNO IV			272.300	32.075	304.375

5.	TJESTENINA					
5.1.	TJESTENINA RAZNA (1/2 kg; 5/1 kg)	kg	5500	45.000	11.250	56.250
5.2.	MLINCI 1/1	kg	600	9.000	2.250	11.250
5.3.	PUNJENA TJESTENINA (tortellini) - nije jav. nab.	kg	2100	57.500	14.375	71.875
5.4.	NJOKE VALJUŠCI	kg	1500	30.000	7.500	37.500
	UKUPNO V			141.500	27.875	169.375
6.	KOLAČI					
6.1.	BISKVITNI KOLAČI razni 60 g	kom.	16000	40.000	10.000	50.000
6.2.	PRHKI KOLAČ razni 60 g	kom.	16000	32.000	8.000	40.000
6.3.	SAVIJAČA razna 60 g	kom.	16000	32.000	8.000	40.000
6.4.	MUFFIN razni 60 g	kom.	16000	32.000	8.000	40.000
6.5.	MEDENO TIJESTO 60 g	kom.	8000	20.000	5.000	25.000
6.6.	PITA S KORAMA razne 60 g	kom.	14000	35.000	8.750	43.750
6.7.	MLIJEČNI SLADOLED i ostale smrz. slastice	kom.	3000	15.000	3.750	18.750
	UKUPNO VI		89000	206.000	51.500	257.500
7.	MLIJEKO I ML. PROIZV.					
7.1.	MLIJEKO svježe 1/1, 1/5	l	9000	27.000	1.350	28.350
7.2.	JOGURT od 150 g do 200 g	kom.	8000	8.000	2.000	10.000
7.3.	JOGURT voćni razni okusi od 150 g do 200 g	kom.	8000	10.000	2.500	12.500
7.4.	SIRNI namaz 250 gr. razni	kom.	2000	15.000	3.750	18.750
7.5.	MASLAC i sl.	kg	500	11.000	2.750	13.750
7.6.	VRHNJE ZA KUHANJE 1/1	l	3000	27.000	6.750	33.750
7.7.	SIR ZA REZANJE cca 2,5 kg	kg	300	11.000	2.750	13.750
7.8.	SIR OSTALO (ribani, svježi)	kg	600	6.000	1.500	7.500
7.9.	PUDING razni okusi 125 g	kom.	12000	8.500	2.125	10.625
7.10.	ČOKOLADNO ml. 0,20 l	kom.	4000	4.000	1.000	5.000
7.11.	VRHNJE KISELO 200 g	kom.	500	600	150	750
7.12.	SHAKE NAPITAK	kom.	6000	21.000	5.250	26.250
7.13.	MLIJEČNI NAMAZ 70 g	kom.	600	800	200	1.000
	UKUPNO VII			149.900	32.075	181.975
8.	POVRĆE					
8.1.	KRUMPIR	kg	28000	65.000	16.250	81.250
8.2.	BLITVA	kg	500	4.600	1.150	5.750
8.3.	KELJ	kg	800	7.000	1.750	8.750
8.4.	LEĆA	kg	100	2.000	500	2.500
8.5.	GRAH	kg	1600	21.000	5.250	26.250
8.6.	MRKVA	kg	2500	12.000	3.000	15.000
8.7.	LUK CRVENI	kg	2400	10.000	2.500	12.500
8.8.	PERŠIN LIST	kg	50	3.000	750	3.750
8.9.	ČEŠNJAK	kg	150	3.500	875	4.375
8.10.	PAPRIKA SVJEŽA	kg	200	2.400	600	3.000
8.11.	KUPUS SVJEŽI	kg	3000	4.500	1.125	5.625
8.12.	KUPUS KISELI	kg	600	4.500	1.125	5.625
8.13.	ZELENA SALATA	kg	2600	22.100	5.525	27.625
8.14.	PORILUK	kg	600	5.000	1.250	6.250
8.15.	RAJČICA	kg	700	6.500	1.625	8.125
8.16.	TIKVICA	kg	600	7.200	1.800	9.000
8.17.	MAHUNA smrz.	kg	1200	10.200	2.550	12.750
8.18.	GRAŠAK smrz.	kg	1200	13.500	3.375	16.875
8.19.	MJ. POVRĆA razno smrz.carsko	kg	1500	15.000	3.750	18.750
8.20.	ŠPINAT smrz.	kg	12000	13.000	3.250	16.250
8.21.	KELJ pupčar smrznuti	kg	1800	18.000	4.500	22.500

8.22.	KRASTAVAC	kg	500	4.000	1.000	5.000
	UKUPNO VIII		62.600	254.000	63.500	317.500
9	KONZERVIRANO povrće i voće					
9.1.	CIKLA 4/1	kg	1500	11.000	2.750	13.750
9.2.	KRASTAVCI kiseli 5/1	kom.	1000	8.000	2.000	10.000
9.3.	PAPRIKA kisela fileti 5/1	kg	500	5.000	1.250	6.250
9.4.	RAJČICA PIRE	kg	900	12.000	3.000	15.000
9.5.	ĐUVEĐ 5/1	kom.	150	7.000	1.750	8.750
9.6.	VOĆNI KOMPOT	kg	900	12.000	3.000	15.000
9.7.	KUKURUZNI ŠEĆERAC	kg	500	5.500	1.375	6.875
	UKUPNO IX		5450	60.500	15.125	75.625
10.	NAMIRNICE					
10.1.	JAJA A KLASA	kom.	22000	22.000	5.500	27.500
10.2.	RIŽA	kg	2000	14.000	3.500	17.500
10.3.	KUKURUZNI GRIZ	kg	800	5.000	1.250	6.250
10.4.	PŠENIČNI GRIZ	kg	100	500	125	625
10.5.	PUDING razni okusi	kg	20	500	125	625
10.6.	KAKAO INSTANT	kg	150	5.500	1.375	6.875
10.7.	MED	kg	100	3.800	950	4.750
10.8.	MARMELADA razna	kg	160	8.000	2.000	10.000
10.9.	ULJE 1 L, 10/1 L + palmino	l	4000	35.400	4.602	40.002
10.10.	ŠEĆER	kg	800	4.300	559	4.859
10.11.	SOKOVI prirodni razni	l	5000	25.000	6.250	31.250
10.12.	CORNFLEX pahuljice i sl.	kg	100	3.000	750	3.750
10.13.	BRAŠNO	kg	1600	9.000	2.250	11.250
10.14.	NAMAZ LINOLADA i sl. 2,5/1	kom.	45	3.600	900	4.500
10.15.	DIVKA	kg	10	1.000	250	1.250
10.16.	ČAJ RINFUZA - razni	kg	150	5.000	1.250	6.250
10.17.	SOKOVI sirup	l	600	12.000	3.000	15.000
10.18.	CEDEVITA ili jednakovrijedan proizvod	kg	700	25.000	6.250	31.250
10.19.	ČOKOLADNE KUGLICE	kg	70	3.000	750	3.750
10.20.	ČOKOLADNE FIGRE SV. NIKOLA	kom.	750	3.500	875	4.375
10.11.	MARGO	kg	100	3.000	750	3.750
10.12.	KEKSI, ČOKOLADICE I SL.	kg	100	5.000	1.250	6.250
10.13.	TUNA U ULJU	kom.	50	5.100	1.275	6.375
	UKUPNO X			202.200	45.786	247.986
11.	VOĆE					
11.1.	JABUKA	kg	2000	12.000	3.000	15.000
11.2.	KRUŠKA	kg	3000	34.000	8.500	42.500
11.3.	BANANA	kg	4500	40.000	10.000	50.000
11.4.	NARANČA	kg	2200	18.000	4.500	22.500
11.5.	MANDARINA / KLEMENTINA	kg	2000	13.000	3.250	16.250
11.6.	JAGODA	kg	300	6.000	1.500	7.500
11.7.	TREŠNJA	kg	300	5.000	1.250	6.250
11.8.	BRESKVA/NEKTARINA	kg	400	4.000	1.000	5.000
11.9.	ŠLJIVA	kg	200	1.500	375	1.875
11.10.	KIWI	kg	400	4.000	1.000	5.000

11.11.	*GROŽĐE*	*kg*	*600*	*7.500*	*1.875*	*9.375*
11.12.	*KESTEN*	*kg*	*170*	*3.500*	*875*	*4.375*
11.13.	*SUHO VOĆE*	*kg*	*100*	*4.931*	*1.233*	*6.164*
	UKUPNO XI	*kg*	*10000*	*153.431*	*38.358*	*191.789*
12.	*ZAČINI*					
12.1.	*VEGETA ili jednakovrijedan proizvod*	*kg*	*400*	*14.000*	*3.500*	*17.500*
12.2.	*PAPAR*	*kg*	*10*	*700*	*175*	*875*
12.3.	*PAPRIKA MLJEVENA SLATKA*	*kg*	*200*	*6.500*	*1.625*	*8.125*
12.4.	*KOCKA ZA JUHU*	*kg*	*200*	*8.500*	*2.125*	*10.625*
12.5.	*OCAT*	*l*	*400*	*3.000*	*750*	*3.750*
12.6.	*SOL*	*kg*	*800*	*2.300*	*575*	*2.875*
	UKUPNO XII			*35.000*	*8.750*	*43.750*
	SVEUKUPNO I - XII-PREHRANA			*2.066.931*	*463.069*	*2.530.000*
13.	*OSTALO*					
13.1.	*PAPIRNATE SALVETE 100/1*			*11.000*	*2.750*	*13.750*
13.2.	*PVC ČAŠE 0,2 L 100/1*			*8.000*	*2.000*	*10.000*
13.3.	*PAP. ČAŠE 0,20 L 80/1*			*2.400*	*600*	*3.000*
13.4.	*MAT. ZA ČIŠĆENJE*			*16.000*	*4.000*	*20.000*
13.5.	*UREDSKI MAT.*			*8.000*	*2.000*	*10.000*
	UKUPNO XII			*45.400*	*11.350*	*56.750*
	SVEUKUPNO I - XIII			*2.112.331*	*474.419*	*2.586.750*

The Strength2Food project in a nutshell

Strength2Food is a five-year, €6.9 million project to improve the effectiveness of EU food quality schemes (FQS), public sector food procurement (PSFP) and to stimulate Short Food Supply Chains (SFSC) through research, innovation and demonstration activities. The 30-partner consortium representing 11 EU and four non-EU countries combines academic, communication, SMEs and stakeholder organisations to ensure a multi-actor approach. It will undertake case study-based quantitative research to measure economic, environmental and social impacts of FQS, PSFP and SFSC. The impact of PSFP policies on nutrition in school meals will also be assessed. Primary research will be complemented by econometric analysis of existing datasets to determine impacts of FQS and SFSC participation on farm performance, as well as understand price transmission and trade patterns. Consumer knowledge, confidence in, valuation and use of FQS labels and products will be assessed via survey, ethnographic and virtual supermarket-based research. Lessons from the research will be applied and verified in 6 pilot initiatives which bring together academic and non-academic partners. Impact will be maximised through a knowledge exchange platform, hybrid forums, educational resources and a Massive Open Online Course.

Strengthening European Food Chain Sustainability by Quality and Procurement Policy

Deliverable No: D6.3

EVALUATION OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF DIFFERENT MODELS OF PSFP IN A SCHOOL CONTEXT:

GREECE COUNTRY REPORT

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Academic Partners

1. **UNEW**, Newcastle University (United Kingdom)
2. **UNIPR**, University of Parma (Italy)
3. **UNED**, University of Edinburgh (United Kingdom)
4. **WU**, Wageningen University (Netherlands)
5. **AUTH**, Aristotle University of Thessaloniki (Greece)
6. **INRA**, National Institute for Agricultural Research (France)
7. **BEL**, University of Belgrade (Serbia)
8. **UBO**, University of Bonn (Germany)
9. **HiOA**, National Institute for Consumer Research (Oslo and Akershus University College) (Norway)
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11. **CREDA**, Centre for Agro-Food Economy & Development (Catalonia Polytechnic University) (Spain)
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16. **EUFIC**, European Food Information Council AISBL (Belgium)
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19. **Coldiretti**, Coldiretti (Italy)
20. **ECO-SEN**, ECO-SENSUS Research and Communication Non-profit Ltd (Hungary)
21. **GIJHARS**, Quality Inspection of Agriculture and Food (Poland)
22. **FOODNAT**, Food Nation CIC (United Kingdom)
23. **CREA**, Council for Agricultural Research and Economics (Italy)
24. **Barilla**, Barilla Group (Italy)
25. **MPNTR**, Ministry of Education, Science and Technological Development (Serbia)
26. **Konzum**, Konzum (Croatia)
27. **Arilje**, Municipality of Arilje (Serbia)
28. **CPR**, Consortium of Parmigiano-Reggiano (Italy)
29. **ECOZEPT**, ECOZEPT (Germany)
30. **IMPMENT**, Impact Measurement Ltd (United Kingdom)

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EXTENDED ABSTRACT

This report presents the methods and results of the WP6.3 Greece study into the environmental, economic and social impacts of public sector food procurement, focusing on primary school meals. School meals were introduced in Greece for the first time in 2016-17 by the Ministry of Labour, Social Insurance and Social Solidarity and the Ministry of Education in a fully funded program ("School Meals") to address social inequality risks. In the first year, 38 primary schools participated and then during the school year 2017-18, the program was extended to 798 schools. In the program, all meals are prepared by private catering firms under contract, and transported to schools to be consumed. Schools themselves do not have on-site kitchen or canteen facilities.

The methodological approach of WP6.3 is to analyse and compare two different PSFP models in each country, in terms of their environmental, economic and social impacts. In Greece the two models chosen were "LOW" and "LOC" models. Case 1 (LOW) took place in the large urban area of Thessaloniki, specifically the Municipality of Evosmos – Kordelio (Western Thessaloniki). This area has low social and economic status indicators. 'LOW Caterer' was the awarded procurer, contracted to prepare and deliver meals to 33 primary schools in the Municipality at a fixed price of **€2.23**. The contract was awarded according to the Most Economically Advantageous Tender (MEAT) framework, and most of LOW Caterer's first tier suppliers (6 out of 8) were located outside the municipality or abroad. Case 2 (LOC) took place in the rural, mountainous municipality of Kastoria, in northwestern Greece. 'LOC Caterer' was the awarded procurer, contracted to prepare and deliver the meals to 15 primary schools at a fixed price of **€2.22**. Although the LOC case contract was awarded according to the MEAT framework, a larger proportion of LOC first tier suppliers (5/11), and also upstream producers, were located in the prefecture of Kastoria. Hence, Case 2 represented the LOC procurement model.

Unveiling the findings of the environmental impact assessment in the two cases, in Thessaloniki (LOW) case, the carbon footprint of the average meal was 2.41 kg CO_2eq (4.89 kg CO_2eq per kg of food), while in Kastoria (LOC) case, it was 1.87 kgCO2eq per meal (4.34 kg CO_2eq per kg of food). Although the emissions of LOC case were smaller than LOW case, the procurement model itself (geographical distance of suppliers) had little input into this result, because transport emissions contributed only a relatively modest amount to total carbon footprint in both LOC and LOW cases. Instead, the main reason for the smaller emissions in LOC case were (i) a smaller quantity of food was procured for the LOC average meals than LOW average meals (430g vs 490g), (ii) LOC meals had a lower proportion of beef on the menus compared with LOW case. However, the most significant finding of this study in terms of environmental impact was the very high contribution of food waste disposal to total carbon footprint in both LOW and LOC cases (27% and 25%, respectively), which was due to the waste being disposed in landfill. We estimated that substantial reductions in total carbon footprint would be possible if waste disposal switched to anaerobic digestion. These would outweigh reductions possible from changing procurement model, or reducing beef/increasing vegetables on the menus.

The findings on the economic impact of the procurement models revealed that in both cases, the economic value of the school meals contracts to the firms involved (catering firms and first tier suppliers) was limited, as the value of these contracts represented only negligible proportions of their total businesses (based on data obtained from large firms). Nevertheless,

the school meals program is forecast to expand in future years and so the potential for higher economic values to suppliers will increase, although it is not clear whether these increases will differ according to procurement model. The research also investigated the economic multiplier effects of the case models, and here a clear difference was found between the two cases. Specifically, the LOC model in Kastoria generated €1.37 for every €1 spent in the local economy for the preparation of the school meals (i.e. LM3=2.37), whereas the LOW model in Thessaloniki generated €0.59 for every €1 spent in the local economy (LM3=1.59). Therefore, the LOC model had a much greater local economic impact than the LOW model. The main reasons for this were that although a slightly smaller proportion of staff lived locally in LOC case, the total was still very high (90%), and a much higher proportion of the LOC case total budget was spent on staff compared with LOW case (42% vs 14%). Moreover, in the LOC case, close to two thirds of the supplier budget was spent on local firms, compared with only 22% in LOW case. The starting budget for the five selected primary schools in Kastoria was €81,252 for the total of 36,600 school meals during the 120 school days while the starting budget of Thessaloniki was €233,614.8 for a total of 104,760 school meals. It is remarkable that the LOC procurement model generates, proportionately, 2.3 times more income than the LOW procurement model.

In terms of social impact, the research identified no key differences between LOW and LOC models on employment and training indicators, however differences were observed in levels of social connectedness. Specifically, in LOW case, relations between supply chain members tended to be based on the interactions between specific individuals necessary for tasks to be performed (e.g. catering firm drivers interacting with school managers to arrange deliveries), whereas in LOC case, supply chain relations were more extensive and 'matrix' in form, involving numerous opportunities for informal social interaction beyond specific tasks and jobs. These social impacts seem related to the socio-economic context of the two case study areas. In LOW case, the opportunities for connectedness are constrained by the impersonal urban fringe context, reinforced by the financial crisis which has created further tensions in the social environment. In LOC case, the rural context provides an existing social network 'platform' which the members of the supply chain in the case can build on, and which the school meals contract itself helps to reinforce. Nevertheless, in both cases, the research found little evidence of connections between supply chain members in the school meals services and the schools themselves. Suppliers in both cases also did not seem to participate in school or community events relating to food, health or sustainability. Moreover, there is limited social impact in terms of marginalized or deprived groups (e.g. drug addicts, people with disabilities) as the low-cost nature of the program results in these groups being excluded from the process.

To this extent, the research shows that public procurement based on short chain models has the potential to bring economic and social advantages to local areas, especially where these areas have good local infrastructures and business networks. Moreover, meals services based on elements of the Mediterranean diet (high proportions of fruits and vegetables, smaller proportions of meat and dairy products) would support Mediterranean farmers to produce high-quality agricultural products (i.e. fruit, lentils, local cheese), and promote healthy nutrition from a younger age. These kinds of meal compositions could also reduce carbon footprint, although the greatest carbon reductions come from switching to more environmentally friendly methods of waste disposal. In addition, provisions about the involvement of deprived social groups (social enterprises) would help them develop new skills about farming or food production. Transparent procedures, following the eProcurement initiative of the Union would ensure that these recommendations realize and do not fall under oligopolies and unfair competition.

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List of Abbreviations and Acronyms

BRC: British Retail Consortium

ERP: Enterprise Resource Planning

LOW: Low-cost Model

LOC: Local Model

Ministry of LSS: Ministry of Labour, Social Security and Social Solidarity

F&V: Fruit and Vegetables

TEI: Technical Educational Institution of Kastoria

1. INTRODUCTION & METHODS

This report presents the methods and results of the WP6.3 Greece study into the environmental, economic and social impacts of public sector food procurement, focusing on primary school meals. The study was conducted in the regions of Thessaloniki and Kastoria.

The methodological approach of WP6.3 is to identify and compare two different PSFP models for school meals in each country, in terms of their environmental, economic and social impacts. As explained in D6.1 Greece Country Report, until very recently no meals were offered in schools in Greece, for cultural and social practice reasons. However, in the 2016-17 school year, due to concerns for socio-economic inequality and child poverty risks, the Greek Ministry of Labour, Social insurance and Social solidarity (LSS), in collaboration with the Ministry of Education, launched the "School Meals" program in 38 primary schools, selected from specific Municipalities based on deprivation criteria. In the school year 2017-18, with a total budget of €14,636,956.2, the program was expanded to 798 public primary schools, located in areas with low social and economic indicators, to prepare and deliver school meals to a total of 110,748 pupils over 120 days. None of the public schools in Greece comes with kitchen facilities and thus private catering enterprises are contracted for the preparation and delivery of school meals to the pupils in schools. As can be appreciated, this context of very recent and few examples of public school meals provision presented some challenges to the identification of different PSFP models in Greece. However, two models were able to be defined: a low-cost model (LOW) and a local procurement model (LOC).

The LOW case comprised the "School Meals" provision program as it has been implemented in Thessaloniki, specifically the Municipality of Evosmos – Kordelio, located at the western side of Thessaloniki. The private caterer was awarded the contract by the Ministry of LSS to provide the meals according to the "most economically advantageous" (MEAT) tender provisions of public procurement law. Thus there were no limitations or specifications on the origin of the products to comprise the meals. Hence, we defined this case as LOW case. The dataset comprised the supply chain (first tier suppliers and catering firm) that provided meals for a sample of five schools in the case.

The LOC case study comprised the "School Meals" provision program as it has been implemented in Kastoria, which is located in northwestern Greece. In this case, the private caterer that was awarded the contract also achieved the MEAT framework of the Ministry of LSS. However, in its choice of suppliers, this caterer also took advantage of agreements already made with local firms that supplied the caterer with goods for another large contract (the canteen of the Technical Educational Institution (TEI) of Kastoria). Therefore, this case represented the LOC procurement model for this research. The dataset comprised the supply chain (first tier suppliers and catering firm) that provided meals for a sample of five schools in the case.

In both cases, the research included data collection – primary and secondary – in order to measure the carbon footprint as well as the economic and social impact of the two procurement models along their supply chains.

The fieldwork for the Case 1 (LOW) included face to face interviews and telephone interviews (primary data collection) and desk research of websites and documents (secondary data collection) in spring and summer of 2018. In particular, 22 interviews of 15 informants were carried out including: the R&D manager of the LOW Caterer, its Quality Assurance (QA) manager, the Caterer's kitchen staff, suppliers' representatives and head teachers of the five selected primary schools. Secondary data were collected from government and company databases. The collected data were used to apply the environmental, economic and social impact analysis in collaboration with the WP partners.

Table 1: Profile of interviewees in Case 1: Thessaloniki, Evosmos-Kordelio

Identity	Interview Date & Duration
R&D manager of LOW Caterer	24/04/2018, 2hrs, 15/05/2018, 0.5hrs, 01/06/2018, 2hrs & 18/07/2018, 1hrs
QA manager of LOW Caterer	25/04/2018, 1hrs
Kitchen staff of LOW Caterer (n=3)	25/04/2018, 1hrs
QA manager, LOW Fresh Supplier A	16/05/2018, 1.5hrs
QA manager, LOW Vegetable Supplier	16/05/2018, 1hrs
QA manager, LOW Dairy Supplier	18/05/2018, 0.5hrs
QA manager, LOW Fish Supplier	16/05/2018, 1hrs
QA manager, LOW Chicken Supplier	18/05/2018, 0.5hrs
QA manager, LOW Pasta Supplier	17/05/2018, 1hrs
QA manager, Rice Supplier	17/05/2018, 0.5hrs
Headteacher, LOW School A	22/01/2018, 2hrs & 19/04/2018, 0.5hrs
Headteacher, LOW School B	22/01/2018 – 2hrs & 19/04/2018 0.5hrs
Headteacher, LOW School C	23/01/2018 – 1hrs
Headteacher, LOW School D	29/01/2018 – 1hrs
Headteacher, LOW School E	29/01/2018 – 0.5hrs

The fieldwork for the Kastoria (LOC) case study took place in spring of 2018. Primary data collection was completed with in-depth physical and telephone interviews with the QA manager and the kitchen staff of the LOC caterer, managers of the suppliers and the head teachers of the five selected primary schools. In total, 17 interviews with 16 informants were conducted (Table 2). The research for the secondary data collection included the scrutiny of websites of the Caterer and its suppliers, databases of the government, the school menus information and the database of the Primary Education Office in Kastoria. The collected primary and secondary data were used to perform the environmental and economic impact assessment.

Table 2: Profile of interviewees in Case 2: Kastoria

Identity	Interview Date & Duration
QA manager, LOC caterer	27/04/2018, 1.5hrs, 07/05/2018 1hrs & 19/06/2018, 0.5hrs
Kitchen manager in Kastoria	14/02/2018, 1.5hrs
Kitchen staff of LOC Caterer (n=2)	14/02/2018, 1hrs
QA manager, LOC Vegetable Supplier	22/05/2018, 1hrs
QA manager, Agrifreda S.A.	24/05/2018, 0.5hrs
QA manager, LOC Dairy Supplier	22/05/2018, 1hrs
QA manager, LOC Fish Supplier	23/05/2018, 1hrs
QA manager, LOC Meat Supplier	22/05/2018, 1hrs
QA manager, Eurimac S.A.	24/05/2018, 0.5hrs
QA manager, Rice Supplier	25/05/2018, 0.5hrs
QA manager, LOC Fresh supplier	22/05/2018, 1hrs
Headteacher, LOC school A	14/02/2018 – 2hrs
Headteacher, LOC school B	14/02/2018 – 0.5hrs
Headteacher, LOC school C	15/02/2018 – 0.5hrs
Headteacher, LOC school D	15/02/2018 – 0.5hrs
Headteacher, LOC school E	14/02/2018 – 1hrs

1.

2. CASE 1 Thessaloniki (LOW) MONOGRAPH

2.1. Profile of Thessaloniki, Evosmos-Kordelio

The municipal unit of Thessaloniki is located in the north of Greece. The municipal unit of Thessaloniki is the second largest in Greece with population of 1,110,312 citizens (ELSTAT, 2011) and is comprised of 14 municipalities covering a total area of 3.682km^2. The capital is Thessaloniki city, which has a population of 325,182 citizens (ELSTAT, 2011). The city is neighbouring with the municipality of Evosmos-Kordelio. Evosmos-Kordelio which is the study area of this research, comprises an area of 13 km^2 with a population of 101,010 citizens (ELSTAT, 2011). The area is populated mostly with low-income citizens, repatriated Greeks from the former USSR and economic immigrants, thus making it a deprived area (Municipality of Evosmos-Kordelio, 2018[11]).

Figure 1: Map of the region of Thessaloniki and the municipality of Evosmos - Kordelio

As it is an urban area, agriculture has a minor role in the economy of Evosmos-Kordelio and accounts only for 0.96% of workforce (ELSTAT, 2018)[12] while SMEs (24.6%) and Public sector (9.3%) are the biggest single industries in the area. The rest of the Municipality's workforce is employed in the construction industry (6.9%), hotel industry (6.5%), education (6.4%) and hospitals (6.63%). In the Thessaloniki region more widely, the agriculture sector has a major role in the rural municipalities of Volvi (29%), Lagadas (16%) and Delta (13%).

2.2. Primary school meals provision and service contract in Thessaloniki

As was explained in Section 1, the provision of publicly funded meals in primary schools in Greece began very recently, with a pilot implementation of the "School Meals" program in 38 primary schools in Greece during the 2016-17 school year. In 2017-18, the program "School Meals" was extended to 798 primary schools (18% of total). In both phases, the program was implemented and supervised by the Ministry of LSS in collaboration with the Ministry of Education. The two Ministries coordinated the publication of the proclamation and ran the

[11] http://www.kordelio-evosmos.gr/index.php?option=com_content&task=view&id=331&Itemid=494
[12] http://www.statistics.gr/el/statistics/-/publication/SAM04/-

selection process at the Municipal level under the provisions of the Directive 2014/24/EU and the national procurement Law 4412/2016. Primary Schools (798) from which all pupils were eligible to participate in the program, were selected to participate according to specific deprivation criteria, including Municipalities with: i) population over 17.000, ii) minimum 5% participation in the social security program “Social Solidarity Income”, iii) minimum 7% unemployment rate. Subsequently, the tendering process for the catering contracts were handled through the electronic auction National system of electronic public procurements (http://www.promitheus.gov.gr/).

Compliance with the obligations of the proclamation was supervised by the two Ministries with the collaboration of the Greek Food Safety Authority “EFET” and the Hellenic Labour Inspectorate “SEPE”. School managers and the teachers of the primary schools reported to the Primary Education Office. Subsequently, the managers of the Primary Education Offices interacted with the catering companies to avoid any deviation from the provisions of the program and changes in the numbers of participanting pupils (Figure 2).

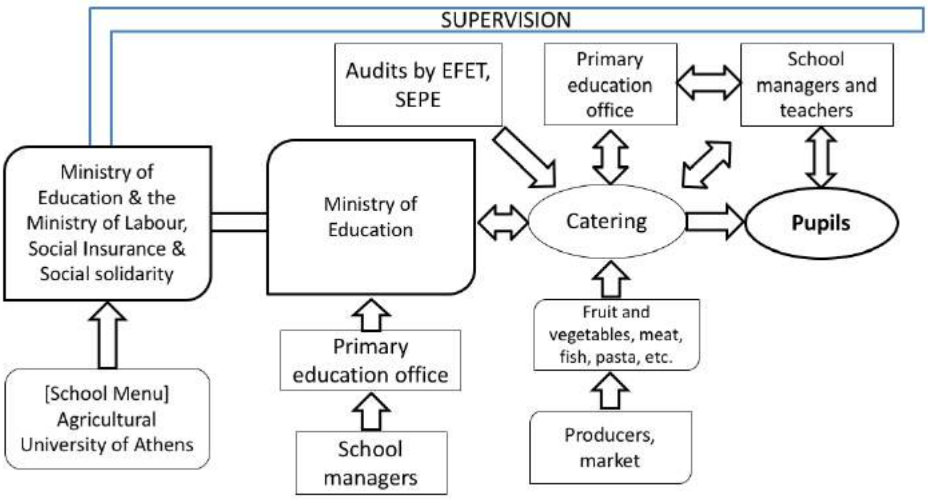


Figure 2: The school meals execution path in Greece

The Municipality of Evosmos-Kordelio counts 33 primary schools and two primary schools for children with special needs (Primary Education Office, 2018). All 33 schools were selected to participate in the expanded "School Meals" pilot project of 2017-18 as a result of the Municipality’s efforts to include all the primary schools of Evosmos-Kordelio. The contract tender for the primary schools of Evosmos-Kordelio was advertised in 2017 and the bids were evaluated according to the criteria of the MEAT framework (there were no specific criteria relating to sustainability in the tender). Following this process, a local catering firm "LOW Caterer" was awarded the contract of 60 days which expanded to 60 more days until the end of the school year. A total budget of €1,614,430.8 was allocated to cover the provision of the meals for 120 days to the 33 primary schools. The number of pupils eligible to participate in the program daily was 6,033 (183 pupils/school)[13]. The cost of each meal was set in the contract at €2.23. The contract also specified that each meal must include one single-option main dish (comprised of meat or fish), plus salad and bread, although nutritional requirements were not specified. Once a week, the meat/fish was substituted by a dairy product (e.g. FETA cheese). As primary schools did not provide school meals prior to the program, there are no kitchens or canteens on-site. Therefore, pupils are served the meals either in their classrooms, in corridors or other communal areas. Figure 3 shows an example of a served meal, and example of a classroom prepared for the serving of the meals.

Figure 3: (a) Preparation of the school lunch time at the LOW school A (b) A typical school meal from the LOW Caterer at the primary schools of Evosmos-Kordelio.

2.3. The current school meals supply chain in Thessaloniki

As the contract holder for Evosmos-Kordelio, LOW Caterer procures all the food items, and cooks all the meals, for the 33 schools in the study area. Due to the centralized system of public-school meal procurement and the lack of any kitchen facilities on-site in schools, LOW Caterer undertakes all the preparation and cooking of meals in its central kitchen premises in the industrial zone of Sindos, Thessaloniki. Figure 4 demonstrates the organisation of the supply chain.

[13] During the school year 2014-2015 the national average pupils roll was 142 p./school (4.253 public primary schools with 600.781 pupils), which is lower than the average pupil rolls of the participated schools of Evosmos - Kordelio (ELSTAT, 2018).

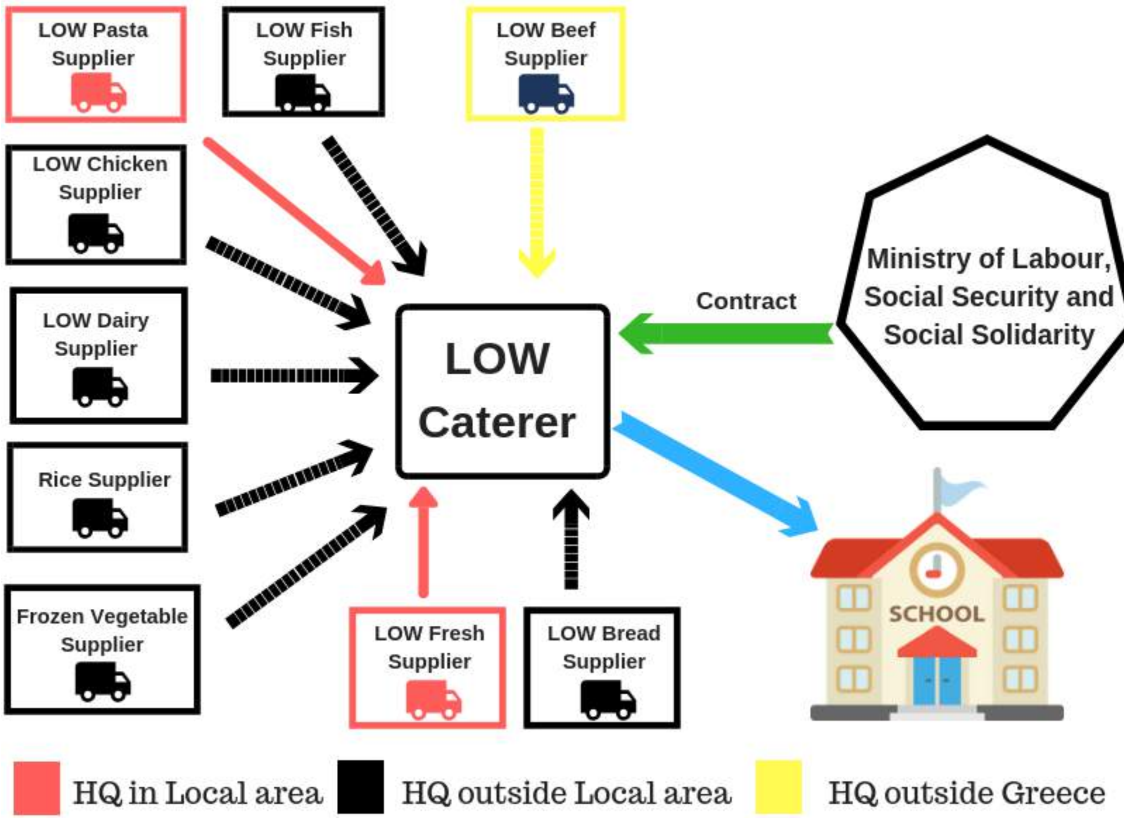


Figure 4: Organisation of the Thessaloniki school meals supply chain

**HQ: Headquarters*

As Figure 4 shows, the current school meals supply chain in Evosmos - Kordelio was initiated by the award of the contract to LOW Caterer by the Ministry of LSS. Each week, LOW Caterer procures the ingredients for the preparation of the meals from its suppliers, with a priority on low-cost goods. The first-tier suppliers that LOW Caterer uses (e.g. for vegetables, meat and processed/frozen goods) are large companies located in Greece at an average distance of 265km from Thessaloniki, while one company (LOW Beef Supplier) is located in Germany (LOW Caterer imports beef products directly for all its activities from this firm). First-tier suppliers procure the products from farmers from non-local areas (to Thessaloniki) or import them from abroad. Each day, LOW Caterer prepares the school meals and places them into single-portion sealed plastic containers. Subsequently, the meals are packed in thermal incubators and then transported in LOW Caterer's own vans to the participant primary schools one hour prior to the lunch time (which takes place at 13:15-14:00). Each van transports the meals of 4 schools in its delivery round to the facilities of the primary schools. Lastly, the LOW Caterer vans collect the empty thermal incubators from each school after lunch (14:00-14:30), and then the process begins again the next day with preparation and transport of the following round of school meals. The plastic containers were taken for recycling as part of the pupils and teachers recycling initiatives while plate waste is emptied into bins in the schools for disposal in landfills of Assirros (Thessaloniki).

Below are presented the key supply chain members in the LOW Thessaloniki case.

2.3.1. LOW Caterer (school meal provider)

LOW Caterer was established in 1980 and is part of a Group of companies (Vivartia Group) that mainly operates in the food sector and participates in public tenders such as the "School Meals" program. The headquarters of LOW Caterer are located in the industrial zone of Sindos, Thessaloniki, therefore the firm is local to the Evosmos-Kordelio Municipality since its average distance from the sample of five schools is 10.1km (<50km). The annual turnover of the firm for the economic year of 2017 was €47,195,412, and the company estimates to increase it during the year of 2018 to €52 million euro. In 2017, the company invested €637,000 in new equipment and transportation vehicles. The company has posted a positive operating profit for the last two years.

In the school year 2017-18, LOW Caterer was awarded the contract to deliver the "School Meals" program in two Municipalities of Thessaloniki: Evosmos - Kordelio (33 schools) and Ampelokipi-Menemeni (15 schools). In addition, the firm holds contracts both with private companies and the public sector such as the program for feeding refugees. LOW Caterer has a total of 645 employees at its site in Sindos, of which five employees work for the preparation and the delivery of the school meals to the sample of 5 schools in our case study (daily average of 873 school meals).

2.3.2. LOW Fresh Supplier

LOW Fresh Supplier is part of the same group of companies (Vivartia Group) which LOW Caterer participates within, and is also located in the industrial zone of Sindos, Thessaloniki. The company supplies LOW Caterer with fresh vegetables (Figure 4), including cabbage, onions, potatoes, cabbage, zucchini, carrots, beetroot peppers and lettuce. Under the vertical integration framework of the Group, this leads to economies of scale between the two companies.

The activities of LOW Fresh Supplier A include the production of fresh and frozen vegetables (conventional and organic), mixed vegetables, combinations of frozen vegetables based on traditional Greek recipes, as well as tomato products and fresh salads. The production plant of the firm complies with the National and International food quality management and safety standards. The company is certified with the standards EN ISO 9001/2008, EN ISO 22000/2005, I.F.S. and B.R.C. that guarantees the safety of the food production. The suppliers of the company, Greek farmers, operate under long-term contracts with the company that enriches loyalty and constant supply. Furthermore, the farmers apply the quality management system "integrated crop management" as a method to ensure compliance with good agricultural practices. The turnover of the firm is €84,210 million, and its distance from LOW Caterer is 2.1 km.

2.3.3. Frozen Vegetable Supplier

The Frozen Vegetable Supplier was established in 2000 and is located in the agricultural area of the region of Pella (Northern Greece). The area is well known for its agricultural activity and specifically for the production of various fruits and vegetables. The company is engaged in manufacturing and processing of frozen fruits, pastries and other sweet products. Beyond its activities in Greece, the company cooperates with firms abroad from whom it imports products that are not available in the local area and exports processed frozen products to countries such as France, Italy, Germany and Saudi Arabia. Frozen Vegetable Supplier supplies LOW Caterer with frozen vegetables (parsley and red pepper) and vegetable cubes (onion, carrot and pepper cubes). The turnover of the firm is €32,753 million, and its distance from LOW Caterer is 80 km.

2.3.4. LOW Dairy Supplier

The company of LOW Dairy Supplier was founded in 1967 in Arta (Western Greece). It produces traditional milk products such as feta cheese, yogurt and galotyri (a traditional soft cheese). Moreover, the company's product list includes also dairy products of hard cheese such as gruyere, kefalotyri, kefalograviera and pecorino. Its processing activity is applied under quality standards, ISO 22000:2005 and FSSC 22000:2010. The company supplies LOW Caterer with Kefalotyri and FETA cheese. The turnover of the company is €3,723 millio, and its distance from LOW Caterer is 319 km.

2.3.5. LOW Fish Supplier

LOW Fish Supplier is engaged in the import, export, processing, packaging and distribution of frozen fish products. The company was founded in 1968 and during its 50 years operation, the company has gained a domestic market share of more than 25% and a significant increase in its export activity. It is located in Aspropyrgos, Attica-Greece in its modern facilities, in an area of 12.072 m^2. The facilities of the company include advanced production lines for processing and packaging of fresh & frozen fish. Storage is achieved in High Capacity Chillers and freezer buildings of 1,050 m^2 with capacity of 3,500 euro-pallets that operates with a robotic management system. Moreover, they are equipped with quality control laboratories, where daily checks ensure the quality of the seafood products. The turnover of the company is €36,147 million and its distance from LOW Caterer is 501 km.

2.3.6. LOW Chicken Supplier

Founded in 1992, LOW Chicken Supplier merchandizes various meat products such as pork, chicken, veal and lamb along with other complementary food (pita bread, sausages, French fries, cheese, salami, seafood, vegetables etc.) in its 4,000 m^2 industrial plant, and supplies LOW Caterer with chicken meat. The company applies standard production and hygiene procedures at its operations and is certified with the ISO 22000 standard. The turnover of the company in 2016 was €86,264million and its distance from LOW Caterer is 106 km.

2.3.7. Pasta Supplier

Pasta Supplier is a joint venture company which was established in 1996 in the Industrial Zone of Kilkis, Cental Macedonia (North Greece). The workforce of the company is experienced in the production of various pasta products. The company specializes in the manufacture of own-label pasta products and other private labels in its production plant, with an annual production capacity of over 72,000 tones. Its activities include the production and marketing of pasta products at domestic retail stores and exports to more than 45 countries, either under its own brand name or with private labels. The turnover of the company is €34.77 million and its distance from LOW Caterer is 49 km.

2.3.8. LOW Beef Supplier

LOW Beef Supplier is a company dedicated to meat production and trading of fresh and frozen meat products in southern Bavaria, one of Germany's major cattle-producing areas. The company operates a large slaughterhouse and trading activities in its home town in Buchloe. It oversees a network of slaughterhouses, processors, and trading companies throughout Germany. The LOW caterer imports beef directly from the LOW beef supplier in Bavaria for all its catering activities.

2.3.9. Rice Supplier

Rice Supplier is located in western Greece, and in the town of Agrinio, Etoloakarnania. The company runs an advanced network of rice and pulses producers throughout Greece and supplies rice to both LOW and LOC Caterers. Rice is mainly sourced from farmers in Messolonghi (Western Greece). It is the first private company to produce a PGI (Protected Geographical Indication) certified pulse-product, Giant-Elephant Beans from Kastoria (Northern Greece). The turnover of the company is €26.9 million and its distance from LOW Caterer is 397 km.

2.4. The featured schools in Case 1 Thessaloniki (LOW)

The sample of five primary schools which are located in the Municipality of Evosmos - Kordelio and are included in the “LOW” model case study are presented in Table 3. Alongside the other 28 schools in the Municipality, these five schools participated in the “School Meals” program for the first time in 2017-18, when the pupils received and consumed the school meals which were delivered by LOW Caterer. As Table 3 shows, the total number of pupils in each school ranged from 297 (LOW School D), to 129 (LOW School C), giving an average roll size of 232 pupils/school. This is slightly smaller than the average for the whole Municipality (235). In terms of meal uptake, it is noteworthy that although all of the pupils were eligible to take part in the program for 24 weeks, the average meal uptake for all five schools was 78%, which is the same as the average for the whole Municipality. The main reason is the pupils parents either want to control their children’s diets or they don’t want to participate in the school meal program. The highest meal uptake was 95% (LOW School C) and the lowest was 58% (LOW School A). The pupils that don’t participate in the school meal program but stay at school after the normal schedule, which ends at 13:15, bring their own food and consume it with the rest of the pupils in the classrooms. The next sections present some more details about the five schools.

Table 3: The five primary schools of the Thessaloniki (LOW) case

Name of the school	Size of roll/meal uptake	
	Size of roll	Meal uptake
LOW School A	266	58,3%
LOW School B	276	67,0%
LOW School C	129	95,3%
LOW School D	297	82,5%
LOW School E	192	85,9%

2.4.1. LOW School A

LOW School A is located in Evosmos-Kordelio. The pupil roll is 266, higher than the average pupil roll of the municipality (235 pupils). However, taking into consideration the meal uptake of 58.3% which is lower than the average meal uptake of the municipality (78.01%), ultimately 155 pupils received the school meals on a daily basis, while the average pupil participation was 183 pupils. The school shares the same courtyard and borders with the LOW school B and C although the school administration and the teachers are separated. The headteacher runs environmental actions in which the pupils participate dynamically. For instance, each day a pupil is responsible and supervises the recycling practices of the school - including the packaging materials of the school meals. There were no other food or health related actions in the school at the time of data collection.

2.4.2. LOW School B

LOW School B shares the same location with LOW School A and LOW School C. The pupil roll was 276 pupils which is higher than the average pupil roll of the Municipality. The meal uptake was 67% leading to a participation of 185 pupils, slightly higher than the average school meal participation of the Municipality (183 pupils). There were no food or health related projects at the school at the time of data collection.

2.4.3. LOW school C

LOW School C, which shares the same courtyard and border with LOW School B and LOW School A had a pupil roll of 129 pupils which is lower than the average pupil roll of the other schools in the Municipality of Evosmos - Kordelio. The meal uptake was 95.3% which was higher than the average uptake (78,01%) and the highest in the five featured schools. As a result, 123 pupils participated in the school meals program. No known food or health related projects were happening at the school at the time of data collection.

2.4.4. LOW school D

LOW School D is located in Evosmos-Kordelio. It shares the same courtyard and borders with LOW School E, but the administrative offices of both schools are separated from each other. The registered pupils of LOW School D were 297 and the meal uptake was 82.5%, higher than the average uptake meal of the primary schools in the Municipality. In total, 245 pupils participated in the school meal program. There are no food or health related projects in the school.

2.4.5. LOW school E

LOW School E shares the courtyard and borders with LOW School D. The enrolled pupils at LOW School E were 192, with a meal uptake of 85.9% (7.89% higher than the average meals uptake of the municipality). Hence, in total 165 pupils received daily school meals from LOW Caterer. There were no food or health related projects at the school at the time of data collection.

3. CASE 2 KASTORIA (LOC) MONOGRAPH

3.1. Profile of Kastoria

Kastoria is a prefecture (regional unit) of Western Macedonia, located in northwestern Greece on the border with Albania (Figure 5). The prefecture is divided into three municipalities, of which one, Kastoria, contains the capital town of the same name, which is located on the peninsula on the western side of Lake Orestiada, surrounded by limestone mountains. The town covers an area of 57.3 km^2 with a population of 13,387 citizens, while the municipality of Kastoria covers an area of 763.3 km^2 and has a population of 35,874 citizens (ELSTAT, 2011). The municipal unit, which is the study area of this research, is comprised by the town of Kastoria and the villages Aposkepos, Kefalari and Chloi. The economy of the region is predicated on fur production, tourism and agriculture (Municipality of Kastoria, 2018). Agriculture is the single largest employer in the region with 17.77% of the workforce, followed by SMEs in the retail sector (16.44%) and the Public Sector which comprises 10.96% of labour (ELSTAT,2018)[14], while the rest is occupied in the tourism sector (6.37%), education (8.83%) and other sectors (26.59%) such as fur production. The main agricultural products of Kastoria are apples and pulses. It can be seen that compared with LOW case, the LOC case area is more rural, with lower population density and greater reliance on tourism and agriculture.

Figure 5: Map of Municipality of Kastoria

3.2. Primary school meals provision and service contract in Kastoria

The municipality of Kastoria counts 29 primary schools and one primary school for children with special needs (Primary education office, 2018). The provision of publicly funded school meals in this municipality has the same context as Case 1 (LOW), that is, until very recently

[14] http://www.statistics.gr/el/statistics/-/publication/SAM04/-

no meals were offered in any schools. However, in the year 2017-2018, fifteen primary schools in the municipality of Kastoria were selected to participate in the "School Meals" program, under the same arrangements and procedures as Case 1 (LOW) (described in Section 2.2 and Figure 2). The contract tender for the primary schools of Kastoria was advertised in 2017 and, like LOW case, the bids were evaluated according to the MEAT framework, with no specific criteria relating to sustainability. The outcome of the process was the award of the contract to "LOC Caterer" for 120 days during the school year 2017-18, an established private catering and food service company with a local branch in Kastoria and headquarters in Thessaloniki. Although LOC Caterer won the contract under the MEAT framework, it already held the catering contract for the Higher Education Institution of Western Macedonia in Kastoria, for which it had developed a local supply network. To achieve economies of scale with the School Meals contract, it took advantage of these agreements with local suppliers, so leading to the development of short supply chains for the procurement of foods for the school meals contract. A total budget of €248,151.6 was allocated by the Ministries to cover the provision of meals for 120 days to the 15 primary schools of Kastoria. The number of pupils eligible to participate in the program daily was 932 for the 15 participated primary schools (meal uptake 81%, 62 pupils/school)[15]. The pre-defined cost of each meal was set at the price of €2.22. The contract also specified that each meal be comprised of one single-option main dish (meat/fish with starchy food or a mix of both), plus salad and bread. Once a week, the meat/fish in the main meal was substituted by a dairy product (FETA cheese), and once every two weeks, by egg. As primary schools did not provide school meals prior to the program, there were no kitchens or canteens on-site. Therefore, like in LOW case schools, pupils were served the meals in their classrooms, in corridors, or other communal areas. Figure 6 shows an example of a meal, and of a table prepared for serving. Regarding the primary schools that participated in the study (n=5), 305 pupils received daily the school meals of LOC caterer (meal uptake 84.1%, 61 pupils/school).

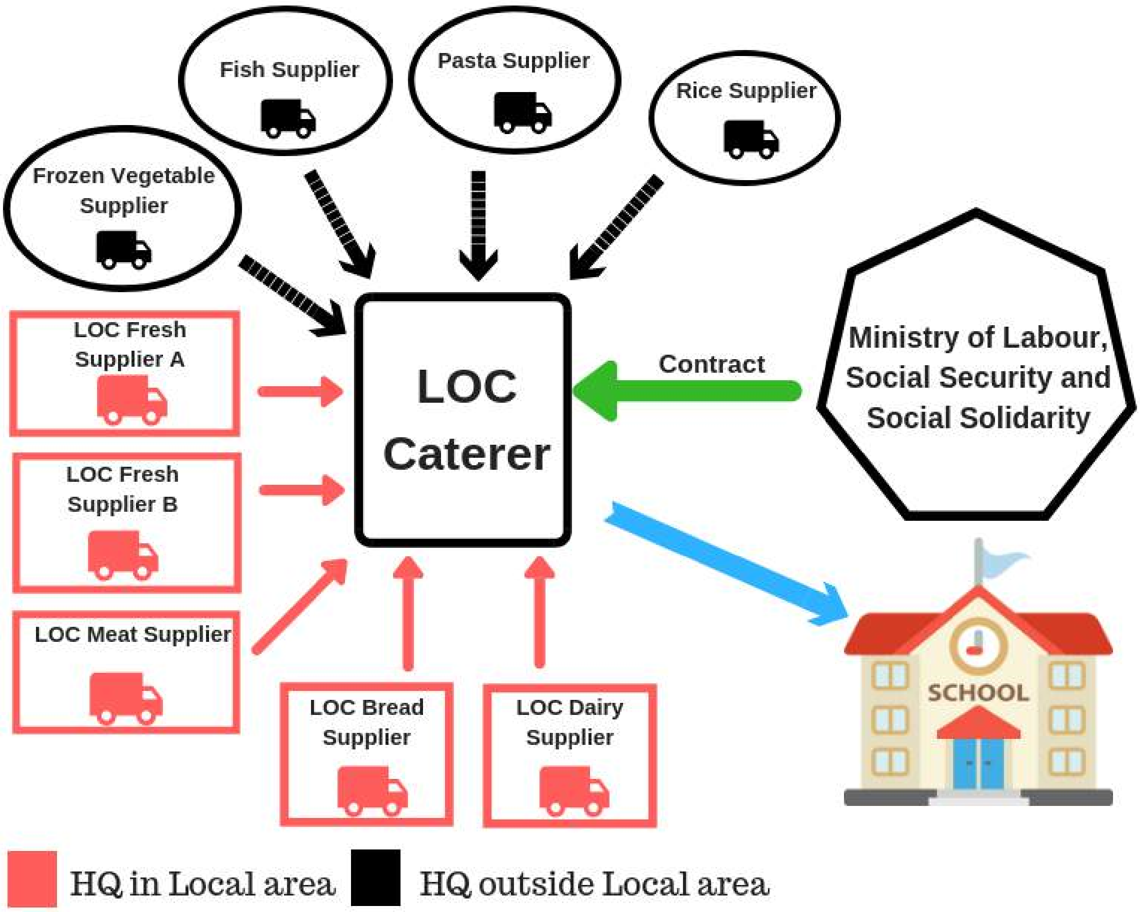
Figure 6: A typical school meal from LOC Caterer, and typical table setting at the primary schools of Kastoria

[15] During the school year 2014-2015 the national average pupils roll was 142 p./school (4.253 public primary schools with 600.781 pupils), which is lower than the average pupil rolls of the participated schools of Evosmos - Kordelio (ELSTAT, 2018). However, it is noteworthy that the average pupils roll in rural areas are lower than in the cities which increase the average pupils roll Nationally.

The program started on 08/01/2018 (first day after the Christmas holidays) and ended on 13/06/2018 (end of school year), counting 27 weeks. However, taking into account the Easter holidays (2 weeks), 4 days of public holidays and one day for an excursion, the total weeks ultimately were 24 (120 days). The "School Meals" tendering proclamation projected 60 days, but an extension of 60 more days was decided nationwide by the Ministry of LSS and the Ministry of Education responsible for the tendering awarding procedures (Ministry of Education, 2017).

3.3. The current school meals supply chain in Kastoria

As the contract holder for Kastoria, LOC Caterer procures all the food items and cooks all the meals for the 15 schools in the study area. Since there is a lack of kitchen facilities inside schools, LOC caterer undertakes all the preparation and cooking of meals in its fully-equipped central kitchen facilities in Kastoria town. Figure 7 demonstrates the organisation of the supply chain.



**HQ: Headquarters*

Figure 7: Organisation of the Kastoria (LOC) school meals supply chain

As Figure 7 shows, the current school meals supply chain in Kastoria was initiated by the award of the contract to LOC Caterer by the Ministry of LSS. Like LOW Caterer, each week LOC Caterer sources the food ingredients for the preparation of the meals from its suppliers, with a priority on lowest cost. Unlike LOW case however, LOC Caterer used pre-existing agreements with local suppliers from another local catering contract to build its procurement. Therefore, LOC Caterer's first-tier suppliers for fresh vegetables, meat, cheese and bread are all small-scale companies that reside in the Municipality of Kastoria, an average distance of 6.3 km from LOW Caterer's site. These first-tier suppliers procure products from farmers located mostly in local areas. The remaining suppliers include processed food and vegetables that are not viable to produce in Kastoria, and these are scattered around Greece, on average 202 km distant from LOC Caterer's site. Each day, LOC Caterer prepares the school meals and places them into single-portion sealed plastic containers. Subsequently, the meals are packed in thermal incubators and then transported in LOC Caterer's own vans directly to the primary schools one hour prior to the lunch time (which takes place at 13:15-14:00). Each van transports the meals of 5 schools in the delivery round to the facilities of the primary schools. Lastly, the LOC Caterer vans collect the empty thermal incubators from each school after lunch (14:00-14:30), and then the process begins again the next day with preparation and transport of the following round of School meals, as in LOW Case. The plastic containers were taken for recycling as part of the pupils and teachers recycling initiatives while plate waste is emptied into bins in the schools for disposal in landfills of Maniaki (Kastoria).

The next sections give some more detail about the first-tier suppliers in LOC case. Frozen Vegetables Supplier, Pasta Supplier and Rice Supplier are all the same suppliers as LOW case, therefore the description of these companies is given in Sections 2.3.3, 2.3.7 and 2.3.9, respectively. The distances of these companies from the site of LOC Caterer are 122 kms, 239 kms and 303 kms, respectively.

3.3.1. LOC Caterer

LOC Caterer is a private company which was established in 1969. The company operates in various sectors such as contract food services (mainly for educational institutions and hospitals), organization and operation of canteens, event catering services, production of prepared food for direct consumption, "cook and chill" & frozen products, small meals, sandwiches, processing and standardization of meat products and organization of restaurants. The headquarters of the firm are in Assiros, Thessaloniki (North Greece), with branch offices maintained in Athens (Attica), Ioannina (Western Greece) and Kastoria. The annual turnover of the firm for the economic year 2016 was €32,516,555.35 and it has run a cumulative 6% growth rate over the last 5 years. In total, the company employs 17 staff at the Kastoria branch. LOC Caterer Kastoria site is in Kastoria, on average 4.1 kms from each of the five schools in this study sample.

3.3.2. LOC Fresh Supplier A

LOC Fresh Supplier A works in the production and marketing of agricultural plant products, especially fresh fruit (apples, grapes) and vegetables (tomatoes, potatoes, beans, onions and other). Its estates and facilities are located in the municipality of Vitsi, Kastoria. The privately-owned buildings are built on a plot of 10,000 m². The main building covers an area of 1200 m², in which sorting and packing machines are housed. There is also a storage space of 200 m² for packaging materials. The product maintenance area consists of three controlled atmosphere chillers which are strictly controlled to maintain optimal conditions for maintaining the quality characteristics of the products. The turnover of the company is €1,858 million, and it is located 10.7 kms from the LOC Caterer site.

3.3.3. LOC Meat Supplier

This company was founded in 1955 in Germas, Kastoria, Greece. Its initial operations included only pork husbandry and related products. Since 1984 the company has produced cold cuts (salami, bacon, pastirma) and it expanded its business further in 2007 with the development of a new manufacture plant for various meat products (pork, beef, chicken, minced meat, sausages, cold cuts). LOC Meat Supplier supplies beef and chicken to LOC Caterer. The company is located 2.5 kms from the LOC Caterer site.

3.3.4. LOC Fish Supplier

LOC Fish Supplier was established in 1998 in Katerini, Greece, in order to produce, process and distribute frozen fish (cod, sea bass, Deepwater redfish, sea bream, sardines, swordfish, anglerfish, perch) and seafood (mussels, octopus, shrimps, squids, crabs, lobster). The company carries out all safety and quality assurance measures, by holding the ISO 22000:2005 quality certification, and by applying HACCP (Hazard Analysis of Critical Control Points) system implementation. The company also continuously invests in modern facilities, infrastructure and human resources. LOC Fish Supplier supplies frozen fish to LOC Caterer for the school meals contract. LOC Fish Supplier has a turnover of €18,923 million, and is located 188 kms from the LOC Caterer site.

3.3.5. LOC Dairy Supplier

LOC Dairy Supplier has a plant production of cheese in Argos Orestiko, Kastoria. It manufactures traditional Greek cheese products made using 100% Greek fresh pasteurized sheep and goats' milk. The main cheeses it produces are feta, kefalograviera and kefalotyri (both hard table cheeses) and kaseri (a medium hard cheese). The company supplies feta cheese to LOC Caterer for the school meals contract. LOC Dairy Supplier is located 5.9 kms from the site of LOC Caterer.

3.3.6. LOC Fresh Supplier B

This company was founded in 2003 and its headquarters are located in Mavrochori, Kastoria. Its main operations include the processing, sorting, packaging and storage of agricultural products and the production of tomatoes, potatoes, peppers, eggplants and apples. In its own premises, the company houses the sorting and packaging machines, as well as the maintenance area which consists of three cold storage chambers for storage of the fresh fruit and vegetables.

The company supplies LOC Caterer with fresh vegetables for the school meals contract. LOC Fresh Supplier B is located 11.4 kms from the site of LOC Caterer.

3.4. The featured schools in Case 2 Kastoria (LOC)

The sample of five primary schools, which are located in Kastoria town and are included in the “LOC” model case study, are presented in Table 4. Alongside the other 10 schools in the Municipality, these five schools participated in the “School Meals” program for the first time in 2017-18, when the pupils received and consumed the school meals delivered by LOC Caterer. As Table 4 shows, the total number of pupils in each school ranged from 83 (LOC School A) to 65 (LOC Schools C and D), giving an average roll size of 73 pupils. This is slightly smaller than the average for the Municipality, which is 77 pupils. In terms of meal uptake, although all pupils were eligible to participate in the “School Meals” program for the 24 weeks, the average meal uptake for all five schools was 84% (61 pupils per school), higher than the Municipality average of 81%. The highest meal uptake was 89% (LOC School C) and the lowest was 80% (LOC School D). All schools served the school meals in the classrooms and the hall due to the lack of dining rooms. The teachers at the schools ran initiatives with recycling although projects related to food or health were not taking place at the time of data collection. Overall, compared with LOW case, the five schools in LOC case are much smaller in size and have higher uptake of the school meals. The next sections present some more details about the five schools.

Table 4: The five primary schools of the Kastoria (LOC) case

Name of the school	Size of roll/meal uptake	
	Size of roll	Meal uptake
LOC school A	83	84,3%
LOC school B	71	84,5%
LOC school C	65	89,2%
LOC school D	65	80,0%
LOC school E	79	82,3%

3.4.1. LOC school A

LOC school A is located in Kastoria town. The pupil roll size was 83, higher than the average pupils roll of the Municipality (77 pupils). Furthermore, the meal uptake was recorded as 84,3% which is close to the average participation of the primary schools in Kastoria Municipality (81%). Ultimately 52 pupils received the school meals on a daily basis, compared with the average pupil participation in the five studied primary schools of 61.

3.4.2. LOC school B

LOC School B is located in Kastoria town.The pupil roll of LOC school B was 71, higher than the average for the Municipality. The meal uptake was 84,5% leading to a participation of 60 pupils in the School Meals program, higher than the average school meal participation of the Municipality (81%).

3.4.3. LOC school C

LOC school C is located in Kastoria town. The school has a roll of 65 pupils which is lower than the average of all schools in Kastoria (77). The meal uptake was 89,2% which is considered higher than the average uptake (81%). In total 58 pupils participated in the school meal program.

3.4.4. LOC school D

LOC school D is located in the town centre of Kastoria. The school has 65 registered pupils and the meal uptake was recorded as 80%, slightly lower than the average for primary schools in the Municipality (81%). In total, 52 pupils participated in the school meal program.

3.4.5. LOC school E

LOC School E is located in Kastoria town. This school had 79 registered pupils and a meal uptake of 82.3%. Hence, an average of 65 pupils received daily the school meals, 39 of them consumed it at the school during the lunch time and 26 pupils received the school meals to consume at home.

4. ENVIRONMENTAL IMPACT OF SCHOOL MEALS SERVICES

4.1. Methodology to measure environmental impact

Our core measure of environmental impact was carbon footprint, expressed as the kgsCO_2eq emitted from the production, processing, transportation and waste of food items purchased by the five featured schools in Case 1 (LOW) (i.e. LOW Schools A-E) and Case 2 (LOC) (i.e. LOC Schools A-E), respectively, over a school year.

To estimate the emissions from the production and processing of food items supplied to the schools, we used two sets of emissions factors. For fresh items, we used the factors proposed by Audsley et al. (2009). For processed items, we used the factors of the Rowett Institute of Nutrition and Health Database (2017), as these include emissions for processing items. Both sets of factors encompass the emissions caused by all the activities arising from the production of food items up to and including transport to the regional distribution centre (RDC) level. In our study, the RDC level equates to wholesalers (i.e. the first-tier suppliers described in Section 2). To estimate the emissions relating to the transportation of food items from wholesalers/suppliers to schools (i.e. 'local' transportation), we used the calculation method recommended by Defra (2013), which is based on estimating suppliers' delivery round distances and frequencies, taking account of the types of vehicles and fuel used, the number of drops to other customers in the rounds, and the proportion of the loads comprised by the food items to the schools featured in the case[16]. According to Kellner & Otto (2011), the formula below assumes 89% weighted average allocated to the distance of the delivery round and 11% for the vehicle load.

To estimate the emissions relating to waste, we applied the emissions factors for waste handling proposed by Moult et al (2018). These capture the emissions from transportation of waste from schools to waste disposal sites, and from the processing of the waste itself, for five different food categories (fruit and vegetables, bread, cheese, fish, and meat).

4.1.1 Measurement method for Case 1 (LOW) Thessaloniki

The measurement process for Case 1 (LOW) was as follows:

First, from LOW Caterer, we identified which food items were purchased from first-tier suppliers to prepare the school meals for LOW Schools A-E, and in which quantities, for two 5-day weeks in 2018 (February and April). The two data collection periods gave the possibility to capture any changes in procurement due to seasonal shifts in the menu. From this, we generated a list of the total volumes of foods purchased by LOW Caterer in those periods, including fresh fruit and vegetables, fresh meat, dairy, ambient goods (bread, pasta, rice), and

[16]The formula we used was: $\text{Total CO2 Emissions From Transportation Process per Week} = \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Drops}}{\text{Total Drops}} \times 89\%\right) + \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Load}}{\text{Vehicle Load}} \times 11\%\right)$

processed and frozen items. From these data we estimated the average weekly volumes (in kgs) of all foods purchased by LOW Caterer to supply meals for LOW Schools A-E, then multiplied these volumes by 24 weeks to estimate the total volumes (kgs) of the food items purchased over one school year.

Having estimated total food purchase volumes in LOC case, next we calculated emissions (kgsC0$_2$e) from the agricultural production, processing and upstream transportation of these foods, using the emissions factors of Audsley et al (2009) and the Rowett Institute of Nutrition and Health (2017), multiplied by the total volumes calculated in the first step. To select the most appropriate factor from the origin options (EU, rest of world), we used information given by the suppliers in interview as to the origin of the foods they supplied to LOW Schools A-E (and also where origin changed over the course of the year, in the case of fresh fruit and vegetables).

Then, we calculated the emissions (kgsC0$_2$e) relating to the transportation of the food items from the suppliers to LOW Caterer for the 24 week school year, applying the measurement method of Defra (2013) to the information given by suppliers in interviews on their delivery round distances and frequencies, types of vehicles, fuel and the number of drops to other customers in the rounds.

Finally, we calculated the emissions (kgsC0$_2$e) relating to the handling of waste by taking the data on volumes (in kgs) of plate waste generated at two LOW Schools over four weeks (as collected in WP6.2 and reported in D6.2), and aggregating these (based on averages of food waste per meal for each food category from the two LOCSchools) to the five LOW Schools, for the 24 week school year. We then multiplied the aggregate plate waste volume of all five LOW Schools by Moult et al's (2018) waste handling emissions factors, taking account of the emissions attached to different categories of waste.

The total carbon footprint for LOW case was therefore the sum (in kgsC0$_2$e) of the above sets of emissions applied to the total aggregate food volumes purchased by LOW Schools A-E, as described above.

4.1.2. Measurement method for Case 2 (LOC) Kastoria

The measurement method for LOC case Kastoria followed the same methodology as for LOW case described above, including the same data collection period (February and April 2018).

4.2. Which foods are supplied in the school meals services?

This section reports the total volumes of foods supplied to the featured schools in Thessaloniki (LOW) and Kastoria (LOC) cases over one school year, and the composition of the average meal (pre-preparation and cooking) in both cases.

4.2.1. Foods supplied in Case 1 Thessaloniki (LOW) service

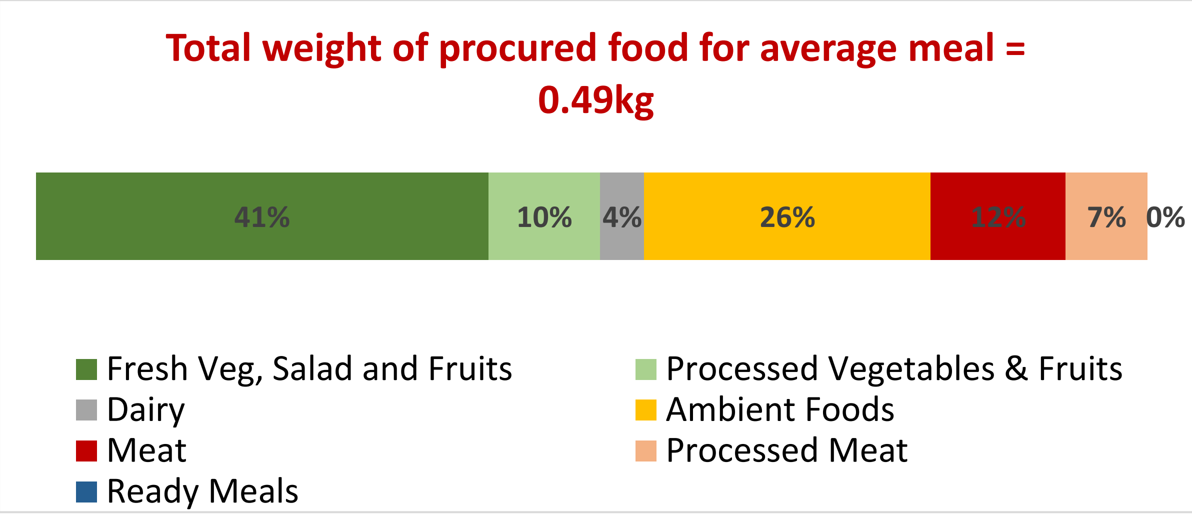
Table 5: Annual volumes of foods supplied to Thessaloniki (LOW) schools (n=5)

Food Category	**Volume (kg/ltr)**
Fresh fruit and vegetables	20,889
Processed fruit and vegetables	5,430
Dairy	2,024
Ambient	13,239
Fresh meat	6,216
Processed meat	3,771
Ready Meals	0
Total	**51,570**

As Table 5 demonstrates, the total volume of food items supplied by LOW Caterer to the five LOW schools in Thessaloniki over 24 weeks was 51,570kg. Of this total, Fresh fruit and vegetables represented the largest component, followed by ambient products, fresh meat, processed fruit and vegetables, and then small quantities of dairy products and processed meat. Within these food categories, purchases focused on a narrow range of simple items. The category 'fresh fruit and vegetables' in fact consisted 100% of vegetables (no fruit was purchased at all for these school meals), of which 28% was potatoes, 16% each of carrots, beetroot and tinned tomatoes, and then small amounts of other vegetables including salad items. The fresh meat category was comprised only of beef (68%) and chicken (32%), while the ambient foods were 49% bread, 23% pasta, 10% rice and 14% olive oil. The dairy category was 100% cheese (85% feta), and processed meat was 100% frozen fish. No ready-made meals were purchased by LOW Caterer.

The above yearly purchase volumes were divided by the total number of meals served at the five Thessaloniki LOW Schools, in order to calculate the total weight and composition of an average meal at these schools. Figure 8 shows the results. It should be emphasised that the total weight refers to the weight of the foods procured for the average meal, rather than the weight of the served meal.

Figure 8: Composition of average meal in Case 1 Thessaloniki (LOW)



As Figure 8 shows, the weight of the food procured for the average meal at LOW Schools A-E is 490g, and is comprised of 41% fresh vegetables, 10% processed vegetables, 4% dairy, 26% ambient, 12% fresh meat and 7% processed meat. Therefore, the average meal contains just over half vegetables (over three quarters of which are fresh), just over a quarter starchy foods/oil (half of this is bread) a fifth meat (most of which is fresh) and very small amounts of dairy (all cheese).

4.2.2 Foods supplied in Case 2 Kastoria (LOC) service

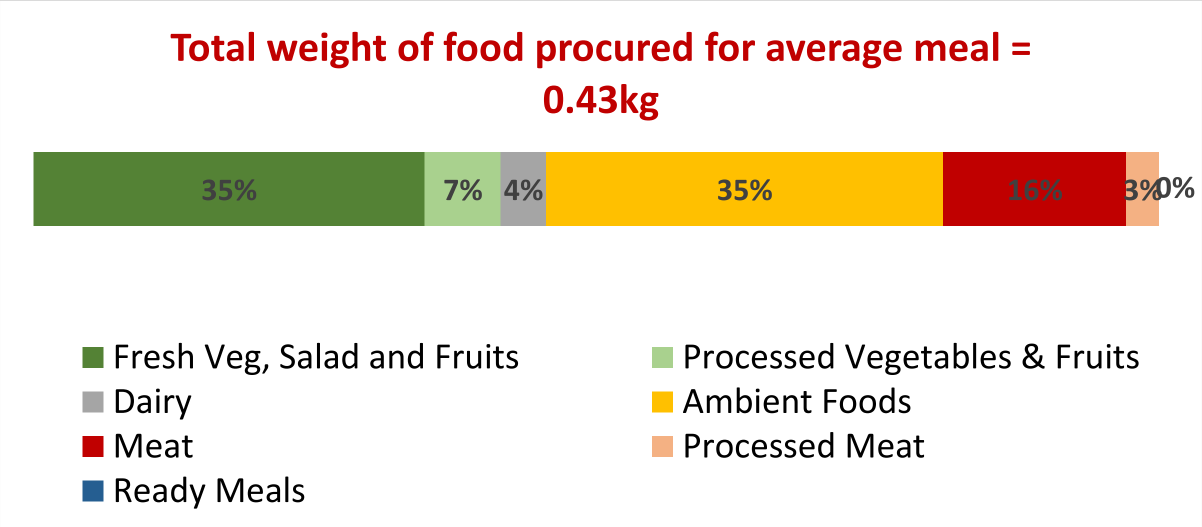
Table 6: Annual volumes of foods supplied to Kastoria (LOC) schools (n=5)

Food Category	**Volume (kg/ltr)**
Fresh fruit and vegetables	5,441
Processed fruit and vegetables	1,055
Dairy	717
Ambient	5,525
Fresh meat	2,541
Processed meat	458
Ready Meals	**0**
Total	**15,736**

As Table 6 demonstrates, the total volume of food items supplied by LOC Caterer to the five LOC schools in Kastoria over 24 weeks was 15,736kg. Of this total, Fresh fruit and vegetables and ambient foods represented the largest volumes followed by fresh meat, then processed vegetables, dairy and processed meat. Like in LOW case, within these categories the procurement of food items by LOC Caterer followed a narrow strategy. The category 'fresh fruit and vegetables' consisted 100% of vegetables (again, no fruit purchased), of which carrots was the largest single item (20%), followed by spinach and tomatoes, then smaller amounts of six other types of vegetables, including salads. Like LOW case, the fresh meat category was comprised only of chicken and beef, although in LOC case the proportions were reversed (68% chicken vs 32% beef), while the ambient foods were 42% bread and 14% pasta, followed by small amounts of lentils, rice and groats. The dairy category was comprised of cheese (100% feta) and eggs, and processed meat was 100% frozen fish. Like LOW case, no ready-made meals were purchased by LOW Caterer.

The above yearly purchase volumes were divided by the total number of meals served at the five Kastoria LOC Schools, in order to calculate the total weight and composition of an average meal at these schools. Figure 9 shows the results. Again it is emphasised that the total weight refers to the weight of food procured for the average meal, rather than the weight of the served meal.

Figure 9: Composition of average meal in Case 2 Kastoria (LOC)



As Figure 9 shows, the weight of the food procured for the average meal at LOC Schools A-E is 430g, and is comprised of 35% fresh vegetables, 7% processed, 4% dairy, 35% ambient, 16% fresh meat and 3% processed meat. So the average meal in LOC case is under half vegetables (of which 90% are fresh), over one third ambient (of which under half is bread), almost a fifth meat (84% of which is fresh), and small amounts of dairy (feta cheese and eggs). Comparing the average meals in the two cases, it can been seen that the relative proportions of the main food categories are quite similar and in both cases, a quite narrow range of items is procured. However, although the average LOW meal has a greater proportion of vegetables compared with LOC meal, it contains the same proportion of meat and within this, a greater proportion of beef vs chicken. It can be expected that these differences will affect the carbon footprints of the two cases.

4.3. How far do foods travel in school meals services?

Next for environmental impact, we report the distances travelled by foods to reach the schools in the LOW and LOC cases. Specifically, using data gathered from the first tier suppliers (described in Section 2) relating to their geographical distances from the Caterers, and also their delivery volumes and frequencies, we estimated the annual kms travelled by these suppliers to deliver to Caterers the volumes of foods reported in the preceding section. Note that the results in this section indicate the distances travelled by foods only in the last downstream phase of transportation from first tier supplier to Caterer, rather than from the foods' original source in terms of farm or place of production (although in some cases, these were very close to first tier supplier). Also, the calculation here has not been moderated to take account of other customer drops in the delivery round or backhaul activity. Nevertheless, the estimates here help interpretation of subsequent results relating to transport emissions from both LOC and LOW cases, as part of the carbon footprint calculation. The travelled distances of the food ingredients from first tier suppliers to LOW Caterer are presented in Table 7. All suppliers made one delivery per week to LOW Caterer for the school meals.

Table 7: Annual kms travelled by foods, from suppliers to caterer, in Thessaloniki (LOW)

Food Category	Kms
Fresh vegetables	101
Processed vegetables	3,922
Dairy	15,024
Ambient	21,662
Fresh meat	24,876
Processed meat (frozen fish)	23,760
Total	**89,345**

As Table 7 shows, fresh meat, processed meat and ambient foods are the items that contribute by far the greatest kms travelled in LOW case. This reflects the fact that, with the exception of Pasta Supplier, the suppliers of these items are located >300 km from LOC Caterer. In contrast, the kms travelled for processed and fresh vegetables are much lower, reflecting the fact that these suppliers are located 2km and 80km from LOC Caterer, respectively.

Table 8: Annual kms travelled by foods, from suppliers to caterer, in Kastoria (LOC)

Food Category	Kms
Fresh vegetables	1,061
Processed vegetables	5,856
Dairy	283
Ambient	43,536
Fresh meat	149
Processed meat (frozen fish)	9,024
Total	**59,909**

Table 8 shows the travelled distances of the food ingredients from first tier suppliers to LOC Caterer. Again, all suppliers made one delivery per week to LOC Caterer for the school meals. It can be seen that ambient foods contribute by far the greatest amount of total kms travelled, reflecting the distant locations of the three suppliers (303km, 239km and 183km, respectively). In contrast, the transportation distances of fresh meat and dairy are very low, as these suppliers are based only 2.5 and 6km from LOC Caterer. Comparing the two cases, it can be seen that the foods in LOW case were transported considerably more kms (50% more) than those in LOC case.

4.4. What are waste levels in school meals services?

In this section, we report the food waste levels for schools in both Cases. A full breakdown of plate waste volumes per food category is reported in D6.2 Greece Country Report, for two Thessaloniki Schools (LOW Schools A and B), and two Kastoria schools (LOC Schools A and E). Here, we present estimates of total plate waste for all five LOW and five LOC models schools. To arrive at these estimates, we first calculated the average plate waste per week at each of the two schools per case, then multiplied these by 24 wks to estimate the total annual plate waste at those schools. We then used these results to estimate the annual plate wastes at the remaining three schools in each case, based pro-rata on the total number of meals served at those schools. Finally, we summed the annual totals for each school to arrive at the annual totals of plate waste per case. Tables 9 and 10 present the total food waste volumes per case, broken down by food category.

Table 9: Annual plate waste in Thessaloniki schools (LOW) (n=5 schools)

Food Category	Total Waste (Kg)
Meat & Fish	2,779
Starchy food (e.g. pasta, rice, bread)	10,723
Vegetables	5,153
Dairy (FETA Cheese)	412
Mixed (composite meals e.g. pasta with minced beef)	3,960
Total	**23,026**

Table 10: Annual plate waste in Kastoria (LOC) schools (n=5 schools)

Food Category	Total Waste (Kg)
Meat & Fish	516
Starchy food (e.g. pasta, rice, bread)	1,767
Vegetables	1,853
Dairy (FETA Cheese)	350
Mixed (composite meals, e.g. pasta with minced beef	1,543
Total	**6,029**

As Table 9 shows, the highest plate waste volumes in LOW case came from starchy foods (47%), followed by vegetables (22%) and then meat (12%). In fact, these foods contributed even more to the waste total when the 'Mixed' category is included. In contrast, dairy foods represented a very small component of LOW Schools' waste. Table 10 shows that in LOC case, the highest plate waste volumes came from the vegetable food category (31%) and the starchy food category (29%), although these proportions are even greater when the 'Mixed' category is included. Meat and dairy were both very small components of LOC Schools' waste.

Overall therefore, vegetables and starchy foods were the main components of plate waste in both LOW and LOC cases, whereas meat and dairy were much smaller components. The total volume of plate waste in LOW case was 23,026kg, which represented 43% of the total amount of food served in the meals over 24 weeks. The total volume of plate waste in LOC case was 6,029kg, or 38% of the total food served. As a result, the pupils in the LOC case consumed, on average, 5% more food volume than the pupils in the LOW case. However, it can be remarked that the waste levels in both cases are very high.

4.5. What is carbon footprint of school meals services?

This section presents the core environmental impact results for the school meals services in Greece LOC and LOW cases. In particular, sections 4.5.1 and 4.5.2 capture the total carbon footprint of the services in each Case respectively, and the contribution of the main supply main activities (production/processing, local transportation and waste) to the total carbon footprint. The descriptions in the preceding sections of meal compositions, kms travelled from first tier suppliers, and waste volumes, are used to help interpret the results in each case.

4.5.1 Carbon footprint of Case 1 Thessaloniki (LOW) service

The total carbon footprint of the school meals service for the five LOW schools in Thessaloniki was calculated using the measurement method described in 4.1.1. Total emissions data were obtained from the production, processing, transportation and waste of food items purchased, for the five participant schools, for 120 school days. Table 11 shows the results.

Table 11: Carbon footprint of school meals service in Thessaloniki (LOW) (n= 5 schools)

Category	**KgsCO$_2$eq**
1 Production, processing, upstream transport emissions, of which:	154,662
1.1 Fresh vegetables	16,931
1.2 Processed vegetables	7,331
1.3 Dairy	19,632
1.4 Ambient	35,483
1.5 Fresh meat	57,936
1.6 Processed Fish	17,348
2 Transport emissions (first tier suppliers to LOW Caterer)	25,850
3 Transport emissions (from LOW Caterer to 5 schools)	2,667
4 Plate waste handling and disposal	68,805
Total	**251,985**

As Table 11 shows, the LOW case school meals service to the five schools in Thessaloniki generated a total carbon footprint of 251,985kgCO_2eq. The "production, processing, and upstream transportation" emissions category was responsible for the largest part (62%) of this total, while the emissions relating to food waste handling comprised the next largest proportion (27%). Finally, although the majority of LOW case suppliers were located a far distance from LOW Caterer, emissions related to downstream transportation comprised only a modest amount (11%) of the total carbon footprint.

To facilitate interpretation and comparison of case results, the total carbon emissions for LOW case are reported on a per average meal basis, and per kg of meal basis. To derive emissions per meal, we divided the total emissions from the foods purchased by the schools in one year (251,985 kgCO_2eq) by the total number of meals served (873 daily meals*5days*24weeks = 104,760 meals). By this calculation, the average meal at LOW Schools A-E generated 2.41 kgs kgCO_2eq. Figure 10 shows the breakdown of these emissions, by type of food and stage of supply chain activity. To derive emissions per kg of meal, we divided the total emissions figure (251,985 kgCO_2eq) by the total volume of foods procured (pre-preparation and cooking) (51,570 kgs). By this calculation, emissions for every 1kg of average meal at LOW Schools A-E were 4.89k g of CO_2eq.

Figure 10: Carbon footprint of school meals service in Case 1 Thessaloniki (LOW) (n=5 schools)

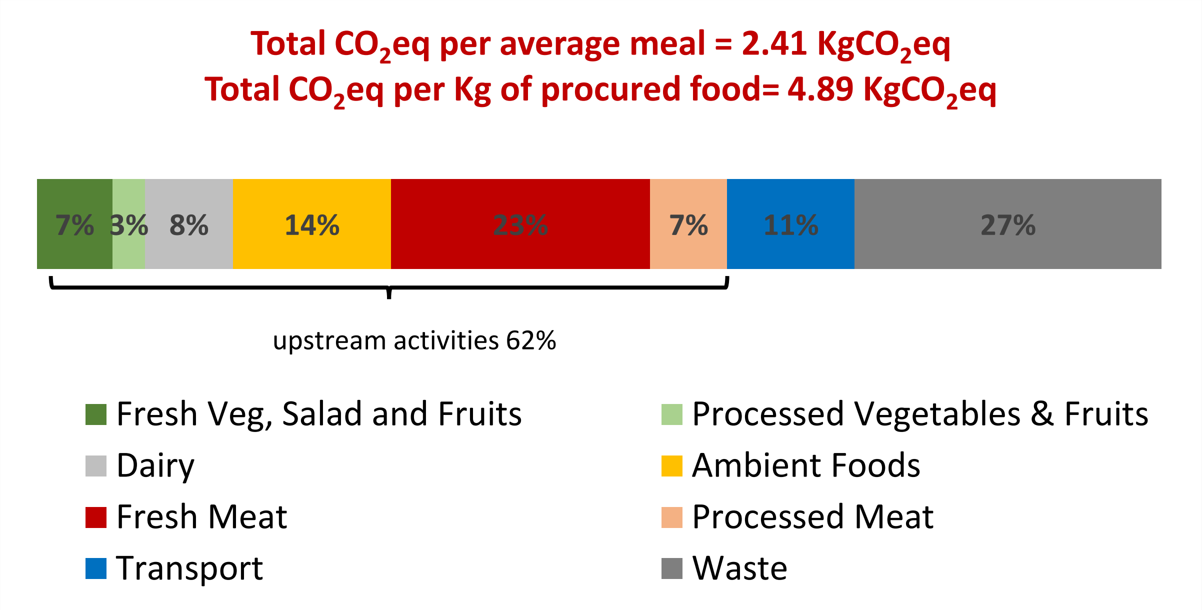


Figure 10 confirms that the upstream activities involved in producing and processing foods, and transportation to first tier suppliers, represents the largest proportion of the total carbon footprint in LOW case (62%). Within this it can be seen that meat (fresh and processed) contributes the greatest single emissions burden (30%), although meat represents only 19% of the volume of the average LOW case meal. The next highest emissions category is plate waste, at 27% of total carbon footprint. This high burden reflects the high levels of plate waste in LOW case (43% of food served is wasted), and also the landfill disposal method, which carries a very high emissions burden. Switching to an alternative disposal method (e.g. composting) would greatly reduce this emissions burden. Finally, it can be seen that the food categories of ambient, dairy (cheese) and vegetables represent small proportions of the total carbon footprint. Ambient items and vegetables have low emissions factors, while cheese, although quite high in carbon emissions, appears in very small volumes on the menus.

4.5.2 Carbon footprint of Case 2 Kastoria (LOC) service

Based on the measurement method described in 4.1.2, we calculated the total carbon footprint of the school meals service for the 5 Kastoria schools (i.e. LOC Schools A-E). Hence we summed the total emissions associated with the production, processing, transportation and waste of food items purchased by these five schools over 24 weeks. Table 12 shows the results.

Table 12: Carbon footprint of school meals service in Kastoria (LOC) (n= 5 schools)

Category	**Kgs CO_2eq**
1 Production, processing, upstream transport emissions, of which:	40,894
1.1 Fresh vegetables	5,284
1.2 Processed vegetables	1,380
1.3 Dairy	5,076
1.4 Ambient	12,084
1.5 Fresh meat	14,963
1.6 Processed Fish	2,105
2 Transport emissions (first tier suppliers to LOC Caterer)	9,125
3 Transport emissions (from LOC Caterer to 5 schools)	915
3 Waste	17,290
Total	**68,224**

As Table 12 shows, the total school meal emissions in LOC case are 68,224kg CO_2eq. The biggest contributor to the total is the upstream activities of production, processing and transportation of foods to first tier suppliers (60%), followed by handling and disposal of plate waste (25% of the total). Finally, although half of the LOC case suppliers are located quite short distances from LOC Caterer, the local transportation of school meals (from suppliers to

LOC Caterer and then from LOC Caterer to schools) is responsible for 15% of the total carbon emissions.

Again to facilitate comparison of case results, the total carbon emissions for LOC case are reported on a per average meal basis, and per kg of meal basis. Emissions per meal were calculated by dividing the total emissions from the foods purchased by the five schools in one year (68,224 kgCO_2eq) by the total number of meals served (305 daily meals*5days*24weeks = 36,600 meals). By this calculation, the average meal at LOC Schools A-E generated 1.87 kgCO_2eq. Figure 11 shows the breakdown of these emissions, by type of food and stage of supply chain activity. Emissions per kg of meal were calculated by dividing the total emissions figure (68,224 kgCO_2eq) by the total volume of foods procured (pre-preparation and cooking) (15,736 kgs). By this calculation, emissions for every 1kg of average meal at LOC Schools A-E were 4.34 kg of CO_2eq.

Figure 11: Carbon footprint of school meals service in Case 2 (LOC) (n= 5 schools)

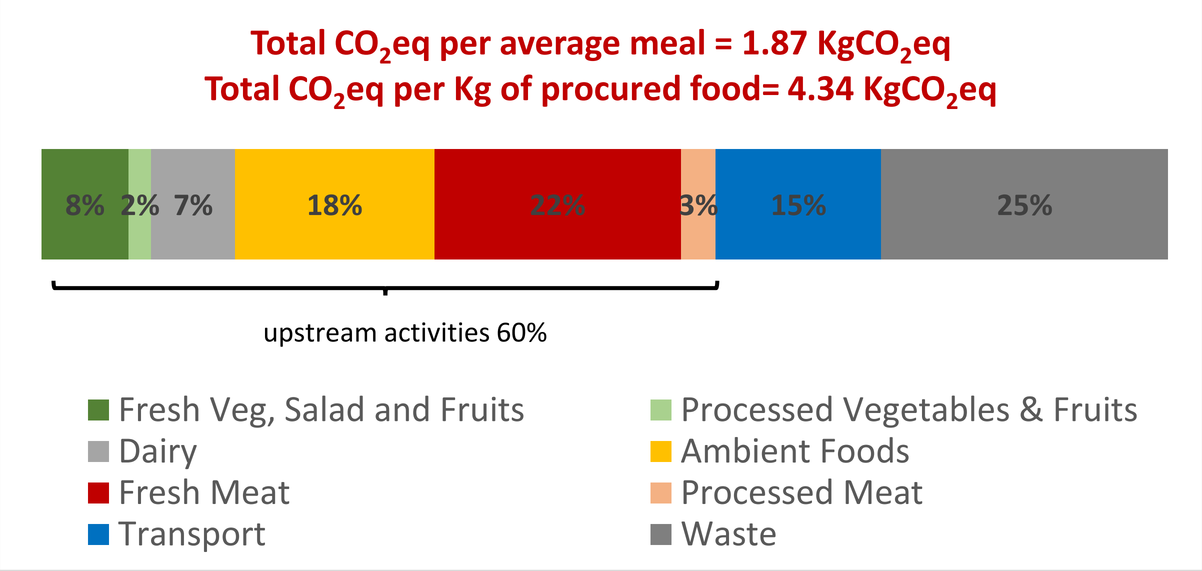


Figure 11 confirms that, like LOW case, the upstream activities involved in producing and processing foods, and transportation to first tier suppliers, represents the largest proportion of the total carbon footprint in LOC case (60%). Within this it can be seen that meat (fresh and processed) contributes the greatest single emissions burden (25%), equal in size to the plate waste burden (also 25% of total carbon footprint). Like LOW case, this high burden reflects the high levels of plate waste in LOW case (38% of food served), and also the landfill disposal method. Ambient foods and transport contribute the next highest emissions (18% and 15%, respectively), while vegetables and dairy contribute small amounts of emissions.

4.5.3 Comparison of carbon footprint of Cases 1 (LOW) and 2 (LOC)

The preceding sections show that the carbon footprint of the Thessaloniki (LOW) meals service was higher than Kastoria (LOC), on the basis of a 5 schools sample in each Case. In particular, the carbon emissions of the average school meal in Thessaloniki are 2.41kg CO_2eq, whereas Kastoria average meals emit 1.87kg CO_2eq. Therefore, the average LOC case school meal produces around 22% less carbon emissions than the average school meal in the LOW case.

Overall however, both LOW and LOC carbon footprints have remarkably similar profiles. In both cases, meat (fresh and processed) is the biggest category, followed by plate waste (also a big contributor), then ambient and transport categories (both contribute modest 11-18% in each case), then vegetables and dairy (counting <10% of emissions). The main reason for the average meal in LOC case producing 22% less emissions than LOW meal is that the size of the average meal in LOC case is smaller (430g vs 490g). This effect is reinforced by the per kg emissions comparison, where the difference in emissions between the cases (4.34kg vs 4.89kg) is a much smaller margin than the per meal difference. Beyond this, the main reason why LOC case meals have slightly lower emissions per kg is that LOW case meals contain a greater proportion of beef (both cases have same volume of meat overall). However, the main reflection on the case studies is they are both high emissions, due to (i) plate waste, all of which going to landfill (ii) relatively high proportions of meat (and beef) in the average meal.

4.6 Procurement management scenarios to reduce carbon footprint

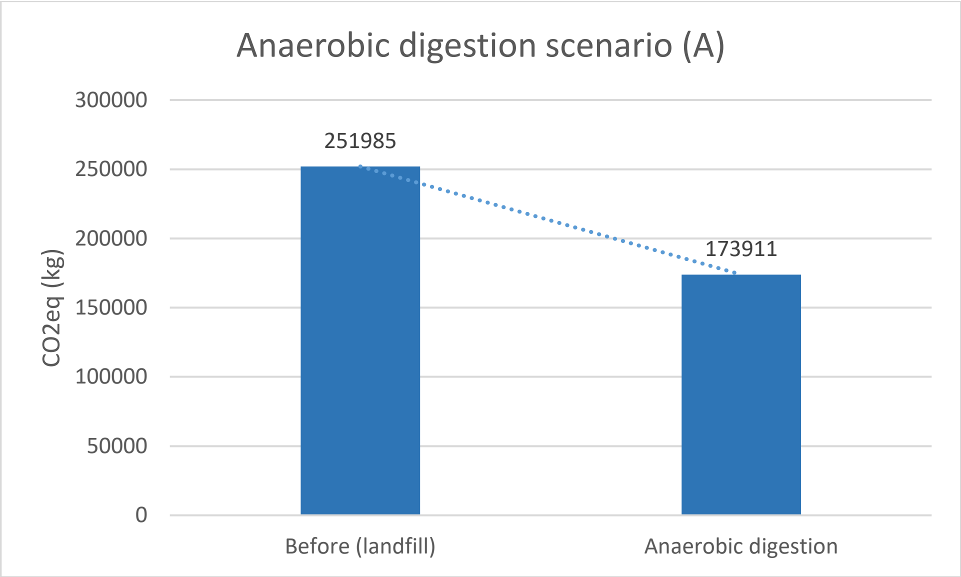
The preceding sections have shown how different activities in the supply chain contributed to the carbon footprint of the Thessaloniki (LOC) and Kastoria (LOW) meals services. To conclude our analysis of the environmental impact of the services, we report results of our exploration of four different procurement management scenarios and their effects on carbon emissions in both Cases: (i) substitution of waste disposal method (from landfill to anaerobic digestion, (ii) adjustment to meat and dairy components in the average meal (from beef to chicken and from cheese to yoghurt, (iii) consolidation of downstream transportation (reduction in the number of first tier suppliers used from nine to four), and (iv) a scenario showing the combined effects of adoption of two of the preceding scenarios.

4.6.1 Carbon footprint reduction scenarios in Thessaloniki (LOW)

This section reports the analysis of the four scenarios in Thessaloniki (LOW) case. First, given the large contribution of the existing waste disposal method (landfill) to total carbon footprint in LOW case, we tested Scenario A "Anaerobic Digestion". This scenario assumes a switch from 100% disposal of waste in landfill to 100% disposed by anaerobic digestion. As Figure 12 shows, under this scenario, the total carbon footprint of LOW case drops from 251,985 kgCO_2eq to 173,911 kgCO_2eq, which equates to a fall in per meal emissions from 2.41 to 1.66

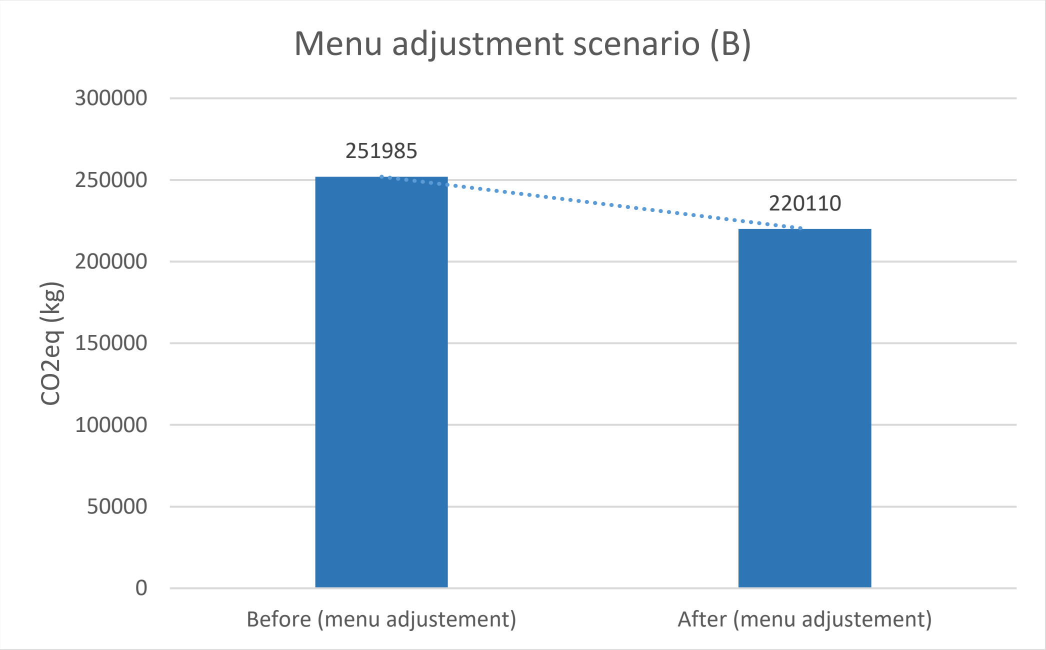
$kgCO_2eq$. Hence, under Scenario A a substantial reduction in emissions (31%) is possible, compared with the existing arrangements in the LOW case.

Figure 12: Emissions reduction under Scenario A "anaerobic digestion" (LOW)



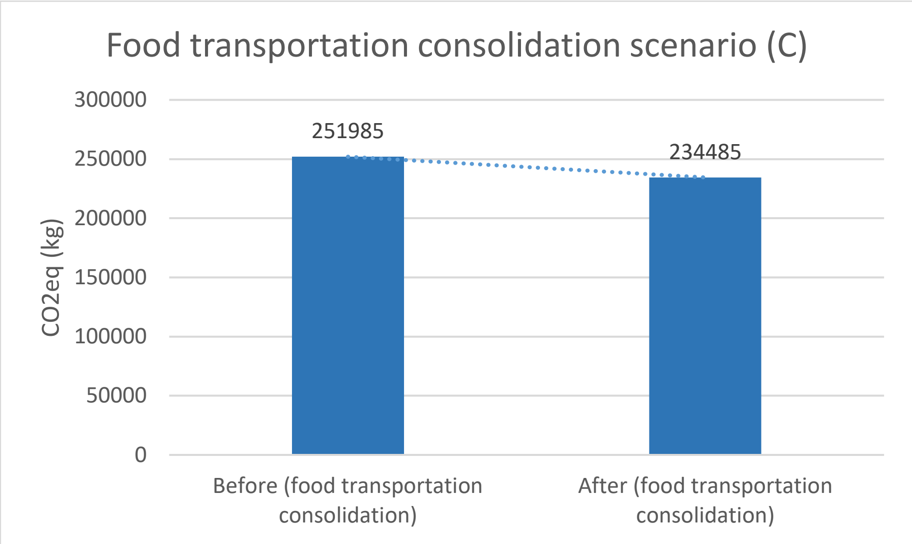
As the menus in the LOW case were found to contain relatively high amounts of beef, which has a large carbon burden compared with white meats such as chicken, the second scenario we tested was Scenario B "Menu adjustments". Under this scenario, we assumed that the beef meat on the menu is replaced proportionally with chicken meat by 50%. We also assumed that the FETA cheese in the meals is replaced by the less carbon intensive yoghurt. Figure 13 shows that the total emissions for LOW case would drop from 251,985kgsCO_2eq to 220,110.3kg CO_2eq, a reduction of 13%. Overall therefore, Scenario B results in emissions reduction, but at a more modest rate than Scenario A.

Figure 13: Emissions reduction under Scenario B "menu adjustments" (LOW)



The third scenario we examined was Scenario C "food transport consolidation". As the existing supply chain arrangements in LOW case involved nine different suppliers transporting foods individually to LOW Caterer, and the majority of these were located a far distance from LOW Caterer's facilities, we assumed that four suppliers sourced the catering for all foods, two local and two non-local. We then tested what would be the effect on transport emissions of this reduction in the number of suppliers. As Figure 14 shows, the fall in total emissions in LOW case is modest, from 251,985 kgCO_2eq to 234,485 kgCO_2eq (11%). This equates to a fall in emissions per average meal from 2.41 kg CO_2eq to 2,24 kg CO_2eq. Therefore, Scenario C results in a smaller reduction in emissions compared with Scenarios A and B.

Figure 14: Emissions reduction under Scenario C "transport consolidation" (LOW)



The final scenario we examined (Scenario D) involved combining the actions in Scenarios A and B. Hence, we tested what would be the reduction in carbon emissions from switching LOW case waste disposal method from landfill to anaerobic digestion, and adjusting the menu to replace beef meat proportionally with chicken meat by 50%, and the FETA cheese by yoghurt. As Figure 15 shows, this scenario would result in a total drop in emissions from 251,985 kgCO_2eq to 144,703kg CO_2eq (Figure 15), a substantial reduction of 43%. This equates to a fall in emissions per average meal from 2.41 to 1.38kg CO_2eq.

Figure 15: Emissions reduction under Scenario D "combination scenario" (LOW)

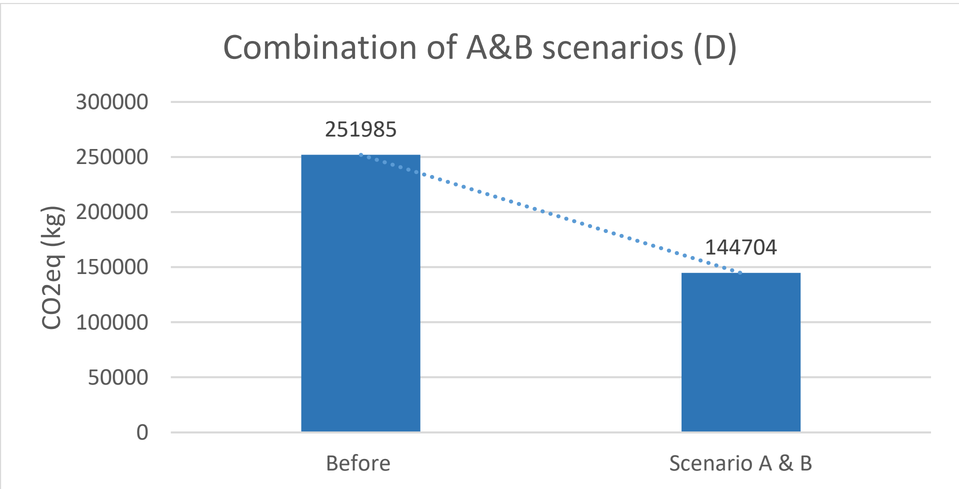
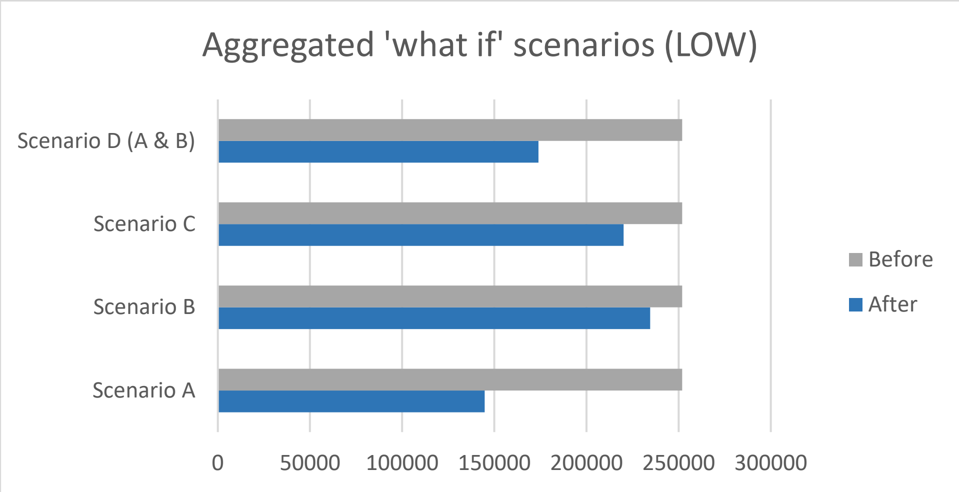


Figure 16 summarises the results of the preceding scenario analyses. It confirms that the combination of anaerobic digestion and the menu adjustment (Scenario D) is the most effective strategy to reduce carbon footprint in Thessaloniki LOW case, leading to the most substantial reduction in emissions. The second most effective strategy is Scenario A, where the food waste destination switches from landfill to anaerobic digestion. Overall, efforts to consolidate transportation would lead to only modest reductions in total carbon footprint, therefore, from an environmental perspective, this would be a less effective strategy than the other scenarios mentioned.

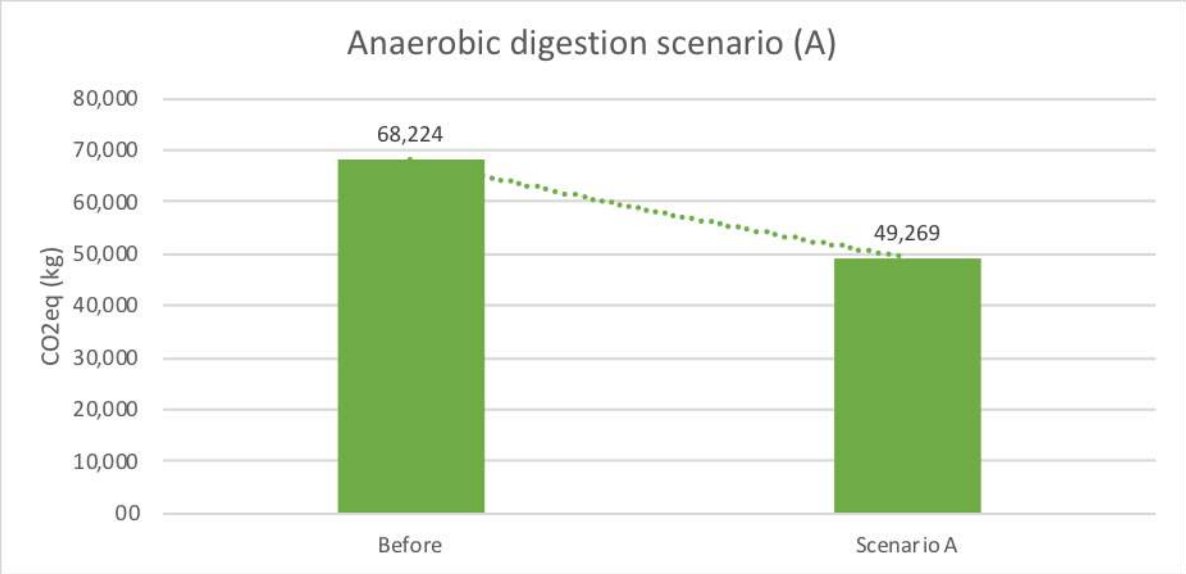
Figure 16: Summary of scenario analyses in Thessaloniki (LOW) case



4.6.2 Carbon footprint reduction scenarios in Kastoria (LOC)

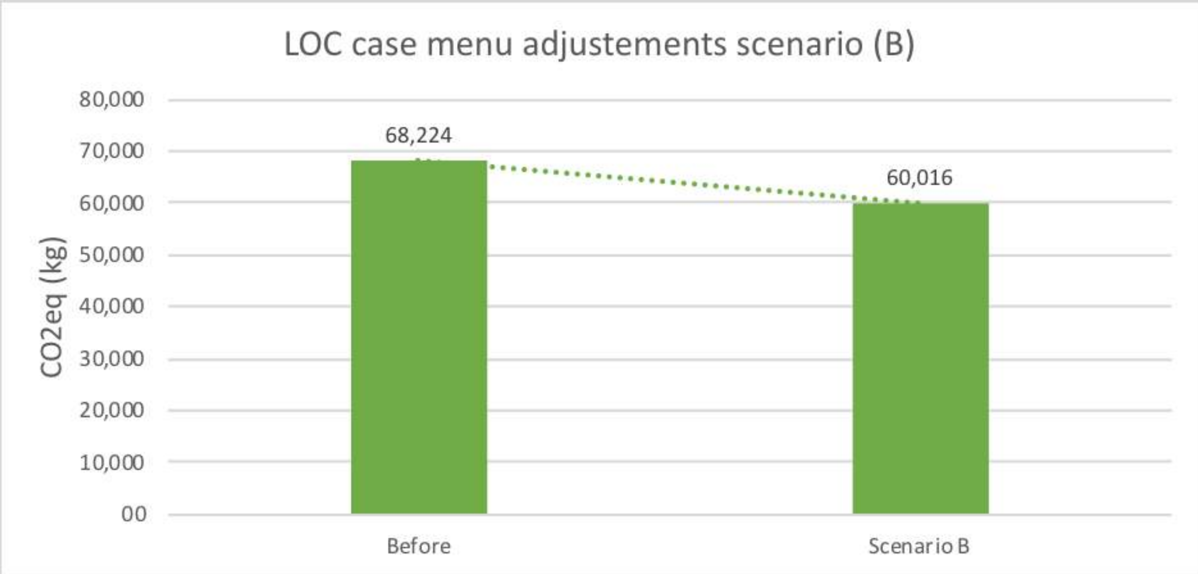
This section reports the analysis of the four scenarios in Kastoria (LOC) case, which followed the same principles as Thessaloniki (LOW) case. First, given the large contribution of the existing waste disposal method (landfill) to total carbon footprint in LOC case, we tested Scenario A "Anaerobic Digestion". This scenario assumes a switch from 100% disposal of waste in landfill to 100% disposed by anaerobic digestion. As Figure 17 shows, under this scenario, the total carbon footprint of LOC case drops from 68,224 kgCO_2eq to 49,269 kgCO_2eq, which equates to a fall in per meal emissions from 1.87 kgCO_2eq to 1.35 kgCO_2eq. Hence, under Scenario A a substantial reduction in emissions (20%) is possible, compared with the existing arrangements in the LOC case.

Figure 17: Emissions reduction under Scenario A " anaerobic digestion" (LOC)



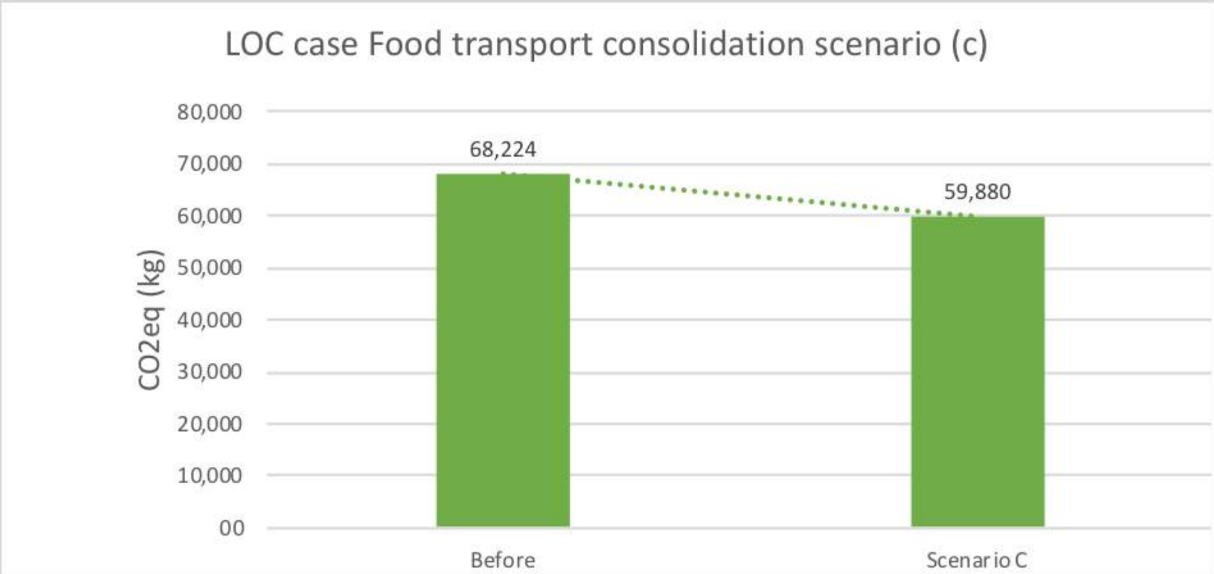
The second scenario we tested in LOC case was Scenario B "Menu adjustments". Under this scenario, we assumed that the beef meat on the menu is replaced proportionally with chicken meat by 50%. We also assumed that the FETA cheese in the meals is replaced by the less carbon intensive yoghurt. Figure 18 shows that the total emissions for LOC case would drop from 68,224 kgCO_2eq to 60,016 kgCO_2eq, a reduction of 12%. This equates to a fall in carbon emissions per average meal from 2.14 to 1.64 kgCO_2eq. Overall therefore, Scenario B results in emissions reduction, but at a more modest rate than Scenario A.

Figure 18: Emissions reduction under Scenario B “menu adjustments” (LOC)



The third scenario we examined was Scenario C "food transport consolidation". As the existing supply chain arrangements in LOC case involved 11 different suppliers transporting foods individually to LOW Caterer, of which half were located a far distance from LOC Caterer's facilities, we assumed that five suppliers sourced the catering for all foods, three local and two non-local. We then tested what would be the effect on transport emissions of this reduction in the number of suppliers. As Figure 19 shows, the fall in total emissions in LOC case is modest, from 68,224 kgCO_2eq to 59,880 kgCO_2eq (12%). This equates to a fall in emissions per average meal from 2.41 kg CO_2eq to 1.64 kg CO_2eq. Therefore, Scenario C results in a smaller reduction in emissions compared with Scenario A, and the same reduction as Scenario B.

Figure 19: Emissions reduction under Scenario C "transport consolidation" (LOC)



The final scenario we examined (Scenario D) involved combining the actions in Scenarios A and C. Hence, we tested what would be the reduction in carbon emissions from switching LOC case waste disposal method from landfill to anaerobic digestion, and decreasing suppliers from 11 to five (three local and two non-local suppliers). As Figure 20 shows, this scenario would result in a total drop in emissions from 68,224 kgCO_2eq to 40,818 kg CO_2eq, a substantial reduction of 40%. This equates to a fall in emissions per average meal from 2.41 to 1.12 kgCO_2eq.

Figure 20: Emissions reduction under Scenario D "combination scenario" (LOC)

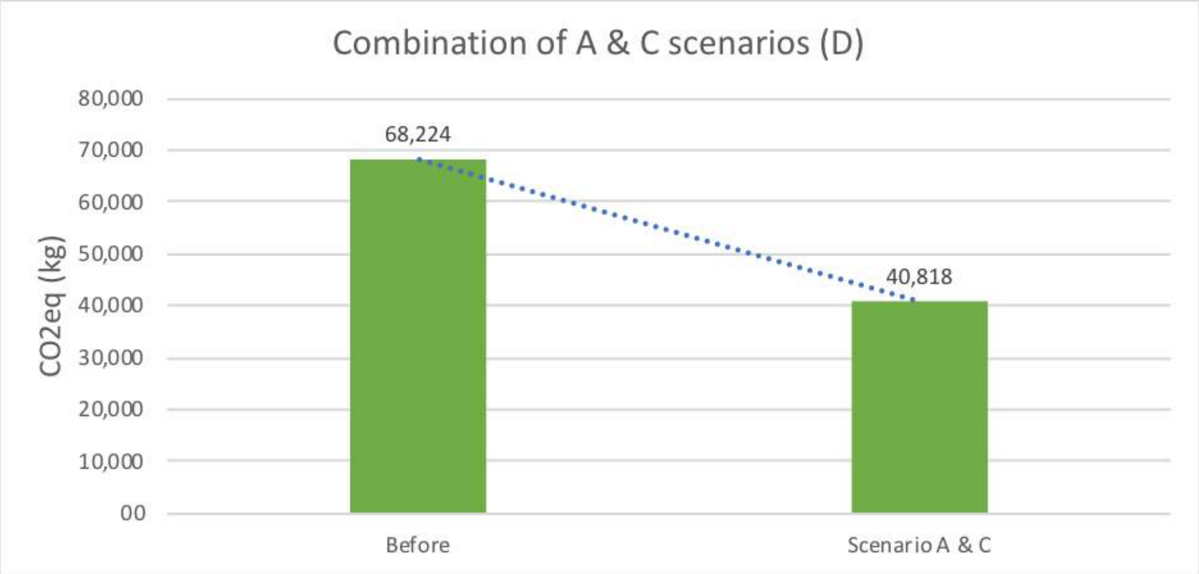
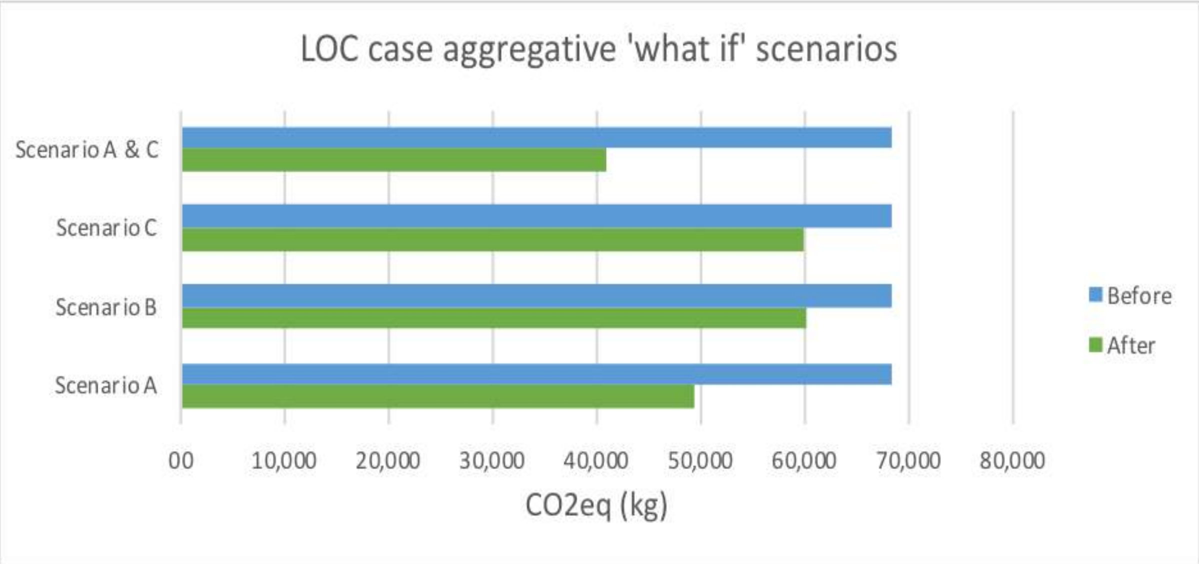


Figure 21 summarises the results of the preceding scenario analyses. It confirms that the combination of anaerobic digestion and transportation consolidation (Scenario D) is the most effective strategy to reduce carbon footprint in Kastoria LOC case, leading to the most substantial reduction in emissions. The second most effective strategy is Scenario A, where the food waste destination switches from landfill to anaerobic digestion. Overall, efforts to consolidate transportation alone, and efforts to adjust menus alone, would lead to only modest reductions in total carbon footprint, therefore, from an environmental perspective, these would be less effective strategies than the other scenarios mentioned.

Figure 21: Summary of scenario analyses in Kastoria (LOC) case



Lastly, it is evident that the waste management could impact in decreasing the total carbon footprint of the school meals in both cases. As a result, a combination of the waste management scenario with the environmental friendly food items and/or few nearby suppliers would decrease the environmental impact of the school meals effectively.

5. ECONOMIC IMPACT OF SCHOOL MEALS SERVICES

In this Section, we report the results of the economic impact of the school meals services in the LOC and LOW cases. The measures of economic impact used in both cases were (i) local economic multiplier effect, and (ii) the economic value of the contract to suppliers. Economic value was estimated with the assistance of basic financial measures like turnover and growth rate and the dependence of the supply chain members on the school meals contracts in the case studies. The method to estimate local economic impact is given in the next section.

5.1. Methodology to measure local economic impact

The measurement of the local economic impact of the school meals services in LOW and LOC cases was based on the "Local Multiplier 3 (LM3)" methodology[17]. LM3 was developed by NEF Consulting and Adam Wilkinson (NEF Consulting, 2018) and, for this research, it aimed to measure the economic impact of the school meals supply chains on the local economies of Thessaloniki and Kastoria by tracing, respectively, the expenditures of LOW Caterer and LOC Caterer on their staff and suppliers in connection with their preparation of the school meals. In both cases, the impact was estimated by tracking the expenditures of a starting budget (i.e. the total budget provided by the state to fund a school meals service), through three rounds of spending. In practice, the analytical steps were as follows. First, the geographic dimensions of the local area were set. For both LOW and LOC cases, this was defined as a 50km radius from the facilities of the Caterer. Then, for each case, we tracked the budget expenditures as follows:

2. The first stage (LM1) records the transfer of the starting budget from the Ministry of LSS to the Caterer, to cover the cost of meals provision. Budget retention/leakage was determined by the geographic location of the HQ of the Caterer, relative to the 50km local area radius.
3. The second stage (LM2) involves tracking the expenditures of the Caterer on its staff, its first tier suppliers and other costs. Retention/leakage at this stage was determined by the geographic residence of staff, first tier suppliers and recipients of other cost expenditures, relative to the 50km local area radius
4. The third stage (LM3) captures the estimations of the expenditures of the first tier suppliers on their staff and upstream suppliers, related to the school meals contract, and the Caterer staff's personal expenditures.

The outcome of the LM3 calculation is a ratio reported between 1 and 3. Specifically, LM3=1 indicates that no economic values from the school meals contract have been retained within the local area, while LM=3 indicates that 100% values of the contract have been retained.

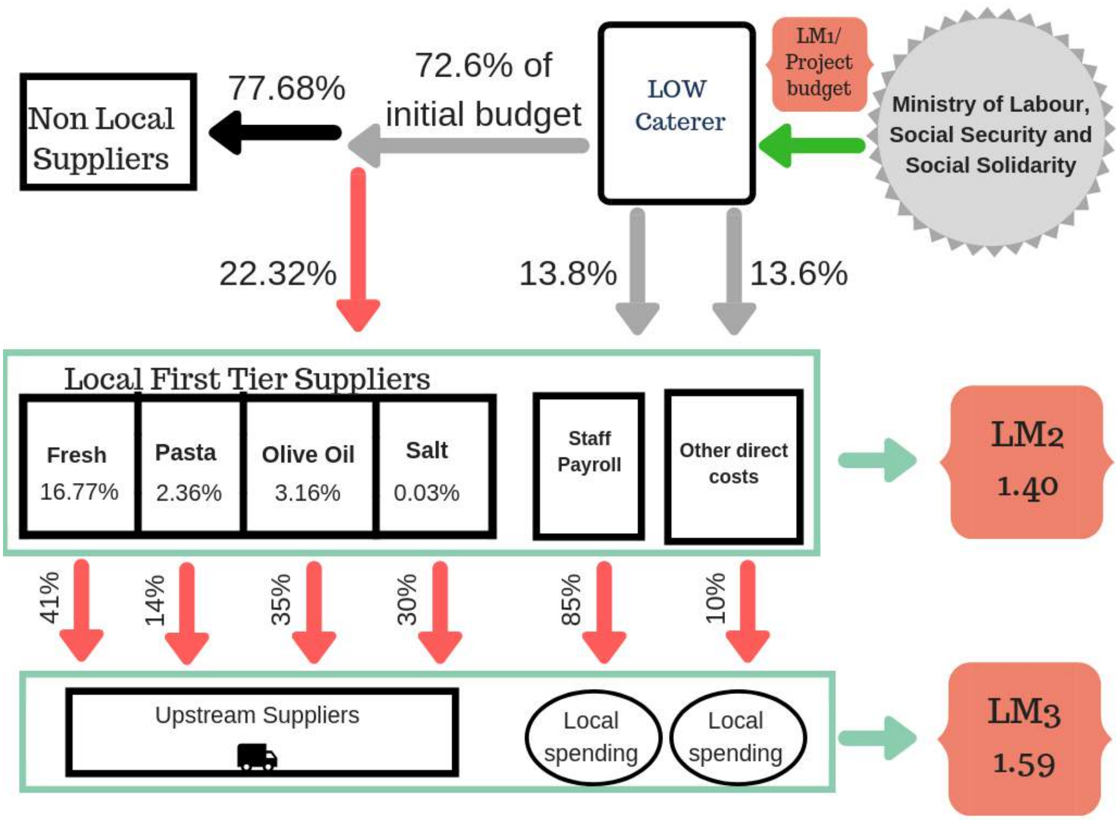
[17] Full explanation of the method is available at www.lm3online.com.

5.2. What are local economic multipliers of the school meals services?

The results from the LM3 analysis of Case 1 in Thessaloniki (LOW), are presented in Figure 22. As can be seen, the LM3 ratio for this case is calculated as 1.59. This signifies that for every €1 spent by the Ministry of LSS in the budget for school meals in LOW case, an additional €0.59 is generated in the local economy (50km radius from LOW Caterer facilities).

The explanation of this result is as follows. First, LOW Caterer receives the starting budget directly from the Ministry of LSS. As the company's headquarters are located within the radius of the study area, the initial budget receipt is considered to be 100% local (LM1=1). The expenditures of LOW Caterer include staff payments (which were 13.8% of the starting budget), payments to first tier suppliers (72.6% of starting budget) and other direct costs (13.6%). At this stage (LM2), the local economic multiplier is estimated at 1.40. At the next stage (LM3), as LOW Caterer's workforce resides in the local area, 85% of the amount spent on staff in Round 2 is estimated to be re-spent locally. However, other direct costs are mostly directed outside the local area (taxes, interest etc.) leaving only 10% re-spent locally. In terms of the respend of first tier supplier incomes, the majority of LOW Caterer's supply expenditure (77.68% of supply budget) is directed to non-local suppliers who are located far from Thessaloniki. Therefore, although "Fresh Supplier" (a local supplier) spends 41% on local farmers (fresh vegetables), the expenditures of the other suppliers account for very little amounts, therefore these expenditures do not have any substantial economic effect in the local area.

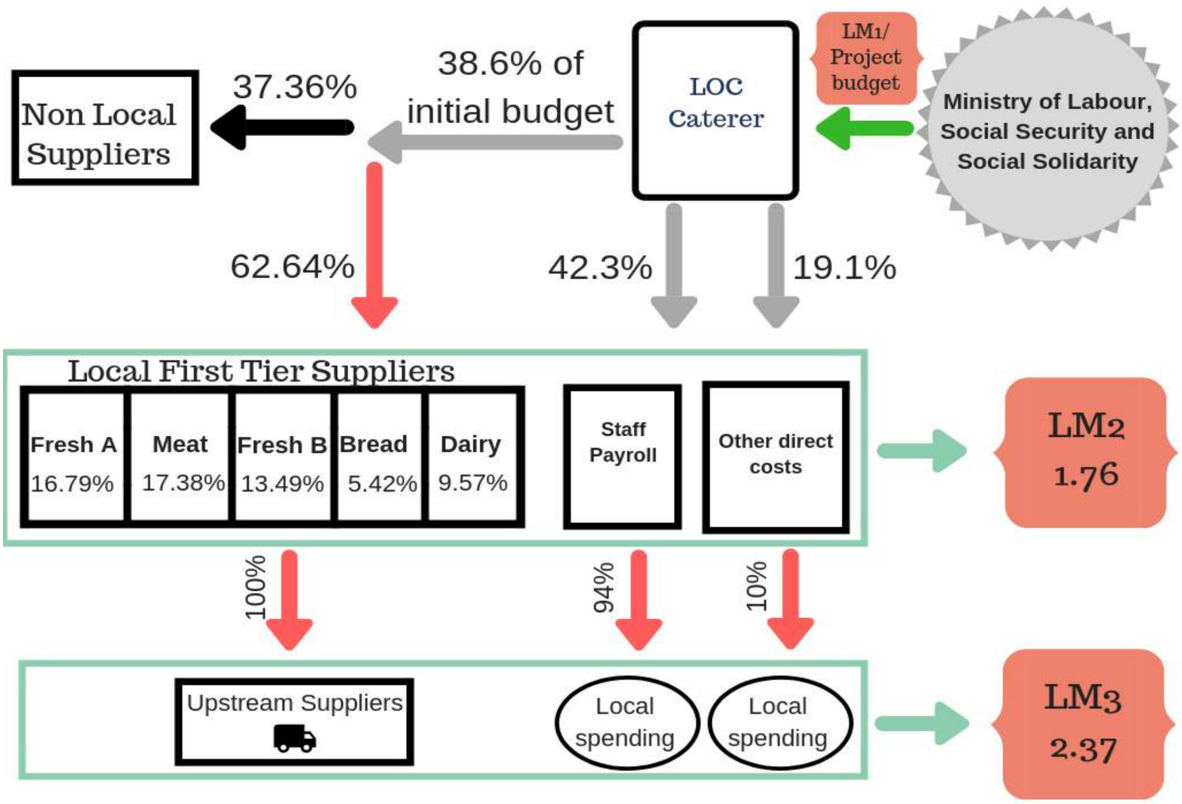
Figure 22: Local multiplier analysis (LM3) of Case 1 (LOW) school meals service



The results from the LM3 analysis of Case 2 in Kastoria (LOC), are presented in Figure 23. As can be seen, the LM3 ratio for this case is calculated as 2.37**.** This signifies that for every €1 spent by the Ministry of LSS in the budget for school meals in LOC case, an additional €1.37 is generated in the local economy (50km radius from LOC Caterer facilities).

The explanation of this result is as follows. First, LOC caterer receives the starting budget directly from the Ministry of LSS. As the company's headquarters locate within radius of the study area, the initial budget is considered to be 100% spent locally (LM1=1). The expenditures of LOC Caterer include staff payments (which were 42.3% of the starting budget), payments to first tier suppliers (38.6% of starting budget) and other direct costs (19.1%). The difference between the staff payments of LOW caterer and LOC caterer is attributed to the operating facilities since the LOW caterer operates from the headquarters with more advanced equipment while the LOC caterer operates through its local facilities in Kastoria. At this stage (LM2), the local economic multiplier is estimated at 1.76. At the next stage (LM3), as the vast majority of the workforce resides in the local area 94% of the amount spent on staff in Round 2 is estimated to be re-spent locally. However, other direct costs are mostly directed outside the local area (taxes, interest etc.) leaving only 10% re-spent locally. In terms of the respend of first tier suppliers' incomes, the majority of LOC Caterer's supply expenditure (63% of supply budget) is directed to local suppliers with sites in Kastoria municipality. Of these, LOC Fresh Supplier A and LOC Fresh Supplier B (fresh vegetables), which account for 30.28% of LOC Caterer's total supplier expenditure, spent 100% of their incomes on local farmers, as did the LOC Meat Supplier (17.38% of LOC Caterer's supplier expenditure), the LOC Dairy Supplier (9.57%) and the LOC Bread Supplier (5.42%). The remaining LOC Caterer supplier expenditures are directed to non-local upstream suppliers.

Figure 23: Local multiplier analysis (LM3) of Case 2 (LOC) school meals service



Overall therefore, the LM3 analysis shows that the spending of the school meals budget in LOC case had a higher local economic multiplier effect than in LOW case. The main reason was that close to two thirds of the supplies budget in LOC case was spent on firms within the 50km local area, whereas in LOW case only 22% of the supplies budget was spent locally. In addition, although a slightly smaller proportion of the payroll expenditure in LOC case was on staff residing in the local area compared with LOW payroll expenditure, these staff costs comprised a much greater proportion of the overall school meals budget in LOC case (42%) compared with the proportion in LOW case (14%).

5.3 'What if' scenarios to increase local economic multipliers

Case 1 Thessaloniki: Four scenarios were developed to explore the possibility of a better LM3 indicator, compared with the existing situation.

Scenario A: The most impactful scenario involves the assumption that LOW Caterer adopts the procurement adjustments described in the Scenario C of the environmental impact scenario analysis (Section 4.6.1), namely Food Transport Consolidation. Under this scenario, LOW Caterer procures from four suppliers in total, two local and two non-local. The results of the LM3 analysis show this scenario would generate a maximum **2.32** score for the LOW case which is higher by **73%** than the existing one.

Scenario B: The second most feasible scenario would involve LOW Caterer switching from three existing suppliers that are non-local (LOW Beef Supplier, LOW Chicken Supplier and LOW Bread supplier), to local alternatives. The results of the LM3 analysis show this scenario would generate a **2.08** indicator which is higher by **42.5%** than the existing one.

Scenario C: This scenario assumes that LOW Caterer continues to procure meat from LOW Chicken Supplier but hires local suppliers for Beef and Bread. Under this scenario, the LM3 indicator would drop dramatically from Scenario B to **1.78**.

Scenario D: Finally, this scenario assumes that LOW Caterer substitutes LOW Frozen Vegetable Supplier, which is a non-local firm, with an alternative local supplier. Under this scenario a **1.87** indicator would be generated. All other scenarios require that almost all suppliers are local.

Figure 24 summarises the above results.

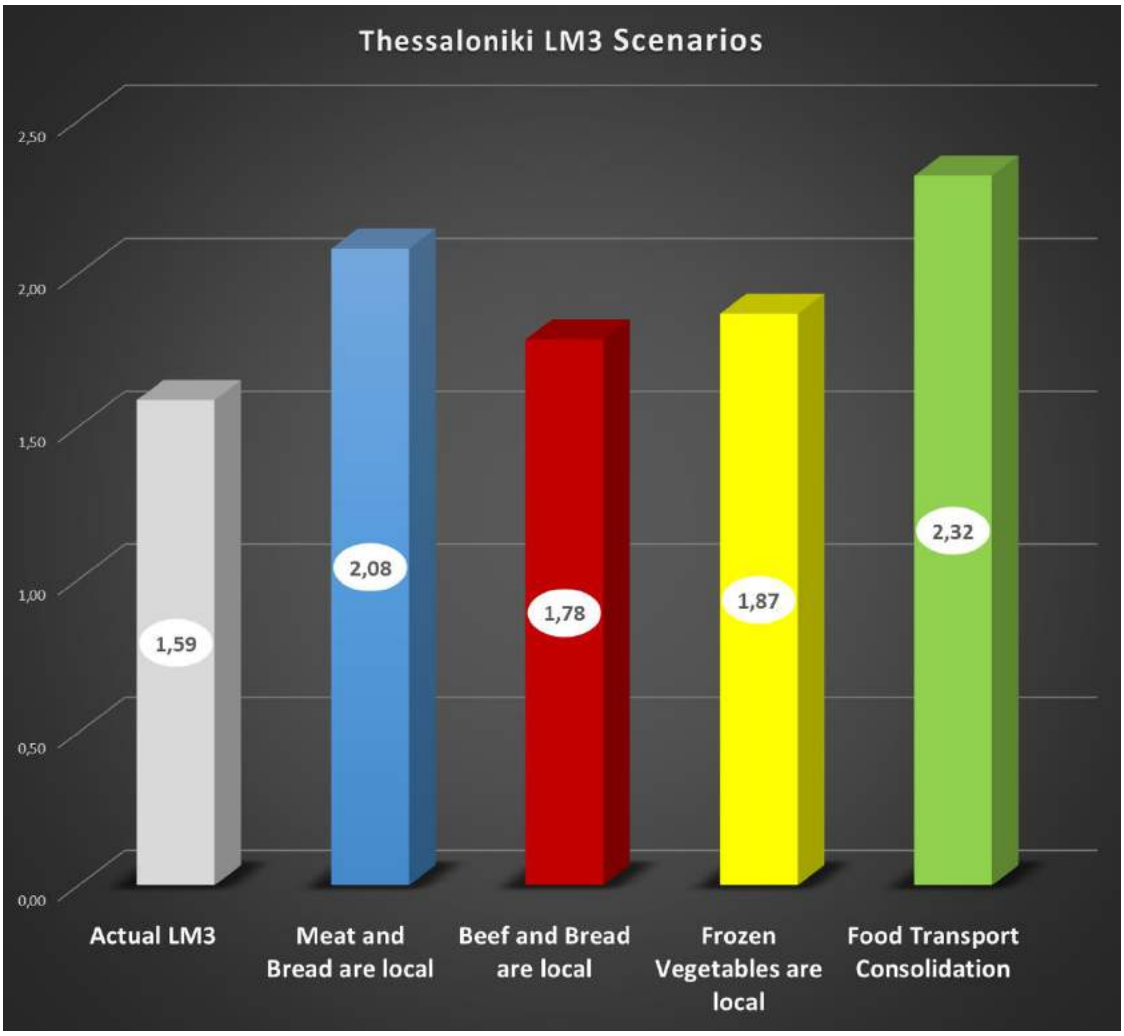


Figure 24: LM3 Scenarios for Case 1 Thessaloniki (LOW)

<u>Case 2 Kastoria:</u> Two scenarios were developed to explore the possibility of a better LM3 indicator for Kastoria school meals budget, compared with the existing situation.

Scenario A: The most impactful scenario involves the assumption that LOC Caterer adopts the procurement adjustments described in the Scenario C of the environmental impact scenario analysis (Section 4.6.1), namely Food Transport Consolidation. Under this scenario, LOC Caterer procures from five suppliers in total, three local and two non-local. The results of the LM3 analysis show this scenario would generate a maximum **2.47** score for the LOC case which is higher by **10%** than the existing one.

Scenario B: As almost all possible suppliers already have headquarters in the local area, further possibilities for increasing the number of local suppliers are limited. For example, olive oil supply can be only external as Kastoria area does not grow olive groves. Scenario B represents the only realistic switch, which would be to substitute the current, non-local, **Frozen Vegetable Supplier** with a local supplier if one exists. Under this scenario, a **2.45** indicator would be generated, which is almost the maximum.

Figure 25 summarises the results.

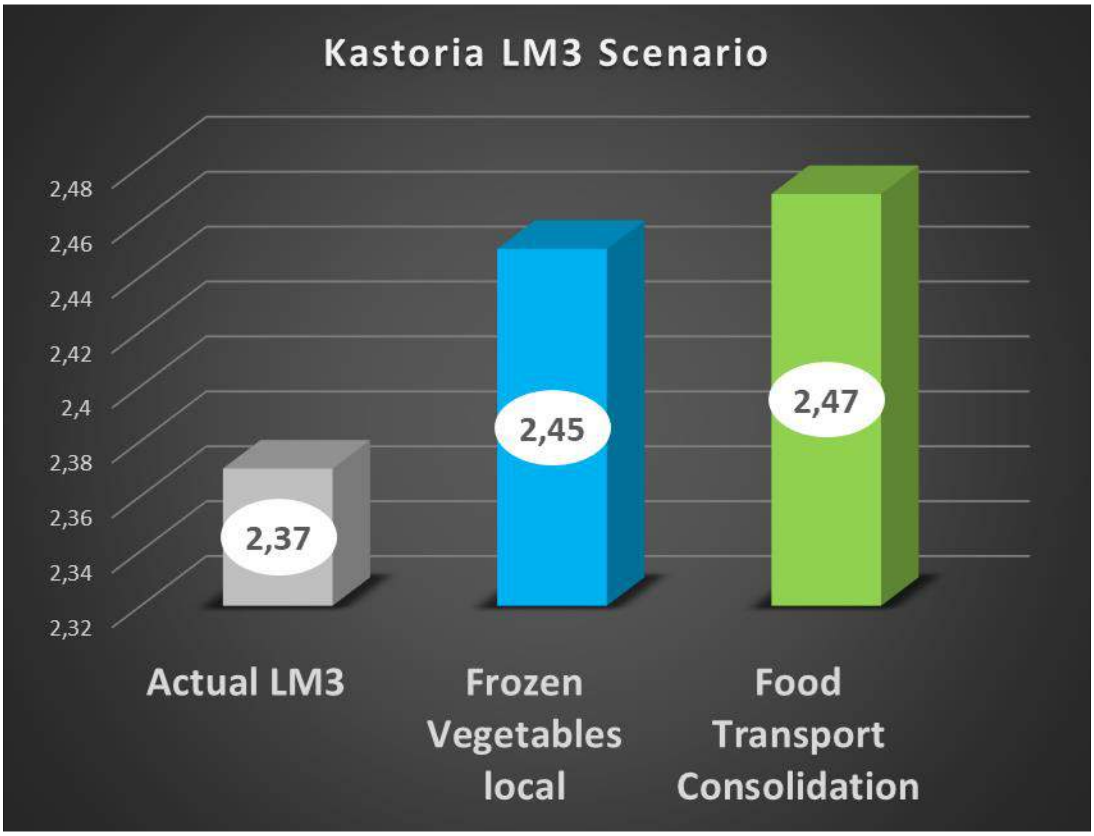


Figure 25: LM3 Scenarios for Case 2 Kastoria (LOC)

It is evident from Figures 24 and 25 that Food Transport Consolidation would maximize the potential of local economic multiplier effects for both LOW and LOC cases. However, this scenario does imply the most complex reorganisation efforts in the supply chains of all the scenarios. Similar results are possible with Scenario Bs, which imply more straightforward adjustments to procurement practices, assuming local alternatives exist (2.08 for Thessaloniki; 2.45 for Kastoria).

5.4. Economic value of the school meals service

To assess the economic value of the "School Meals" program as implemented in Thessaloniki and Kastoria, all firms who received income from the program budget in each case (the Caterer/first tier suppliers) were asked to give their employee numbers and turnovers, in order to obtain an estimate of the size of their businesses, and an estimation of their growth rates over the last 5 years. Moreover, the firms were asked to report what proportions of their total turnovers were accounted for by the school meals contract, and if there was any new business/product development related to the project. As the majority of supply chain members in both Cases were not willing to share financial data, we report the available results descriptively.

5.4.1 Economic value in Case 1 Thessaloniki (LOW) service

Three firms in the LOW case supply chain provided information on economic value of the school meals contract (Table 13). It is notable that the suppliers involved are characterized as medium-sized and large enterprises as they employ more than 50 or 250 employees (EU, 2018[18]). However, LOW Caterer allocates only 39 persons, out of a total of 645, to meet the "School Meals" program needs. As the companies present large turnovers, the value of the program contract to all of them is negligible, but managers expect the value to grow as the program will expand to more schools all over Greece. The companies' growth rates are mostly negative as the country was striving financially in the past few years, which has had a negative impact in all aspects of the Greek economy.

Table 13: Economic value of school meals contract in Case 1 Thessaloniki (LOW)

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 years
	(employees)	(turnover)		
LOW Caterer	645 (39)	€47,195m	0.5%	-23%
LOW Fresh Supplier	378	€84,210m	Negligible	19%
Rice Supplier	164	€26,9m	Negligible	-17.5%

5.4.2 Economic value in Case 2 Kastoria (LOC) service

Three firms in the LOC case supply chain provided information on economic value of the school meals contract (Table 14). Similar to the LOW case, the school meals contract is not a significant part of the enterprises' turnovers. Particularly, the LOC Caterer earns less than 1% of its annual turnover from the contract, while other suppliers earn negligible amounts. Nevertheless, according to the interviews, some first tier suppliers involved are small

[18] https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Enterprise_size

enterprises that operate efficiently and create added value, although they didn't reveal their annual turnover or employment data. A positive growth rate was reported for the two businesses operating outside the study area, but negative for the local company. This is partly due to the harsh economic climate of the Kastoria region in general.

Table 14: Economic value of school meals contract in Case 2 Kastoria (LOC)

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 years
	(employees)	(turnover)		
LOC caterer	748 (17 allocated to LOC school meals preparation)	€ 32,517m	0.98%	6%
LOC Fish Supplier	46	€18,923m	Negligible	45%
LOC Fresh Supplier B	30	€18,578m	Negligible	-43,4%
Rice Supplier	164	€26,9m	Negligible	-17,5%

5.4.3 Comparison of economic values in Cases 1 and 2

It is evident that for both Cases, the "School Meals" program represents a niche sector and has a minor role in suppliers' business operations. However, economic data collection refers to the pilot year of the project 2016-2017. At that time, school participation was limited all over the country, therefore contracts were few and low. In the school year 2018-2019, 954 primary schools participate in the program, a significant increase from an initial contract for 26 schools at the beginning of the program. In conclusion, school meal contracts could prove more attractive for caterers and their first tier suppliers, as the state funding grows. Also, it is owrth remarking that the companies from which data was gathered here were all large sized. It could be that the school meals contract represents a greater proportion of total business for the smaller sized suppliers. Unfortunately it was not possible to get the information from these firms.

6. SOCIAL IMPACT OF SCHOOL MEALS SERVICES

6.1 Methodology to measure social impact

The aim of the social impact analysis was to assess the social outputs of the school meals contract implementation in Thessaloniki (LOW) case and in Kastoria (LOC) case. The analysis took into account the following:

(a) *employment related aspects* – the number and the types of jobs generated through the school meals activities along the overall supply chain as well as the skills and the training aspects for maintaining the qualifications level of the companies in the school meals framework.

(b) *working environment characteristics and connectedness in school meals services* – under this heading, data were gathered firstly on the working environment and the job satisfaction of the employees that provide their services in the school meal supply chain and secondly the connectedness of the Caterers and the downstream suppliers' staff with the rural communities that produce the school meals' food ingredients (farmers, breeders and local processors – e.g. cheese products).

The results of the social impact analysis are mainly descriptive due to the small sample size in both case studies (LOW and LOC cases). Therefore, in the following subchapters, the social impact assessment is demonstrated under the the descriptive framework by revealing the collected data of the applied research in Thessaloniki (LOW) case and in Kastoria (LOC) case.

6.2. What are the employment-related impacts of school meals services?

6.2.1 Employment related impact in Case 1 Thessaloniki (LOW) service

Table 15 summarises the employee profiles of the suppliers in LOW case that were willing to share information. In terms of employment impact, 39 out of 645 staff at LOW Caterer were employed directly on the school meals contract, which represents 6% of the workforce. However amongst LOW first tier suppliers, as only very small/negligible proportions of their businesses were dependent on the school meals contract, the employment impact is also negligible for these firms. Similarly, the training profiles shown are not a consequence of the suppliers' involvement in the contract. However, it is interesting to view the types of employment arrangement that are in place amongst the companies that successfully competed to supply to the school meals contract.

Table 15: Employment related impact of school meals service in Case 1 (LOW)

Company name	Job Type		Employee profile		Skills/Training Development	
	FT	PT	M/F	Ethnic minority	% staff on training/with qualifications	Types/levels of qualifications
LOW Caterer	100%	0%	67% M	0%	100%[19]	-Cooking staff: HACCP and food safety aspects (ISO22000) -ERP for administrative staff. -Professional driving license for the delivery drivers of the school meals
LOW Fresh Supplier	N/A	N/A	74% M	N/A	100%	-Agronomist: field inspections -Processing/packaging: HACCP and food safety aspects (ISO22000) -ERP for administrative staff. -Professional driving license for the drivers
LOW Dairy Supplier	75%	25%	85% M	0%	100%	-Cheese production: school for dairy products, HACCP and food safety aspects (ISO22000) -ERP for administrative staff. -Professional driving license for the drivers
Frozen Vegetable Supplier	30% (50% season al)	20%	60% M	0%	100%	-Processing/packaging: HACCP and food safety aspects (ISO22000) -ERP for administrative staff. -Professional driving license for the drivers
LOW Olive Oil Supplier	100%	0%	65% F	0%	100%	-Processing/packaging: BRC, HACCP and food safety aspects (ISO22000) -ERP for administrative staff.

[19] In Greece is mandatory for the employers who work in the food industry to be trained in HACCP and food safety aspects (ISO22000).

						-Professional driving license for the drivers
LOW Bread Supplier	33%	67%	70% M	0%	100%	-Bread production: School for bakers, HACCP and food safety aspects (ISO22000) -ERP for administrative staff. -Professional driving license for the drivers

As regards to the employment profile of LOW Fresh Supplier, the employment rate that is related to the school meals is negligible and thus its calculation was not attributable. The company has 378 employees and 74% are men. When it comes to qualifications, the field auditors are agronomists and the personnel that work on the processing/packaging business level are trained with HACCP and other food safety aspects (ISO22000).

LOW Dairy Supplier employs 20 workers and 75% of them work full time and 25% seasonally. A share of 85% from the workforce are men and only 15% are female. The sector of cheese production is employed with graduates of the Greek Dairy Tech School and all of them have been trained with HACCP and food safety aspects (ISO22000). Training material is given to the employees in order to enhance the effectiveness of the quality standards of the company.

LOW Frozen Vegetable Supplier has 30 employees and 30% work full time, 20% part time and 50% seasonally. Regarding gender aspects, 60% of the personnel are men and none of the workforce belongs to ethnic minorities. Moreover, the company has trained its staff with HACCP and food safety certificates.

LOW Olive Oil Supplier has a total workforce of 25 employees and all of them provide their services full-time. The personnel of the company is 65% women and 35% men. Women work mostly at the production and packaging line. The company trains its staff for the food safety and HACCP aspects.

Lastly, LOW Bread Supplier employed 12 staff and 66% of them work part time. A share of 70% of them are men and all of them meet the qualification criteria of the company with internal and external training.

6.2.2 Employment related impact in Case 2 Kastoria (LOC) service

The employment profile of the school meals service in Kastoria (LOC) case is shown in Table 16. In terms of employment impact, 17 out of the 748 staff members at LOC Caterer were employed full time for the school meals, which represents <2% of the workforce. It is noteworthy that more women (70%) are employed in LOC Case than in LOW Case (33%). The kitchen staff that work on the school meals preparation sector are trained with the HACCP and food safety aspects (ISO22000). Similarly with Case 1, the administrative staff are trained with the company's ERP system and the drivers of the school meals are professional drivers.

In terms of the first tier suppliers, as with LOW case, only very small/negligible proportions of LOC suppliers' businesses were dependent on the school meals contract. Therefore, it is assumed that the employment impact of the LOC school meals contract, both in terms of jobs and training profiles, is negligible for first tier suppliers.

Table 16: Employment related impact of school meals service in Case 2 (LOC)

Company name	Job Type		Employee profile		Skills/Training Development	
	FT	PT	M/F	Ethnic minority	% staff on training/with qualifications	Types/levels of qualifications
LOC caterer	100%	0%	30% F 70% M	0%	100%[20]	-Cooking staff: HACCP and food safety aspects (ISO22000) -ERP for administrative staff. -Professional driving license for the drivers of the school meals
LOC Fresh Supplier A	26%	74%	39% F 61%M	0%	100%	- HACCP and food safety
LOC Meat Supplier	30%	70%	15% F 85% M	0%	100%	-Meat production: Slaughter and Butcher license, HACCP and food safety aspects (ISO22000) -ERP for administrative staff. -Professional driving license for the drivers
LOC Bread supplier	44%	56%	44% F 56% M	0%	100%	-Processing/packaging: HACCP and food safety aspects (ISO22000) - Bakery certification
LOC Fresh Supplier B	67%	33%	70% F 30% M	0%	100%	-Processing/packaging: GLOBAL GAP certification -ERP for administrative staff. -Professional driving license for the drivers

[20] In Greece is mandatory for the employers who work in the food industry to be trained in HACCP and food safety aspects (ISO22000).

6.2.3 Comparison of employment impacts in Cases 1 and 2

It is evident that all of the participating companies in both case studies follow the same training activities and types of qualifications. This happens because all companies are certified with Quality Systems such as ISO22000, HACCP or other more strict QS such as the BRC. Moreover, in Greece, it is obligatory that employees that work with food are trained with HACCP and food safety aspects such as ISO22000 and repeat the training program at least every three years. Therefore, all employees have been trained with the food safety criteria, however administrative staff enters the sector after their training with the company's ERP systems.

As for the job types, the employees of companies in LOC Case 2 demonstrate higher percentage of seasonality in comparison with LOW Case 1 since the catering in Kastoria operates with schools and the technological educational institution (Kastoria) which are closed in summer. Furthermore, it is noteworthy that more women have been employed at the companies that entered the school meals services of Case 2.

Lastly, the horizontal obligation of the food related companies to train their staff about HACCP and food safety aspects seems to have a positive effect on the training companies culture. Hence, the companies have advanced on training their staff and providing training material for the enhancement of the employees' effectiveness and the qualifications set. For instance, the employers trained for food safety related aspects, ISO22000 and HACCP all over the year.

6.3. What is the working environment and connectedness in school meals services?

The staff absence rate was taken into account in order to explore commitment of the employees to their job. Moreover, in-depth interviews with staff members in various positions offered a wider view of the social cohesion among stakeholders in the school meals supply chain.

6.3.1 Working environment and connectedness in Case 1 Thessaloniki (LOW) service

It was found that LOW Caterer's employees experience long-term relationships as the working environment is satisfying and managers offer support in contingency and offer financial and other supports to personnel in need, beyond statutory obligations. It is remarkable that LOW Caterer's staff absence rate is the same as the country's average (1.55%) and includes only illness leave. However, interactions with other supply chain members were found to be limited as only specific employees come into contact with those other members (e.g. Supply department with upstream suppliers, Drivers with school teachers and Managers with School management). This is mainly attributed to the more estranged environment of the big cities like Thessaloniki. Activities for community engagement such as events or festivals with the suppliers, caterers and schools didn't take place.

To this extent all first-tier suppliers reported typical and limited communications with others in the School Meals supply chain. So, there were no examples of suppliers engaging in field visits with schools, or participating in school project or community activities. This does not signify that they considered the working environment to be unpleasant. The LOW Fresh Supplier reported a Staff absence rate lower than the national average (1.1%) and all other suppliers reported a Staff absence rate the same as the national average.

6.3.2 Working environment and connectedness in Case 2 Kastoria (LOC) service

It was found that LOC caterer operates in Kastoria a kitchen/restaurant with local staff and suppliers. This creates a family-business environment as employees meet and interact with each other after work. Interaction with local suppliers like LOC Meat Supplier and LOC Vegetable Supplier happens on a daily basis and staff members have created friendly relationships above typical social interaction. Therefore, supply chain members are connected to each other both horizontally and vertically, as the "School Meals" program is a well-known project in the area. LOC Bread supplier not only provides goods to meet school meals needs but is also a retail bakery for staff members of LOC Meat Supplier, LOC Fresh supplier and vice versa. Drivers from every supply-chain member interact with each other daily and even hang out together. Members of the supply chain operate in a small town where the social cohesion is higher than a big city like Thessaloniki. Moreover, all members participate in the children's meals sector, an aspect which makes inter-relationships advance easier through the common social purpose. However, suppliers don't interact directly with schools themselves. In particular, the suppliers don't engage in the schools' community activities through events or festivals.

6.3.3 Comparison of environment and connectedness in Cases 1 and 2

The findings from LOW and LOC cases revealed that the working environment amongst the members of both school meals supply chains was good, with low rates of staff absence, In terms of connectedness however, it was found that staff in smaller cities and local supply chains can interact, communicate and hang out more easily than in larger enterprises or cities. Social cohesion was greater in Kastoria as the School Meals project signifies a common cause and benefit for all. The feeling that a member of the supply chain may serve the children of another member allows relationships to flourish easier. However, the School Meals impact could be complementary as Greeks in provincial areas tend to have social relationships with each other that could exist beforehand. On the other hand, Thessaloniki is more impersonal even when it comes to common cause. Neighbourhoods are larger than in small towns and people are more estranged. This results in typical relations among supply chain members that do not let people come together. Financial crisis also played a significant role in the social cohesion impact. Though people tend to be open to solidarity and voluntarianism, when it comes to earn a living they become rigid and unconcerned.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 What has been learned from this research?

This report has presented the results of WP6.3 research into the environmental, economic and social impacts of two different PSFP models for the provision of school meals in Greece. First, in a deprived municipality of the large city area of Thessaloniki a LOW case model was analysed, in which the contract was awarded according to the MEAT framework, and only a small proportion of suppliers (2 out of 8) were located in the municipality. Second, in the rural, mountainous municipality of Kastoria in north west Greece, a LOC case model was analysed, where despite the contract being awarded also according to the MEAT framework, a larger proportion of suppliers (5/11) were located in the municipality. In both cases, as nationally, school meals were introduced for the first time in 2016-17 by the Ministries of LSS and Education in a fully funded program to address social inequality risks. All meals are prepared by private catering firms under contract, and transported to schools to be eaten in classroom, halls, etc., as schools do not have any on-site kitchen or canteen facilities.

Overall, the research found that the LOC case model exhibited higher local economic impacts, and some qualitatively stronger social impacts (working environment and connectedness) than the LOW model. However, there were no notable differences between the models in terms of economic value of the contracts to suppliers, or employment and training outcomes. For environmental impact, the research found carbon emissions in the LOC model to be slightly smaller than the LOW model, however these differences were due to menu composition rather than the procurement model, and the greatest contribution to emissions in both models came from the high levels of plate waste and the chosen disposal method (landfill). As the research also observed some key differences in the socio-economic context and features of the two case study areas (rural with well-established social networks vs urban with weaker social fabric), these have implications for how different types of PSFP model may be implemented, and the potential for stakeholders to maximise sustainability outcomes from them. The next sections discuss these key findings.

7.2. How could environmental impacts of public procurement be improved?

In terms of environmental impacts, the research found that the carbon footprint of Kastoria LOC case was indeed slightly smaller than Thessaloniki LOW case, however the difference between the two was small (4.34 kg CO_2eq per kg of average meal in LOC case vs 4.89 kg CO_2eq per kg of average meal in LOW case). Moreover, although short chains result in less transport emissions (and enhance economic and social prosperity, see below), the procurement models themselves (geographical distance of suppliers) played only a minor role in this result, because transport emissions contributed only a relatively modest amount to total carbon footprint in both LOC and LOW cases. Instead, the main reason for the smaller emissions in

LOC case related to the composition of the meals: (i) a smaller amount of food was procured in total for the LOC average meal than LOW (430g vs 490g), (ii) LOC meals had a lower proportion of beef on the menus compared with LOW case. However, the most significant finding of this study in terms of environmental impact was the very high contribution of food waste disposal to total carbon footprint in both cases, which was due to the waste being disposed in landfill. We estimated that reductions in total carbon footprint of 31% (LOW case) and 20% (LOC case) would be possible if waste disposal switched to anaerobic digestion. These reductions would far outweigh those possible from either changing arrangements in the procurement model, and would also have more impact than increasing vegetables/reducing beef on the menus, in either case. The feasibility of switching the disposal method from landfill to anaerobic digestion is identified in scenarios (A) where the environmental impact dropped by 43% in the LOW case and 20% in LOC case. As a result, this recommendation is important to reduce the environmental impact of the school meals, although the lack of infrastructure in Greece limits the capability of adopting this strategy. It is evident that the development of the Anaerobic Digestion waste disposal method would create jobs and improve the environmental impact of food-waste management. Further actions have to be taken for the collection of the wastes from schools and their delivery to the Anaerobic Digestion sites. Of course, actions to reduce the amounts of plate waste from meals (e.g. optimization of meal portions) would also help reduce carbon footprint, whichever disposal method is used.

Therefore, to improve the environmental outcomes of the school meals services in both models, attention can be paid to the following actions, in priority order, for the greatest reductions in emissions: (i) switching disposal of plate waste from landfill to a more environmentally friendly alternative, and implementing ways of reducing levels of plate waste (e.g. optimization of meal portions), (ii) adjusting menu composition to reduce levels of meat (in particular beef) while increasing levels of fruits and vegetables according to the principles of the Mediterranean diet (at present, neither LOC nor LOW case menus contained any fruits and only quite a limited range of vegetables), (iii) exploring ways to reduce transport emissions by consolidating suppliers or making more use of local suppliers, where these can reduce kms travelled to transport foods.

7.3. How could economic impacts of public procurement be improved?

In terms of economic impacts, the research found that in both cases, the economic value of the school meals contracts to the firms involved (catering firms and first tier suppliers) was limited, as the value of these contracts represented only tiny/negligible proportions of their total businesses (based on data supplied by larger firms in the case samples). Nevertheless, the school meals program is forecast to expand in future years and so the potential for higher economic values to suppliers will increase, although it is not clear whether these increases will differ according to procurement model. The research also investigated the economic multiplier effects of the case models, and here a much clearer difference was found between the two cases. Specifically, the local economic multiplier effect of LOC case (LM3=2.37) was higher than LOW Case (LM3=1.59). The main reasons for this were that although a slightly smaller proportion of staff lived locally in LOC case, the total was still very high (90%), and a much higher proportion of LOC case budget was spent on payroll compared with LOW case (42% vs 14%). Moreover, the split of the LOC supplier budget between local and non-local firms was almost the reverse of LOW case, with close to two thirds spent on local suppliers. Based on these results, the scenarios developed so far, and the comparison between the two models, it is evident that the local economic impact of public procurement actions is maximized when supply chains entail the **"**locality**"** features of employing high proportions of local staff and allocating high proportions of budget expenditure to local firms. Organizations that reside and operate in the local area benefit their local economies far better than distant businesses that operate low-cost. Although it seems tempting for policy makers and public administrators to prefer low-cost models as it saves budget that can be spent elsewhere, local PSFP models generate more income for the areas in which the services are provided.

However, the economic impacts of different school meals procurement models can also be dependent on the socio-economic context of the area in which the service is provided. Deprived areas that are rural, remote and less alluring for large contractors can take advantage of the "local" model to optimize and maximize cash flows. This would result in higher demand and job creation as the "local" economy grows. On the other hand, deprived areas in the urban fringe could benefit from "low-cost" models as a measure of social security. As labour and capital mobility is easier and frequent in urban areas, citizens could be part of the production chain as this particular industry grows.

7.4. How could social impacts of public procurement be improved?

In terms of employment impact, the research found that in both cases, the number of jobs due to the school meals contract was very small for Caterers, and negligible for first tier suppliers, as the value of the contracts represented very small proportions of the firms' overall businesses (based on data from larger firms in the case samples). In terms of staff training and skills development amongst supply chain members, there was also no difference found between LOW and LOC cases - in both, mandatory processes were followed and examples existed of additional training/development activities. Hence, the research identified no differences between LOW and LOC models on these indicators.

In terms of working environment and connectedness, staff absence rates were reported as low in both LOW and LOC cases, and the impression from interviews was that the general relations between supply chain members were good. Beyond this, the research did identify key differences in social connectedness between the two cases. Specifically, in LOW case, relations between supply chain members tended to be based on the interactions between specific individuals necessary for tasks to be performed (e.g. catering firm drivers interacting with school managers to arrange deliveries), whereas in LOC case, supply chain relations were more extensive and 'matrix' in form, involving numerous opportunities for informal social interaction beyond specific tasks and jobs. These social impacts seem related to the socio-economic context of the two case study areas. In LOW case, the opportunities for connectedness are constrained by the impersonal urban fringe context, reinforced by the financial crisis which has created further tensions in the social environment. In LOC case, the rural context provides an existing social network 'platform' which the members of the supply chain in the case can build on, and which the school meals contract itself helps to reinforce. For example, through the school meals contract, LOC Caterer could take advantage of existing supplier relationships it had developed to service another local contract, and make economies of scale with them. Therefore, the school meals contract encouraged LOC Caterer to perform a 'channel captain' role based on a localisation strategy.

In both cases, the research found little evidence of connections between supply chain members in the school meals services and the schools themselves. Suppliers in both cases also did not seem to participate in school or community events relating to food, health or sustainability. Therefore, to improve these social impacts, specific actions are recommended. Training days, events and informative sessions at schools are two possible options to enhance the social impact of public procurement actions and bring supply chain members together. In fact, the involvement of social enterprises at the beginning of the project in 2016 helped marginal and deprived groups (drug addicts, people with disabilities) reintegrate in Greek society, feel part of it again and even contribute to the country’s GDP. Ever since, large tender companies have taken up most of the contracts and put aside social enterprises since the MEAT procurement model was adopted and SMEs could not challenge the participated large firms. Consequently, targeted procurement projects could assist people that are dependent on social security benefits to make a living of their own.

7.5. What policy interventions would help?

The introduction of EU Procurement Directive 2016 was designed to encourage improved sustainability outcomes of PSFP in Member States. In Greece, the Directive has been implemented by adopting the MEAT framework. Social and environmental provisions had not been adopted like in 2016, at the beginning of the project, where social enterprises participated in the school meals program. It is recommended to split large contracts into smaller lots in order to encourage SMEs application at the procurement level. Furthermore, awarding provisions for disposal methods and food waste monitoring strategies are recommended in order to set targets for food waste reduction along with health and nutritional related aspects. Moreover, it is recommended to adopt awarding criteria for caterers that emphasize in local food sourcing and foster the local-social cohesion.

Initiatives such as the mandatory adoption of eProcurement[21] by 2018 will assist Member States to optimize their procurement strategies. It would also create opportunities for SMEs to access public procurement and compete larger companies. However, the provision that contracts below €750,000 related to social services may not be published at the EU level could prove tricky, as procurements could be broken down to smaller projects in order to avoid EU monitor.

Other policy interventions would include the food waste management by developing the infrastructures for anaerobic digestion. This policy would positively affect the environmental outcome of the program as well as create more jobs that are attributed to the school meals. Furthermore, local economies development would be stimulated by using territorial strategies, like LOC caterer's strategy. The adoption of a "local tender policy" would ensure that not only staff but also supplier and other costs are spent within the area of need. Local farmers could supply the project tenders, thus retaining their occupation and contribution to the local economy too. It would also have a positive side effect as households save income that could be spent elsewhere.

7.6. What local/practice interventions would help?

The expansion of the project in more LOC procurement models would reduce carbon footprint due to shorter supply chains and provide healthier food to Greek pupils. However, adjustments and optimization, according to pupils' real needs, has to be done as excessive food waste is not only an environmental but also an economic issue. Moreover, the adoption of a more Mediterranean-diet menu would: i) reduce production carbon footprint as vegetables emit less than livestock, ii) improve pupil diet and nutrition, iii) support Mediterranean agricultural products (olive oil, tomatoes, nuts, cheese, fruit) over trans-fat products (butter, red meat etc.).

Social provisions could be implemented, particularly in urban areas where social solidarity is lower and creates marginal groups of people. This would offer an opportunity for vocational training not only to marginal but every interested part of the society to obtain new skills. For instance, food related events or festivals with the food suppliers, caterers and schools would enhance the social engagement. Collaboration between the members of the school meals supply chain and the schools could be led by the "Channel captains" like the caterers. To this extent, the collaboration between school managers, the pupils' parents, and the chain members is of vital importance in order to improve the school menus at local level and the cost-benefit framework of the school meals implementation. Furthermore, an open forum for the school meals where specialists, caterers, suppliers, school managers and active parents would produce results for advancing the relationships between the chain actors and improving both the functionality and the outcome of the school meals program.

[21] https://ec.europa.eu/growth/single-market/public-procurement/rules-implementation_en

The establishment of the Unified Independent Public Procurement Authority[22] in 2011 is a ground base for the adaptation of the eProcurement initiative directed by the European Commission by the end of 2018. Harmonization with pan-European standards and procedures would enhance the credibility of the agency but also its efficiency.

Local actors may be influential for improving the school menus, find the optimal portion sizes per school, or even per class, and bring suppliers and schools together. For this purpose, opening projects or initiating training sessions and events by local actors or local associations would help developing relationships between schools and chain member, improve the socio-economic aspects of the program, reduce the food waste and enhance the pupils' dietary status.

[22] http://www.eaadhsy.gr/index.php/category-articles-eaadhsy/18-c-nomiko-arxis/19-n-4013-2011

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The Strength2Food project in a nutshell

Strength2Food is a five-year, €6.9 million project to improve the effectiveness of EU food quality schemes (FQS), public sector food procurement (PSFP) and to stimulate Short Food Supply Chains (SFSC) through research, innovation and demonstration activities. The 30-partner consortium representing 11 EU and four non-EU countries combines academic, communication, SMEs and stakeholder organisations to ensure a multi-actor approach. It will undertake case study-based quantitative research to measure economic, environmental and social impacts of FQS, PSFP and SFSC. The impact of PSFP policies on nutrition in school meals will also be assessed. Primary research will be complemented by econometric analysis of existing datasets to determine impacts of FQS and SFSC participation on farm performance, as well as understand price transmission and trade patterns. Consumer knowledge, confidence in, valuation and use of FQS labels and products will be assessed via survey, ethnographic and virtual supermarket-based research. Lessons from the research will be applied and verified in 6 pilot initiatives which bring together academic and non-academic partners. Impact will be maximised through a knowledge exchange platform, hybrid forums, educational resources and a Massive Open Online Course.

Strengthening European Food Chain Sustainability by Quality and Procurement Policy

Deliverable No: D6.3

EVALUATION OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF DIFFERENT MODELS OF PSFP IN A SCHOOL CONTEXT:

ITALY COUNTRY REPORT

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Academic Partners

1. **UNEW**, Newcastle University (United Kingdom)
2. **UNIPR**, University of Parma (Italy)
3. **UNED**, University of Edinburgh (United Kingdom)
4. **WU**, Wageningen University (Netherlands)
5. **AUTH**, Aristotle University of Thessaloniki (Greece)
6. **INRA**, National Institute for Agricultural Research (France)
7. **BEL**, University of Belgrade (Serbia)
8. **UBO**, University of Bonn (Germany)
9. **HiOA**, National Institute for Consumer Research (Oslo and Akershus University College) (Norway)
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25. **MPNTR**, Ministry of Education, Science and Technological Development (Serbia)
26. **Konzum**, Konzum (Croatia)
27. **Arilje**, Municipality of Arilje (Serbia)
28. **CPR**, Consortium of Parmigiano-Reggiano (Italy)
29. **ECOZEPT**, ECOZEPT (Germany)
30. **IMPMENT**, Impact Measurement Ltd (United Kingdom)

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Extended abstract

This country report presents and discusses the main findings of the sustainability analysis of the school meals service in Italian primary schools. The three dimensions of sustainability (i.e. environmental, economic and social) have been investigated in relation to two territorial case studies: Parma and Lucca school meals services. These two cases show two different food procurement models: local-organic for Parma and organic for Lucca. The case classification relates to the school meals service contract specifications: more local-organic (LOC-ORG) oriented in the Parma contract and more organic (ORG) oriented in Lucca.

Parma and Lucca cases also differ in terms of the organisation of the meals preparation and distribution. In Parma, the meals organisation is hybrid in the sense that the majority of the schools are served by a central kitchen, whilst a small number have their own internal kitchens, where the meals are prepared by adopting the same menus and recipes of the central kitchen. In Lucca, meal preparation is completely centralised. The school kitchens' role is limited to composing and serving the meals.

Parma case comprises 29 suppliers, while Lucca case is 9. The difference in the number of suppliers is a consequence of the model adopted to manage the supply chain. In both cases, the main role in the school meals supply chain is played by the caterer, which is the recipient of the benefits and obligations deriving from the contract. ParmaCater is a national big firm with headquarters outside Parma, while LuccaCater is a small-medium firm very connected with the territory and with headquarters within the Lucca province. The economic size of the caterer affects the suppliers' selection and management. In the case of Parma, all the suppliers are specialized in specific food categories, and almost all of them have a medium-large size. In the case of Lucca, there are suppliers specialised in one single food category and suppliers providing many categories of foods. There are thus differences in each caterer's supply chain structure, which relates to the caterer's bargaining power and its economies of scale. In other words, the bigger the caterer is, the more attractive the contract is for suppliers, as a higher number of school meals contracts lowers the suppliers' management costs.

The measure of environmental impact used for the school meals services was carbon footprint. In particular, we estimated the carbon emissions from the agricultural production, food processing, transportation, and food waste management of the meals served to a sample of five schools per case study. The Parma school meals service showed a lower carbon footprint (956gCO_2eq per meal) than in Lucca (1,046gCO_2eq per meal). This difference (Parma was -9% of Lucca) was mainly due to the greater share of fruit and vegetables and lower impact of ready meals products in Parma. In both cases, dairy products showed the highest impact together with ambient food. Within the dairy category, hard cheeses (Parmigiano-Reggiano, Grana Padano and Pecorino cheese) registered the highest total impact. In terms of local transportation, the emissions from central kitchen to schools were found to be very small, however, the transportation of food from suppliers to caterers was more substantial, especially in Parma, where local transport emissions were 18% of total carbon footprint, compared with 7% in Lucca. It is noteworthy that 24 suppliers out of 29 involved in the Parma school meals supply chain are located more than 100kms from Parma, while in Lucca the average distance is much lower. We estimated also the impact of food waste management on the basis of the quantity of food served and not eaten by the children (plate waste), and of the waste management method. According to the estimation carried out after a plate waste study in four

schools (two for each case), both the school meals services exhibited a very high level of food waste corresponding to 26% of the total volume of served food for Parma and 38% for Lucca. In Parma as in Lucca, the method adopted for food waste treatment is composting. This is one of the most sustainable waste management in comparison with landfill. The total impact was indeed very modest both in Parma and in Lucca (no more than 1% of the total impact). The procurement scenarios analysis revealed that substituting frozen fruit and vegetables with fresh products does not provide significant reductions in carbon emissions, thanks to the high share of fresh fruit and vegetables already included in meals preparation. Similarly, the scenario of total substitution of beef with poultry meat resulted in a very low emission impact improvement. More significant was the substitution of other single food items. For Parma, the substitution of the current canned tomatoes with a local product would reduce total emissions by 3.5%, whereas for Lucca the substitution of the breaded cutlet with fresh poultry meat would mean a reduction of almost 10% in total emissions.

The economic impact assessment of the school meals service was developed through the implementation of LM3 methodology and the economic analysis of the key suppliers. The aim of LM3 is to identify the proportions of money retained within the local area at different levels of the supply chain. LM3 indicates the contribution of the school meal service to the local economic development. The financial flows are tracked starting from the City Council budget to second tier suppliers' expenditure. Lucca LM3 indicator was 6.3% higher than the same indicator for Parma. The slightly higher ratio in Lucca was due to the higher proportion of first tier suppliers located within the local area, which permits retention of 68% of the initial budget within the area at the second LM3 level versus 53% in Parma. The main finding of the economic value analysis is that the suppliers' organisation pattern relies on caterer size, i.e. on the caterer's bargaining power towards suppliers. In general, the share of suppliers' turnover due to Parma and Lucca school meals service contract was very low, so we can argue that the participation of suppliers in new public school meals service tenders relies on the suppliers' specialisation and targets, rather than on a single contract.

Finally, the social impact analysis aimed to assess the community engagement within, and social contribution of, the school meals service contracts in each case, from caterers and their suppliers. In addition, the degree of connectedness within the supply chain was evaluated. All the key suppliers exhibit strong commitments toward their staff, in the form of qualifications training, financial support to staff's families, and engagement in gender equity. In some cases, suppliers adopted social responsibility initiatives, in the form of sustainability/social reports, offers of internships for students, firm study tours, and charitable activities. However, the suppliers' involvement in local engagement projects with the school meals contract remained marginal. The direct participation of suppliers within school initiatives and events was weak, and in some cases, their participation was only indirect, such as the delivery of ethnic foods in the context of ethnic meal projects. The prominent role in coordinating social activities at the local level was covered by both the caterers, who proposed several projects in collaboration with their respective City Councils. The analysis of the relationships among suppliers within the supply chain showed a strong level of vertical coordination within the supply chain by each individual supplier and between suppliers and the caterer. Horizontal coordination among suppliers within school meals contract was substantially absent. This appeared as a missed opportunity that might be exploited in the future.

Overall, both Parma and Lucca pay attention to local products with the aim to include territorial ingredients in the school meals. However, only in Lucca case, a project with the specific aim to enhance a local food supply chain has been carried out. This project concerns the Garfagnana trout, a local trout raised in local farms, and it aimed to support the rural community. The Lucca school meals service thus offered to children the opportunity to discover and taste a product rooted within the territory and, at the same time, contributed to rural development. In Parma case, even though there were not clear commitments towards rural communities and relationships with local farmers, local products were included in school menus, such as Parmigiano-Reggiano and Prosciutto di Parma, providing a non-negligible contribution to local rural areas. However, Parma and Lucca schools fall into territories very rich in terms of quality agri-food products (PDO, PGI, organic), therefore it is relatively easy (i.e. low transaction costs) to identify local food suppliers able to be part of a school meals service contract. The variety of agriculture in these areas offers also the opportunity to develop specific projects with several objectives: increasing the understanding of children, their families and teachers towards local agriculture, sustaining agriculture (also in lagging areas, as in the mountains), contributing to rural viability and reducing the environmental negative externalities due, for instance, to transportation. Furthermore, the LM3 findings suggest that greater efforts for involving local producers will have positive effects on local economy including rural areas.

Finally, after the analysis carried out on the Parma case (LOC-ORG) and Lucca case (ORG), we can conclude with some recommendations for improving the sustainability of the entire school meals service supply chain. We can summarize the recommendations in four main points: 1) better specification of "local food"; 2) more prominent role of the City Council in selecting suppliers; 3) improving the connectedness within the meals service supply chain including community engagement; 4) reducing the food waste.

The local origin of food is a key variable affecting the local economic, social, and (to a lesser extent) the environmental impact of school meals. It is fundamental that tenders and subsequent contracts specify the meaning and boundaries of "local food" or "km0" food. The distance or radius from the meals service centre (e.g. City Council) should consider carefully the production area. Therefore, at contract design stage, a preliminary study about the local foods and corresponding volume potential can considerably help to define the spatial distribution of food and the corresponding distance limit to include in the tender. It is quite obvious that it is not possible to find all the food products within a local area, but some important foods included in school menus can be produced locally, for example fresh fruit and vegetables, cheese, tomato sauce and pasta. Local suppliers can therefore support local economy and rural communities, and can contribute to reductions in transport emissions.

A second aspect to be considered in preparing school meals service tenders is to encourage City Councils to take a more prominent role in identifying food suppliers. This result could be achieved through a separation of the food procurement activity from the meal preparation service, so that City Councils can keep the whole or partial responsibility in selecting food suppliers. This can apply for all the products or only for some specific categories (e.g. fresh fruit and vegetables, fresh meat, dairy products), or specifying in the contract the participation of the City Council in selecting suppliers. This can contribute to balancing the reasonable economic objectives of the principal contractor (i.e. the caterer) with the more general objectives of the City Council.

Third, the present analysis demonstrated that most firms involved in the school meals service contracts have the skills and resources for developing initiatives addressed to schoolchildren and local communities. Study tours organised, within firms and farms, to understand the origin of food, projects on the diversity of food and food culture, or on specific (local) food supply chains, are just some examples of projects requiring the involvement of different actors belonging to the school meals service supply chain. Some similar projects have been developed by Parma and Lucca schools or are still in progress. However, in all these experiences, the involvement of food suppliers, beyond the caterer, is quite marginal or missing. A greater participation of suppliers can thus produce benefit for the entire service and for the local community. In this respect, canteen commissions could promote an important action of project proposal and solicitation. We believe that the costs for these initiatives are greatly lower than the benefits.

Fourth, food waste is one of the most important issues resulting from this analysis, in both cases. Food waste means also waste of environmental and economic resources. It is crucial to revise the current model of preparation and distribution of meals, because although the current menus aim to achieve the right nutritional intake, and much effort is made to enhance quality and provenance of the ingredients, children seem to dislike a significant share of what is served to them. Different actions could be proposed in this respect: improving the food culture understanding among children, through more and new initiatives to discover the food benefits by involving food suppliers (e.g. study tours, laboratories), improving the presentation/taste of served meals, and identifying tailored menus according to needs and preferences of children. Exploring experiences at international level in dealing with food waste in school canteens could be also considered.

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List of Abbreviations and Acronyms

BCFN: Barilla Centre for Food and Nutrition

BRC: British Retail Consortium

EPD: Environmental Product Declaration

EU: Europe

F&V: Fruit and Vegetables

GMO: Genetically Modified Organisms

GPP: Green Public Procurement

HACCP: Hazard Analysis Critical Control Point

HQ: HeadQuarter

IFS: International Food Standard

ISEE: Indicatore Situazione Economica Equivalente (Equivalent Economic Situation Indicator)

IT: Italy

LCA: Life Cycle Assessment

LM3: Local Multiplier 3, method developed by New Economics Foundation

LOC-ORG: local - organic

NGO: Non-governmental Organisation

ORG: organic

PDO: Protected Designation of Origin

PGI: Protected Geographical Indication

ROW: Rest of the World

TSG: Traditional Speciality Guaranteed

1. Introduction & Methods

This country report presents the findings of WP6.3 research into the sustainability outcomes of primary school food chains in Italy. Two case studies, with different procurement models, were compared: (i) a local and organic (LOC-ORG) model (Parma), in which the procurement contract encouraged sourcing of foods from within a local/regional areas and a minimum amount of organic materials of the food employed for meal preparation (70% of total); (ii) an organic (ORG) model (Lucca), in which the procurement contract specified that the majority of foods used in meal preparation must be of organic origin. In both cases, our research involved measuring the carbon footprints, the local economic impacts and the social impacts of the procurement chains supplying food to the schools.

The study was conducted in two municipalities, which are also administrative centres of their provinces: Parma (Case 1) located in Emilia-Romagna Region, in the North of Italy, and Lucca (Case 2) in Tuscany Region, in the Centre of Italy.

The proposed menus are drawn up in accordance with National and Regional Guidelines that establish the reference for the energetic content and nutrient intake referred to the school meals, also taking into account a certain frequency of consumption associated to the different food groups. Our intention was to compare two case studies referring to two different regional guidelines, but comparable in terms of geographical characteristics.

The fieldwork for Parma case study started first, in February 2017, with desk research. Thereafter, the bulk of primary data collection was conducted in October 2017 for both Parma and Lucca case studies, with follow up in winter and spring 2018, and with completion work in winter 2018. The data collection included two preliminary meetings for both the case studies, one in November 2017 and the second in January 2018 for Parma, while they took place in January and July 2018 for Lucca case study. The informants were the Officers from the Operative Units for school catering services, the local managers and the catering supervisors of the two catering firms involved in Parma and Lucca case. With the officers and the managers, several email and telephone exchanges occurred in the period between and after the face-to-face meetings. The telephone and email exchanges provided the main sources of information about economic and environmental impacts of the school meals chain and partially for the social dimension, since in this case, relevant data were obtained in supplier websites. The internet represented the most relevant source of information on contract tender documents, school menu information and company databases. A meeting with the local manager of Parma Cater also took place some days before the data collection of plate waste referred to in WP6.2, to know the peculiarities of food procurement for those schools with internal kitchens compared to those supplied by the cooking centre. The face-to-face meetings with catering supervisors instead aimed to know how the school lunches were organised and how the food waste was managed. The meeting lists for Case 1 and 2 are reported in Tables 1 and 2.

Table 1: Profile of face-to-face meetings in Case 1: Parma (LOG-ORG)

Identity	**Meeting Date & Duration**
Officer, Council Operative Unit for School catering service Local manager, *ParmaCater* (catering firm currently holding school meals contract)	23th November 2017, 1h 29th January 2018
Local manager, *ParmaCater* (catering firm currently holding school meals contract)	February 2018 0.5 h March 2018 0.5 h
Catering supervisor (ParmaCater), SchoolOne	February 2018 0.5 h February March 2018 0.5 h
Catering supervisor (ParmaCater), SchoolTwo	February 2018 0.5 h March 2018 0.5 h

Table 2: Profile of face-to-face meetings in Case 2: Lucca (ORG)

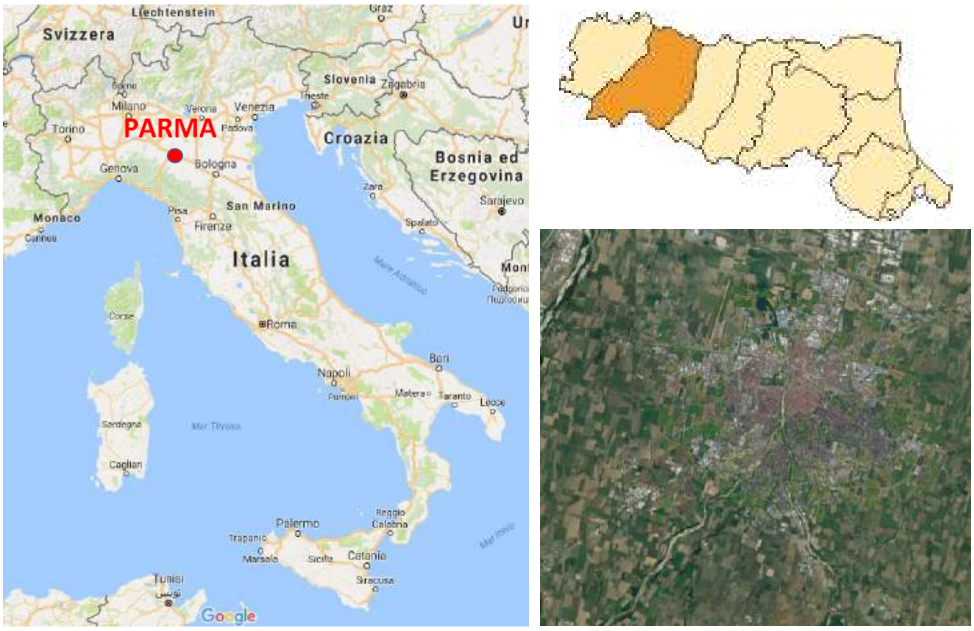
Identity	**Interview Date & Duration**
Officer, Council Operative Unit School catering service Manager, *LuccaCater* (catering firm currently holding school meals contract)	22th January 2018 1 h 4th July 2018 1 h
Catering supervisor (*LuccaCater*), SchoolOne	January 2018 0.5 h April 2018 0.5 h
Catering supervisor (*LuccaCater*), SchoolTwo	December 2017 0.5 h March 2018 0.5 h

2. Case 1 Parma (LOC-ORG) monograph

2.1 Profile of Parma

Parma is a city in the northern Italian region of Emilia-Romagna. It comprises an area of 260.6 km^2 (20th among 111 provincial capitals) with a density of 746 persons per km^2 (58th among 111 provincial capitals).

Figure 1: Geographic position of Parma in Italian peninsula and in the Emilia-Romagna Region



On January 1st 2017, there were 194,417 resident citizens in Parma (18th among 111 provincial capitals), of whom 47.7% were males and 52.3% were females. The population characteristics are similar to the national distribution: people aged until 18 years old represent a share of 15%, while people aged 18 to 35 years have a share of 19%, from 36 to 50 years 22%, from 51 to 65 years 20%, and over 65 years 25%. Children aged from 5 to 10, who represent the target of our research, are 10.556, i.e. 5.43% of the entire population.

The Parma territory is entirely flat, with two rivers defining its boundaries, the Taro River on the west part and the Enza River on the east, the latter separating Parma from the nearby province of Reggio Emilia. The Apennines mountain range is located about 15 km south, outside the municipal territory.

Parma benefits from a vast and fertile agricultural area, with a processing industry employing state-of-the-art technologies (particularly, in the tomato, pasta, and milk processing) and an impressive distribution network. Wines, liqueurs, Parmigiano Reggiano cheese and Prosciutto di Parma (Parma ham) are among the many GIs and world-renowned products of the area, made at both artisanal and industrial level. Parma features several of the most vital industrial sectors: mechanical (agricultural machinery and food industry), chemical, glass, pharmaceuticals. Tourism represents also an important economic sector, fostered by the monumental heritage of the city and the natural beauties of the area.

According to a national ranking of the provincial capitals, which takes into consideration specific areas to measure the socio-economic condition of the city, Parma is ranked as follows: Wealth 13rd/111; Business/Innovation 15th/111; Integration 34th/111 and Welfare 11st /111.

2.2 Primary school meals provision in Parma

Parma's municipality counts 33 primary schools, 1 of which is private and 6 are charter, with an average pupils number over 200, more than the Italian national average of 171.

Parma's policies on meal provision guarantee school meals to children attending school lessons in the afternoon. In Parma, the uptake of school meals in primary and junior high schools is about 47%: out of 11,906 children, about 5,594 benefit from school meals. Thus, this percentage refers to children aged from 6 to 14 years old. However, the percentage for primary schools alone is considerably higher. In this context, it is worth mentioning that Italian primary schools can be distinguished between those where pupils remain at school for a total of 40 hours during the week and those where pupils are at school for 27-30 hours during the week. In the first case, almost all the children have lunch at school, while in the second case the pupils usually go home for the lunch, excepting for the days in which the lessons continue in the afternoon.

Usually, the fee paid for a meal is shared between parents and the municipality, based on the Equivalent Economic Situation Indicator (ISEE) as follows: € 2.30/meal (ISEE € 0-6,360.17); € 4.12/meal (ISEE € 6,360.18-11,764.89) and € 6.18/meal (ISEE above € 11,764.90). The latter fee is also paid by the families residing outside of Parma.

In addition, there are some reductions for families with two or more children, with an ISEE lower than € 20,000 and partial or total exemption in case of social and/or economic hardship.

2.3 The school meals service contract in Parma

In Italy, the Ministry of Health identified some elements that Local Authorities and Regions should evaluate (and promote) in defining public tenders in the framework of school meals:

- Use of short distribution chain foods, with increased use of products with few intermediaries between production and distribution. To encourage the use of short chain foods, producers are evaluated based on the geographical origin of foods, valuing local products. In addition, seasonality is considered a positive factor for fruit and vegetables. With regard to the products from short supply chains, the Regions have to draw up indications to define contract tenders able to respect the free circulation of products within the community, protecting the freshness, "zero km"/short chain, local products;
- Transport time to encourage the shortest times possible between meal or food preparation and distribution;
- Use of protected designation of origin (PDO) products, protected geographical indication (PGI) products, traditional speciality guaranteed (TSG) products and other locally recognised products;
- Use of food products with low environmental impact (food organically produced or obtained from integrate production);
- Use of fair trade food products when no local products are available;
- Recovery of unconsumed food products for welfare purposes;
- Monitoring of users' satisfaction

The Regional Law indicates that food products employed for meal preparation must come from organic agriculture, integrated production, typical and traditional products, altogether in a proportion of at least 70%[23]. Priority has to be given to products organically produced and to products for which the lack of GMO is guaranteed. In detail, the catering of pre-schools and primary schools must use organic food if available on the market.

In addition, Parma's municipality has identified supplementary characteristics of food products that could represent a plus for the tenders:

- The food provision has to follow a priority order with respect to local raw materials/products (where "local" means they come from the Parma province), followed by "zero Km" (intended as coming within 100 Km from the Parma City Centre) and "Short Chain" (i.e. coming from Emilia Romagna provinces or extra-Regional, but neighbouring Parma, provinces), in last place;
- Logistic organization, optimal transport both in terms of time and in the use of vehicles with a low environmental impact;
- Use of tap water instead of the plastic-bottled one
- Use of non-food products with reduced environmental impact;
- Recycling of food surpluses, primarily in collaboration with NGOs/third sector associations;
- The application of an adequate differentiated waste collection throughout the supply chain.
- Valorisation and development of paths and initiatives for food education addressed to pupils, families and teachers.

Based on these considerations, we can identify this type of procurement model as Local-Organic, since in Parma the contract tender specifically includes the Ministry of Health provision indications on local sourcing. However, just for organic products, the contract tender specifies a clear minimum threshold, while for local sourcing there is not a clear quantitative indication.

2.4 The current school meals supply chain in Parma

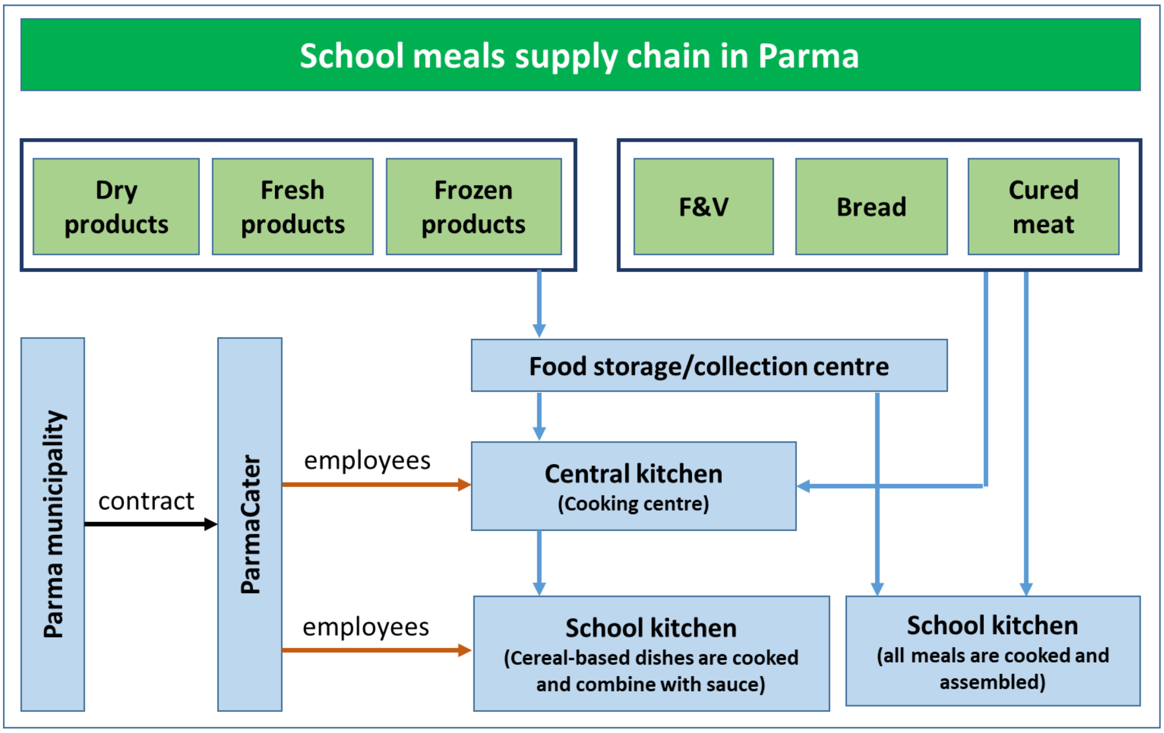
In Parma, the municipality adjudicates school meal contracts to catering companies. The administration of the catering service is conferred through a public procurement procedure launched every six years. The catering firm (ParmaCater) that holds the contract provides its own service management regulation. The contract is divided into 2 lots. The first one provides catering service to primary and junior high schools, while the second one provides catering service to the pre-schools and infant schools.

The catering firm employs the whole school kitchen staff and contracts the supply of fresh produce, groceries, meat and processed/frozen goods to relevant suppliers (wholesalers and distributors). However, the Municipality has the responsibility to check quality, hygiene and health standards of the service provided to the schools.

Since 1995, ParmaCater has been the sole contract holder, delivering foods and goods to the 33 primary schools of the town. However, considering also kindergartens and secondary schools, the total number of schools supplied by ParmaCater is 54.
Figure 2 represents the organisation of the Parma school meals supply chain.

[23] Fish and diet therapy products are excluded from this percentage, based on CE Reg. n. 834/2007, and Regional Lex n° 29 of 4th November 2002

Figure 2: Organisation of the school meals supply chain in Parma municipality.



Bread, fruit and vegetables are supplied on a daily basis to the central kitchen, or directly to the school kitchens. All meals are cooked and prepared in one or other of these locations (see below). Cured meat follows the same line of supply chain, twice a month. On the other hand, fresh, frozen and dry products are supplied every three months to the food storage/collection centre, from they are delivered to the central kitchen or directly to the school kitchens.

The catering service applies two modalities of food preparation and distribution, in compliance with the characteristics of the school kitchens:

1) For 25 primary schools, the meal preparation takes place in the central kitchen that provides lunch meals to the schools. The exceptions to this are cereals-based dishes (e.g. pasta and broth), which are cooked and assembled with sauce or other dressing.

2) In 8 primary schools, the entire menu is cooked and prepared directly in their equipped internal kitchens.

The daily menus and the food quality are specific for all Parma primary schools, which have all the same menus.

In the food storage/collection centre, goods and products are stored in preservation cells at a set temperature, or in climate-controlled ripening rooms, in compliance with the characteristics of the products. The supply process is designed according to the principle of forward workflow, in order to avoid contaminations, while the storage process is based on the "first-in, first-out" principle to guarantee the respect of the product shelf life.

Almost all the supplied foods are "local" because they are produced within Parma province, or can be defined as "0 km" because produced within 100 km from Parma's municipality. In these two categories can be mentioned:

- the majority of cereal-based products, such as bread, fresh and dry pasta. The latter is supplied by BioLand (Brescia province), whereas organic dry pasta is supplied by BrownField (Bologna);
- milk and dairy, such as Ricotta and fresh cheese, which are supplied by BioDairy (Mantova) and Parmigiano Reggiano cheese, delivered by P&RCheese (Reggio Emilia province);
- meat (i.e. pork, chicken, poultry, red and cured meat) provided by QualMeat (Verona);
- extra-virgin olive oil, which is supplied by ExtraOil (Cremona).

In addition, among these, several goods are organic certified (e.g. all meats, milk, yogurt, rice). On the other hand, some food groups, in particular fish and spices (supplied by FrozeFish), are produced in Parma, but the raw materials come from foreign countries, among which North Europe (e.g. halibut), South-America (e.g. hake) and African countries (e.g. perch).

With regard to fruit and vegetables, as well as pulses, they are provided by different suppliers, most of which are located within Emilia-Romagna Region (i.e. VeggieLand, BrownField). Dry pulses and frozen products are organic certified, with the exception of asparagus, basil, aubergines, parsley and pumpkin. Almost all these goods are delivered through a short supply chain, in which the cultivation and the subsequent production phases are carried out within Emilia-Romagna Region or the neighbouring regions.

The next sections give a short description of some of the key stakeholders in the chain[24].

2.4.1 ParmaCater

As mentioned above, ParmaCater has operated the contract for the school meal service in Parma since 1995. It belongs to the ItaCater Group, a cooperative specialised in food and catering not only for public (e.g. hospital, schools) but also for retail sectors, mainly in North-Central Italian regions. ItaCater Group addresses food meal supply to schools, hospitals, senior housing, companies and clinics. The firm is composed by 10 Italian and 1 German firms and takes part of 20 different firms. Some of them have a public-private participation or offer integrated services to people, companies and public entities. In accordance with the quality and sustainability criteria set out in the contract, ParmaCater sets the menus and recipes for the meals, subcontracts suppliers, delivers meals conforming to the number of pupils of every schools, records meal uptake and kitchen waste data, and reconciles payments. 32 people are employed at the Cooking Centre, while 181 people are employed in the school canteens (approximately 5-6 staff members per school, depending on the number of children to be served). In addition, all school kitchen staff members are ParmaCater employees. ItaCater Group's turnover amounted to € 518,179,119 in 2016 and the employees were 11,184.

2.4.2 Bioland

Born in 1997, BioLand is a family owned Italian company that produces different pasta products, including durum wheat and whole wheat pasta, egg noodles, as well as organic pasta, marketing not only its owned-brand but also for large retailers' private labels. The company exports the 60% of its products, in European (40%) and extra European countries (20%). The firm deals with catering and food service sector (i.e. school canteens and hospitals) which covers the 25% of pasta production. In this sector, BioLand is present with both its owned-

[24] The total number of the involved suppliers is about 200. In the present document only the most relevant are mentioned. The selection has been made on the basis of those more frequently involved in the supply chain, as well as on the basis of the products more frequently used.

brand and private labels. Thanks to the quality of its products, the firm won Golosario 2011 Award as the best emergent pasta factory for the promotion of Italian product. The firm had a turnover of € 53,452,801 in 2016 and 112 employees. The distance between BioLand headquarter and Parma primary schools cooking centre is 125 km.

2.4.3 BrownField

BrownField is a joint-stock company whom shares are held by farmers and processors of organic products. Established in 1978, the corporate group encompasses more than 1,000 organic farmers, beekeepers and processors in Italy and 14,000 all over the world. BrownField's organic products are almost 300, such as pasta, rice, tomato sauce, vegetables, pulses, biscuits, fruit juices, jam, honey and baby foods. The corporate group acts on more than 10,000 hectares of Italian organic crops. It uses different ways of food distribution (large organised distribution networks, organic shops, online shop). In the last years, BrownField has experienced a significant growth, reaching a turnover of € 74,016,409 in 2016. The distance between BrownField's headquarter and Parma primary schools cooking centre is 196 km.

2.4.4 ItaRice

Born in 1860, ItaRice is now the holding company of a corporate group. Some of these companies are specialized in rice cultivation, research and experimentation, while others deal with the rice processing and marketing. The ItaRice products and ingredients are addressed to the large organized distribution networks, vending machines, mass catering and industry. In 2015, the ItaRice turnover was equal to € 183,308,528 and the employees were 154. The distance between the ItaRice production centre and Parma primary schools cooking centre is 114 km.

2.4.5 P&RCheese

Born in 1983, P&RCheese is now the worldwide leader firm in the production and marketing of Parmigiano Reggiano cheese and, starting from 2009, it had become one of the leading companies in butter production, packaging and marketing. Among the products proposed by the firm, there are also snacks and other Parmigiano Reggiano-based products. P&RCheese performs a total supply chain control, from the breeding to the marketing, though which it guarantees the quality of its products. In 2016, its turnover amounted to € 316,510,695, while the employees were 289. The distance between the P&RCheese production plant and Parma primary schools cooking centre is 36 km.

2.4.6 BioDairy

Established in 1920, BioDairy is a historical Italian company located in Po Valley, characterized by an ancient tradition of livestock breeding and dairy production. From 2001, BioDairy is part of a Food Group that encompasses other four food companies. Among its dairy products, beside probiotics and goat cheese products, crescenza, stracchino, robiola and squacquerone can be mentioned. As demonstration of the consumers' appreciation towards its products, the company got the Brands Award New Entry 2016. In the same year, the firm's turnover reached € 27,688,708 and the employees were 84. The distance between the BioDairy headquarter and Parma primary schools cooking centre is around 60 km.

2.4.7 QualMeat

QualMeat is a company specialised in the production of meats and cured meat from certified organic farms, distributed throughout Italy and abroad. It belongs to BioBreed, a bigger organic company that operates with high hygiene standards and modern technologies, which supplies the Ho. Re. Ca. channels, food industry and catering. In the last years, BioBreed has experienced a significant growth, recently reaching a turnover of € 12,782,403. The distance between the QualMeat headquarter and Parma primary schools cooking centre is around 114 km.

2.4.8 FrozeFish

Founded in 1965, Frozefish is a local producer and distributor company in the district of Parma that supplies frozen and fresh fish in the North of Italy. It has created different brands of fish products, with a particular attention to sustainability and to biological products. In 1995, FrozeFish has invested in a modern fish factory in Senegal. In 2015, its turnover amounted to € 83,403,669 while the employees were 65. The distance between the FrozeFish headquarter and Parma primary schools cooking centre is around 23 km.

2.4.9 VeggieLand

VeggieLand was founded in 1978 as a company of production, sale and distribution of frozen products made by the union of several different farmers in the same geographic area (Cesena, Emilia Romagna Region). To date, the Group is specialized in the production of frozen vegetables in various production sites throughout the country and it involves 1845 workers within its supply chain. In the last years, VeggieLand developed new lines of celiac products, fish and convenience foods increasing its turnover that in 2016 was € 239,500,000. VeggieLand has two different production plants in the North of Italy, one in Cesena and the other in Rovigo Province (183 and 121 km from Parma primary schools cooking centre, respectively).

2.4.10 ExtraOil

ExtraOil is an historical and modern oil mill, founded in 1810 in Lodi and specialised in the production of fruit and seed oil. Its capacity production amounts to 1,500,000 litres of oil every day that are sold as bulk and packed products. The distribution mainly covers large retailers and is present with both its owned-brand and private labels. In 2015, the ExtraOil turnover was equal to € 167,251,426 and the employees were 133. The distance between the ExtraOil headquarter and Parma primary schools cooking centre is around 73 km.

2.4.11 GoldGarden

GoldGarden is an Italian leader company in distributing fruit and vegetables. It handles more than 50,000 tons/year on two multi-purpose distribution platforms, suitable for all logistic services: incoming goods, quality controls, storage management, preparation and shipping. GoldGarden supplies fresh agricultural products all over Europe, Asia, and the Far East, using modern certified structures. The firm had a turnover of € 105,376,199 in 2015 and 58 employees. The distance between the GoldGarden headquarter and Parma primary schools cooking centre is around 105 km.

2.5 The featured schools in Case 1 Parma

According to the terms of contract, the time for delivering food from the Cooking Centre to the school kitchen must not exceed 50 minutes. Table 3 summarises the pupil roll and meal uptake in ParmaSchools One-Five. Compared to the municipality average, the selected schools are quite a bit bigger than Council average in terms of number of children attending the school. Moreover, the daily average lunch uptake for the selected five schools (> 80%) is higher compared to what we reported for the municipality in Section 2.2. As already mentioned, this discrepancy is due to the fact that the school lunch uptake characterises almost all the pupils who remain at school for a total of 40 weekly hours, while only a very low proportion of children who are at school for 27-30 hours per week take lunch, as well as for children aged from 11 to 14 years.

Table 3: Pupil roll and meal uptake in Parma (LOC-ORG model) featured schools.

	Pupil roll/Daily average meals (n)*	Free meals (n - %)**	Daily average uptake (n - %)***
ParmaSchoolOne	215	6 – 2.8	194 - 90.2
ParmaSchoolTwo	239	8 – 3.3	227 - 95.0
ParmaSchoolThree	530	10 - 1.9	375 - 70.8
ParmaSchoolFour	359	5 - 1.4	291 - 81.1
ParmaSchoolFive	514	3 - 0.6	387 – 75.3

* the numbers correspond to the pupil roll, which equals the number of children who signed up for the school lunch service.

** the percent values refer to the pupil roll number

*** the reported values indicate the average number of pupils who were present at the school canteen during the period February – March 2018.

Based on the Parma public tender specifications, the catering firm engaged in preparing and delivering school meals to the children has to provide a financial support to the educational projects in the context of food education and correct lifestyles promoted by the Educative Sector. These activities consist of informational initiatives as well as laboratories addressed to the kindergartens and primary schools. In detail, the economic support provided has to correspond to 0.6% of the annual value established for primary school procurement.

Moreover, since 2009 the University of Parma has provided to primary school children a program of food and nutrition education, through the creation of a specific figure called “Maestro del Gusto” (literally “Master of Taste”) who has the task of educating students about a healthy and responsible lifestyle. Children follow three thematic lessons along the year based on the importance of good food habits and about the Mediterranean diet. In particular, the last year of the program is focused on food environmental impact, from production to distribution, and on the environmental pyramid. The lessons are provided to all the pupils attending the schools within Parma municipality.

2.5.1 ParmaSchoolOne

ParmaSchoolOne is located in Parma’s city centre, about 700 m far from the municipality and 8.7 km far from the Cooking Centre. It is provided with an internal kitchen where the all the food to be served is cooked and prepared. The institute has 215 pupils, attending the school from Monday to Friday, from 8.30 to 16.30.

2.5.2 ParmaSchoolTwo

ParmaSchoolTwo is located in Vicofertile, which is part of the municipality of Parma. The school is 10.6 km far from the Parma’s city centre and 16.7 km far from the Cooking Centre where all the food[25] is prepared and cooked. The institute has 239 pupils attending the school from Monday to Friday, from 8.30 to 16.30.

2.5.3 ParmaSchoolThree

ParmaSchoolThree is located close to the historical Parma city's centre, about 1.4 km far from the municipality and 8.1 km far from the Cooking Centre where all the food is prepared and cooked. The institute has 530 pupils attending the school from Monday to Friday, from 8.30 to 16.30.

2.5.4 ParmaSchoolFour

ParmaSchoolFour is located in the northeast part of the city, about 3.2 km far from the Parma's municipality and 12.4 km far from the Cooking Centre. It is provided with an internal kitchen where the all the food to be served is cooked and prepared. The institute has 359 pupils attending the school from Monday to Friday, from 8.30 to 16.30.

2.5.5 ParmaSchoolFive

ParmaSchoolFive is located 1.9 km far from the Parma's municipality and 10.1 km far from the Cooking Centre where all the food is prepared and cooked. The institute has 514 pupils attending the school from Monday to Friday, from 8.30 to 16.30.

Figure 3 shows the relative geographical position of the selected primary schools.

Figure 3: Location of the schools and of the Cooking Centre in Parma: numbers 1-5 represent ParmaSchools One - Five.

[25] As already mentioned, the cereal-based products represent an exception since they are cooked and prepared *in loco*, not in the cooking centre.

3. CASE 2 LUCCA (ORG) MONOGRAPH

3.1 Profile of Lucca

Lucca is a town in the Italian Region of Tuscany. It comprises an area of 185.79 km^2 (38th among 111 provincial capitals), with a density of 233 persons per km^2 (72th among 111 provincial capitals).

Figure 4: Geographic position of Lucca in Italian peninsula and in the Tuscany Region.

On January 1st 2017, there were 89,796 resident citizens in Lucca (57th among 111 provincial capitals), of whom 47.7% were males and 52.3% were females. The population characteristics are similar to the national distribution: people aged until 18 years old represent a share of 15%, while people aged 18 to 35 years have a share of 17%, from 36 to 50 years 23%, from 51 to 65 years 21%, and people over 65 represent 24% of the population. Children aged 5 to 10, who represent the target of our research, are 4.502, 5% of the entire population.

Lucca is located in north-west Tuscany, situated on the plain between the Pizzorne Plateau (North) and Mount Serra (South), on the left bank of the River Serchio. The territory reaches a minimum of 1 meter above sea level and a maximum of 950 meters above sea level on the mountain range of the Apennines.

The economic system in Lucca is one of the most thriving in the Tuscany Region. The "engines of growth" are the industrial sectors (paper, shipbuilding, mechanical, chemical and pharmaceutical) and tourism (beach management, hotels, restaurants, clubs). Lucca is also known for other productions, ranging from flowers to "quality and typical" products (oil, wine). Regarding the cultural aspect, Lucca, featuring a rich cultural heritage and landscape, is one of the favourite destinations for tourists from all over the world.

According to a national ranking of the provincial capitals, which takes into consideration specific areas to measure the socio-economic condition of the city, Lucca is ranked as follows: Wealth 39th/111; Business/Innovation 40th/111; Integration 107th/111 and Welfare 14th/111.

3.2 Primary school meals provision in Lucca

Lucca's municipality counts 29 primary schools, 2 of which are private, with an average pupils roll lower than 100, considerably smaller than the Italian national average of 171. The average meal uptake is around 80%.[26]

Lucca's policies on meal provision guarantee school meals to children attending school lessons in the afternoon.

Usually, the fee paid for a meal is shared between parents and the municipality, based on the Equivalent Economic Situation Indicator (ISEE) as follows: free (ISEE € 0-5,500.00); € 2.00 - € 4.99/meal (ISEE € 5,500.01-29,999.99) and € 5.00/meal (ISEE above € 30,000.00).

In addition, there are some reductions for families with two or more children, i.e. a 25% discount for the 2nd child, 50% for the 3rd child, and 100% for the 4th child and next ones.

3.3 The school meals service contract in Lucca

In Italy, the Ministry of Health identified some elements that Local Authorities and Regions should evaluate (and promote) in defining public tenders in the framework of school meals:

- Use of short distribution chain foods, with increased use of products with few intermediaries between production and distribution. To encourage the use of short chain foods, producers are evaluated based on the geographical origin of foods, valuing "zero Km" or local products. In addition, seasonality is considered a positive factor for fruit and vegetables. With regard to the products from short supply chains, the Regions have to draw up indications to define contract tenders able to respect the free products circulation within the community, protecting the freshness, "zero km"/short chain, local products;
- Reduce as much as possible the time span of transport between production and distribution;
- Use of protected designation of origin (PDO) products, protected geographical indication (PGI) products, traditional speciality guaranteed (TSG) products and other locally recognised products;
- Use of food products with low environmental impact (food organically produced or obtained from integrated production);
- Use of fair trade food products when no local products are available.
- Recovery of unconsumed food products for welfare purposes;
- Monitoring of users' satisfaction

In addition, the municipality of Lucca has identified additional characteristics of food products that could represent a plus for the tenders:

- Suppliers must certify the quality of the products and demonstrate the adoption of quality assurance systems and good manufacturing practices ensuring the traceability and labelling of products.
- All the following products must be organic: pasta, fruit, vegetables (both fresh and frozen), potatoes, legumes.

[26] The percent value has been obtained from the average meal uptake referred to the 5 primary schools selected.

- Meat must come from EU or Italian livestock organic breeding.
- Milk, yogurt, eggs and butter must come from livestock organic breeding.
- Cheese must be produced using organic milk or be recognized as PDO or PGI product.
- Olive Oil should be organic and extra virgin.
- Fish must come from Northern Europe, except for the trout, which must come from the Tuscany Region.
- Suppliers can propose to reuse the leftover food.
- The application of an adequate differentiated waste collection throughout the supply chain.

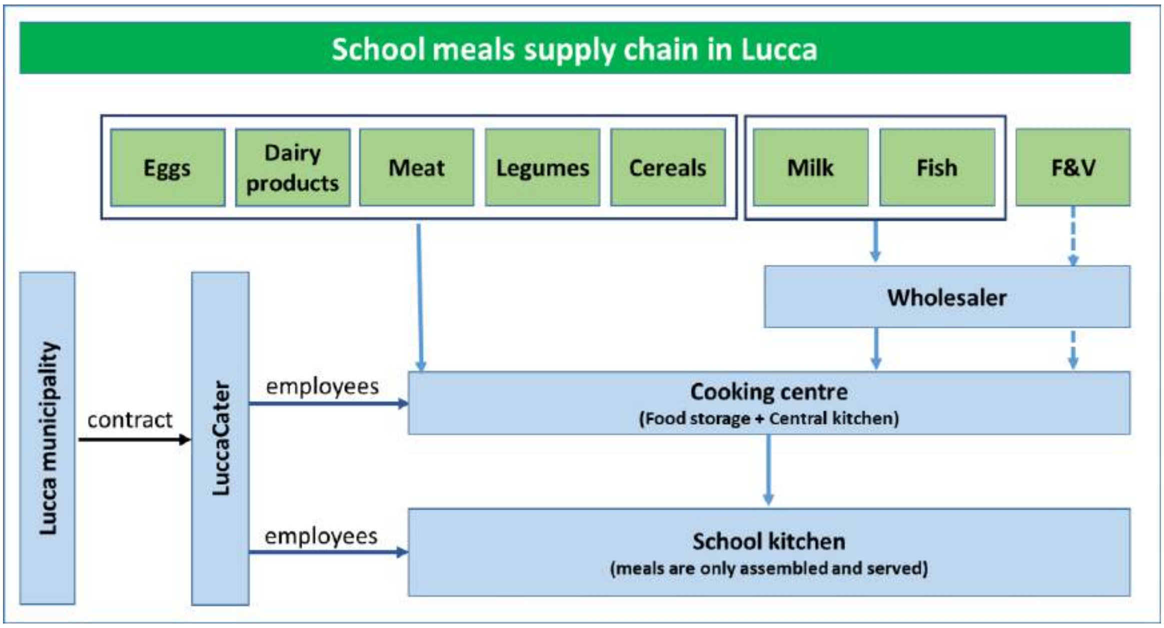
We can identify this type of procurement model as Organic. In fact, any specific reference to local sourcing are not included in the contract tender, beyond the indications required by the Ministry of Health.

3.4 The current school meal supply chain in Lucca

In Lucca, the municipality adjudicates school meal contracts to catering companies. The administration of the catering service is conferred through a public procurement procedure launched every nine years. The catering firm that wins the contract provides its own service management regulation.

The catering firm holding the current contract (LuccaCater) employs the whole school kitchen staff and contracts the supply of fresh produce, groceries, meat and processed/frozen goods to relevant suppliers (wholesalers and distributors). However, the Municipality has the responsibility to check quality, hygiene and health standards of the service provided to the schools.
Since 2002, LuccaCater has been the sole contract holder delivering foods and goods to the 27 State primary schools of the town. However, considering also kindergartens and secondary schools, the total number of schools supplied by LuccaCater is 52.
Figure 5 represents the organisation of the Lucca school meals supply chain.

Figure 5: Organisation of the school meals supply chain in Lucca municipality.



Although a variety of goods are produced in districts close by and in the Region of Tuscany, several fish products come from foreign countries.

Some dairy products (like Burro, Ricotta, Stracchino) are supplied to LuccaCater by an organic farm located in Firenze (DairyFarm), while yogurt and other cheeses (Parmigiano Reggiano and Pecorino) are supplied by BigMover (Pistoia). Milk is supplied by the distributor MilkyWay (Firenze) (sourced from an organic wholesaler in Livorno). BigMover (Pistoia) supplies turkey, pork and chicken meat while a local farm (BioBeef) provides beef and veal meat. LittleEggs distributor (Imola) supplies eggs. Bread and spelt are locally produced (within 20 km from the town), while BigMover (Pistoia) supplies rice, spelt and flour. ItalGoods (Brescia) supplies pasta. Although fresh fruit and vegetables are provided by different wholesalers, they are all delivered by a local distributor (VegFresh). BigMover delivers fish and fish products (sourced from foreign countries).

All products are delivered to a cooking centre where they are stored until use. The cooking centre is a private building belonging to LuccaCater and is comprised of both a warehouse for the storage of ingredients/raw foods and a commercial kitchen where all meals are prepared and then provided to the school kitchens.

The reception of the raw materials and of the products is required daily; however, a weekly plan was established for each supplier, in accordance with the programme of the cooking centre. Products are stored in preservation cells at a set temperature, or in climate-controlled ripening rooms, in compliance with the characteristics of the products. The supply process is designed according to the principle of forward workflow, in order to avoid contaminations, while the storage process is based on the “first-in, first-out” principle to guarantee the respect of the product shelf life.

The next sections give short descriptions of some of the key stakeholders in the chain.

3.4.1 LuccaCater

As mentioned above, LuccaCater has operated the contract for the school meal service in Lucca since 2002. It belongs to the EveryDayCater Group, a regional corporate group that deals with food catering for hospitals, schools and private companies, transports and logistics. In accordance with the quality and sustainability criteria set out in the contract, LuccaCater sets the menus and recipes for the meals, subcontracts wholesalers/suppliers, delivers meals conforming to the number of pupils of every schools, records meal uptake and kitchen waste data, and reconciles payments. From 10 to 25 people are employed at the cooking centre. In addition, all school kitchen staff members are LuccaCater employees (3-4 staff members per school, depending on the number of children to be served). Its turnover amounts to € 7,066,554 in 2016.

3.4.2 BigMover

BigMover is a wholesaler Italian company that deals with distribution and food service. The group has more than 40,000 customers in commercial caterings and canteens, supplying them with more than 10,000 food products. BigMover delivers goods all over Italy, through four different ways of distribution (wholesaler, cash & carry, suppliers and partnership). The group had a turnover of € 1,544 million in the 2016 and 759 employees. There are 26 distribution centres distributed across the Italian territory, mainly in the North. The distance between BigMover and Lucca primary schools cooking centre is around 46 km.

3.4.3 DairyFarm

DairyFarm is a supplier specialized in commercial catering and food service that operates in Tuscany and in some neighbouring regions. It works also as storage for many non-perishable and packaged products. In the last year, DairyFarm has experienced a significant growth of organic products, and of production of fish and dairy. Its turnover reached € 14,586,362 in 2016 with 17 employees. The distance between DairyFarm headquarters and Lucca primary schools' cooking centre is around 63 km.

3.4.4 MilkyWay

MilkyWay is a historical firm born in Firenze in 1930 that collects the 70% of the milk produced in Tuscany and promotes the development of the local territory. It commercialises milk and dairy products for the public sector and private customers. Thanks to its great attention to the environment, it was the first Italian company to achieve the validation of the international guidelines GRI 2002 for the Sustainability Report. It has 174 employees and its turnover was stable in the last 3 years, about € 90 million. The distance between MilkyWay headquarters and Lucca primary schools' cooking centre is around 67 km.

3.4.5 BioBeef

BioBeef is a local organic farm from Lucca (within 30 km from the town), specialised in production and distribution of beef and veal meat, as well as of cured meat. It supplies not only to public sector contractors in the Region, but also to a range of private customers, and has experienced significant growth in recent years. The distance between BioBeef headquarters and Lucca primary schools' cooking centre is approximately 27 km.

3.4.6 LittleEggs

LittleEggs is an egg production company, set up in 1950 by a local farming family. Now it owns farms in six different European countries, with five different brands and three different production lines: barn, organic and free range. LittleEggs follows all the production, from rearing chicks to packaging the finished product. For years, LittleEggs has been a leading supplier of eggs for private labels and served 7000 customers all over Italy. Its turnover amounts to € 545,198,504 in 2015 with 354 employees. The distance between LittleEggs headquarters and Lucca primary schools' cooking centre is approximately 191 km.

3.4.7 NaturalBakery

NaturalBakery is a modern industrial bakery that combines industrial baking with a traditional approach based on artisanal production. It is located 20 km from the town of Lucca. It produces more than 70 types of baking organic products and it employs 71 people. In Italy, the distribution network enables the delivery of fresh products within strict deadlines. About 30% of its production is exported abroad to 16 countries. In 2015, its turnover amount was € 7,405,182 and the employees were 65. The distance between NaturalBakery headquarters and Lucca primary schools' cooking center is approximately 19 km.

3.4.8 ItalGoods

ItalGoods is a leading company in food & beverage distribution for the ho.re.ca channel and institutional catering. It delivers 17000 food items all over Italy and serves foods to operators in 58 countries: wholesalers, food services, street food providers and retailers. ItalGoods also operates internationally with a dedicated Export Department, bringing the ultimate Italian flavours all over the world. In 2016, its turnover amounted to € 286,839,786 with 230 employees. The distance between ItalGoods headquarters and Lucca primary schools' cooking centre is approximately 274 km.

3.4.9 VegFresh

VegFresh is a small fruits and vegetables wholesaler based in Lucca that works also with local farms. The distance between VegFresh headquarters and Lucca primary schools' cooking center is approximately 2 km.

3.5 The featured schools in Case 2 Lucca

According to the terms of contract, the distance between the cooking centre and every school service cannot be more than 30 km. Moreover, all the schools have the canteen commission. Table 4 summarises the pupil roll and meal uptake in Schools One-Five.

Table 4: Pupil roll and meal uptake in Lucca (ORG model) featured schools.

	Pupils attending the school (n)	Pupils roll (n)*	Free meals (n - %)**	Daily average uptake (n - %)**
LuccaSchoolOne	184	168	33 -19.6***	151 – 89.9
LuccaSchoolTwo	249	212	56 – 26.4	186 – 87.7
LuccaSchoolThree	261	244	38 – 15.6	113 – 46.3
LuccaSchoolFour	181	145	43 – 29.7	128 – 88.3
LuccaSchoolFive	158	140	8 – 5.7	126 – 90.0

* the number of pupil roll corresponds to the children who signed up for the school lunch service.

** the percent values refer to the pupil roll number.

***the free meal value reported for SchoolOne has been estimated as the average obtained from the data reported for SchoolTwo-Five since the actual reference is not available.

The Regional guidelines specify the importance of developing educational programs addressed to teachers, parents and students, aimed at educating students towards a conscious consumption and the value of food, taking into consideration the environmental compatibility of food production.

As specified in the contract tender, the services provided by the catering firm engaged in preparing and delivering school meals to the children have to refer to a quality Project. This Project has to involve all the services included in the tender and has to comprise a program of food education.

Based on data obtained on the internet, some primary schools in Lucca (e.g. LuccaSchoolThree) are involved in a project targeted towards the development of educational vegetable gardens. In this framework, some training initiatives are planned for the teachers and for the Council personnel and will be followed by project activities addressed to each school. The vegetable gardens realisation involves different actors (mainly the children and their families as well as the teachers), and their maintenance is carried out by a group of children's parents and grandparents coordinated by a teacher.

3.5.1 LuccaSchoolOne

LuccaSchoolOne is located in the west part of the town, close to the historical walls of the city centre and 8.2 km far from the Cooking Centre. The school has 168 pupils attending the school from Monday to Friday, from 8.30 to 16.30.

3.5.2 LuccaSchoolTwo

LuccaSchoolTwo is located in the northeast part of the town, 3.5 km far from Lucca's municipality and 3.7 km far from the Cooking Centre. The school has 212 pupils, attending the school from Monday to Friday, from 8.30 to 16.30.

3.5.3 LuccaSchoolThree

LuccaSchoolThree is located in the north of the town, 1.7 km far from Lucca's municipality and 3.3 km fam from the Cooking Centre. The school has 244 pupils. Some of them attend the school from Monday to Friday, from 8.30 to 16.30, while others from Monday to Saturday from 8.30 to 13.30, excepting for Tuesday in which they are at school from 8.30 to 16.30.

3.5.4 LuccaSchoolFour

LuccaSchoolFour is located into the old town, about 1.2 km far from Lucca's municipality and 3.1 km far from the Cooking Centre. The school has 181 pupils, attending the school from Monday to Friday, from 8.30 to 16.30.

3.5.5 LuccaSchoolFive

LuccaSchoolFive is located in the north part of the town, about 10.2 km far from Lucca's municipality and 12 km far from the Cooking Centre. The school has 158 pupils, attending the school from Monday to Friday, from 8.30 to 16.30.

Figure 6: Location of the schools and of the cooking centre in Lucca: number 1 -5 represent LuccaSchools One - Five.

4. ENVIRONMENTAL IMPACT OF SCHOOL MEALS SERVICES

4.1. Methodology to measure environmental impact

Our core measure of environmental impact was carbon footprint, expressed as the kgsCO_2eq emitted from the production, processing, transportation, and waste of food items purchased by the five featured schools in Case 1 Parma (LOC-ORG) (i.e. ParmaSchool One-Five) and Case 2 Lucca (ORG) (i.e. LuccaSchool One-Five), respectively, over a 36 week-school year.

To estimate the emissions from the agricultural production of food items supplied to the schools, we used the emissions factors provided by literature, BCFN Double Pyramid database, the Environmental Product Declaration (EPD) database, LCA-Food database, and Ecoinvent database. The combination of these different sources of information allowed us to identify the emissions factors as much as close to the food origin as possible and to the agricultural practice adopted (e.g. organic or conventional production). For instance, for Parmigiano-Reggiano cheese, we used the emissions factors extrapolated from literature analysing this specific Italian quality food. The emissions factors we adopted were all estimated according to a Life Cycle Assessment (LCA) approach, and included the emissions along the food supply chain, from agricultural phase to agri-food processing, if relevant. For any specific foods with missing data sources, we used the average emission factor for the corresponding food category. In most cases, the LCA system boundary, from which the emission factor arose, used the perspective "cradle-to-gate". In Appendix 1, the emissions factors per food item are provided with the corresponding data sources.

To estimate the emissions relating to the transportation of food items from wholesalers/suppliers to schools (i.e. 'local' transportation), we used the calculation method recommended by Defra (2013), which is based on estimating suppliers' delivery round distances and frequencies, taking account of the types of vehicles and fuel used, the number of drops to other customers, and the proportion of the loads comprised by the food items to the schools featured in the case.

To estimate the emissions relating to waste, we applied the emissions factors for waste handling proposed by Moult et al (2018). These capture the emissions from transportation of waste from schools to waste disposal sites, and from the processing of the waste itself, for five different categories (bread, cheese, fruit and vegetables, fish and meat).

4.1.1 Measurement method for Case 1 Parma (LOC-ORG)

The measurement process for Parma (LOC-ORG) was as follows:

First, we collected information on the total volumes of food items purchased by the 5 ParmaSchools over the school year 2017-18. The information about the quantity of foods used in the preparation of the school menus was recorded thanks to the collaboration of the City Council officers' responsible for the school meal organisation and ParmaCater. The documents about the number of children per school, the composition of the different menus and the food preparation recipes allowed the calculation of the total quantity of food prepared and served in the 5 Parma schools (ParmaSchools One-Five), with a detail per food item (e.g. carrots, milk, eggs, etc.). The data collection and the document interpretation was carried out during two meetings in person and by email exchanges and phone calls. The quantity of food was related to the last school year with complete information (2017-2018 school year). In this way, the quantity of foods reflected the seasonal menu composition. For Parma, the school meal service is based on 4 different menus along the school year. The quantity of food related to all the primary schools in Parma was then recalculated for the 5 reference schools using the number of pupils. From this detailed information, we generated a list of the total volumes of foods purchased by these schools in the year. We included all types of food item, such as fresh fruit and vegetables, fresh meat, milk and dairy, eggs, ambient goods (e.g. bread, pasta, rice, flour), and processed and frozen items (including canned goods and ready meals). The only items excluded were those purchased in very small quantities (e.g. certain spices, sauces), bottled water and salt. From these data we estimated the average weekly volumes (in kgs) of all foods purchased by the schools, then multiplied these volumes by 36 (the number of week in a school year) to estimate the total volumes (kgs) of the food items purchased over one school year.

Next, we calculated emissions (kgsCO_2eq) from the agricultural production and processing of these foods, using the emission factors database built from scientific literature, i.e. BCFN Double Pyramid database, EPD database, LCA-Food database and Ecoinvent databases. We then applied per kg emissions factors to the total food volumes calculated in the first step. To select the most appropriate emission factor in the sources from the options of Italy (IT), Europe (EU) and Rest of the World (ROW) origin, we used information given in interviews with City Council officers, through a document that identified the geographical origin for each food item.

Then, we calculated the emissions (kgsCO_2eq) relating to the transportation of the food items from the suppliers to ParmaSchools One-Five for 36 week school year, using information on delivery round distances and frequencies given by City Council officers and ParmaCater interviews and documents. Following Defra (2013), we also took into account the types of vehicles and fuel used, the number of drops to other customers in the rounds, and the proportion of the loads comprised by the food items to ParmaSchools One-Five[27]. According to Kellner & Otto (2011), the formula below assumes 89% weighted average allocated to the distance of the delivery round and 11% for the vehicle load. For the schools served by the central kitchen, we calculated and summed up the emissions of transportation between suppliers and central kitchen, and between the central kitchen and schools.

Finally, we added calculations for waste. For this, we used the core data on volumes (in kgs) of plate waste generated at two ParmaSchools over four weeks, as collected in WP6.2 and reported in D6.2 Italy Country Report. The waste collection method itself was carried out by applying a modified aggregate selective plate waste method (Comstock et al, 1979). Therefore, we measured school lunch plate waste during 5 consecutive observation days in winter and in spring (2017/2018 school year), for a total of 20 days of collection activities (10 for each school)[28]. The procedure used to assess the food waste was a direct weighing method according to which food waste was collected from all the children, but separately for every food category. The total food waste (kg) was obtained from the sum of the food waste (kg) collected across all food categories, for both schools, and across both data collection weeks. The emission factors for the food waste were calculated according to the approach proposed by Moult et al. (2018). In that research, for each food category (bread, cheese, fruit and vegetables and meat) factors of emission for a series of disposal pathways are provided (landfill, composting, anaerobic digestion, incineration, donations, and animal feed). These factors include the contribution of transportation and the matter conversion processes related to waste disposal.

[27]The formula we used was: $\text{Total CO2 Emissions From Transportation Process per Week} = \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Drops}}{\text{Total Drops}} \times 89\%\right) + \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Load}}{\text{Vehicle Load}} \times 11\%\right)$

[28] In detail, the collection activities refer to a total of 39 days instead of 40 since in one school the spring waste collection was performed in 4 days instead of 5.

For ParmaSchool, we adopted the emission factors for composting, the most relevant disposal method adopted in Parma for organic matter wastes.

4.1.2 Measurement method for Case 2 Lucca (ORG)

The measurement method for Lucca (ORG) was identical to that of Parma, except that as Lucca case has the central kitchen model for all schools, in order to estimate transportation emissions, we calculated and summed up the emissions of transportation between suppliers and central kitchen, and between the central kitchen and schools, for all schools in the case. Also for Lucca, the food data collection strategy, thanks to the collaboration of the City Council officers and LuccaCater, allowed us to represent the seasonality of the food served to children across the school year.

4.2. Which foods are supplied in the school meals services?

To begin, this section reports the total volumes of foods supplied to the featured schools in Parma and Lucca over one school year, and the composition of the average meal (pre-preparation and cooking) in both Cases.

4.2.1. Foods supplied in Case 1 Parma (LOC-ORG) service

Table 5: Annual volumes of foods supplied to Parma (LOC-ORG) schools (n=5)

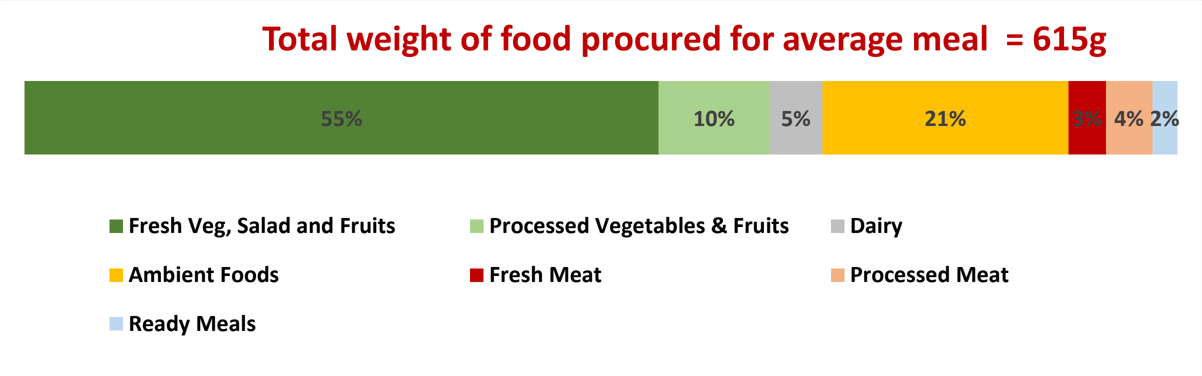
Food Category	**Volume (kg)**
Fresh fruit and vegetables	89,714
Processed fruit and vegetables	15,697
Dairy	7,447
Ambient	34,892
Fresh meat	5,229
Processed meat	6,594
Ready meals	3,506
Total	**163,078**

As Table 5 shows, the total volume of food items purchased by ParmaSchools One-Five was 163,078 kgs, of which 89,714 kgs was fresh fruit and vegetables, 15,697 kgs processed fruit and vegetables, 7,447 kgs dairy, 34,892 kgs ambient, 5,229 kgs fresh meat, 5,229 kgs processed meat and 3,506 kgs ready meals. Of these amounts, it is noteworthy that 11,557 kgs of fresh fruit and vegetables included carrots (13% of the corresponding food category), 7,416kg of fennel (8% of the corresponding food category), 11,922 kgs of apples (13% of the corresponding food category), and 10,536 kgs of bananas (12% of the corresponding food category). The majority of dairy foods includes Parmigiano-Reggiano cheese (34% of the corresponding food category), eggs (26% of the corresponding food category) and milk (18%

of the corresponding food category). Ambient foods were mainly comprised of bread (41% of the corresponding food category) and pasta (26% of the corresponding food category), followed by rice (10% of the corresponding food category) and olive oil (9% of the corresponding food category). The composition of meat categories included white meats (mainly chicken and turkey) for 3,326 kgs (64% of the total quantity of fresh meat); for processed meat, fish was the food item presenting the main incidence in the category (76%). Within the category relating to processed fruit and vegetables, canned tomatoes represented a share of 44%, due to the use of this food product in the sauces preparation for pasta and other dishes (e.g. pizza). The ready meals served to children comprised mainly fresh filled pasta, such as tortelli and gnocchi; overall, fresh filled pasta represented 89% of its food category.

We took the above yearly purchase volumes and divided them by the total number of meals served at ParmaSchools One-Five, in order to calculate the total weight (pre-preparation and cooking) and composition of an average meal at these schools. Figure 7 shows the results. It is emphasised that the total weight refers to the amounts of food procured for the average meal, rather than the weight of the served meal on the plate.

Figure 7: Composition of average meal in Parma (LOC-ORG) schools (n=5)



As Figure 7 shows, the total weight of food procured for the average meal at ParmaSchools One-Five was 615g, and was comprised of 55% fresh fruit and vegetables, 10% processed vegetables, 5% dairy, 21% ambient, 3% fresh meat, 4% processed meat, 2% ready meals. The average meal contained almost two thirds fruit and vegetables (of which 85% is fresh and 15% processed), just over one-fifth ambient, and relatively small amounts of meat and dairy.

4.2.2. Foods supplied in Case 2 Lucca (ORG) service

Table 6: Annual volumes of foods supplied to Lucca (ORG) schools (n=5)

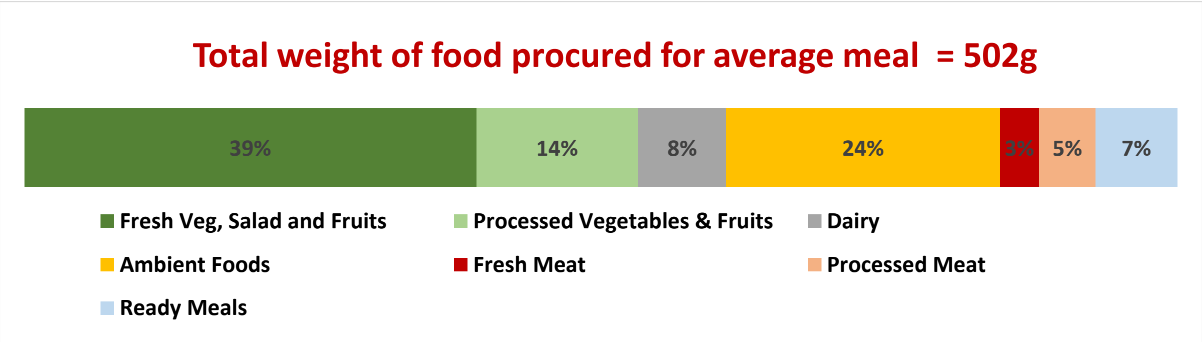
Food Category	Volume (kg)
Fresh fruit and vegetables	24,932
Processed fruit and vegetables	8,934
Dairy	4,877
Ambient	15,099

Fresh meat	2,161
Processed meat	3,126
Ready meals	4,499
Total	**63,627**

As Table 6 shows, the total volume of food items purchased by LuccaSchools One to Five was 63,627kgs, of which 24,932kgs was fresh fruit and vegetables, 8,934kgs processed fruit and vegetables, 4,877kgs dairy, 15,099kgs ambient, 2,161kgs fresh meat, 3,126kgs processed meat and 4,499kgs ready meals. Of these amounts, it is noteworthy that 2,393kgs of fresh fruit and vegetables was comprised of carrots (10% of the corresponding food category), 1,120kgs of potatoes (4.5% of the corresponding food category), 4,541kgs of apples (18% of the corresponding food category), and 3,696kgs of bananas (15% of the corresponding food category). The majority of dairy foods included yogurt (29% of the corresponding food category), Parmigiano-Reggiano cheese (14% of the corresponding food category) and Grana Padano cheese (6% of the corresponding food category). Ambient foods were mainly comprised of bread (40% of the corresponding food category) and pasta (22% of the corresponding food category), followed by rice (12% of the corresponding food category) and olive oil (9% of the corresponding food category). The composition of meat categories included white meats (mainly chicken and turkey) for 1,309kgs (61% of the total quantity of fresh meat); for the processed meat, fish is the food item presenting the main incidence in the category (49%). Within the category related to processed fruit and vegetables, canned tomato represents a share of 43%, due to the use of this food product in the sauces preparation for pasta and other dishes (e.g. pizza). The ready meals served to children comprises mainly fresh pasta (28%) and pizza dough (30%).

We took the above yearly purchase volumes and divided them by the total number of meals served at LuccaSchools One to Five, in order to calculate the total weight (pre-preparation and cooking) and composition of an average meal at these schools. Figure 8 shows the results. Again, it is emphasised that total weight refers to the amount of foods procured per average meal, rather than the weight of the served meal on the plate.

Figure 8: Composition of average meal in Lucca (ORG) schools (n=5)



As Figure 8 shows, the total weight of food procured for the average meal at LuccaSchools One to Five was 502g, and was comprised of 197g (39%) fresh fruit and vegetables, 119g (24%) ambient foods, 70.5g (14%) processed fruit and vegetables, 38.5g (8%) dairy, 35.5g (7%) ready meals, 24.7g (5%) processed meat and 17.1g (3%) fresh meat. The average meals contained high proportions of fresh and processed fruit and vegetables (53%) and ambient foods (24%). The largest part of the ambient foods was represented by bread and pasta (more than 60% of the total volume of ambient foods).

4.3. How far do foods travel in school meals services?

Next for environmental impact, we report the distances travelled by foods, from first tier suppliers to the 5 featured schools, in both Cases. The distance travelled by foods includes distances between suppliers' headquarters and central kitchens, and central kitchens to schools, for some Parma schools and all Lucca schools. It should be emphasised that the estimations are the raw kms travelled for food items in each category, based on the round-trip distances from suppliers to central kitchens/schools, and the frequencies of the suppliers' deliveries. The kms have not been moderated to take into account other customers in the delivery rounds, shared loads or backhauling.

Table 7: Annual kms travelled by foods, from suppliers to 5 schools, in Parma (LOC-ORG)

Food Category	**Kms**
Fresh fruit and vegetables	21,600
Processed fruit and vegetables	86,328
Dairy	84,456
Ambient	91,800
Fresh meat	16,416
Processed meat	2,520
Ready meals	18,720
Total	**321,840**

Table 8: Annual kms travelled by foods, from suppliers to 5 schools, in Lucca (ORG)

Food Category	**Kms**
Fresh fruit and vegetables	432
Processed fruit and vegetables	2,321
Dairy	46,930
Ambient	47,535
Fresh meat	4,265
Processed meat	812
Ready meals	1,169
Total	**103,464**

For Parma (Table 7), the most part of kms covered by the food items was due to fresh and processed fruit and vegetables, which represented together 33% of the total distance. Ambient foods were the other category showing a significant travelled distance (28.5% of the total), followed by dairy products (26%). Within the fruit and vegetables category, the transportation of canned tomatoes (in processed fruit and vegetables category) was 68% of the total distance for the category. This is due to the location of the canned tomato suppliers (South Italy), i.e. about 700 kms from Parma.

For Lucca (Table 8), the categories with the highest distance were dairy and ambient foods representing a share of the total distance of 43% and 50% respectively. Within the ambient food category, pasta shows the main contribution in terms of kms (64%), followed by bread (18%). In the case of pasta, the relevant distance was due to the geographical location of suppliers, while in the case of bread, the frequency of deliveries (daily) was the main reason of the high total distance.

It is noteworthy the significant difference between the Parma and Lucca cases. The location of Parma's suppliers for most of the food items justifies this difference in kms travelled by foods. For instance, as already mentioned, the canned tomatoes that represent a significant share of the processed F&V originate from Campania Region; frozen vegetables come from about 200 kms from Parma's cooking centre, and the pasta supplier is located more than 100 kms from Parma's cooking centre, as is the supplier of fresh meat. Although the geographical dispersion of food suppliers for Parma case would seem to support the idea of an inefficient organisation of the supply chain, this is justified by the food procurement strategy and logistics of ParmaCater that provides meals service for several schools and firms in Italy. It is quite likely that Parma's food procurement strategy affects the environmental impact of the school meal service.

4.4. What are waste levels in school meals services?

In this section, we report the plate waste levels for schools in both Cases. A full breakdown of plate waste volumes per food category is reported in D6.2 IT Country Report, for two Parma schools (ParmaSchools One and Two), and two Lucca schools (LuccaSchools One and Two), which were collected via two week-long periods per school. Here, we present estimates of total plate waste for all five Parma and Lucca schools, aggregated from this D6.2 plate waste data.

Table 9: Annual plate waste in Parma (LOC-ORG) schools

	Plate Waste (kg/year)
ParmaSchool One	6,765
ParmaSchool Two	7,916
ParmaSchool Three	13,077
ParmaSchool Four	10,148
ParmaSchool Five	13,496
Total	51,403

Table 10: Annual plate waste in Lucca (ORG) schools

	Plate Waste (kg/year)
LuccaSchool One	6,792
LuccaSchool Two	8,366
LuccaSchool Three	5,082
LuccaSchool Four	5,757
LuccaSchool Five	5,667
Total	31,663

Tables 9 and 10 report the information about the plate waste recorded during the survey carried out in two out of the five schools considered in each case. Based on the D6.2 data collection, the plate waste in the ParmaSchools represents about 26% of the entire volume of food served, while in the LuccaSchools the plate waste shares up to 38%[29]. In both cases, the volume of wasted food appears significant. The average quantity of plate waste, calculated as ratio between the total plate waste and the total number of pupils taking meals in the five schools, is 35 kg/year/pupil for Parma, and 45 kg/year/pupil for Lucca. As explained in D6.2, LuccaSchool shows 29% more plate waste than for ParmaSchool.

4.5. What is the carbon footprint of school meals services?

We now report the core environmental impact results for the school meals services in Parma and Lucca. Below we present the total carbon footprints of the services in each Case, and the contribution of the main activities of the supply chain (production/processing, local transportation and waste) to the totals.

4.5.1 Carbon footprint of Case 1 Parma (LOC-ORG) service

Based on the measurement method described in 4.1.1, we calculated the total carbon footprint of the school meals service for the 5 Parma schools (i.e. ParmaSchools One-Five). Hence, we summed the total emissions associated with the production, processing, transportation and waste of food items procured by these five schools over one school year. Table 11 shows the results.

[29] These percentages do not reconcile exactly with those that would be generated by dividing the total volume of food procured, by the total volume of waste, in each Case. This is because the latter calculation includes kitchen, preparation and counter waste, whereas the percentages stated here are derived from direct plate waste collection in canteens (from D6.2). We use the direct plate waste percentages here as the more realistic values of plate waste to total food served.

Table 11: Carbon footprint of school meals service in Parma (LOC-ORG) (5 schools)

	kgsCO_2eq
Production, processing, upstream transport emissions	205,159
Fresh fruit and vegetables	34,591
Processed fruit and vegetables	9,884
Dairy	53,037
Ambien	46,776
Fresh meat	25,592
Processed meat	26,813
Ready meals	8,466
Local transportation emission (from suppliers to central kitchen)	40,284
Local transportation emissions (from central kitchen to schools)	4,434
Waste	2,519
Total	**252,395**

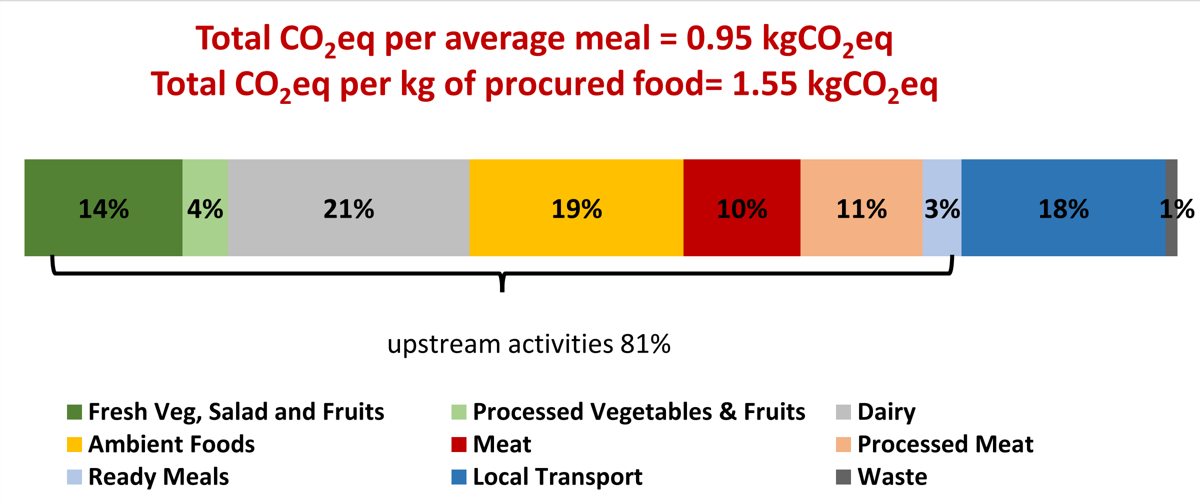
As Table 11 shows, the total emissions of food purchased by the 5 Parma schools was 252,395 kgCO_2eq. It can be seen that most emissions resulted from the production, processing activities (205,189 kgCO_2eq), corresponding to 81% of the total emissions, whereas local transportation (44,717 kgCO_2eq) had an incidence of 18%. Emissions due to food waste treatment equalled 2,519 kgCO_2eq, a share of 1%.

Within the production, processing and upstream transportation activity, a major role in generating carbon emissions was due to ambient foods and dairy products, which together represented 44% of the total emissions for these activities. Ambient foods represented 22% of the total emissions within the upstream activities. Bread production and transportation generate 46% of the total emissions within the ambient category, followed by rice (21%) and pasta (14%). It is interesting to note that dairy products represented just 5% of the total volume of foods, but they generated 22% of the entire carbon emissions of the food upstream activities. The dairy product most responsible for this impact was Parmigiano-Reggiano cheese, with a share of more than 60% in the total emission for the dairy category. Parmigiano-Reggiano is widely used in the preparation of school meals, both as ingredient and condiment (mainly for pasta). Furthermore, Parmigiano-Reggiano, being one of the most important quality agri-food products in the Parma area, is part of the local food oriented strategy of the school meal service of Parma. The carbon emission factor for Parmigiano-Reggiano is more than 12 kgCO_2e/kg (see Appendix 1), significantly higher than the carbon emissions of the other dairy products. This is due to the processing specificities of this cheese, which requires a long ripening period (at least 2 years) leading to a high milk-cheese ratio (about 16kg of milk for obtaining 1kg of Parmigiano-Reggiano).

The food waste impact, as described above, was calculated according to the methodology proposed by Moult *et al*. (2018). In Parma case, the food waste treatment method is

composting. The carbon emissions derived from this food waste treatment option included the composting processes and not subsequent application of compost to the soil.
In order to facilitate comparison, we next calculate the total carbon emissions per average meal, and per kg of meal, at ParmaSchools One-Five. To derive emissions per meal, we divided the total emissions of foods purchased by the 5 schools in one year (252,395 kgCO_2eq) by the total number of meals served (265,320 meals). By this calculation, the average meal at the Parma schools generated 0.95 kgsCO_2eq. Figure 9 shows the breakdown of these emissions, by type of food and stage of supply chain activity. To derive emissions per kg of meal, we divided the average meal emissions figure by the average meal weight (pre-preparation and cooking), which was 0.615 kg. By this calculation, emissions for every 1kg of meal at ParmaSchools One-Five were 1.55kg of CO_2eq.

Figure 9: Carbon footprint of school meals service in Parma (LOC-ORG) (5 schools)



As Figure 9 shows, 81% of total carbon emissions from the meals service to ParmaSchools One-Five was attributable to production/processing of the food items, 18% to local transport, and 1% to waste. Production/processing of the foods was therefore the most significant environmental impact of the chain. Of the production/processing emissions, 21% was attributable to meat (fresh and processed), 21% to dairy, 18% was attributable to fresh and processed fruit and vegetables, 19% to ambient food, and 3% to ready meals. The dairy category exhibits the joint highest share of CO_2 emissions (21%) because of the significant consumption of Parmigiano-Reggiano cheese and of the corresponding high emission factor. Fresh and processed meat represents the second main category in terms of emissions (almost 21%). Within fresh meat, beef contributed to almost 50% of the total food category emissions, while within processed meat, the fillets of fish accounted for the greatest part of the total emissions. Fresh and processed F&V account for 18% of total emissions due to the upstream processes. For this category, transportation from suppliers to kitchen is particularly relevant, since it generates emissions comparable to upstream processes. The distant location of F&V suppliers, in particular, is a key determinant of the total emissions for this category.

4.5.2 Carbon footprint of Case 2 Lucca (ORG) service

Based on the measurement method described in 4.1.2, we calculated the total carbon footprint of the school meals service for the five Lucca schools (i.e. LuccaSchools One to Five). Hence, we summed the total emissions associated with the production, processing, transportation, and waste of food items purchased by these five schools over one school year. Table 12 shows the results.

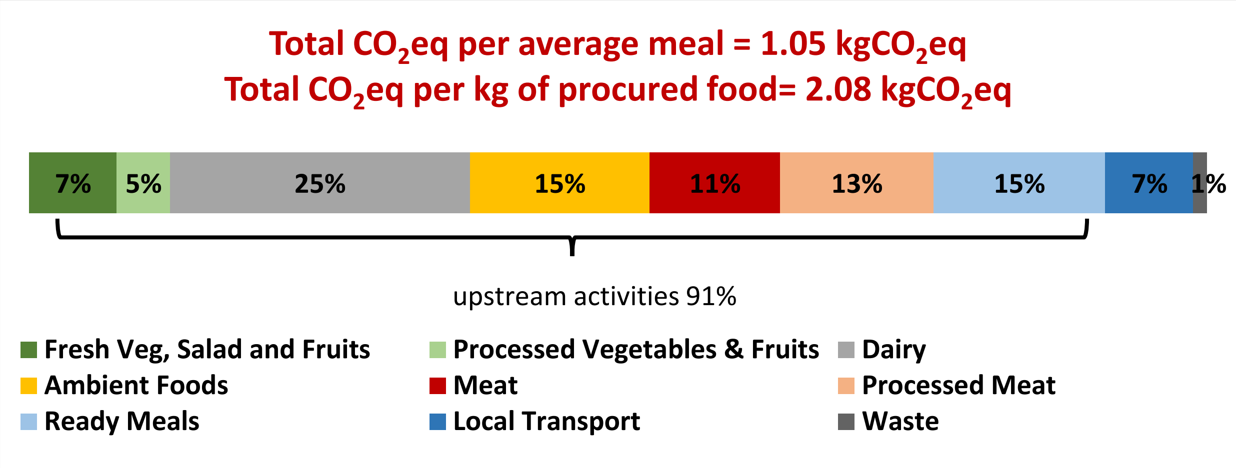
Table 12: Carbon footprint of school meals service in Lucca (ORG) (5 schools)

	kgsCO_2eq
Production, processing, upstream transport emissions	121,044
Fresh fruit and vegetables	9,851
Processed fruit and vegetables	5,999
Dairy	33,742
Ambient	20,221
Fresh meat	14,674
Processed meat	17,246
Ready meals	19,311
Local transportation emission (from suppliers to central kitchen)	5,161
Local transportation emissions (from central kitchen to schools)	4,747
Waste	1,552
Total	**132,504**

As Table 12 shows, the total emissions of food purchased by the five schools was 132,504 kgCO_2eq. It can be seen that most emissions resulted from production, processing and upstream transportation, which accounted for 91% of the total carbon emissions, whereas local transportation contributed for 8% of the total emissions and waste treatments for the remaining 1%.

In order to facilitate comparison, we next calculate the total carbon emissions per average meal, and perkg of meal, at LuccaSchools One to Five. To derive emissions per meal, we divided the total emissions of foods purchased by the five schools in one year (132,504 kgCO_2eq) by the total number of meals served (126,720 meals). By this calculation, the average meal at the LuccaSchools generated 1.046 kgsCO_2eq. Figure 10 shows the breakdown of these emissions, by type of food and stage of supply chain activity. To derive emissions per kg of meal, we divided the average meal emissions figure by the average meal weight (pre-preparation and cooking), which was 0.502 kg. By this calculation, emissions for every 1kg of meal at LuccaSchools One to Five were 2.08kg of CO_2eq.

Figure 10: Carbon footprint of school meals service in Case 2 Lucca (ORG).



As Figure 10 shows, 91% of total carbon emissions from meals service to LuccaSchools One to Five were attributable to production/processing of the food items, 7% to local transport, and 1% to waste. For food waste in Lucca schools, the method adopted is composting, for which the present analysis considers only climate change contribution originating from the processing phase. As with Parma case, production/processing of the foods is therefore by far the most significant environmental impact of the chain. Of the production/processing emissions, 25% is attributable to dairy products, 24% to meat (fresh and processed), 15% to ambient food and ready meals, and 12% to fresh and processed fruit and vegetables. Fresh and processed meat represented almost a third of total production and processing emissions, although it represented only 8% of the volume of the meals. In the same way, dairy represented about one third of the total upstream emissions, even though it also was only 8% of volume of meals. Hard cheeses have a major role in the dairy emissions. Indeed, Lucca menu includes Parmigiano-Reggiano, Grana Padano and Pecorino that together represented more than half of the total emissions for the dairy category. The high emissions of hard cheeses are relied on the conversion yield between milk and ripened cheese. The main driver of ambient food emissions was bread, rice and pasta that account for 44%, 25% and 12% of the total category emissions respectively. Within fresh meat, the white meats (poultry meat and veal) represented 70% of the total environmental impact, due to the high share of these products in the total volume of fresh meat and the high carbon emission factors attributed to veal (21.7 kgCO_2eq/kg). The relatively high contribution of ready meals is also noteworthy, where the breaded cutlets contributed more than 70% of the total category emissions. Even though fresh and processed fruit and vegetables were 53% of the total volume of foods, the carbon emissions for this category accounted for only 12% of the total, due to the relatively low emission factors of the food items included.

4.5.3 Comparison of carbon footprint of Parma and Lucca services

The preceding sections show that <u>the carbon footprint of the Parma (LOC-ORG) meals service is lower than Lucca (ORG)</u>, based on a sample of five schools in each Case. On a per average meal basis, Parma emissions were 0.95kgCO_2eq, whereas Lucca average meals emitted 1.05 kgCO_2eq. On the basis of total meals served annually at the five schools in each case, Parma's emissions savings are 9%. i.e. 24,962 kgCO_2eq compared with those of Lucca.

The key features of the Parma and Lucca services that explain the difference in emissions are: (i) more fruit and vegetables component in Parma (ii); slightly less meat and dairy in Parma; and, iii) relative high incidence of ready meals in Lucca. Overall, both cases demonstrated that the menu composition and the food production are the key determinants of the carbon emissions, rather than the origin of food. However, the emissions due to transportation in Parma are significantly higher than in Lucca. This impact is determined by the high contribution of transportation of fresh and processed F&V in Parma. Although the total emissions for Parma case is lower, the finding about transportation suggests that better management of suppliers' selection and logistics may lead to emission reductions.

4.6 Procurement management scenarios to reduce carbon footprint

The preceding sections have shown how different activities in the supply chain contributed to the carbon footprint of the Parma (LOC-ORG) and Lucca (ORG) meals services. To conclude our analysis of the environmental impact of the services, we report results of our exploration of different procurement management scenarios and their effects on carbon emissions in both Cases.

4.6.1 Carbon footprint reduction scenarios in Parma (LOC-ORG)

In what follows, some new food procurement and school meal service management scenarios were tested for evaluating the environmental impact change with respect to the observed situation. Scenarios were identified according to the Parma school meal management specificities. We simulated the following six scenarios:

- To explore the possible emissions reductions, by switching from processed to fresh fruit and vegetables, we simulated a 50% reduction of the volume of processed fruit and vegetables in Parma case: this scenario considers only the reduction of 50% of frozen vegetables, for which there is a correspondence in fresh vegetable procurement list, and the simultaneous increase in fresh vegetables to compensate the decrease in frozen vegetables.
- To explore possible emissions reductions by switching from high emission beef to lower emission poultry, we simulated the complete substitution of fresh beef meat with poultry meat in Parma case: the beef removal implies an increase in poultry meat of 70%.
- To explore possible transport emissions reductions, we simulated a more local canned tomato supplier: since Parma's current supplier is located at 700 kms from the central kitchen, and Parma is the main tomato processing area in Northern Italy, we assumed to change the current supplier with a local supplier (20kms from the central kitchen).
- To further explore transport emissions reductions, we simulated selection of a local fruit and vegetables supplier: instead of the current fruit and vegetables supplier located at 100kms, the scenario assumed to acquire these products from a supplier close to the central kitchen (25kms).
- To further explore transport emissions reductions, we simulated the local transportation model, from suppliers to kitchen, of Lucca case for Parma: the hypothesis was to substitute the suppliers' distances from schools as found in the Lucca case for each food category in the Parma case.
- To reveal the emissions reductions gained by current waste management practice of composting, we simulated landfill as the food waste management model.

Figure 11: Procurement scenarios to reduce carbon footprint in Parma (LOC-ORG)

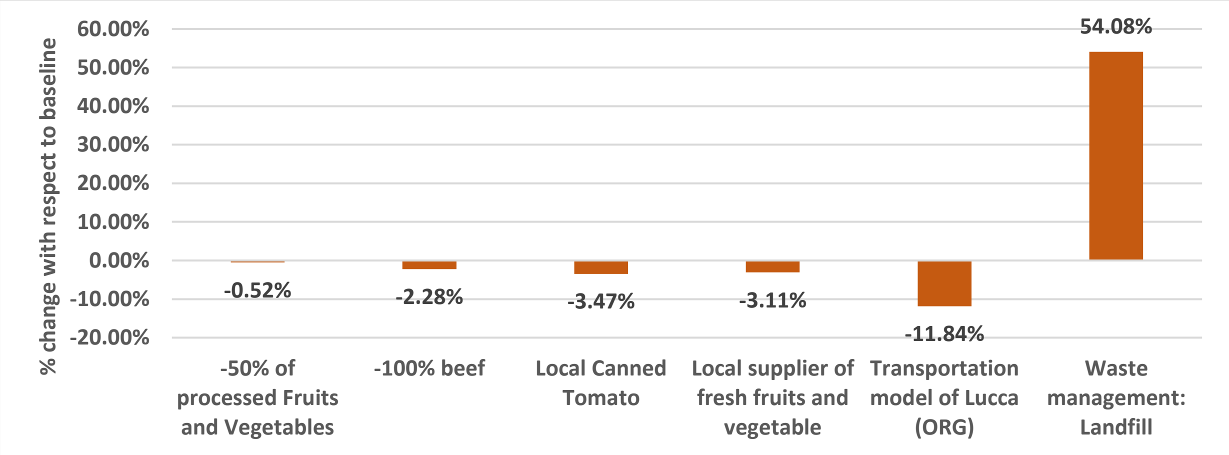


Figure 11 shows the variation in carbon emissions for the different food procurement management scenarios for Parma Schools with respect to the emission level calculated for the observed situation. The substitution of frozen vegetables with fresh ones seems to be not very important in terms of carbon emission variation (-0.52% with respect to the baseline). If Parma Schools decided to substitute beef with poultry meat, the reduction in CO_2 emissions corresponds to 2.28%. The location of canned tomato suppliers is one of the most sensitive variables: buying canned tomatoes within the Parma area would mean a reduction in total CO_2 emissions of 3.47%. The location of the fresh fruit and vegetables, however, is not as relevant as canned tomato. If Parma Schools identified a fruit and vegetables supplier in a radius of 25kms from the central kitchen, the emissions would reduce by 3%. The scenario where ParmaSchools' suppliers are located at a distance similar to LuccaSchools' ones, CO_2 reduction would be almost 12%. The food waste landfill scenario confirms that the composting treatment is a much more environmentally sustainable food waste management practice.

4.6.2 Carbon footprint reduction scenarios in Lucca (ORG)

Similarly, for Lucca Schools, some new food procurement and school meal service management scenarios were hypothesized for supporting decisions about more efficient alternatives in terms of carbon emissions. Scenarios were identified according to the Lucca Schools meal management specificities. We simulated the following four scenarios:

- 50% reduction of the volume of processed fruit vegetables: this scenario considered only the reduction of 50% of frozen vegetables, for which there is a correspondence in fresh vegetable procurement list, and the simultaneous increase in fresh vegetables to compensate the decrease in frozen vegetables.
- The complete substitution of fresh beef meat with poultry meat: the beef removal implied an increase in poultry meat of 70%.
- Substitution of the breaded cutlets with fresh poultry meat.
- Landfill as food waste management model.

Figure 12: Procurement scenarios to reduce carbon footprint in Lucca (ORG)

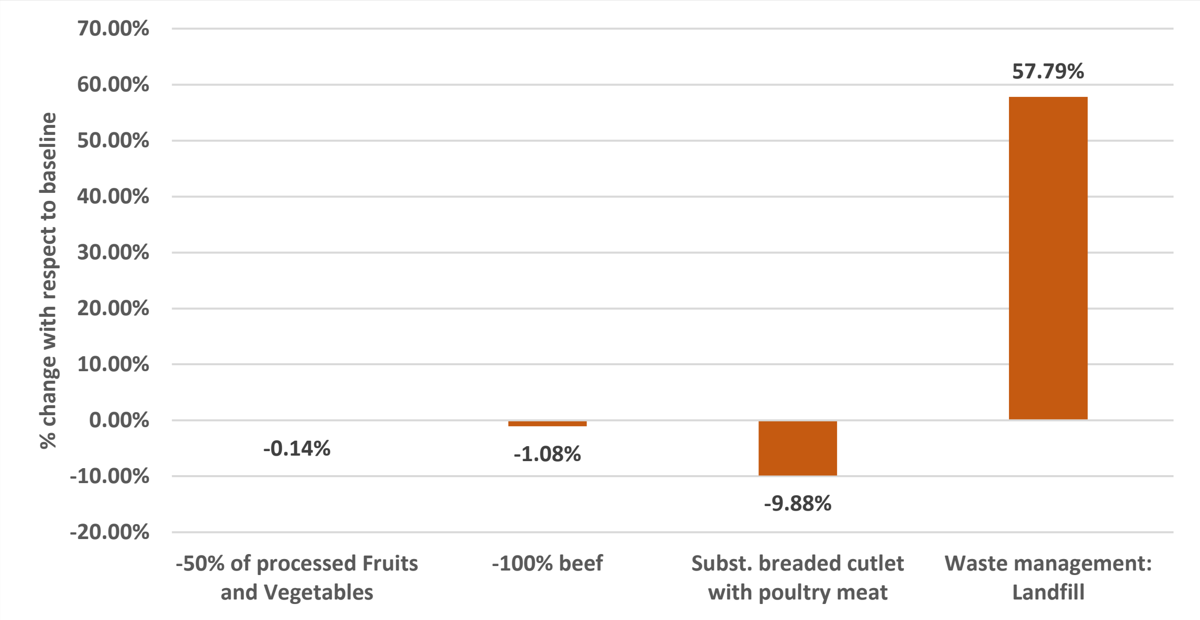


Figure 12 shows the change in carbon emission because of the introduction of new features of the school meal service organisation. The reduction of frozen vegetables does not have substantial effect on CO_2 emissions. We assumed to substitute solely the frozen vegetables with a direct correspondence in the list of fresh vegetables. For instance, processed peas, for which the menu does not consider the use of a fresh product, are not submitted to substitution within the scenario. Canned peeled tomatoes were excluded from the scenario as well. Frozen peas and canned tomatoes represent more than 50% of the entire category of processed vegetables. This explains the low impact of this scenario. In addition, the substitution of beef with poultry meat provides a low positive environmental contribution. On the contrary, the scenario involving the breaded cutlet, the most carbon emissive ready meal, could reduce the CO_2 emission by almost 10%. Also for Lucca, a change in waste management by adopting a landfill practice would increase significantly the carbon emissions (+58%).

5. ECONOMIC IMPACT OF SCHOOL MEALS SERVICES

In this section, we report the results of the economic impact of the school meals services in Parma (LOC-ORG) and Lucca (ORG) cases. The measures of economic impact used in both cases were (i) local economic multiplier effect, and (ii) the economic value of the contract to suppliers.

5.1 Methodology to measure local economic multiplier effect

The aim of the local multiplier analysis was to trace the expenditures of the organisations/firms in the Parma and Lucca school meals supply chains, to identify what proportions of the monies from the meals contracts in each case were retained within (or leaked out of) the local area. To calculate this, we used the 'Local Multiplier 3' (LM3) methodology[30], which involves tracking the expenditures of a starting budget (i.e. the total budget gathered from parental/state contributions to fund a school meals service), through three rounds of spending (LM1, LM2, LM3).

In practice, this involved first defining the geographic dimensions of the local area of the case (in both our Cases, this was 50km radius from Council HQs), then tracking retention/leakage of monies as follows:

2. from the holders of the starting budget to the immediate budget recipients (LM1). In both our Cases, the LM1 stage comprised the budget transfer from Parma and Lucca City Councils to ParmaCater and LuccaCater, respectively. Retention/leakage was determined by the geographic location of the budget recipient's registered HQ, as given for accounting purposes and interviews, relative to the 50 km local area radius.
    - from the budget recipients to their staff and first tier suppliers/wholesalers (LM2). In our Cases, LM2 involved tracking SchoolCaters expenditures on their own staff, their first tier suppliers (i.e. all the contracted suppliers described earlier in the Monographs), and other costs. Retention/leakage was determined by the geographic residence of staff, first tier suppliers and recipients of direct cost expenditures, relative to the 50 km local area radius.
    - from the first tier suppliers to their staff and upstream suppliers (LM3). In our Cases, LM3 involved estimating the proportions of the expenditures of the first tier suppliers on their staff and upstream suppliers that were retained in the local area. Retention was estimated as a single % of overall expenditure, with default rates (e.g. 66%, based on previous studies) applied according to whether or not the first tier supplier was located within the local area.

    In terms of calculation outcome, LM3 is expressed as a ratio between 1 (indicating that no value has been retained within the local area) and 3 (indicating that 100% of values have been retained at the different stages).

[30] Full explanation of the method is available at www.lm3online.com.

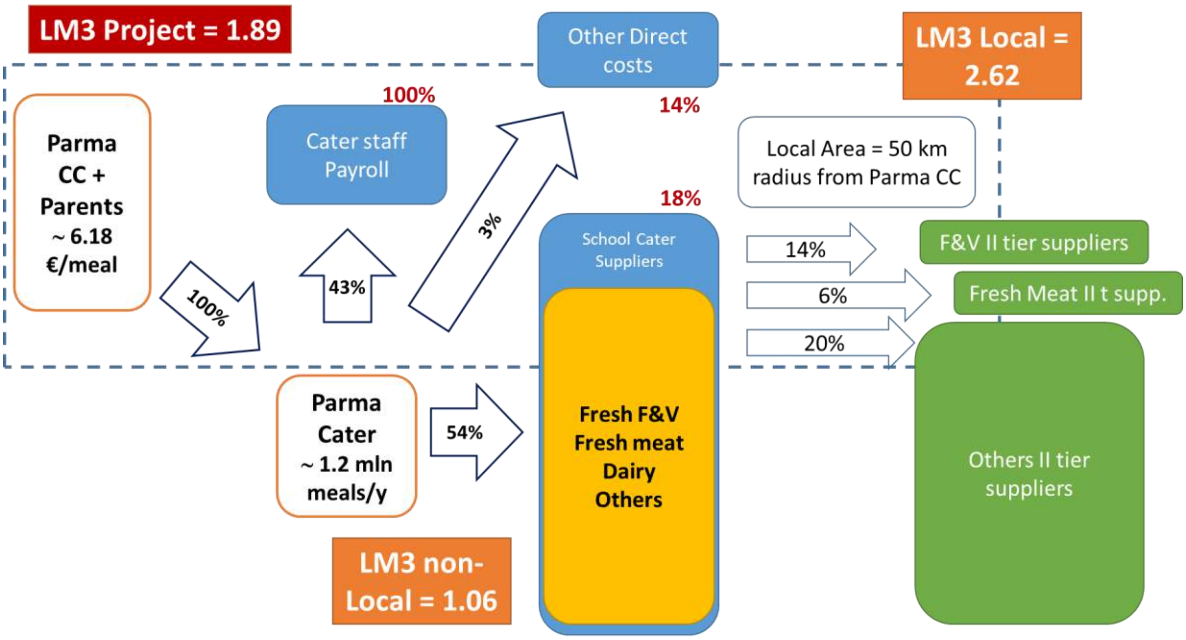
5.2 What are local economic multipliers of the school meals services?

5.2.1 Local economic multiplier of Parma (LOC-ORG) service

First, we report the Parma LM3 calculation and results. In terms of local area, the local boundary was defined as a 50 km radius from Parma City Council offices, in Parma City. This area takes in the entire Parma province, except part of the remote mountain region and part of the neighbouring province of Reggio Emilia. The contract tender subscribed by the school catering service in Parma, states that a "zero Km" product is a food originating at no more than 100 kms from the city where the school meal service takes place . Such a distance applied to our case would have included a very large area with at least four Emilia-Romagna provinces involved. To keep the local meaning of the economic indicator, 100km radius seemed a too high distance, so we decided to assume 50km as a reasonable distance, which covers the province of Parma and portions of the surrounding provinces. Using this radius, just a small share of the value transferred to first tier suppliers (18%) is retained within local area.

Figure 13 shows the results of the LM3 analysis and the proportions of flows of expenditures at each stage. The ratios shown are 'Project LM3' ratios.

Figure 13: Local multiplier analysis (LM3) of Parma school meals service.



As Figure 13 shows, the first flow of expenditure in the chain (LM1), is the transfer of money from Parma City Council (budget holder) to ParmaCater (budget recipient), to pay for the school meals service. To calculate the size of the budget, we multiplied the total annual number of meals served by ParmaCater by the fixed price per meal set out in the contract. To determine retention/leakage, we assessed ParmaCater's registered HQ for accounting purposes. This was in the province of Bologna, outside of the defined local area. Hence at this stage, we interpreted that values from the meal budget leak out from the local area (Project LM1=1), although as the budget is administered by the ParmaCater office in Parma, the monies do flow back at the start of the next stage.

The second flow of expenditure in the chain (LM2) is ParmaCater's spend on staff, suppliers and direct costs. We established from publicly available accounts information (AIDA database[31]), from documents received by the City Council officers and from interviews, that 43% of ParmaCater's expenditure was on staff, 54% was on suppliers[32], and 3% was on direct costs. To determine retention/leakage, we first established that, as all ParmaCater staff were resident within the local area, this expenditure was retained locally. According to City Council and agri-food product prices provided by ISMEA, leader institute in monitoring Italian agri-food markets[33], we estimated the distribution of ParmaCater among food suppliers, so that we can measure the economic weight of each first tier supplier on the total budget. The expenditure retained at local level relates to the location of each first tier supplier. For instance, since Vegland is located further than 50 kms, most of the budget allocated to Vegland leaked outside the local area. On the contrary, as PR is located at 25 kms from the City Council, the related expenditure is kept within the local area. The same approach is applied to the other first tier suppliers. Finally, we applied the default local multiplier for the proportion of direct costs retained in the local area. Therefore, in total at this stage, we estimated that 53% of the value of the starting budget was retained in the local area (Project LM2 = 1.53).

The third flow of expenditures in the chain (LM3) was the private spend of ParmaCater's staff (i.e. their own discretionary income spend), and the business expenditures of first tier suppliers on their staff and upstream suppliers. To determine retention/leakage of ParmaCater staff private expenditure, we applied a default estimate of local retention, based on 100% staff's local residence. To determine retention/leakage of suppliers' expenditures, we broke down the turnover of each supplier according to the data obtained from AIDA database for identifying the expenditure for workers and expenditure for goods and other services; then, we applied the following criteria:

- For distance exceeding 100kms, we assume that all the personnel lives outside the local area;
- For distance equal to or lower than 25kms, we assume that all the personnel lives within the local area and spends all its budget within local area;
- For distances ranging between 25kms and 100km, the share of local expenditure is estimated in the following way: distance x 0.5/100;
- The share of local expenditure for second tier suppliers of goods and services is estimated through interviews and expert knowledge.

Following these estimates, we calculated the Project LM3 ratio for the Parma school meals chain to be 1.89. This means that for every €1 spent by the initial budget generators (i.e. Parma City Council, via parents/carers), an additional €0.89 is generated within the local area.

To conclude the LM3 analysis for Parma, we also report the Local LM3 and Non-Local LM3 ratios (Table 13).

[31] https://www.bvdinfo.com/en-gb/our-products/data/national/aida
[32] Source: calculated from FreshGrocer's target food cost per meal, communicated via interview.
[33] http://www.ismea.it/istituto-di-servizi-per-il-mercato-agricolo-alimentare

Table 13: Project, local, and non-local LM3 estimates for Parma (LOC-ORG) meals service

		Explanation
Project LM3	1.89	1€ triggers a flow of 1.89€ within the school meal service supply chain
Local LM3	2.62	1€ spend only on local suppliers generates an extra benefits of 1.63€ for the local economy
Non-Local LM3	1.06	1€ spent for non-local suppliers contributes to activate 0.06€ within the local area

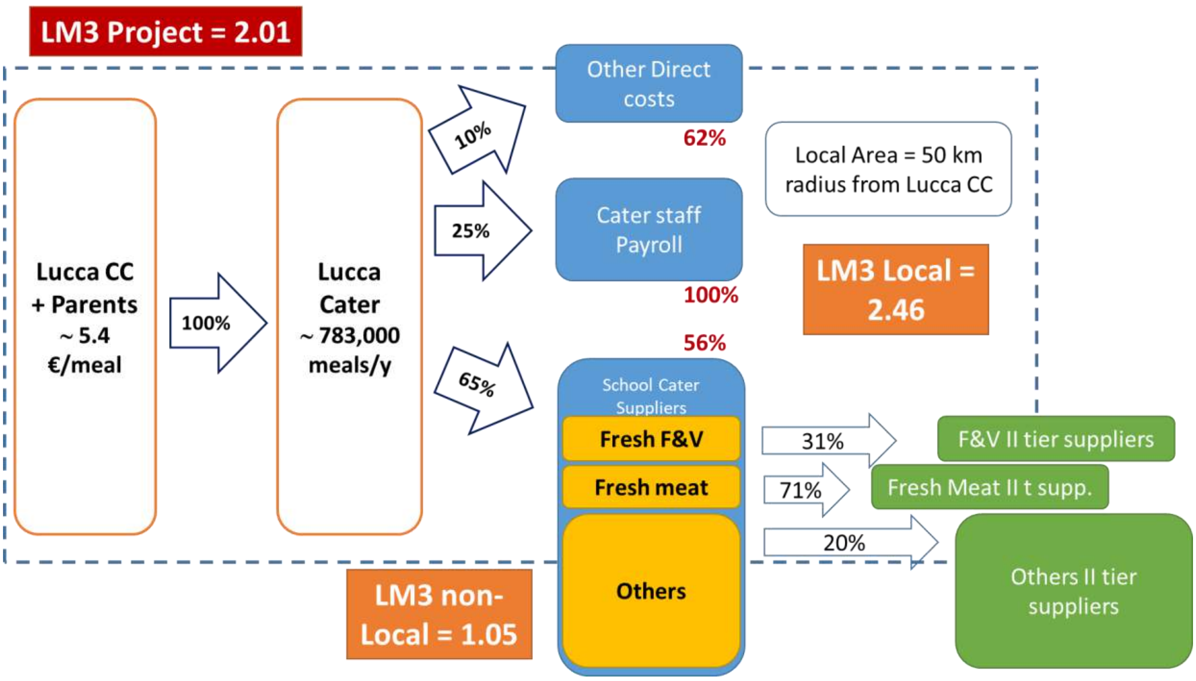
It is important to remark that if all the suppliers were local, the LM3 would reach a maximum level 2.62, while if all the suppliers were located outside the local area, the LM3 would reach the minimum value of 1.06. Therefore, the global result of 1.89 means that the non-local suppliers have an important role in driving the contribution of the meals service to the local economy.

5.2.2 Local economic multiplier of Lucca (ORG) service

Next, we report the Lucca LM3 calculation and results. In terms of local area, the local boundary was defined as a 50km radius from the Lucca City Council offices. We decided to maintain the same radius of Parma for comparative reasons. The local area of Lucca case includes the entire province of Lucca and most part of the surrounding provinces. Unlike Parma case, this radius allows to include many first tier suppliers. Using this radius, BigMover, NaturalBakery, BioBeef and VegFresh are defined as 'local', as they all have HQs within the Lucca area or surrounding zone. DairyFarm, MilkyWay, LittleEggs and ItalGoods are all placed outside the radius of 50kms. Hence, these suppliers are defined as 'non-local'.

Figure 14 shows the results of the LM3 analysis for Lucca (ORG) meals service, and the proportions of flows of expenditures at each stage. The ratios shown are 'Project LM3' ratios.

Figure 14: Local multiplier analysis (LM3) of Lucca (ORG) school meals service



As Figure 14 shows, the first flow of expenditure in the chain (LM1), is the transfer of monies from Lucca City Council (budget holder) to LuccaCater (budget recipient), to pay for the school meals service. From interviews and the school meal service contract, we established the size of this budget. LuccaCater, along with all other Lucca city Council departments, is based within the city of Lucca, hence at this stage we interpreted that most values from the meal budget are retained the local area (Project LM1=2.0).

The second flow of expenditure in the chain (LM2) is LuccaCater's spend on staff, suppliers and direct costs. From interviews and LuccaCater's balance sheet obtained through AIDA database, we established that 25% of LuccaCater's expenditure was on staff and 65% was on suppliers, and 10% on other direct costs. To determine retention/leakage, we first inferred that, as all LuccaCater staff were resident within the local area, most of this expenditure was retained locally. Second, according to the quantity purchased from each first tier suppliers and the agri-food prices provided by ISMEA, we defined the distribution of LuccaCater's budget among its different first tier suppliers. In this way, we established that LuccaCater's expenditure on suppliers was broken down as follows: BigMover = 40%; DairyFarm = 3.2%; MilkyWay = 1%; LittleEggs = 1%; NaturalBakery = 5%; BioBeef = 4%; FreshVeg = 7%; Energy consumption = 38%. As BigMover, NaturalBakery, BioBeef and VegFresh were located within the local area, we inferred that all of this expenditure was retained. The expenditures of DairyFarm, MilkyWay, LittleEggs, ItalGoods and Energy provider leaked out. Therefore, in total, at this stage we estimated that 68% of the value of the starting budget was retained in the local area (Project LM2 = 1.68).

The third flow of expenditures in the chain (LM3) was the private spend of Lucca Cater's staff (i.e. their own discretionary income), and the business expenditures of first tier suppliers on their staff and upstream suppliers. According to the analysis of the balance sheets of every LuccaCater's first tier supplier, we identified the share of turnover dedicated to payroll and share for other inputs and services. More specifically, we broken down the turnover of each supplier according to the data obtained from AIDA database for identifying the expenditure for workers and expenditure for goods and other services. For identifying the retention/leakage expenditure we applied the criteria used for Parma case.

Following these estimates, we calculated the LM3 ratio for the Lucca school meals chain was 2.01. This means that for every €1 spent by the initial budget generators (i.e. Lucca City Council, via parents/state), an additional €1.01 is generated within the local area.

To conclude the LM3 analysis for Lucca, we also report the Local LM3 and Non-Local LM3 ratios (Table 14).

Table 14: Project, local, and non-local LM3 estimates for Lucca (ORG) meals service

		Explanation
Project LM3	2.01	€1 triggers a flow of €1.89 within the school meal service supply chain
Local LM3	2.46	€1 spent only for local suppliers generates an extra benefits of €1.63 for the local economy
Non-Local LM3	1.05	€1 spent for non-local suppliers contributes to activate €0.06 within the local area

Overall, the Parma (LOC-ORG) school meals service had a lower LM3 ratio (1.89) compared with the Lucca (ORG) service (2.01). Both of these are relatively low ratios in the context of the food sector. In particular, Parma case LM3 is mostly due to a large part of its procurement originating from non-local first tier suppliers (82%). The slightly higher ratio in Lucca is due to higher proportion of first tier suppliers located within the local area, which permits to retain within the area 68% of the initial budget at the second LM3 level versus 53% of Parma. If for Lucca the key local expenditure at the second stage results to be the expenditure for local first tier suppliers (36% of the turnover), in the case of Parma the most important expenditure is the payroll (43% of the total turnover). If we move to the third LM3 level, in both cases the most part of the local expenditure is due to payroll (17% for Lucca and 29% for Parma).

5.3 'What if' scenarios to increase local economic multipliers

To explore what would happen to the LM3 ratio for Parma if more or less suppliers had HQs within 50km radius, we undertook two 'what if' analyses. First, we calculated the LM3 for a scenario where the fresh fruit and vegetables supplier was located in the local area using the average share of responding estimated for the current situation. The LM3 moves from 1.89 to 1.97 with a 4% increase. Second, we calculated what would happen to the LM3 ratio if the fresh meat supplier was located inside the local area. In this scenario, the LM3 reaches 2.05 (+9% with respect to the current situation), a figure above that of Lucca in the current situation. Finally, we considered the scenario "all inside", where all the first tier suppliers (ParmaCater's labour excluded) are supposed to be local. LM3 would show 35% increase with a value of 2.55. On the contrary, if we considered the scenario "all outside", LM3 drops to 1.76 (-7%).

To explore what would happen to the LM3 ratio for Lucca if more or less suppliers had HQs within 50km radius, we undertook four what if analyses. First, we calculated LM3 for the case where DairyFarm is located within the local area. In this scenario, LM3 slightly increases, +1.4%. The second scenario raises to 50% the share of BigGrocer's local suppliers, compared with the current situation of 18%. This increase in local suppliers resulted in a LM3=2.09 (+4%). Finally, we considered the scenario "all inside", where all the first tier suppliers (LuccaCater's labour excluded) are considered to be local. LM3 would show 21% increase with a value of 2.43. On the contrary, if we considered the scenario "all outside", LM3 drops to 1.42 (-30%).

To conclude, we note that in the most pessimistic local supplier scenarios, Parma and Lucca cases show a different value chain pattern. Parma case is more reliant on payroll. Indeed, even if we assume all the suppliers non-local, the LM3 does not reduce very much. On the contrary, in the case of Lucca, the disappearance of local suppliers would lead to a 22% reduction in LM3 value, because the proportion of starting budget expenditure on payroll is smaller than in Parma. This means that for Lucca the main driver in the LM3 indicator is the presence of suppliers within local area, rather than its own payroll.

5.4 Economic value of the school meals service

To explore what economic values are experienced by members of school meals supply chains, from their involvement in a contract, we collected for each supplier in both Cases, through AIDA database, the current employee numbers and turnovers, in order to obtain an estimate of the size of their businesses, and an estimation of their growth rates over the last 5 years. We estimated also the proportion of their business dependent on the school meals contract. This latter estimation resulted from the ratio between the food provision value of each supplier and its own turnover. The food provision value was obtained through the combination of the quantity of food items provided by each suppliers and the corresponding market prices. As the absolute number of supply chain members in both Cases was relative small, we report the results descriptively.

5.4.1 Economic value in Case 1 Parma (LOC-ORG) service

Parma case shows a relatively high number of suppliers in comparison with Lucca case, 29 vs 9. This is due to the business size of ParmaCater. As Table 15 shows, ParmaCater has a turnover more than €518 mln with more than 11,000 workers. This is a national firm characterized by a massive organisation of food. In terms of business size, we found the members of the supply chain each (excluding ParmaCater) had turnovers of between €13mln and €316mln and employed between 17 and 289 staff. For all the supply chain members, except one, turnover revealed a significant increase during the last five years. Most of the firms enhanced the competiveness in the market obtaining a significant enlargement of their market shares. It is noteworthy that some important firms in the school meal supply chain are cooperatives. This is the case of ParmaCater and VeggieLand, which represent important actors within the regional and national economy.

For all the suppliers, the Parma school meals contract represented only a small part of their business, because of the reference market that exceeds the regional boundaries. Table 15 summarises the data. ParmaCater is by far the most important entities within the membership of the Parma school meal contract supply chain. For ParmaCater, the Parma school meal service contract represents a very small share of its total annual budget (0.9%). As mentioned above, this result is due to the national relevance of the firm. As a whole, school meal service represents 36% of the total ParmaCater's budget, the most important sector for ParmaCater. ParmaCater is also the main school meal service provider of the schools in the province of Parma.

Table 15: Economic value of school meals contract in Parma (LOC-ORG)

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 yrs	Growth annual rate in last 5 yrs
	(employees)	(turnover .000 €)			
ParmaCater	11184	518,179	0..9%	18.8%	3.5%
BioLand	112	53,453	0.1%	-25.9%	-5.8%
BrownField	17	72,914	negligible	40.8%	7.1%
ItaRice	166	186,281	negligible	26.4%	4.8%
P&RCheese	289	316,511	negligible	25.9%	4.7%
Biodairy	84	27,689	0.1%	4.9%	1.0%
QualMeat	22	12,782	4.1.%	28.3%	5.1%
FrozeFish	59	76,586	0.2%	9.1%	1.8%

VeggieLand	68	199.509	negligible	27.6%	5.0%
ExtraOil	132	188.239	negligible	16.7%	3.1%
GoldGarden	65	121.225	0.2%	75.8%	11.9%

For BioLand, the Parma contract comprises a very small % of turnover. The domestic market is an important target for the firm, even though the exports of pasta represent more than 50% of turnover. During the last five years, turnover decreased at annual rate of 6%, as a result of a resizing of the entire business. BioLand has proven to be very attractive for school meal service provision, thanks to the organic pasta produced since 2000.

For BrownField, the Parma school meals contract is a negligible part of the entire firm turnover, although the firm supplies many school meals services through the main school meals service contractors. During the years, Brownfield consolidated its position on the market with a communication policy addressed to enhance the level of reputability of its organic products. The firm's strategy allowed it to increase turnover significantly in both private and public sectors. BrownField shows 40% of turnover growth during the last five years and an annual growth rate of 7%.

ItaRice is the leading rice producer in Italy, with a turnover of more than €186mln and 166 workers employed within the different firm tasks. According to the last five balance sheets, ItaRice showed a strong increase in turnover with +26% in the period, i.e. an annual growth rate of about 5%. Thanks to the different varieties of rice, the ItaRice became an important provider of public and private catering services.

For P&R Cheese, the Parma school meal contract comprises a very small % of turnover. We can affirm that P&R is the unique firm that provides a Parmigiano-Reggiano branded product on the market. Parmigiano-Reggiano is generally placed with the Consortium of Parmigiano-Reggiano brand. P&R built during the years a reputation and a brand recognized by consumers as a brand associated to Parmigiano-Reggiano. P&R Cheese is a reference brand for Parmigiano-Reggiano. The geographical location, the high volume of product managed each year and capacity to be responsive at the customer needs, make P&R Cheese an important actor both for public and private food catering services.

BioDairy is an old company specialized in the production of fresh cheeses. The turnover is about €28mln, 5% more than five years ago corresponding to an annual increase of 1%. The objective of the firm, as declared by its president, is to consolidate its position within the market of fresh cheese (e.g. robiola and stracchino cheeses) and to enhance the efficiency level in processing activity by keeping the quality of the product and the connection with the territory. BioDairy developed organic fresh cheeses targeted to a growing organic market. The expertise and the deep market knowledge has made BioDairy one important provider of fresh quality cheese for the school meals services. Indeed, one of the targets for the future is to develop this sector of activity.

Organic meat production is at the core of QualMeat business. The turnover of QualMeat amounts to about €13mln. During the last five years the company registered an important growth in sales value (+28%), with an annual increase rate of 5%. This was the result of the activity promoted by the company within the market of quality meat, and in particular of organic quality meat. For the future, some relevant investments in new buildings and machineries will allow a greater efficiency of the entire processing system. The incidence of the estimated meat value within Parma school meals contract is 4.1% of the company turnover. This is the highest share observed among the Parma school meals service suppliers.

For FrozenFish, the Parma school meals services comprises 0.2% of turnover. FrozenFish is a leading company in the frozen fish sector. The wide market of FrozenFish means the Parma contract represents a very low share of the total turnover of €77mln. During its history, FrozenFish addressed production toward a market more and more characterized by meals catering services and, in particular, by school meals services. FrozenFish has developed specific fish products suitable for school meals service, i.e. products without fishbone and with constant weight. Furthermore, the regional and national relevance in the frozen fish sector helps to place the company at the centre of the interest of the main school meals contractors.

For VeggieLand, the Parma school meals service comprises a negligible % of turnover. It represents one contract amongst a set of public and private contracts operated in Emilia-Romagna and other Italian regions. VeggieLand is one of the most important companies in the sector of frozen vegetables in Italy. It is part of a network of cooperatives aiming at developing the agricultural activity of its members (farmers and agri-food processing companies). During these last five years, the turnover increased 28%, with an annual growth of 5%.

For ExtraOil, the Parma school meals service comprises a negligible share of turnover. The reference markets are big retail, restaurants and catering, where school meals service plays a significant role in opening new economic opportunities. ExtraOil is investing in technology and R&D to improve the efficiency and quality of its products. For instance, oil-blending trials is an important activity carried out for identifying different tastes and aroma. The process of market expansion is revealed in the increase of business along the last five years, amounting to 17% of turnover.

GoldGarden is placed at 100 kms from Parma and it acts as an integrated firm, in the sense that, with its parent company, it covers and coordinates all the phases of the fresh fruit and vegetables supply chain, from agriculture to distribution. It becomes along the year one of the main market and logistics place for fruit and vegetables in Emilia-Romagna. GoldGarden is following a policy of market expansion, as the turnover data demonstrate: in five years, the sales value registered an increase of almost 78%, with an annual growth of 12%, the highest among the firms involved within the Parma meals service contract. The proportion of turnover due to Parma contract is 0.2%, very small, but in any case representative of the reference organic products market of GoldGarden.

5.4.2 Economic value in Case 2 Lucca (ORG) service

In terms of business size, we found the members of the Lucca supply chain had turnovers of between €1mln and €1,400m, and employed between 8 and 736 staff. We estimated that the number of full time jobs in supplier firms dependent on the school meals contract is 55. The estimation resulted from the proportion of the provision value and the turnover of each suppliers. This figure might underestimates the real number of workers involved in the school meals contract. Growth rates of suppliers varied considerably from those who were experiencing high levels of growth, to those who described their recent development as more of a consolidation of their position. For some suppliers, the Lucca school meals contract represented only a small part of their business, while for other suppliers, as LuccaCater and FreshVeg, the school meals service represented a significant activity for their business. Lucca meals service supply chain is characterised by a combination of large wholesalers and smaller firms. Wholesalers re-sell goods produced by other firms, while the other firms produce and sell their own products. Table 16 summarises the data.

Table 16: Economic value of school meals contract in Case 2 Lucca (ORG)

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 yrs	Growth annual rate in last 5 yrs
	(employees)	(turnover .000 €)			
LuccaCater	146	7,461	40.5%	31.1%	5.6%
FreshVeg	8	2,222	7.2%	4.5%	0.9%
DairyFarm	17	14,586	0.5%	20.3%	3.8%
MilkyWay	168	20,812	negligible	n.a.	n.a.
ItalGoods	247	314,677	negligible	48.0%	8.2%
LittleEgg	361	500,173	negligible	-6.3%	-1.3%
BioBeef	10	3,745	2.6%	3.0%	0.6%
BigMover	773	1,382,444	negligible	22.2%	4.1%
NaturalBakery	64	6,897	1.5%	-11.6%	-2.4%

As Table 16 shows, in term of turnover and employed workers, FreshVeg is the smallest company in the supply chain. The company activity focuses on selectin and trade of quality fruit and vegetables. In particular, FreshVeg can provide private and public sector with a wide variety of organic fruit and vegetables. This aspect concurred to select the company as member of the Lucca school meals contract. During these last years, FreshVeg experienced a slight expansion of its business showing an annual growth rate of 1%. The school meals contract represents a slight significant share of FreshVeg activity (about 7%). Unfortunately, we do not have specific information about the involvement of the company in other meals service contracts, although it is likely that the collaborative experience within Lucca contract led to won new businesses in private and public sectors.

DairyFarm is a regional firm specialised in providing food products for catering services. Lucca meals service contract represents just a small share of its turnover (0.5%). Along the years, DairyFarm developed its business by new investments in the firm facilities and a strong consolidation in the public sector. The last five years registered a significant increase of the turnover (+20%), confirming thus the expansion policy of the company. The most important customers of DairyFarm are, in particular, schools, universities and hospitals ranging from Tuscany to Umbria. We can argue that Lucca school meals service contract contributed considerably to won new contracts.

For MilkyWay, the Lucca school meals contract comprises a very small part of the business. MilkyWay is an historical industry in Tuscany carrying out its activity in the dairy sector. It is a company strongly linked with the Tuscany area where all the processed milk originates. MilkyWay is the buyer of milk from about 59 dairy farms in Tuscany. Unfortunately, the balance sheet data do not allow a comparison of the current turnover with the previous ones. However, according to the annual report it is possible to affirm that the company is experiencing a period of strong expansion. Due to the regional relevance of the company, we can suppose that MilkyWay could win new business in the meals service sector, although the Lucca contract seems to be a negligible determinant.

For ItalGoods, the Lucca school meals contract comprises a negligible share of turnover. ItalGoods is a big company leader in the sector of food and beverages targeted at private and public meals service. It is the company, among those involved in Lucca contract, showing the greatest economic expansion during the last five years (+48%), with an annual growth rate of 8%. Considering the wide reference market, ItalGoods systematically participates in public tenders on meal services. The Lucca school meals contract represents for ItalGoods a small part of its business within its core activity.

For LittleEgg, also a big firm, Lucca school meals service comprises a very small % of turnover. LittleEgg is one of the first firms in Italy dealing with egg processing for agri-food industry preparation, catering, and meals services. LittleEgg is a provider of fresh and pasteurized eggs to both LuccaCater and ParmaCater. The market leadership of the company is a key driver for the participation in many public and private meal services contracts. During the last five years, LittleEgg registered a slight decrease (-7%), due to the regular variability of the turnover observed during the years. Due to the large size of the company, the Lucca meals service contract does not seem significant for future contracts or for the participation to public tenders.

BigMover is by far the greatest company involved in the school meals contracts. Its turnover exceeds €1 bln with a constant increase during the year. The annual growth rate of turnover corresponds to 4%, i.e. an increase of 22% along the time span. It is obvious that the Lucca contract comprises a negligible share of turnover. As a whole, the catering services represent about 18% of the company turnover. Hence, we can suppose that the Lucca meals service contract could only marginally affect the BigMover's new public meals service contract opportunities.

NaturalBakery is a medium firm located in Tuscany Region and specialised in bakery products, mainly bread. Lucca meals contract comprises about 1.5% of NaturalBakery turnover. Along the years, NaturalBakery invested in machinery and in the quality of its products. Unfortunately, the adverse systemic economic conditions do not help the smooth development, with negative consequences for the entire company. This is why NaturalBakery at the moment cannot look to win or to participate in new meals contracts.

5.4.3 Comparison of economic values in Parma (LOC-ORG) and Lucca (ORG)

The economic organisation of the school meals services supply chain for the two cases is quite different. In the case of Parma contract, the suppliers are several and mostly placed far from Parma City Council: 5 out of 29 suppliers are placed within the local area. Local suppliers in Parma represent about 18% of the total budget spent for food procurement. In the case of Lucca, 4 out of 9 suppliers can be considered local suppliers and they represent more than 56% of the total expenditure for the food procurement. In particular, some key suppliers, such as GoldGarden for Parma, are placed far from the City Council, whereas Lucca Contract involves a relative high number of key suppliers (e.g. BigMover, VegLand, NaturalBakery) which are placed around the city or within a radius of 50kms. In both cases, the average turnover of the suppliers is quite large (€161mln for Parma and € 250 mln for Lucca). In the case of Lucca, the food procurement is concentrated amongst a relatively small number of suppliers, some of which provide a large set of food products. For instance, BigMover is not a producer, but a wholesaler of food and non-food products. Since LuccaCater is a medium-sized firm, few suppliers mean lower costs of supply chain coordination. In Parma case, the provision of food is distributed among specialised food companies managed by ParmaCater.

The presence of national scale firms (e.g. ItaRice and BigMover) contributes to increase the average turnover for the two groups of suppliers. Unlike Lucca case, ParmaCater decided to involve in the supply chain the food processors, without involving resellers. On the contrary, LuccaCater opted to concentrate the food procurement into some key suppliers. For instance, for LuccaCater, BigMover is a key supplier, since it provides a wide typology of products (from dairy products to frozen vegetables). Within Lucca contract supply chain there are three big wholesalers (BigMover, ItalGoods and DairyFarm) specialised in catering service. Within the Parma contract supply chain, all the firms involved produce the food supplied to ParmaCater. This latter suppliers' organisation seems to be more expensive in terms of coordination, but more effective for monitoring the quality of the food processing. In this respect, ParmaCater developed an integrated system for the food safety, quality and traceability (SGQSA) in compliance with UNI 10854:1999, UNI EN ISO 9001:2015, UNI EN ISO 22000:2005 and ISO 22005:2008. However, we can argue that the configuration of the Parma contract supply chain relies on ParmaCater economic size. The national scale of ParmaCater results in a high bargaining power towards the firms and, thus, in a strict coordination between food suppliers and ParmaCater policies. All the suppliers within the Parma meals contract supply chain benefits from the affiliation with ParmaCater which holds several school meals services in many Italian areas. LuccaCater is characterized by local scale and relative low bargaining power towards its potential suppliers. Furthermore, for most of the suppliers, Lucca contract represents a low or negligible share of their turnover. This implies that the new public meals contract opportunities are dependent on the specific specialisation and market targets of each supplier, rather than on the participation in the Lucca school meals supply chain, although this can always comprise an added value in tenders' participation.

6. SOCIAL IMPACT OF SCHOOL MEALS SERVICES

6.1 Methodology to measure social impact

The goal of the social impact analysis was to assess what social values were generated by the operation of the Parma (LOC-ORG) and Lucca (ORG) school meals services. The indicators we took into account to measure social impact were:

(i) employment-related criteria. Under this heading, we gathered data on the number and types of jobs linked to the school meals service, and the diversity profile of staff and levels of training/skills development in place within the businesses participating in the supply chain.

(ii) criteria relating to the working environment of the service chain and connectedness of people within it, including rural communities. Under this heading, we gathered data on the well-being and job satisfaction, and the level of engagement with others in the supply chain, and what kinds of activities/occasions such engagement represented. Within this, we explored the extent to which the school meals procurement brought caterers and schools into contact with rural and farming communities that produce food items.

Given the small sample sizes of informants in both Cases, we give a descriptive reporting of the results relating to the above indicators.

6.2 What are the employment-related impacts of school meals services?

6.2.1 Employment related impact in Parma (LOC-ORG) service

In terms of the types of employment offered by suppliers, we found a substantial proportion of full-time positions, in primarily medium or relatively low skilled work. The ethnic profile of suppliers' workforces tended to reflect the wider profile of the Region, with the vast majority of staff being of white Italian ethnicity. The gender split was representative of the food supply/catering sector more generally, with almost all depot and delivery jobs being filled by male employees, and almost all staff working in school kitchens being female. According to the interviews and firms’ documents, all the suppliers conveyed a strong commitment to training and skills development beyond mandatory standards. Table 17 summarises the findings, and below some more descriptive detail is given on each of the key suppliers.

Table 17: Employment related impact of school meals service in Parma (LOC-ORG)

	Job Type		Employee profile		Skills/Training Development	
	FT	PT	M/F	Ethnic minority	% staff on training/with qualifications	Types/levels of qualifications
ParmaCater	17%	83%	87%F 13%M	4-5%	100%	Mandatory for all staff: food safety, health and safety, manual handling, safeguarding, allergen training Specific training activities for head cookers and kitchen operators
BioLand	88%	12%	29%F 71%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, BRC, IFS
BrownField	100%	0%	83%F 17%M	Sector/ regional profile	100%	Organic production regulation; health and safety.
ItaRice	90%	10%	26%F 74%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, BRC, IFS
P&RCheese	90%	10%	26%F 74%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, BRC, IFS; Environmental management
Biodairy	90%	10%	25%F 75%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, IFS; Organic production
QualMeat	91%	9%	25%F 75%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, IFS; Organic production
FrozeFish	87%	13%	31%F 69%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP;
VeggieLand	89%	11%	60%F 40%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, BRC, IFS

ExtraOil	90%	10%	25%F 75%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, BRC, IFS; DTP 125
GoldGarden	83%	17%	31%F 69%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, IFS; Organic production; global GAP

ParmaCater employed 11184 staff. Of these, 19 FT staff were the support team who have management, finance and administrative roles, working mainly out of Parma. The 9537 workers represented the kitchen staff located entirely on different school sites. In Parma, 32 staff work in central kitchen and 181 in canteen. Most of the kitchen employees worked between 15 and 40 hrs per week, depending on their grade and the number of meals they were responsible for serving. For permanent workers, 32% of the staff works less than 20 hours per week, 17% up to 20 hours per week, 31% more than 20 hours per week, and 20% full time. 100% of staff held mandatory certificates in food safety, health and safety, manual handling, safeguarding and allergen training. At the whole company level, they attend 21730 hours of training. 87% of the kitchen staff are female and most part of the personnel is employed with permanent contracts (98%). In addition, part-time is the more frequent type of contract, as consequence of the job specificities. ParmaCater follows the criteria established by the international standard SA80000 on the ethics and social responsibility and involves workers in meeting the objectives included in ISO14001 and environmental management and ISO 50001:2011 on energy efficiency. In Parma, 32 staff are involved in central kitchen and 181 in canteen.

BioLand employed 112 staff, of which 18% administration/office staff. According to the information retrieved by the statics on employment for BioLand sector, 71% staff is male and 29% female. The personnel involved in administrative activity tends to be female. Since the beginning, Bioland has obtained the organic production certification that implies the use of organic raw materials. Staff attended specific training for applying HACCP criteria in food preparation. Furthermore, BioLand meets the British Retail Consortium (BRC) standard and International Food Standard (IFS) certification that requires specific knowledge and skills of the staff in product preparation and processing organisation.

BrownField employed 18 staff. All the staff is employed full time, of which two third with temporary contract. Female workers represent the majority: 12 employed in sales department, both for domestic and foreign markets, three out of four are employed in the quality assurance department, and six out of eight in the administrative service. This a virtuous aspect of the firm that is part of a company policy aimed at promote gender parity in fruit and vegetables sector. BrownField processes organic food through third parties under specific contracts. Therefore, BrownField staff should not be obliged to follow training on food handling, hygiene, and HACCP, as requested for workers in agri-food industry.

ItaRice employed 166 staff, of which 3% department directors, 34% administration/office staff, and 66% rice factory staff. The statistics about national employment for the corresponding relevant sector pointed out how the male component is prevalent, as well the full time labour contract. All the factory machinery for food production is submitted to the HACCP rules, so that factory staff is prepared for implementing the mandatory criteria on food hygiene and safety. In addition, ItaRice obtained BRC and IFS certifications that add other commitments beyond the mandatory ones. This means that the staff should be prepared also for managing the production according to these quality schemes.

P&R Cheese employed 289 staff, of which 2% department directors, 32% administration/office staff, and 65% production staff. According to the national statistics about the employment in P&R Cheese sector, most part of the staff is male and hired through full-time contract. In 2017, P&R Cheese developed the project “firm welfare” for giving a financial sustain to workers for covering part of the expenditure in school taxes, books, and care for the elderly. Furthermore, P&R Cheese organized courses addressed to improve the French and English language skills of its employees. All production staff have knowledge and skills in the application of HACCP rules. In addition, P&R Cheese was BRC and IFS accredited, which meant that a suite of standards had to be met in terms of working processes and employee training. P&R Cheese received the Global Standard for Food Safety Grade “AA” and obtained the following certifications: Food Safety Management (ISO 22000:2005), organic production, environmental management (ISO14000), and Occupational Health and Safety (BS OHSAS 18001). All these certifications confirm the high attention of the firm for the quality assurance of its products and the high level of skills in food quality and safety matter of the entire staff.

Biodairy employed 84 staff, of which 18 as administrative/office staff and 66 as production staff. Also for Biodairy, the statistics of the employment show a prevalence of male workers and full-time contracts. Biodairy carries out the production activity in accordance with HACCP regulations, therefore the staff is trained for monitoring in continuous the processing process for preventing problems in food safety and guarantee the quality of the products. Biodairy produces organic products, for which it obtained a certification according to Reg. EC 834/2007. In addition, Biodairy is also IFS accredited, so that the staff was also introduced to this quality assurance scheme that requires specific knowledge and skills.

QualMeat employed 22 staff, of which 41% administrative/office staff and 59% production staff. The distribution of the staff by gender and type of contract is consistent with the distribution observed for reference sector. As the other agro-industries, QualMeat provided to its staff specific training activity on health and safety and food safety training as required by HACCP protocol. As organic producer, QualMeat leads the production process by following the rules Reg. EC 834/2007 established. In this regards, staff has to know the specific requirements for organic production. Furthermore, QualMeat obtained also IFS certification that imposes a production organization aiming at guarantee the quality of the products.

FrozeFish employed 59 staff, of which just 10% dedicated to the production department. The most part of the production activity is carried out by subcontractors. From the FrozeFish’s president, the priority is to safeguard the health and safety of the staff through training activities and other specific activity to improve the level of awareness about the risks and in relation to the good practices to put in place. All the workers are trained for HACCP and internal quality assurance implementation. FrozeFish has developed a specific framework for the guarantee the quality along the supply chain, that involves suppliers and own staff. As reported by the quality system assurance director, FrozeFish introduced also a scheme of social responsibility.

VeggieLand employed 68 staff, of which about 65% production staff. The majority of production staff are women. One of the main priority of VeggieLand is the health and safety of its staff. In an interview, the health and safety director presented a new communication and information campaign addressed to VeggieLand workers aimed at enhancing the awareness towards the theme of health and safety in a working environment and, thus, preventing accidents. VeggieLand adopted HACCP system, which requires a specific training for the staff.

VeggieLand is BRC, IFS, organic production and OHSAS 18001 accredited. All these certifications imply further training activity for the staff.

ExtraOil employed 132 staff, most of which are administration/office staff (55%). 25% staff were female and 75% male. The distribution between full-time and part-time workers, and between male and female worker is consistent with the national statistics on employing in the corresponding agri-food sector. ExtraOil is submitted to the mandatory HACCP protocol that requires a training process for all the staff involved in the production activity. In addition, ExtraOil obtained BRC and IFS certifications with further obligations in terms of staff knowledge and skills. ExtraOil organizes courses and trainings addressed to the staff on health and safety, technology innovation and food quality. All the staff is involved in the sustainable olive oil project accomplished in 2017 with the certification DTP 125 “Sustainable Extra-virgin Oil”.

GoldGarden employed 65 staff, of which 62% administrative/office staff. As communicated by the President of the company board, during the conference on annual activity report, the labor turnover was negligible and training policies relates on the health and safety in working environment and for keeping the product and process certifications. Beyond the mandatory certifications (e.g. HACCP), GoldGarden was the recipient of other voluntary certifications: such as organic production (Reg. EC 834/2007), IFS logistic standard, BRC global standard (storage and distribution), Global GAP (chain and custody), BS OHSAS 18001:2007, SA8000:2014 (processing, packaging and trading fruit and vegetables). All these standards require specific preparation by the staff.

6.2.2 Employment related impact in Lucca (ORG) service

In terms of the types of employment offered by suppliers, we found a substantial proportion of full-time positions, in primarily medium or relatively low skilled work. The ethnic profile of suppliers' workforces tended to reflect the wider profile of the region. The gender split was representative of the food supply/catering sector more generally, with almost all depot and delivery jobs being filled by male employees, and almost staff working in school kitchens being female. All suppliers conveyed commitment to training and skills development, and offered diverse examples of the ways in which employees were being supported to upskill. Table 18 summarises the findings, and below some more descriptive detail is given on each of the key suppliers.

Table 18: Employment related impact of school meals service in Lucca (ORG) service

	Job Type		Employee profile		Skills/Training Development	
	FT	PT	M/F	Ethnic minority	% staff on training/with qualifications	Types/levels of qualifications
LuccaCater	6%	94%	93%F 7%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP

FreshVeg	83%	17%	31%F 69%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety
DairyFarm	90%	10%	25%F 75%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP
MilkyWay	94%	6%	19%F 81%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, BRC, IFS
ItalGoods	89%	11%	23%F 73%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP
LittleEgg	90%	10%	26%F 74%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP, BRC, IFS
BioBeef	91%	9%	25%F 75%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP
BigMover	93%	7%	28%F 72%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP
NaturalBakery	69%	31%	25%F 75%M	Sector/ regional profile	100%	Mandatory for all staff: health and safety; HACCP

LuccaCater employed 146 staff, of which 93% are female. Almost all the workers have part-time contract (94%). The ethnic minority share reflects the regional situation. The staff turnover is quite low due to the substantial stability (long period) of the meals service contract. All the staff working in the kitchen is trained in food safety and hygiene according to the HACCP rules. In addition, LuccaCater is ISO22000:2005 accredited, in them of food safety and risk analysis that implies further qualifications for the staff.

FreshVeg employed 8 staff. Type of job and gender rates are supposed to be consistent with the national statistics on employment for the corresponding sector. The staff is trained to apply the hygiene and food safety rules in handling fruit and vegetables. The courses about hygiene and food safety are organised by the local labour union organisation of which FreshVeg is member.

DairyFarm employed 17 staff, of which more than 70% dedicated to the production department. During the last year, DairyFarm hired 5 new staff. All the staff within production department is trained in the framework of HACCP regulations. Furthermore, DairyFarm is also certified for stocking and marketing organic products, so that staff has also knowledge about the criteria established by Reg. EC 834/2007.

MilkyWay employed 168 staff, of which 40% employed in production department. During the last year, one worker resigned and one new staff has been hired. In average, the turnover corresponds to 5.8% (year 2015). 81% of the staff is male and in the production department all the staff tends to be male. The full-time contracts are prevalent in comparison to the part-time ones. The distribution in terms of educational attainment is: 32% secondary lower school, 50% secondary upper school, and 18% high education (bachelor). Each year MilkyWay welcomes students (undergraduates or secondary school students) for a training period. In particular, the coaching programme is usually developed within the quality control laboratory, certifications department and sales department. All these activities are shared with the young trainees and aimed at qualifying them. MilkyWay organised for the staff training activity on mandatory food safety rules (e.g. HACCP) and on several voluntary certifications obtained along the years. MilkyWay is indeed BRC, IFS, BS OHSAS 18001:2007, ISO 14001:2004, organic production accredited. All these certifications required further training engagement beyond the mandatory one.

ItalGoods employed 247 staff, of which 47% were employed in production department. During the last year, the turnover was positive, 7.4%. The distribution of the staff between males and females and full-time and part-time is supposed to be in line with the statistics on the employment for the corresponding sector. ItalGoods is provided by HACCP system, therefore all the staff is committed to apply the criteria about hygiene, food safety and risk analysis during their activity. In addition, ItalGoods can benefit from the certifications ISO9001:2015, ISO22000:2005, organic product compliance and sustainable fishing. All these certifications require staff training.

Since Parma case and Lucca case shared the same supplier of fresh and pasteurized eggs, the description of LittleEgg proposed for Parma applies also for Lucca.

BioBeef employed 10 staff, of which 8 in production department and 2 in administration department. The distribution in terms of gender and type of job is supposed to reflect the national statistics on employment for the corresponding sector. The training activity was mainly addressed to improve the level of knowledge in applying the HACCP rules and on health and safety on job place. Staff should also meet the requirements about the organic production compliance.

BigMover employed 773 staff, of which 28% female and 72% male. The turnover was in 2017 23.5% (26.2% for females, 22.5% for males), and in 2016 19.1% (16.5% females, 20% males). 21% of the female staff had a part-time contract, whereas just 0.8% of the male staff had a part-time contract. BigMover declared that one of the company main objective is to increase the level of qualification of its staff according to the individual attitudes and always with due regard for human characteristics. BigMovers established a permanent training programme, called “BigMover Academy”, where staff can develop knowledge, skills and share experience. During last two years, just for the health and safety themes BigMovers provided to staff more than 4000 hours of courses, at a whole. BigMovers provided staff with BigMover is also committed in reaching the gender equality within the company organisation. 3 out of 6 member of the company board are female. In this regard, BigMover was the recipient of the award “Rose Apple” for having enhanced the female presence in company top management. In collaboration with universities, BigMover welcomes graduate and undergraduate students for limited period of internship in the different company areas.

NaturalBakery employed 64 staff. Unfortunately, at the beginning of 2018, the adverse market situation obliged the company to withdraw. Since it was not possible to retrieve more detailed information about this supplier, we can suppose that the gender and type of job distribution is consistent with the national statistics on employment for the same sector and that the staff was trained according to the HACCP and the organic production rules.

6.2.3 Comparison of employment impacts in Parma and Lucca

Parma key suppliers employed from 18 to 11000 staff, mostly hired with full-time contract. The distribution of staff by gender and type of job is consistent with the sector profile. Female staff is prominent in ParmaCater and in fruit and vegetables firms, due to the specificities of the work required in this sectors. All the staff attended mandatory trainings in health and safety on working place and food quality and safety. In addition, most firms provide their staff with specific training programmes on voluntary certifications.

Lucca key suppliers employed from 10 to 773 staff, mostly hired with full-time contract. The distribution of staff by gender and type of job is consistent with the sector profile. Female staff is prominent in LuccaCater and in fruit and vegetables firms. All the staff attended mandatory trainings in health and safety on working place and food quality and safety. In addition, most firms provide their staff with specific training programmes on voluntary certifications. The presence of a large firm, such as BigMover, increases the average size of suppliers within the Lucca's school meals service contract. This explains the fact that Lucca school meals supply chain is more characterized by small firms than in Parma case.

All the suppliers involved in both school meals services, main contractor included, exhibit a strong tendency to invest in staff qualification. In most cases, the training activity goes beyond the mandatory courses required by health and safety regulations. Firms organise specific training programmes for improving knowledge and skills in voluntary certification schemes, such as organic production, British Retail Consortium standard, International Food Standard and BS OSHAS standard series. In some cases, firms formally state, through public documents, the valuable role of staff within the firm organisation and the actions for improving the staff wellbeing. Financial support for workers' families, cultural events, sustainability projects involving staff are some relevant examples of the firms' commitment towards human resources. It appeared also a general interest to promote the gender equality within the firms' organisation in all departments, from production line to top management, although the gender issue in this type of supply chain is not so relevant. Some firms were the recipients of awards for having sustained the female qualification. Both in Parma and in Lucca, some firms have specific internship programmes for students in collaborations with schools and universities. The analysis of the employment impact demonstrated that the propensity to invest on staff relies on the firm size. Generally speaking, small firms do not show a prominent attitude in developing programmes or projects beyond those necessary for law compliance.

6.3 What is the working environment and connectedness in school meals services?

6.3.1 Working environment and connectedness in Parma (LOC-ORG) service

To explore how the Parma school meals contract impacts on working environment and suppliers' sense of connectedness to others in the chain, we referred to company documents and personal and by phone interviews to the members of the school meals services. We asked interviewees to talk about their experiences working in the supply chain and to describe any events or occasions, which brought them into contact with other members of the chain. <u>The results arising during the information collection was a strong degree of interaction between ParmaCater and its first tier suppliers in defining the product characteristics to include in the school meals preparation and in assuring the quality and origin of the foods. However, the level of connectedness between food suppliers and Parma schools through the organisation of events or specific programmes appeared relatively low.</u> This is also probably due to the role of

ParmaCater in the school meals supply chain and its economic organisation. ParmaCater is a big national company with many contracts in and outside the Emilia-Romagna Region. This could affect the involvement intensity within the supply chain, in the sense that suppliers contain initiatives at the commercial stage.

However, some initiatives during recent years have been organised in collaboration with suppliers. In the past years, Parma City Council, ParmaCater and QualMeat organised interesting farm visits for schoolchildren to meet animals and to discover animal breeding. Another interesting, and more recent, initiative proposed by City Council in collaboration with ParmaCater and some suppliers is the project “Crescere in Armonia – Growing in Harmony”, a project addressed to children, their parents and school teachers for supporting beneficial life styles and promoting a new culture on food themes and nutrition with a particular focus on sustainability concepts and biodiversity protection. In 2018, within the project, some initiatives have been organised: “Food Factor”, a series of laboratories where children meet the food science and food supply chain; “SOS-Teniamo l’Ambiente”, for promoting sustainable behaviours towards energy consumption, food waste, circular economy; “Lo spreco da non alimentare”, a prize contest that invites schoolchildren to propose projects to reduce food waste. An indirect involvement of the suppliers is the project “Menu Interculturali a Scuola – Intercultural Menus at School”, thanks to which children learn to know the food characterizing different cultures in our society. During the school year, some days are dedicated to ethnic lunches, such as Balkan menu (with rice and “byrek”), Indian menu (with chicken with curry) and Maghrebi menu (with fish cous-cous).

6.3.2 Working environment and connectedness in Lucca (ORG) service

To explore how the Lucca school meals contract impacts on working environment and suppliers’ sense of connectedness to others in the chain, we referred to company documents and personal and by phone interviews to the members of the school meals services. We asked interviewees to talk about their experiences working in the supply chain and to describe any events or occasions, which brought them into contact with other members of the chain. The most striking finding was that although the suppliers demonstrated to have skills and resources to initiatives in collaboration with the City Council, few suppliers undertook activities with primary schools in Lucca. Only LuccaCater was very active in organising with the City Council events and developing projects. The projects representative of the very positive relationship between LuccaCater and the City Council were called “Bampé” and “OltreBampé”. Bampé and OltreBampé are Italian-French projects aimed at improving the understanding of children, parents and teachers about the rural culture and the food originating from the territory. The projects aim also to include in the school menu the food products of the territory, so that children can taste the traditions and know rural cultural roots of the area where they live. This is also very useful for rural development objectives. An example of the results of this project and of the connection of the suppliers with the Lucca school meals service is the insertion of the Garfagnana Trout in the menu. As testified by the City Council representative, this also an example of short supply chain and, hence, of food sustainability.

As in the Parma case, also for Lucca the caterer is the most important entity in the school meals contract, not just for being the winner of the contract tender, but also because LuccaCater is the direct interface with the City Council for developing initiatives in the framework of the contract. In this regards, LuccaCater proved to be very dynamic and proactive. Hence, most food suppliers participate just indirectly to the different initiatives that are organised with the schools at local level. What arises from the analysis is that suppliers have skills and resources for developing together with City Council and LuccaCater new events addressed to schoolchildren. This is an important opportunity to be investigated in the perspective to improve the community engagement of each suppliers involved in the school meals contract.

6.3.3 Comparison of environment and connectedness in Parma (LOC-ORG) and Lucca (ORG)

Both in Parma and in Lucca, the caterer plays a central role in coordinating the activities within the school meals supply chain. During recent years, some initiatives have been developed with the participation of suppliers, with important results for children, their families and, in general, for the entire local community. However, the suppliers' involvement in local engagement projects remains marginal. For the Parma cases, suppliers are located relatively far from the schools, so that the logistics issues might be a reason of this low participation. Another possible cause of the local disconnectedness is the type of food procurement organisation of ParmaCater, more focussed on supply chain planning for ensuring physical food delivery than on other beneficial services involving suppliers. The individual supplier analysis showed that several firms organise regular initiatives with schoolchildren outside the school meals contract, from nutritional education to the production plant visits. This represents a potential unexploited opportunity for building new types of relationships within the supply chains.

What is explained above for Parma also applies for Lucca case, where the valuable initiatives and events organised in these years have been carried out almost exclusively by the City Council in collaboration with LuccaCater. Also within the Lucca school meals supply chain there are suppliers committed to social responsibility, so that it could be relatively easy to establish relationships with them beyond the food delivery. As in Parma case, several suppliers showed strong vertical coordination with their agricultural products suppliers, i.e. farmers. All these aspects reveal very interesting opportunities of interaction with suppliers. Furthermore, the presence of local key suppliers (e.g. for fruit and vegetables category) can be the occasion for exploring the possibility to organize initiatives (e.g. seminars, study tours) to enhance the school meal contract community engagement.

7. CONCLUSIONS AND RECOMMENDATIONS

The present country report presents and discusses the main findings of the sustainability analysis of the school meals service in Italian primary schools. The three dimensions of sustainability (i.e. environmental, economic and social) have been investigated in relation to two territorial case studies: Parma and Lucca school meal services. These two cases show two different food procurement models: local and organic for Parma and organic for Lucca. The case classification relates to the school meals service contract specifications: more local-organic (LOC-ORG) oriented in Parma contract and more organic (ORG) oriented in Lucca.

Parma and Lucca cases also differ in terms of the organisation of the meals preparation and distribution. In Parma, the meals organisation is hybrid in the sense that the majority of the schools are served by a central kitchen and a small part have their own internal kitchens, which prepare the meals by adopting the same menus and recipes of the central kitchen. In Lucca, the meals preparation is completely centralised. School kitchens are limited to assembling and serving the meals.

The main role in the school meals supply chain is played by the caterer, which is the recipient of the benefits and obligations deriving from the contract. ParmaCater is a national big firm with headquarters outside Parma, while LuccaCater is a small-medium firm very connected with territory and with headquarters within the Lucca province. The economic size of the caterer affects the suppliers' selection and management. In the case of Parma, all the suppliers are specialized in a specific food category, and almost all have a medium-large size by turnover. In the case of Lucca, there are suppliers specialised in one single food category and suppliers providing many categories of foods. There are thus different supply chain structures, which relates to the caterer’s bargaining power and its economies of scale. In other words, the bigger the caterer is, the more attractive the contract is for suppliers, and the higher the number of school meals contracts is, the lower the suppliers' management costs are in terms of food procurement.

The environmental impact measured for school meals service was the carbon footprint. In particular, we estimated the carbon emissions from the agricultural production, food processing, transportation, and food waste management of the meals served to a sample of five schools per case study. The Parma school meals service showed a lower carbon footprint (0.95 kgCO_2eq per meal) than in Lucca (1.05 kgCO_2eq per meal). This difference (+9% for Lucca) was mainly due to the greater share of fruit and vegetables and lower impact of ready meals products in Parma. In both cases, dairy products showed the highest impact together with ambient food. Within dairy category, hard cheeses (Parmigiano-Reggiano, Grana Padano and Pecorino cheese) registered the highest total impact. In terms of local transportation, the emissions from central kitchen to schools were found to be very small, however, the transportation of food from suppliers to caterers was more substantial, especially in Parma, where local transport emissions were 18% of total carbon footprint, compared with 7% in Lucca. It is noteworthy that many suppliers (24 out of 29) involved in Parma school meals supply chain are located at more than 100 kms from Parma, while in Lucca the average distance is much lower. We estimated also the impact of food waste management on the basis of the quantity of food served and not eaten by the children and of the waste management method. According to the estimation carried out after a plate waste study in four schools (two for each case), both the school meals services exhibited a very high level of food waste corresponding to 26% of the total volume of served food for Parma and 38% for Lucca. In Parma as in Lucca, the method adopted for food waste treatment is composting. This is one of the most sustainable waste management methods in comparison with landfill. The total impact is indeed very modest both in Parma and in Lucca (no more than 1% of the total impact). The procurement scenarios analysis revealed that substituting frozen fruit and vegetables with fresh products does not provide significant reductions in carbon emissions, thanks to the high share of fresh fruit and vegetables already included in meals preparation. Similarly, the scenario of total substitution of beef with poultry meat resulted in very low emission impact improvement. More significant is the substitution of other single food items. For Parma, the substitution of the current canned tomatoes with a local product would reduce total emission by 3.5%, whereas for Lucca the substitution of the breaded cutlet with fresh poultry meat would mean a reduction of almost 10% in total emissions.

The economic impact assessment of school meals service was developed through the implementation of the LM3 methodology and the economic analysis of the key suppliers. The aim of LM3 is to identify the proportions of money retained within the local area at the different levels of the supply chain. LM3 provides the contribution of the school meal service to the local economy development. The financial flows were tracked starting from the City Council budget to second tier suppliers expenditure. Lucca LM3 indicator is 6.3% higher than the same indicator for Parma. The slightly higher ratio in Lucca was due to a higher proportion of first tier suppliers located within the local area, which permits to retain within the area 68% of the initial budget at the second LM3 level versus 53% of Parma. The main findings of the economic value analysis is that the suppliers' organisation pattern relies on caterer size, i.e. on its bargaining power towards suppliers. In general, the share of suppliers' turnover due to Parma and Lucca school meals service contract was very low, so that we can argue that the participation in new public school meals service tenders relies on the suppliers' specialisation and targets rather than on a single contract.

Finally, the social impact analysis aimed to assess the community engagement and social contribution within the school meals service contract from caterers and their suppliers. Also, the degree of connectedness within the supply chain was evaluated. All the key suppliers exhibit strong commitments toward their staff, in the form of qualification trainings, financial support to staff's families, and engagement in gender equity. In some cases, suppliers adopted social responsibility initiatives, in the form of sustainability/social reports, offers of internships for students, firm study tours, and charitable activities. However, the suppliers' involvement in local engagement projects with the school meals contract remained marginal. The direct participation of suppliers within school initiatives and events is weak, and in some cases their participation is just indirect, such as the delivery of ethnic foods in the context of ethnic meal projects. In both cases, the prominent role in coordinating social activities at the local level was covered by the caterer, which undertook several projects in collaboration with the City Council. The analysis of the relationships among suppliers within the supply chain showed a strong level of vertical coordination within the supply chain of each individual supplier and between suppliers and caterer. Horizontal coordination among suppliers within school meals contract was substantially absent. This appeared as a missed opportunity that might be exploited in the future.

7.1 How could environmental, economic and social impacts of Parma service be improved?

According to the analysis developed on ParmaCase, some environmental, economic and social impacts can be improved through a new and more efficient supply chain organisation. More specifically, the environmental impacts could be improved by shortening the average distance between food suppliers and Parma schools. This can be achieved by selecting more local suppliers for some key food items. For instance, since Parma area is one of the most important processed tomato districts in Italy and Europe, canned tomatoes could be obtained from local processors. The same applies for pasta, since the most important market player in this sector produces pasta in Parma. A greater share of local suppliers means also more financial flows within the territory leading to beneficial economic effects in the local area. The social analysis pointed out a high level of connectedness between City Council and ParmaCater, but it revealed also a lacking of collaboration with the food suppliers. The level of community engagement of ParmaCater is relevant but it is not so relevant for its food suppliers. Almost all the events or initiatives organised at local level have been developed by the City Council in collaboration with ParmaCater. Food suppliers participate often just indirectly with their products, although the analysis reveals that they have the resources for participating in an active way to local initiatives addressed to schools. This appears as a missed opportunity for the schools and for all the actors involved in the school meals service supply chain. Redefinition of the tenders and a greater participation of City Council in selecting suppliers can help to involve more suppliers in the initiatives addressed to children.

Beyond the nutritional aspects of the meals served to children as reported in D6.2, one of the main findings of the analysis is the high level of food waste generated in Parma schools. Food waste means also waste of environmental and economic resources. It would be important to revise the current model of preparation and distribution of meals, because although the current menus aim to achieve the right nutritional intake, and much effort is made to enhance quality and provenance of the ingredients, children seem to dislike a significant share of what is served to them. Different actions could be proposed in this respect: improving the food culture understanding among children, through more and new initiatives to discover the food benefits by involving food suppliers (e.g. study tour, laboratories), improving the presentation/taste of served meals, and identifying tailored menus according to needs and preferences of children. The food waste in Parma schools is relevant and solutions should be undertaken.

7.2 How could environmental, economic and social impacts of Lucca service be improved?

The results achieved for LuccaCase show room for improvement in environmental, economic and social impacts. In particular, little modifications in school menu can reduce significantly the carbon emissions. For instance, the substitution of ready meat plates with fresh meat plates would contribute to save a relevant amount of CO_2 emissions. It would also be important to reflect on the opportunity to select local producers for some food items that are now concentrated in a few multi-product suppliers. This is the case, for instance, of extra-virgin olive oil and poultry meat. The contribution of the LuccaCase to the local economy could be improved by developing new projects involving local producers in the supply chain, as the project “Garfagnana Trout” that generated positive impacts for rural development. The interlinkages among actors within the supply chain was strong between City Council and LuccaCater but very weak for the other food suppliers. As in Parma, food suppliers were only marginally involved in local/school initiatives, although they had resources and skills for these purposes. This is an opportunity to be exploited for getting long-run benefits for children and for the entire supply chain. More local involvement means also more commitment toward local community and schools, and more cohesion within the different supply chain stages.

From D6.2, as in ParmaCase, LuccaCase showed a significant level of food waste: -more than one third of the served meals becomes waste. This is a major sustainability issue of the school meals service, especially considering the national and municipal resource and effort to ensure quality and sourcing of ingredients. The findings of the present analysis suggest a redefinition of the school meals service organisation to improve children's acceptance of the food served to them. It is important to analyse the reasons for this significant amount of food waste produced by the schools and to propose solutions, such as: improving the food culture, through more and new initiatives to discover the food benefits by involving food suppliers (e.g. study tour, laboratories), improving the presentation/taste of served meals, and identifying tailored menus according to needs and preferences of children. We pointed out that the food waste in Lucca schools is significant and solutions should be undertaken.

7.3 What policy interventions would help?

EU food procurement regulation has improved very much over recent years. From objectives concerning the minimization of public spending through award criteria, the regulation has been supplemented by new aspects such as efficiency, and environmental and social concerns. However, public entities are subject to strict constraints defined by the procurement procedure, the selection criteria and the time frame within which the procedure has to be concluded. This situation produces issues in balancing the budgetary considerations with social and environmental objectives. After the complexity and the uncertainty associated with social and environmental tender specifications, public entities have been reluctant to include these aspects in the tenders. The EU green public procurement (GPP) rules help public authorities in making more sustainable the public food procurement contracts. However, EU GPP maintains a certain level of flexibility, leaving Member States and public authorities to identify supplementary sustainable criteria themselves. It is the case with the local supply chain boundaries. The Parma school meals service contract defines the maximum distance for considering a food product originating from a local supply chain. In this respect, a product is defined "km 0" if it is produced within a radius of 100 km from the school and is obtained from a short supply chain if produced in one of the nine Emilia Romagna provinces or in the neighbouring provinces of the place where schools are located. EU regulation could provide more criteria for identifying in a transparent and consistent way the territorial boundaries for "zero km" and short food supply chain products.

As the analysis suggests, it is important to identify actions to minimize the food waste in school meals service. This could be promoted in the EU regulation by providing examples of good practices and strategies to implement to avoid this issue. The food waste monitoring methodology is another aspect that EU rule could define for supporting City Councils in detecting hotspots.

7.4 What local/practice interventions would help?

According to the Italian school meals services and the environmental, economic and social results obtained, some interventions for improving the sustainability of the entire supply chain can be proposed:

1. Promoting the development of new projects on sustainability themes in collaboration with the suppliers (e.g. the "Garfagnana Trout" initiative within the project Bambé can be considered a good practice to extend to other school meal services).
2. Redefining the concept of local product and short supply chain to incorporate more food products originating from the territory. A preliminary study about the local foods and corresponding volume potential can considerably help to define the spatial distribution of food and the corresponding distance limit to include in the tender.

Contract tenders could also specify minimum thresholds for local sourcing (like the thresholds that exist for organic sourcing)

3. Separating in the school meals service contract the food preparation service from the food procurement, so that City Councils can define the characteristics of food suppliers. The separation can give the responsibility of supplier selection to City Councils, so that suppliers can be identified according to criteria more connected with the local origin of food rather than logistics objectives. The same result might be reached by introducing into the meals service contract a more prominent role of the City Council in selecting suppliers.
4. According to the previous bullet, separating the food procurement into small lots could facilitate participation of small local suppliers. In particular, this can be done for products for which a local supply chain exists (e.g. cheese, fruits, vegetables, bread, fresh fish, poultry meat). Central purchasing improves the bargaining power of the public procurer, but at the same time reduces the opportunity for small and, often, local suppliers to participate in food supply chain.
5. Introducing innovative approaches such as the Dynamic Purchasing System experienced in Bath & North East Somerset Council, UK, where the school service contract remains open for new suppliers. This approach can work in presence of several contractors providing food and services. Each qualified suppliers can participate to frequent competitions during the year for providing schools with local and seasonal products.
6. Introducing more sustainability awards for the best food suppliers and best school meals supply chains. If established at regional level, the award may be considered as a selection criterion within tenders.
7. Improving the supply chain engagement though organisation of meetings with the participation of City Council, principal contractors and food suppliers, so that it is possible to propose initiatives and arrangements in the framework of the contract. Moreover, canteen commissions could also be assigned the responsibility of suggesting initiatives to improve the connectedness within the school meals service supply chain.
8. Sharing experiences among different school meals services located in different geographical areas can offer valuable suggestions and good practices to implement.
9. Stricter rules in the school meals service contract for reducing food waste and encouraging actions to minimize food waste in the schools and along the food supply chain.
10. Continuous monitoring of food waste produced by schools, type of plate and ingredients.

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Appendix 1. Emission factors

Food	Food category	CO_2eq EF ($kgCO_2eq/kgFood$)	Type of source	Source
Asparagus	Fresh Vegetables and Salad	0,623	LCA database	Ecoinvent 3.1 for Asparagus
			BCFN database	Blanke, M., F. Schaefer. Application of PAS 2050-1 supplementary requirements for horticultural products: carbon footprint of pumpkin and asparagus, 2012. In: Corson, M.S., H.M.G. Van der Werf. Book of Abstract of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012), 1-4 October 2012, Saint Malo, France. Rennes, France: INRA, 2012. GROUP 4(A):357-361.
			BCFN database	Hofer, B. How to reduce the environmental footprint of consumer goods: LCA studies on fruit and vegetables production, Coop Switzerland, 37th LCA Discussion Forum, Lausanne, 19th March 2009
			BCFN database	Schafer, F., M. Blanke, J. Fels. Comparison of CO_2e emissions associated with regional, heated and imported asparagus. In Schenck, R., D. Huizenga. Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2014), 8-10 October 2014, San Francisco, USA. ACLCA, Vashon, WA, USA.
Aubergine	Fresh Vegetables and Salad	0,600	LCA database	Ecoinvent 3.1 (impact of greenhouse cultivation practice removed)
Basil	Fresh Vegetables and Salad	0,352	LCA database	Ecoinvent 3.1 for Iceberg Lettuce
			BCFN database	Hospido, A., L. Milà i Canals, S. McLaren, M. Truninger, G. Edwards-Jones, R. Clift. The role of seasonality in lettuce consumption: a case study of environmental and social aspects, Int J LCA 14:381–391, 2009.
			BCFN database	Milà i Canals, L., S.J. Cowell, A. Hospido, D. Jones, G. Koerber, P. Cross, B. Hounsome, G. Edwards-Jones. LCA of horticultural crops including indicator of pesticide rating, from the Project 'Comparative Assessment of Environmental, Community and Nutritional Impacts of Consuming Fruit and Vegetables Produced Locally and Overseas', by the Rural Economy and Land Use (RELU) Programme
Beans	Fresh Vegetables and Salad	0,371	BCFN database	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.

			BCFN database	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			BCFN database	Abeliotios, K., V. Detsis, C. Pappia. Life cycle assessment of bean production in the Prespa National Park, Greece, J Clean Prod 41:89-96, 2013.
			BCFN database	Romero-Gámez, M., E.M. Suárez-Rey, A. Antón, N. Castilla, T. Soriano. Environmental impact of screenhouse and open-field cultivation using a life cycle analysis: the case study of green bean production, J Clean Prod 28:63-69, 2012.
Beets	**Fresh Vegetables and Salad**	0,110	**BCFN database**	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
Broccoli	**Fresh Vegetables and Salad**	0,377	**BCFN database**	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			BCFN database	Venkat, K. Comparision of twelve organic and conventional farming system: a life cycle greenhouse gas emissions perspective, J Sustain Agric 36(6):620-649, 2012
Cabbage	**Fresh Vegetables and Salad**	0,133	**BCFN database**	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.
			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Xu, X., Y. Lan. A comparative study on carbon footprints between plant- and animal-based foods in China, J Clean Prod 112:251-2592, 2016.
Carrots	**Fresh Vegetables and Salad**	0,228	**BCFN database**	Cederberg, C., M. Wivstad, P. Bergkvist, B. Mattsson, K. Ivarsson. Hållbart växtskydd. Analys av olika strategier för att minska riskerna med kemiska växtskyddsmedel,Rapport MAT21 6/2005. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Miljøstyrelsen. Miljøvurdering af konventionel og økologisk avl af grøntsager. Arbejdsrapport nr. 5/2006. København: Miljøstyrelsen. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.

			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Karlsson, H. Seasonal Vegetables - An Environmental Assessment Seasonal Food, Norwegian University of Life Science, Department of Plant and Environmental Sciences - Master Thesis, 2011.
Cauliflower	**Fresh Vegetables and Salad**	0,218	**BCFN database**	Xu, X., Y. Lan. A comparative study on carbon footprints between plant- and animal-based foods in China, J Clean Prod 112:251-2592, 2016.
			BCFN database	Pathak, H., N. Jain, A. Bhatia, J. Patel, P.K. Aggarwal. Carbon footprints of Indian food items, Agric Ecosys Environ 139:66–72, 2010.
			BCFN database	Blonk, H., A. Kool, B. Luske, J. Scholten. Methodology for assessing carbon footprints of horticultural products A study of methodological issues and solutions for the development of the Dutch carbon footprint protocol for horticultural products, Blonk Milieu Advies BV, March 2010.
Celery	**Fresh Vegetables and Salad**	0,415	**LCA database**	Ecoinvent 3.1 for Celery
Dried chickpeas	**Fresh Vegetables and Salad**	0,711	**LCA database**	Ecoinvent 3.1 for Organic Fava Beans
Fennel	**Fresh Vegetables and Salad**	0,444	**LCA database**	Ecoinvent 3.1 for Fennel
Garlic	**Fresh Vegetables and Salad**	0,283	**LCA database**	Ecoinvent 3,1 for Onion
			BCFN database	Cederberg, C., M. Wivstad, P. Bergkvist, B. Mattsson, K. Ivarsson. Hållbart växtskydd. Analys av olika strategier för att minska riskerna med kemiska växtskyddsmedel,Rapport MAT21 6/2005. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Miljøstyrelsen. Miljøvurdering af konventionel og økologisk avl af grøntsager. Arbejdsrapport nr. 5/2006. København: Miljøstyrelsen. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
Green beans	**Fresh Vegetables and Salad**	0,590	**BCFN database**	Xu, X., Y. Lan. A comparative study on carbon footprints between plant- and animal-based foods in China, J Clean Prod 112:251-2592, 2016.
Onion		0,283	**LCA database**	Ecoinvent 3,1 for Onion

	Fresh Vegetables and Salad		**BCFN database**	Cederberg, C., M. Wivstad, P. Bergkvist, B. Mattsson, K. Ivarsson. Hållbart växtskydd. Analys av olika strategier för att minska riskerna med kemiska växtskyddsmedel,Rapport MAT21 6/2005. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Miljøstyrelsen. Miljøvurdering af konventionel og økologisk avl af grøntsager. Arbejdsrapport nr. 5/2006. København: Miljøstyrelsen. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
Peppers	**Fresh Vegetables and Salad**	**0,324**	**BCFN database**	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Xu, X., Y. Lan. A comparative study on carbon footprints between plant- and animal-based foods in China, J Clean Prod 112:251-2592, 2016.
Potatoes	**Fresh Vegetables and Salad**	**0,170**	**LCA database**	Ecoinvent 3.1 for Organic Potatoes
			BCFN database	Cederberg, C., M. Wivstad, P. Bergkvist, B. Mattsson, K. Ivarsson. Hållbart växtskydd. Analys av olika strategier för att minska riskerna med kemiska växtskyddsmedel,Rapport MAT21 6/2005. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Kok, R., R.M.J. Benders, H.C. Moll. Energie-intensiteiten van de nederlandse consumptieve bestedingenanno 1996. IVEM, Rijksuniversiteit Groningen, 2001. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Williams, A.G., E. Audsley, D.L. Sandars. Environmental burdens of producing bread wheat, oilseed rape and potatoes in England and Wales using simulation and system modelling, Int J LCA 15:855–868, 2010.
			BCFN database	Lindenthal, T., T. Markut, S. Hörtenhuber, M. Theurl, G. Rudolph. Greenhouse gas emissions of organic and conventional foodstuffs in Austria, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL I:319-324.

Pumpkin	**Fresh Vegetables and Salad**	0,545	**BCFN database**	Schäfer, F., M. Blanke. Farming and marketing system affects carbon and water footprint e a case study using Hokaido pumpkin, J Clean Prod 28:113-119, 2012
			BCFN database	Blanke, M., F. Schaefer. Application of PAS 2050-1 supplementary requirements for horticultural products: carbon footprint of pumpkin and asparagus, 2012. In: Corson, M.S., H.M.G. Van der Werf. Book of Abstract of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012), 1-4 October 2012, Saint Malo, France. Rennes, France: INRA, 2012. GROUP 4(A):357-361
Radicchio	**Fresh Vegetables and Salad**	0,352	**LCA database**	Ecoinvent 3.1 for Iceberg Lettuce
			BCFN database	Hospido, A., L. Milà i Canals, S. McLaren, M. Truninger, G. Edwards-Jones, R. Clift. The role of seasonality in lettuce consumption: a case study of environmental and social aspects, Int J LCA 14:381–391, 2009.
			BCFN database	Milà i Canals, L., S.J. Cowell, A. Hospido, D. Jones, G. Koerber, P. Cross, B. Hounsome, G. Edwards-Jones. LCA of horticultural crops including indicator of pesticide rating, from the Project 'Comparative Assessment of Environmental, Community and Nutritional Impacts of Consuming Fruit and Vegetables Produced Locally and Overseas', by the Rural Economy and Land Use (RELU) Programme
Tomatoes	**Fresh Vegetables and Salad**	0,457	**BCFN database**	Hofer, B. How to reduce the environmental footprint of consumer goods: LCA studies on fruit and vegetables production, Coop Switzerland, 37th LCA Discussion Forum, Lausanne, 19th March 2009.
Zucchini	**Fresh Vegetables and Salad**	0,199	**LCA database**	Ecoinvent 3.1 for Zucchini
			BCFN database	Lindenthal, T., T. Markut, S. Hörtenhuber, M. Theurl, G. Rudolph. Greenhouse gas emissions of organic and conventional foodstuffs in Austria, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL I:319-324.
Lettuce	**Fresh Vegetables and Salad**	0,352	**LCA database**	Ecoinvent 3.1 for Iceberg Lettuce
			BCFN database	Hospido, A., L. Milà i Canals, S. McLaren, M. Truninger, G. Edwards-Jones, R. Clift. The role of seasonality in lettuce consumption: a case study of environmental and social aspects, Int J LCA 14:381–391, 2009.

			BCFN database	Milà i Canals, L., S.J. Cowell, A. Hospido, D. Jones, G. Koerber, P. Cross, B. Hounsome, G. Edwards-Jones. LCA of horticultural crops including indicator of pesticide rating, from the Project 'Comparative Assessment of Environmental, Community and Nutritional Impacts of Consuming Fruit and Vegetables Produced Locally and Overseas', by the Rural Economy and Land Use (RELU) Programme
Lentils	**Fresh Vegetables and Salad**	**0,711**	**LCA database**	Ecoinvent 3.1 for Organic Fava Beans
Apples	**Fresh Fruits**	**0,261**	**EPD database**	Environdec (2018) - Environmental Declaration for apple - www.environdec.com
			BCFN database	Vinyes, E., Asin, L., Alegre, S., Muñoz, P., Boschmonart, J., & Gasol, C. M. (2017). Life Cycle Assessment of apple and peach production, distribution and consumption in Mediterranean fruit sector. Journal of cleaner production, 149, 313-320.
Apricots	**Fresh Fruits**	**0,381**	**BCFN database**	Vinyes, E., Asin, L., Alegre, S., Muñoz, P., Boschmonart, J., & Gasol, C. M. (2017). Life Cycle Assessment of apple and peach production, distribution and consumption in Mediterranean fruit sector. Journal of cleaner production, 149, 313-320.
Banana	**Fresh Fruits**	**0,815**	**BCFN database**	Iriarte, A., M. G. Almeida, P. Villalobos. Carbon footprint of premium quality export bananas: Case study in Ecuador, the world's largest exporter, Sc Tot Env 472:1082-1088, 2014
			BCFN database	Roibas, L., A. Elbehri, A. Hospido. Carbon footprint along the Ecuadorian banana supply chain: Methodological improvements and calculation tool. In Schenck, R., D. Huizenga. Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2014), 8-10 October 2014, San Francisco, USA. ACLCA, Vashon, WA, USA.
			BCFN database	Blonk, H., A. Kool, B. Luske, J. Scholten. Methodology for assessing carbon footprints of horticultural products A study of methodological issues and solutions for the development of the Dutch carbon footprint protocol for horticultural products, Blonk Milieu Advies BV, March 2010.
			BCFN database	Hofer, B. How to reduce the environmental footprint of consumer goods: LCA studies on fruit and vegetables production, Coop Switzerland, 37th LCA Discussion Forum, Lausanne, 19th March 2009.
Cherries	**Fresh Fruits**	**0,260**	**BCFN database**	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.

Kiwi	**Fresh Fruits**	**1,238**	**EPD database**	Environdec (2018) - Environmental Declaration for kiwi - www.environdec.com
			BCFN database	Mithrarante, N., A. Barber, S. J. McLaren, Carbon Footprinting for the Kiwifruit Supply Chain, NZ Ministry of Agriculture and Forestry, 2010.
			BCFN database	McLaren, S., A. Hume, N. Mitraratne. Carbon management for the primary agricultural sector in New Zeland: case studies for the pipfruit and kiwifruit industries, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL I:293-298.
Lemon	**Fresh Fruits**	**0,650**	**BCFN database**	Beccali, M., M. Cellura, M. Iudicello, M. Mistretta. Resource Consumption and Environmental Impacts of the Agrofood Sector: Life Cycle Assessment of Italian Citrus-Based Products, Environ Manage 43:707–724, 2009.
Mandarin orange	**Fresh Fruits**	**0,295**	**BCFN database**	Ribal, J., N. Sanjuán, G. Clemente, L. Fenollosa, in press. Medición de la eco-eficiencia en procesos productivos en el sector agrario. Caso de estudio sobe producción de cítricos. In: Mordini, M., T. Nemecek, G. Gaillard, Carbon & Water Footprint of Oranges and Strawberries - A Literature Review, FDEA, ART edition, 2009.
			BCFN database	Sanjuán, N., L. Úbeda, G. Clemente, A. Mulet, F. Girona. LCA of integrated orange production in the Comunidad Valenciana (Spain),Int J Agr Resour Govern Ecol 4:163-177, 2005. In: Mordini, M., T. Nemecek, G. Gaillard, Carbon & Water Footprint of Oranges and Strawberries - A Literature Review, FDEA, ART edition, 2009.
			BCFN database	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			BCFN database	Dwivedi, P., T. Spreen, R. Goodrich-Schneider. Global warming impact of Florida's Not-From-Concentrate (NFC) orange juice, Agric Syst 108:104–111, 2012.
Oranges	**Fresh Fruits**	**0,295**	**BCFN database**	Ribal, J., N. Sanjuán, G. Clemente, L. Fenollosa, in press. Medición de la eco-eficiencia en procesos productivos en el sector agrario. Caso de estudio sobe producción de cítricos. In: Mordini, M., T. Nemecek, G. Gaillard, Carbon & Water Footprint of Oranges and Strawberries - A Literature Review, FDEA, ART edition, 2009.

			BCFN database	Sanjuán, N., L. Úbeda, G. Clemente, A. Mulet, F. Girona. LCA of integrated orange production in the Comunidad Valenciana (Spain),Int J Agr Resour Govern Ecol 4:163-177, 2005. In: Mordini, M., T. Nemecek, G. Gaillard, Carbon & Water Footprint of Oranges and Strawberries - A Literature Review, FDEA, ART edition, 2009.
			BCFN database	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			BCFN database	Dwivedi, P., T. Spreen, R. Goodrich-Schneider. Global warming impact of Florida's Not-From-Concentrate (NFC) orange juice, Agric Syst 108:104–111, 2012.
Peaches	**Fresh Fruits**	**0,381**	**BCFN database**	Vinyes, E., Asin, L., Alegre, S., Muñoz, P., Boschmonart, J., & Gasol, C. M. (2017). Life Cycle Assessment of apple and peach production, distribution and consumption in Mediterranean fruit sector. Journal of cleaner production, 149, 313-320.
Pear	**Fresh Fruits**	**0,261**	**EPD database**	Environdec (2018) - Environmental Declaration for apple - www.environdec.com
			BCFN database	Vinyes, E., Asin, L., Alegre, S., Muñoz, P., Boschmonart, J., & Gasol, C. M. (2017). Life Cycle Assessment of apple and peach production, distribution and consumption in Mediterranean fruit sector. Journal of cleaner production, 149, 313-320.
Plums	**Fresh Fruits**	**0,321**	**EPD database**	Environdec (2018) - Environmental Declaration for apple - www.environdec.com
			BCFN database	Vinyes, E., Asin, L., Alegre, S., Muñoz, P., Boschmonart, J., & Gasol, C. M. (2017). Life Cycle Assessment of apple and peach production, distribution and consumption in Mediterranean fruit sector. Journal of cleaner production, 149, 313-320.
Chicken meat	**Meat**	**3,650**	**LCA Food database**	LCA Food (2018) - www.lcafood.dk
Pork meat	**Meat**	**4,560**	**LCA Food database**	LCA Food (2018) - www.lcafood.dk
Turkey meat	**Meat**	**4,160**	**LCA database**	Agribalyse for Turkey
Beef	**Meat**	**7,009**	**BCFN database**	Arias, S.L., J.S. Rovira. Life cycle assessment of four fattening calves systems in Spain, 2012. In: Corson, M.S., H.M.G. Van der Werf. Book of Abstract of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012), 1-4 October 2012, Saint Malo, France. Rennes, France: INRA, 2012.. GROUP 1(A):657-658.
Trout in fillets	**Meat**	**2,147**	**LCA Food database**	LCA Food (2018) - www.lcafood.dk

			BCFN database	Aubin, J., E. Papatryphon, H.M.G. van der Werf, S. Chatzifotis. Assessment of the environmental impact of carnivorous finfish production systems using life cycle assessment, J Clean Prod 17:354–361, 2009.
			BCFN database	Silvenius, F., J. Gronroos, H. Hartikainen, S. Kurppa, M. Kankainen, T. Makinen, R. Tahvonen, J. Vielma. LCA of Finnish rainbow trout, results and significance on different allocation methods, 2012. In: Corson, M.S., H.M.G. Van der Werf. Book of Abstract of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012), 1-4 October 2012, Saint Malo, France. Rennes, France: INRA, 2012. GROUP 1(A):705-706.
Veal	**Meat**	**21,700**	**EPD database**	Environdec (2018) - Environmental Declaration for veal - www.environdec.com
Butter	**Dairy**	**8,311**	**LCA database**	Ecoinvent 3.1 for Butter from Cow Milk
			BCFN database	Kanyarushoki, C., H.M.G. van der Werf, F. Fuchs. Life Cycle assessment of cow and goat milk chains in France, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL II:174-179.
			BCFN database	Nilsson, K., A. Flysjö, J. Davis, S. Sim, N. Unger, S. Bell. Comparative life cycle assessment of margarine and butter consumed in the UK, Germany and France, Int J LCA 15(9):916-926, 2010.
			BCFN database	TESCO. Product Carbon Footprint Summary, Issued August 2012.
			BCFN database	Flysjo, A., A. K. Modin-Edman, How to use LCA in a company context the case of a dairy cooperative. In Schenck, R., D. Huizenga. Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2014), 8-10 October 2014, San Francisco, USA. ACLCA, Vashon, WA, USA.
Fresh eggs	**Dairy**	**2,700**	**EPD database**	Environdec (2018) - Environmental Declaration for eggs - www.environdec.com
Whole Milk	**Dairy**	**1,604**	**EPD database**	Environdec (2018) - Environmental Declaration for milk - www.environdec.com
Mozzarella cheese	**Dairy**	**10,574**	**Scientific publication**	Simonetto, M., Mazzi, A., Fedel, A., Pieretto, C., Scipioni, A. Carbon footprint analysis of mozzarella and ricotta cheese production and influence of allocation procedure, Proceedings of the Internationa Conference "LCA for feeding the planet and energy for life" Stresa 6-7 October 2015, Milano 8-9 October 2015, 266-269.

Partially Skimmed Milk	**Dairy**	**1,340**	**LCA database**	Ecoinvent 3.1 for Butter from Cow Milk - www.environdec.com
Pasteurized eggs	**Dairy**	**2,700**	**EPD database**	Environdec (2018) - Environmental Declaration for eggs - www.environdec.com
Ricotta cheese	**Dairy**	**3,213**	**Scientific publication**	Simonetto, M., Mazzi, A., Fedel, A., Pieretto, C., Scipioni, A. Carbon footprint analysis of mozzarella and ricotta cheese production and influence of allocation procedure, Proceedings of the Internationa Conference "LCA for feeding the planet and energy for life" Stresa 6-7 October 2015, Milano 8-9 October 2015, 266-269.
Stracchino cheese	**Dairy**	**5,570**	**EPD database**	Environdec (2018) - Environmental Declaration for Stracchino - www.environdec.com
Yogurt	**Dairy**	**2,828**	**LCA database**	Ecoinvent 3.1 for Yogurt from Cow Milk
			BCFN database	Flysjo, A., A. K. Modin-Edman, How to use LCA in a company context the case of a dairy cooperative. In Schenck, R., D. Huizenga. Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2014), 8-10 October 2014, San Francisco, USA. ACLCA, Vashon, WA, USA.
			BCFN database	Environdec (2018) - Environmental Declaration for Yogurt - www.environdec.com
			BCFN database	González-García, S., E.G. Castanheira, A.C. Dias, L. Arroja. Environmental life cycle assessment of a dairy product: the yoghurt, Int J LCA 18(4):769-811, 2013.
			BCFN database	Lindenthal, T., T. Markut, S. Hörtenhuber, M. Theurl, G. Rudolph. Greenhouse gas emissions of organic and conventional foodstuffs in Austria, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL I:319-324.
			BCFN database	Büsser, S., N. Jungbluth. LCA of Yoghurt Packed in Polystyrene Cup and Aluminium-Based Lidding,ESU-services Ltd. Uster, Switzerland. Commissioned by German Aluminium As-sociation (GDA) in cooperation with European Aluminium Foil Association (EAFA), Düsseldorf, Germany, 2009.
Grana Padano cheese	**Dairy**	**15,930**	**Scientific publication**	Guerci, M., Proserpio, C., Famiglietti, J., Zanchi, Z., Bilato, G. Carbon footprint of Grana Padano PDO cheese in a full life cycle perspective, Distretto Latte Lombardo, Polytechnic University of Milan, 2016, http://sites.unimi.it/agrifood_lcalab/wp-content/uploads/2016/10/Poster_Carbon-Footprint-of-Grana-Padano-PDO-cheese-in-a-full-life-cycle-perspective.pdf

Mozzarella for pizza	**Dairy**	**10,574**	**Scientific publication**	Simonetto, M., Mazzi, A., Fedel, A., Pieretto, C., Scipioni, A. Carbon footprint analysis of mozzarella and ricotta cheese production and influence of allocation procedure, Proceedings of the Internationa Conference "LCA for feeding the planet and energy for life" Stresa 6-7 October 2015, Milano 8-9 October 2015, 266-269.
Parmigiano Reggiano cheese	**Dairy**	**12,370**	**Firm report**	Caseificio Cramasche. Carbon Footprint Analysis: Parmigiano Reggiano DOP, Study Report, http://www.ilredeiformaggi.com/upload/moduli/X96allegato1-1X_cfp-report-parmigiano-reggiano-study-report.pdf
			Scientific publication	Pignedoli, S., Valli, L., Menghi, A. “Innova latte 2030” svela l'impronta di carbonio, Agricoltura, 6/2012, http://www.crpa.it/media/documents/crpa_www/Settori/Ambiente/Download/Archivio-2012/AgRER_6_2012_p65.pdf
Pecorino cheese	**Dairy**	**25,200**	**Scientific publication**	Favilli A., Rizzi F., Iraldo F. (2008) - Sustainable production of cheese thanks to renewable energy. an LCA of the Pecorino Toscano DOP from the geothermal district of Lardello, Italy. 6th International Conference on LCA in the Agri-Food Sector, Book of Abstract, pag 71. Zurich, November: 12-14.
Asiago	**Dairy**	**10,100**	**Scientific publication**	Dalla Riva. A., Thoma, G., Jasmina, B., Daesoo, D., Cassandro, M., De Marchi, M. (2016), Sostenibilità ambientale nel caseario: il caso Asiago dop, L'Informatore Agrario, p. 27-31
Provolone	**Dairy**	**10,100**	**Scientific publication**	Dalla Riva. A., Thoma, G., Jasmina, B., Daesoo, D., Cassandro, M., De Marchi, M. (2016), Sostenibilità ambientale nel caseario: il caso Asiago dop, L'Informatore Agrario, p. 27-31
Taleggio	**Dairy**	**10,100**	**Scientific publication**	Dalla Riva. A., Thoma, G., Jasmina, B., Daesoo, D., Cassandro, M., De Marchi, M. (2016), Sostenibilità ambientale nel caseario: il caso Asiago dop, L'Informatore Agrario, p. 27-31
Robiola (soft cheese)	**Dairy**	**5,570**	**EPD database**	Environdec (2018) - Environmental Declaration for Stracchino - www.environdec.com
Bread	**Ambient Food**	**1,494**	**BCFN database**	Kulak, M., T. Nemecek, E. Frossard, V. Chable, G. Gaillard. Life cycle assessment of bread from several alternative food networks in Europe, J Clean Prod 90:104-113, 2015.
Extra virgin olive oil	**Ambient Food**	**1,240**	**BCFN database**	Polo, J.A., J.A. Salido, A. Mourelle. Calculation and verification of carbon footprint in agricoltural product, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL I:105-110.
Pasta	**Ambient Food**	**0,715**	**EPD database**	Environdec (2018) - Environmental Declaration for Pasta-Food Service - www.environdec.com
Rice	**Ambient Food**	**2,750**	**BCFN database**	Blengini, G.A., M. Busto. The life cycle of rice: LCA of alternative agri-food chain management systems in Vercelli (Italy), J Environ Manage 90:1512-1522, 2009.

Barley	**Ambient Food**	0,498	**BCFN database**	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			BCFN database	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.
			BCFN database	Meul, M., C. Ginneberge, C.E. Van Middelaar, I.J.M. de Boer, D. Fremaut, G. Haesaert. Carbon footprint of five pig diets using three land use change accounting methods, Livest Sci 149:215–223, 2012.
			EPD database	Environdec (2018) - Environmental Declaration for Barley - www.environdec.com
			BCFN database	Roer, A-G., A. Korsaeth, T.M. Henriksen, O. Michelsen, A.H. Stomman. The influence of system boundaries on life cycle assessment of grain production in central southeast Norway, Agric Syst 111:75–84, 2012.
Brown rice	**Ambient Food**	2,750	**BCFN database**	Blengini, G.A., M. Busto. The life cycle of rice: LCA of alternative agri-food chain management systems in Vercelli (Italy), J Environ Manage 90:1512-1522, 2009.
Corn flour	**Ambient Food**	0,398	**BCFN database**	Meul, M., C. Ginneberge, C.E. Van Middelaar, I.J.M. de Boer, D. Fremaut, G. Haesaert. Carbon footprint of five pig diets using three land use change accounting methods, Livest Sci 149:215–223, 2012.
Flour	**Ambient Food**	0,415	**EPD database**	Environdec (2018) - Environmental Declaration for Flour - www.environdec.com
Lasagna	**Ambient Food**	2,313	**EPD database**	Environdec (2018) - Environmental Declaration for Egg pasta - www.environdec.com
Millet	**Ambient Food**	0,498	**BCFN database**	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			BCFN database	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.
			BCFN database	Meul, M., C. Ginneberge, C.E. Van Middelaar, I.J.M. de Boer, D. Fremaut, G. Haesaert. Carbon footprint of five pig diets using three land use change accounting methods, Livest Sci 149:215–223, 2012.
			BCFN database	Environdec (2018) - Environmental Declaration for Barley - www.environdec.com
			BCFN database	Roer, A-G., A. Korsaeth, T.M. Henriksen, O. Michelsen, A.H. Stomman. The influence of system boundaries on life cycle assessment of grain production in central southeast Norway, Agric Syst 111:75–84, 2012.

Spelt	**Ambient Food**	0,360	**BCFN database**	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
Whole wheat pasta	**Ambient Food**	0,715	**EPD database**	Environdec (2018) - Environmental Declaration for Pasta-Food Service - www.environdec.com
Cous-cous	**Ambient Food**	0,970	**EPD database**	Environdec (2018) - Environmental declaration for "Durum Wheat Semolina" - www.evirondec.com
Pizza dough	**Ambient Food**	1,494	**BCFN database**	Kulak, M., T. Nemecek, E. Frossard, V. Chable, G. Gaillard. Life cycle assessment of bread from several alternative food networks in Europe, J Clean Prod 90:104-113, 2015.
Wine	**Ambient Food**	0,770	**Scientific publication**	Petti, L., Raggi, A., De Camillis, C., Matteucci, P., Sára, B., & Pagliuca, G. (2006, November). Life cycle approach in an organic wine-making firm: an Italian case-study. In Proceedings fifth australian conference on life cycle assessment, melbourne, australia (pp. 22-24).
Beans Frozen	**Processed Vegetables**	0,449	**BCFN database**	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.
			BCFN database	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			BCFN database	Abeliotios, K., V. Detsis, C. Pappia. Life cycle assessment of bean production in the Prespa National Park, Greece, J Clean Prod 41:89-96, 2013.
			BCFN database	Romero-Gámez, M., E.M. Suárez-Rey, A. Antón, N. Castilla, T. Soriano. Environmental impact of screenhouse and open-field cultivation using a life cycle analysis: the case study of green bean production, J Clean Prod 28:63-69, 2012.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
Beets Frozen	**Processed Vegetables**	0,165	**BCFN database**	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.

			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Cabbage Frozen	**Processed Vegetables**	0,190	**BCFN database**	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.
			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Xu, X., Y. Lan. A comparative study on carbon footprints between plant- and animal-based foods in China, J Clean Prod 112:251-2592, 2016.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
Carrots Frozen	**Processed Vegetables**	0,342	**BCFN database**	Cederberg, C., M. Wivstad, P. Bergkvist, B. Mattsson, K. Ivarsson. Hållbart växtskydd. Analys av olika strategier för att minska riskerna med kemiska växtskyddsmedel,Rapport MAT21 6/2005. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Miljøstyrelsen. Miljøvurdering af konventionel og økologisk avl af grøntsager. Arbejdsrapport nr. 5/2006. København: Miljøstyrelsen. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Karlsson, H. Seasonal Vegetables - An Environmental Assessment Seasonal Food, Norwegian University of Life Science, Department of Plant and Environmental Sciences - Master Thesis, 2011.
			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.

Cauliflower Frozen	**Processed Vegetables**	0,312	**BCFN database**	Xu, X., Y. Lan. A comparative study on carbon footprints between plant- and animal-based foods in China, J Clean Prod 112:251-2592, 2016.
			BCFN database	Pathak, H., N. Jain, A. Bhatia, J. Patel, P.K. Aggarwal. Carbon footprints of Indian food items, Agric Ecosys Environ 139:66–72, 2010.
			BCFN database	Blonk, H., A. Kool, B. Luske, J. Scholten. Methodology for assessing carbon footprints of horticultural products A study of methodological issues and solutions for the development of the Dutch carbon footprint protocol for horticultural products, Blonk Milieu Advies BV, March 2010.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
Celery Frozen	**Processed Vegetables**	0,548	**LCA database**	Ecoinvent 3.1
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Green beans Frozen	**Processed Vegetables**	0,449	**BCFN database**	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.
			BCFN database	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.

			BCFN database	Abeliotios, K., V. Detsis, C. Pappia. Life cycle assessment of bean production in the Prespa National Park, Greece, J Clean Prod 41:89-96, 2013.
			BCFN database	Romero-Gámez, M., E.M. Suárez-Rey, A. Antón, N. Castilla, T. Soriano. Environmental impact of screenhouse and open-field cultivation using a life cycle analysis: the case study of green bean production, J Clean Prod 28:63-69, 2012.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
Onion Frozen	**Processed Vegetables**	**0,373**	**LCA database**	Ecoinvent 3,1
			BCFN database	Cederberg, C., M. Wivstad, P. Bergkvist, B. Mattsson, K. Ivarsson. Hållbart växtskydd. Analys av olika strategier för att minska riskerna med kemiska växtskyddsmedel,Rapport MAT21 6/2005. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Miljøstyrelsen. Miljøvurdering af konventionel og økologisk avl af grøntsager. Arbejdsrapport nr. 5/2006. København: Miljøstyrelsen. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.

			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Peas Frozen	**Processed Vegetables**	0,417	**BCFN database**	Meul, M., C. Ginneberge, C.E. Van Middelaar, I.J.M. de Boer, D. Fremaut, G. Haesaert. Carbon footprint of five pig diets using three land use change accounting methods, Livest Sci 149:215–223, 2012.
			BCFN database	Nguyen, T.T.H., I. Bouvarel, P. Ponchant., H.M.G. van der Werf. Using environmental constraints to formulate low-impact poultry feeds, J Clean Prod 28:215-224, 2012.
			BCFN database	Carlsson-Kanyama, A. Climate change and dietary choices — how can emissions of greenhouse gases from food consumption be reduced?, Food Policy 23(3/4):277–293, 1998.
			BCFN database	González, A., B. Frostell, A. Carlsson-Kanyama. Protein efficiency per unit energy and per unit greenhouse gas emissions: Potential contribution of diet choices to climate change mitigation, Food Policy 36:562–570, 2011.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
Peeled canned tomatoes	**Processed Vegetables**	1,042	**EPD database**	Environdec (2018) - Environmental Declaration for Canned Tomato - www.environdec.com
Potatoes Frozen	**Processed Vegetables**	0,225	**LCA database**	Ecoinvent 3.1 for Organic Potatoes
			BCFN database	Cederberg, C., M. Wivstad, P. Bergkvist, B. Mattsson, K. Ivarsson. Hållbart växtskydd. Analys av olika strategier för att minska riskerna med kemiska växtskyddsmedel,Rapport MAT21 6/2005. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.
			BCFN database	Kok, R., R.M.J. Benders, H.C. Moll. Energie-intensiteiten van de nederlandse consumptieve bestedingenanno 1996. IVEM, Rijksuniversiteit Groningen, 2001. In: Gössling, S., B. Garrod, C. Aall, J. Hille, P. Peeters. Food management in tourism: Reducing tourism's carbon 'foodprint', Tourism Manage 32:534-543, 2011.

			BCFN database	Williams, A.G., E. Audsley, D.L. Sandars. Environmental burdens of producing bread wheat, oilseed rape and potatoes in England and Wales using simulation and system modelling, Int J LCA 15:855–868, 2010.
			BCFN database	Lindenthal, T., T. Markut, S. Hörtenhuber, M. Theurl, G. Rudolph. Greenhouse gas emissions of organic and conventional foodstuffs in Austria, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL I:319-324.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Pumpkin Frozen	**Processed Vegetables**	**0,719**	**BCFN database**	Blanke, M., F. Schaefer. Application of PAS 2050-1 supplementary requirements for horticultural products: carbon footprint of pumpkin and asparagus, 2012. In: Corson, M.S., H.M.G. Van der Werf. Book of Abstract of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012), 1-4 October 2012, Saint Malo, France. Rennes, France: INRA, 2012. GROUP 4(A):357-361.
			BCFN database	Schäfer, F., M. Blanke. Farming and marketing system affects carbon and water footprint e a case study using Hokaido pumpkin, J Clean Prod 28:113-119, 2012.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.

			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Savoy cabbage Frozen	**Processed Vegetables**	**0,190**	**BCFN database**	Kramer, K.J., H.C. Moll, S. Nonhebel. Total greenhouse gas emissions related to the Dutch crop production system, Agric Ecosys Environ 72:9-16, 1999.
			BCFN database	Yoshikawa, N., K. Amano, K. Shimada. Evaluation of environmental load on fruits and vegetables consumption and its reduction potential, Ritsumeikan University, 2009
			BCFN database	Xu, X., Y. Lan. A comparative study on carbon footprints between plant- and animal-based foods in China, J Clean Prod 112:251-2592, 2016.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
Spinach Frozen	**Processed Vegetables**	**0,277**	**LCA database**	Ecoinvent 3.1 for Spinach
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Tomatoes Frozen	**Processed Vegetables**	**0,603**	**BCFN database**	Hofer, B. How to reduce the environmental footprint of consumer goods: LCA studies on fruit and vegetables production, Coop Switzerland, 37th LCA Discussion Forum, Lausanne, 19th March 2009.

			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Zucchini Frozen	**Processed Vegetables**	**0,263**	**LCA database**	Ecoinvent 3.1 for Zucchini
			BCFN database	Lindenthal, T., T. Markut, S. Hörtenhuber, M. Theurl, G. Rudolph. Greenhouse gas emissions of organic and conventional foodstuffs in Austria, 2010. In: Notarnicola, B., E. Settanni, G. Tassielli, P. Giungato. Proceedings of the VII International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2010), 22-24 September 2010, Bari, Italy. Bari, Italy: Università degli studi di Bari Aldo Moro, 2010. VOL I:319-324.
			Scientific publication	i Canals, L. M., Muñoz, I., Hospido, A., Plassmann, K., McLaren, S., Edwards-Jones, G., & Hounsome, B. (2008). Life Cycle Assessment (LCA) of domestic vs. imported vegetables. Case studies on broccoli, salad crops and green beans. United Kingdom, Cent. Environ. Strateg. Univ. Surrey, 46.
			Scientific publication	i Canals, L. M., Chapagain, A., Orr, S., Chenoweth, J., Anton, A., & Clift, R. (2010). Assessing freshwater use impacts in LCA, part 2: case study of broccoli production in the UK and Spain. The International Journal of Life Cycle Assessment, 15(6), 598-607.
			Scientific publication	Gottfridsson, L. (2014). Global warming potential and nutritional content of fresh and frozen roots.
Sweetcorn	**Processed Vegetables**	**0,332**	**Scientific publication**	Usubharatana, P., & Phungrassami, H. (2016). Ecological Footprint Analysis of Canned Sweet Corn. Journal of Ecological Engineering, 17(3), 22-29.
Apple juice	**Processed Fruits**	**0,511**	**EPD database**	Environdec (2018) for category "Pear Juice" - www.environdec.com
Orange juice	**Processed Fruits**	**0,780**	**BCFN database**	Dwivedi, P., T. Spreen, R. Goodrich-Schneider. Global warming impact of Florida's Not-From-Concentrate (NFC) orange juice, Agric Syst 108:104–111, 2012

			BCFN database	Dwivedi, P., T. Spreen, R. Goodrich-Schneider. Global warming impact of Florida's Not-From-Concentrate (NFC) orange juice, Agric Syst 108:104–111, 2012
			BCFN database	Beccali, M., M. Cellura, M. Iudicello, M. Mistretta. Resource Consumption and Environmental Impacts of the Agrofood Sector: Life Cycle Assessment of Italian Citrus-Based Products, Environ Manage 43:707–724, 2009.
Peach juice	**Processed Fruits**	**0,910**	**Scientific publication**	De Menna, F., Vittuari, M., & Molari, G. (2015). Impact evaluation of integrated food-bioenergy systems: A comparative LCA of peach nectar. Biomass and bioenergy, 73, 48-61.
Pear Juice	**Processed Fruits**	**0,511**	**EPD database**	Environdec (2018) for category "Pear Juice" - www.environdec.com
Baked ham	**Meat heavy processed**	**10,000**	**LCA Food database**	LCA Food - http://www.lcafood.dk/
Bresaola	**Meat heavy processed**	**9,472**	**BCFN database**	Arias, S.L., J.S. Rovira. Life cycle assessment of four fattening calves systems in Spain, 2012. In: Corson, M.S., H.M.G. Van der Werf. Book of Abstract of the 8th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2012), 1-4 October 2012, Saint Malo, France. Rennes, France: INRA, 2012.. GROUP 1(A):657-658.
			Scientific publication	Schivazappa, C., Parolari, G., Virgili, R., Valerio, A., Time-related changes in chemical and physical parameters during ripening of GPI Bresaola of Valtellina, Industria Conserve, 79, 2004: 305-317
Bacon	**Meat heavy processed**	**3,633**	**LCA Food database**	LCA Food - http://www.lcafood.dk/
			BCFN database	Michaelowa, A., B. Dransfeldb. Greenhouse gas benefits of fighting obesity, Ecol Econ 66:298-308, 2008.
Hamburger beef	**Meat heavy processed**	**5,460**	**LCA Food database**	LCA Food - http://www.lcafood.dk/
			EPD database	Environdec (2018) for category "Beef hamburger" - www.environdec.com
Cod sticks	**Meat heavy processed**	**2,883**	**BCFN database**	Fulton, S. Fish and fuel: Life Cycle Green House Emissions associated with Icelandic cod, Alaskan Pollock and Alaskan pink Salmon fillets delivered to the United Kingdom, Dalhousie University, School for Resource and Environmental Studies, 2010.
			BCFN database	Findus, Fish from Norway or New Zealand on Swedish plates? Climate change emissions of three seafood production chains from the sea to the table,2008. In: Sonesson, U., J. Davis, F. Ziegler. Food production and emissions of greenhouse gases,SIK Report 802, Göteborg, 2010.

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			BCFN database	Svanes, E., M. Vold, O. J. Hanssen. Environmental assessment of cod (Gadus morhua) from autoline fisheries, Int J LCA 16:611–624, 2011.
			BCFN database	Winther, U., F. Ziegler, E. Skontorp Hognes, A. Emanuelsson, V. Sund, H. Ellingsen. Carbon Footprint and energy use of Norwegian seafood products, SINTEF Fisheries and Aquaculture, 2009.
			BCFN database	Buchspies, B., S.J. Tölle, N. Jungbluth. Life Cycle Assessment of High-Sea Fish and Salmon Aquaculture, ESU-services Ltd., Practical training report, Uster, May 2011.
			BCFN database	Guttormsdòttir, A.B. Life Cycle Assessment on Icelandic cod product based on two different fishing methods, Verkfræðideild Háskóli Íslands, 2009.
Flounder	**Meat heavy processed**	**1,625**	**BCFN database**	Vázquez-Rowe, I., P. Villanueva-Rey, J. Mallo, J.J. De la Cerda, M.T. Moreira, G. Feijoo. Carbon footprint of a multi-ingredient seafood product from a business-to-business perspective, J Clean Prod 44:200-210, 2013.
			BCFN database	Fet, A.M., E.M. Shau, C. Haskins. A Framework for Environmental Analyses of Fish Food Production Systems Based on Systems Engineering Principles, Syst Eng 13(2):109-118, 2010.
Parma ham	**Meat heavy processed**	**23,110**	**Scientific publication**	Gerboni, E., Falconi, F., Olivieri, G., & Cortesi, P. (2017). LIFE-CYCLE CARBON FOOTPRINT ANALYSIS OF THE PARMA HAM PDO (PROTECTED DESIGNATION OF ORIGIN) ON-THE-BONE. Environmental Engineering & Management Journal (EEMJ), 16(8).
Salmon fillets	**Meat heavy processed**	**3,625**	**BCFN database**	Winther, U., F. Ziegler, E. Skontorp Hognes, A. Emanuelsson, V. Sund, H. Ellingsen. Carbon Footprint and energy use of Norwegian seafood products, SINTEF Fisheries and Aquaculture, 2009.
			BCFN database	Buchspies, B., S.J. Tölle, N. Jungbluth. Life Cycle Assessment of High-Sea Fish and Salmon Aquaculture, ESU-services Ltd., Practical training report, Uster, May 2011.
			BCFN database	Blonk, H., A. Kool, B. Luske, S. de Waart. Environmental effects of protein-rich food products in the Netherlands - Consequences of animal protein substitutes, Blonk consultants, 2008.

Squid	**Meat heavy processed**	6,910	**BCFN database**	Iribarren, D., I. Vazquez-Rowe, A. Hospido, M.T. Moreira, G. Feijoo. Updating the carbon footprint of the Galician fishing activity (NW Spain), Sci Total Environ 409:1609–1611, 2011.
Tuna with oil	**Meat heavy processed**	4,061	**BCFN database**	Hospido, A., P. Tyedmers. Life cycle environmental impacts of Spanish tuna fisheries, Fish Res 76:174-186, 2005.
			BCFN database	Iribarren, D., I. Vazquez-Rowe, A. Hospido, M.T. Moreira, G. Feijoo. Updating the carbon footprint of the Galician fishing activity (NW Spain), Sci Total Environ 409:1609–1611, 2011.
			BCFN database	Tan, R.R., A.B. Culaba. Estimating the Carbon Footprint of Tuna Fisheries.
Breaded Cutlet (beef)	**Ready meals**	42,400	**LCA Food database**	LCA Food - http://www.lcafood.dk/
Broth	**Ready meals**	0,591	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Gnocchi (fresh pasta)	**Ready meals**	0,375	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Chicche (fresh pasta)	**Ready meals**	0,375	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Anolini (fresh filled pasta)	**Ready meals**	1,392	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Ice cream	**Ready meals**	1,242	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Jam tart	**Ready meals**	1,274	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Mashed potatoes	**Ready meals**	0,821	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Pesto sauce	**Ready meals**	2,600	**EPD database**	Environdec (2018) - Environmental Declaration for Pesto sauce - www.environdec.com
Pizza (without mozzarella)	**Ready meals**	0,873	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Pudding (sweet)	**Ready meals**	1,960	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Ravioli (fresch filled pasta)	**Ready meals**	1,392	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Tortelli (fresh filled pasta)	**Ready meals**	5,399	**Barilla's recepee tool**	Estimated by Tool Chef Barilla (2018)
Dough frozen	**Ready meals**	1,494	**BCFN database**	Kulak, M., T. Nemecek, E. Frossard, V. Chable, G. Gaillard. Life cycle assessment of bread from several alternative food networks in Europe, J Clean Prod 90:104-113, 2015.

The Strength2Food project in a nutshell

Strength2Food is a five-year, €6.9 million project to improve the effectiveness of EU food quality schemes (FQS), public sector food procurement (PSFP) and to stimulate Short Food Supply Chains (SFSC) through research, innovation and demonstration activities. The 30-partner consortium representing 11 EU and four non-EU countries combines academic, communication, SMEs and stakeholder organisations to ensure a multi-actor approach. It will undertake case study-based quantitative research to measure economic, environmental and social impacts of FQS, PSFP and SFSC. The impact of PSFP policies on nutrition in school meals will also be assessed. Primary research will be complemented by econometric analysis of existing datasets to determine impacts of FQS and SFSC participation on farm performance, as well as understand price transmission and trade patterns. Consumer knowledge, confidence in, valuation and use of FQS labels and products will be assessed via survey, ethnographic and virtual supermarket-based research. Lessons from the research will be applied and verified in 6 pilot initiatives which bring together academic and non-academic partners. Impact will be maximised through a knowledge exchange platform, hybrid forums, educational resources and a Massive Open Online Course.

Strengthening European Food Chain Sustainability by Quality and Procurement Policy

Deliverable No: D6.3

EVALUATION OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF DIFFERENT MODELS OF PSFP IN A SCHOOL CONTEXT:

SERBIA COUNTRY REPORT

February 2019

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Academic Partners

1. **UNEW**, Newcastle University (United Kingdom)
2. **UNIPR**, University of Parma (Italy)
3. **UNED**, University of Edinburgh (United Kingdom)
4. **WU**, Wageningen University (Netherlands)
5. **AUTH**, Aristotle University of Thessaloniki (Greece)
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21. **GIJHARS**, Quality Inspection of Agriculture and Food (Poland)
22. **FOODNAT**, Food Nation CIC (United Kingdom)
23. **CREA**, Council for Agricultural Research and Economics (Italy)
24. **Barilla**, Barilla Group (Italy)
25. **MPNTR**, Ministry of Education, Science and Technological Development (Serbia)
26. **Konzum**, Konzum (Croatia)
27. **Arilje**, Municipality of Arilje (Serbia)
28. **CPR**, Consortium of Parmigiano-Reggiano (Italy)
29. **ECOZEPT**, ECOZEPT (Germany)
30. **IMPMENT**, Impact Measurement Ltd (United Kingdom)

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EXTENDED ABSTRACT

This report presents the WP6.3 research into the environmental, economic and social impacts of two models of primary school meals procurement in Serbia. Individual schools are normally responsible for contracting and managing their own food supplies/meals, and are obliged to accept lowest cost tenders. However, there is some variation in the geographical distances between schools and the first tier suppliers they contract with, which may affect sustainability outcomes. Therefore, the first procurement model we define is a local (LOC) model, in which more than 70% of food is procured from suppliers less than 15 km distance from the school (in reality over 94% of food contract value). The second procurement model is a low-cost (LOW) model, in which at least 30% of food (by value) is procured from suppliers at least 15 km distant from the schools. In practice, the procurement decisions of schools take place in a fluid manner on an annual basis, which means the stability of models over time is rather weak. For the purposes of this study, both LOC and LOW models were defined according to the suppliers contracted at the time data collection began, early during the 2017-18 school year. Specifically, the dataset for LOC case comprised the supply chains to four primary schools (two in Belgrade, two in Novi Sad), each of which had more than 70% of food from its first tier suppliers located less than 15 km distance from its site. Conversely, the dataset for LOW case comprised the supply chains of four primary schools (three in Belgrade, one in Novi Sad) each of which had at least 30% of food from first tier suppliers located at least 15 km distance from the school site.

The goal of the research was to identify differences between the two models in terms of the environmental, economic and social impacts of the supply chains, as well as to define steps/activities which could improve the procurement processes. This report provides an overview of methodology and research results. It comprises eight sections. After an introduction, we will present the school meal context in Serbia or, more specifically, we will introduce pivotal differences between the analyzed regions, and we will identify key procedures and regulations in the process of organizing school meal procurement in Serbia. The third and fourth sections of the report are dedicated to detailed description of the food procurement models analyzed (LOC and LOW model).

For every school and its supply chain in the analyzed sample, we have conducted environmental, economic and social analyses according to the defined methodology and this is explained in detail in the fifth, sixth and seventh report sections. Finally, in the last section, we will present conclusions and recommendations for the improvement of both models of school meal procurement in Serbia, based on results obtained from the three types of analysis.

Interviews took place with suppliers and kitchen staff. The interviewed companies belong to the different levels of supply chain, operate in various municipalities, differ in size and founding time and come from diverse industries, such as: meat production, baking, dairy, trade, etc. In the following analysis we present results from the selected interviews, chosen on the basis whether the companies supplied schools which were finally included in the sample. In the second stage, we performed interviews with the kitchen staff employed in eight selected schools and explored their affiliation regarding the region.

In terms of supply chain and meals service organisation, in LOC case, the four schools contract directly with only 1-2 first tier suppliers each, comprising a mix of large and small firms. Schools in LOC case serve around 127 lunches per day on average, all of which are prepared

and cooked on-site. In LOW case, the four schools contract directly with 3-6 first tier suppliers each; again these comprise a mix of larger and smaller family-owned firms. Schools in LOW case serve an average of around 213 meals per day; again these are all cooked on-site.

For environmental impact, we analysed, for both cases, the quantities of the different foods procured, the kms travelled by first tier suppliers, and the plate waste rates. We then used these data to estimate the total carbon footprints for the case meal services. From the food procurement data, we found that the average meal in LOC case is comprised of 44% fruit and vegetables, 33% ambient foods, 14% meat, 3% processed meats, 5% dairy and 0.3% ready-made foods. Total food procured per meal is 358 g. The average meal in LOW case has an almost identical proportion of fruit and vegetables (45%), but smaller proportions of ambient foods (25%) and larger proportions of meat (17%) and dairy (9%), and ten times as much ready-made foods (3%). A slightly larger weight of food (388 g) is procured per meal in LOW case. We calculated that the total km travelled annually by first tier suppliers in LOC case (c.42,900 km) were smaller than in LOW case (c.71,900 km). The total numbers of deliveries annually to all LOC and LOW case schools were almost identical, so the smaller annual transport distance in LOC schools is essentially because of the smaller geographical distances between LOC suppliers and schools. However, one LOC school used a supplier for bread and pastries located 91 km from the school, and this resulted in an impressive annual delivery round of over 31000 km to deliver bread and pastries. Without this supplier, the annual total km travelled by first tier suppliers to LOC schools was only c. 11700 km. In terms of plate waste, we found that the quantities in LOC case (8226 kg total, 88.6 g per average meal and around 22% of served portions) were smaller than in LOW case 15536 kg total, 109.5 g per average meal and around 33% of served portions. Regarding carbon footprint, we found that the total emissions of the meals service in LOC case (4 schools combined) were 94543 kgCO_2eq (including transport and waste emissions), equivalent to 1.03 kgCO_2eq per average meal, or 2.89 kgCO_2eq per kg of meal. In LOW case, total emissions by purchase quantities and per meal were larger (207401 kgCO_2eq and 1.35 kgCO_2eq, respectively), as were emissions per kg (3.48 kgCO_2eq). The main explanation lies in the differences in average meal composition between the cases, in particular, the smaller proportion of meat in LOC average meal. Also, it is interesting to note the higher transportation emissions in LOW case. We explored 10 management scenarios to reduce carbon footprint and found that the management scenario with the single greatest effect in reducing emissions was double reducing beef consumption in total meat and fish and replacing it with 60% chicken. Replacing the beef in a beef-based meal once a week with an equal weight of haricot beans had a similar effect on a yearly basis, though replacing other meats (pork or chicken) instead of beef would have a much smaller impact. Replacing biscuits, cakes and sweets, with fruit available locally-grown for most of the school year, would have a small impact on CO_2 emissions (around only 1-2%) but would improve the nutritional content of school lunches.

Although reductions in CO_2 emissions could clearly be achieved by introducing meat-free menus on a regular basis, new Ministry regulations require schools to include meat in lunches every day. Thus, targeting reduction in the quantities used each meal, and replacing beef with chicken where possible is a better strategy. Note that, according to the procurement and menu data available, schools already differ by more than 20% in their food production/processing CO_2 emissions. Transport and delivery frequency scenarios should be largely additive and could reduce CO_2 emissions in total by around 10.6%, though schools would be unable to influence these scenarios, being required to accept the lowest economic bid in procurements, which could come from a local or a distant food supplier. Schools also have little opportunity to change their current food waste disposal methods, and in any case the introduction of the most environmentally-friendly option of anaerobic digestion would reduce overall CO_2 emissions by only 2%.

To analyse the economic impacts of LOC and LOW procurement models, we calculated the local economic multiplier effects of the supply chains for both LOC and LOW model schools, using LM3 methodology. We found the LM3 indicator for LOC case schools, in aggregate, was 2.46. This means that for every €1 spent from the initial budgets of the schools, an additional €1.46 is contributed to the local areas. The LM3 indicator for LOW case schools, in aggregate, was 2.12. this means that for every €1 spent from the initial budgets of the schools, an additional €1.12 is contributed to the local areas. The LM3 indicators in both models are quite high considering the food sector context. The main driver may be the high proportion of employee costs from local area and the presence of a propotion of local suppliers, even in LOW case. The higher value of LM3 indicator in LOC model, when compared to LOW model, is the result of higher share of local suppliers in total suppliers. However, this is not only seen in the number of suppliers but also in the higher proportion of budget (in absolute terms) spent on local suppliers in LOC versus the LOW model. LM3 indicator variance between local and non-local suppliers is significant and amounts to 1.31 (under local suppliers it is 2.65 while under non-local suppliers its value is 1.33). The observed difference in LM3 indicator between local and non-local suppliers, under both models, supports the idea of intensifying the use of local suppliers in order to generate higher value for the local economy.

We also measured the economic value, to suppliers, for their involvement in LOC and LOW models. The only significant difference, in which schools from LOC model have an edge over schools from LOW model, is the size of the suppliers. Companies, which supply schools from LOC model, are categorized as micro or small companies. This enables schools to develop closer cooperation with suppliers and establish higher level of flexibility in terms of the entire supply process.

To analyse the social impacts of the LOW and LOW procurement models, we explored employment-related impacts and working enviroment/connectedness in both LOC and LOW model schools. We found that suppliers who work in LOC model are dominantly trade companies, while the ones which are involved in LOW model are usually production companies. All of them employ local citizens, whereas production companies tend to employ less educated staff. Furthermore, production companies are usually organized as the enterpreneurs, while trade companies are mostly limited liability companies or corporations.

All respondents in both models state that they have a good cooperation, based on the long-term collaboration and mutual trust. In the LOC procurument system, trade companies compete not only for schools as customers, but also for local producers, as their suppliers. This may sometimes lead to unfair business practices and to lower level of trust among partners of supply chain compared to the LOW model. Furthermore, it is observed that in small companies (dominantly present in LOW model), all employees are involved in the tendering procedure, while the owner/general manager is in charge of this process. Even though that school procurement does not make the majority of their revenues, but usually smaller than a half of the income, it is clear that they value this partnership highly.

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List of Abbreviations and Acronyms

LOC – LOCAL MODEL OF PROCURUMENT

LOW – LOWEST PRICE MODEL OF PROCURUMENT

RSD – SERBIAN NATIONAL CURRENCY – DINAR

EUR – EURO

PS – PRIMARY SCHOOL

F&V – FRUIT AND VEGETABLES

1. INTRODUCTION & METHODS

This report presents the WP6.3 research into the environmental, economic and social impacts of two models of primary school meals procurement in Serbia. Individual schools are normally responsible for contracting and managing their own food supplies/meals, and are obliged to accept lowest cost tenders. However, there is some variation in the geographical distances between schools and the first tier suppliers they contract with, which may affect sustainability outcomes. Therefore, the first procurement model we define is a local (LOC) model, in which more than 70% of food is procured from suppliers less than 15 km distance from the school (in reality over 94% of food contract value). The second procurement model is a low-cost (LOW) model, in which at least 30% of food (by value) is procured from suppliers at least 15 km distance from the schools. In practice, the procurement decisions of schools take place in a fluid manner on an annual basis, which meals the stability of models over time is weak, as suppliers frequently change from one year to the next, and can sometimes change during a year if a school is unhappy with a supplier. Therefore, schools selected to represent LOC and LOW models for the school year 2017-2018 may not be in those categories for the 2018-2019 school year. For the purposes of this study, both LOC and LOW models were defined according to the suppliers contracted at the time data collection began, early during the 2017-18 school year.

Specifically, the dataset for LOC case comprised the supply chains to four primary schools: two in Belgrade ("Dositej Obradović" and "Ljuba Nenadović") and two in Novi Sad ("Miloš Crnjanski" and "Djordje Natošević"). Each of these schools had more than 70% of food from its first tier suppliers located less than 15 km distance from its site. Meanwhile, the dataset for LOW case comprised the supply chains of four primary schools, three in Belgrade ("Pavle Savić", "Drinka Pavlović"and "Gavrilo Princip") and one in Novi Sad ("Kosta Trifković".). Each of these schools in LOW case had at least 30% of food from first tier suppliers located at least 15 km distance from the school site.

Public authorities in Serbia do not regulate the selection of procedures and vendors in the meals procurement process for primary schools (7- to 14-year-olds). Schools may use either their own kitchens and cooks to provide meals (*ca* 25% of PS), or they may use external caterers to provide ready meals (*ca* 75% of PS). Schools may provide up to four meals per day: breakfast, morning snack, lunch, afternoon snack, with one or more schools providing nearly every permutation of those four meals! Only *ca* 36% of PS provide lunch, and only *ca* 15% of PS provide lunch using their own kitchen staff.

The food procurement process is not centralized, which makes schools responsible for their own meal procurement. The current legal provisions define lowest economic price as the selection criterion in procurement decision making.

Our selection of schools was determined by a number of factors. For our activities in WP9.1.1 we are focusing exclusively on schools that make their own meals, and those schools that provide lunches, or at least a cooked breakfast. This reduced our choice of schools for WP6.3 to only those schools that provide lunches in their own kitchens. We also were faced with interviewing a large number of suppliers, because of the frequency of schools with multiple lots, and many of the suppliers approached were not willing to provide information needed for the environmental, economic and social analyses. Some schools with multiple suppliers were reluctant to give us access to the hundreds of suppliers' delivery notes, which we needed to undertake the carbon footprint analysis. In consequence, the selection of the eight schools listed above was a compromise between using easily-accessible schools fitting the LOC and LOW model criteria, making their own lunches, and those schools that could give us sufficent delivery notes for their suppliers, who would also agree to provide information for the analyses.

As indicated above, all eight schools that represent LOW and LOC models are located in the cities of either Belgrade or Novi Sad. Belgrade is the capital of Serbia with the largest number of primary schools distributed across Belgrade's 17 municipalities and, according to the Statistical Office of the Republic of Serbia data, approximately 120000 children attend primary schools in Belgrade. Novi Sad is the largest city in the Vojvodina province and the second largest city in Serbia. Twenty-two schools are located in Novi Sad and 15 more schools are located in the peri-urban area, which makes it second to Belgrade for the number of primary schools. Only seven schools in Belgrade provide their own meals, the others using caterers. In contrast, the reverse is true in Novi Sad, with only one of its schools known to use an external caterer.

To achieve the research goals we combined quantitative and qualitative methods and collected data from primary as well as from secondary sources. As secondary sources we used schools' and their suppliers' websites; available financial statements; current legal provisions pertaining to this area; tender documentation and related materials available on the Public procurement portal, as well as on websites of specific schools. Field data collection involved face to face and telephone interviews with suppliers and school officials. These interviews provided the main sources of information about economic and social impacts of the school meals chains, as well as food delivery information, menu normatives and meal numbers for their environmental impact analyses. The interviews also provided us with a deeper understanding of the relationships between parties in the chains and how these systems generally work. In addition to directors, as the highest officials in schools and companies, relevant information was collected from other employees. Thus, for example, a great deal of relevant information was obtained from kitchen employees, especially information pertaining to food preparation, its quality, lunch break organization and children's satisfaction with meals. Similarly, important data concerning the procurement process, procurement time schedule, tender documents, frequent difficulties in the procurement process, and food delivery records, etc. were obtained from school secretaries and the accounting department. We used a questionnaire, together with interviews for collecting data relevant for the research. We also conducted a survey among relevant supply chain parties to standardize data related to environmental, economic and social analysis aspects and to evaluate their personal satisfaction, as well. Data for the economic and social analyses were collected from February 2017 to October 2018, and data for the environmental analyses were collected throughout the 2017-2018 school year from school visits.

The following tables provide a summary overview of all interviews conducted with key supply chain parties; more specifically school officials and their suppliers, for LOC and LOW models separately. School visits to collect environmental data combined information gathering for both WP6 and WP9 activities, so were typically around 1 h per occasion, varying from only 15 min (to collect photocopied delivery notes, for example) up to 2 h for detailed discussion with school director, administrative staff and kitchen staff. These visits, carried out by EUTA researchers, are only to a minor extent listed in Tables 1 and 2.

Table 1: Profile of interviewees in LOC model chains

Identity	Interview Date & Duration
"Avala Merkur" – company director	14.12.2017 duration of interview 1 h 30 min
"Avala Merkur" – company director (telephone interview)	We carried out three to four interviews during December 2017 and March 2018. Total duration of interviews was 1 h
"Market Padina" – assistant director	6.12.2017 duration of interview 1 h 15 min
Univerexport	4.7.2018, 19.9.2018, 16.10.2018 interviews carried out by EUTA during visits to schools in Novi Sad (1 h, 2 h, 30 min, respectively)
PS "Dositej Obradović" (two cooks, school secretary, school principal, school accountant)	Interviewing week (11-15.12.2017) (duration of the interviews with school officials was: 2 h, 15 min, 15 min, 40 min, respectively)
PS "Ljuba Nenadović" (two cooks, school principal)	Interviewing week (11-15.12.2017) (duration of interviews with school officials was: 2 h, 30 min, respectively)
PS "Miloš Crnjanski"	Schools in Novi Sad visited by EUTA as part of WP9 activities
PS "Đorđe Natošević"	Schools in Novi Sad visited by EUTA as part of WP9 activities

Table 2: Profile of interviewees in LOW model chains

Identity	Interview Date & Duration
"Zorić Temerin" – company director	14.12.2017 duration of interview 1 h 30 min
"Zorić Temerin" – company director (telephone interview)	We carried out two interviews, one in December 2017 and one in June 2018. Total duration of interviews was 50 min.
"Avala Merkur" – company director	14.12.2017 duration of interview 1 h 30 min
"Avala Merkur" – company director (telephone interview)	We carried out three to four interviews during December 2017 and March 2018. Total duration of interviews was 1 h
"Mlekobel" – company director	8.12.2017 interview lasted 2 h
"Mlekobel" – assistant director (telephone interview)	We carried out two telephone interviews during December 2017, total duration was 20 min
"Komercservis-produkt" assistant director (telephone interview)	30.11.2017 duration of interview 1 h
"Komercservis-produkt" assistant director and company director (telephone interview)	An interview with assistant director was carried out during December 2017, lasting 20 min; An interview with company director was carried out during July 2018, lasting 20 min

PS “Pavle Savić” (two cooks, school secretary, school accountant)	Interviewing week 04-08.12.2017 (Duration of the interviews with school officials was: 2 h, 30 min, 15 min, 20 min, respectively). Additionally, to collect further data we exchanged several emails with survey participants.
PS “Gavrilo Princip” (One cook and two kitchen assistants, school principal)	Interviewing week 18-22.12.2017 (Duration of interviews with school officials was: 4 h, 1 h, respectively).
PS “Drinka Pavlović”	School visited by EUTA as part of WP9 activities
PS “Kosta Trifković”	Schools in Novi Sad visited by EUTA as part of WP9 activities

2. SCHOOL MEALS CONTEXT IN SERBIA

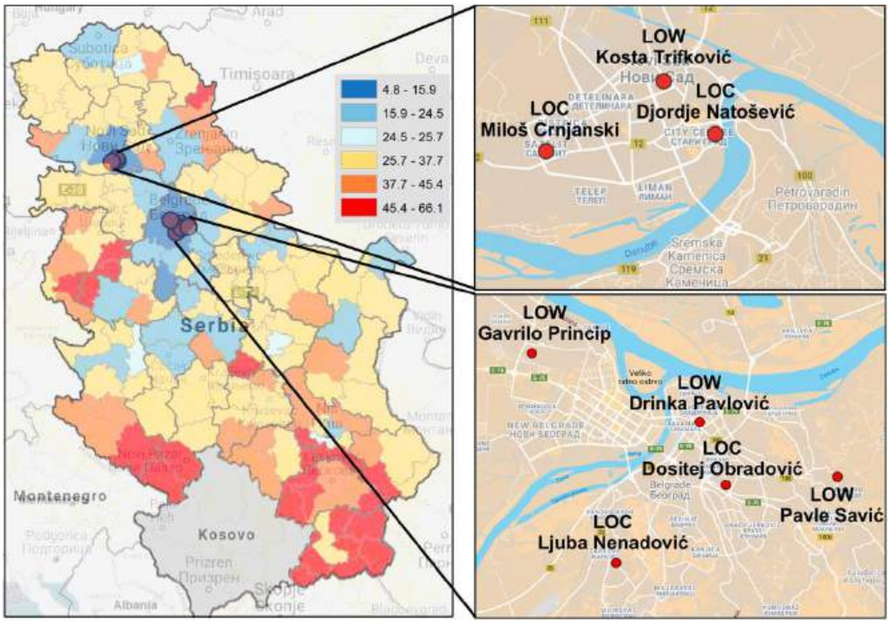
2.1. Profile of Belgrade and Novi Sad

Serbia is in Central and Southeast Europe, bordering the EU countries Croatia, Hungary, Romania and Bulgaria, with a population of about 7.2 million. The territorial organisation of Serbia includes five regions (Belgrade region, Vojvodina region, Šumadija and western Serbia region, eastern and southern Serbia region and Kosovo-Metohija region). The City of Belgrade is included as a separate territorial unit established by the Constitution and law. Serbia has 30 administrative areas, 24 cities, 30 urban municipalities, 150 municipalities, 6,158 villages and 193 urban settlements (Serbian Government). The research was conducted in two areas in Serbia, in the municipalities located in the Northern and Central parts of Serbia.

Belgrade

Belgrade is the capital and largest city of Serbia. Belgrade region, as a whole, covers 3234 km² and consists of 157 settlements. The population of Belgrade region amounts was 1,683,962 at the 2011 census (Statistical Office of the Republic of Serbia, 2011), giving 521 inhabitants/km² in 2016. The urban area of the City of Belgrade has a population of 1.23 million.

Figure 1: The location of LOC and LOW schools in Belgrade (lower image) and Novi Sad (upper image), in relation to levels of poverty around Serbia.



The level of development of the local economy is rated as Group 1 (the highest), which indicates a higher degree of development than the Serbian average. Participation of the active population in the total population is approximately 45%. Within the active population, 85% are employees, 11% are those who are currently unemployed, but were previously employed and 4% are those are currently unemployed and they never had a job previously. The relative levels of poverty around Serbia are shown in Figure 1. Blue shaded areas indicate low poverty and red indicates high poverty. Clearly Belgrade and Novi Sad have poverty levels much below the Serbian average.

There are 17 municipalities in the Belgrade region, with around 130 primary schools in Belgrade and Zemun urban centres, while only some of them have been included in this research. Participation of the active population in the total population in Belgrade region is approximately 43%. Only 5% of people in the Belgrade region are without primary education, which is less than half the national average (13.7%). On the other hand, in the Belgrade region more than a quarter of citizens (27.8%) have college or university degrees, which is much higher than the national average of 16.2%, according to the Census in 2011.

Novi Sad

Novi Sad is a municipality in the Vojvodina province. It was formed on June 14, 2002. The total area amounts to 610 km². The total population in this area amounted to 319,484 on 30th of June, 2016. Vojvodina region, as a whole, covers a surface area of 21,614 km², consisting of 467 settlements. The population of Vojvodina region was 1,881,357 in June 2016. The average number of inhabitants/km² in Vojvodina region was 87 in 2016. As an autonomous province, Vojvodina has its own revenue sources and is able to provide additional services and support compared with the rest of Serbia (including Belgrade). Thus Novi Sad city provides a service to schools to have the nutritional and microbiological quality of their primary school meals analysed by the Vojvodina Institute of Public Health. This used to happen elsewhere in Serbia, but no longer.

Figure 2: Vojvodina autonomous province and Novi Sad municipality

Gender distribution shows 52.8% of females and 47.2% of males. The age distribution is 70.8% of the population being 15-65 years old, of which around 24% is 20-34 years old, approximately 14% is 55-64 years old, and about 14% is 65 or older. The average age in Novi

Sad is 39.8 years. Approximately 53% of the Novi Sad population has completed secondary school education, with a further *ca* 21% of the population going on to complete a university degree. Only around 13% of the population stopped at the end of primary education.

There are 37 primary schools in Novi Sad, which distinguishes this municipality as one of the largest in Serbia according to the number of elementary schools. In total, 22 of these schools are on the territory of the City of Novi Sad, while the other schools are situated in the suburbs and villages in Novi Sad region: Bukovac, Stepanovićevo, Futog, Budisava, Petrovaradin, Sremska Kamenica, Kovilj, Kisač, Veternik, Rumenka, Begeč, Šangaj and Kać.

Participation of the active population (employees, self-employed and unemployed) in the total population is approximately 45%. Within the active population, 80.1% are employees, 14.6% are those who are currently unemployed, but were previously employed and 5.3% are those who are currently unemployed and they never had a job previously. Participation of the active population in the total population in the Vojvodina region is around 41%. The percentage of employees in the total active population (77.3%) is higher in Novi Sad than in Vojvodina region.

The inactive population in Novi Sad makes up 54.6% of the total population, comprising 37.3% pensioners, 27.7% children under the age of 15, and 18.1% students. The population structure according to branch of industry shows the highest percentage of employees to be in the sector of wholesale and retail (18.6%), 11.5% of employees works in the field of manufacturing industry and 8.5% of employees works in the field of health and social protection.

2.2. Organisation of school meals in Serbia

There are approximately 1200 state primary schools, many of which include a number of satellite schools (Ministry of Education). Around 29% of primary schools prepare meals within their own premises, though only 15% of schools make their own lunches. A third of primary schools provide no meal of any sort, and the remaining schools use an external caterer of some sort - usually a local bakery, but sometimes a local kindergarten (Strength2Food survey). Although only a few primary schools have HACCP certification, this is not a legal requirement for schools to provide their own meals to children. Meals that are offered are either a snack or breakfast or lunch or various combinations of those three meals. The average price of the school lunch for parents is around 143 RSD (€1.19, range €0.33-2.08) (Strength2Food survey). Lunches in Belgrade and Novi Sad average around 173 RSD (€1.45) and 74 RSD (€0.62), respectively. Novi Sad restricts the price schools can charge to parents to only 2660 RSD (€22.2) per month for breakfast, snack and lunch combined, so the lunch cost is based on directors' estimates of the proportion spent on lunches. This figure has not changed for 12 years and is a sore point with school directors who complain that this amount does not cover the cost of buying the food.

Caterers usually provide 1-2 free meals per certain number of meals (a typical procurement selection criterion). Therefore children from the most economically vulnerable families, by the decision of the school director, usually get either free or half-price meals. In 2011, the Ministry of Education introduced the initiative that schools and local governments, at the level of municipalities, should provide one free meal a day for pupils in primary schools, so as to ensure that each child aged 7-14 has at least one meal a day. However, the municipalities allegedly due to the lack of finances, refused to participate in this programme. The same initiative was introduced at the level of the capital city – Belgrade in 2013, but this also has not been launched in practice.

Clear budgetary allocations for food are missing, although the Law on Primary Education from 2013 recommends all schools to organize the provision of meals, while there are no specific policies dealing strictly with the issue of school meals provision. Thus, apart from control of meal prices by Novi Sad municipality, individual school directors may charge whatever figure they decide for meal prices, provided this is approved by the school's parents council, though Ministry regulations state that the amount charged to parents should be only sufficient to cover either the cost of the meal ingredients (no kitchen staff or other running costs may be charged to parents), or the cost of food provided by a caterer. In reality most schools do not know how much it costs to prepare each meal. Analysis of menu normatives by EUTA shows that some schools charge too much to parents, though other schools are sometimes having to subsidise the cost of meal ingredients, especially in Novi Sad. One of the Belgrade schools in our survey has recently lowered the price it charges to parents for its lunches (2018-2019 school year) as a result of Strength2Food raising the issue of overcharging for ingredient costs with the school. This school has since closed its kitchen and is using a caterer!

Until September, 2018 meal provision in primary schools was regulated only by the general policies governing the area of public procurement and food safety (Law on food safety, Law on public procurement, Law on Public Health, Law on Health Care, Law on Sanitary Surveillance). They mainly pertain to:

- requirements of sanitary regulation of food procurement and transportation,
- obtaining the needed quality standards (for example, HACCP),
- the administrative procedure while applying for publicly declared tenders, etc.

There are strategic documents which refer to this, created and adopted by the Ministry of Health, and Ministry of Youth and Sports and Ministry of Social Affairs. The related strategies are: Strategy of Youth Health and Development, Poverty Reduction Strategy and Strategy on Health Care. The scope of work of the Ministry of Health is dominantly focused on the provision of information on illnesses incurred by the incorrect diet, while they do not act in a preventive manner.

Specific programmes and policies: Regulation on National programme on health care for women, children and youth; Rulebook of standards on school space, equipment and teaching aids for primary schools; Plan of action for the environment and health of children in the Republic of Serbia for the period 2009-2019; "Joint programme for the inclusion of Roma and marginalized children in education " (Serbian Red Cross); "Healthy growth" (Institute for public health "Batut"). The roles of the parties in meal provision are not clearly defined and no institution takes responsibility for the resolution of any issues or problems that occur.

In September 2018, the Ministry of Education, Science and Technological Development introduced its first regulations specifically targeting meal provision in primary schools ("On Miscellaneous Conditions for Organising, Exercising and Monitoring the Nutrition of Pupils in the Primary School"). This was accompanied by Guidelines and Recommendations on

Organising, Exercising and Monitoring the Nutrition of Pupils in the Primary School, together with nutritional advice on the preparation of school meals, and foods to avoid. Strength2Food staff gave advice to the Ministry during the preparation of this Regulation.

Unfortunately, shortly before this Regulation was introduced, the Ministry also introduced revised regulations governing the funding of personnel in schools (July, 2018), and these new regulations made it more difficult for school directors to employ staff to work in their kitchens to prepare and serve school meals. In consequence, two of our Serbian Strength2Food schools seriously considered giving up their own meals provision and using a caterer, despite the health risks associated with transport of ready-prepared meals to schools (the cause of a recent outbreak of food poisoning in several Belgrade primary schools), and Strength2Food evidence that the nutritional quality of meals provided by caterers in Serbian schools, particularly breakfasts and snacks, is on average lower than that of school-prepared meals. As stated above, one of those two schools has now closed its kitchen and is using a caterer for its lunches (2018-2019 school year).

2.3. The school meals procurement and supply chain for Serbian primary schools

Because there is no centralised food procurement provided for primary schools, the complexities and challenges of food procurement are therefore faced and replicated by every school having to use procedures described by Procurement Law (annual total food value over 500000 RSD, *ca* €4200). Bulk purchasing of foods by several schools does not occur, and schools can vary the numbers of lots from one (a single supplier for all foods) to at least nine (potentially nine different suppliers bidding for foods worth maybe no more than €250).

The most frequent complaints of schools about the public sector procurement procedures are for organising school meals and children's excursions. In consequence, to minimise the administrative load for food procurements, documentation is usually "copy-pasted" from previous years' documentation, and the most frequent number of lots used by schools for food procurement is one. This means, around a quarter of all schools buying food for their own meals use general food distributors to deliver everything, considerably reducing the school's administrative load.

Further, because schools usually do their procurements independently of other schools, the type of procurement option, food quality criteria and bid eligibility criteria differ from one school to the next. Only a few schools use the services of an agency to organise their procurements, for which schools have to pay out of their own budget. Those schools are usually in Belgrade.

In a majority of schools, the tendering procedure is organized either in March and April or in June and July. The main and only authority in the process of tendering and awarding school meal contracts is the Parents Council, which exists in every primary school in Serbia. This council makes the recommendation on who shall be the school food caterer, if this option is chosen. The detailed explanation of the stages, participants and roles in the tendering procedure is provided in the Annex No. 1. Every school has the obligation to announce a public procurement call, and consequently inform all the interested companies to submit their offers.

Once the process of application is over, the Parents Council reviews the offers received and recommends the most favourable one (the one with the lowest price, and acceptable quality).

Although schools may divide food procurement into more than one lot, for example according to fruit and vegetables, meat, dairy, frozen food and other foods, typically general food distributors will bid for and win several lots. Food suppliers can vary from small companies, with a local catchment area (such as Market Padina doo used by primary school Ljuba Nenadović in Belgrade, other bidders are major national food suppliers with millions of Euros annual turnover, such as Univerexport, based in Novi Sad and supplying foods to Drinka Pavlović, Belgrade and Djordje Natosević, Novi Sad during 2017-2018.

Suppliers can often be changed by the school during a school year, if the school is not happy with the quality of food being delivered, or the timing of food delivery. Because school contracts are generally of relatively small value for many companies, primary schools are often given a low priority when it comes to scheduling delivery times, so food is delivered too late to prepare lunch, for example. To win contracts, bidders will sometimes ignore food quality criteria to put in a low bid (a particular problem with meat, which may be delivered with too high a fat content, or looking watery, as though it has not been kept properly frozen). For this reason, many schools will have preferred companies that they are happy to award contracts to and others that they will reject because of previous bad experiences.

3. CASE 1 - LOC MODEL PRIMARY SCHOOLS IN SERBIA

The four schools selected to represent the LOC model are divided between Belgrade (two schools) and Novi Sad (two schools). Table 3 summarises the pupil roll and meal uptake in the four LOC and four LOW schools.

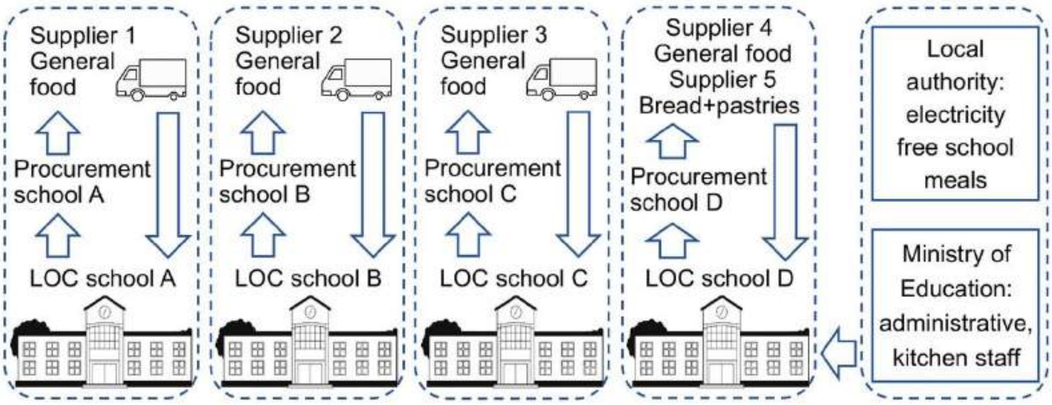
Table 3: Pupil roll and meal uptake in Serbian LOC and LOW model schools*

LOC schools	Pupil roll[a]	Daily average lunches	Daily average lunch uptake (%)[b]	Number of suppliers
Dositej Obradović	471	80	68	1
Ljuba Nenadović	1204	70	23	2
Miloš Crnjanski	1096	155	57	1
Djordje Natošević	957	174	73	2
LOW schools				
Pavle Savić	1730	83	19	3
Drinka Pavlović	914	375	164[c]	6
Gavrilo Princip	838	150	72	5
Kosta Trifković	1221	246	81	4

* Note that Ministry regulations require primary schools providing all-day stay ("boravak") to offer meals to only years 1 and 2, so nearly all children having lunches will be in years 1 and 2 (a quarter of the pupil roll).

[a] data for 2016-2017 school year.
[b] Lunch uptake % based on years 1 and 2 only.
[c] Many children from other years also have lunches.

Figure 3: Organisation of the LOC primary school meals supply chain



The organisation of the LOC model meal supply chain for our four LOC schools is shown in Figure 3. As explained above, primary schools in Serbia are responsible for their own food procurements and selection of food suppliers. The Ministry of Education, Science and Technological Development is responsible for salaries for all school staff, including kitchen staff. The local authority (municipality) is responsible for heating and power supplies to schools (which do not have separate meters for their kitchens), and also pays schools for the children given free school meals. In theory, the Ministry expects local authorities also to carry the cost of school meal schemes introduced by the Ministry (see section 2.2), but in practice this rarely happens because municipalities always claim they have no money. A few schools use the services of agencies for their procurements (for example, Drinka Pavlović, Pavle Savić). Parents are required to pay only for the cost of food purchased, though any surplus at the end of the school year is used by schools for small investments in their kitchen facilities, such as minor items of equipment.

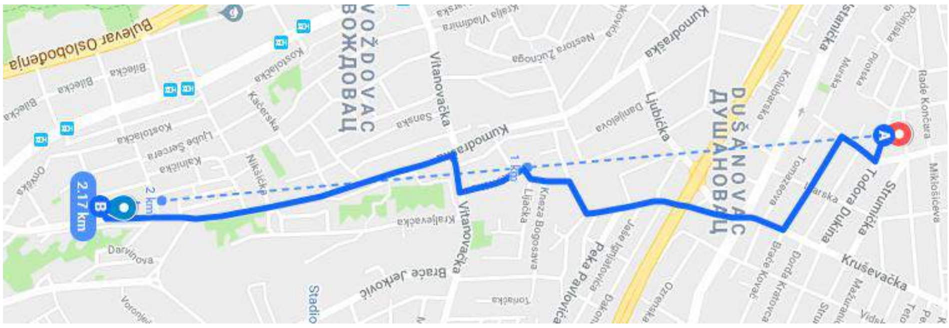
3.1. Dositej Obradović supply chain and meals service

PS “Dositej Obradović” was formed in 2002 by the merger of two other schools. It is located in Voždovac municipality, about 4 km from the centre of Belgrade. Average net salary of the municipality was RSD 50,203 in October 2017 (418 EUR per month). On the basis of income and investment information, this is a relatively well-developed municipality. At 8.6%, it has the seventh-lowest level of poverty amongst Serbia's 168 municipalities.

The number of children in all eight grades is 471. The total number of meals prepared in this kitchen per day is 135, of which around 80 are lunches, and around 45 are snacks. Around 10 children also have their breakfast in school. The school uses its own kitchen facilities and its kitchen staff (two full time employees) for preparing all meals. Meal prices are 70 RSD (approximately 0.58 EUR) for breakfast and snack and 200 RSD (approximately 1.67 EUR) for lunch.

Persons responsible for conducting the procurement tender process are the school secretary and the school principal. After potential suppliers have submitted their offers, a food procurement committee of three people examines the offers and makes a decision to choose the best offer. The Committee members in this school are: Director of accounting sector, one school kitchen employee and one school teacher. The entire process lasts 20 to 25 days.

Figure 4: Location of Dositej Obradović (LOC) and its supplier



Code	Supplier name	Location	Distance from school in km	Bid value without VAT (in EUR)
B	Avala merkur	Belgrade	3.6	16058.57

*Note: school is denoted by “A” and red pin, and the supplier is depicted as a blue pin.

The school usually divides its food procurement into 9 lots, though typically has a single supplier for all foods, which varies from year to year depending on the lowest bidder.

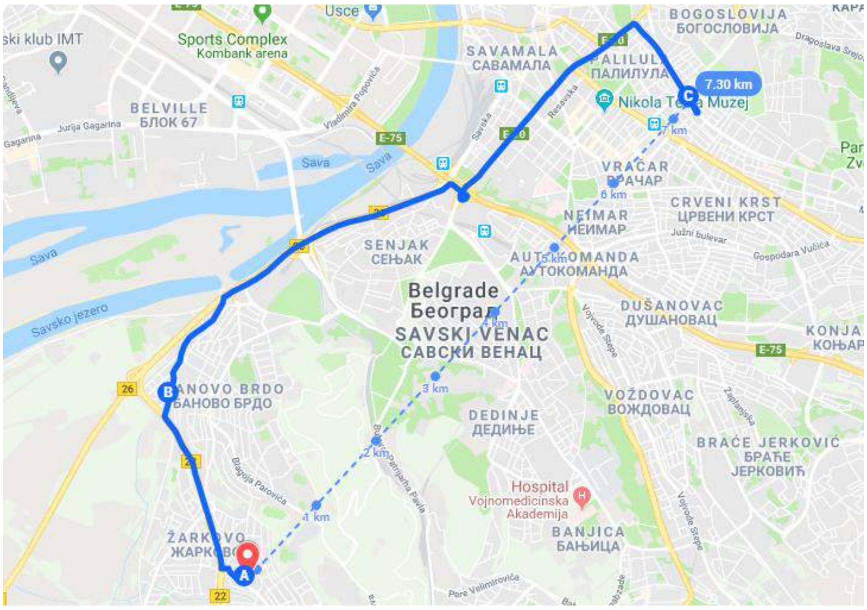
3.2. Ljuba Nenadović supply chain and meals service

Primary school “Ljuba Nenadović” is one of the oldest schools in Belgrade, founded in 1841. It is located in the Belgrade suburb Čukarica, about 8 km from the centre of Belgrade in an area which the school says is relatively deprived for Čukarica. The average net salary in Čukarica was RSD 45,867 in October 2017 (382 EUR), and the level of poverty in the municipality is around 8.3%, so relatively low.

The number of children in all eight years in this school is 1204, of which 48% attend the first four grades. The school provides extended stay for 289 first and second year students, to whom meals are offered, but not always taken up. These children are offered breakfast (when pupils attend regular afternoon classes); lunch and a snack (when pupils attend regular morning classes). [Note - many large schools in Serbia have a two-shift system, with children rotating each week between the early shift and the late shift.] The average number of lunches across the two shifts is 70 per day. Breakfast and snack are not mandatory meals and parents decide if they will prepay for these meals or not.

The school has its own kitchen facilities for preparing breakfast, snack and lunch each day. Two members of staff, one cook and one assistant, prepare the meals. Breakfast, morning snack and lunch prices are 60 RSD (€0.50), 30 RSD (€0.25) and 170 RSD (€1.42), respectively.

Figure 5: Location of Ljuba Nenadović (LOC) and its suppliers



Code	Supplier name	Location	Distance from school in km	Bid value without VAT (in EUR)
B	Market Padina	Belgrade	2.6	12849.00
C	Catering&Bake	Belgrade	11.4	557.17

*Note: school is denoted by “A” and red pin, and suppliers are depicted as blue pins B and C.

The school's procurement process lasts between 30 and 40 days. The school divides its food items into three lots: meat and processed meat, bread and pastries, fruit and vegetables and other foods. After the submission of offers, the three-member committee makes the best supplier choice in accordance with criteria prescribed by legal provisions. For the past three years the, main food supplier has been "Market Padina", a small local (nearly 3 km) food trader that also sells direct to the public. The other food supplier is a bakery (in 2017, located near the middle of Belgrade, see map, below). The school has had problems in recent years with lack of bidders, leading to a) having to re-apply the whole procurement procedure, and b) no meals for children for several weeks! Indeed, it has just carried out its food procurement procedure for the 2018-2019 school year making changes to the quantities and type of foods required, in some cases responding to advice from Strength2Food researchers, and the school had no bidders for any of the three lots in the procurement documentation.

3.3. Miloš Crnjanski supply chain and meals service

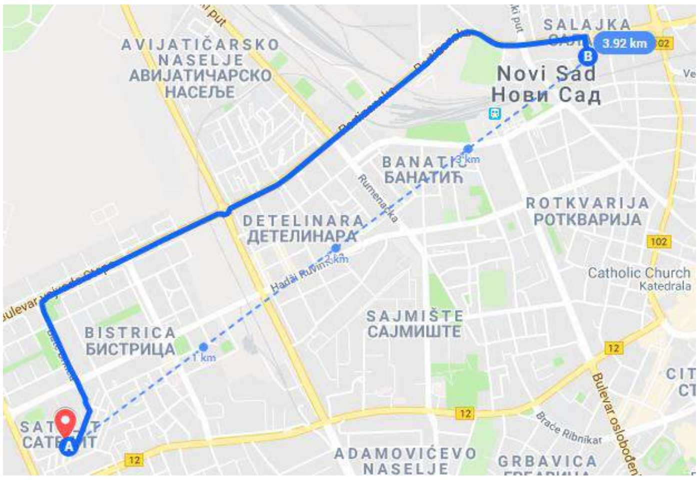
Primary school “Miloš Crnjanski” is located in Novi Sad and was founded in 1962. It is located on the western periphery of Novi Sad. The school roll is constantly increasing and the school is struggling to fit everyone in. A consequence is that space for children staying the whole day (who would normally be given lunch) is very cramped.

Overall 1096 children, from years 1 to 8, attend this school. The school organizes extended stay (whole-day teaching) for approximately 350 students of the first three years. The school has kitchen facilities, which prepare three school meals per day: breakfast, snack and lunch. Being in Novi Sad, the school is restricted to a monthly prepayment by parents for all three meals of 2660 RSD (€22.17). The kitchen's four members of staff prepare and serve approximately 150 breakfasts, 150 lunches and 350 snacks per day.

The food procurement procedure is as for other schools, is usually held at the end of the school year and lasts for about one month. The food Procurement Committee usually consists of the school secretary, accountant and a member of the teaching staff.

For many years, this school has had a cooperation with one supplier that fulfills all the requirements stated in the tender documentation. That company is ILLI Group from Novi Sad, which is located only 4.9 km away from this primary school. Although all foods were in a single lot for 2017-2018, during the previous three years, lot numbers have varied from one to seven. ILLI Group has always been a successful bidder in those years.

Figure 6: Location of Miloš Crnjanski (LOC) and its suppliers



Code	Supplier name	Location	Distance from school in km	Bid value without VAT (in EUR)
B	ILLI Group	Novi Sad	4.9	20970.96

*Note: school is denoted by "A" and red pin, and the supplier is depicted as a blue pin.

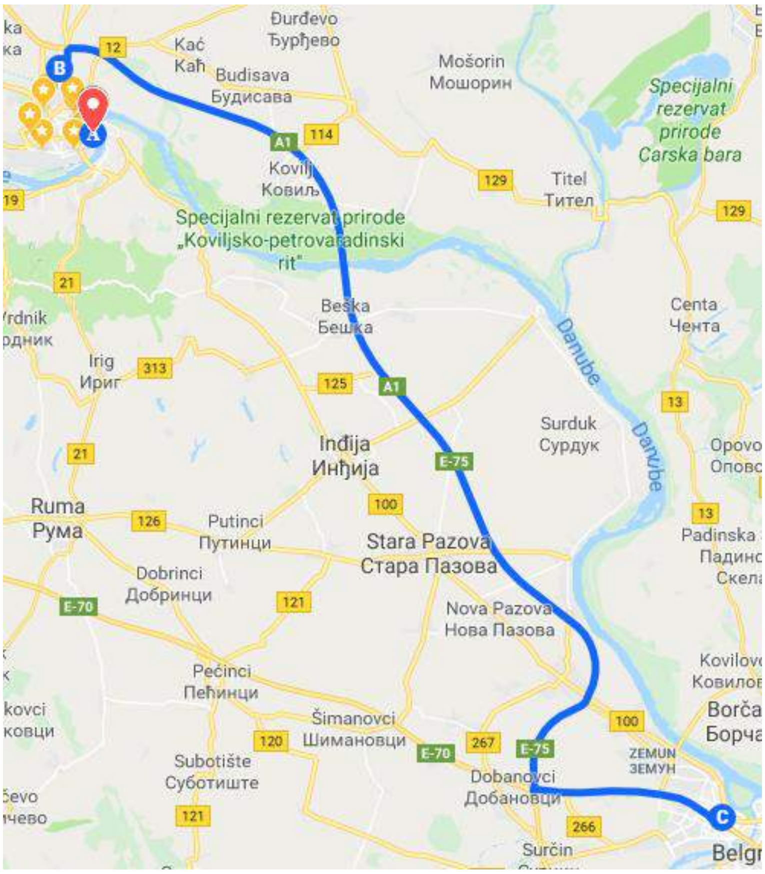
3.4. Djordje Natosević supply chain and meals service

Primary school "Đorđe Natošević" was founded in 1953 and is located close to the centre of Novi Sad. The school director is particularly keen on promoting a healthy lifestyle among his pupils. Thus it is one of the rare PS in Serbia buying some organic milk, but not a lot - because of the higher cost and monthly 2660 RSD ceiling for meals. The school emphasises the potential negative effects on health that fast food consumption can have.

The total school roll is 957, with extended stay provided for 400 pupils of the first four years. One breakfast, two snacks and one lunch are prepared on a daily basis (for which parents pay 2660 RSD per month), of which around 140 pupils from years 1 and 2, and around 35 pupils from years 3 and 4 have lunch. The total number of meals provided in the school was around 1000 per day. There are three kitchen staff members.

The tender procedure lasts something over a month, conducted by the school secretary. The Procurement Committee which evaluates bids consists of the school secretary (a lawyer) and two kitchen employees. The school has divided its foods into two lots (bakery products and other foods) for the last three years. During 2017/2018 the school had food contracts with two big suppliers: Univerexport from Novi Sad and Don Don bakery from New Belgrade.

Figure 7: Location of Djordje Natosević (LOC) and its suppliers



Code	Supplier name	Location	Distance from school in km	Bid value without VAT (in EUR)
B	Univerexport	Novi Sad	8.2	36415.78
C	Don-Don	Belgrade	83.8	2038.01

*Note: school is denoted by "A" and the red pin, and suppliers are depicted as blue pins. Although Don-Don is over 80 km from the school, its contract value is only 5% of the total food procurement value, so the school was classified as LOC.

4. CASE 2 - LOW MODEL PRIMARY SCHOOLS IN SERBIA

Organisation of the LOW model meal supply chain for our four LOW schools is essentially identical to that described for the LOC schools, shown in Figure 3, except that LOW schools have three or more suppliers instead of typically only one.

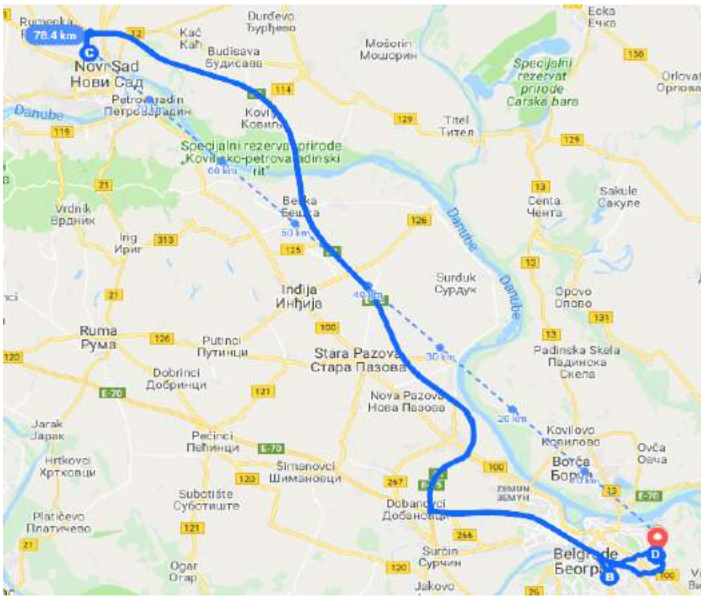
4.1. Pavle Savić supply chain and meals service

PS Pavle Savić is located in the municipality Zvezdara, one of Belgrade's residential suburbs on the periphery of the city, about 8 km from the city centre. Zvezdara is one of the most densely populated municipalities in Serbia, with both a positive birth rate and a positive migration rate. The average salary in Zvezdara is significantly higher than the national average and its poverty rate is low at only 8.3%.

With 1730 pupils, Pavle Savić is the largest school in Belgrade, yet provides only 83 lunches, on average per day. There are two members of kitchen staff. Lunch is the only meal provided at the school, for which parents pay 180 RSD (€1.50), a price recently reduced from 210 RSD, prompted by information on meal costs from the Strength2Food project. The school's food procurement procedure, usually with four lots, lasts about a month, though Pavle Savić suffers from frequent problems of lack of bidders. Therefore, procurements for some lots often have to be repeated. This leads to regular interruptions in meal provision, a source of particular frustration for the school and parents. This school rents out part of its dining space to a local bakery, which provides bread for the school lunches.

This school was already very worried about being able to keep its kitchen open because of the difficulty of providing adequate staffing, resulting in a very large workload for existing kitchen staff. This pressure on staff was compounded in July, 2018 when new Ministry regulations were introduced, restricting further the number of non-teaching staff. In consequence, after the end of the 2017-2018 school year, the school cook decided to retire, and the school has now closed its kitchen and is using a caterer to supply lunches.

Figure 8: Location of Pavle Savić (LOW) and its suppliers



Code	Supplier name	Location	Distance from school in km	Bid value without VAT (in EUR)
B	Avala merkur	Belgrade	4	6681.73
C	Big trade	Novi Sad	102	3030.92
D	Pekara Ivanović	Belgrade	0	424.24

*Note: school is denoted by the red pin, and suppliers are depicted as blue pins

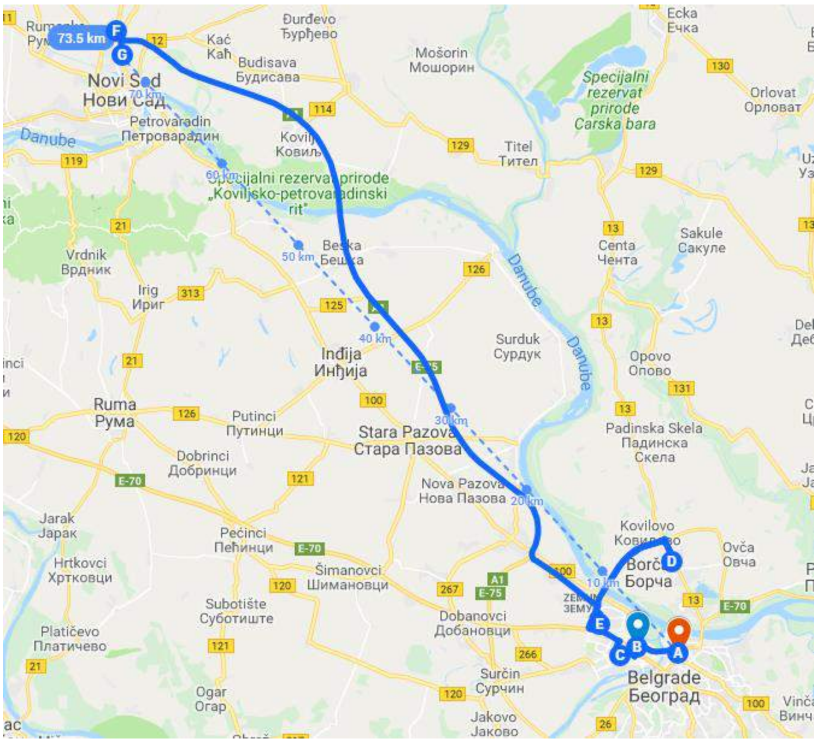
4.2. Drinka Pavlović supply chain and meals service

Drinka Pavlović is located in central Belgrade, municipality Stari Grad. The population here is well-educated, with around 40% of adults having a university degree. The employment level (82%) is much higher than in Belgrade region (43%). According to both the average income and education level, Stari Grad is in the top 5 municipalities in Serbia, so the municipality has almost the lowest poverty level in Serbia (5.4%). Therefore, the socio-economic profile of Drinka Pavlović pupils is much higher than the national average.

The school has 914 pupils in the school, divided into two shifts. The school organizes extended stay for children for years 1 to 4, so provides lunches for a relatively large proportion of its children. Around 375 lunches and 450 snacks are provided, giving 825 meals daily. There are five members of kitchen staff. The school charges 80 RSD for a snack and 140 RSD for lunch (€0.67 and €1.17, respectively).

The school's food procurement procedure lasts for several months (January to March in 2017). This is partly because of the larger than average number of lots (seven), and occasionally a lot may not receive any bids. Thus, the school has more suppliers than any other school in our survey, two of which come from Novi Sad (Figure 9).

Figure 9: Location of Drinka Pavlović (LOW) and its suppliers



Code	Supplier name	Location	Distance from school in km	Bid value without VAT (in EUR)
B	Don-Don	Novi Beograd	5	1264.08
C	Domaća Trgovina	Belgrade	8	5871.13
D	Frikom	Beograd	6	3719.88
E	Mleko Promet	Zemun	12	6014.00
F	Univerexport	Novi Sad	93	20691.37

G	Big Trade	Novi Sad	93	23186.67

*Note: school is denoted by “A” and the red pin, and suppliers are depicted as blue pins

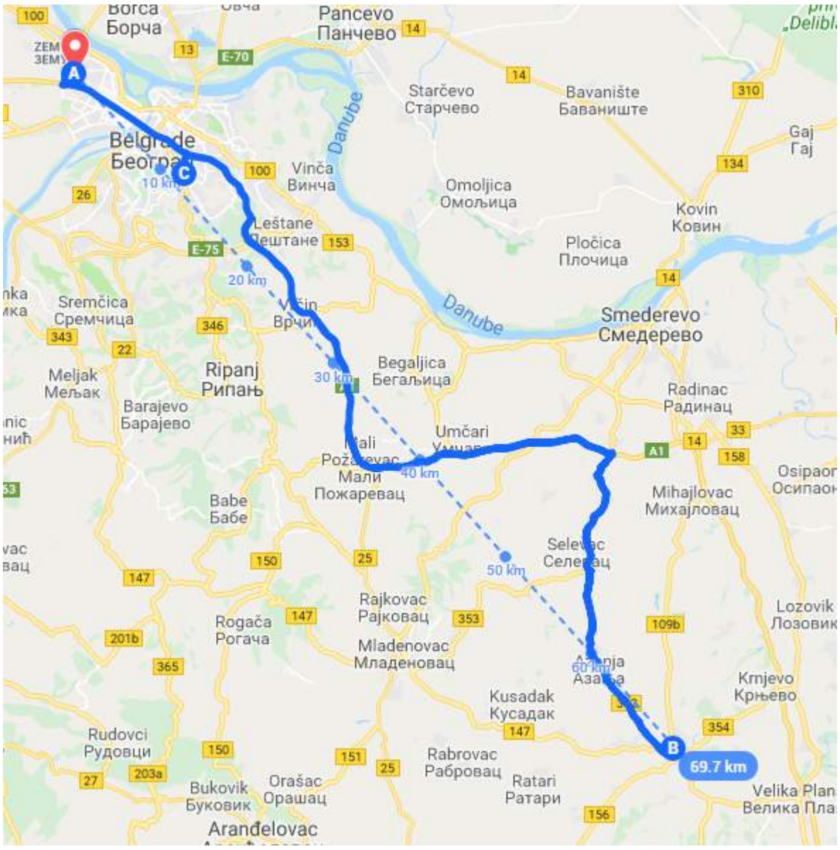
4.3. Gavrilo Princip supply chain and meals service

Gavrilo Princip school is located in Zemun municipality, about 10 km from the centre of Belgrade. Zemun is one of the most developed municipalities of Belgrade, with two large and still growing industrial zones. The average salary in Zemun is more than 20% higher than the national average, though the level of poverty (11%) is higher than that in most of Belgrade. This may be explained by the relatively high proportion of Roma children on the school roll.

The school has 838 children across the eight years, and provides two meals each day – snack and lunch. Lunch is served to about 150 children, at a price of €1.67 (200 RSD), while the snack is served to about 125 children at a price of €0.50 (60 RSD). There are two full-time and one part-time kitchen staff members.

The school also has a relatively large number of lots for its food procurement (9), resulting in five food suppliers. At the start of the Jan-Dec 2017 contract, the majority of foods were being supplied by a large food distributor located well outside Zemun (120 km). However, because of unreliability of delivery times (the school was a low-priority customer), frequent food substitution and poor quality, the school changed its main supplier. Thus, many WP6.3 data for this school were collected for suppliers not listed as the original procurement winners. The relevant details on the original tender winners are provided in Figure 10.

Figure 10: Details of Gavrilo Princip school original suppliers

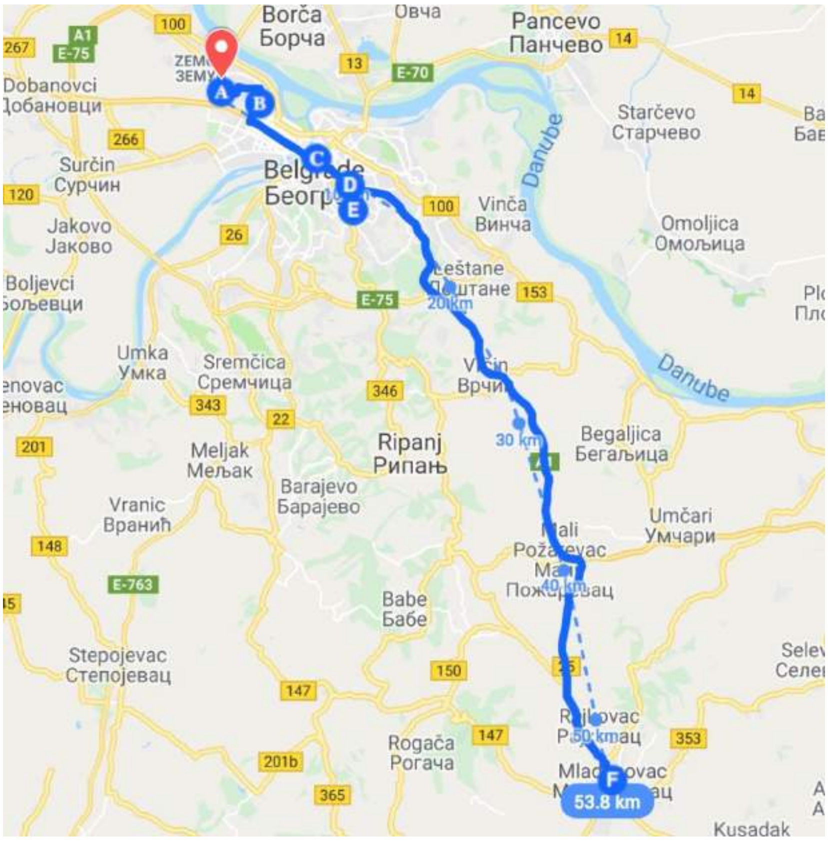


Code	Supplier name	Municipality	Distance from school in km	Bid value without VAT (in EUR)
B	Palanka Promet	Smederevska Palanka	91	10375.00
C	Avala merkur	Belgrade	15	10823.15

*Note: school is denoted by "A" and red pin, while suppliers are depicted as blue pins

As with Pavle Savić, because of new Ministry regulations (July 2018) restricting the number of non-teaching staff, the school seriously considered closing its kitchen and using an external caterer instead. This threat was made more acute in Gavrilo Princip by the resignation at the end of the 2017-2018 school year of the main cook because of poor wages and lack of staff support. The school has a temporary replacement at the moment, though we are pleased to say that the school director has managed to keep the kitchen open for the 2018-2019 school year, as he is very keen not to use an external caterer, because he believes the kitchen gives better quality meals, and he has the support of the parents for keeping the kitchen open.

Figure 10: Location of Gavrilo Princip (LOW) and its current suppliers



Code	Supplier name	Municipality	Distance from school in km	Bid value without VAT (in EUR)
B	Neca	New Belgrade	4	1666.67
C	Panić Trade	Belgrade	10	577.5
D	TZMKR Šicko	Belgrade	14	6210.00
E	Avala Merkur	Belgrade	15	8750.63

F	Granice	Mladenovac	60	4180.3

*Note: school is denoted by "A" and the red pin, and suppliers are depicted as blue pins

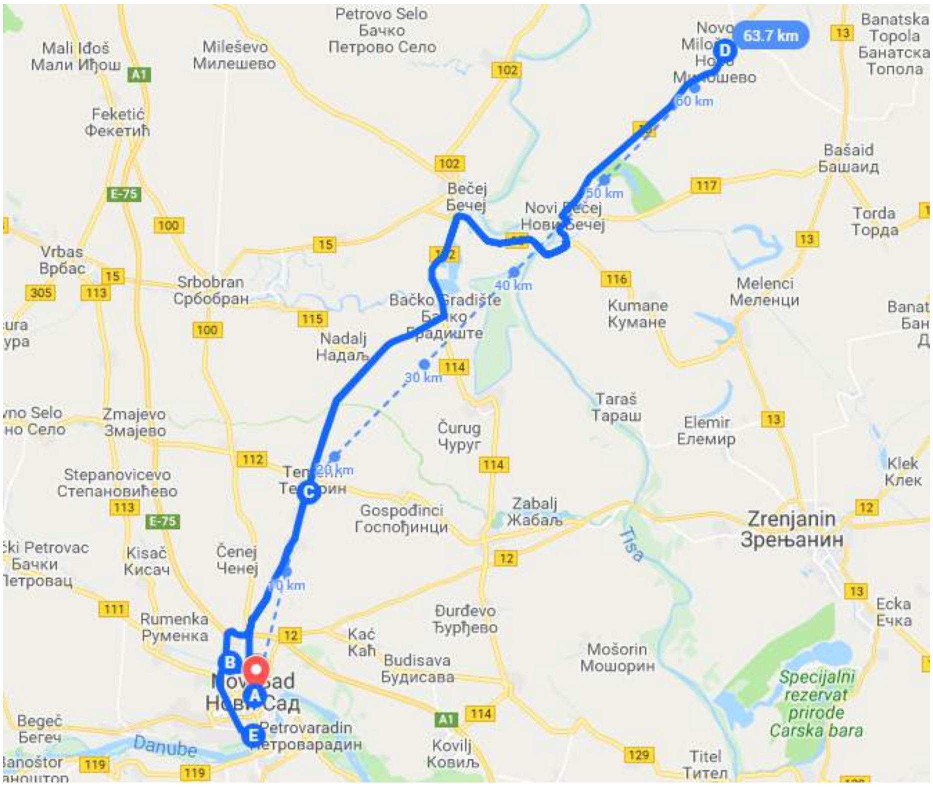
4.4. Kosta Trifković supply chain and meals service

Kosta Trifković school is in Novi Sad municipality, close to the centre of the city. The socio-economic profile of the pupils and its family indicates a relatively low level of poverty (16%), though the highest of the LOW schools.

The school roll in 2017 was 1221 pupils. Average number of meals served in the school daily is around 992, comprising 246 breakfasts and lunches, together with around 500 snacks. There are six members of kitchen staff. As for other Novi Sad schools, the cost of meals is limited to 2660 RSD (€22.17) per month for three meal each day. The school estimates that only about 60 RSD (€0.50) is spent on lunch. Despite the relatively low level of poverty in Novi Sad overall, this school has a relatively high number of free meals, paid for by the municipality. Thus, the costs of food provision for 76 children are covered by the local government.

The food procurement contracts are typically awarded in spring each year. This is another school with a relatively large number of lots for its food procurement (9), resulting in contracts to four suppliers in 2017, three of which were in Novi Sad (Figure 11).

Figure 11: Location of Kosta Trifković (LOW) and its suppliers



Code	Supplier name	Location	Distance from school in km	Bid value without VAT (in EUR)
B	Big Trade	Novi Sad	4	5490.00
C	Zorić	Temerin	18	6620.63

D	Mlekobel	Novo Miloševo	76	6674.58
E	Komercservis-produkt	Novi Sad	4	8792.04

*Note: school is denoted by “A” and the red pin, and suppliers are depicted as blue pins

5. ENVIRONMENTAL IMPACT OF SCHOOL MEALS SERVICES

5.1. Overall methodology to measure environmental impact

Our core measure of environmental impact was carbon footprint, expressed as the $kgCO_2eq$ emitted from the production, processing, transportation and waste of food items purchased by the four featured schools in Case 1 (LOC) and Case 2 (LOW), respectively, over a 180 day school year. Data collection for cooking $kgCO_2e$ was considered, but as no school kept a record of electricity use by their kitchen, this was abandoned as too complex and time-consuming to study further.

Very few studies of CO_2 emissions of Serbian agricultural production systems have been carried out. Nevertheless, Djekić and coworkers have recently been studying Serbian meat and dairy production systems in Serbia (Djekić *et al*., 2013; 2015; Skunca *et al*., 2018), so $kgCO_2e$ from these publications are used for pork, chicken and dairy production. These $kgCO_2e$ emission factors include activities along the production chain until sale to the consumer. For all remaining foods, to estimate the emissions from the production and processing of food items supplied to the schools, we used two sets of emissions factors. For fresh items, we used the factors proposed by Audsley *et al*. (2009). For processed items, we used the factors of the Rowett Institute of Nutrition and Health Database (2017), as these include emissions related to the activity of processing. Both sets of factors encompass the emissions caused by all the activities arising from the production of food items up to and including transport to the regional distribution centre (RDC) level. In our study, the RDC level equates to wholesalers (i.e. the first-tier suppliers described in Section 3 and 4).

To estimate the emissions relating to the transportation of food items from wholesalers/suppliers to schools (i.e. 'local' transportation), we used the calculation method recommended by Defra (2013), which is based on estimating suppliers' delivery round distances and frequencies, taking account of the types of vehicles and fuel used, the number of drops to other customers in the rounds, and the proportion of the loads comprised by the food items to the schools featured in the case[34]. According to Kellner & Otto (2011), the formula below assumes 89% weighted average allocated to the distance of the delivery round and 11% for the vehicle load.

To estimate the emissions relating to waste, we applied the emissions factors for waste handling proposed by Moult *et al*. (2018). These capture the emissions from transportation of waste from schools to waste disposal sites, and from the processing of the waste itself, for five types of food category (fruit and vegetables, bread, cheese, fish, and meat).

In our study, foods were grouped according to the following categories: fresh vegetables, fresh fruit, fresh meat, dairy produce and eggs, ambient foods (such as sugar and cooking oil), processed vegetables, processed fruit, processed meat and ready-made foods such as pizza, biscuits and cakes. The only items excluded were those purchased in very small quantities (e.g.

[34]The formula we used was: $\text{Total CO2 Emissions From Transportation Process per Week} = \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Drops}}{\text{Total Drops}} \times 89\%\right) + \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Load}}{\text{Vehicle Load}} \times 11\%\right)$

certain spices, sauces) and bottled water. For the final analysis of kgCO_2e yearly totals, data for fruits and vegetables were combined, to give seven food categories.

5.2. Methodology details for LOC and LOW model schools

In principle, the methodology for data collection from LOC schools and LOW schools was identical, though the methodology varied sometimes from one school to another, according to the availability of information. We collected delivery invoices for all types of food from each school for a period of at least seven weeks, usually during the months of September to December 2017, and usually from school visits because of the number of delivery invoices involved. However, Dositej Obradović provided their delivery invoices for almost the whole year (January to mid-November 2017). Frequencies of deliveries of each food item during this audit period of delivery invoices were used to estimate annual delivery frequencies for each item (needed to estimate transport CO_2 emissions). Annual kgsCO_2e production and processing quantities for each food and school were calculated from their annual procurement document quantities, after adjusting quantities to estimate those used only for lunches, as described below. Only one of our eight schools, Pavle Savić, provided only lunches.

Thus, for comparison with results for other countries, where the only meal provided is lunch, we estimated annual food quantities delivered to the other seven schools for only lunches as follows. We had menu normatives (recipes for meals each week) for each school except Ljuba Nenadović (the cook keeps the recipes in her head!), and used these together with our best estimates of numbers per meal type (frequently varying according to who we asked in the school, and when) to work out quantities per day for each meal. Some foods, particularly fresh meat, fresh and frozen vegetables, were nearly always exclusively for lunch, though sometimes also for breakfast. From menu normatives we calculated % used for lunches for each food in the food procurement document for each school. These percentages were used to calculate total food quantities bought each year for lunch. Note, however, that menu normatives were, in reality, not always used. It was clear for some schools, for which we had several weeks of menus, that some lunch items were not on the list of normatives, and some normative items were never listed on menus for lunch!

For some schools, it was evident that foods and their quantities given in procurement documents did not correspond with quantities actually being delivered to schools. Thus, occasionally, quantities delivered during the 3-4 month delivery note collection period were already greater than procurement quantities for the whole year!

Food percentages used for lunch by Ljuba Nenadović were assessed from ingredients and quantities given by the cook for lunches during the two weeks of the WP6.2 plate waste study, together with frequencies of meal components from weekly menus for several months. Therefore, quantities used annually for lunch by most of our schools are subject to several uncertainties.

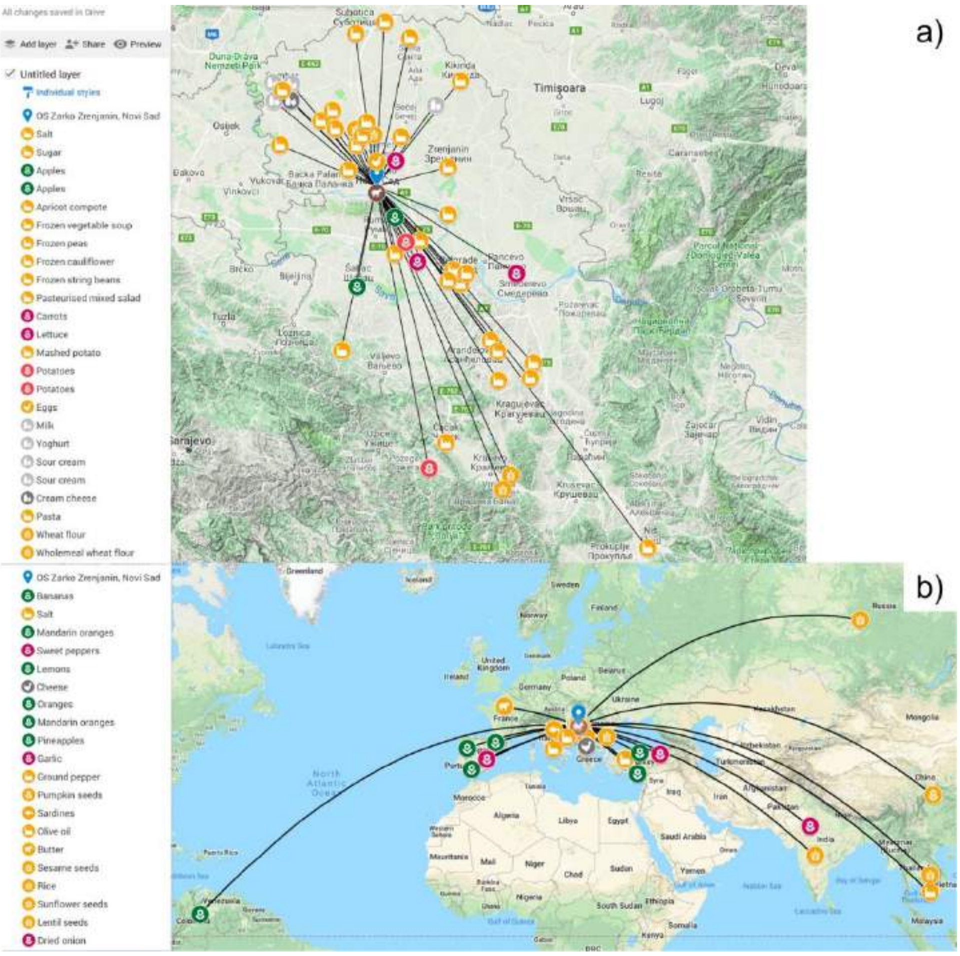
This procedure to calculate food quantities delivered for only lunch gave realistic quantities of total food per child for lunches for most LOC and LOW schools (see Figure 13, below).

Quantities of each food category were calculated using plate waste data (see D6.2) and menu normatives, as follows. On every sampling day, each meal component, for which % plate waste was measured, was broken down into its individual ingredients according to the relevant menu normative, and each ingredient assigned to one of the seven food categories listed in section 5.1. The number of meals served that day was also recorded. Totals for each food category were obtained by summing the quantities of each food item with the food category served during the 10 sampling days for each school. Average plate waste per food category per child per day was obtained for each school in the plate waste study as follows. For each food category, the daily waste (kg) generated from the 10 meals was summed and divided by the total number of meals served in those 10 days.

For the other four schools not in the plate waste study, for each food category the total waste recorded for the 10 days in all four of the plate waste schools was divided by the total meal number served in 10 days in those four schools, to get an average plate waste per food category per child per day. The average plate waste data were used for non-plate-waste schools.

Total annual waste per child for each food category was calculated by multiplying waste per child per day by 180 (school days per year).

Figure 12: Food origins for foods delivered to a school in Novi Sad, showing a) Serbian-produced foods and b) imported foods



We calculated kgsCO_2e emissions from the agricultural production and processing of the foods using Audsley et al.'s (2009) per kg emissions factors for RoE and RoW multiplied by the annual quantities used for lunch calculated in the previous step. Most fruit and vegetables (except bananas and citrus fruit), eggs and dairy products are either produced in Serbia or imported from elsewhere in Europe, depending on the time of year (information either from interviewing suppliers or from food labels collected for us by the school cooks). An example of food origins is shown for one of our WP9.1.1 schools in Figure 12a, b. This distribution of food origins will be typical for schools being supplied by major food distributors. Note that Serbian legislation does not require all foods to be identified with their country or locality of origin, so the origin of most vegetables, and some fruits is usually not known.

Having calculated the number of deliveries and average quantities of each food category delivered during the audit period from each supplier, these delivery frequencies were assumed for the remaining weeks of the 2017-2018 school year - 36 weeks per school year, using annual quantities for lunch only, as calculated from the procurement documents.

Transportation emissions were calculated only for the distance from the first tier supplier to the school (the basis for LOC and LOW designations), using information on delivery round distances and frequencies given by suppliers in interview. Where this information was not available from suppliers, an assessment of number of customers per delivery round was made based on the number of food contracts won during public sector procurements by the supplier in either Belgrade or Novi Sad during the previous year (accessible from www.ekapija.com/en/company) and the typical frequency per week of food deliveries for that company. Data from Defra (2013) were used to take into account the types of vehicles and fuel used, typically small or medium-sized vans, sometimes refrigerated, running on diesel. Delivery quantity per customer was assumed to be the same, except when delivery quantities by a supplier were available for more than one school, when quantity means were used.

Schools were asked to give their method of waste food disposal. Three schools sent their waste food to landfill, where no CH_4 capture is in place. One school used a waste homogeniser to send its food waste to the wastewater disposal system, assumed, according to the options of Moult *et al*. (2018), to be closer to landfill disposal than any alternative disposal method. Two schools gave surplus meals to school staff and others to take home (donations), and two schools gave waste food for animal feed. Emission factors for these waste disposal routes were taken from Moult *et al*. (2018).

Finally, we divided these kgCO_2e emission categories for lunch for each school by the number of children regularly having lunch in each school. Only one school could give us a reliable record of the number of children having lunch each day. Other schools gave us estimates according to the number of parents paying for lunches, or lunch numbers typically prepared by the cook. These are subject to error, depending on whether the information was given by the school director, administrative staff or kitchen staff.

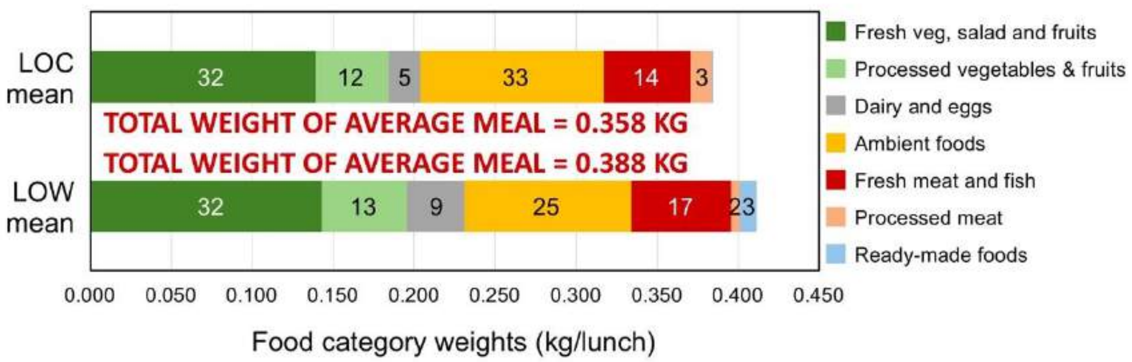
5.3. Foods supplied in the school meals services

As with other aspects of meal provision, LOC and LOW schools do not differ systematically in the type of meals provided or the type of menu cycle for lunches. Four of the schools have no set menu cycle; it being left to the cook to decide from week to week what the menus for the following week will be (Dositej Obradović, Ljuba Nenadović, Gavrilo Princip and Djordje Natošević). Two schools (Pavle Savić and Miloš Crnjanski) have a four-week menu cycle which does not change during the year. Drinka Pavlović has a one-week menu cycle that differs for the winter and summer seasons, and Kosta Trifković has a one-week menu that changes four times a year.

Serbian lunches have a characteristic format, with usually a soup or broth (with or without meat and/or noodles) to begin with. The main course typically has fresh or processed (dried or smoked) meat or fish (nearly always fried in batter, because frozen fish loses its consistency when thawed). A meat-free dish is often provided at least once every two weeks (replacing meat with either cheese or legumes). A side salad characteristically accompanies the main course, of either fresh or pickled salad vegetables - sliced cabbage, cucumber, tomato, lettuce, pickled gherkins or pickled beetroot are the usual salads. Dessert will either be fruit (according to season), a cake or sweet pastry (either prepared by the cook, often to use up the previous day's leftover fruit, or provided by the in-school bakery) or a ready-made sweet food such as a chocolate bar, a couple of biscuits or a pudding. Only one school, Pavle Savić, served only lunches each day, and lunch weights for most schools were close to that for Pavle Savić, showing that estimates of food item % for lunch were probably reliable.

Quantities of the main food categories per meal are shown in Figure 13. As expected, ANOVA of the seven food categories showed no significant differences between LOC and LOW schools in quantities of each food category per meal (P=0.30). As Figure 13 shows, the average meal at LOC schools is 358 g in total ingredient weight, and is comprised of 32% fresh fruit and vegetables (of these, invoice data showed potatoes to be the single most important vegetable item followed by cabbage, haricot beans and smaller amounts of cucumber and tomatoes, whilst apples are the most important fruit item, followed by bananas and oranges), 12% processed vegetables (comprised fairly equally of processed tomatoes (tinned and puréed), frozen peas/beans and pickled vegetables such as cabbage, gherkins, beetroot), 5% dairy (mainly milk, eggs and cheese), 33% ambient (around half of which is bread, followed by oil, flour, pasta and sugar), 14% fresh meat (split fairly evenly between chicken, pork and beef), and 3% processed meat (comprised mainly of pork and fish fingers). There is only a very small proportion of ready-made food.

Figure 13: Composition of average meals in LOC and LOW case schools*

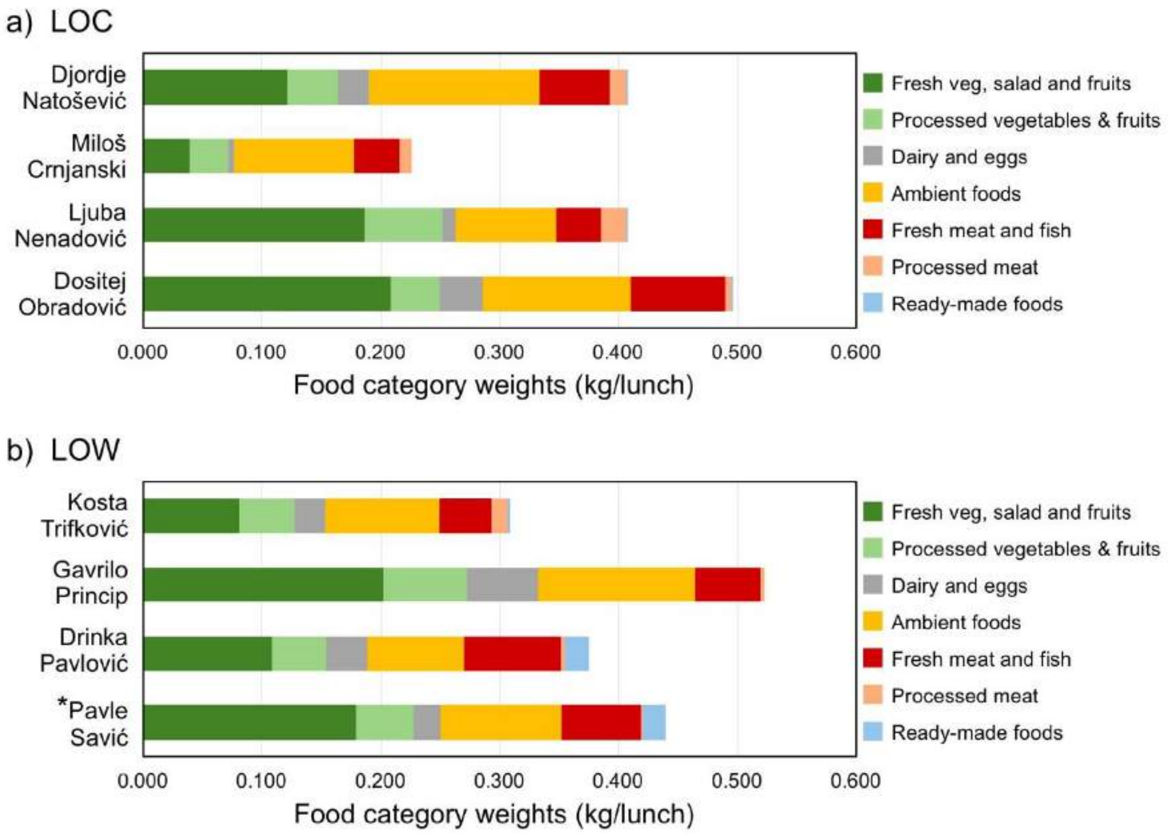


* Numbers within bars indicate % of total meal.

The average meal at LOW schools (Figure 13) is 388 g in total ingredient weight, and is comprised of 32% fresh fruit and vegetables (of these, the invoice data showed potatoes are again the single most important vegetable item followed by cabbage, haricot beans and very small amounts of a range of other vegetables, whilst apples are again the single most important fruit item followed by bananas and oranges), 13% processed vegetables (comprised mainly of frozen vegetables, followed by small quantities of processed tomatoes and pickles), 9% dairy (comprised of high variations in proportions of milk, eggs, cheese and cream across the four schools), 25% ambient (around half of which is bread, followed by oil, pasta and flour), 17% fresh meat (with high variations across the schools in proportions of beef, chicken and pork, although beef dominates in two schools), and 2% processed meat (dominated by pork). Like LOC case, there is only a very small proportion of ready made food.

Comparing the average meal in LOC and LOW case schools, it can be seen that the LOC case meal is slightly smaller in weight than LOW case. In terms of composition, the meals in both cases have an almost identical proportion of fruit and vegetables, with potatoes and apples representing the single biggest contributors to total weight in both cases. The LOW case average meal has slightly higher proportions of dairy products and fresh meat than LOC case, and beef also features more prominently relative to pork and chicken. The LOW average meal has a lower proportion of ambient foods, although in both cases, this category is dominated by bread, with smaller proportions of oil, pasta and flour.

Figure 14: Weights per food category per lunch (kg) for a) four LOC schools and b) four LOW schools.

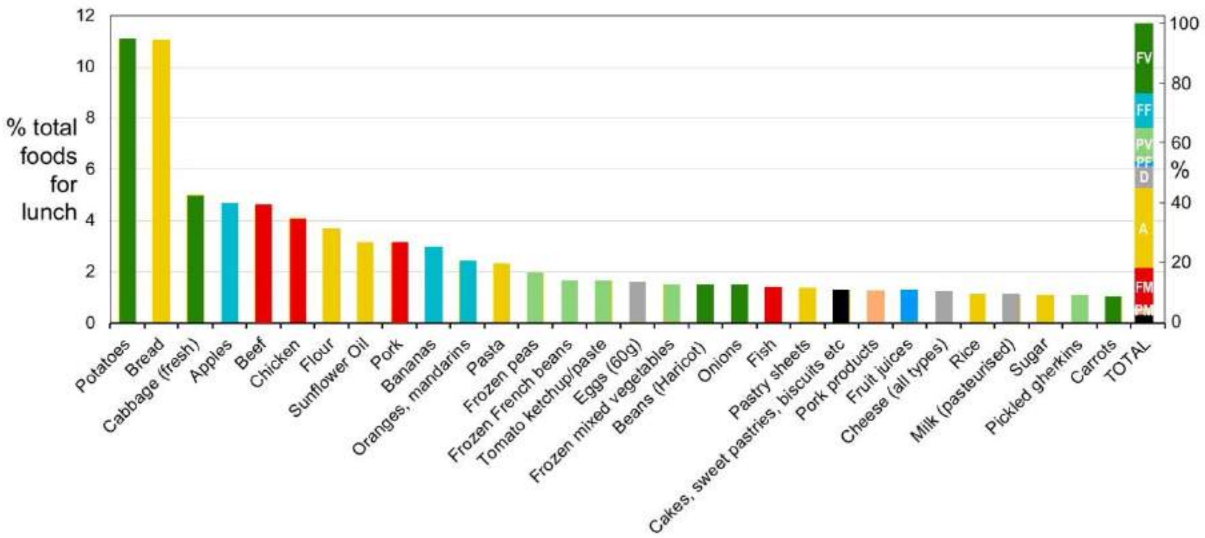


* Pavle Savić is the only school to provide only lunch, and therefore to have the most reliable estimates of food category quantities per meal.

Although proportions of each category shown in Figure 13 were broadly similar on a case mean basis, variation amongst schools within LOC and LOW cases was considerable (Figure 14), with individual food categories, such as fresh fruit and vegetables, varying by over 5-fold amongst the four LOC schools and 2.5-fold amongst the four LOW schools. Amongst LOC schools, Miloš Crnjanski had particularly small quantities for lunch, because of the absence of any desserts, though fruit is frequently given for other meals. Miloš Crnjanski also gave less processed fruit and vegetables than other schools. However, combined weights of components for five lunches analysed for nutritional content by the Institute of Public Health, Vojvodina averaged over 400 g, so the low total weight per lunch here (226 g), calculated from menu normatives, is probably unrealistic. This school uses a larger proportion of solid ingredients, such as pasta and rice (that absorb water during cooking) for lunches than other schools, though this couldn't account for all the reduction in weight per lunch. Dositej Obradović gave the most fresh fruit and vegetables of the eight schools (over 200 g per day). Gavrilo Princip also gave just over 200 g per day of fresh fruit and vegetables for lunch. In particular, the procurement document shows rather large quantities of fresh cabbage and potatoes on a per child basis, compared with other schools. Thus, the kitchen may have a relatively high food preparation waste.

As no evidence was found for any food category differences in lunch food quantities between LOC and LOW schools, food quantities for the eight schools were combined to identify the most frequently used foods for lunches (Figure 15). Potatoes and bread far exceeded any other food (both around 11%), with other vegetables and fruit featuring strongly amongst the most popular foods. Indeed, the combined fresh vegetable and fresh fruit categories accounted for almost 35% of total food weight for lunch. The typical composition of lunches is shown by the composite bar for the eight schools, on the right-hand side of Figure 15. Fruit and vegetables (fresh and processed) accounted for 48.1% of an average lunch. Fresh meat was 13.3% of an average lunch. All processed food together (excluding ambient and ready-made foods) accounted for only 15.6%, compared with 48.2% for fresh vegetables, fruit and meat combined. Dairy produce (including eggs) was 7.1%, relatively low because milk and yoghurt were nearly always given for breakfast and snacks. Water was available for lunches.

Figure 15: The top 30 foods used for lunches in the LOC and LOW schools, ranked as % of the total food purchased for lunch. Bars are coloured according to the food category percentages shown on the right-hand side*.



* Food category codes: FF - fresh fruit
FV - fresh vegetables
PF - processed fruits (canned, dried, frozen, juices)
PV - processed vegetables (canned, dried, frozen, pickled)
D+E - dairy products and eggs
FM - fresh meat and fish
PM - processed meats and fish (sausages, patés, dried meats, etc)
A - ambient foods (dry and room temperature foods)
RM - ready-made foods (pizzas, filled rolls, cakes, biscuits, etc)

5.3.1. Weekly food deliveries to LOC and LOW model schools

Weekly delivery frequencies for each food category, except ready-made foods, were higher for LOC than for LOW schools (Table 4), because LOC schools had a single supplier for every food category, except bread and pastries for one LOC school. It was therefore possible to deliver the occasional vegetable, for example, as the supplier was delivering milk or sugar. Delivery frequencies were also dependent on the school kitchen's storage facilities. Some schools had deep-freeze facilities for fresh meat, but other schools, such as Ljuba Nenadović needed fresh deliveries every day when meat was on the menu because it had no suitable storage facilities for fresh meat.

Because LOW model schools had more suppliers than LOC schools, this led to some food categories being delivered by more than one supplier. Thus, for Tables 4 to 6, dairy and eggs and ambient food categories have been separated into separate dairy, eggs, bread and (other) ambient foods categories.

Table 4: Frequency of deliveries per week for each food category (Sept-Dec 2017).

Food / School	FF+FV	PF+PV	D	E	FM	PM	B	A	RM
LOC 1[a]	1.35	0.94	1.24	0.29	0.75	1.47	0.29	1.18	0.59
LOC 2	4.00	3.62	3.38	1.38	3.08	2.00	4.00	3.92	1.00
LOC 3	1.00	1.14	4.00	1.00	1.00	1.00	4.86	1.57	1.14
LOC 4	2.16	2.88	2.48	0.72	2.48	1.76	4.56	2.32	0.88
LOC mean	**2.13**	**2.15**	**2.78**	**0.85**	**1.83**	**1.56**	**3.43**	**2.25**	**0.90**
LOW 1	0.93	0.87	0.80	0.40	2.13	0.33	0.20	0.87	0.00[b]
LOW 2[c]	1.27	1.40	1.13	1.13	1.87	1.40	2.93	1.00	0.73
LOW 3	1.33	0.56	1.86	0.56	1.63	1.13	4.57	0.22	2.29
LOW 4	0.65	0.47	2.12	0.47	0.76	0.82	0.94	0.71	0.82
LOW mean	**1.05**	**0.83**	**1.70**	**0.72**	**1.60**	**0.92**	**2.81**	**0.64**	**1.28**

[a] School codes: LOC 1 - Dositej Obradović, Belgrade
LOC 2 - Ljuba Nenadović, Belgrade
LOC 3 - Miloš Crnjanski, Novi Sad
LOC 4 - Djordje Natošević, Novi Sad
LOW 1 - Pavle Savić, Belgrade
LOW 2 - Drinka Pavlović, Belgrade
LOW 3 - Gavrilo Princip, Zemun
LOW 4 - Kosta Trifković, Novi Sad

[b] No deliveries during September to December 2017

[c] No daily delivery information, only frequency of each item per month, so used the item with maximum delivery frequency each month.

B is bread and E is eggs. Food categories as in Figure 15

Food quantities delivered each delivery were higher for LOW than for LOC schools for every food category (Table 5), because delivery frequencies were usually lower for LOW schools. There was no evidence that delivery weights for food categories transported more than 15 km (red text in Table 5) were any larger than those delivered by local suppliers, to save on fuel costs for example. Indeed, because Pavle Savić provided only lunches, its quantities of fresh meat and processed meat per delivery were relatively low, despite the supplier having to come from nearly 100 km away. Note that food quantities in Table 5 are for all meals provided by the schools, though very few of those deliveries would have been specific for other meals provided by the schools.

Table 5: Average food weight (kg) delivered each delivery per food category (Sept-Dec 2017)

Food / School	FF+FV	PF+PV	D	E	FM	PM	B	A	RM
LOC 1	38.79	20.47	29.95	25.55	7.13	7.74	21.41	42.98	34.42
LOC 2	17.55	5.52	5.54	1.68	9.96	3.49	0.76	4.89	1.17
LOC 3	43.17	25.04	35.67	6.69	41.19	20.44	22.23	47.29	30.03
LOC 4	44.06	15.59	88.73	8.40	12.55	11.56	20.13	22.69	27.23
LOC mean	**35.89**	**16.65**	**39.97**	**10.58**	**17.71**	**10.81**	**16.13**	**29.46**	**23.21**
LOW 1	75.19	14.47	4.75	1.83	14.19	3.06	63.50	22.18	-[a]
LOW 2	175.59	116.24	124.86	12.39	59.22	13.15	19.28	149.77	13.07

LOW 3	84.48	23.80	74.89	12.86	19.08	4.42	20.69	164.18	42.52
LOW 4	156.97	132.17	65.68	40.55	67.29	39.45	267.36	161.63	48.28
LOW mean	**123.06**	**71.67**	**66.60**	**16.91**	**39.95**	**15.02**	**92.71**	**124.44**	**34.62**

[a] No deliveries during September to December 2017

Food categories and school codes as in Figure 15 and Table 4, respectively. Numbers in red indicate deliveries from greater than 15 km.

5.3.2. Delivery distances to LOC and LOW model schools

Distances travelled by foods from first tier suppliers to schools varied from less than 1 km (the school used a bakery just across the road), to just over 100 km (delivery rounds estimated to be 204 km). A major food distributor initially used by Gavrilo Princip was 120 km from the school. This distributor had a customer base extending to Subotica in northern Serbia, almost 300 km from its base in Svilajnac.

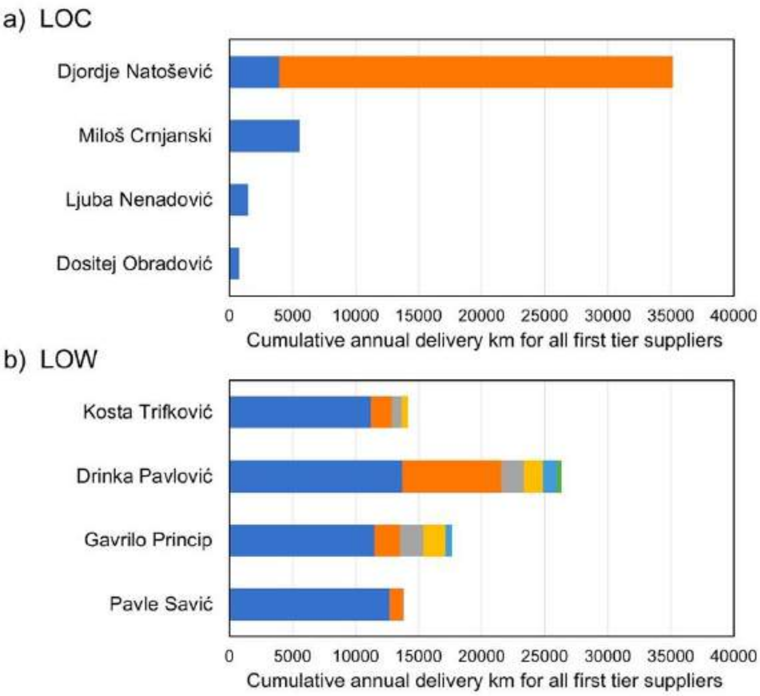
For LOC schools, the average road distance from supplier to the four schools (excluding one supplier of bread contributing only 5% to the total annual school food budget) was 4.5 km (13.5 km mean delivery round distance). Average number of suppliers per school was 1.25.

Many suppliers of food to LOW schools (average 4.5 suppliers per school) were also local. Mean distance from local suppliers to these schools was 7.7 km (23.0 km delivery round). Each LOW school had either one or two first tier suppliers more than 15 km from the school - our criterion for the designation of a LOW model school. On average, these suppliers were 73.7 km from the schools, with average delivery rounds estimated to be 163.5 km.

Annual km travelled by each food category (Figure 16) was determined not only by the distance of the school from its suppliers, but also the storage capacity of the school, the frequency of using a particular category of foods for meals and the type of foods being delivered. Thus, Kosta Trifković (LOW 4) had relatively large capacity storage facilities, so even though large quantities of bread and ready-made foods were being delivered, the frequency of deliveries was relatively low (<1 delivery per week, Table 4). Eggs were not used frequently in menus, so delivery frequencies for eggs were also <1 delivery per week, and the average delivery round for eggs for the eight schools was only 19 km. The relatively long ambient storage life of ready-made foods (typically biscuits and confectioneries) led to delivery frequencies of about once per week (1.1), so annual food km for LOC schools was also very low.

Annual delivery km for each first tier supplier are shown in Figure 16. Despite LOC schools, by definition, being largely supplied locally, the greatest annual food km for any food category was bread and pastries for one of the LOC schools (>31000 km per year for Djordje Natošević school, Figure 16, and Appendix 5 and 6). The school is in Novi Sad and the bakery is 91 km from the school in New Belgrade, with essentially daily deliveries (4.6 deliveries per week, Table 4) of bread and pastries. To put this in perspective, the distance travelled annually by the bakery to deliver bread and pastries to Djordje Natošević is equivalent to travelling over three quarters of the circumference of Earth. This long-distance contribution to annual km transport for LOC schools resulted in total transport for the four schools of *ca*. 42900 km, reducing to only *ca*. 11700 km in the absence of bread and pastry deliveries to Djordje Natošević, equivalent to 2927 km per year per LOC school. In comparison, the total km travelled annually by first tier suppliers in LOW schools was much greater, at *ca*. 71900 km, equivalent to 17976 km per year per school. The total numbers of deliveries annually to all LOC and LOW case schools were almost identical (979 km LOC and 970 km LOW), so the smaller annual transport distance in LOC schools is essentially because of the smaller geographical distances between LOC suppliers and schools.

Figure 16: Annual km transport by each first tier supplier to LOC and LOW schools*



* Within schools, each colour represents a different supplier. Suppliers to LOW schools are shown in order of decreasing delivery distances.

Considering individual food categories (Appendix 5), for all deliveries over 15 km (including bread and pastries to Djordje Natošević) across all food categories, the average annual km for a food category was 10180 km, compared with only 901 km per food category for the annual delivery distance travelled by food categories to schools with local suppliers - a difference of 11-fold.

5.4. Energy use and waste levels in school meals services?

There is no tradition in Serbia of cold salads as a main course, so school lunches are always hot meals, requiring boiling, frying or baking the main course. Hot plates are therefore in use every day, and ovens typically a couple of times a week. Unfortunately, schools in Serbia do not have separate energy meters for their kitchens, so it was not possible to assess the energy use by kitchens for meal preparation, food storage, fume extraction, etc. However, it was clear that school kitchens in Serbia differ markedly in their facilities, varying from a wood-burning stove with oven and hot plates, and no refrigeration facilities in some rural schools (not included in WP6.3) to several stoves, with multiple rings, several ovens, several deep freezers and refrigerators, fume extractor, dishwasher, boiler for hot water, air conditioner, food mixers, and other small kitchen electrical equipment.

Even schools in Belgrade complained that their kitchen facilities were very poor - old, small capacity and not enough good storage facilities. For example, one Belgrade school had to provide nearly 100 lunches per day with only four hot plates, one oven and one refrigerator. Clearly, the scale and type of kitchen facilities will have a major impact on the frequency of food deliveries and the type of meals possible.

Regarding food waste, while some schools claimed to have essentially no food preparation waste (some schools bought ready-prepared frozen vegetables to give reduced preparation time and reduced food preparation waste), other schools complained that the quality of some of their vegetables was so low that large proportions had to be cut off and rejected. For example, one school changed its vegetable supplier as nearly half of the potatoes were being rejected because of disease, fork holes, poor shapes, and so on. Not only did this impact on the level of food waste, but it led to more, ill-afforded food preparation time. At least two schools explained that they always prepared 10% more meals than the number of children expected, to allow for children asking for more, and extra people turning up unexpectedly. Nevetheless, food preparation waste was not specifically recorded for WP6.3.

However, plate waste was recorded in four Belgrade schools (Dositej Obradović, Ljuba Nenadović, Pavle Savić, and Gavrilo Princip) every day for one week in the autumn term (2017) and another week in the following spring (2018). Details of this are given in the D6.2 report for Serbia. Therefore, for these four schools (2 LOC and 2 LOW) food waste represents data collected for those four schools during two weeks. Plate waste per food category for the other four schools is based on plate waste/meal for each food category meaned across the four plate-waste schools. Plate waste quantity per year for each food category was determined by multiplying total plate waste for two weeks by 18.

In terms of plate waste, overall, average plate waste per meal was greater in LOW case schools than in LOC case schools: 88.6 g and 109.5 g per average meal, respectively, equivalent to 22% and 33% of served portions, respectively. Thus, we estimated that combined annual quantities in LOC case and LOW case were 8226 kg and 15536 kg, respectively. This equated to 17.8 kg per child per year (15.9 kg for each child in LOC schools and 19.7 kg for each child in LOW schools). The food category which generated by far the largest plate waste was fresh fruit and vegetables (7.92 kg/child/year over all schools), followed by fresh meat and bread with 2.38 and 2.37 kg/child/year, respectively.

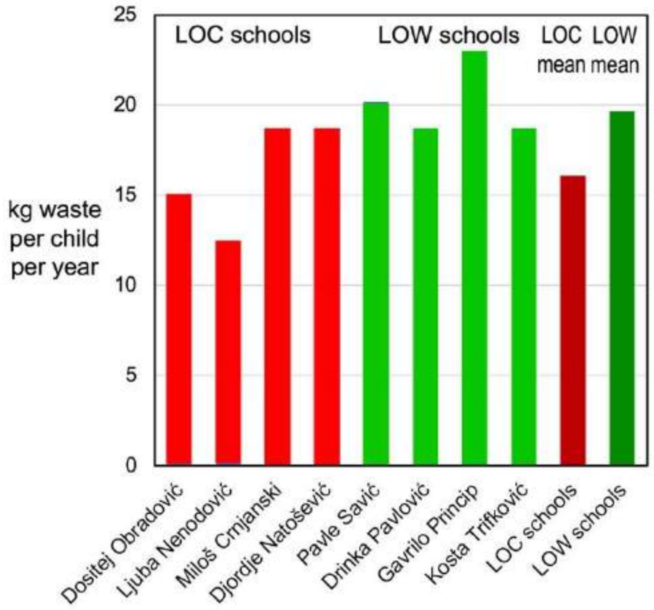
Table 6: Annual plate waste per child (kg) according to food category

Food / School	FF+FV	PF+PV	D	E	FM	PM	B	A	RM
LOC 1	7.71	0.90	0.50	0.09	1.43	0.58	2.90	1.10	0.01
LOC 2	4.78	1.66	0.41	0.01	1.59	0.88	1.63	1.56	0.02
LOC 3	8.06	2.16	1.07	0.06	2.48	0.47	2.40	1.99	0.04
LOC 4	8.06	2.16	1.07	0.06	2.48	0.47	2.40	1.99	0.04
LOC mean	**7.15**	**1.72**	**0.76**	**0.06**	**2.00**	**0.60**	**2.33**	**1.66**	**0.03**
LOW 1	9.98	1.73	0.48	0.10	2.73	0.51	2.36	2.13	0.00
LOW 2	8.06	2.16	1.07	0.06	2.48	0.47	2.40	1.99	0.04
LOW 3	8.63	3.35	2.03	0.04	3.36	0.19	2.47	2.63	0.10
LOW 4	8.06	2.16	1.07	0.06	2.48	0.47	2.40	1.99	0.04
LOW mean	**8.68**	**2.35**	**1.16**	**0.07**	**2.76**	**0.41**	**2.41**	**2.18**	**0.05**

Rows highlighted in red are for schools with plate waste measured for 10 days. Other rows show data based on mean plate wastes. Food categories and school codes as in Figure 14 and Table 4, respectively.

Total annual plate waste per child for individual schools is shown in Figure 17. Although annual plate waste for LOW schools was 24% higher than for LOC schools, this was mainly due to a particularly high plate waste for Gavrilo Princip (LOW, 22.8 kg/child) and low plate waste for Ljuba Nenadović (LOC, 12.5 kg/child).

Figure 17: Total annual plate waste per child for four LOC and four LOW model schools



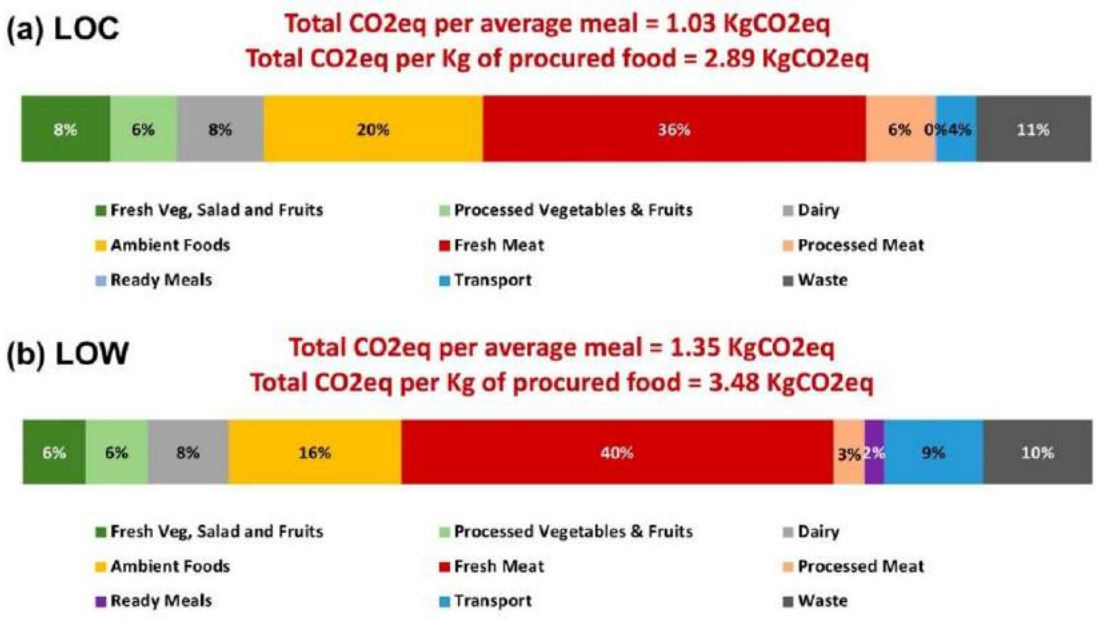
5.5. The carbon footprint of school meals services

This section presents the core environmental impact results for the school meals services in Serbia LOC and LOW cases. In particular, the total carbon footprints of the services in each case are reported respectively, showing the contribution of the main supply activities (production/processing, local transportation and waste) to the total carbon footprints. The descriptions in the preceding sections relating to meal composition, kms travelled from first tier suppliers, and waste quantities, are used to help interpret the results in each case.

Regarding annual carbon footprint, we found that the total emissions of the meals service in LOC case (four schools combined) were 94,543 kgCO_2eq (including transport and waste emissions), compared with total emissions for four LOW case schools of 207,401 kgCO_2eq. To facilitate interpretation and further comparison of case results, the total carbon emissions for LOC and LOW cases are reported on a per average meal basis, and per kg of meal basis. To derive emissions per meal, we divided the total emissions from the foods purchased by the case schools in one year by the total number of meals served annually. By this calculation, the average meal at LOC case schools generates 1.03 kgCO_2eq, while in LOW case schools it is 1.35 kgCO_2eq. To derive emissions per kg of meal, we divided the total emissions figure in each case by the total quantity of foods procured (pre-preparation and cooking). By this calculation, emissions for every 1 kg of average meal at LOC schools were 2.89 kgCO_2eq, while in LOW schools the emissions were 3.48 kgCO_2eq. The main explanation for more CO_2 emissions per meal in LOW than LOC case schools lies in the differences in average meal composition between the cases, in particular, the smaller proportion of meat in LOC average meals (Figure 13).

Figure 18 shows the breakdown of these emissions, by type of food and stage of supply chain activity. As shown in Figure 18, carbon emissions from lunches generated by food production and processing totalled 85% and 81% for LOC and LOW schools, respectively, hence the vast majority of the total emissions in each case came from the upstream supply chain activities of producing, processing and undertaking first stage transportation of the foods. Within these activities, it was the production and processing of fresh meat and fish which contributed the largest CO_2 emissions per meal, accounting for 36% and 40% in LOC and LOW schools, respectively. In total, fresh and processed meats represented nearly 50% total food emissions in both LOC and LOW schools, though as food category weights per meal, they represented only around 17%. This emphasises the high carbon burden associated with meat production and processing, particularly red meat.

Figure 18: Food category, transport and waste disposal kgCO2eq per average lunch for LOC (a) and LOW (b) schools



As expected from LOC and LOW definitions, total transport CO_2 was higher for the LOW schools (9%, compared with 4% for LOC schools), which reflects the greater geographical distances, and therefore higher kms travelled, between the first tier suppliers and schools in LOW case. However, because of the higher numbers of children having lunches in LOW schools (854 total meals per day, compared with 504 in the four LOC schools), more food was transported per delivery load to LOW schools (Table 5), so transport CO_2 emissions per lunch are not much higher than those for the LOC schools, except Djordje Natošević, which has bread delivered in a delivery round estimated to be 190 km. The transportation and disposal of food waste overall contributed around 10% to total CO_2 emissions in both cases. These relatively high overall waste proportions reflect the fact that half of the schools in both samples send their waste to landfill, which carries a high emissions burden.

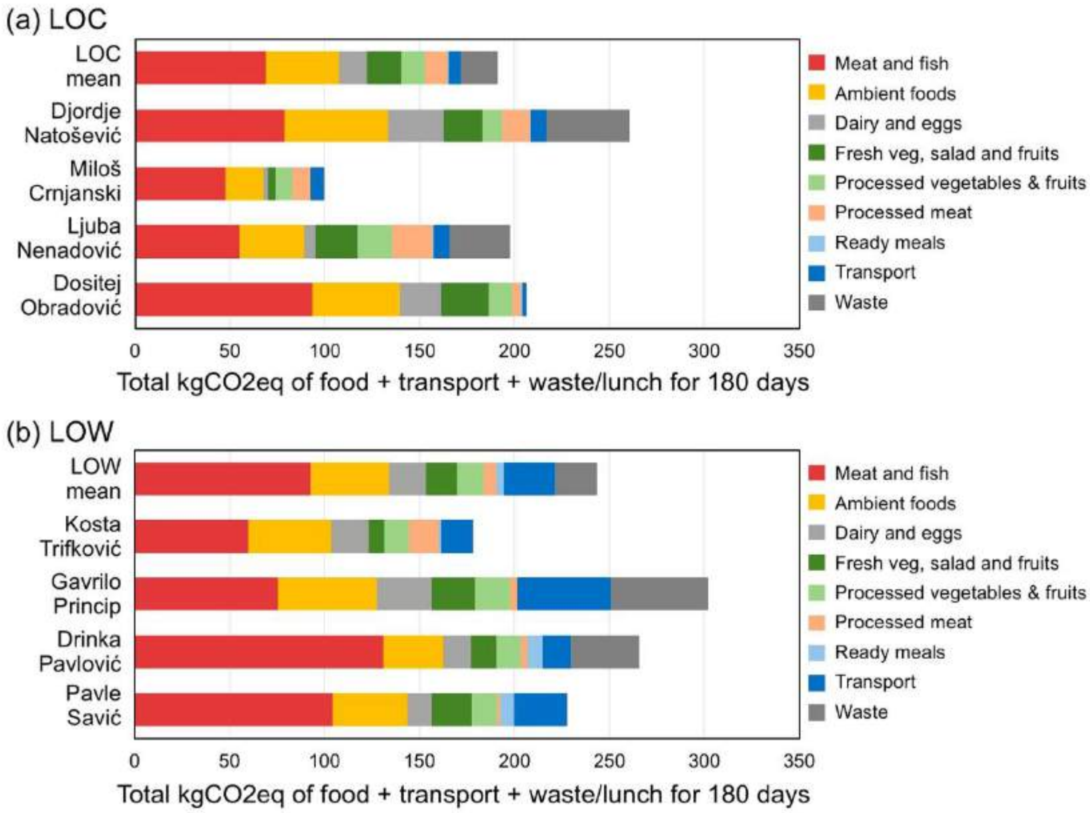
Table 7 compares mean CO_2 emissions (kgCO_2e) of school lunch provision per meal for the four LOC and four LOW schools. Although overall CO_2 emissions per lunch are 46 kgCO_2e higher for LOW schools, the majority of this is accounted for by 24 kgCO_2e more for fresh meat and fish provision, with a proponderance of beef used by LOW school Drinka Pavlovic (see below), as well as 20 kgCO_2e more transport emissions for LOW schools.

Table 7: Mean CO_2 emissions (kgCO_2e) of school lunch provision per meal in LOC and LOW model schools

CO2 emission source	LOC schools	LOW schools
Production, processing, upstream transport emissions	165.4	194.3
Fresh fruit and vegetables	17.8	16.4
Processed fruit and vegetables	12.6	14.4
Dairy and eggs	15.0	19.1
Ambient foods	38.7	41.5
Fresh meat and fish	68.6	92.5
Processed meat	12.3	6.3
Ready-made foods	0.5	4.1
Local transportation emissions	6.7	26.7
Waste	19.2	21.8
Total	**196.6**	**242.8**

Comparison of kgCO_2e per child for lunches over a school year of 180 days for each school (Figure 19) showed a three-fold range in total CO_2 emissions amongst schools, with Miloš Crnjanski having a total of only 100 kgCO_2e per child and Gavrilo Princip 302 kgCO_2e per child. Meat and fish contributed the greatest quantities of kgCO_2e per child in every school, though the proportions varied from 25% to 50% of total emissions for Gavrilo Princip and Drinka Pavlović, respectively. Drinka Pavlović used a high proportion of beef in its lunches (60% of all meat and fish, compared with only 25% of meat and fish used by Gavrilo Princip).

Figure 19: Emissions (kgCO2eq) for each food category (ranked by decreasing emissions), transport and waste disposal per average lunch for each LOC (a) and LOW (b) school



Gavrilo Princip was notable for transport and waste disposal together contributing one third of its total lunch kgCO_2e (33%). Three methods of food waste disposal were reported by our eight schools: landfill (without CH_4 capture), donation (to others in school or outside), or animal feed. Disposal by landfill had a dramatic impact on increasing waste kgCO_2e (32-51 kgCO_2e range amongst the four schools using landfill disposal.

5.6. Procurement management scenarios to reduce carbon footprint

The preceding section demonstrated how variation amongst individual schools in food category quantities, transport distances and waste food disposal methods had much more impact on overall CO_2 emissions than LOC and LOW model designations. Therefore, rather than considering the impact of different food procurement management scenarios on mean lunch carbon emissions for LOC and LOW schools, individual schools are selected to demonstrate specific scenarios.

Because Drinka Pavlović had the largest meat, particularly beef, quantity per child of our eight schools (81 g/child/day), this school is selected to provide baseline CO_2 emissions for food production/processing for most CO_2 management scenarios. Procurement management scenarios are also the focus of WP9 activities in Serbia (WP9.1.1 and WP9.5.1). Therefore the list of scenarios summarised in Table 8 includes five scenarios specifically relevant for WP9 activities. Table 8 also gives an assessment of the likelihood that at least one of our schools could implement the CO_2 management scenario. In practice, several would be unlikely to happen, being beyond the control of the school, local authorities or even Ministry of Education, Science and Technological Development. Nevertheless, seven of the 10 scenarios have at least the possibility to be implemented by one or more schools during the Strength2Food project. Each scenario is presented in detail below.

5.6.1. Local instead of distant supplier

A few food suppliers had delivery rounds over 200 km, delivering to Belgrade from Novi Sad (Bid Trade and Univerexport). In contrast, other schools used suppliers with very short delivery rounds (9-15 km). The impact of delivering all foods with either 12 km or 204 km delivery rounds was compared, using delivery information for Dositej Obradović (using a single supplier with a 12 km delivery round, and 80 children having lunch) and Pavle Savić (using a supplier with a 204 km delivery round, and 83 children having lunch). The local and distant suppliers had the same delivery frequencies (1.7 deliveries per week), so the total food delivered to Pavle Savić school was assumed to come from the supplier with a 204 km delivery round, with 1.7 deliveries per week. Transport emissions for the two scenarios were 24.7 kgCO_2e per child per year for the 204 km delivery round and 1.9 kgCO_2e per child per year for the 12 km delivery round, a 13-fold difference, equivalent to a 7.1% difference in total food+tranport+waste disposal CO_2 emissions per year (Table 8).

Table 8: Effect of 10 scenarios on CO_2 emissions (kgCO_2e) per lunch for a school year (180 days) using existing meat emissions for Drinka Pavlović, and mean waste emissions for all eight schools as the starting point.

Scenario		Before	After	% total	Likelihood
1	local instead of distant supplier (12 versus 204 km)	24.7	1.9	7.1	already
2	6 instead of 2 customers/delivery round	8.6	2.9	1.8	unlikely
3	2 instead of 10 deliveries per week	6.7	1.3	1.7	unlikely
4	one meat-free lunch per week	32.5	1.6	9.6	already
5	organic instead of conventional potatoes	4.3	3.7	0.2	possibly
6	local (25 km) instead of distant (200 km) producer	0.6	0.8	-0.1	possibly
7	60% chicken instead of 60% beef	130.9	95.6	11.0	possibly
8	Barilla menu (vegetable croquettes) instead of goulash once per month	20.9	9.7	3.5	definitely
9	fruit instead of biscuits/cakes for dessert	7.9	3.9	1.2	probably
10	waste to anaerobic digestion instead of landfill	1.6	-4.7	2.0	unlikely
Sub-total		**238.6**	**114.5**		
Remainder (food production-[meats+potato])		**81.7**	**81.7**		
Grand total		**320.3**	**196.1**	**38.8**	

Note: Likelihood indicates the possibility of one or more of our schools being able to implement the scenario. Scenarios in red are specifically relevant for WP9.1.1 and 9.1.5 activities.

5.6.2. Few or many customers per delivery round

The minimum number of customers per delivery round was estimated to be two, for a school using a small-scale local supplier with no other public sector customers. In contrast, one of the large food distribution companies (Univerexport) said it had typically 4-5 customers per delivery round. An upper limit of six customers per delivery round was therefore selected for testing. The supplier for Ljuba Nenadović was estimated to have only two customers per 9 km delivery round, so transport CO_2 emissions for this supplier were calculated using six customers instead of only two, assuming the same delivery load to each customer (34.8 kg) and same delivery frequency (4.6 deliveries per week). This reduced transport CO_2 emissions from 8.6 to 2.9 $kgCO_2e$ (1.8% overall CO_2 emissions reduction) on a per child basis (Table 8). In reality the reduction in CO_2 emissions would be less than that as more customers would mean a longer delivery round. For example, a delivery round increasing to 15 km instead of 9 km would only reduce transport emissions to 4.8 $kgCO_2e$ instead of 2.9 $kgCO_2e$.

5.6.3. Few or many deliveries per week

The maximum frequency of deliveries per week (on the basis of delivery invoices) was 10.3 to Miloš Crnjanski school, using a single supplier on a 15 km delivery round. Many food delivery frequencies were around only once a week, though the average delivery frequency for perishable foods was around 2 deliveries per week (1.9 for fresh meat and dairy produce). So, assuming school storage facilities could accommodate larger quantities delivered less frequently, the impact on CO_2 transport emissions of reducing delivery round frequency for the Miloš Crnjanski food supplier from 10 to 2 per week was assessed. To achieve the same delivery quantities per week, each delivery was increased from 48.5 kg to 242.5 kg, and the same number of customers per delivery round (4) was assumed. The impact of the five-fold reduction in delivery frequency was to reduce transport CO_2 emissions from 6.7 to 1.3 $kgCO_2e$ (1.7% overall emission reduction) (Table 8).

5.6.4. One meat-free lunch per week

Already five of our WP6.3 schools have at least one meat-free lunch every two weeks; usually a pasta dish with cheese instead of meat. Nevertheless, the impact of replacing a meal using beef with a meal without meat was tested. The beef portion (73.5 g) in a lunch from Drinka Pavlović having goulash as the main course was replaced with an equal quantity of haricot beans, keeping meal ingredients and quantities otherwise the same. The consequence of this substitution was a reduction in CO_2 emissions for that meal from 32.5 to 1.6 $kgCO_2e$ over a school year of 36 weeks, reducing overall CO_2 emissions per meal by 9.6% (Table 8). In reality, pork and chicken are often used by schools as well as beef (having on average only half the carbon footprint of beef), so a reduction of emissions per year of 5-10% for one meat-free meal per week is more realistic.

5.6.5. Organic instead of conventional potatoes

As part of WP9.1.1 and 9.5.1 activities, discussions are in progress with several schools in Novi Sad and organic growers around Novi Sad to trial the introduction of some organic vegetables and fruits in several Novi Sad schools. Because of the price premium for organic produce, to make the introduction of some organic produce as cost-neutral as possible, changes in the menus and quantities and type of meat for those schools are planned.

Potatoes constitute the largest quantity of food for the eight schools combined (11 t/year) (Figure 14). Thus, the implication of replacing conventional potatoes with organic potatoes was determined for the eight WP6.3 schools (mean 8.4 kg/child). Under production conditions similar to those used in Serbia, Moudrý *et al.* (2013), calculated farm gate CO_2 emissions for conventional and organic potato production to be 0.143 and 0.126 kgCO2e, respectively. Using these relative farm gate emission factors gave annual total potato emissions of 4.3 and 3.7 kgCO2e/meal, a 0.2% reduction (Table 8).

5.6.6. Local instead of distant vegetable producer

Our discussions with organic producers in WP9.5.1 are focusing on growers close the schools in Novi Sad (typically around 25 km from the city). In contrast, a major potato-growing area in Serbia is in the south around Ivanjica, and potatoes are known to be delivered to the supplier of Ljuba Nenadovic school. Therefore, we tested the consequence of replacing long-distance transport within Serbia (200 km from the producer) with a short food supply chain (25 km) from an organic vegetable cluster delivering directly to the school. For this comparison, a small van for local supplies of organic potatoes once a week was compared with a lorry delivering potatoes 200 km once a week to a supplier local to the school. Quantities per journey were assumed to be 45 kg (average quantities required by Drinka Pavlović each week) for each of 5 customers for the local organic delivery and 2.7 t (enough for 60 customers of 45 kg) for a weekly delivery from Ivanjica. The consequence of converting from long-distance transport using a lorry to short-distance transport using a van was an overall slight increase in transport CO_2 emissions: 0.60 to 0.84 kgCO_2e per meal for a year for 200 km and 25 km transport, respectively (Table 8).

5.6.7. Changing from 60% beef to 60% chicken

Drinka Pavlović procured not only the greatest quantity of meat per child (21.5% of all foods, compared with 14.8% for the mean of all 8 schools), but also bought the largest proportion of beef (60% of its meat and fish). In contrast, Miloš Crnjanski procured only 11% beef, but 44% chicken. Chicken constituted 33% of the total meat and fish procured by Drinka Pavlović. Our analyses of food preferences of WP9.1.1 show that children prefer chicken to beef. Therefore, we tested the scenario of replacing 60% beef, 33% chicken of Drinka Pavlovic with 60% chicken, 33% beef. This led to a large reduction in annual CO_2 emissions per meal from 130.9 to 95.6 kgCO_2e, an overall reduction of 11.0% (Table 8).

5.6.8. Replacing goulash with a BARILLA menu once per month

Drinka Pavlović currently serves goulash once a week every week on its summer menus (assumed to be equivelent to 18 times a year). For WP9.1.1, BARILLA has developed a series of nutritious menus that we are discussing with schools for them to introduce gradually during the rest of the project. One of those menus is vegetable croquettes (replacing meat with cheese), which has a calorific value similar to the Drinka Pavlović goulash menu, which includes a salad side dish and bread. The carbon footprints of the goulash and vegetable croquette menus, served 18 times per year, were 20.9 and 9.7 kgCO_2e per lunch, respectively (Table 8), equivalent to a 3.5% reduction in overall CO_2 emissions.

5.6.9. Replacing biscuits and cakes with fruit for dessert

In a two week menu cycle, Drinka Pavlović currently serves fruit as a dessert only twice, biscuits and cakes are served five times and no dessert on three occasions. Replacing those biscuits and cakes servings (40 g per portion, EF 2.18 kgCO_2e) with either apples or pears (100 g per portion, EF 0.43 kgCO_2e) would give an annual reduction of CO_2 emissions per lunch from 7.9 to 3.9 kgCO_2e, an overall reduction in total emissions of 1.2% (Table 8).

5.6.10. Anaerobic digestion instead of landfill (with no CH_4 capture)

Half of our LOC and LOW schools currently dispose of their waste food to landfill (with no CH_4 capture). If all LOC and LOW schools used anaerobic digestion for their food waste disposal, CO_2 emissions for waste disposal would go from the current annual mean per pupil of 1.6 kgCO_2e to -4.71 kgCO_2e (i.e. CO_2 capture), equivalent to an overall reduction in CO_2 emissions of 2.0% (Table 8).

5.6.11. Conclusions from CO2 management scenarios

The management scenario with the single greatest effect in reducing emissions (11.0%) was reducing beef consumption from 60% to 33% total meat and fish and replacing it with 60% chicken. Replacing the beef in a beef-based meal once a week with an equal weight of haricot beans had a similar effect on a yearly basis (9.6%), though replacing other meats (pork or chicken) instead of beef would have a much smaller impact. Nevertheless, reduction in the use of meat, especially beef, by our schools as part of WP9.1.1 activities is very likely. Reducing the quantity of meat per main course is also likely for those schools that adopt menus developed by BARILLA, as several of these menus use small quantities of chopped meats or fish with pasta or rice instead of a traditional piece of meat with potato and/or vegetables, for example.

Replacing biscuits, cakes and sweets (given regularly in lunches by 6 of our eight schools), with fruit, especially apples and pears (available locally-grown for most of the school year), would have a small impact on CO_2 emissions (around only 1-2%) but would improve the nutritional content of school lunches.

Although reductions in CO2 emissions could clearly be achieved by introducing meat-free menus on a regular basis, new Ministry regulations (introduced September 2018[35]) require schools to include meat in lunches every day. Thus, targeting reduction in the quantities used each meal, and replacing beef with chicken where possible is a better strategy. Scenarios 4, 7 and 8 inevitably interact, so their benefits from introduction would not be additive. Nevertheless, an overall reduction of 10% in CO_2 emissions by modifying the type, frequency and quantities of meats and fish on the menus should be realistic for some of our schools by the end of the project. Note that, according to the procurement and menu data available, schools already differ by more than 20% in their food production/processing CO_2 emissions.

Transport and delivery frequency scenarios (scenarios 1-3) should be largely additive and could reduce CO_2 emissions in total by around 10.6% (Table 8), though schools would be unable to influence these scenarios, being required to accept the lowest economic bid in procurements, which could come from a local or a distant food supplier.

Schools also have little opportunity to change their current food waste disposal methods, and in any case the introduction of the most environmentally-friendly option of anaerobic digestion would reduce overall CO_2 emissions by only 2%. Nevertheless, schools vary in the type and quantity of plate waste generated (WP6.2), so changes in the lunch menus using information on children's food preferences from WP9.1.1 could help to reduce plate waste and hence waste CO_2 emissions in the future.

[35] Rulebook on Detailed Requirements for Organizing, Implementing and Monitoring Nutrition of Pupils in Elementary School. "Official Gazette of RS", no. 68/2018 of 7.9.2018

6. ECONOMIC IMPACT OF SCHOOL MEALS SERVICES

6.1 Methodology to measure economic impact

Our study sought to understand the economic values generated in the local area, and amongst members of the local supply chain, in both LOC and LOW models. The specific indicators used to assess these were:

1. Local multiplier analysis (LM3): the purpose of the first indicator is to identify what portion of the value generated through procurement process is retained in the local community. In order to calculate this, Local Multiplier 3 methodology – LM3 was used.
2. The size and growth rate of supply chain members' businesses (suppliers of school). This indicator pertains to entire business growth rate of the schools supplier, observed through change of number of employees, revenue, as well as change of other financial indicators in the past five years.
3. The proportion of supply chain members' total business dependent on the school meals contract. This indicator evaluates significance of cooperation with the school for specific suppliers. In some cases, the supplier assessed this significance on their own, but in the majority of cases available secondary data was utilized for calculations. Namely, the indicator was derived as a ratio between value of revenue generated from contracts with the school (sum of all suppliers invoices to the school during the period of one year) and total revenue value of specific supplier for that year (operating income from income statement)
4. Amount of new business won as a result of the contract. Information needed for calculating this indicator was mostly obtained through interviews with suppliers.

6.2 What are local economic multipliers of the school meals services?

The aim of the local multiplier analysis was to trace the expenditures of the schools in the LOC and LOW cases, to identify what proportions of the monies from the meals contracts in each case were retained within (or leaked out of) the local area. To calculate this, we used the 'Local Multiplier 3' (LM3) methodology[36], which involves tracking the expenditures of a starting budget (e.g. the total budget gathered from parent contributions to fund a school meals service), through three rounds of spending. In Serbia, each school organizes its own procurement independently, therefore within each case, the budget expenditures were tracked through the rounds for each of the four schools individually, and then these values were aggregated to estimate a case level LM3 result.

LM3 indicator is the proportions of the expenditures of the school budget on staff, suppliers and direct costs, that are retained in the local area. Retention was determined by the geographic location of staff, suppliers and direct cost expenditures (radius of 15km).

With the aim of calculating LM3 indicator, the following data has been collected, for each LOC and LOW model school, respectively:

[36] Full explanation of the method is given is available at www.lm3online.com.

- total budget of the school for catering provision
- expenditure for kitchen staff wages
- expenditures on food suppliers
- other expenditures (e.g. administrative staff time spent on catering arrangements)

In addition, the information on which expenditure category remains in the local area have been collected, considering the geographical proximity of employees and suppliers in relation to school. All the abovementioned data has been collected through interviews with relevant persons in the chain. In the text below, there is a graphical overview for each of the schools from LOC and LOW model with cost split and interpretation of the calculated values for LM3 indicators. The same methodology was used for all eight schools from both models using the 15km radius as a threshold for the local area. Therefore, the position of suppliers, employees and other expenditures on the charts (inside or outside of local area limits) graphically indicates the extent to which certain elements have local or non-local character. This is explained in more details in LM3 indicator interpretation for each school. In terms of calculation outcome, LM3 is expressed as a ratio between 1 (indicating no value has been retained within the local area) and 3 (indicating that 100% of values have been retained). Additionally, the percentage distribution of budget between suppliers, employees and other expenditures indicates the significance of these elements in total school expenditures.

6.2.1 Local economic multiplier of Dositej Obradović (LOC) supply chain

Figure 20: Local multiplier analysis (LM3) of Dositej Obradović (LOC) supply chain

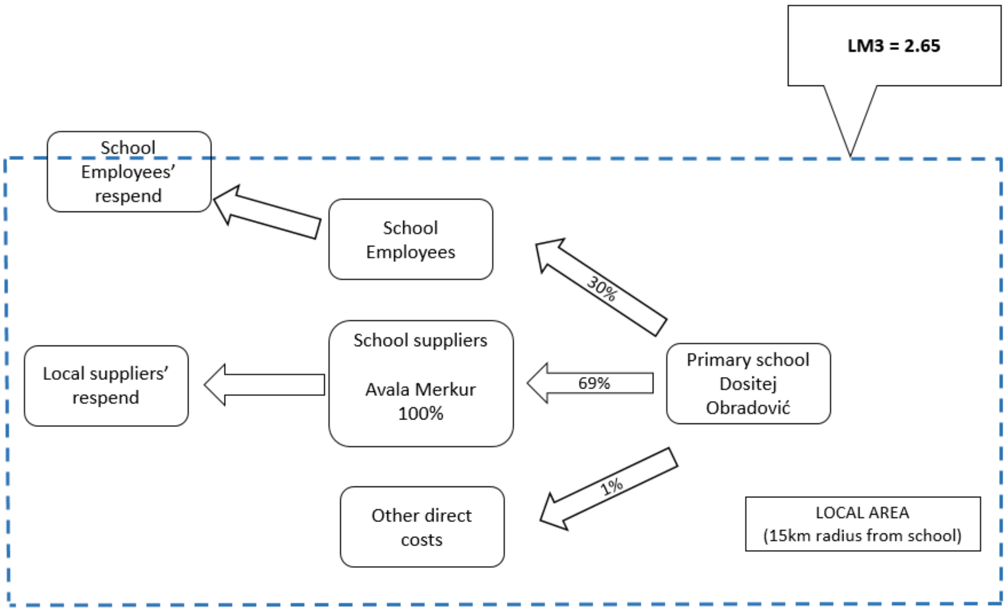


Figure 20 shows that 30% of the budget for Dositej Obradovic school is spent on staff, 69% on suppliers and 1% on other direct costs. As all the staff are resident in the local area, and the one supplier (Avala Merkur) is also located within 15kms of the school, a very high proportion of the budget expenditure is retained within the local area through the respending round. The analysis found the value of LM3 for Dositej Obradovic elementary school is 2.65. The LM3 analysis result indicates that each **€1.00** spent from the initial budget, generates an additional **€1.65** in local economy.

6.2.2 Local economic multiplier of Ljuba Nenadović (LOC) supply chain

Figure 21: Local multiplier analysis (LM3) of Ljuba Nenadović (LOC) supply chain

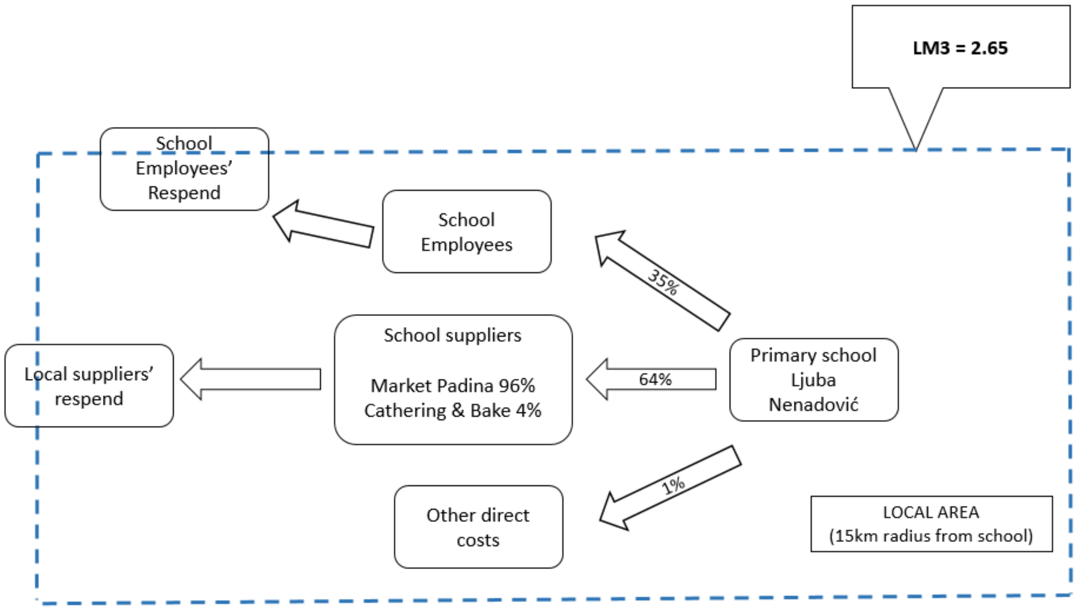


Figure 21 shows that 35% of the budget for Ljuba Nenadovic school is spent on staff, 64% on suppliers and 1% on other direct costs. As all the staff are resident in the local area, and both suppliers (Market Padina and Catering & Bake) are also located within 15kms of the school, a very high proportion of the budget expenditure is retained within the local area through the respending round. The analysis found the the value of LM3 for Ljuba Nenadovic elementary school is 2.65. The LM3 analysis result indicates that each **€1.00** spent from the initial budget generates an additional **€1.65** in local economy.

6.2.3 Local economic multiplier of Miloš Crnjanski (LOC) supply chain

Figure 22: Local multiplier analysis (LM3) of Miloš Crnjanski (LOC) supply chain

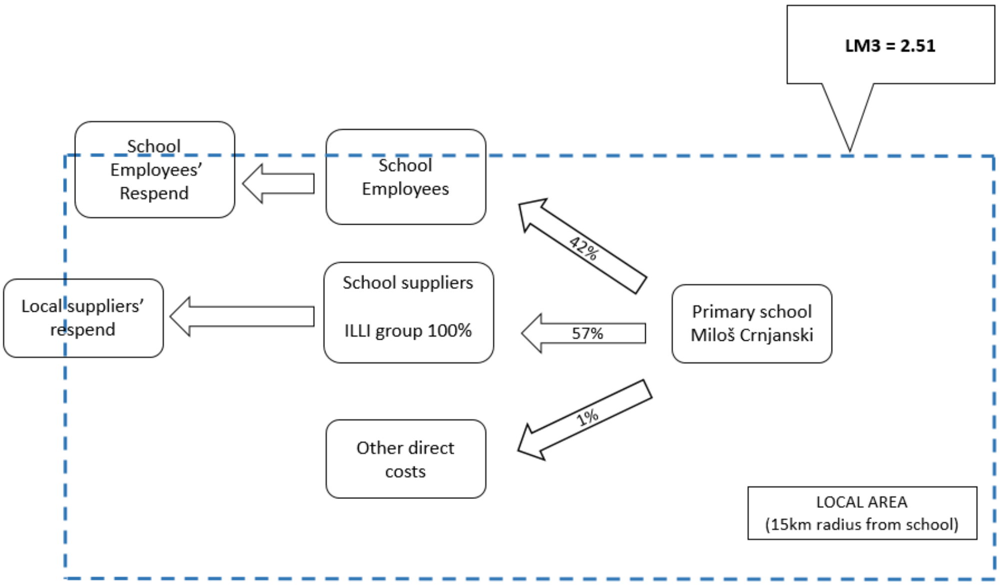


Figure 22 shows that 42% of the budget for Milos Crnjanski school is spent on staff, 57% on suppliers and 1% on other direct costs. Three quarters of the staff budget is spent on employees resident in the local area, and the one supplier (ILLI Group) is also located within 15kms of the school. Therefore, a high proportion of the total budget expenditure is retained within the local area through the respending round. The analysis found the value of LM3 for Milos Crnjanski elementary school is 2.51. The LM3 analysis result indicates that each **€1.00** spent from the initial budget generates an additional **€1.51** in local economy.

6.2.4 Local economic multiplier of Djordje Natošević (LOC) supply chain

Figure 23: Local multiplier analysis (LM3) of Djordje Natošević (LOC) supply chain

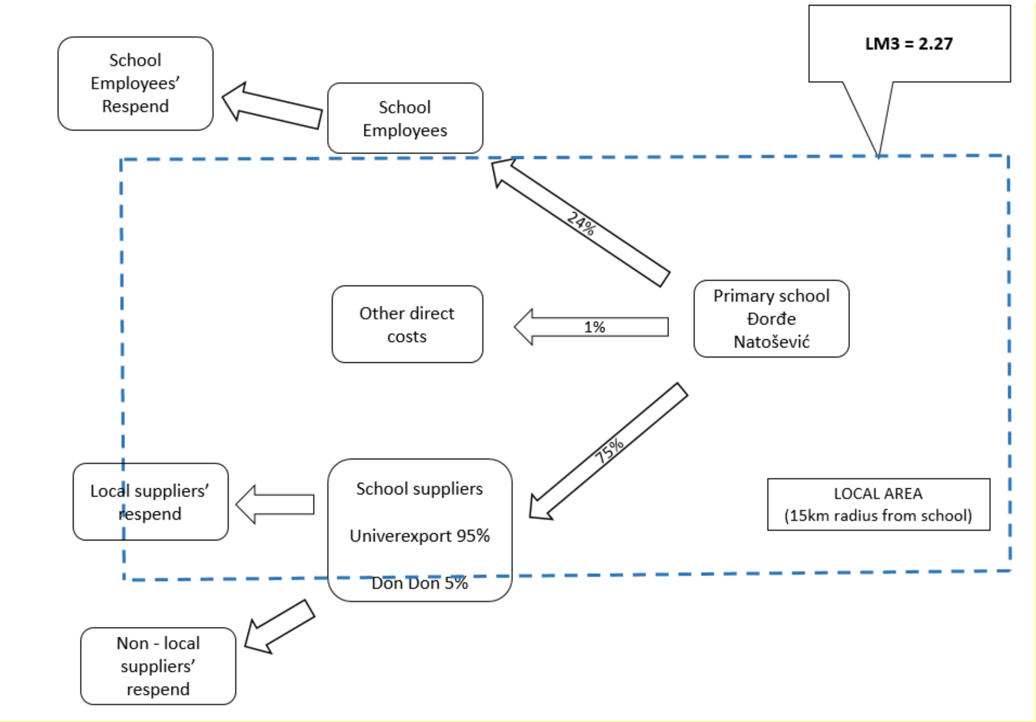


Figure 23 shows that 24% of the budget for Đorđe Natođević school is spent on staff, 75% on suppliers and 1% on other direct costs. All of the staff budget is spent on employees resident outside the local area, and of the two suppliers to the school, although one (Univerexport) is located within 15kms of the school, the other one (DonDon) is located much further away (84kms). Therefore, a smaller proportion of the total budget expenditure is retained within the local area, through the respending round, than for the other LOC schools. The analysis found the value of LM3 for Đorđe Natođević elementary school is 2.27. The LM3 analysis result indicates that each **€1.00** spent from the initial budget generates an additional **€1.27** in local economy.

6.2.5 Local economic multiplier of Pavle Savić (LOW) supply chain

Figure 24: Local multiplier analysis (LM3) of Pavle Savić (LOW) supply chain

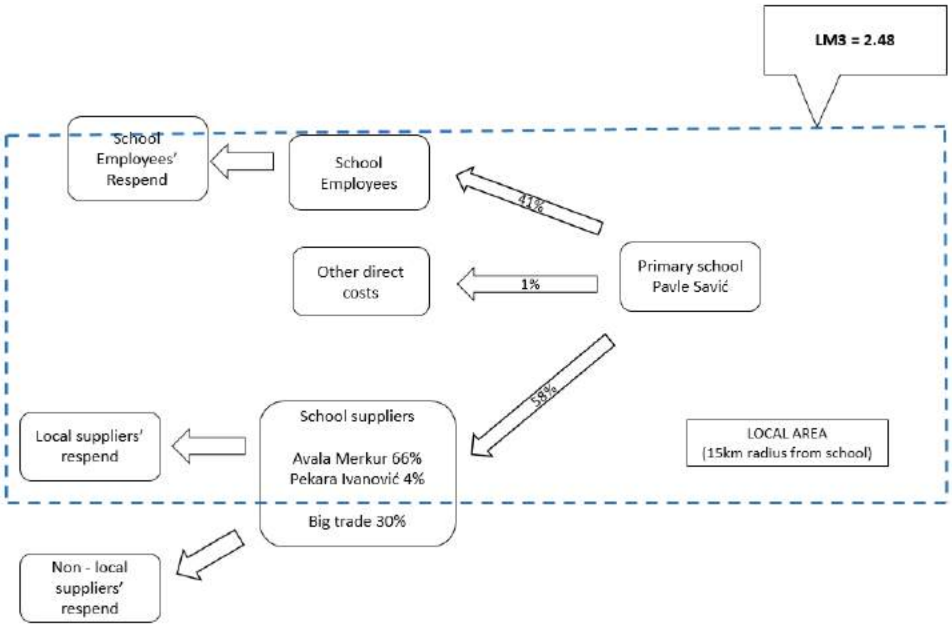


Figure 24 shows that 41% of the budget for Pavle Savic school is spent on staff, 58% on suppliers and 1% on other direct costs. All of the staff budget is spent on employees resident within the local area, and of the three suppliers to the school, two (Avala Merkur, Pekara Ivanovic) are located within 15kms of the school, while the other one (Big Trade) is located much further away (102kms). Therefore, a fairly high proportion of the total budget expenditure is retained within the local area, through the respending round. The analysis found the value of LM3 for Pavle Savic elementary school is 2.48. The LM3 analysis result indicates that each **€1.00** spent from the initial budget generates an additional **€1.48** in local economy.

6.2.6 Local economic multiplier of Kosta Trifković (LOW) supply chain

Figure 25: Local multiplier analysis (LM3) of Kosta Trifković (LOW) supply chain

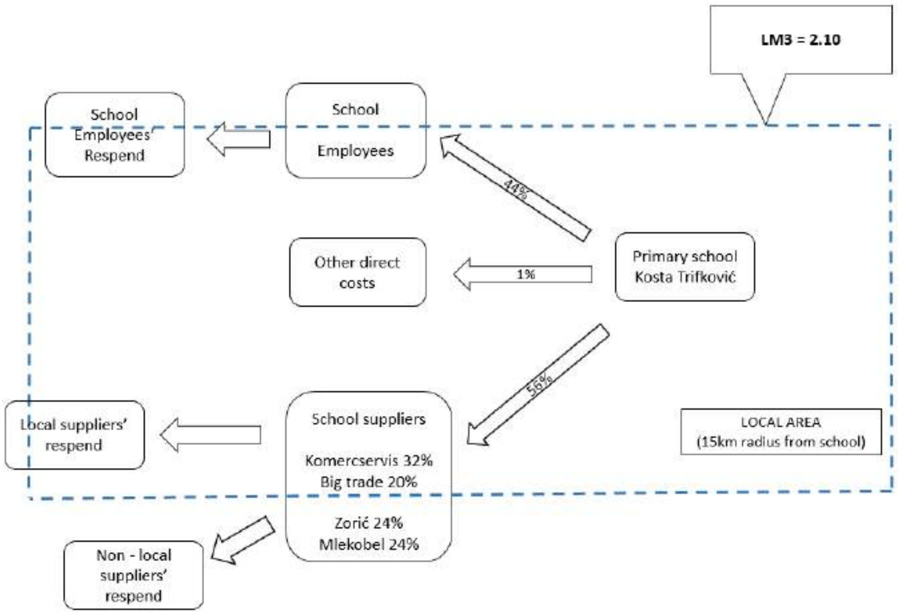


Figure 25 shows that 44% of the budget for Kosta Trifkovic school is spent on staff, 56% on suppliers and 1% on other direct costs. Two thirds of the staff budget is spent on employees resident within the local area, and of the four suppliers to the school, two (Komercservis, Big Trade) are located within 15kms of the school, while the other two (Zoric, Mlekobel) are located further away. Therefore, a reasonable proportion of the total budget expenditure is retained within the local area, through the respending round. The analysis found the value of LM3 for Kosta Trifkovic elementary school is 2.10. The LM3 analysis result indicates that each **€1.00** spent from the initial budget generates an additional **€1.10** in local economy.

6.2.7 Local economic multiplier of Drinka Pavlović (LOW) supply chain

Figure 26: Local multiplier analysis (LM3) of Drinka Pavlović (LOW) supply chain

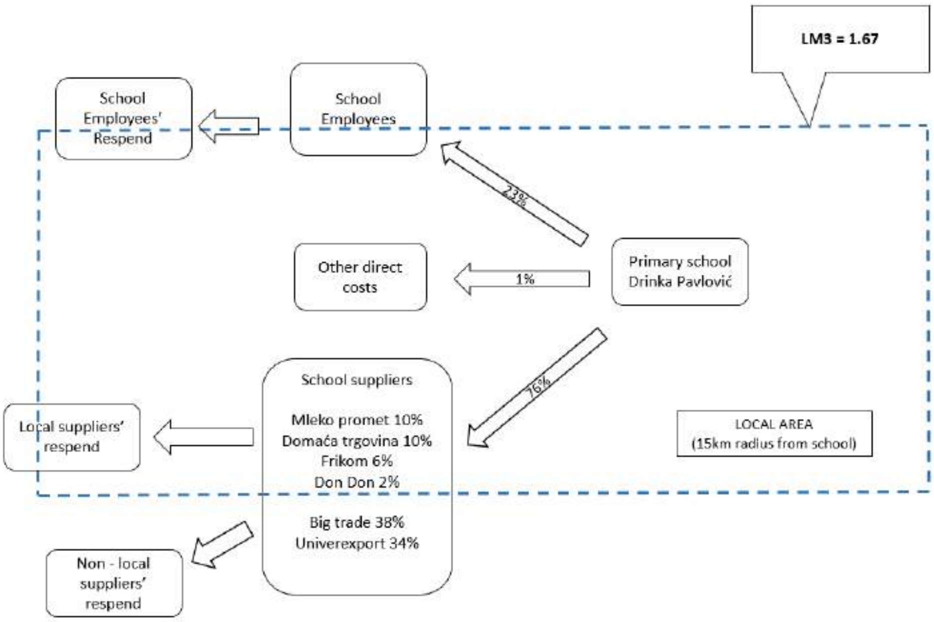


Figure 26 shows that 23% of the budget for Drinka Pavlovic school is spent on staff, 76% on suppliers and 1% on other direct costs. Less than a quarter of the staff budget is spent on employees resident within the local area, and of the six suppliers, four (Mleko Promet, Domaca trgovina, Frikom, Don Don) are located within 15kms of the school, while the other two (Big Trade, Univerexport) are located much further away (93kms). Moreover, a large proportion (72%) of the total supplier budget is spent on those two suppliers. Therefore, only a small proportion of the total budget expenditure is retained within the local area, through the respending round. The analysis found the value of LM3 for Drinka Pavlovic elementary school is 1.67. The LM3 analysis result indicates that each **€1.00** spent from the initial budget generates an additional **€0.67** in local economy.

6.2.8 Local economic multiplier of Gavrilo Princip (LOW) supply chain

Figure 27: Local multiplier analysis (LM3) of Gavrilo Princip (LOW) supply chain

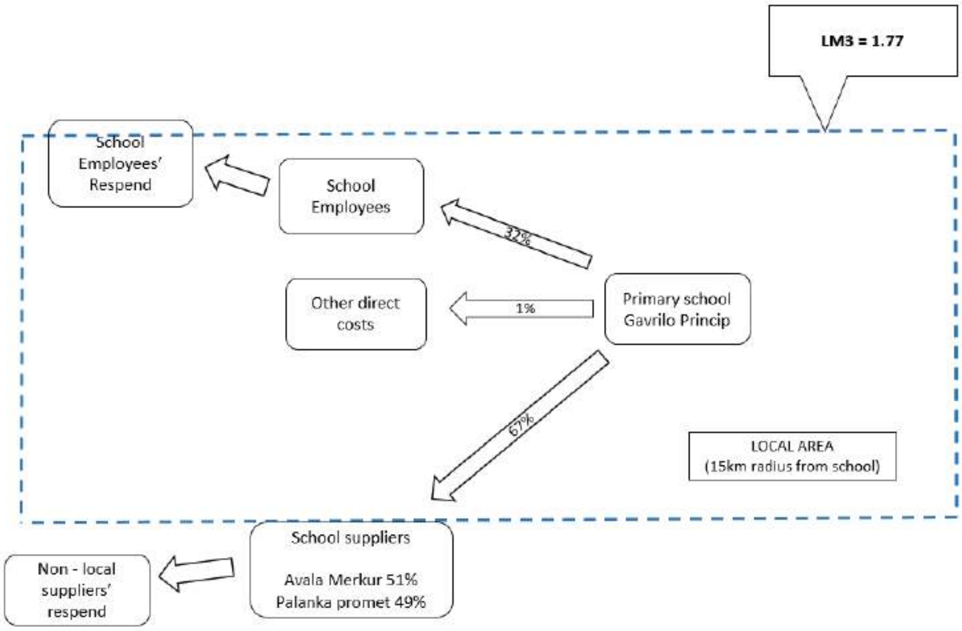


Figure 27 shows that 32% of the budget for Gavrilo Princip school is spent on staff, 67% on suppliers and 1% on other direct costs. All of the staff budget is spent on employees resident within the local area, but both of the two suppliers (Palanka Promet, Avala Merkur) are located further than 15kms from the school. As the supplier budget represents two thirds of the total budget, only a small proportion of the total budget expenditure is retained within the local area, through the respending round. The analysis found the value of LM3 for Gavrilo Princip elementary school is 1.77. The LM3 analysis result indicates that each **€1.00** spent from the initial budget generates an additional **€0.77** in local economy. It may be recalled from Section 4 that the contracted suppliers for Gavrilo Princip switched during the undertaking of the research, and for the LM3, the analysis has been conducted on the original contracted suppliers. We inspected the budget expenditures and supplier locations under the new arrangements and found that although the new arrangements involve some local suppliers, the vast majority of the total supply budget is still spent on non-local suppliers. Therefore the LM3 estimate above remains a good reflection of the local multiplier effect for this school supply chain.

6.2.9 Comparison of local economic multipliers in LOC and LOW chain

In addition to calculating the LM3 indicator value for each school seperately, an aggregated value was calculated for the case model under which schools operate. More precisely, by using aggregated values for all the required inputs of four LOC schools, the value of LM3 indicator for the LOC model case was calculated. The same approach was used for LOW model schools. In this section, we discuss the main features of the budget expenditures of the schools in LOC and LOW cases respectively, and present the results of the aggregated LM3 analysis in each case.

Overall, Figures 20-23 reveal the general pattern of expenditures of schools in the LOC case. Expenditures on catering staff by these schools range from 24-42% of total meals budgets, giving an average of 33%. For two LOC schools, catering employees in these schools were 100% local, but for the other two schools, employees were either a mix of local and non-local, or 100% non-local, using the 15km radius threshold. In terms of supply budgets, perhaps unsurprisingly given the definition of the case, very high proportions are spent on local suppliers (100% of supplier spend is local in three schools, and 95% in the fourth school). It can be expected that the combination of relatively high expenditure proportions on local staff, and very high expenditure proportions on local suppliers, have a positive impact on local multiplier effect.

The expenditure values and proportions for LOC case schools were entered into the LM3 online tool for analysis. The calculation revealed the Project LM3 ratio for the LOC case school meals chain is 2.46. This means that, on average, for every €1 spent by the initial budget generators (e.g. parent contributions) in the four LOC schools, an additional €1.46 is generated within the local areas of the schools. Table 9 presents the result, together with estimates of Local and Non-Local LM3s.

Table 9: Project, local, and non-local LM3 estimates for LOC case schools

		Explanation
Project LM3	2.46	For every €1 spent in the LOC case school meals service, an additional €1.46 is generated in the local economy
Local LM3	2.65	If only local suppliers were used in LOC case meals service, then for every €1 spent an additional €1.65 would be generated in the local economy
Non-Local LM3	1.33	If only non local suppliers were used then for every €1 spent an additional €0.33 would be generated in the local economy

Meanwhile, Figures 24-27 reveal the general pattern of expenditures of schools in the LOW case. Expenditures on catering staff by these schools range from 23-44% of total meals budgets, giving an average of 35%, slightly higher than LOC case. For two LOW schools, catering employees were 100% local, but for the other two schools, employees were a mix of local and non-local, using the 15km radius threshold. In terms of supply budgets, unsurprisingly given the definition of the case, lower proportions are spent on local suppliers compared with LOC case (around one third on average, compared with almost all in LOC case). It can be expected that the much lower proportion of local supply expenditures of LOW case schools will have a negative impact on local multiplier effect, although the employment arrangements may moderate the effect somewhat.

The expenditure values and proportions for LOW case schools were entered into the LM3 online tool for analysis. The calculation revealed the Project LM3 ratio for the LOW case school meals chain is 2.12. This means that, on average, for every €1 spent by the initial budget generators (e.g. parent contributions) in the four LOC schools, an additional €1.12 is generated within the local areas of the schools. The local multiplier effect for LOW case is indeed smaller than LOC case. Table 10 presents the result, together with estimates of Local and Non-Local LM3s.

Table 10: Project, local, and non-local LM3 estimates for LOW case schools

		Explanation
Project LM3	2.12	For every €1 spent in the LOC case school meals service, an additional €1.12 is generated in the local economy
Local LM3	2.65	If only local suppliers were used in LOC case meals service, then for every €1 spent an additional €1.65 would be generated in the local economy
Non-Local LM3	1.33	If only non local suppliers were used then for every €1 spent an additional €0.33 would be generated in the local economy

Therefore, the results of the local multiplier analysis show the value of LM3 indicator for the LOW model case is 2.12, while for LOC model it is 2.46. It is worth mentioning that the value of LM3 idicators in both models are quite high considering the food sector context. The main driver may be the high proportion of employee costs from local area and the presence of a reasonable proportion of local suppliers even in the LOW case models. The higher value of LM3 indicator in LOC model, when compared to LOW model, is the result of higher share of local suppliers in total suppliers (5 out of 6 in LOC whereas in LOW model it is 8 out of 15). However, this is not only seen in the number of suppliers but also in the higher proportion of budget (in absolute terms) spent on local suppliers in LOC versus the LOW model.

6.3 'What if' scenarios to increase local economic multipliers

In order to analyze what is happening with LM3 indicators in LOW model, we observed their values under two scenarios. First one is assuming all suppliers are from local area. The second one assumes a 10% increase of total budget (spending) in the local area.

In the first scenario, value of LM3 indicator would increase to 2.66, indicating that if only local suppliers would be used, each €1.00 of the gross project income would generate an additional €2.66 in local economy. On the other hand, if only non-local supplers are used, the value of this indicator is much lower at €1.36. In the second scenario, with 10% increase in total budget spending in the local area, additional value generated in the local area increases as well from the current €247,030 to €262,0833.

Similar results can be observed in LOC model as well. LM3 indicator variance between local and non-local suppliers is significant and amounts to 1.31 (under local suppliers it is 2.65 while under non-local suppliers its value is 1.33). The observed difference in LM3 indicator between local and non-local suppliers, under both models, supports the idea of intensifying the use of local suppliers in order to generate higher value for the local economy. Finally, if the value of total budget spent locally increases by 10% within the LOC model, additional value generated in local area would increase as well from €325,450 to €342,803.

6.4 Economic value of the school meals service

In order to assess the economic value of the school meals contract, we firstly gathered data on the following indicators: the size and growth rate of supply chain members' businesses (measured by turnover, employee numbers and estimated growth over past 5 years and etc.), the proportion of supply chain members' total business dependent on the school meals contract (estimated as the % of total business) and amount of new businesses won as a result of the contract (measured by number of the new customers/contracts gained).

Data on income, number of employees and estimated growth in the last five years which were used for evaluating size and growth rate of supply chain members' businesses, were collected through interviews with suppliers. The majority of interviewees were willing to provide necessary information, although in some cases we had to utilize secondary information. Thus, missing data was obtained through financial statements available on Business Registers Agency, as well as Bisnode database. Additionally, in the most of cases, suppliers provided the information on percentage of total revenue generated through contracts with schools. In cases in which suppliers did not state what part of their revenue comes from schools, we have calculated necessary data on basis of percentage of income value generated from the contract between the school and individual supplier compared to total value of supplier's revenue. Aside from this, suppliers gave their opinion on effect that cooperation with the school had on obtaining new contracts. More specifically, what is the number of contracts signed with new clients as a result of successful cooperation with the school. The following text presents all data collected from interviewees in LOC and LOW supply chain models.

Regardless of LOC and LOW supply chain models, as we have stated before, centralized procurement on the level of school groups does not exist in Serbia, and every school is responsible for its procurement. In that regard, aforementioned indicators for suppliers as parties in supply chain are given in the following text. After tabular summary of defined indicators for all LOC model suppliers, a more detailed overview is given for the most important members of supply chain. The same applies for members of LOW model supply chain (school suppliers).

6.4.1 Economic value in LOC model school meal chains

The following table presents values of all aforementioned indicators for every school meal supplier in LOC model. The first and the second column show data on number of employees and company's total revenue in the last available business year. The third column demonstrates how important the contract with the school is, expressed as the percentage of their yearly revenue. Next column shows the average employee number growth rate and revenue growth rate over the last five years. The last column pertains to the number of new contracts that supplier obtained based on recommendation from the school.

Table 11: Economic value of school meals contract in LOC model chains

Supplier of school	Size of total business		% turnover dependent on Contract with school[37]	Growth rate in last 5 yrs	New business won as a result of contract
	employees	*turnover in EUR*			
Avala Merkur	5	244655	6.5%	Average growth rate (employees): 5% Average growth rate (turnover): -7%	Negligible
Market padina	15	Owner refused to provide this information. The data was not present in the Business registry.	1%	Average growth rate (employees): - Average growth rate (turnover): -	Negligible
ILLI group	16	2745147	0.76%	Average growth rate (employees): 8% Average growth rate (turnover): 13%	Negligible
Univer-export	2076	142758855	0.03%	Average growth rate (employees): 10% Average growth rate (turnover): 4%	Negligible
Catering & Bake	13	509434	0.004%	Average growth rate (employees): 0.3% Average growth rate (turnover): 45%	Negligible
Don Don	915	55788118	0,06%	Average growth rate (employees): 9% Average growth rate (turnover): 15%	Negligible

Taking into account the fact that the data from the previous table are given either for last year or as the average for five-year period, the following section provides data for every year separately and for every individual supplier in order to give a more detailed overview.

[37] Suppliers were mostly not willing to disclose these information with us. The pecentage in table shows the share of supplier's turnover coming from the contracts with sample schools. In majoriry of cases this % is approximately equal to the total share of turnover coming from the contracts with all schools supplied.

Table 12: Business overview of Avala Merkur company for 2012- 2017 period.

Avala Merkur	2012	2013	2014	2015	2016	2017
Net profit	1090	9569	380	428	583	490
EBIT (operating margin)	2990	14113	1761	140	2624	1865
EBITDA	5813	16966	5374	3264	5702	4626
Cash	2999	10162	15394	477	5127	1325
Working capital	18141	26840	11210	7482	6738	6474
Obligations to suppliers	62963	60449	38104	33578	48157	44652
Productivity	21	29	21	16	20	23
Company size	small	micro	micro	micro	micro	micro
Operating income (EUR)	266219	302140	274293	255143	262407	244656
Growth rate (%)	-	13%	-9%	-7%	3%	-7%
Number of employees (EUR)	4	5	5	5	5	5
Growth rate (%)	-	25%	0%	0%	0%	0%

Although it can be noted that productivity and profitability of the company vary during the observed period, this is a company that constantly records positive financial results. Additionally, although it started as a small company, according to the current categorization of companies by size, this company falls under micro company category. Specific indicators of size and business growth rate for this supply chain member is shown in the table below. More precisely, business revenue fluctuation over the period of five years shows relative stability in starting years as well as the negative growth rate in later years.

When we interviewed the owner of the company, we got similar information pertaining to employee number fluctuation. More specifically, as well as operating income, the number of employees has negative growth rate. At the start, number of employees was seven, while this number stagnated during the last five years and currently amounts to five employees in total.

We also asked interviewees to estimate the proportion of their business dependent on the school meals contract, and the size of any new business won as a direct result of the contract. Regarding the value Avala Merkur generates on basis of contracts made with schools we can say that it is very low (around 5-6% of total revenues). When it comes to additional value, generated as a result of doing business with the schools, this supplier says that there were no new contracts made as a result of existing contracts with schools.

Next relevant supplier within LOC model is company Market Padina that supplies primary school “Ljuba Nenadović”. We could not obtain necessary information on financial health of the company from the owner. We have checked Business Registers Agency's database, but it seems that this company did not submit financial data. From informal conversation with owner, we have found out that tax liability for VAT each month amounts to approximately RSD 5 million (around 42,000EUR). This suggests that turnover is significant and that VAT from issued invoices is higher than VAT from received invoices. Taking into account that banks see this company as an important client (according to retailer words), we may conclude that firm's solvency is good. Our interviewees have stated that the percentage of revenue generated from contracts with schools is insignificant. Additionally, albeit this supplier has worked with other schools and kindergartens, these contracts were not a result of cooperation with “Miloš Crnjanski” school.

Data on business and growth rate in the last five years for three remaining suppliers (ILLI group, Univerexport and Catering & Bake) were mostly gathered from secondary sources, more specifically, from available financial statements as well as from their official websites.

Table 13: Business overview of ILLI Group company for 2012- 2017 period.

ILLI group	2012	2013	2014	2015	2016	2017
Net profit	85554	93945	71463	152500	124570	53861
EBIT (operating margin)	98331	108075	69950	188644	151945	70734
EBITDA	111829	120226	81631	202835	167625	83623
Cash	39527	124082	159410	200426	419041	285230
Working capital	210195	220294	132368	181589	265639	161354
Obligations to suppliers	449189	192155	432529	568455	584990	478127
Productivity	20	31	43	39	30	30
Company size	small	Small	Small	Small	small	Small
Operating income(EUR)	1596260	1779582	1935791	2884611	2912321	2745147
Growth rate (%)	-	11%	9%	49%	1%	-6%
Number of employees	11	13	14	15	18	16
Growth rate (%)	-	18%	8%	7%	20%	-11%

ILLI group is a small company that supplies “Miloš Crnjanski”. Apart from the last year, this company reports positive revenue growth rate. When it comes to the number of employees, we can note that it varies from 11, the number of employees in 2012, to the current 16 employees. Although the company did not provide any information on portion of revenue generated from working with the schools, we can estimate that contribution from cooperation with “Miloš Crnjanski” is insignificant and amounts to 1% of total profit. We base this estimation on the available data on value of the contract signed with the school and companies yearly revenue.

Table 14: Business overview of Univerexport company for 2012- 2017 period.

Univerexport	2012	2013	2014	2015	2016	2017
Net profit	3438822	2822890	1863816	587374	1732526	444398
EBIT (operating margin)	2013933	2158020	4150356	3046624	4948883	5186646
EBITDA	3325419	3792464	5994545	5231459	7377274	7880676
Cash	2572154	2533380	2520381	2349479	5002547	6045376
Working capital	-5855346	-3403183	-7913264	-12310770	-7857730	-11854545
Obligations to suppliers	21637265	18311170	18538686	29313535	29429694	39307554
Productivity	3	3	2	2	2	2
Company size	-	large	Large	large	Large	large
Operating income (EUR)	121642594	120213412	110927377.5	124651485.2	129003655.1	142758855
Growth rate (%)	-	-1%	-8%	12%	3%	11%
Number of employees	1325	1413	1428	1829	2034	2076
Growth rate (%)	-	7%	1%	28%	11%	2%

Univerexport, which supplies primary school “Đorđe Natošević”, is a large company and it has wide distribution network across the whole country. This is a relatively financially prosperous company that records positive business results in the observed period of time. Based on data given in the following tables, we can conclude that, after a short period of decline, more specifically negative growth rate of -1% and -8% in 2012 and 2013 respectively, this company records significant growth rates in last three years. Increase in the number of employees that goes up to 28% in 2015 is additional proof of this.

Table 15: Business overview of Catering & Bake company for 2012- 2017 period.

Catering & Bake	2012	2013	2014	2015	2016	2017
Net profit	4300	6551	6655	10491	16271	-17312
EBIT (operating margin)	5056	7702	7829	12341	19138	-17312
EBITDA	5637	7894	8077	12588	21365	-9226
Cash	0	148	471	2277	4973	0
Working capital	-9823	-8295	-19048	-19913	19381	-143890
Obligations to suppliers	20920	9778	18568	26516	26346	16865
Productivity	6	3	3	3	4	2
Total income	126215	109279	143454	164685	470972	509434
Company size	small	Micro	Micro	micro	micro	Micro
Operating income (EUR)	126215	109279	143454	164685	470972	509434
Growth rate (%)	-	-13%	31%	15%	186%	8%
Number of employees	4	3	6	9	12	13
Growth rate (%)	-	-0.3	1.0	0.5	0.3	0.1

Catering & Bake, the supplier of “Ljuba Nenadović” school, was a small company at its beginning and became a micro company in the last five years. Excluding negative business results in 2017, the company had positive results over the period of previous five years. When it comes to company growth rate, estimated on the basis of size criteria, we can conclude that the company had constant growth tendency and it increased the number of employees from three to current 13. Similar growth rate is evident in business revenue throughout the observed five-year period. Considering the importance of cooperation with schools, the revenue generated from contracts with “Ljuba Nenadović” school is insignificant and amounts to 0.004% of company’s yearly income.

Company DON DON Serbia was founded in 2008 and is part of the DON DON group which operates since 1993, headquartered in Slovenia. It is classified as a large company and has operations in Serbia and neighbouring countries (Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Kosovo and Bulgaria).

The company is a leader in producing fresh, packed and freezed bread and pastries. In addition to continious improvements in production technology, this company keeps up with the trends in nutrition quality. Therefore, the company operates in line with the highest standards in baking industry (HACCP, ISO 9001) and offers pastries without additives and numbers E.

Besides the main production facility located near Belgrade (place: Pudarci) company has several other production facilities such as: Fidelinka bakery Subotica, Žitoprodukt Zrenjanin, Žitopek Niš, MS bakery Jakovo, Zlatni Pek Leskovac, AD Pekarstvo Kraljevo i Žitoprodukt Kragujevac.

Table 16: Business overview of Don Don company for 2012- 2017 period.

Name	2012	2013	2014	2015	2016	2017
Net profit	606340	1657594	1027701	1637469	1440922	2269139
EBIT (operating margin)	1276795	3265886	4048800	-52867	2770881	2421267
EBITDA	1431661	3555535	4446946	558663	3587396	3843864
Cash	274186	104141	2516173	1217132	6232548	827186
Working capital	-1432549	-223199	-1206490	1963937	132840	-1579199
Obligations to suppliers	7923720	6317478	8715251	8738930	11373304	11929753
Productivity	3	3	3	3	2	2
Company size	Large	large	large	large	Large	large
Total income	27808585	36877910	40251359	45128093	45774858	55788118
Growth rate (%)	-	33%	9%	12%	1%	22%
Number of employees	619	635	707	622	853	915
Growth rate (%)	-	3%	11%	-12%	37%	7%

When it comes to DON DON's financial health, from the table below we can see that it was recording continious growth, exceeding even 30% in certain years. Additionally, the level of investments in technological support and new production systems is very high. Growth rate of the number of employees, the second indicator of economic value, affirms the abovementioned, with the exception of 2015. In 2016, number of employees increased by 37%. This was due to the opening of the production plant in Kragujevac, specialized in tost production. Daily production capacity, of only this production facility in Kragujevac, amount to 100,000 tost pieces. Cooperation with schools is good, but the revenues generated through this channel are insignificant and represent less than 1% of total company revenue.

As is evident from the earlier detailed analysis of each school supplier that belongs to LOC model, they are predominantly micro or small companies, with the exception of Univerexport and Don Don, which are large companies. All companies have good business results and record a positive growth tendency in the previous five years. In addition, although the companies positively evaluate their cooperation with the schools, the level of income generated from that process is usually low, compared to their total yearly revenue. Despite the business with schools has neglectible impact to overall company performance, suppliers view the cooperation with schools as very good to excellent. This is mainly due to already established procurement activities, payments as well as excellent relationships with schools procurement representatives.

6.4.2 *Economic value in LOW model school meal chains*

In the same manner as presented for the LOC model schools, we will give the overview of defined indicators for every LOW model supplier, and then proceed to a more detailed information about their size, growth and financial significance of cooperation with the schools. Data presented in the following sections pertain only to suppliers which are further than 15 km from schools (as defined by criteria), while suppliers in vicinity within 15 km from schools, are not analyzed.

Table 17: Economic value of school meals contract in LOW model chains

Supplier of school	Size of total business		% turnover dependent on Contract[38]	Growth rate in last 5 yrs	New business won as result of contract
	employees	*turnover in EUR*			
Big trade	105	12687378	0.25%	Average growth rate (employees): 1% Average growth rate (turnover): 14%	Negligible
Mlekobel	14	737858	5%	Average growth rate (employees): -4% Average growth rate (turnover): -4%	Negligible
Zorić	78	476485	10-15%	Average growth rate (employees): 22% Average growth rate (turnover): 6%	Negligible
Frikom	910	109862188	0.03%	Average growth rate (employees): -1% Average growth rate (turnover): 4%	Negligible
Komercservis product	13	1673061	30%	Average growth rate (employees): 11% Average growth rate (turnover): 22%	Significantly

Mlekobel, the supplier of "Kosta Trifković" school, was founded in 1996. It has been involved in the process of school supplying for 18 years. Less than 10% of goods is delivered to schools (around 5% of revenue comes from contracts with schools). Schools are small consumers, children's meals are moderate, and quantity of milk within meal portion is small. Considering the financial state of the company, Mlekobel had a rapid business declines in 2014 and again in 2017.

[38] The pecentage in table shows the share of supplier's turnover coming from the contracts with sample schools, except for two suppliers, Zorić i Mlekobel. These two supplers provided us with the data on the % of turnover coming from the contracts with all schools supplied.

Table 18: Business overview of Mlekobel company for 2012- 2017 period.

Mlekobel	2012	2013	2014	2015	2016	2017
Net profit	39783	53061	835	1866	3888	945
EBIT (operating margin)	46395	68055	2852	12793	-14311	-45234
EBITDA	58539	78113	11169	23112	-2843	-33164
Cash	8802	5888	5432	19174	510	6001
Working capital	44786	94721	79184	72953	73336	83969
Obligations to suppliers	74975	80084	60790	49184	56612	50358
Productivity	7	8	7	7	6	7
Company size	Small	micro	Micro	Micro	micro	Micro
Total income	932181	1047643	821539	800363	738789	737858
Growth rate (%)	-	12%	-22%	-3%	-8%	0%
Number of employees	18	16	12	13	15	14
Growth rate (%)	-	-11%	-25%	8%	15%	-7%

Considering the fact that this supplier is 75 km away from “Kosta Trifković” school, we can conclude that school’s procurement budget does not retain in the local area of the school, but it is allocated to the local area of the supplier. Cooperation with schools is quite good, considering orders placed and payments. All arrangements with schools are formalized through tender procedure, so there is no room for recommendation among schools, because the final choice of supplier depends on tender procedure and biddings.

Bread and pastry procurement in “Kosta Trifković” school is another example of LOW supply chain model. The supplier is company Zorić from Temerin. Namely, Zorić is located approximately 18 km from the school. Apart from pastry, which amounts to 80% of delivery, additional 20% is related to milk and dairy products provision. The supplier produces bread and pastry, while the milk and dairy producst are obtained from another supplier and delivered to the school.

As we can see in the following table, Zorić is a small company, which had positive growth rate of 9% per year in the observed five-year period. Consequently, business growth rate is accompanied by constant increase in the number of employees, which reached 26% in some years. Approximately 10-15% of total revenues come from schools procurements. 35 employees work in bakery, while 10 out of 35 people work for schools procurements. All employees come from local area, which is outside of “Kosta Trifković” school area. This implies that school’s funds leave its local area.

Table 19: Business overview of Zorić iz Temerina company for 2012- 2017 period.

Zorić	2012	2013	2014	2015	2016
Number of employees	35	45	49	62	78
Net profit	142580	248199	204881	265987	114892
EBIT (operating margin)	165892	345022	262438	283911	79054
EBITDA	176418	362799	284553	288951	151775
Cash	50959	17995	28787	39991	54206
Working capital	516786	571239	498031	669174	750994
Obligations to suppliers	250751	248748	228037	168114	254332
Productivity	29	17	13	10	9
Company size	small	small	Small	Small	Small
Operating income	3826939	4185051	4353335	4754555	4764850
Growth rate (%)	-	9%	4%	9%	0%
Number of employees	35	45	49	62	78
Growth rate (%)	-	29%	9%	27%	26%

The company Komercservis product was founded in 2000 in Novi Sad. It is specialized for public procurement for different types of public institutions (hospitals, schools, kindergartens, military, Ministry of Interior etc). Since the inception, company takes part on tenders for public procurements for schools. At first it was ad hoc process, but later on, the process of tender application was formalized and nowadays company takes part on almost every tender in Vojvodina. This is a small business subject that, apart from the last year, mainly records positive business results. Revenue growth rate went over 30% in some periods, which can be seen in the tables below. The number of employees increased in the last period, as well. For example, employee growth rate was 25% and 20% in 2014 and 2015, respectively. The employees are not divided into sectors ie. they are all involved into all procurements. All employees work on school procurements and they all live in local area.

Table 20: Business overview of Komercservis company for 2012- 2017 period.

Komerservis product	2012	2013	2014	2015	2016	2017
Net profit	66770	74222	36790	81882	96669	16527
EBIT (operating margin)	69593	73987	38352	99748	82788	6044
EBITDA	72996	78043	43329	107789	90352	14552
Cash	27753	54744	44404	42844	65083	95845
Working capital	105216	169048	183468	151472	80731	87218
Obligations to suppliers	120895	131069	74439	134428	188569	235480
Productivity	84	59	74	44	38	36
Company size	Small	Micro	Micro	small	Small	Small
Total income	637725	869515	1063209	1288786	1714684	1673061
Growth rate (%)	-	36%	22%	21%	33%	-2%
Number of employees	8	8	10	12	13	13
Growth rate (%)	-	0%	25%	20%	8%	0%

Number of schools that Komercservis supply is significant, but these procurements are not of the great value, so the total participation of schools procurement contracts in total revenues is app 30%. Cooperation with schools is rated with 4 on the scale from 1 to 5. Main challenges exist in the area of capacities for storage, cook's requests, lack of staff's knowledge of legislation. On a basis of recommendation, company got certain agreements with other schools. For example, schools have invited this company for procurement and for 3 years now, Komercservis supplies these school.

Apart from the mentioned suppliers, we can identify other suppliers that also belong to LOW model such is Big trade. This supplier has not wanted to participate in the interview, thus the information related to its size were collected from its respective official financial statements (see table below).

Table 21: Business overview of LOW model companies for 2012- 2017 period.

Suppplier of the school	Indicator	2012	2013	2014	2015	2016	2017
Big trade	Total income (EUR)	7170535	7581543	6691347	7142760	7862508	12687379
	Growth rate (%)	-	6%	-12%	7%	10%	61%
	Number of employees	119	170	177	179	163	105
	Growth rate (%)	-	43%	4%	1%	-9%	-36%

6.4.3 Comparison of economic values in LOC and LOW model chains

When it comes to this indicator, no major differences can be observed between the investigated models. In both cases we face with companies which have relatively stable performance with occasional variations in number of employees and revenues. Perhaps the only significant difference, in which schools from LOC model have an edge over schools from LOW model, is the size of the suppliers. Companies, which supply schools from LOC model, are categorized as micro or small companies with the exception of one specific supplier. This enables schools to develop closer cooperation with suppliers and establish higher level of flexibility when it comes to entire supply process, which was confirmed in the interviews with several schools from LOC model.

7. SOCIAL IMPACT OF SCHOOL MEALS SERVICES

7.1 Methodology to measure social impact

The goal of the social impact analysis was to assess what social values were generated by the operation of the LOC and LOW school meals services. In order to better understand the extent of the integration and inter-dependence of members in supply chain, we have performed in-depth interviews with both school kitchen staff and suppliers representatives. The main aim was to comprehend whether one type of the procurement model (LOC vs. LOW) creates more jobs than the other or if it influences bargaining power among stakeholders. The indicators we took into account to measure social impact were:

(i) employment-related criteria. Under this heading, we gathered data on the number and types of jobs linked to the school meals service, and the diversity profile of staff and levels of training/skills development in place within the businesses participating in the supply chain.

(ii) criteria relating to the working environment of the service chain and connectedness of people within it, including rural communities. Under this heading, we gathered data on the well-being and job satisfaction of interviewees, and their testimonies relating to how much they engaged with others in the supply chain, and what kinds of activities/occasions such engagement represented. Within this, we explored the extent to which the school meals procurement brought caterers and schools into contact with rural and farming communities that produce food items.

Given the small sample sizes of informants in both Cases, we give a descriptive reporting of the results relating to the above indicators.

7.2 What are the employment-related impacts of school meals services?

7.2.1 Employment related impact in LOC model school meals chains

Table 22: Employment related impact of school meals service in LOC model chains

Name	Total Employees (n)	FT:PT (%)	Seasonal (%)	Male: Female (%)	Age	Education	Ethnic Minority (%)
Avala Merkur	5	100:0	0	60:40	31-40: 2 Over 60: 3	High school:5	0
Market padina	15	100:0	0	10:90	21-30: 4 31-40: 4 41-50: 4 51-60: 3	High school: 14 College: 1	7
Univere xport	2076	Large majority: FT PT – when	0	30:70	up to 20: 42 21-30: 623 31-40: 727 41-50: 310 51-60: 270 over 60: 104	Elementary school: 104 High school: 1765 College: 62 University: 145	

		need arises					
ILLI group	46 (16+30)	35:65	0				

Note: FT – permanent job; PT – part-time job; Catering & Bake refused to participate in this research.

It is observable from the above table that there are no seasonal employees in Avala merkur, while number of men is higher than the number of women. All employees are full-time employed, with no part time workers. Company does not conduct any training on skills improvement, seminars, workshops, etc. When they hire a new employee, they make efforts to explain them the importance of every customer. Also there is mutual support between employees in adopting new knowledge. The informant states that there is no employee who is currently learning for new qualifications.

In Market padina skills improvement trainings are organized within company. Between employees exist mutual support for acquiring new knowlege. Interviewee says that he thinks that the fluctuation rate is average, like in the other companies in Serbia. He also emphasizes that it is hard to find high quality employees and states that the workers quit the job when they are offered a higher salary. All employees come from local area, they work full-time and they are permanently employed in company. Rarely, company takes seasonal workers when this is necessary.

There are about 2,100 employees in Univerexport, who work in their stores all over Serbia. The most of the labourforce has primary and secondary education degrees. In the office designated for tenders and trade unions currently work four persons, but very soon, their number will be reduced to two. They will be dominantly in charge of delivery management. At this moment, 99% of deliveries are successfully implemented. Moreover, five persons are in delivery team for schools, which makes about 0.25% of their overall labourforce. Given that Univerexport has revenues of more than 133 million of EUR yearly, the share of income by schools represents its minor part.

Table 23: Employment related impact of school meals service in LOC model schools

School name	Number of kitchen staff	Net salary a month per worker (in EUR)	Live locally	Live outside local radius
Ljuba Nenadović	2	191.67	2	0
Đorđe Natošević	3	216.67	0	3
Miloš Crnjanski	4	204.17	3	1
Dositej Obradović	2	187.50	2	0

The size of the team in the kitchen is rather equal in all schools in LOC model. Approximately one third of kitchen staff live outside the radius of 15 km from school, while they receive pretty unequivalent monthly salaries, with an average of almost 200 EUR (199 EUR). Given that Đorđe Natošević school is located in the centre of Novi Sad, where living cost attains much higher than average value, it is not surprising that kitchen staff cannot afford it, thus they live further from school. The kitchen staff is comlpetely consisted of females, who works as the chefs, serving ladies, kitchen support staff, etc. Their working day usually starts at 6 a.m. Schools do not provide any trainings for cooks, nor they have resources allocated to that purpose. The school kitchen employs trained kitchen staff.

In Ljuba Nenadović school, one cook reports to have a diabetes, so she has difficulties with walking and standing and she cannot help with kitchen cleaning. In Miloš Crnjanski school, total number of employees is four, three females and one male. Three employees live in the proximity of the school and spends their earnings in local area. All employees have completed training, which is usually conducted by more experienced kitchen staff. Cooks from Dositej Obradović mentioned that their salary has been reduced for more than 10% recently, but not mentioning the reasons for that.

7.2.2 Employment related impact in LOW model school meals chains

Table 24: Employment related impact of school meals service in LOW model chains

Name	Total Employees (n)	Permanent: Part time job (%)	Seasonal (%)	Male: Female (%)	Age	Education	Ethnic Minority (%)
Zorić doo	93	100:0	0	30:70	Under 20: 5 21-30: 34 31-40: 34 41-50: 10 51-60: 5 Older than 60: 5	Finished Elementary school: 10 Three-year High school: 39 Four-year High school: 39 College: 1 Faculty: 3 Master/PhD studies: 1	35
Komercservis Produkt	14	100:0	0	50:50	21-30: 2 31-40: 5 41-50: 5	Four-year High school: 11 College: 1	n/a

					Older than 60: 2	Faculty : 2	
Mlekobel	20	100:0	0	50:50	21-30: 15 31-40: 5	Elementary school: 2 Four-year High school: 15 College: 3	20

Note: FT – permanent job; PT – part-time job; Big Trade and Palanka Promet refused to participate in this research, while Univereksport and Avala merkur are explained in the previous model.

Informant from Zorić states that bakers voluntarily do some trainings for skill improvement, while there is also mutual support among co-workers for adopting new knowledge. However, there is no employee who is currently learning for new qualifications. The absence from work is not very common, whereas the most usual reasons are sick and maternity leaves. The owner has never fired a worker, but some of them quit in order to go to live abroad.

The interviewee from Komercservis thinks there is no place for training or qualifications improvements, given that they have enough workers with the graduation (faculty or college diploma) degree. He reports fluctuation rate of 0%. Moreover, he cites that their company rarely faces with the absence of workforce.

In the workforce of Mlekobel there are three people of Hungarian origin. In terms of training, firm emphasized that every new employee must go through the training on Safety at work. This training is oral, but in the case of drivers, it includes field training. In case of production, this process is slower. In the beginning, new employee in production starts doing tasks like cleaning and chopping, while in time their salary growes. Among employees exist mutual support for acquiring new knowlege. The informant states that there is no employee who is currently learning for new qualifications. She also adds that there are a lot of employees who already have families, so maybe that is the reason of situation like this. Absence rate in the company is very low. They experienced a large number of maternity absence in previous period, but currently there is no one on that sort of leave. Mlekobel allows a few days of absence in situations like absence due to illness of children and so forth.

Table 25: Employment related impact of school meals service in LOW model schools

School name	Number of kitchen staff	Net salary a month per worker (in EUR)	Live locally	Live outside local radius
Kosta Trifković	6	191.67	4	2
Gavrilo Princip	2.5	216.67	2.5	0

Pavle Savić	2	187.50	2	0
Drinka Pavlović	5	195.00	1	4

The size of the school kitchen team varies from 2 to 6 members, with an average number of 4. It consists of the females dominantely, while almost 40% of them live at a distance of more than 15 km away from the corresponding school. Analogous to the explanation for Đorđe Natošević school in previous chapter, the same holds for Drinka Pavlović school. Given that Drinka Pavlović is in the hart of the capital city, which implies much higher than average cost of living, it is not surprising that almost all kitchen staff live outside local radius.

Schools do not invest any funds into additional education of cooks and they do not provide any perks nor financial assistance for them. The average salary is slightly below 200 EUR (198.50 EUR), while it is the greatest in Gavrilo Princip school. In the same school, one woman is part-time employed and works 4 hours a day, only for the assistance. Working day in all schools but in Pavle Savić starts at 6 a.m. In Pavle Savić it starts at 5.30 a.m. and their salary has been recently reduced for more than 10%.

7.2.3 Comparison of employment impacts in LOC and LOW model chains

Due to specific nature of procurement system in Serbian schools, in which each school organizes tender for itself, the collected data cannot be generalized, but they can serve only as indicators of possible state of affaires in supply chain that belong to different models.

It is noticeable that suppliers who work in LOC model are dominantly trade companies, while the ones which are involved in LOW model are usually production companies. All of them employ local citizens, which is understandable due to lower transport costs and rather high unemployment rates in the investigated municipalities.

It may be observed that production companies tend to employ less educated staff, with the majority obtained high school degree, while with a significant share of people with only elementary school degree. It might lead to the conclusion that LOC model supply chain creates more higher-paid job posts (for people with higher degree of education) than LOW model supply chain. Nevertheless, it can be result of the industry sector in which investigated suppliers work, since production usually requires more manual workers than trade does. This notion is also reflected in the age distribution, given that there is significant share of younger than 40 workers in production companies. Gender structure is similar in both models and expected from the point of view of working sectors (e.g. women dominantely work in bakeries).

Furthermore, production companies are usually organized as the enterpreneurs, while trade companies are mostly limited liability companies or corporations. From the table presented below, it is observable that average salaries significantly vary between these two. While in entrepreneur companies it is about €220, in other companies it is almost as twice as that (about €43). Therefore, employment in LOC model might have higher positive impact than the employment in LOW model.

Table 26: Net salaries according to the employer profile, July 2018

	Net salary (RSD)	Net salary (EUR)
Republic of Serbia	49202	410.02
Avarage salary of employees with permanent contracts	49565	413.04
Avarage salary of employees with permanent contracts	32099	267.49
Average salary of employees in legal entities	52172	434.77
Average salary of enterpreneures and their employees	26796	223.30
Average salary in public sector	54887	457.39
Average salary in non-public sector	46401	386.68

Source: CEKOS IN, http://www.cekos.rs/prose%C4%8Dne-neto-zarade-plate-jul-2018-godine

The employment of national minorities in supply chain members is mainly correlated with the general structure of the population in certain parts of the country in which these actors do their business. According to Census from 2011 (Statistical Office of the Republic of Serbia, 2011), ethnic minorities constituted 16.67% of population in Serbia. However, their share in Northern part (Vojvodina) was 33.24%, while in Belgrade region it was 9.28%. In line with that, it is understandable why firms which operate in Vojvodina report higher share of ethnic minorities among their employees, than the ones which are situated in the central and Belgrade regions.

Finally, in schools in both investigated models approximately 35% of kitchen staff live outside the local radius of 15 km. This is understandable in view of the fact that two schools (Đorđe Natošević in LOC and Drinka Pavlović in LOW) in the sample operates in two the most prosperous parts of the country (as explained in the school profiles in chapters 3 & 4). Thus, employees earning minimum wage cannot afford living in these wealthy neighbourhoods.

7.3 What is the working environment and connectedness in school meals services?

In order to better understand the opinions of various actors included in the supply chain, we have conducted satisfaction survey among some of employees of some of suppliers, along with the in-depth interview perfomed with a company representative. Besides that, the interviews with school cooks, principals and secretaries are undertaken, in order to examine their views related to the connectedness of stakeholders in supply chain.

7.3.1 Working environment and connectedness in LOC model chains

Avala merkur has been founded in 1992 as a trade store (entrepreneurship) and later on it was transformed into LLO. The owner and CEO is a female and her responsibilities are: purchases of food items from well-established suppliers, monitoring of tender documentation, control of food items, cooperation with wide range of suppliers, etc. She has undertaken management of company in 1995 when she was fired from previous job and since that period she has managed the company. She does not take part into local or state parties or any other type of activities.

SME should have large experience in preparation for tender, according to her words. She deals with this type of job for 35 years. Her company's clients were kindergartens, hospitals and other public institutions. After introducing model of unified procurements, her company stopped with procurements for kindergartens because only one supplier gets the tender.

This company cooperates with primary school Dositej Obradović and there was no interruption in cooperation with school. Current cooperation with primary school Dositej Obradović is rated with 5 on scale from 1 to 5. Besides, Avala merkur also cooperates with Pavle Savić and Gavrilo Princip schools. However, the respondent states that primary school Pavle Savić is a small school, so they order very small quantities, a half of kilo of rice or few litres of milk, for example. Communication with schools depends on situation. This company donated commodities to school for pupils with defected sight and sometimes cooperates with schools for some special events.

Supply procedure foresees that when schools demand food items (Monday or Tuesday morning), Avala Merkur contacts its suppliers in order to purchase those items and deliver them to school as soon as possible. Company has an outsourced accounting which means that bookkeeping is done by subcontracted agency, while Avala Merkur issues and receives invoices and following documentation. All employees work full time and there are no seasonal workers. All employees work on activities for school procurements.

The informant has mentioned that all data from tender documentation are public and that her competitors misuse these data for unfair market play. She thinks that there is trust between her and her partners but she doesn't feel enough protected about her business information. She faced with situations in which their competitors found some information about her suppliers and used it to get tender, so she lost it. This company has not experienced communication with local bodies.

Market Padina company was founded in 1990 and their headquarters are in Čukarica. Even though the official founder is a female, most of the management is operated by her husband. Core business is trade, but, beside trade, this company has its own production of pastry and bread and a newsstand. The company currently cooperates with three schools. Cooperation with two schools is informal, ad hoc based i.e. these schools buy from Market Padina when it is necessary (there is no contract signed between these two parties). Market Padina has food procurement contract only with “Ljuba Nenadović” school. According to our interviewee, the school expressed great satisfaction regarding cooperation with Market Padina. Marked Padina rated it with mark „4“ (marks are between 1 and 5, where the mark „5“ is the highest). This company enjoy trust in supply chain. The retailer has done procurements for schools for the past 10 years. At the very beginning, supplying process was ad hoc i.e. when the school had an order to make, it contacted retailer and retailer supplied them with necessary goods. The procurement process was formalized a couple of years ago. Retailer mentioned that significant barrier for entering the tender process is excessive documentation. Documentation preparation is time-consuming process and it has discouraged this company to take part in tenders. They think that if documentation volume is reduced, it would be incentive for the retailers to participate in tenders. Moreover, they think that many requirements cited in tenders calls are unecessary, such as to have 5 trucks or 3 vans if you want to apply for tender.

Market Padina supplied National Bank of Serbia for years with necessary goods. The cooperation stopped because NBS fixed prices of goods in contract, whereas prices on market were constantly increasing. This meant that Market Padina had to buy goods on market from producers on high prices and sell them to the NBS on lower prices (it generated loss for Market Padina). Retailer also supplied kindergartens, but they had certain problems with delayed payments, so the company decided to end the cooperation.

All company staff is involved in the process of supplying to the schools. The shift manager is in charge of this process (there are two shifts and two managers) and he/she organizes delivery for that day according to specification which school sends for particular day. Food is delivered directly to schools, every second or third day. All food in the delivery tour is intended only for schools. The food is transported by one vehicle (Mercedes), specifically designated for school. Consumption is 12 liters per 100 km. They plan to buy Caddy with Thermo King, which will only be used for school. When food is delivered, the distance is 5-6 km. There is no delivery during school breaks. They participate in delivery if school events and celebrations are organized.

All employees come from local area, which implies that a part of companies income that is used for employee salaries is retained in local community, but this is not the case when it comes to company's payments to its supplier. Namely, this retailer cooperates with significant number of suppliers outside of local area. The reason for this is required quality. For instance, company buys veal from Sjenica, a town 255 km away from Belgrade, buckwheat flour comes from Užice, which is 168 km away from Belgrade. They have all kinds of fruits and vegetables. Everything is fresh. Milk and dairy products are purchased from local suppliers (Belgrade and the surroundings of Belgrade). Pasta, oil, vinegar are purchased from local suppliers. Bread and pastry they produce (they have bakery). They do not import meat. They get meat from the slaughterhouses. The suppliers are "Nedeljkovic" (pork meat), "Agro livestock" (beef and veal meat), "Agro-Mil" - Kruševac (chicken), "Delikates" - Sjenica (lamb and veal), fish ("Frikom", "Talas ribarstvo", "Principal Duo"). Approximately one tone of meat is delivered per week. A warehouse is located across the road from the store, and soon the construction of new 1000m2 warehouse, located in Železnik, will be finished. The company also owns storage space next to the retail store.

In our satisfaction survey, we investigated three members of staff. All employees rated facility equipment as „excellent" and all of them think they have enough rights to say or participate in food production/procurement activities. On question „In which degree do you feel like a part of this company", average mark was 4.33. Speaking of emotion of support for developing new skills, two employees marked it at 3 and one at 4. All 3 employees rated general work satisfaction as „pretty satisfied" (grade 4).

Univerexport was established in 1990, as the trade company (both for domestic and international trade). Throughout time, they have built their brand and nowadays their shops are present in all towns all over Vojvodina and Belgrade. The firm was established by a female. It has 36 retail stores in its distribution network, five wholesales and three subsidiary companies. The subsidiary companies are: Mesna industrija AD Bačka, Trgopromet and AD Alba. Although Univerexport was founded as a family company, its rapid development started only a year later, and during this period the company grew from opening storehouses for warehouse operations to the opening of the first wholesale and the first retail store. Univerexport now operates through several trade forms: wholesale, supermarkets, markets, mini markets. Although it is registered as retail and wholesale trade company, this company has its own trade brands such are: Bašbaš, UNI, Bubzi, Dajdaj, Merzer, Dirka and D'ardi.

They supply three schools – two in Novi Sad and one in Belgrade and they rate communication with them at very satisfactory level – 4, while there have not been any interruptions in their partnership for the tenders that they won. They communicate with schools' representatives on a daily basis – either by telephone or by email. Univerexport has taken part in numerous schools' activities, such as charity initiatives, donations, education, packages for the first graders, etc. In addition, the company operates its own charity foundation which specifically finances projects in the domain of education, in which many primary schools from Novi Sad participate.

The food is delivered to schools from Novi Sad on a daily basis, while for school in Belgrade the delivery is outsourced to other company. Respondent emphasizes that it would be better if the frequency of deliveries would be organized more rarely and if there would be less lots (optimally: only one) in a tender. Even though there are 14 purchasers from Novi Sad to whom Univerexport delivers goods in three tours daily, the majority of goods in each tour is designated for two schools that they deliver to. They do not perform deliveries during holidays seasons.

This company cooperates with local producers during the season of some fruits and vegetables, and in that period of time approximately 20-30% of F&V quantities are procurred from local producers. Sometimes, company buys organic F&V from local producers, but thy could not estimate the share of it. Other part of the quantity comes from imports. Besides, they also collaborate with bigger local companies, such as MDD from Kać (village next to Novi Sad), which operates in retail and wholesale. It is very important to mention that Univerexport owns meat production company and supplies schools with pork and beef meat produced in it (AD Bačka from Vojvodina region). They purchase chicken and turkey meat from different producers, while they procure meat products from well established brands, such as Neoplanta, Carnex, etc.

ILLI group was founded in 1995 in Novi Sad by a female. The company is specialized in the production of pastry and frozen goods, while monthly production volume amounts to 300 t. The average time of employment of 30 workers in production is 10 years, proving the good working environment and atmosphere in ILLI group facilities. ILLI group is a stable company that has recorded positive business results in the past five years. Apart from the last year, productivity and profitability indicators have a tendency of growth. Potential cause of somewhat lower business revenue in the past year are large expenditures in the form of investments in expansion of distribution network to surrounding countries. The proof of company's stability and long-term vision are its customers. Among company's most important clients are the four biggest retail chains in the country, the biggest ice cream and frozen produce producer in the country, leading distributors in the region as well as one of the biggest food companies in the world. ILLI group has long-term contracts with all of them.

Interviewees from schools in LOC model stressed the importance of the selection of well known bidders to be their supplier. For instance, they mentioned that once they had to organize the second tender when their previous bakery products procurer was closed due to big affair of poisoning children with food on a territory of Belgrade. They cite that they have good communication with suppliers and usually long tradition of collaboration with them.

7.3.2 Working environment and connectedness in LOW model chains

Zorić doo dompany has been founded in 1992 year in Temerin. The lack of employment forced the owner to start his own business (he searched a job suitable for his high school education - electrotechnical school, but there was no job for him). He decided to open a retail store with his friend. Later on, he decided to finish his studies in the area of management. Today, he manages the whole process, closes deals, determines major actions in everyday business etc. His company employs 93 persons. Zorić doo encompases production of pastry (bakery) and 10 retail stores.

He states that he is not member of any local or state political party and he is not in any leading position in municipality. Sometimes, he gives financial support for voluntary and sports activities. The company's communication with schools and local bodies is just on a business level and he reports to have good communication with all partners in supply chain.

Zorić doo started cooperation with schools six years ago, when his bakery started operating. His company applies each year for tenders and once the tender has been won, contract is signed for a year and there is no interruption in cooperation with schools. Zorić doo participates in approximately 20 tenders per year for different institutions. Company currently supplies 5-6 schools, but the informant was reluctant to disclose the names of these schools. Current cooperation with schools is rated with 4 on a scale from 1 to 5. Space for improvement is dynamics of delivery. He mentions that it is easier for his firm that pastry and dairy products (as main food items) are delivered once a day. Zorić doo produces pastry in bakery and 80% of delivery is pastry. Pastry is produced during night and it is delivered to schools next morning. 20% of total delivery are dairy products which Zorić doo purchases from large, well - known companies (such as Imlek).

Figure 28: Supply chain of Zorić company

According to the interviewee, he purchases ingredients for pastry production (flour, oil, etc.) on a basis of price criterion. He mentioned that his company buys from producers who offer the lowest price, even though they do not come from local area. He was not willing to share information about percentage of suppliers who do not come from local area.

Three employees have been asked to rate their answers on the scale from 1 – not satisfied at all to 5 – totally satisfied. The average mark for the emotion of belonging to this firm is 5, while general job satisfaction is rated as „totally satisfied". Concerning their participation in the functioning of procurement and production all three employees rated it at 3 - “enough“, facility equipment at 5 (excellent) and support for developing of new skills at 4 (very much).

Komercservis has been founded in 2000 in Novi Sad. It is specialised for public procurement for different types of public institutions (hospitals, schools, kindergartens, army, Ministry of Interior, etc.) encompassing 75 institutions in total. Company is owned by two males and one female. It is family owned company, while the CEOs are sons of the founder. However, original founder is a responsible person for schools procurements. There are 14 employees and they are not divided into sectors i.e. they are all involved in all procurements. Our interviewee highlights that he is not on position in municipality and he is not member of any political party.

Since its foundation, the company takes part in tenders for public procurements for schools. Firstly, it was an ad hoc process, but later on, the process of tender application was formalised and nowadays company takes part on almost every tender in Vojvodina. Number of schools that Komercservis supply is significant, but these procurements are not of the great value, so the total share of schools procurement contracts in total revenues is about 30%. The list of primary schools that they have procured in 2017/2018 is:

1. Dositej Obradovic, Novi Sad
2. Jovan Popovic, Novi Sad
3. 9. maj, Zrenjanin
4. Servo Mihalj, Zrenjanin
5. Žarko Zrenjanin, Novi Sad
6. Petefi Šandor, Novi Sad
7. Kosta Trifković, Novi Sad
8. P.P.Njegoš, Zrenjanin
9. Vuk Karadžić, Zrenjanin
10. Vuk Karadžić, Novi Sad
11. Sonja Marinković, Novi Sad

During 17 years of cooperation with schools in rare occasions there was disruption in supplying. The main reason are changes in tender conditions (for example, unified procurement where all products are unified in one group instead of allocation in few different parties - meat, F&V, diaries, etc.) or simple school wants to change source of procurement. These occasions are rare, because with most of the schools company cooperates for 10 years or more. Cooperation with schools is rated with 4 on the scale from 1 to 5. Main challenges are noticed in area of capacities for storage, cook's requests, lack of staff's knowledge in legislation area. Informant states that there is trust between actors in supply chain and he emphasizes trust is really important matter when doing business with someone.

Komercservis is a mediator between producers, wholesalers and schools. This company buys goods and delivers them to schools. Certain goods are previously stored in Komercservis's storages and certain types of goods are directly delivered to schools.

Regarding the satisfaction, three employees rated it at 4.67. All employees answer that they feel free to say or to suggest some innovations in supply chain. Two participants rate equipment of building as excellent, whereas one grades it is average. They do not really feel encouraged to improve their skills, grading it at average score of 3.33.

The company ***Mlekobel*** has been founded in 1996 in Novo Miloševo. Novo Miloševo is a small village near municipality of Novi Bečej. It is family owned company, founded by a male, while in the near future, company will be led by his daughter. At the moment he organizes whole operating process, creates preconditions for continuous business performance and production. He does not take part in any local activities (volunteering, sports, etc.) and he is not member of any political party. Company currently employs 20 persons.

Mlekobel's products are: yogurt, sour milk, sour cream, cheese, cream cheese, white cheese and sheep sour milk. Mlekobel does not own its own cattle (cows and sheeps). They purchase milk from small local farmers. This milk represents the raw material for Mlekobel. After production process, there are several products that are above mentioned. There are several purchasing points and sometimes, milk is purchased directly from households (without bringing milk to purchases points). Milk is storaged in special milk coolers. Milk cooler volumes up to 2000 l. Mlekobel purchases 3,500 – 4,000 litres of milk on a daily basis. In case that production needs are lower than this quantity, Mlekobel sells excessive amount of milk to the other dairies. Mlekobel buys two types of milk (cow and sheep milk) from 58 small farmers (quantities significantly varies among farmers). All farmers are from local area. The longest distance between Mlekobel and farmers is 15 km. All other farmers are located closely to Mlekobel. After purchasing, milk goes to production process after which it is stored and delivered to schools and other institutions. Production process is regulated with HACCP and ISO standard 22000.

Mlekobel is involved in the process of school supplying for 18 years. Each year school announces tender for a period of supply of one year. Mlekobel applies for tender and if it offers the lowest price, it will win the tender. In that case, Mlekobel signs contract with school and it commits for dairy supply. Sometimes there is an interruption in school supply, if Mlekobel loses tender. In that case, other firm will supply concrete school with milk and dairy products fo a period of one year. Mlekobel is currently supplying following primary schools:

1. Miloje Čiplić from Novi Bečej;
2. Kosta Trifković, Novi Sad
3. Petefi Šandor, Novi Sad
4. Miloš Crnjanski, Novi Sad
5. Jan Kolari, Novi Sad
6. Vuk Karadžić", Novi Sad,
7. Slavko Rodić, Temerin,
8. Vuk Karadžić, Zrenjanin,
9. Petar P. Njegoš, Zrenjanin,
10. Jovan J.Zmaj, Zrenjanin,
11. Dositej Obradović, Zrenjanin,

12. Šamu Mihalj, Bečej.

Beside these primary schools, Mlekobel supplies other public institutions like kindergartens, hospitals, gerontological centers etc. Cooperation with schools is quite good, considering orders placed and payment. They have been invited to school events linked with donations. Communication with local community bodies does not exist. Also there was no any help from authorities. Moreover, informants states that relationship with farmers is based on contract and mutual trust (bona fides principle)

Our satisfaction survey with three employees reveals that emotion of belonging to this firm is high, rated at 4. However, this emotion is not translated to their job satisfaction, rating it at 2, 4 and 5. They claim that they are very much included in the procurement and production process (3, 3 and 5). Speaking of facility equipment, two employees rated it as „average“, while the last one rated it as „excellent“. The feeling of support for developing new skills is rated as „average“ twice, while the third employee rated it as „pretty much“.

Informants from schools which apply „the lowest price“ criterion cite that it is difficult to find good quality products for the lowest price. They report a problem with fish procurement, since suppliers who offer meat, do not offer fish at the same time. Additional problem is quality of firms who apply for tender procedure. These firms are often small firms which do not fulfill all standards for food delivery. For example, after floods in Serbia, one supplier offered salad from contaminated soil; on the other ocassion school tested meat, i.e. sausages and it was determined that this sausage was not for human nutrition because there were blood clots, white parts of meat of unknown origin and animal whiskers 12 mm long. However, reknowned firms (with established brands) do not want to apply for procurement, due to very small values, according to our interviewees.

7.3.3 Comparison of environment and connectedness in LOC and LOW model chains

All respondents in both models state that they have a good cooperation, based on the long-term collaboration and mutual trust. However, all of them see some possibilities for the improvement of it.

In the LOC procurement system, trade companies compete not only for schools as customers, but also for local producers, as their suppliers. This may sometimes lead to unfair business practices and to lower level of trust among partners of supply chain compared to the LOW model. All parties mentioned trust as the basis for cooperation, but beside that, contracts can help the improvement of relations among partners too. However, it would require the signing of longer term contracts (both with second tier suppliers, as well as with schools). Moreover, improvement of personal relations between school secretaries and suppliers‘ dispatch office can be beneficial too. Majority of them stated to have professional relations, but usually limited to interaction between cooks and delivery staff.

It is interesting to note that even in LOW model, suppliers tend to procure schools which are in their vicinity, within 100 km range (please see the list of schools that they supply and geographical positions in the Appendix 1). It may be the result of their cost efficiency or ecological awareness, but more probably it is related to their familiarity with local legislation (Vojvodina region differs from Belgrade region in terms of food procurement laws) and state of affairs in the nearby schools.

It can be recognized that all three investigated companies in LOC model were established by women, while all three in LOW model were founded by men. Even though the small size of sample limits our potential for conclusions, it could indicate that women feel more confident and able to run trade than production companies.

Furthermore, it can be observed that in small companies (dominantly present in LOW model), all employees are involved in the tendering procedure, while the owner/general manager is in charge of this process. Even though that school procurument does not make the majority of their revenues, but usually smaller than a half of the income, it is clear that they value this partnership highly. Some of them mentioned the regularity of the payment for the goods delivered to schools, practice not much present in Serbian market, which is probably the most important criterion for this commitment. This appreciation of the partnership is also corroborated by the fact that they participate in school donation activities. Nevertheless, schools could invest more efforts into these relations, e.g. by inviting representatives of the suppliers to some school activities not always related to fund raising.

The importance of cooks in the food supply chain is manifold. As it was demonstrated by Jamie Oliver programmes, the coaxing of Nora Sands school chef was the crucial point in the programme. In most of the schools, in Serbia likewise in UK, cooks create menu and the quality of children’s diet will depend on their expertise and preferences in this field. Nonetheless, they are usually underappreciated in schools, earning minimum wage, working in bad conditions without almost any appliances and not having any opportunity to increase their competences. Moreover, they are usually only contact person in school who have correspondence with suppliers (their delivery team).

There have been several initiatives conducted jointly by schools and the suppliers, to improve children diet. The selected results are depicted in Table 27.

Table 27: Good practices on healthier meals in Serbian elementary schools

Good practice	No. of schools which listed the particular good practice
Education on the healthy diet – within classes or on the specific lectures (conducted by teachers, experts, institutes, etc.)	143
Local suppliers/caterers are used which positively influence freshness and quality of meals	13
There are donors who cover some parts of the meals’ costs	7
Schools participate in various regional or national projects (e.g. Honey breakfast, Let’s grow up healthy, etc.) on healthier eating	20
Promotioanal material (e.g. flyers, posters, etc.) is distributed	10

One of the prominent examples is „Honey breakfast“. Association of the beekeepers of Vojvodina launched this initiative in the city of Pancevo, when they gave lectures to more than of 1000 pupils of grades 1-4, and distributed breakfasts based on honey. This example is one of the rare actions which indicates schools‘ connectedness to rural/farming communities in either model.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 How could environmental, economic and social impacts of LOC model services be improved?

Although LOC supply model provides multiple benefits to schools compared to LOW model, still there are various elements in the model that can be improved in environmental, economic and social context.

Most of the suppliers using this model procure their materials from local producers. Still, there are a few exceptions. For example, certain suppliers from this model (e.g. Market Padina) purchase and transport raw materials from producers that are located more than 150 km away from them. This way, significant financial resources are spent on transportation (reflected through faster amortization of vehicles, higher spending on gasoline etc.). Additionally, replacing these producers with the ones from the local area of supplier and local area of school, would affect positively on the reduction of environmental pollution. Some of the suppliers from the LOC model do not have the adequately equipped transportation vehicles (e.g. Avala Merkurs vehicles do not have coolers). Improvement in this context might be reflected on the food quality that school gets.

On the other hand, procurement of food from the suppliers from local area sometimes implies procuring small quantities of food several times within the very short period of time. This has negative implications in environmental and economical sense. Better organization, long-term planning and centralization of procurement for schools in local area could yield certain improvements.

Employees are rated cooperation with other members of the supply chain as very good to excellent. Also, in most cases, newly hired employees go through job trainings organized by more senior and experienced colleagues. Additional improvements in social context can be achieved by introducing mandatory professional trainings in order for employees to be on track and familiar with the latest innovations and recommendations in their areas. Likewise, organizing more entertainment events with other members of supply chain would increase cohesion of its members. There are still no specific actions for developing food-related curricula, and involving suppliers/producers in that. However, certain schools are supplied by the Agricultural High School in their town, which indicates their orientation towards local procurement and the influence of suppliers to the menu quality.

8.2 How could environmental, economic and social impacts of LOW model services be improved?

The two presented models share many communalities in their systems, however, some differences could be observed too. Firstly, it seems that the model of procurement that is applied to schools, translates to the whole supply chain, i.e. suppliers which supply schools at the lowest cost tend to procure their raw materials based on the same criteria (e.g. Zorić), while suppliers which operate within LOC model with schools, tend to procure more their raw materials from LOC suppliers as well (e.g. Univerexport). Consequently, if all schools introduced the criterion of locality in their tender requirements, that would have significant spill over effects in the specific territory in which supply chain operates. More precisely, this measure would stimulate the presence of short food supply chains.

In the LOW model, high inter-dependence of members is present along the supply chain. The most often mentioned issue pertains to the storage facility. Due to very limited space capacities in schools, they are not in position to store greater quantities of goods. On the other hand, their suppliers – production companies, do not own enough of storage space neither. Moreover,

bigger suppliers in both models, who supply several schools, complained about the request from schools to deliver a few times a day or a week. Not only does this practice increases their cost, but they also cite negative impact for the environment. The solution can be found in joint rent of storage facilities, but this measure may demand longer term contracts, than a year, between suppliers and schools. The other possibility would be provision of credits with lower interest rate for schools and suppliers which want to enlarge their warehouses.

The satisfaction survey, conducted with some employees of LOW model suppliers, demonstrates high job satisfaction and positive working atmosphere among staff. However, they do not feel very much encouraged to improve their skills and competences, nor do they attend any sort of specific training. This is also true for the kitchen staff in schools, independent of procurement model. In this way, human resources remain at the same level or even deteriorate over time, due to changes that inevitably occur in the business environment. Additional education could help employees to exercise their full professional potential, increase their job satisfaction and enable them to better prepare and react to market changes.

8.3 What policy interventions would help?

The most needed policy intervention pertains to the tender procedure. Informants from all stakeholders in this research were unanimous in their opinon that tender procedures and criteria should be changed. However, their views differed according to their size and the position in supply chain.

Small producers emphasize that they have difficulties with preparation of the excessive tendering documentation and the requirement to have references from participation on previous tenders, which is especially challenging for newly established companies. Both of these issues increase entry barriers for new firms and negatively affect their possibilites to become involved in tender procurement. Respondents say that over time they have become more experienced and some of them outsource the preparation of documentation to some specialized agents, which greatly improves their prospects to apply for new and numerous tenders. In terms of the references, an interviewee proposed taking into consideration a weighting of previous cooperation with schools.

Complicated tendering procedures and the lack of competences for their preparation are also cited as issues by schools. This either lead to higher cost – so a school engages a specialized agency and pays it a fee for the preparation of tender, or it leads to the employment of an inappropriate tender procedure (e.g. as it is reported for one school in Kikinda). Therefore, all procurements in schools which share these problems are performed ad hoc. This is not only counterproductive for schools, but it eliminates pariticipation in procurement for many firms too. Thus, it might be useful to make the same tender procedures mandatory for all schools and to simplify the procedure in general.

Furthermore, some suppliers complain about discriminatory conditions for some tenders. One such requirement is, for example, a score for the delivery time of up to 1-2 hours in cases of emergency delivery. Every supplier that does not fulfill this condition does not get positive scores and it may lose a tender. It is not completely clear if this measure tends to encourage local producers to participate in tender or if it discourages small producers from applying (given the lack of their possibilities to keep excessive quantities of goods in their stocks). Unethical business practices are also mentioned in the context of competitors. One respondent cited that all data from tender documentation are public and that their competitors misuse these data for unfair market play. However, the transparency of the whole process should be encouraged and not limited.

In terms of tender specifications, it appears that for some goods the criteria are not well defined. For example, in the dairy sector, it is questionable why schools insist on UHT milk, since this criterion eliminates possibility for small milk producers to take part on tenders, because they offer fresh milk that must be used within couple of days. The respondent claims that fresh milk is much better than UHT milk, given that UHT milk is full of artificial additives. He cites: "Moreover, on the packaging it is only observable "best before date", i.e. the last date when it can be used, while the date of production is not shown. It can be produced three weeks ago or a month ago and children drink this milk instead of fresh milk. Mlekobel company produces milk and at the same day milk is delivered to schools. Cheese and other products are delivered 2-5 days after production process which is time necessary to pass for getting the good quality."

Schools and companies agree about the harmful impact of making the lowest price the essential contract award criterion. Schools argue that it is difficult to find reliable business partners if they cannot pay to them competitive market price. Moreover, they are very much limited in their possibility to choose who they want to work with, given that well known brands and companies do not want to work in these conditions. This leaves schools in the position of collaborating with smaller and younger firms, which quite often do not possess needed certificates, manforce or skills to execute tenders on the high level of quality. On the other hand, the lowest price criterion is significant barrier for a company too. Therefore, the list of tender criteria needs to be prescribed at the national level, and in a mandatory way, it should include: quality requirements, references from previous tenders, regularity of delivery, etc.

Finally, the tender procedure which caused the majority of controversial responses among our interviwees pertained to the practice of dividing the contract into small lots or keeping it unified. When there is no division among lots, but all food items are consolidated into one – mixed lots, small producers of specific items cannot apply for tender. Respondents think that consolidated tenders are usually meant for big trade companies and that the results of these tender types are previously set i.e. tender is formed in a way that one, precise company wins. Therefore, the suggestion would be to organise each tender through lots because only then small, private companies can take part. Producers think that this solution is better for producer and for schools, because, when a tender is organised through lots, each producer will give their best products (in whose production they are specialised), while trade companies mix all food items and their objective is to complete orders.

8.4 What local/practice interventions would help?

All informants reported that they have not had any assistance nor collaboration with public authorities – either on local or on national level. They tended to perceive public authorities more as their foes than as their allies. This was reflected, for instance, in their very high reluctance to take part in this research, since they assumed that the researchers were some sort of auditors sent by the authorities (e.g. tax officers). Some of them completely refused to cooperate, sticking to their doubts even after the reassurance from our side. This implies that there is a significant level of mistrust between policy makers and business actors. Hence, the efforts should be made to strengthen these ties and to build and maintain trustworthy relations. The easiest way to do that is to have an officer in the Ministry of Finance who will be in charge to communicate all changes and provide and explain all asked information on tendering procedure to all interested parties.

Both models contribute equally to affirmative action in labourforce, given that all schools in sample employ females as their kitchen staff. However, the positive impact of the increase in employment rate is neutralized with the rather small salaries which they receive, which equals minimum wage in the country. They usually work in difficult conditions, standing long hours, lifting heavy weights and without suitable equipment. Moreover, their wages are highly vulnerable to reductions, whenever authorities make budget cut offs for public institutions (which has happened several times in the last decade).

Providing that cooks represent one of the professions with the highest demand both in national and regional market (Serbian Chamber of Commerce, 2017), younger cooks usually opt for better paid jobs in private sector or abroad. This leaves schools with rather aging staff and low probability of their replacement in the future. With respect to that, public authorities need to invest great funds in subsidizing cooks' salaries, protecting them from further decrease of their wages, investing in modern equipment of school kitchens, and investing in their training. If any of these recommendations fail to take place, children's diets will not be significantly improved (and we can see the degree of negative consequences of such a failure in Jamie Oliver's programme and UK's meal system in schools and children obesity).

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APPENDICES

Appendix 1. Steps in the tendering process of public procurement of food in primary schools

No.	ACTIVITY	PERSON IN CHARGE
1.	**The decision to start the process of public procurement** (according to the article 53 of Law on public procurement (LPP) the decision must contain: the title and address of the ordering party; the sequence number of public procurement for the current year; the subject of public procurement, the title and the mark of general dictionary of the procurement; type of public procurement process; the estimated value of public procurement in total, and especially for each party when it is possible; the general dates during which particular phases of the public procurement process shall be carried out; the data on the appropriation within the budget, i.e. the financial plan).	Most often the Decision to start the process of public procurement is initiated by the school principal, in some cases the school secretary with the permission of the school principal, while in some schools the entire process of food public procurement is delegated to an external entity (the agency).
2.	**The decision to form a Committee for public procurement** (according to the article 54 of the LPP, the Committee for public procurement has at least three members out of which one is a clerk in charge of public procurement or a person with obtained University degree from the Faculty of Law, the studies of the second degree (MSc, Specialist academic studies, Specialist expert studies), i.e. on studies of the first degree in the duration of at least four years. In the majority of contacted schools, the Committee members are mostly teachers which possess expert knowledge in the field, but every member must have its own deputy. The decision also defines the Committee deputies).	The school principal
3.	**Forming of the Statement on non-existence of conflict of interests** (in order to confirm that there is no relationship between the members of the Committee for public procurement and the potential providers which might influence the impartiality of the purchaser when making a decision to initiate the process of public procurement).	Signed by the members of the Committee for public procurement
4.	**The preparation of the documentation and the advertisement for public procurement** (the competition documentation usually contains the General data on public procurement and the data on the subject of public procurement; the conditions to participate in the process of public procurement from the articles 75 and 76 of the LPP; the instruction how to prove the condition fulfillment; the instruction for the providers how to create an offer and the conditions to take part in the process of public procurement). The very offer should contain the following documents- The Offer document (The data on the provider in the mutual offer, the data on the subcontractor), The document containing the costs of offer preparation, The declaration of the provider on the fulfillment of the mandatory conditions needed in order to take part in the process of public procurement, The declaration of the	The Committee for public procurement

	subcontractor on the fulfillment of the mandatory conditions needed in order to take part in the process of public procurement, The declaration on giving security for good job fulfillment, The declaration on the independent offer, The declaration on fulfilling conditions from the article 75, point 2 of the LPP, The Reference list of completed services.	
5.	**The public call for delivering offers** (The advertisements on public procurement are published on the Portal of public procurement and on the internet page of the ordering party).	The school secretary or the Committee for public procurement
6.	**Answering to potential questions connected to the inclarity of the procurement conditions** (in case that the public call or the defined conditions for the registration of the provider for public procurement contain any inclarity, it is possible to clarify them sending a public question from the provider to the Committee for public procurement. All communication in the procedure of public procurement and connected to the job fulfillment of public procurement is performed in a written way, i.e. by post, e-mail or fax, as well as by the announcement on the Portal of public procurement).	The school secretary or the Committee for public procurement
7.	**The revision of the competition documentation** (opening, judging and classifying offers, i.e. applications). During the process of offer opening it is possible for the providers to be present.	The school secretary or the Committee for public procurement
8.	**Composing a written Report on the expert grade of the offer** (after reviewing all delivered offers the Committee for public procurement composes a Report on the expert grade of the offer, where the best offer is chosen based on several criteria. The committee analyzes which of the providers has delivered suitable and acceptable offers, performs a calculation control of the offers with the aim to revise potential calculation errors within the offers, compares acceptable and adequate offers from the standpoint of the criteria of the selection of best offer which is "the lowest offered price".	The school secretary or the Committee for public procurement
9.	**The preparation of the suggestion of the Decision to award a contract** (in some schools, the Committee for public procurement prepares a suggestion of the decision based on which the final decision is made by the school principal, secretary or the Parents' council, while in some schools, the final decision is brought by the very Committee for public procurement, when this step of composing a suggestion is excessive).	The Committee for public procurement
10.	**Deciding on the selection of the provider**	The Parents' council, the school principal or the Committee for public procurement
11.	**Delivering the Minutes on the opening of offers by all providers** (in the period of 3 days from the day the offers have been opened).	The school secretary, the Committee for public procurement
12.	**Contract signing with the chosen provider**	The school principal

Appendix 2. Profiles of municipalities in which suppliers operate (if they are not already described in part 2 of the Country Report)

Temerin is municipality in the Vojvodina region. Total area amounts to 170 km². Total population in this area amounts to 27.830 on a 30th June 2016. Distribution of population from aspect of gender is following: 50,75% of total population are women and 49,25% of total population are men. 70,21% of total population is 15-65 years old, approximately 21% of total population is 20-34 years old and approximately 15,50% of total population is 55-64 years old, while about 14% have 65 years and more. Average age in Temerin is 40,5 years. From the aspect of the educational level, the highest percentage of population has high school education (58,41%), around 20,52% of population has primary education and around 6% of population has university degree. Vojvodina region, as a whole, cover surface area of 21.614 km² and it consist of 467 different settlements. Population that inhabits Vojvodina region amounts to 1.881.357. Average number of inhabitants/km² in Vojvodina region is 87 in 2016. year.

Active population includes both employed (employees and self-employed) and unemployed people, but not the economically inactive, such as pre-school children, school children, students and pensioners. Participation of the active population in the total population is approximately 43%. Within active population, 77,37% are employees, 16,63% are those who are currently unemployed, but were previously employed and 6% are those who are currently unemployed and they never had job before. Participation of the active population in the total population in Vojvodina region is app 41%. Percantage of employees in total active population is higher in Temerin than in Vojvodina region (77,27%).

Inactive population in Temerin makes up 57% of total population. Within inactive population, 36,07% are pensioners, 27,26% are children under the age of 15 and 14,18% are students.

Population structure according to branch of an industry is following: the highest percentage of employees is classified in sector of manufacturing industry (33,8%), 19% of emloyees work in a field of wholesale and retail and 8,5% of emloyees work in a field of agriculture, forestry and fishing.

Average net salary for period 2011-2015:

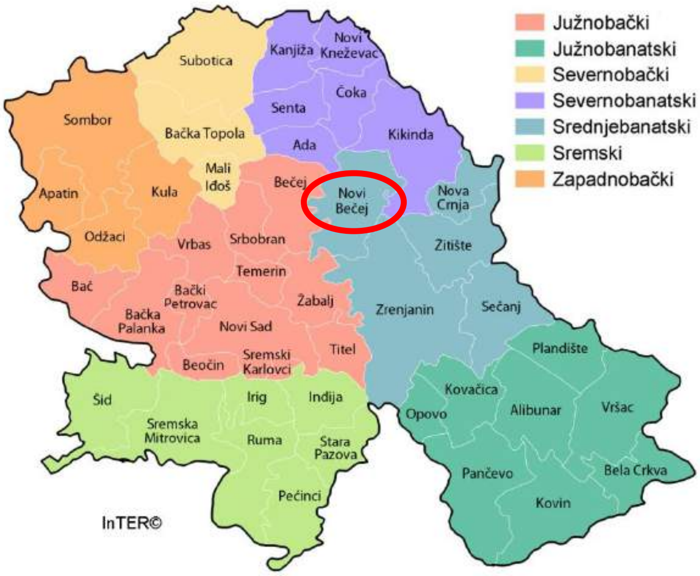
Year	Average net salary
2015	34.121
2014	34.194
2013	32.556
2012	29.910
2011	28.736

Average net salary amounts to RSD 37.600 in October 2017.

Total amount of investments made in 2016 in Temerin is RSD 628.451. 6,38% of total amount is invested in new capacities, 59,42% is invested in reconstruction and modernisation and the rest is invested in maintaining of the current level of capacities. Total invested amount is allocated among sectors in the following manner: nearly 48,30% is invested in sector of manufacturing industry, 31,21% in sector of agriculture, forestry and fishing and 5,34% is invested in wholesale and retail. Vojvodina region which integral part Temerin is, invested in 2016 total amount of RSD 128.807.056. Investments in Temerin make up 0,49% of total investments in Vojvodina region. The highest part of total investments in Vojvodina region takes investment in manufacturing industry (47,41%), following sectors of wholesale and retail (9,71%) and agriculture, forestry and fishing (7,30%).

The photo of Zorić company

Novi Bečej is municipality in the Vojvodina region. Total area amounts to 609 km². Total population in this area amounts to 23.116 on a 30th June 2016. Distribution of population from aspect of gender is following: 50,97% of total population are women and 49,03% of total population are men. 69,82% of total population is 15-65 years old, approximately 19% of total population is 20-34 years old and approximately 16% of total population is 55-64 years old, while about 15,61% have 65 years and more. Average age in Novi Bečej is 41.5 years. From the aspect of the educational level, the highest percentage of population has high school education (44,58%), around 27,24% of population has primary education and around 4,38% of population has university degree. Vojvodina region, as a whole, cover surface area of 21.614 km² and it consist of 467 different settlements. Population that inhabits Vojvodina region amounts to 1.881.357. Average number of inhabitants/km² in Vojvodina region is 87 in 2016. year.



Active population includes both employed (employees and self-employed) and unemployed people, but not the economically inactive, such as pre-school children, school children, students and pensioners. Participation of the active population in the total population is approximately 41%. Within active population, 75,60% are employees, 6,65% are those who are currently unemployed, but were previously employed and 3,34% are those who are currently unemployed and they never had job before. Participation of the active population in the total population in Vojvodina region is app 41%. Percantage of employees in total active population is higher in Vojvodina region (77,27%) than in Novi Bečej.

Inactive population in Novi Bečej makes up 59% of total population. Within inactive population, 36,88% are pensioners, 24,67% are children under the age of 15 and 10,40% are students. Population structure according to branch of an industry is following: the highest percentage of employees is classified in sector of manufacturing industry (36,1%), 12,5% of emloyees work in a field of wholesale and retail and 10,1% of emloyees work in a field of health and social protection.

Average net salary for period 2011-2015:

Year	Average net salary
2015	32.309
2014	33.670
2013	32.959
2012	30.976
2011	28.603

Average net salary amounts to RSD 33.249 in October 2017.

Total amount of investments made in 2016 in Novi Bečej is RSD 325.698. 33,27% of total amount is invested in new capacities, 28,27% is invested in reconstruction and modernisation and the rest is invested in maintaining of the current level of capacities. Total invested amount is allocated among sectors in the following manner: nearly 44% is invested in sector of wholesale and retail, 22,39% in sector of manufacturing industry and 8,55% is invested in electricity, gas and steam supply. Vojvodina region which integral part Novi Bečej is, invested in 2016 total amount of RSD 128.807.056. Investments in Novi Bečej make up 7,55% of total investments in Vojvodina region. The highest part of total investments in Vojvodina region takes investment in manufacturing industry (47,41%), following sectors of wholesale and retail (9,71%) and agriculture, forestry and fishing (7,30%).

Photo of Mlekobel facilities

Appendix 3. Profile of interviewed suppliers included in the preliminary sampling

Identity	Interview Date & Duration
"Tulimirović" doo - company director and assistant director	22.11.2017. Duration of interview with company director is 1h 15 min. We conveyed three phone interviews during Nov and Dec 2017 with assistant director. Total duration of phone interviews is 40 min.
"Šareni mačak"- company director	07.12.2017. Duration of interview with company director is 2h.
"Štrand mesara"- company director and assistant director	12.12.2017. Duration of interview with company director is 1h 15 min. We conveyed one phone interviews during Dec 2017 with assistant director. Total duration of phone interviews is 15 min.
"Master Trade" - assistant director	We conveyed 3-4 phone interviews and mail communication during Nov and Dec 2017 with assistant director. Total duration of phone interviews is 45 min.
"BNB Ketering" - Owner and sales manager	28.11.2017 Total duration of interview with owner and sales manager is 2h 30 min.
"Lido" – Low department	Mail communication during Nov and Dec 2017.

Appendix 4: Weights per food category per lunch (kg) for four LOC schools and four LOW schools. Red text shows relatively low and high food category weight.

Food[a] School[b]	FF+FV	PF+PV	D+E	FM	PM	A	RM	Total
LOC 1	0.122	0.053	0.041	0.006	0.011	0.153	0.033	0.419
LOC 2	0.187	0.066	0.010	0.037	0.022	0.085	0.001	0.408
LOC 3	0.045	0.038	0.005	0.045	0.003	0.050	0.000	0.187
LOC 4	0.122	0.043	0.026	0.059	0.014	0.143	0.001	0.408
LOC mean	**0.119**	**0.050**	**0.021**	**0.037**	**0.013**	**0.108**	**0.009**	**0.356**
LOW 1[c]	0.179	0.048	0.023	0.067	0.002	0.102	0.019	0.440
LOW 2	0.109	0.046	0.034	0.081	0.004	0.082	0.020	0.375
LOW 3	0.202	0.071	0.059	0.055	0.003	0.132	0.000	0.523
LOW 4	0.081	0.047	0.026	0.044	0.013	0.096	0.002	0.309
LOW mean	**0.143**	**0.053**	**0.036**	**0.062**	**0.006**	**0.103**	**0.010**	**0.412**

[a] Food category codes:
FF - fresh fruit
FV - fresh vegetables
PF - processed fruits (canned, dried, frozen, juices)
PV - processed vegetables (canned, dried, frozen, pickled)
D+E - dairy products and eggs
FM - fresh meat and fish
PM - processed meats and fish (sausages, patés, dried meats, etc)
A - ambient foods (dry and room temperature foods)
RM - ready-made foods (pizzas, filled rolls, cakes, biscuits, etc)

[b] School codes:
LOC 1 - Dositej Obradović, Belgrade
LOC 2 - Ljuba Nenadović, Belgrade
LOC 3 - Miloš Crnjanski, Novi Sad
LOC 4 - Djordje Natošević, Novi Sad
LOW 1 - Pavle Savić, Belgrade
LOW 2 - Drinka Pavlović, Belgrade
LOW 3 - Gavrilo Princip, Zemun
LOW 4 - Kosta Trifković, Novi Sad

Appendix 5. Annual km travelled by each food category from suppliers to schools.

Food categories and school codes as in Figure 15 and Table 4, respectively. Numbers in red indicate deliveries from greater than 15 km.

Food / School	FF+FV	PF+PV	D	E	FM	PM	B	A	RM
LOC 1	583	406	536	125	324	635	125	510	255
LOC 2	1296	1173	1095	447	998	648	1296	1270	324
LOC 3	540	616	2160	540	540	540	2624	848	616
LOC 4	1400	1866	1607	467	1607	1141	31190	1503	570
LOC mean	**955**	**1015**	**1349**	**395**	**867**	**741**	**1349**[a]	**1033**	**441**
LOW 1	1004	940	864	432	15643	2424	7	940	-[b]
LOW 2[c]	1097	806	1464[d]	976	13733	10282	1582	7344	5361
LOW 3	1915	806	10714	524	1878	1302	1974	317	989
LOW 4	468	338	12593	338	657	709	1489	511	1204
LOW mean	**1121**	**723**	**6409**	**568**	**7978**	**3679**	**1263**	**2278**	**2518**

[a] Mean excludes annual km for LOC 4 school.

[b] No ready-made foods bought.

[c] No daily delivery information, only frequency of each item per month, so used the item with maximum delivery frequency each month.

[d] Excludes chocolate-flavoured milk supplied on a 204 km delivery round during delivery of ambient foods.

The Strength2Food project in a nutshell

Strength2Food is a five-year, €6.9 million project to improve the effectiveness of EU food quality schemes (FQS), public sector food procurement (PSFP) and to stimulate Short Food Supply Chains (SFSC) through research, innovation and demonstration activities. The 30-partner consortium representing 11 EU and four non-EU countries combines academic, communication, SMEs and stakeholder organisations to ensure a multi-actor approach. It will undertake case study-based quantitative research to measure economic, environmental and social impacts of FQS, PSFP and SFSC. The impact of PSFP policies on nutrition in school meals will also be assessed. Primary research will be complemented by econometric analysis of existing datasets to determine impacts of FQS and SFSC participation on farm performance, as well as understand price transmission and trade patterns. Consumer knowledge, confidence in, valuation and use of FQS labels and products will be assessed via survey, ethnographic and virtual supermarket-based research. Lessons from the research will be applied and verified in 6 pilot initiatives which bring together academic and non-academic partners. Impact will be maximised through a knowledge exchange platform, hybrid forums, educational resources and a Massive Open Online Course.

Strengthening European Food Chain Sustainability by Quality and Procurement Policy

Deliverable No: D6.3

EVALUATION OF ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACT OF DIFFERENT MODELS OF PSFP IN A SCHOOL CONTEXT:

UK COUNTRY REPORT

February 2019

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Academic Partners

1. **UNEW**, Newcastle University (United Kingdom)
2. **UNIPR**, University of Parma (Italy)
3. **UNED**, University of Edinburgh (United Kingdom)
4. **WU**, Wageningen University (Netherlands)
5. **AUTH**, Aristotle University of Thessaloniki (Greece)
6. **INRA**, National Institute for Agricultural Research (France)
7. **BEL**, University of Belgrade (Serbia)
8. **UBO**, University of Bonn (Germany)
9. **HiOA**, National Institute for Consumer Research (Oslo and Akershus University College) (Norway)
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11. **CREDA**, Centre for Agro-Food Economy & Development (Catalonia Polytechnic University) (Spain)
12. **UMIL**, University of Milan (Italy)
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16. **EUFIC**, European Food Information Council AISBL (Belgium)
17. **EUTA (BSN)**, European Training Academy (Balkan Security Network) (Serbia)
18. **TOPCL**, Top Class Centre for Foreign Languages (Serbia)

Stakeholder Partners

19. **Coldiretti**, Coldiretti (Italy)
20. **ECO-SEN**, ECO-SENSUS Research and Communication Non-profit Ltd (Hungary)
21. **GIJHARS**, Quality Inspection of Agriculture and Food (Poland)
22. **FOODNAT**, Food Nation CIC (United Kingdom)
23. **CREA**, Council for Agricultural Research and Economics (Italy)
24. **Barilla**, Barilla Group (Italy)
25. **MPNTR**, Ministry of Education, Science and Technological Development (Serbia)
26. **Konzum**, Konzum (Croatia)
27. **Arilje**, Municipality of Arilje (Serbia)
28. **CPR**, Consortium of Parmigiano-Reggiano (Italy)
29. **ECOZEPT**, ECOZEPT (Germany)
30. **IMPMENT**, Impact Measurement Ltd (United Kingdom)

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EXTENDED ABSTRACT

This country report presents the findings of WP6.3 research into the sustainability outcomes of primary school food chains in the UK. Using case studies, a pair of contrasting procurement models was analysed: (i) a local model (LOC), in which the procurement contract encouraged the sourcing of foods from the local area, and (ii) a low cost model (LOW), in which the procurement contract made no local sourcing specification. In both cases, our research involved measuring the carbon footprints, the local economic impacts and the social impacts of the procurement chains supplying food to the schools. Data were gathered via two main sources: depth interviews with key stakeholders (Local Authority (LA) procurement/catering officers, catering unit managers, suppliers and headteachers) and secondary data sources (including school/supplier websites, contract tender documents, ordering records and logistics data).

The LOC study was conducted in County Durham, north east England. It is a large region by area and population, with relatively high levels of socio-economic deprivation, particularly in the ex-mining and industrial districts in the south and east. To the north and west the County is rural, although with relatively little crop-based agriculture. There are 230 state primary schools, with an average roll of 135 pupils, considerably smaller than the English national average. Of these, the LA, Durham County Council (DCC), is responsible for providing meals (lunches) to 200 schools. Meals provision itself is outsourced under contract to a private catering firm (SchoolCater). The contract encourages the local sourcing of food, as well as targets for environmental and social outcomes. SchoolCater employs all catering staff and subcontracts with three key suppliers (FreshGrocer, FreshMeat and GoodsMover) to deliver foods directly to the schools. Almost all schools have their own kitchens, where catering staff are based. A set menu is applied across the County, comprised daily of two hot options (at least one vegetarian), one cold option (e.g. sandwich), plus dessert. Only water is served to drink. The menu is designed by SchoolCater on a 3 week cycle, with two changes each year, one autumn/winter and one spring/summer. At the time of data collection, the price of a school meal in Durham was £2.00 (€2.27). Average meal uptake across all schools was 65%.

The LOW study was conducted in Inverclyde, a region in west central Scotland. It is one of the smallest Scottish administrative regions, with a population concentrated in three main coastal towns. Inland, the region is characterised by rough hill and moorland, with little to no crop-based agriculture. Although there are pockets of affluence, several areas of Inverclyde exhibit high levels of deprivation, particularly those previously reliant on declined shipbuilding, heavy industry and (more recently) IT sectors. There are 20 state primary schools, all managed by the LA, Inverclyde Council (IC). The average school roll is 266, which is higher than the Scottish average. IC is responsible for providing meals (lunches) to all these schools, which it does in-house via its Facilities Management department. This department employs all catering staff, (who are based on school sites - almost all schools have their own kitchens), and contracts with four key suppliers (ScotVeg, ScotMeat, ScotDairy, ScotMover) to deliver foods directly to schools. The contracts make reference to social outcomes, but are less demanding than Durham on environmental outcomes, and there is no target for local sourcing. Facilities Management also designs the menu, which operates on a 3 week cycle, changed once per year. Catering unit managers can make modest adjustments to this menu according to their perceptions of childrens' preferences, hence it is not identical across all schools. Normally, the daily menu

comprises three hot options (one is baked potato), one cold option (e.g. sandwich), plus dessert. Cartoned milk (including flavoured milk, in some schools) and water are available to drink. At the time of data collection, the price of a school meal in Inverclyde schools was £1.95-£2.00 (€2.21-€2.27).

To measure the environmental impact of the school meals services in both Durham (LOC) and Inverclyde (LOW) cases, we first collected purchase invoices to calculate the types and volumes of foods procured by a sample of five schools in Durham (LOC) and Inverclyde (LOW) cases respectively, over a 190 day school year. We then applied emissions factors to these volumes to estimate the carbon emissions (in kgs $C0_2e$) generated from the production, processing, transportation and waste of these foods. The results showed that although the volume of food purchased for the average meal in both cases was the same (490g), the carbon footprint of the Durham (LOC) meals service was smaller than Inverclyde (LOW). On a per average meal basis, Durham emissions were 1.20 kgs $C0_2eq$, whereas Inverclyde average meals emitted 1.27 kgs $C0_2eq$. Importantly, the difference between the two cases was *not* due to the greater localisation of the Durham procurement model, as transport emissions amounted to the same (very small) proportions of the total carbon footprints of both cases. Instead, the difference related to the composition of the meals, specifically, (i) the greater proportion of fruit and vegetables in Durham meals, which have a low carbon burden, and (ii) the large quantities of milk accompanying Inverclyde meals, which contribute a higher carbon burden. We also undertook scenario analyses in both cases to explore the effect on carbon emissions of adjusting, respectively, the composition of the menus, the transportation arrangements, and also switching waste disposal methods. The results of these analyses confirmed that menu adjustments, particularly reducing the proportions of red meat served, generated greater reductions than consolidating transport arrangements, although it is waste disposal method that has the most dramatic implications for carbon emissions.

To measure the economic impact of the school meals services in both cases, we undertook a local economic multiplier (LM3) analysis of the services, and also explored the economic value of the contracts to the suppliers in each case. The LM3 analysis revealed that the Durham (LOC) meals service had a higher economic multiplier effect than the Inverclyde (LOW) service, although the difference between the two was small (LM3 ratios were 2.28 and 2.25, respectively). Hence, for every £1 spent from the original budget in Durham, an additional £1.28 was generated in the local economy, whereas in Inverclyde the additional value was £1.25. The higher value in Durham was due to a greater proportion of the supplier budget directed to local firms compared with Inverclyde (50% vs 15%). The substantial difference in the cases' local supplier expenditures did not translate into a greater difference in ratios because of the features of the cases' payroll expenditures: Inverclyde spent a higher proportion of its total budget on staff compared with Durham, which increased its ratio. More generally, the LM3 analysis confirms the important contribution of payroll expenditures to local economic impact in public procurement. Specifically, in services which involve high labour intensity and reliance on a workforce located conveniently for locally dispersed sites (as is the case with school meals services), payroll has an uplift effect on overall economic multiplier, although LM3 increases can still be gained from adjustments in supplier arrangements. In terms of economic value of the contracts, the analysis found many similarities between LOC and LOW cases. In both, with the exception of School Cater, the school meals contract represented only very small proportions of suppliers' total turnovers, and had contributed a neglible direct impact on winning new business. This was the situation even for the smaller firms in each case. Nevertheless, suppliers in both cases spoke positively about their involvement in the Durham and Inverclyde school meals contracts, and indicated that these contracts contributed to a portfolio of public sector supply contracts. Therefore in both cases, the school meals services were strategically important to suppliers rather than of high, direct, economic value.

In terms of social impact, we gathered information on employment-related factors (jobs and skills development) within the school meals chain in each case, as well as impressions of the working environment and levels of connectedness between members of the chain. Overall, we found employee profiles in the Durham and Inverclyde supply chains were very similar, with gender balances and ethnic minority representations reflective of sectoral norms, whilst in terms of skills development, we found that in both cases, suppliers demonstrated considerable commitment to staff development, with many examples of support given to staff for upskilling and obtaining qualifications, beyond mandatory ones. To this extent, the school meals contracts clearly attracted businesses that engaged in high standards of human resource management and good employment practices. A difference between the large and small firms in both cases was that the larger suppliers in the cases (i.e. GoodsMover, ScotDairy and ScotMover), in addition to supporting employees to gain recognised third party qualifications, also offered their own study and training programmes, linked to internal career progression. Meanwhile, although the smaller firms had less elaborate training programmes, they gave examples of flexible and bespoke training/qualifications created specifically to fit the needs of certain employees and roles.

From a policy perspective, the research indicates there is merit in encouraging localised PSFP models as these can build supply chains capable of leveraging positive economic and social impacts. However, for these benefits to be maximised, policy attention also needs to focus on more fundamental socio-economic development within regions, as procurement models pursued in isolation will have less sustainability impact than those which are integrated with wider regional strategies for health, education and economic development. For environmental impacts, the research indicates that localised models have a relatively neutral effect, because transport emissions represent only a small component of the carbon footprint of school meals services. To enhance the environmental impacts of PSFP, policy attention should be focused more on actions such as setting guidelines for low carbon menus (that still meet nutritional requirements), and devising interventions that minimise food and packaging waste, regardless of procurement model.

From a local practices perspective, managers of school meals services should focus on waste disposal methods, menu design, and then transportation arrangements, in order to reduce the environmental impacts of school meals services. To enhance local economic impacts, greater use of local suppliers is encouraged, which may involve working with local business development agencies and networks, in regions where the agrifood sector is underdeveloped. To enhance social impacts, managers are encouraged to work with suppliers, catering staff and school leaders post-contract award, to identify ways for suppliers to share their skills and resources with schools and the wider community. Such activities would also be a way of expanding the social role of school meals services and integrating them better into the wider life of the schools.

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List of Abbreviations and Acronyms

DCC: Durham County Council

IC: Inverclyde Council

LA: Local Authority

RDC: Regional Distribution Centre

1. INTRODUCTION & METHODS

This country report presents the findings of WP6.3 research into the sustainability outcomes of primary school food chains in the UK. Using case studies, a pair of contrasting procurement models was analysed: (i) a local model (LOC), in which the procurement contract encouraged the sourcing of foods from the local area, and (ii) a low cost model (LOW), in which the procurement contract made no local sourcing specification. In both cases, our research involved measuring the carbon footprints, the local economic impacts and the social impacts of the procurement chains supplying food to the schools.

The LOC study was conducted in County Durham, north east England. This area was chosen because the local authority (LA) was known to be actively engaged in addressing sustainability issues, including in relation to its procurement practices for school food. At the time of study, the procurement contract encouraged use of the local sourcing and also referred to various environmental and social outcomes. The fieldwork for the Durham (LOC) study commenced in autumn 2016 with telephone interviews and desk research. Thereafter, the bulk of the primary data collection was conducted in January and February 2017, with follow up and completion work in spring-autumn 2018. There were two main components. First, we undertook face-to-face interviews with a total of 15 informants, including from the LA and main catering firm supplying meals, wholesaler managers, farmers, processors, school headteachers and kitchen staff (Table 1). These interviews provided the main sources of information about economic and social impacts of the school meals chains, and, to some extent, environmental impacts. Second, we also undertook secondary data research, including scrutiny of school and supplier websites, LA contract tender documents, school menu information, company databases, and ordering records and logistics data supplied by interviewees. These sources provided us with much information to perform the environmental and economic impact assessments.

Table 1: Profile of interviewees in Case 1: Durham (LOC)

Identity	Interview Date & Duration
LA Procurement Officer and Head of Catering	15-11-16, 2hrs & 22-10-18, 2hrs
General Manager, 'SchoolCater' (catering firm currently holding school meals contract)	17-01-17, 2hrs & 18-05-18, 1hr
Headteacher, NorthSchool A	18-01-17, 2hrs
Catering Supervisor, NorthSchool A and Area Manager, SchoolCater	18-01-17, 1hr
Headteacher, NorthSchool B	19-01-17, 1hr
Catering Supervisor, NorthSchool B	19-01-17, 0.5hrs
Manager, 'FreshGrocer' (wholesaler currently supplying fruit, vegetables, eggs and milk to schools)	01-02-17, 2hrs

Manager, 'LORG Dairy' (dairy farm/processor supplying organic milk to schools in north east England)	14-02-17, 1hr
Manager, 'ECOFarm' (organic beef/pork producer supplying 100% organic meat to NorthSchool A)	14-02-17, 1.5hrs
Manager, 'FreshMeat' (wholesaler currently supplying meat to all schools except VillageSchool)	15-05-18, 1.5hrs
Headteacher, NorthSchool C	11-06-18, 0.5hrs
Headteacher, NorthSchool D	12-06-18, 1hr
Headteacher, NorthSchool E	15-06-18, 1hr

The LOW study was conducted in Inverclyde, a region in west central Scotland. This area was chosen because the local authority (LA) was known to be interested in measuring the sustainability impacts of its school meals supply chain, although to date had not actively pursued any alternative procurement practices. As a result, this case represented the LOW procurement model of the pair of UK cases. The fieldwork for the Inverclyde (LOW) case study commenced in autumn 2017 with a depth interview with members of Inverclyde LA, and desk research. Thereafter, the bulk of the primary data collection was conducted in February and March 2018. We undertook 10 face-to-face interviews with a total of 15 informants, including the LA facilities services manager responsible for supplying meals, as well as managers of all the suppliers, and the head/deputy head teachers of five selected schools in the region (Table 2). As with the Durham (LOC) case, we also undertook considerable secondary data research, including scrutiny of school and supplier websites, LA contract tender documents, school menu information, company databases, and ordering records and logistics data supplied by interviewees. These sources provided us with much information to perform the environmental and economic impact assessments.

Table 2: Profile of interviewees in Case 2: Inverclyde (LOW)

Identity	**Interview Date & Duration**
LA Facilities Manager and Schools Liaison Officer	20-11-17, 1hr
Headteacher, ScotSchool A	19-02-18, 1hr
Headteacher and Deputy Head, ScotSchool B	20-02-18, 1hr
Deputy Head, ScotSchool C	21-02-18, 1hr
Manager and Assistant, ScotMeat (wholesaler currently supplying meat to all schools)	21-02-18, 1hr
Headteacher and Deputy Head, ScotSchool D	12-03-18, 1hr
Contract Manager, ScotDairy (wholesaler currently supplying milk to all schools)	12-03-17, 2hrs

Headteacher, ScotSchool E	14-03-18, 1hr
Director and CEO, ScotVeg (wholesaler currently supplying fresh fruit and vegetables to all schools)	14-03-18, 1.5hrs
Contract Manager, ScotMover (wholesaler currently supplying frozen, chilled and grocery goods to schools)	26-03-18, 1.5hrs

2. CASE 1 DURHAM (LOC) MONOGRAPH

2.1. Profile of County Durham

County Durham is an administrative region located in the north east of England (Figure 1). It comprises an area of 2,225km^2 (6th largest in England) and population of 519,700 (7th largest in England). The largest settlement and regional capital is Durham City, with a population of 42,000 (8.5% of regional total). Geographically, County Durham has contrasting landscapes: to the west are large areas of very sparsely populated moorland, while to the north and east are areas once dominated by industrial land use (coalmining and quarrying). Therefore, although the region has a relatively low population density of 233 persons per km^2, there is comparatively little agricultural production. Cereals are the main crops in the more fertile southern and eastern parts of the county, whereas the northern and western uplands are dominated by livestock farming (Durham County Council, 2016).

Figure 1: Map of Case 1 (LOC) Durham Area*

*county boundary to the south east is indicated by the brown border line: towns of Darlington, Stockton-on-Tees, Middlesborough and Hartlepool fall outside the boundary

County Durham underwent major economic and social change in the late 20th century, following the decline of the coal mining and steel industries which had previously dominated the region. The LA invested in a succession of land reclamation and infrastructure projects, demolishing smaller mining villages and building two large New Towns (Durham County Council, 2016). Although levels of social deprivation have improved over the last 5 years, County Durham is still ranked as the 75th most deprived area out of 326 LA areas in England (i.e. within highest quartile), and is the most deprived area out of the 11 LA areas in the north east (Durham County Council, 2016). 46% of the county's total population experiences income deprivation, with the most deprived districts (all ranked within the 10% most deprived districts in England) being concentrated in southern and eastern parts of the county, and along the coast. On average, the population profile is aging, with groups aged 65+ increasing in the last five years, whilst those of school and working age have declined in number. In terms of ethnicity, only 2% of the population is ethnic minority.

2.2. Primary school meals provision in County Durham

County Durham has 230 primary schools in total, with an average pupil roll of 135, considerably smaller than the English national average of 275 (Department for Education, 2016). However, the proportion of children eligible for free school meals (an indicator of deprivation) across all schools is 20.8%, considerably higher than the English national average of 14.3% (Department for Education, 2016). The body with core responsibility for providing school meals is the LA, Durham County Council (DCC). In common with LAs in other regions, DCC receives funding from the UK government to cover the full cost of meals to children from lower income households, as well as to all children in the first three years of schooling. Parents/carers pay the full price of meals in all other cases. At present, the price per meal in County Durham schools is £2.00 (€2.28). In England, all primary school meal provision in a region can be serviced either directly by the relevant LA, or via a third party catering firm contracted by the LA. As school budgets are devolved from LAs or central government (e.g. in the case of Academies), headteachers also have the right to opt out of LA provision and contract their own meals service if they want to. In County Durham however, the majority of schools (200 out of 230) have chosen to stay with the LA contracted arrangements.

2.3. The school meals service contract in County Durham

In terms of contract, historically, DCC undertook school meal provision in-house, employing kitchen staff on-site in schools, and contracting directly with suppliers. The meals service was put out to tender for the first time in 1994, and was won by a multinational catering firm. This firm operated the contract until 2008, when DCC issued a new tender document with a range of additional criteria relating, for example, to nutritional provision, staff training, and supply chain management (Appendix 1). These criteria were mapped to a corresponding list of Key Performance Indicators (KPIs) which the successful bidder was required to report on annually. The successful bidder in this process was “SchoolCater”, a catering firm based in the north west of England. This firm has since held the Durham school meals contract to the present day. During much of this time, SchoolCater has operated to the standards of the UK Soil Association’s Food For Life programme[39], holding a bronze Catering Mark across all schools. This requires, for example, that all eggs are certified free range, all meat is Red Tractor[40] approved, and all fish is Marine Stewardship Council[41] certified. SchoolCater has also supported individual schools pursuing silver and gold awards (which require, for example, greater purchasing of certified organic food).

In terms of budget, it is noteworthy that the exact value of the Durham school meals contract is not fixed, but depends on how successful the contractor (i.e. SchoolCater) is in encouraging pupil uptake of meals. At present, the average uptake across all schools is 65%, a significant increase in the levels SchoolCater inherited in 2008 (c.45-50%). SchoolCater employs all school catering staff, and head cooks are responsible for fiscally managing their orders/stock.

In terms of menus, these are organised on a 3 weeks cycle, and are reviewed twice per year. Hence, there is one menu for spring/summer months, and one for autumn/winter. Menus are designed to reflect seasonal changes in fresh produce and dishes. The daily menu consists of one main dish (normally a choice of 2-3 options, including one vegetarian) and a dessert (which consists of minimum 50% fruit).

[39] http://www.foodforlife.org.uk/schools.
[40] http://www.redtractor.org.uk
[41] http://www.msc.org

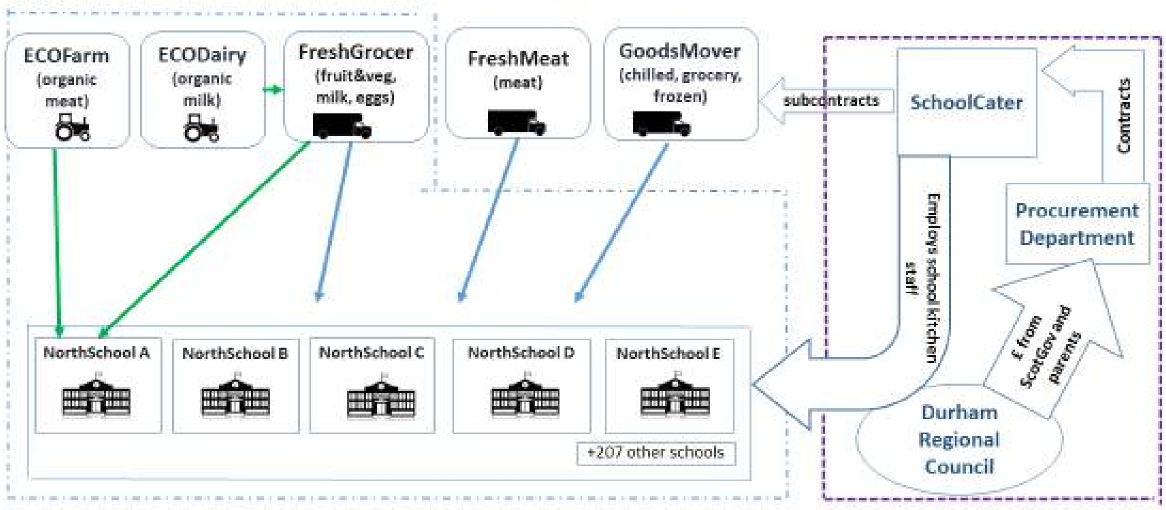
2.4. The current school meals supply chain in County Durham

Figure 2 presents diagrammatically the organisation of the Durham school meals supply chain. It shows that SchoolCater operates the meals contract on behalf of DCC, employing all the school kitchen staff and subcontracting the supply of fresh produce, groceries, meat and processed/frozen goods to relevant first tier suppliers (wholesalers and distributors). It is the first tier suppliers who actually deliver goods to the 200 schools - SchoolCater does not perform any delivery function itself. In turn, the first tier suppliers source items from next tier wholesalers, processors and/or farmers, at least some of whom are located in the region (namely, producers of fresh eggs and milk, some fresh meat and some fresh vegetables).

The supply of goods to NorthSchools B, C, D and E is very typical of most schools in County Durham – fresh fruit and vegetables, eggs and milk are supplied by the distributor FreshGrocer, sourced from a local fruit and veg wholesaler, egg farm and dairy farm respectively. Fresh meat is supplied by the wholesaler FreshMeat, and processed/frozen items are supplied by GoodsMover, a national foodservice company. Orders for goods are placed by school kitchen staff directly to the relevant supplier, usually on a weekly basis. Fresh and perishable items are normally delivered twice per week, whereas ambient/frozen items are delivered twice per month.

The supply of goods to NorthSchool A differs from the typical situation in two important ways. First, rather than using the conventional source of milk, it procures milk from a 100% organic dairy farm (ECODairy, also located in the region). This organic milk is also delivered by FreshGrocer. Second, rather than sourcing from FreshMeat, NorthSchool A procures all its fresh meat exclusively from a local organic farm (ECOFarm). The manager of this farm delivers orders directly to NorthSchool A from the farm.

Figure 2: Organisation of the Durham school meals supply chain



The next sections give short descriptions of some of the key stakeholders in the chain.

2.4.1. SchoolCater

As mentioned above, SchoolCater has operated the contract for the school meals service in County Durham since 2008. It is a regional organisation, with headquarters in the north of England (not County Durham). In accordance with the quality and sustainability criteria set out in the contract, SchoolCater sets the menus and recipes for the meals, subcontracts wholesalers/suppliers, determines the specific list of goods that schools can order, records meal uptake and kitchen waste data, and reconciles payments. In addition, all school kitchen staff are SchoolCater employees, although they are based entirely on school premises, and regarded as part of their school's 'family'. Winning the County Durham contract represented a big increase in operations for the firm, and it has experienced significant growth since 2008. The firm’s operations in County Durham employ 620 staff (of which 600 are the kitchen staff based on school sites).

2.4.2. FreshGrocer

FreshGrocer has operated in its present form since 1994, when it was purchased by a well-established fresh producer dealer in the region to develop a distribution and foodservice capacity for the firm. It has been under the same management since that time, and now supplies many public sector contracts throughout the north east region, as well as hotels, restaurants, cafes, etc. FreshGrocer has a company ethos of supporting the local economy, businesses and the community, as well making sustainability improvements. Some years ago, it played a proactive part in improving the efficiency of deliveries to schools by acting as an intermediary in the distribution of eggs, milk and bread (these items were originally delivered separately by the respective producers). FreshGrocer has a turnover of c.£11million (€12.5m), and employs 77 staff.

2.4.3. FreshMeat

FreshMeat is a fourth generation meat processing and distribution company with strong roots in the north east. Like FreshGrocer, it supplies to other public sector contracts in the region as well as a range of private customers, although the numbers of these have fluctuated over the years. As per the Food For Life scheme requirements, all the meat it supplies to County Durham schools is Red Tractor certified, which means it is of UK origin. FreshMeat has a turnover of c.£15million (€17.1m), and employs 75 staff.

2.4.4. GoodsMover

GoodsMover is a large national foodservice and distribution company, with headquarters based in the south of England. It supplies a range of ambient, chilled, processed and frozen items to County Durham Schools, as well as non-food kitchen and janitorial supplies. It operates one delivery depot in the region. In total, the GoodsMover Group has a turnover of £3.3billion (€3.8bn) and employs c7000 staff in the UK. In the regional depot, the turnover is £80million (€91.3m), with 196 staff.

2.4.5. ECO Farm

ECO Farm was set up in 2011 by a local farming family, as a linked set of enterprises centered on a theme of ecology and sustainability (notably an organic beef, sheep and pig farm which supplies a butchery, shop and café). Since 2015, ECO Farm has supplied NorthSchool A directly with all its fresh meat - beef and pork come directly from the farm, and all chicken is sourced from a 100% organic chicken farm in a neighbouring county. The manager of ECO Farm delivers the orders once per week using her own vehicle. The business has a turnover of c£700k (€799k), and employs 30 staff.

2.5. The featured schools in Case 1 Durham (LOC)

Table 3 summarises the pupil roll and meal uptake in NorthSchools A-E.

Table 3: Pupil roll and meal uptake in Durham (LOC) featured schools

	Pupil roll	% free meals	Daily average meals	Daily average uptake
NorthSchool A	49	10%	35	70%
NorthSchool B	209	18%	146	70%
NorthSchool C	137	55%	59	43%
NorthSchool D	178	16%	93	53%
North School E	303	34%	178	65%

2.5.1. NorthSchool A

NorthSchool A is located in a rural district in the far west of the county. It is one of the smaller schools in the SchoolCater contract, having only 49 pupils, of which c.35 have school meals (70% uptake). The local community is agricultural with relatively low levels of deprivation (c.10% of children are eligible for free school meals). The current headteacher, who has been in post for 3 years, has initiated a range of projects and activities on food, health and growing, which reflect a personal interest and commitment to these issues. It was through the drive of the headteacher that a Food For Life gold award was obtained for the school, in turn providing the stimulus for the switch in supply of meat from FreshMeat to ECO Farm.

2.5.2. NorthSchool B

NorthSchool B is located in the south of County Durham, in an ex-mining district with relatively high levels of deprivation. The school has 209 pupils, which places it slightly above average size for the county. Although NorthSchool B procures food from the same suppliers used by most schools in the county, the headteacher has a personal commitment to pursuing food and health issues in the curriculum and in wider school life. This means NorthSchool B has undertaken various projects not typical of most schools, for example, rearing chickens and growing vegetables in polytunnels on-site. Uptake of school meals is 70%, which is very high for a school in this kind of district.

2.5.3. NorthSchool C

NorthSchool C is located in the north of the county, approximately 10kms from Durham city. The area has high levels of deprivation, and 55% of pupils are eligible for free school meals. The school has 137 pupils, which is average sized for the county. The headteacher of NorthSchool C has pursued several diet and health related initiatives in recent years, including Healthy School Badge scheme enhanced status, which included nurse-led sessions on healthy eating, and chefs delivering cookery classes to pupils and parents. The headteacher has networked actively and skillfully to mobilise funds and resources to realise these initiatives, and regards food and health issues to be 'embedded in the curriculum'. However, uptake of school meals is 43%, which is very low for schools in the county.

2.5.4. NorthSchool D

NorthSchool D is located in a rural location in the far south west of County Durham, in a relatively affluent area. A high proportion of the pupils come from farming/agricultural backgrounds. The school has 178 pupils, slightly above average for the county, of which 16% are eligible for free school meals. The school has pursued several food and health related initiatives in the past, including gardening and cooking clubs, however these were dependent on the voluntary input of certain staff members, and ceased when those staff left. The headteacher expressed enthusiasm for health projects, but explained that with the relatively affluent, rural catchment, children were generally in good health and had good knowledge of where food comes from, so other priorities are pursued. Uptake of school meals is 53%, which is lower than average for schools in the county.

2.5.5. NorthSchool E

NorthSchool E is located 3 kms from Durham city in an area of relatively high deprivation, with 34% of pupils being eligible for free school meals. The pupil roll is 303, making it one of the larger schools in the county. The headteacher actively pursues a healthy packed lunch policy, and uses pupil members of School Nutritional Action Group (SNAG) to help monitor packed lunches in the canteen, and encourage peers to make healthier choices. The school has a gardening club and weekly health club on Friday afternoons. It also runs Healthy Eating and Good Manners awards weekly to pupils for good choices/behaviour in the canteen. However, much of the food-related initiatives in the school revolve around activities targeted at pupils at risk of malnourishment, such as breakfast clubs and holiday hunger clubs. The uptake of school meals is 65%, which is average for the county.

3. CASE 2 INVERCLYDE (LOW) MONOGRAPH

3.1. Profile of Inverclyde

Inverclyde is an administrative region located in west central Scotland (Figure 3). It comprises an area of 160km^2 (4th smallest Local Authority (LA) in Scotland) and population of 78,800 (5th smallest and 1.5% of the total Scottish population) (Office for National Statistics, 2017). The largest town and regional capital is Greenock, with a population of 45,000. Geographically, the population of Inverclyde is heavily concentrated within the north-facing coastal contiguous towns of Port Glasgow, Greenock and Gourock, with smaller settlements of Inverkip and Wemyss Bay situated on the west-facing coast. Inland, the region is characterised by rough hill and moorland, and is very sparsely populated. There is very little agriculture in Inverclyde, with production activities centred on livestock rearing.

Figure 3: Map of Case 2 (LOW) Inverclyde Area

The late 19th and early 20th centuries were times of economic growth and prosperity for Inverclyde, through shipbuilding and associated heavy industry. The region experienced sharp economic decline in the 1970s with the loss of the shipbuilding industry. This was followed by a period of recovery in the 1980s and 90s, due to a successful policy of inward investment which attracted several large IT companies (e.g. IBM) to locate in the area. However, this activity declined in the early 2000s, leaving the economy in very difficult circumstances. 44 out of 104 districts in Inverclyde fall within the highest 15% of deprivation in Scotland, the highest proportion of all the regions in the west of Scotland, and three districts of the town of Port Glasgow fall within the highest 5%. At the same time, there are also more affluent districts (e.g. Gourock, Kilmacolm), due to the spectacular landscape and easy travel to Glasgow, hence some locations have become popular amongst commuting professionals. In Inverclyde, the overall population is declining, whereas the Scottish population as a whole is increasing. A lower proportion of 16-29 year olds, and a higher proportion of persons aged 60 and older reside in Inverclyde compared to the Scottish average (Office for National Statistics, 2017). Life expectancy is also lower than the Scottish average. In terms of ethnicity, only 1% of the population is non-white ethnic minority.

3.2. Primary school meals provision in Inverclyde

Inverclyde has 20 primary schools in total, with an average pupil roll of 266, compared with the Scottish national average of 198 (Scottish Government summary statistics 2017). The proportion of children eligible for free school meals (an indicator of deprivation) across all primary schools is 57%, this compares with the Scottish national average of 37% (Healthy Living Survey Scotland, 2018). In common with LAs in other regions, IC receives funding from Scottish Government to cover the full cost of meals to children from lower income households, as well as to all children in the first three years of schooling. Parents/carers pay the price of meals in all other cases. At present, the price per meal in Inverclyde schools varies between £1.95 and £2.00 (€2.23 - €2.28). In Scotland, most LAs provide school meals directly through their in-house catering functions, and Inverclyde Council (IC) is an example of this, providing meals through its Facilities Management department. Schools in Inverclyde are obliged to take the meals provided by this department - there is no opt-out.

3.3. The school meals service contract in Inverclyde

Inverclyde Council has undertaken school meal provision in-house since creation of the region in 1996, employing kitchen staff on-site in schools, and contracting directly with suppliers. 18 out of the 20 schools have kitchens on-site: the remaining 2 schools are served by the next nearest school with a kitchen. The number of staff employed directly is 194, comprised of 4 members of management team, 24 catering managers (who work on-site in schools), 10 cooks, and c.156 catering support staff.

In terms of budget, the Facilities Management department works to an annual budget allocated to it by the Education Department of IC. The budget level may reflect several factors of which one is the broad cost of meal provision, however there is no precise mapping between the real costs of supplying and serving meals in a given year, and the sum of the budget in the subsequent year. Catering managers or cooks working on-site are not required to fiscally manage their orders/stock.

In terms of contract, the Facilities Management department is also responsible for tendering and managing the contract with suppliers. It operates four separate contracts (i) fruit and vegetables, (ii) fresh meat, (iii) dairy and (iv) groceries/frozen goods. All contracts except for (i) are let through the national Scotland Excel Framework Agreement: the fruit and vegetables contract is let through a smaller framework agreement between Inverclyde and three neighbouring councils. In the contract, there are specifications relating to quality, size and aspects of transportation, but currently there are no specifications relating to origin (neither regional nor Scottish), as these would raise the price of goods. In accordance with Scottish Government standards, all red meat supplied is Red Tractor certified, and all fish is Marine Stewardship Council certified. At present, IC is not accredited with Food For Life (FFL). No suppliers are supplying organic items, nor items produced within Inverclyde region. This is in part due to cost, and also because very little agrifood production exists within the region, with the result that sourcing produce very locally is difficult.

In terms of menus, these are organised on a 3 week cycle, and are reviewed once per year. Hence, the same menu is offered at each school for the whole school year, with some small variations to reflect seasonal changes in availability of vegetables. Daily menus comprise two courses, normally a main dish (from a range of hot and cold options) and a dessert, although some schools also offer a soup option.

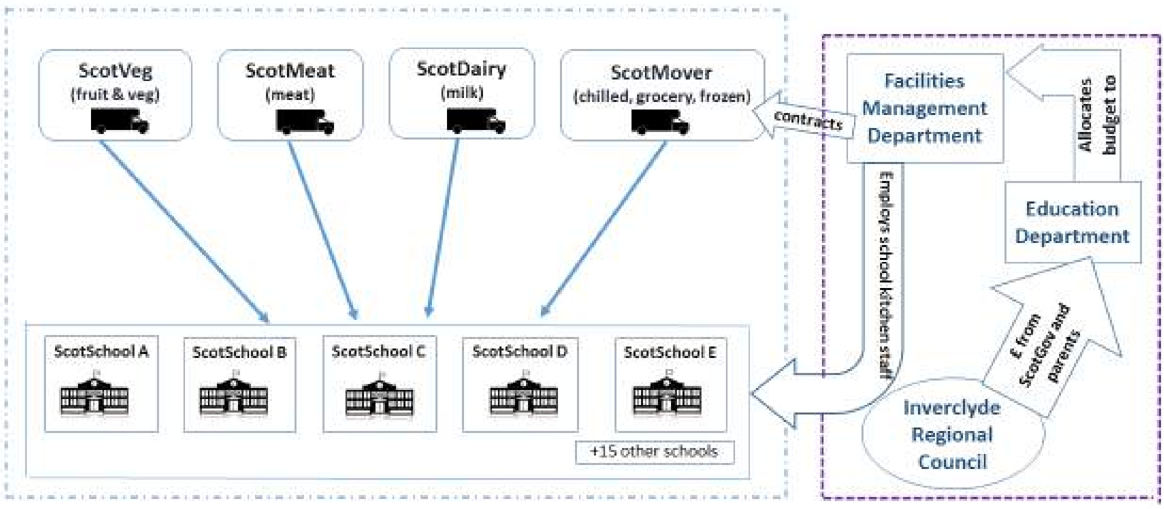
For 2017-18, the average meal uptake across all primary schools was 73%, with uptake in Yr1-3 being higher at 80% (recall school meals are free to parents for all pupils in Yr1-3).

3.4. The current school meals supply chain in Inverclyde

Figure 4 presents diagrammatically the organisation of the Inverclyde school meals supply chain. It shows that income for school meals from parents and Scottish Government comes to Inverclyde Council, who then draw from this to allocate an annual budget to the Facilities Management department, to manage the provision of school meals (the allocation is made via the Education Department). Facilities Management employs all the school catering staff and contracts the supply of fresh produce, milk, meat and groceries/processed/frozen goods to relevant first tier suppliers (wholesalers and distributors). It is these first tier suppliers who actually deliver goods to the 20 schools. In turn, the first tier suppliers source items from next tier wholesalers, processors and/or farmers, of whom none, at present, are located within Inverclyde region.

The supply of goods to ScotSchools A-E is very typical of the remaining 15 primary schools in Inverclyde – fresh fruit and vegetables are supplied by the distributor "ScotVeg", fresh meat is supplied by the butcher/wholesaler "ScotMeat" (sourced from abattoirs based in Scotland and England), milk is supplied by the processor/distributor "ScotDairy" and processed/frozen items are supplied by "ScotMover", a national foodservice company. Orders for goods are placed by school kitchen staff directly with the relevant supplier, usually on a weekly basis. Fresh and perishable items are normally delivered twice per week, whereas the delivery cycle for ambient/frozen items may be less than this. Individual schools order different quantities of items from suppliers, due to variations in pupil numbers and meal uptake. In addition, the specific items they order also vary. The differences are due to the (relatively small) variations in menus and dishes offered by each school, pupil preferences for certain items (e.g. specific salad vegetables), and special dietary requirements.

Figure 4: Organisation of the Inverclyde school meals supply chain



3.4.1. Inverclyde Council Facilities Management

As mentioned above, Facilities Management has been responsible for the school meals service in Inverclyde since the region's creation in 1996. The unit comprises a team of 4 staff based at the Council headquarters (a team leader, nutritional coordinator, and two cluster managers who each manage half of the catering staff). This team advises on recipes for the meals, following Scottish government nutritional standards, and undertakes nutritonal checks of recommended dishes. This team also contracts wholesalers/suppliers, sets the specific lists of goods that schools can order, collects meal uptake and waste data (counter, kitchen and dining waste), and processes supplier invoices. In addition, there are 24 catering managers (head cooks), 10 further cooks, and 156 catering support staff, all based on-site in schools. It is catering managers (head cooks) who take the lead in developing menus, hence there is no standard menu across all schools (although in practice the variations across schools are quite small). Recipes are nutritionally evaluated. All staff are Facilities Management employees.

3.4.2. ScotVeg

ScotVeg is a 98 year old fruit and vegetable wholesaler located in the city of Glasgow. It specialises in packing and distribution of fresh produce to commercial trade and public sector customers, and holds contracts for a number of councils across Central Scotland in addition to Inverclyde. Over the years, the current Directors have developed a range of creative materials for schools liaison and educational purposes, and are active in undertaking school visits/presentations. ScotVeg also was awarded a Gold sustainable business award, reflecting their commitment to waste reduction and recycling. ScotVeg's current turnover is £5m (€5.7m) and the firm employs 23 staff.

3.4.3. ScotMeat

ScotMeat is a third generation butchery and meat processing firm with strong roots in Central Scotland. It was set up in the 1930s by the father of the present senior Director, as a retail butchery. The present senior Director began catering butcher service in the 1980s, and this activity now dominates the firm. Public sector contracts are a core part of that business, and ScotMeat supplies 6 other council contracts in addition to Inverclyde. Beef, lamb and pork is usually sourced from abattoirs in England, unless LAs specify PGI product (which will be Scotch PGI, and more expensive). All meat supplied to Scottish schools is Red Tractor certified[42]. The firm has a turnover of £6.5m (€7.4m), and has 55 employees.

3.4.4. ScotDairy

ScotDairy has its origins in a postwar dairy farm and milk bottling business based in countryside to the south of Glasgow. Since 2015, it has been owned by one of the largest dairy firms in the UK, which has its headquarters in England. Currently, ScotDairy comprises two milk processing plants and offices in Central Scotland, plus 5 distribution depots. All milk delivered to Scottish schools (including Inverclyde) comes from Scottish farms, which is supplied under contract. ScotDairy's parent firm also supplies the yoghurts to Inverclyde schools, although these are made in England and distributed by ScotMover, not direct delivery. ScotDairy's turnover is £137m (€156.4m), and it employs 946 staff.

3.4.5. ScotMover

ScotMover is a large foodservice and distribution company, with its main offices and distribution hub located in Central Scotland. Its parent company has its headquarters in the south of England. ScotMover supplies a very wide range of ambient, chilled, processed and frozen items, as well as non-food kitchen and janitorial supplies. In addition to holding the Inverclyde council contract, ScotMover supplies all but one of the other LAs in Scotland, either directly as a contract holder, or by acting as a third party distributor on behalf of another contract holder (this arrangement is common for larger, rural regions where ScotMover has the scale to pool LA and commercial customers to make the delivery costs viable). ScotMover is able to source Scottish origin products for many of its lines, and for schools can offer Scottish cheese, eggs and fish as standard. However, many Scottish origin products are more expensive, in particular meat. The turnover of ScotMover's Central Scotland base is £60million (€68.5m), and it employs 329 staff.

[42] http://assurance.redtractor.org.uk/.

3.5. The featured schools in Case 2 Inverclyde

Table 4 summarises the pupil roll and meal uptake in ScotSchools A-E, in 2017-18.

Table 4: Pupil roll and meal uptake in Inverclyde (LOW) featured schools

	Pupil roll	% free meals (P4-P7)	Daily average meals	Daily average uptake
ScotSchool A	203	51%	164	81%
ScotSchool B	379	51%	286	76%
ScotSchool C	238	27%	176	74%
ScotSchool D	456	48%	349	77%
ScotSchool E	192	14%	124	65%

3.5.1. ScotSchool A

ScotSchool A is a co-educational, denominational (Catholic) primary school located in the large town of Greenock, in central Inverclyde. It has 203 pupils, which makes it a medium-sized school for the region. The district in which School A is located exhibits quite high levels of deprivation, and 51% of P4-P7 pupils are eligible for free meals. ScotSchool A has a number of health and food-related initiatives, including Daily Mile walk/run for all pupils, and a Health Group, which promotes healthy lunch/snack choices. However, the headteacher notes that the school has not placed a huge priority on these issues in the past. Uptake of school meals is 81%, which is higher than the average for all schools in this region (73%) (Scottish average uptake = 55% (Healthy Living Survey Scotland, 2018).

3.5.2. ScotSchool B

ScotSchool B is a co-educational, non-denominational primary school located in the same district of Greenock as School A, above. It has 379 pupils, which makes it a large-sized school for the region. As with ScotSchool A, ScotSchool B serves a community that exhibits high levels of deprivation, and 51% of P4-P7 pupils are eligible for free meals. ScotSchool B has followed some eco and health initiatives in the past, with food-related projects targeting basic cooking and eating skills, for which there is a need given the profile of the catchment. However, in the past few years there has been little activity of this kind due to pressure on the school to improve core numeracy and literacy of pupils. Uptake of school meals is 76%, which is a little higher than the average for all schools in the region (73%).

3.5.3. ScotSchool C

ScotSchool C is a co-educational, non-denominational primary school serving a seaside town on the west coast of Inverclyde region. It has 238 pupils, which makes it a medium-sized school for the region. The host town is relatively affluent, although there are pockets of deprivation: 27% of P4-P7 pupils are eligible for free meals. ScotSchool C has pursued a number of health and food-related initiatives in recent years, reflecting a personal enthusiasm and commitment of the deputy headteacher. These include a successful bid for specialist funding to get food subjects embedded in curriculum, including running a multipurpose cafe within the school (to provide in-house cooking for pupils, a community cafe for older visitors and Fair Trade cafe). The bid also involved a growing component - the school janitor led a group that planted potatoes, carrots and rhubarb, these were gathered in and children helped to make soup with it. In the canteen, a pupil-led initiative involves groups of older pupils encouraging their peers to make healthy lunch choices and to eat up their food. Uptake of school meals is 74% which is the average for schools in this region.

3.5.4. ScotSchool D

ScotSchool D is a co-educational, non-denominational primary school serving a large town in the east of Inverclyde region. It has 458 pupils, which makes it the largest primary school in the region. The host town exhibits high levels of deprivation, and 48% of ScotSchool D's pupils are eligible for free meals. The school has actively pursued several food and health-related initiatives, particularly in terms of encouraging healthy eating practices amongst the most vulnerable children and their families, including after-school cooking and food learning classes. The school also has a pupil-run Health and Wellbeing Group which has made posters about unhealthy snacks and encouraged more healthy meal choices. In-school cooking classes are also run as part of the curriculum. Uptake of school meals is 77% which is slightly higher than the average for all schools in this region.

3.5.5. ScotSchool E

ScotSchool E is a co-educational, non-denominational primary school serving a focal village, and surrounding rural communities, in the east of Inverclyde region. It has 190 pupils, which makes it a small to medium-sized school for the region. The area served by ScotSchool E is affluent, with low levels of deprivation, and only 14% of pupils are eligible for free meals. The current headteacher has a personal enthusiasm for food and health issues, and was successful last year in getting funding for a 'Grow It, Cook It, Eat It' programme of activities. This has involved getting kitchen resources to allow for cookery classes (both as part of curriculum and after school), and funding for a school gardening/growing project. The latter project has been undertaken in collaboration with volunteer parents, local gardening club and a social enterprise, who have pledged their time/expertise to maintain the site. ScotSchool E places importance on healthy eating but has not had to introduce initiatives such as a packed lunch policy or monitoring of lunchtime choices because pupils generally make good choices, linked to the affluence of the area. Uptake of school meals is 65%, which is a bit below the average for the region.

4. ENVIRONMENTAL IMPACT OF SCHOOL MEALS SERVICES

4.1. Methodology to measure environmental impact

Our core measure of environmental impact was carbon footprint, expressed as the kgsC0_2e emitted from the production, processing, transportation and waste of food items purchased by the five featured schools in Case 1 Durham (LOC) (i.e. NorthSchools A-E) and Case 2 Inverclyde (LOW) (i.e. ScotSchools A-E), respectively, over a 190 day school year.

To estimate the emissions from the production and processing of food items supplied to the schools, we used three sets of emissions factors. For fresh items, we used the factors proposed by Audsley et al (2009). For processed items, we used the factors of the Rowett Institute of Nutrition and Health Database (2017), as these include emissions for processing activities. Finally, for the organic meat and dairy items supplied to NorthSchool A, we adopted Williams et al's (2006) factors, because these encompass estimates for both conventional and organic meat and dairy products. All sets of factors encompass the emissions caused by all the activities arising from the production of food items up to and including transport to the regional distribution centre (RDC) level. In our study, the RDC level equates to wholesalers (i.e. the first-tier suppliers described in Section 2).

To estimate the emissions relating to the transportation of food items from wholesalers/suppliers to schools (i.e. 'local' transportation), we used the calculation method recommended by Defra (2013). This is based on estimating suppliers' delivery round distances and frequencies, taking account of the types of vehicles and fuel used, the number of drops to other customers in the rounds, and the proportion of the loads comprised by the food items to the schools featured in the case[43]. According to Kellner & Otto (2011), the formula below assumes 89% weighted average allocated to the distance of the delivery round and 11% for the vehicle load.

To estimate the emissions relating to waste, we applied the emissions factors for waste handling proposed by Moult et al (2018). These capture the emissions from transportation of waste from schools to waste disposal sites, and from the processing of the waste itself, for five different food categories (fruit and vegetables, bread, cheese, fish, and meat).

4.1.1 Measurement method for Case 1 Durham (LOC)

The measurement process for Durham (LOC) was as follows:

First, we collected the delivery invoices sent by all the Durham suppliers (FreshGrocer, FreshMeat, GoodsMover, ECOFarm) to NorthSchools A-E over two time periods in the 2017-18 school year: 9 weeks in autumn 2017 and 3 weeks in spring 2018, to reflect the seasonal change in menu. From these invoices, we generated a list of the total volumes of foods purchased by these schools in those periods. We included all types of food item (fresh fruit and vegetables, fresh meat, milk and dairy, eggs, ambient goods (e.g. bread, pasta, rice, flour), and processed and frozen items (including canned goods and ready meals). The only items excluded

[43] The formula we used was: $\text{Total CO2 Emissions From Transportation Process per Week} = \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Drops}}{\text{Total Drops}} \times 89\%\right) + \left(\text{Total Delivery Rounds CO2} \times \frac{\text{School Load}}{\text{Vehicle Load}} \times 11\%\right)$

were those purchased in very small quantities (e.g. certain spices, sauces) and bottled water. From these data we estimated the average weekly volumes (in kgs) of all foods purchased by the schools, then multiplied these volumes by 38 to estimate the total volumes (kgs) of the food items purchased over one school year.

Next, we calculated emissions (kgsC0_2e) from the agricultural production and processing of the foods, multiplying the per kg emissions factors mentioned earlier by the total volumes calculated in the above step. To select the most appropriate factor from the options of UK, EU and ROW origin, we used information given by the suppliers in interview as to the origin of the foods supplied to Durham schools, and also where origin changed over the course of the year, in the case of fresh fruit and vegetables.

Then, we calculated the emissions (kgsC0_2e) relating to the transportation of the food items from the suppliers to NorthSchools A-E for a 38 week school year, using information on delivery round distances and frequencies given by suppliers in interview, and applying the estimation method of Defra (2013).

Finally, we calculated the emissions (kgsC0_2e) relating to the handling of waste by taking the data on volumes (in kgs) of plate waste generated at two NorthSchools over four weeks (as collected in WP6.2 and reported in D6.2), and aggregating these (based on averages of food waste per meal for each food category from the two NorthSchools) to the five NorthSchools, for the 38 week school year. We then multiplied the aggregate plate waste volume of all five NorthSchools by Moult et al's (2018) waste handling emissions factors, taking account of the emissions attached to different categories of waste.

The total carbon footprint for Durham LOC case was therefore the sum (in kgsC0_2e) of the above sets of emissions applied to the total aggregate food volumes purchased by NorthSchools A-E, as described above.

4.1.2 Measurement method for Case 2 Inverclyde (LOW)

The measurement method for Inverclyde (LOW) was identical to that of Durham except for two features. First, as Inverclyde operates a single 3-week menu cycle for the whole school year, we collected invoices for one 6 week period (summer-autumn 2017), rather than two. This time period nevertheless captured a seasonal shift in fresh vegetable procurement. Second, as there were no organic items being supplied to Inverclyde schools, all emissions factors used were drawn from Audsley et al (2009) and the Rowett Institute of Nutrition and Health (2017) database.

4.2. Which foods are supplied in the school meals services?

To begin, this section reports the total volumes of foods supplied to the featured schools in Durham and Inverclyde over one school year, and the composition of the average meal (pre-preparation and cooking) in both Cases.

4.2.1. Foods supplied in Case 1 Durham (LOC) service

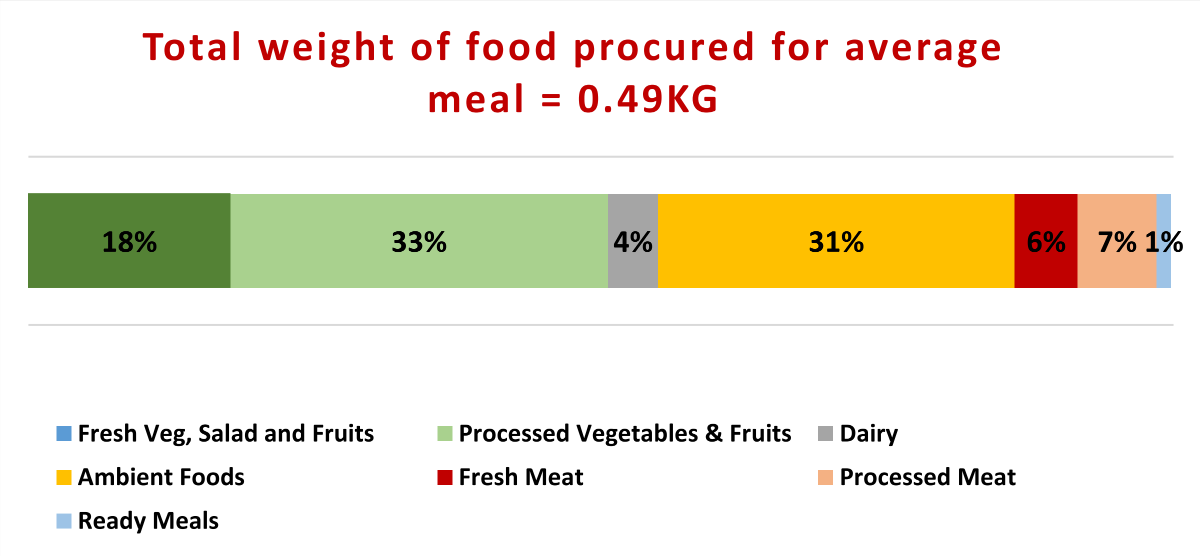
Table 5: Annual volumes of foods supplied to Durham (LOC) schools (n=5)

Food Category	Volume (kg/ltr)
Fresh fruit and vegetables	8,756
Processed fruit and vegetables	16,344
Dairy	2,295
Ambient	15,426
Fresh meat	2,738
Processed meat	3,414
Ready meals	626
Total	**49,598**

As Table 5 shows, the total volume of food items purchased by NorthSchools A-E was 49,598kgs. Of this total, the largest component was processed fruit and vegetables, which was comprised mainly of frozen mixed vegetables and potato chips/mash, with small amounts of tinned tomatoes and beans, and tinned fruit. This was followed by ambient goods, around a quarter of which was flour and flour-based mixes, but which also included bread, sugar, vegetable spreads and oils, and pasta. The next largest component was fresh fruit and vegetables, almost half of which was potatoes, followed by carrots (c.15%), and broccoli (10%), then small amounts of cabbage, onions and cauliflower, and salad vegetables such as peppers, tomatoes, cucumber and lettuce. Apples were the dominant fruit (c.9% of the category), followed by very small quantities of oranges, pears and bananas. Processed meat represented the next largest category (around half of which was frozen breaded fish, c.15% tinned fish and 10-15% sliced ham/chicken), then fresh meat (at least a third of which was beef, and the rest pork, chicken and turkey), dairy (almost entirely milk, cheddar and yoghurt) and finally very small quantities of ready meals (mainly frozen omelettes and pastry). Overall, the schools' inventories included a reasonable amount of labour-saving ingredients, e.g. sponge mixes, bottled sauces, and prepared frozen vegetables.

To facilitate comparison between the cases, we took the above yearly purchase volumes and divided them by the total number of meals served at NorthSchools A-E, in order to calculate the total weight (pre-preparation and cooking) and composition of an average meal at these schools. Figure 5 shows the results. It should be emphasised that the total weight refers to the weight of foods procured for the average meal, rather than the weight of the served meal on the plate.

Figure 5: Composition of average meal in Durham (LOC) schools (n=5)



As Figure 5 shows, the total weight of food procured for the average meal at NorthSchools A-E is 490g, and is comprised of 18% fresh fruit and vegetables, 33% processed vegetables, 4% dairy, 31% ambient, 6% fresh meat, 7% processed meat and 1% ready meals. Therefore, the average meal in LOC case contains just over half fruit and vegetables (of which two thirds is processed), just under one third ambient, 13% meat (of which just over half is processed), small amounts of dairy and very small ready meals.

4.2.2. Foods supplied in Case 2 Inverclyde (LOW) service

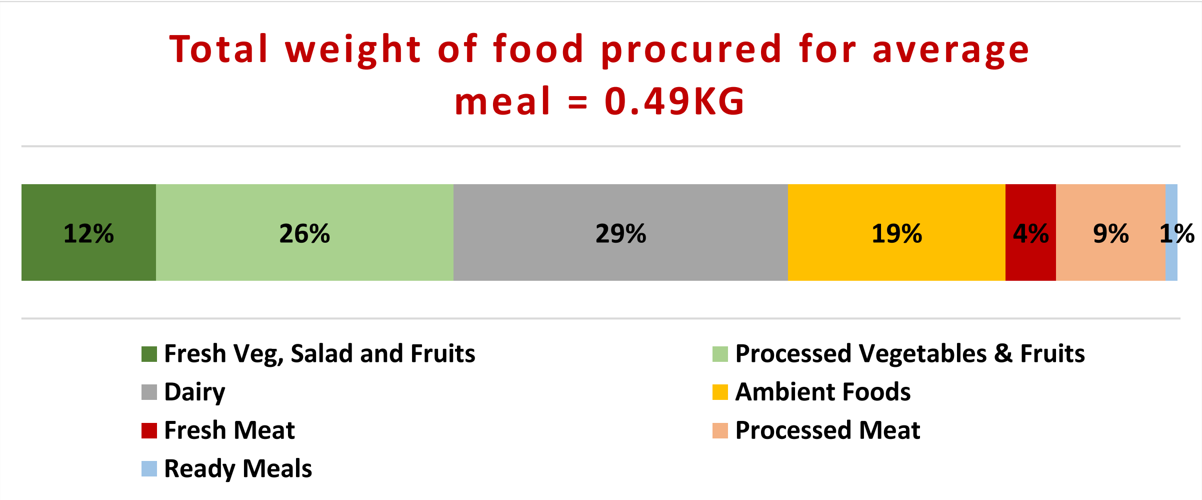
Table 6: Annual volumes of foods supplied to Inverclyde (LOW) schools (n=5)

Food Category	**Volume (kg/ltr)**
Fresh fruit and vegetables	11,754
Processed fruit and vegetables	26,029
Dairy	29,240
Ambient	18,986
Fresh meat	4,546
Processed meat	9,726
Ready meals	1,032
Total	**101,313**

As Table 6 shows, the total volume of food items purchased by ScotSchools A-E was 101,313kgs. Of this total, the single largest component was dairy products, 70-80% of which was cartoned drinking milk (including, for four out of the five schools, around 50%-66% chocolate or strawberry flavoured milk), then smaller quantities of yoghurt and cheddar. The next largest category was processed fruit and vegetables, around half of which was frozen potato chips/mash, followed by various frozen vegetables (e.g. beans, broccoli, carrots) and then smaller quantities of tinned tomatoes and baked beans. Fruit juice and fruit flavoured jelly dominated processed fruit. The next largest category was ambient goods, around half of which was bread, followed by smaller quantities of flour and flour-based mixes, vegetable spreads and oils, and pasta and rice (the latter comprising c.5% each). Fresh fruit and vegetables represented the next largest component, of which potatoes were the single biggest item (50%-66%), followed by small amounts of carrots (5%-12%) and very small amounts (1-2%) each of other field vegetables (cabbage, onion, leek) and salads (tomatoes, lettuce, cucumber). Apples, grapes and melon were the dominant fruits (c.10% contribution each), with smaller quantities of banana and oranges. Processed meat represented the next category (comprised of around one third frozen breaded fish, around one third processed chicken, 10-20% sliced ham/turkey and c.10% tinned fish (tuna)). Fresh meat, the second smallest category, was comprised only of beef (c.50%-66% in four out of five schools) and pork. There were very small quantities of ready meals (mainly frozen omelettes, ready made pizza bases and pastry squares). As in LOC case, the schools' inventories included quite a lot of labour-saving ingredients, e.g. sponge mixes, bottled sauces, and prepared frozen vegetables.

Again to facilitate comparision, we took the above yearly purchase volumes and divided them by the total number of meals served at ScotSchools A-E, in order to calculate the total weight (pre-preparation and cooking) and composition of an average meal at these schools. Figure 6 shows the results. Again, we emphasise that total meal weight refers to the quantity of foods procured for the average meal, rather than the weight of the served meal.

Figure 6: Composition of average meal in Inverclyde (LOW) schools (n=5)



As Figure 6 shows, the total weight of food procured for the average meal at ScotSchools A-E is 490g, and is comprised of 29% dairy, 26% processed vegetables, 19% ambient, 12% fresh fruit and vegetables, 9% processed meat, 4% fresh meat and 1% ready meals. Therefore, the average meal in LOW case contains high proportions of dairy products and processed vegetables (more than half the total volume is comprised of these foods), and a relatively small proportion of fresh fruit and vegetables.

Comparing the composition of the average meals in LOC and LOW case (pre-preparation and cooking), it can be seen that the LOC average meal has a considerably larger proportion of total fruit and vegetables than LOW (51% vs 38%), and within this, the proportion of fresh produce in LOC case is also higher (18% vs 12%). Also, a striking difference between the cases is the much larger proportion of dairy products in the LOW average meal (29% vs 4%), which is due to the high quantities of cartoned drinking milk in LOW case (only water is offered for drinking in Durham schools). LOC case has a higher proportion of ambient goods compared with LOW case (31% vs 19%), but both cases have the same proportions of meat (13%), albeit Inverclyde schools have a greater proportion of beef in the fresh meat category.

4.3. How far do foods travel in school meals services?

Next for enviromental impact, we report the distances travelled by foods, from first tier suppliers to schools, in both Cases (Tables 7 and 8). The estimations are the raw kms travelled for food items in each category, based on the round-trip distances from suppliers to schools, and the frequencies of the suppliers' deliveries. The kms have not been moderated to take into account other customers in the delivery rounds, shared loads or backhauling.

Table 7: Annual kms travelled by foods, from suppliers to schools, in Durham (LOC)

Food Category	**Kms**
Fresh fruit and vegetables	14,045
Processed fruit and vegetables	4,908
Dairy	3,681
Ambient	4,633
Fresh meat	26,087
Processed meat	1,025
Ready meals	188
Total	**54,567**

Table 8: Annual kms travelled by foods, from suppliers to schools, in Inverclyde (LOW)

Food Category	**Kms**
Fresh fruit and vegetables	20,966
Processed fruit and vegetables	12,260
Dairy	66,495
Ambient	8,943
Fresh meat	21,934
Processed meat	4,581
Ready meals	486
Total	**135,665**

Table 7 shows that in Durham LOC case, the total distance travelled by foods over the school year was 54,567 kms. Fresh meat deliveries represented almost half this total, due to a combination of the relatively distant location of the FreshMeat supplier (38 kms from Durham city) and frequent deliveries for this food category. Fresh fruit and vegetables represented the next biggest category (26%), although the absolute kms travelled were quite low, reflecting the proximate location of FreshGrocer to County Durham (24 kms from Durham city). The kms travelled by processed and ambient goods were even more modest, due to the central location of GoodsMover's depot within the County, and less frequent deliveries compared with fresh goods. Table 8 shows that the total distance travelled by Inverclyde LOW case foods was considerably more than LOC case, at 135,665 kms. Dairy products, comprised mainly of cartoned drinking milk, represented half the total, reflecting the relatively distant location of ScotDairy (56 kms from Greenock), and the daily delivery schedule for these products. (In interview, the ScotDairy manager mentioned that this firm works with councils to find ways to reduce delivery frequencies because the milk products have a good shelf life, however the barriers are often limited storage capacity in schools and/or food safety worries of catering staff.) Deliveries of fresh meat and fresh fruit and vegetables represented very similar kms, due to the suppliers being located at similar distance from Inverclyde region, and having the same delivery frequencies. Ambient and processed goods represented only a modest contribution to total kms, as although ScotMover's depot is the most distant of Inverclyde's suppliers (63 kms from Greenock), the delivery frequency was lower for these types of goods than fresh items.

4.4. What are waste levels in school meals services?

In this section, we report the plate waste levels for schools in both Cases. A full breakdown of plate waste volumes per food category is reported in D6.2 UK Country Report, for two Durham schools (NorthSchools D and E), and two Inverclyde schools (ScotSchools A and E), which were collected via two week-long periods per school. Here, we present estimates of total plate waste for all five Durham and Inverclyde schools, aggregated from this D6.2 plate waste data.

Table 9: Annual plate waste in Durham (LOC) schools

	Plate Waste (kg/yr)
Vegetables	3,207
Fruit	936
Meat and Fish	1,367
Starchy Carbs	4,445
Dessert	1,209
Other	63
Total	11,227
% of food served	26%

Table 10: Annual plate waste in Inverclyde (LOW) schools

	Plate Waste (kg/yr)
Vegetables	844
Fruit	1,294
Meat and Fish	2,002
Starchy Carbs	8,095
Dessert	1,003
Milk	3,225
Other	141
Total	16,604
% of food served	25%

Table 9 shows that the total plate waste for the five Durham LOC schools was 11,227 kgs, which was 26% of total food served. Over two thirds of this waste was comprised of starchy carbs and vegetables. Table 10 shows that the total plate waste for the five Inverclyde LOW schools was 16,604 kg, which was 25% of total food served. Almost half of this total was comprised of starchy carbs, with the next largest contributor (19%) being milk.

4.5. What is the carbon footprint of school meals services?

We now report the core environmental impact results for the school meals services in Durham and Inverclyde. Below we present the total carbon footprints of the services in each Case, and the contribution of the main activities of the supply chain (production/processing, local transportation, cooking and waste) to the totals.

4.5.1 Carbon footprint of Case 1 Durham (LOC) service

Based on the measurement method described in 4.1.1, we calculated the total carbon footprint of the school meals service for the 5 Durham schools (i.e. NorthSchools A-E). Hence we summed the total emissions associated with the production, processing, transportation and waste of food items purchased by these five schools over one school year. Table 11 shows the results.

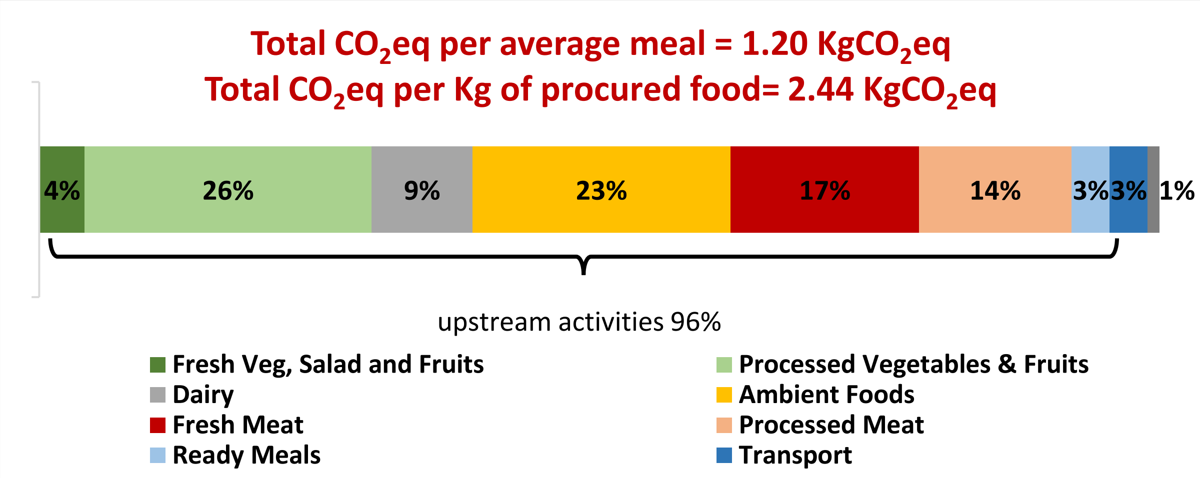
Table 11: Carbon footprint of school meals service in Durham (LOC)

	kgsC0_2eq
Production, processing, upstream transport emissions, of which:	115,705
Fresh fruit and vegetables	4,945
Processed fruit and vegetables	30,974
Dairy	10,911
Ambient	27,909
Fresh meat	20,362
Processed meat	16,480
Ready meals	4,125
Local transportation emissions	4,080
Waste handling emissions	1,284
Total	**121,069**

As Table 11 shows, the total emissions of the school meals service to the five Durham LOC schools was 121,069 kgC0_2eq. It can be seen that the vast majority (96%) of emissions resulted from the upstream activities of production, processing and first phase transportation of the food items, whereas local transportation (from first tier suppliers to schools) represented only 3%, and waste handling only 1% of total emissions.

In order to facilitate comparison with LOW case, we calculated the total carbon emissions of the Durham school meals service to NorthSchools A-E on a per average meal basis, and per kg of average meal basis. To derive emissions per meal, we divided the total emissions of foods purchased by the five schools in one year by the total number of meals served. By this calculation, the average meal at the Durham schools generated 1.20 kgs$C0_2$eq. Figure 7 shows the breakdown of these emissions, by type of food and stage of supply chain activity. To derive emissions per kg of meal, we divided the average meal emissions figure by the average meal weight (pre-preparation and cooking), which was 490g. By this calculation, emissions for every 1kg of meal at NorthSchools A-E are 2.44kg of $C0_2$eq.

Figure 7: Carbon footprint of school meals service in Durham (LOC)



As Figure 7 shows, the largest contributor to the total carbon footprint at Durham LOC case was meat (fresh + processed), which represented 31% of carbon footprint. This high contribution was despite meat comprising only 13% of the weight of the average meal, which illustrates well the high carbon burden of meat relative to other food categories. Fruit and vegetables (fresh + processed) were the next largest contributor to carbon footprint (30%). However, as these items comprised just over half of the total weight of the average meal, this result confirms the relatively low average emissions of foods in this category (though higher contribution of processed items over fresh). Ambient foods contributed 23% to carbon footprint, whilst the contributions of dairy products and ready meals were small (9% and 3%, respectively), reflecting their equally small contributions to average meal volume. Local transport represented a very small proportion of total emissions (3%), which can be explained by the relatively small distances between the suppliers and the schools, and also the logistical coordination role of FreshGrocer, whose activities in collecting and delivering items such as milk and eggs on behalf of other producers increases the efficiency of the chain, thereby reducing local food miles. Waste handling comprised only 1% of total emissions, reflecting the low carbon disposal method adopted by SchoolCater (anaerobic digestion).

4.5.2 Carbon footprint of Case 2 Inverclyde (LOW) service

Based on the measurement method described in 4.1.2, we calculated the total carbon footprint of the school meals service for the five Inverclyde schools (i.e. ScotSchools A-E). Hence we summed the total emissions associated with the production, processing, transportation and waste of food items purchased by these five schools over one school year. Table 12 shows the results.

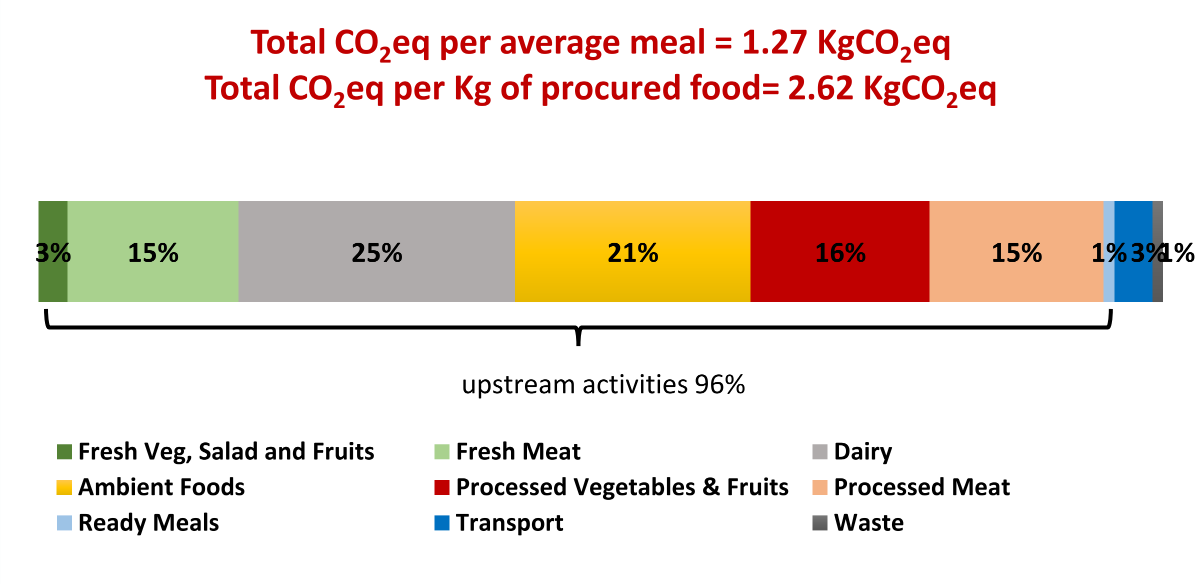
Table 12: Carbon footprint of school meals service in Inverclyde (LOW)

	kgs$C0_2$eq
Production, processing, upstream transport emissions, of which:	253,583
Fresh fruit and vegetables	6,609
Processed fruit and vegetables	42,292
Dairy	65,262
Ambient	55,547
Fresh meat	40,366
Processed meat	40,946
Ready meals	2,562
Local transportation emissions	9,064
Waste handling emissions	2,383
Total	**265,030**

As Table 12 shows, the total emissions of the school meals service to the five Inverclyde schools was 265,030 kgs$C0_2$eq. It can be seen that, like LOC case, the vast majority of emissions (96%) resulted from upstream production, processing and transportation of the food items, whereas local transportation (first tier suppliers to schools) and waste contributed only very small proportions of the total emissions (3% and <1%, respectively).

To facilitate comparison with LOC case, we calculated the total carbon emissions of the Inverclyde meals service to ScotSchools A-E on a per average meal basis, and per kg of meal basis. To derive emissions per meal, we divided the total emissions of foods purchased by the five schools in one year (265,030 kgs $C0_2$eq) by the total number of meals served. By this calculation, the average meal at the Inverclyde schools generated 1.27 kgs$C0_2$eq. Figure 8 shows the breakdown of these emissions, by type of food and stage of supply chain activity. To derive emissions per kg of meal, we divided the average meal emissions figure by the average meal weight (pre-preparation and cooking), which was 490g. By this calculation, emissions for every 1kg of meal at ScotSchools A-E were 2.62g of C02eq.

Figure 8: Carbon footprint of school meals service in Case 2 Inverclyde (LOW) (n=5)



As Figure 8 shows, the largest contributor to total emissions in LOW case (31%) was meat (fresh + processed). As in LOC case, this high contribution was despite meat being only 13% of average meal volume, which again illustrates the high carbon burden of meat. The next largest contributor to emissions (25%) was the dairy category, which is mainly a reflection of the high quantities of drinking milk procured in LOW case. Although milk carries a relatively modest carbon burden compared with other animal products, the volumes in the Inverclyde service were sufficiently high for the resulting emissions to account for a quarter of the total carbon footprint. Ambient foods generated the next highest emissions at 21%, then fruit and vegetables at 17% which, given that this category represented 38% of the weight of the average LOW meal, illustrates again the low carbon burden of fruit and vegetables. Despite LOW case having greater distances between suppliers and schools than LOC case, the contribution of local transport to total emissions was identical (3%). This can be explained by the fact that ScotMover and ScotMilk (in particular) operated efficient distribution channels, taking in multiple customers in their delivery rounds, which moderates the transport emissions burdens allocated to the five schools in the case study. Like LOC case, Inverclyde's waste handling method is the low carbon anaerobic digestion option, hence this activity contributed only a very small proportion of total emissions.

4.5.3 Comparison of carbon footprints of Durham and Inverclyde services

The environmental impact analysis has found that although the same volumes of food were purchased for the average meal in both cases (490g), the carbon footprint of the Durham (LOC) meals service was smaller than that of Inverclyde (LOW). Specifically, the Durham average meal emitted 1.20 kgs$C0_2$eq, whereas Inverclyde's emitted 1.27 kgs$C0_2$eq. However, the difference between the two cases was not due to the type of procurement model (i.e. greater localisation of the Durham procurement), as transport emissions amounted to the same (very small) proportions of the total carbon footprints of both cases. Instead, the difference related to the composition of the meals, specifically, (i) the greater proportion of fruit and vegetables in Durham meals, which have a low carbon burden, and (ii) the large quantities of milk accompanying Inverclyde meals, which contribute a higher carbon burden. Overall, the results of this research show that the carbon footprints of school meals services depend more on what is on the menu (balance of food items), rather than where the foods have come from (local transportation).

4.6.Procurement management scenarios and their effects on carbon footprints

The preceding sections have shown how different activities in the supply chain contribute to the carbon footprint of the Durham (LOC) and Inverclyde (LOW) meals services. To conclude our analysis of the enviromental impact of the services, we report results of our exploration of different procurement management scenarios and their effects on carbon emissions in both Cases.

4.6.1 Carbon footprint scenarios in Durham (LOC) case

In Durham (LOC) case, we explored the effect of four different procurement management scenarios, as follows:

(i) Given the known contribution of red meat (especially beef) to total carbon footprint, we explored what the emissions effect would be from reducing by 50% the amount of red meat in the Durham menus (specifically, the fresh beef and beef burger), and increasing the amount of white meat (specifically, fresh and processed chicken) by the same volume (Scenario 1);

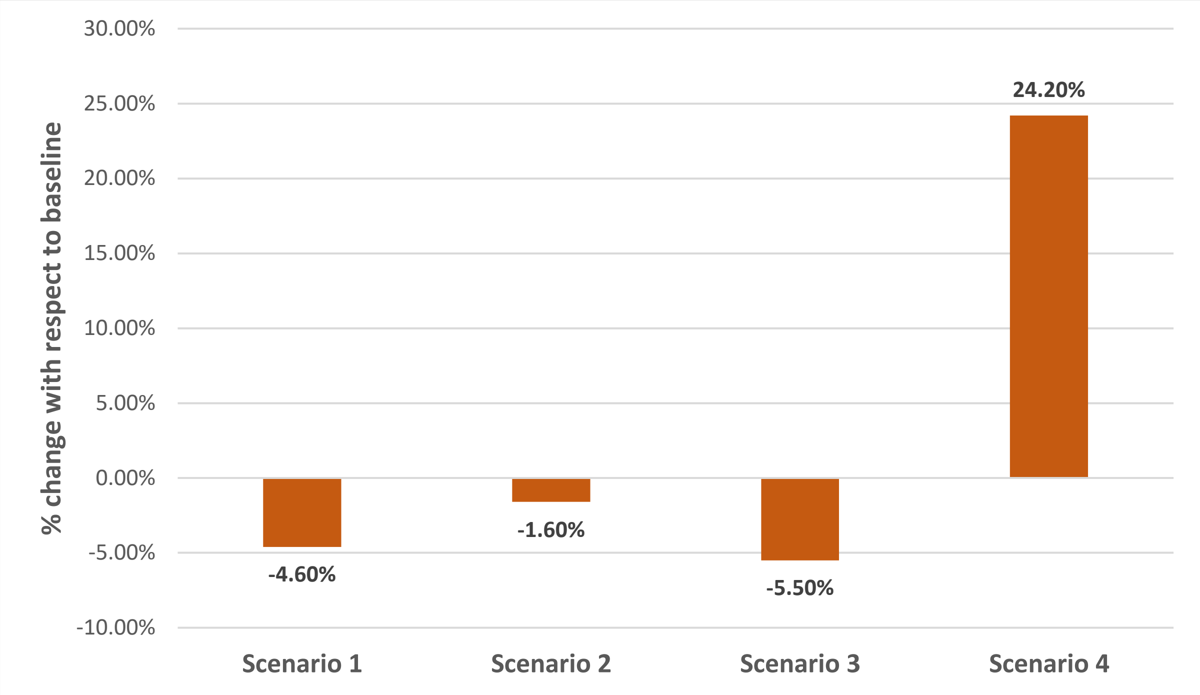
(ii) In view of the logistics coordination role played by FreshGrocer in the existing Durham supply chain, which had a food miles reducing effect, we explored what the effect would be of further consolidation of local transportation, so that one supplier coordinated all the deliveries (Scenario 2).

(iii) To explore a realistic change in the Durham menu, we tested the effect of introducing a one day meat-free menu per week (Scenario 3);

(iv) To illustrate the value, for carbon emissions, of using anaerobic digestion as the waste disposal method, we explored the effect on emissions of switching back to landfill (Scenario 4).

Figure 9 below presents the results. As can be seen, the scenario with the smallest reduction in carbon emissions is Scenario 2 (local transport consolidation), with only a -1.6 change in total kgsC0$_2$eq. This scenario would also likely require quite significant shifts to existing supplier agreements and delivery practices, therefore it does not represent an appealing option. Scenarios 1 and 3, both based on adjusting the amount of meat in the menu, yield better emissions reductions, with the meat-free day option generating the larger effect (-5.5 change in kgsC0$_2$eq). However, the most striking effect comes from switching the waste disposal method back to landfill, which would result in a 24.3% increase in total kgsC0$_2$eq. Overall, this scenario analysis reveals the overlooked importance of waste disposal to total carbon footprint of school meals services, as well as reinforcing the significance of menu adjustments to carbon reduction over transportation adjustments.

Figure 9: Procurement scenarios and carbon footprint effect in Durham (LOC)



4.6.2 Carbon footprint scenarios in Inverclyde (LOW) case

In Inverclyde (LOW) case, we explored the effect of four different procurement management scenarios, as follows:

(i) Given that the Durham (LOC) school meals service was found to have a smaller carbon footprint than Inverclyde, we first explored what the emissions effect would be if Inverclyde adopted Durham's menu (Scenario 1);

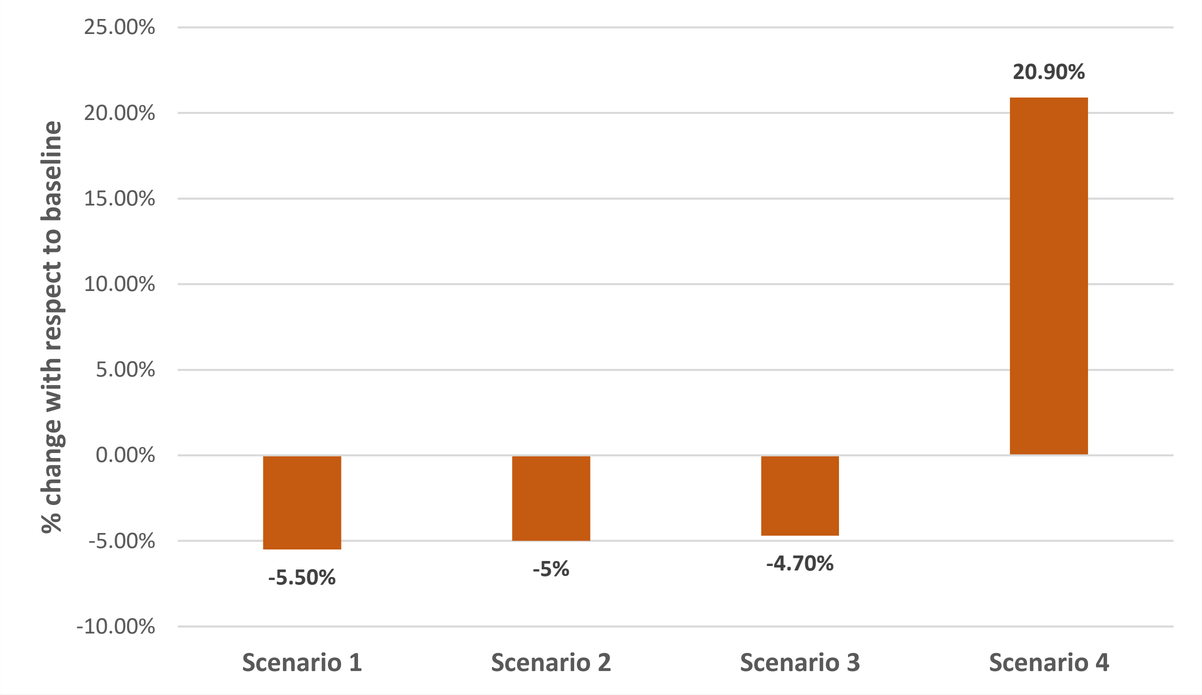
(ii) Given the known contribution of red meat (especially beef) to total carbon footprint, we explored what the emissions effect would be from reducing by 50% the amount of red meat in the existing Inverclyde menus (specifically, the fresh beef and beef burger), and increasing the amount of white meat (specifically, fresh and processed chicken) by the same volume (Scenario 2);

(iii) To explore a realistic change in the Inverclyde menu, we tested the effect of introducing one meat-free menu day per week (Scenario 3);

(iv) To illustrate the value of using anaerobic digestion as the waste disposal method, we explored the effect on emissions of switching back to landfill (Scenario 4).

Figure 10 below presents the results. As can be seen, Scenarios 1, 2 and 3 all yield emissions reductions, with Scenario 1 (switch to Durham menu) generating the greatest change in total emissions (-5.5% kgs$C0_2$eq), followed by Scenario 2 (switch from red to white meat, generating -5% kgs $C0_2$eq) and then Scenario 3 (adoption of meat free day, -4% kgs$C0_2$ emissions). However, as with LOC case, the most striking effect comes from switching waste disposal method to landfill, which would increase total emissions by 20.9%. The magnitude of this increase is slightly smaller than that of LOC case due to the slightly smaller proportion of plate waste generated in Inverclyde.

Figure 10: Procurement scenarios and carbon footprint effect in Inverclyde (LOW)



5. ECONOMIC IMPACT OF SCHOOL MEALS SERVICES

In this section, we report the results of the economic impact of the school meals services in Durham (LOC) and Inverclyde (LOW) cases. The measures of economic impact used in both cases were (i) local economic multiplier effect, and (ii) the economic value of the contract to suppliers.

5.1. Methodology to measure local economic multiplier effect

The aim of the local multiplier analysis was to trace the expenditures of the organisations/firms in the Durham and Inverclyde school meals supply chains, to identify what proportions of the monies from the meals contracts in each case were retained within (or leaked out of) the local area. To calculate this, we used the 'Local Multiplier 3' (LM3) methodology[44], which involves tracking the expenditures of a starting budget (i.e. the total budget gathered from parental/state contributions to fund a school meals service), through three rounds of spending (LM1, LM2, LM3).

In practice, this involved first defining the geographic dimensions of the local area of the case (in both our Cases, this was 40km radius from Council HQs), then tracking retention/leakage of monies as follows:

2. from the holders of the starting budget to the immediate budget recipients (LM1). In our Cases, the LM1 stage comprised the budget transfer from Durham County Council to SchoolCater, and from Inverclyde Council to Facilities Management, respectively. Retention/leakage was determined by the geographic location of the budget recipient's registered HQ, as given for accounting purposes, relative to the 40km local area radius.
    - from the budget recipients to their staff and first tier suppliers/wholesalers (LM2). In our Cases, this stage involved tracking SchoolCater's and Inverclyde Facilities Management's expenditures on their own staff, their first tier suppliers (i.e. all the contracted suppliers described earlier in the Monographs), and other costs. Retention/leakage was determined by the geographic residence of staff, first tier suppliers and recipients of direct cost expenditures, relative to the 40km local area radius.
    - from the first tier suppliers to their staff and upstream suppliers (LM3). In our Cases, this involved estimating the proportions of the private spend of SchoolCater and Facilities Management employees that were retained in the local area, and the proportion of expenditures of first tier suppliers on their staff and upstream suppliers, retained in the local area.

    In terms of calculation outcome, LM3 is expressed as a ratio between 1 (indicating no value has been retained within the local area) and 3 (indicating that 100% of values have been retained).

[44] Full explanation of the method is available at www.lm3online.com.

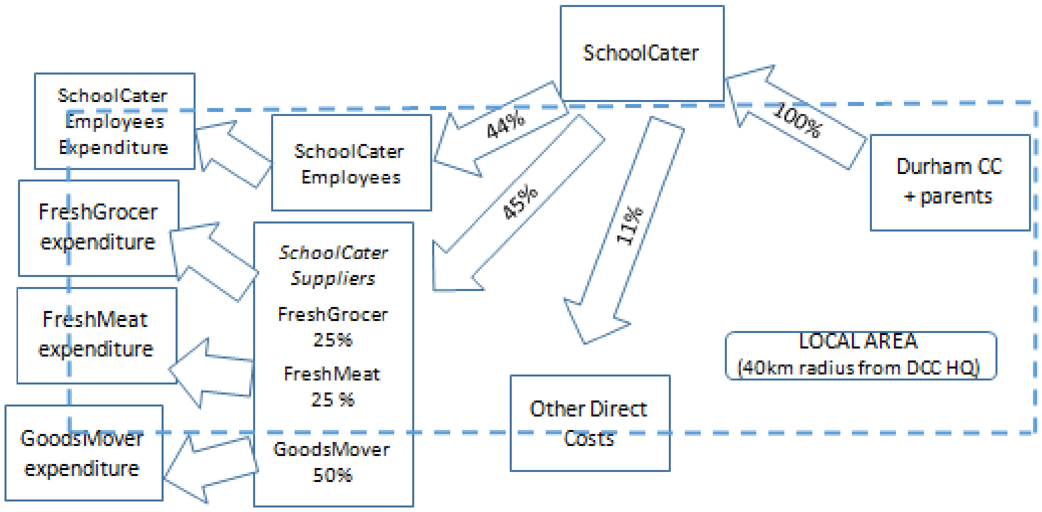
5.2. What are local economic multipliers of the school meals services?

5.2.1 What is local economic multiplier of Durham meals service?

First we report the Durham LM3 calculation and results. In terms of local area, the local boundary was defined as a 40km radius from Durham County Council offices, in Durham City. This area takes in all County Durham plus small areas of Tyneside and Northumberland to the north and neighbouring counties to the south and east. A smaller radius of 35km would have excluded parts of County Durham itself, which would have been inappropriate. Using this radius, FreshGrocer and FreshMeat were defined as 'local' suppliers, both having headquarters within the 40 km boundary. GoodsMover was defined as 'non-local' because although this firm had a depot in County Durham, the headquarters are based in the south of England. This categorisation also accorded with the views expressed by interviewees as to which suppliers were regarded as local/regional or not.

Figure 11 shows the stages of the LM3 analysis for the Durham case, via the flows of expenditures from the initial budget, and their destinations, relative to the 40km local area radius.

Figure 11: Local multiplier analysis (LM3) of Durham school meals service



As Figure 11 shows, the first flow of expenditure in the chain (LM1) is the transfer of monies from Durham County Council (budget holder) to SchoolCater (budget recipient), to pay for the school meals service. To calculate the size of the budget, we multiplied the total annual number of meals served by SchoolCater by the fixed price per meal set out in the contract. To determine retention/leakage, we assessed SchoolCater's registered HQ for accounting purposes. This was in the north west of England, outside of the defined local area. Hence at this stage, we interpreted that the values from the meal budget leak out from the local area, although as the budget is administered by the SchoolCater office in Durham, the monies do flow back at the start of the next stage.

The second flow of expenditure in the chain (LM2) is SchoolCater's spend on staff, suppliers and direct costs. We established from publicly available accounts information (FAME database[45]), and from interviews, that 44% of SchoolCater's expenditure was on staff, 45% was on suppliers, and 11% was on direct costs. To determine retention/leakage, we first established that, as all SchoolCater staff were resident within the local area, the majority of this expenditure was retained locally. Second, we established from interview that SchoolCater's expenditure on suppliers was broken down as follows: FreshGrocer = 25%; FreshMeat = 25%; GoodsMover = 50%. As FreshGrocer and FreshMeat are located within the local area, we inferred that the majority of this expenditure is retained locally. However, as GoodsMover's HQ is in southern England, a high proportion of this expenditure leaks out. Finally, we estimated that 50% of SchoolCater's direct costs were retained locally.

The third flow of expenditures in the chain (LM3) refer to the private spend of SchoolCater's staff (i.e. their own discretionary income spend), and the expenditures of FreshGrocer, FreshMeat and GoodsMover on their staff and upstream suppliers. Based on the formulas applied within the LM3 online tool, estimates were calculated of the proportions of these expenditures retained locally.

Following these estimates, we calculated that the LM3 ratio for the Durham school meals chain is 2.28. This means that for every £1 spent by the initial budget generators (i.e. Durham County Council, via parents/carers), an additional £1.28 is generated within the local area.

Table 13 presents and explains the above result, and also presents ratios for two other procurement scenarios we explored, in which we adjusted the local vs non-local split in SchoolCater's budget expenditure on first tier suppliers.

Table 13: LM3 ratios for Durham (LOC) meals service, under existing procurement model and two alternative scenarios

Scenario	LM3	Explanation
1. Existing procurement arrangements	2.28	Under the existing arrangements, 100% of SchoolCater employee expenditure is on local staff, and 50% of supplier expenditure is on local suppliers (i.e. FreshGrocer and FreshMeat). LM3 ratio indicates that for every £1 spent from SchoolCater's budget, an additional £1.28 is generated within the local area.
2. If expenditure on GoodsMover was switched to a local firm	2.58	Under this scenario, we assume 100% of SchoolCater employee expenditure is on local staff, and 100% of supplier expenditure is on local suppliers (i.e. FreshGrocer and FreshMeat plus local alternative to GoodsMover). LM3 ratio indicates that for every £1 spent from SchoolCater's budget, an additional £1.58 would be generated within the local area.

[45] http://www.bvdinfo.com/en-gb/our-products/company-information/national-products/fame

3. If expenditure on FreshGrocer was switched to a non-local firm	2.14	Under this scenario, we assume, again, that 100% of SchoolCater employee expenditure is on local staff, but that only 25% of supplier expenditure is on local suppliers (i.e. FreshMeat), with both GoodsMover plus FreshGrocer alternative being non-local). LM3 ratio indicates that for every £1 spent from SchoolCater's budget, an additional £1.14 would be generated within the local area

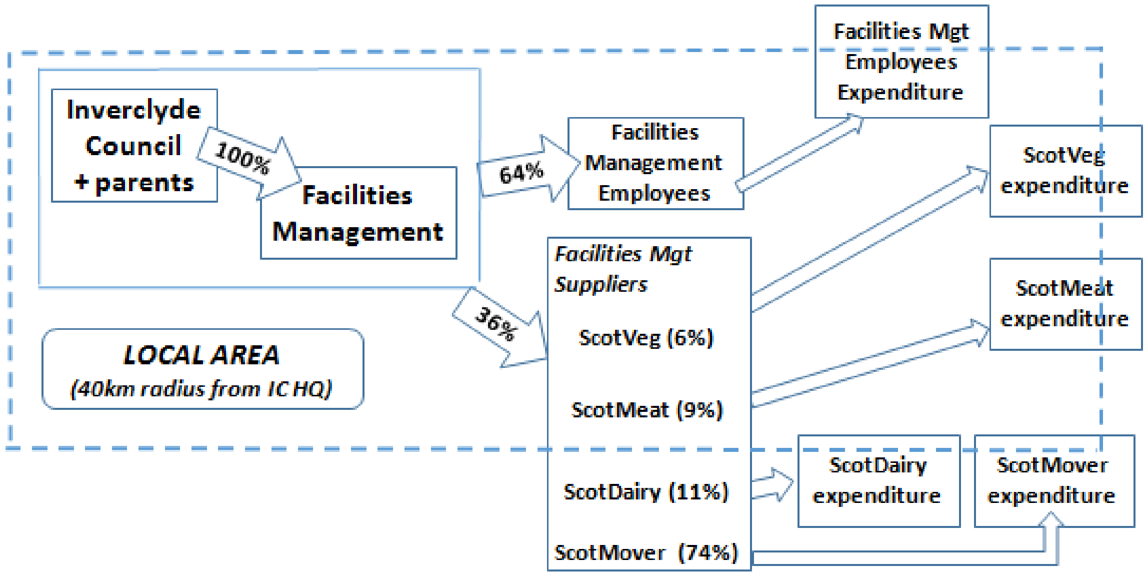
Table 13 shows that under the existing procurement model in Durham (LOC) case, where 100% of SchoolCater's staff budget and 50% of supplier budget are spent locally, the LM3 ratio is 2.28 - a relatively high figure for the food and drink sector. However, the ratio would increase to 2.58 if 100% of the supplier budget was spent on local firms (Scenario 2). Alternatively, if the proportion of supplier budget spent locally were reduced to only 25% (e.g. by replacing FreshGrocer with an alternative firm outside the local area (Scenario 3)), then the LM3 ratio would decrease accordingly to 2.14. The difference in ratios between Scenario 1 and 3 (0.14) illustrates well the monetory value of the local supply networks built up by FreshGrocer in this case, for example through its coordinated distribution of goods from local egg and milk producers. However, although Scenario 3 yields the lowest multiplier effect of those tested here, in absolute terms 2.14 can still be regarded as a reasonable ratio, which reflects the relatively high proportion of the total starting budget devoted to catering staff expenditure, all of whom are local in the Durham case area. The result underscores the importance of payroll expenditure size/destination to economic multiplier effects in public procurement.

5.2.2 What is local economic multiplier of Inverclyde meals service?

Next we report the Inverclyde LM3 calculation and results. In terms of <u>local area</u>, the boundary was defined as a 40km radius from the Inverclyde Council offices in the town of Greenock. This area takes in all Inverclyde, plus parts of neighbouring regions of Ayrshire to the south, Renfrew and Greater Glasgow to the east, and Dunbartonshire to the north. Using this radius, ScotVeg and ScotMeat were defined as 'local', as they both have HQs within the Greater Glasgow area. ScotDairy and ScotMover, although having depots located close to the 40km radius, are owned by parent companies with HQs in England (which are the addresses used for accounting purposes). Hence, these suppliers are defined as 'non-local' for the purpose of LM3 analysis

Figure 12 shows the stages of the LM3 analysis for the Inverclyde case, via the flows of expenditures from the initial budget, and their destinations, relative to the 40km local area radius.

Figure 12: Local multiplier analysis (LM3) of Inverclyde (LOW) school meals service



As Figure 12 shows, the first flow of expenditure in the chain (LM1), is the transfer of monies from Inverclyde Council (budget holder) to Inverclyde Council Facilities Management (budget recipient), to pay for the school meals service. From interviews, we obtained an estimate of this budget. Facilities Management, along with all other Inverclyde Council departments, is based within the region, hence we expect that the values from the meals budget are retained in the local area at this stage.

The second flow of expenditure (LM2) is Facilities Management's spend on its own staff, its first tier suppliers, and direct costs. From interviews, we established that 64% of Facilities Management's budget was spent on staff and 36% on suppliers (hence no other direct costs). As all Facilities Management staff were resident within the local area, we interpret that this expenditure was retained locally. However in terms of the supplier budget, we established that only 15% of this was spent on local firms (ScotVeg and ScotMeat), with the remaining 85% spent on firms with HQs outside the local area (ScotDairy and ScotMover). Hence, we interpret that a large proportion of the supplier budget expenditures leak out of the local area at this stage.

The third flow of expenditures in the chain (LM3) was the private spend of Facilities Management's staff (i.e. their own discretionary income spend), and the expenditures of ScotVeg, ScotMeat, ScotDairy and ScotMover on their staff and upstream suppliers. Based on the formulas applied within the LM3 online tool, estimates were calculated of the proportions of these expenditures retained locally.

Following these estimates, we calculated that the LM3 ratio for the Inverclyde school meals chain is 2.25. This means that for every £1 spent by the initial budget generators (i.e.Inverclyde Council, via parents/carers), an additional £1.25 is generated within the local area.

Table 14 presents and explains the above result, and also presents ratios for two other procurement scenarios we explored, in which we adjusted the local vs non-local split in Facilities Management's budget expenditure on first tier suppliers.

Table 14: LM3 ratios for Inverclyde (LOW) meals service, under existing procurement model and two alternative scenarios

Scenario	LM3	Explanation
1. Existing procurement arrangements	2.25	Under the existing arrangements, 100% of Facilities Mgt employee expenditure is on local staff, and 15% of supplier expenditure is on local suppliers (i.e. ScotVeg and ScotMeat). LM3 ratio indicates that for every £1 spent from Facilities Mgt's budget, an additional £1.25 is generated within the local area.
2. If expenditure on ScotDairy was switched to a local firm	2.30	Under this scenario, we assume 100% of Facilities Mgt employee expenditure is on local staff, and 26% of supplier expenditure is on local suppliers (i.e. ScotVeg, ScotMeat plus local alternative to ScotDairy). LM3 ratio indicates that for every £1 spent from Facility Mgt's budget, an additional £1.30 would be generated within the local area.
3. If expenditures on ScotVeg and ScotMeat were switched to a non-local firm	2.18	Under this scenario, we assume, again, that 100% of Facility Mgt's employee expenditure is on local staff, but that no supplier expenditure is on local firms. LM3 ratio indicates that for every £1 spent from Facility Mgt's budget, an additional £1.18 would be generated within the local area.

Table 14 shows that under the existing procurement model in Inverclyde (LOW) case, where 100% of SchoolCater's staff budget and 15% of supplier budget are spent locally, the LM3 ratio is 2.25. Although slightly smaller than Durham (LOC)'s ratio, this is still a relatively high figure for the food and drink sector. However, the ratio would increase to 2.30 if 26% of the supplier budget was spent on local firms, by switching to a local dairy supplier (Scenario 2). Alternatively, if no supplier budget was spent on local firms (i.e. by replacing ScotVeg and ScotMeat with alternative firms outside the local area (Scenario 3)), then the LM3 ratio would decrease accordingly to 2.18. The 0.7 difference in ratios between Scenario 1 (existing arrangements) and 3 (no local suppliers) illustrates the monetory value of the local employment and expenditure practices of ScotVeg and ScotMeat, even though these firms receive very small proportions of Facility Management's total supplier budget. However, although Scenario 3 yields the lowest multiplier effect of those tested here, in absolute terms 2.18 can still be regarded as a reasonable ratio, and is largely a reflection of the high proportion (almost two thirds) of the total starting budget devoted to catering staff expenditure, all of whom are local in the Inverclyde case. Like Durham (LOC) case, the result underscores the importance of payroll expenditure size/destination to economic multiplier effects in public procurement.

To conclude, the LM3 analysis reveals that the Durham (LOC) meals service has a higher economic multiplier impact than Inverclyde (LOW) service, although the difference between the two is small (2.28 vs 2.25). It means that for every £1 spent from the original budget in Durham, an additional £1.28 is generated in the local economy, whereas in Inverclyde the additional value is £1.25. The higher value in Durham is due to a greater proportion of the supplier budget being spent on local firms compared with Inverclyde (50% vs 15%). The reason why the substantial difference in local supplier expenditures between the two cases does not translate into a larger difference in their LM3 ratios is due to the features of their payroll expenditures: Inverclyde spends a higher proportion of its total budget on staff compared with Durham, which has an uplift effect on its ratio. More generally, the results here confirm the important contribution that payroll expenditures make to local economic impact in public procurement: in services which involve high labour intensity and reliance on a workforce located conveniently for locally dispersed sites (as is the case with school meals services), payroll is likely to make a significant contribution to overall economic multiplier effect. This is the reason why both LOC and LOW cases show quite high LM3 for food and drink sector. Notwithstanding this observation, the results of the scenario analysis reveal how quite large increases in LM3 can be gained from relatively modest adjustment in supplier arrangements, particularly where the suppliers involved have a high allocation of total budget.

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5.3 Economic value of the school meals service

To explore what economic values are experienced by members of school meals supply chains from their involvement in a contract, we asked all suppliers in both cases to give their current employee numbers and turnovers, in order to obtain an estimate of the size of their businesses, and an estimation of their growth rates over the last 5 years. We also asked suppliers to estimate the proportion of their business dependent on the school meals contract, and the size of any new business won as a direct result of the contract. As the absolute number of supply chain members in both cases was small, we report the results descriptively.

5.3.1 Economic value in Case 1 Durham (LOC) service

In terms of business size, we found the members of the supply chain each had turnovers of between £700k and £80m, and employed between 30 and 196 staff. Growth rates varied considerably from those who were experiencing very high levels of growth, to those who described their recent development as more of a consolidation of their position. For all the suppliers, the Durham school meals contract represented only a small part of their business, and the amount of new business won as a result of holding the contract was also estimated to be very modest. Nevertheless, all interviewees spoke very positively of their involvement in the contract and how it fitted in well with other contracts and activities, in a complementary way. Table 15 summarises the data. SchoolCater occupies a somewhat different position, in economic value terms, to the next tier suppliers, as discussed below.

Table 15: Economic value of school meals contract in Durham (LOC)

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 yrs	New business won as result of contract
	(employees)	(turnover)			
SchoolCater (County Durham operations)	620	£8m	c.100%	From 202 to 217 sites, from 450 to 600 employees	New contracts to supply 4 independent schools outside of Durham
FreshGrocer	77	£11m	3-4%	Negligible	Negligible
FreshMeat	75	£15m	5%	Negligible	Negligible
GoodsMover (regional depot)	196	£80m	1%	5%	Negligible
ECO Farm	30	£700k	1%	From £0 to £700k turnover, and from 0 to 30 employees	Negligible

As Table 15 shows, for SchoolCater (County Durham operations), the school meals contract comprises almost 100% of turnover. Since taking over the contract, SchoolCater has grown the number of Durham schools in the contract, and has also grown uptake numbers. In terms of new business, SchoolCater was approached separately by the heads of 4 schools outside the Durham area to supply meals, on the basis of its reputation in Durham. The Durham contract is therefore extremely important to SchoolCater's business.

For FreshGrocer, the Durham school meals contract comprises a very small % of turnover, although the firm services several contracts for local authorities in the wider region, amounting to 20% of total turnover. It can be argued that the Durham schools contract therefore has a value in terms of being a complementary part of the firms operations. In terms of growth rate, FreshGrocer went through a period of large expansion which did not end well, and so in recent years it has consolidated business back in the north east. As such a small proportion of business is due to the Durham school meals contract, it is not possible to attribute any new business specifically to this contract.

For FreshMeat, the Durham schools contract comprises 5% of turnover, and like FreshGrocer, represents one contract in a portfolio of public sector contracts operated in the region. Hence, winning it represents a consolidation of FreshMeat's position in the market. However, the contract is not likely to lead to large amounts of new business, because of FreshMeat's current presence in the region.

For GoodsMover, the Durham schools contract comprises 1% of turnover, and represents one contract in many public sector contracts operated in the region. As part of a business with a multinational parent company, the Durham fits into a portfolio of public and private sector contracts that GoodsMover has in the region.

For ECO Farm, the contract comprises a very small % of turnover, although the fact that the contract represents regular income is appreciated. EcoFarm did experience a small amount of new business in the early days of supply to NorthSchool E, when parents would come to browse the butchery and shop after children talked to them about ECO Farm following tasting the meat in their lunches. However, the main reason for supplying NorthSchool E is the communitarian ethos of ECO Farm: the business has an orientation towards supplying locally, and also to embed itself in the community.

5.3.2 Economic value in Case 2 Inverclyde (LOW) service

In terms of business size, we found the members of the Inverclyde supply chain had turnovers of between £5m and £137m, and employed between 23 and 946 staff. Growth rates of suppliers varied considerably from those who were experiencing high levels of growth, to those who described their recent development as more of a consolidation of their position. For all the suppliers, the Inverclyde school meals contract represented only a small part of their business, and the amount of new business won directly as a result of holding the contract was also estimated to be very small. Nevertheless, all interviewees spoke very positively of their involvement in the contract. Table 16 summarises the data.

Table 16: Economic value of school meals contract in Case 2 Inverclyde (LOW)

	Size of total business		% turnover dependent on Contract	Growth rate in last 5 yrs	New business won as result of contract
	(employees)	(turnover)			
ScotVeg	23	£5m	1.3%	15%	Negligible direct impact
ScotMeat	55	£6.5m	2%	1%	Negligible direct impact
ScotDairy	946	£137m	0.1%	5%	Negligible direct impact
ScotMover	329	£60m	0.5%	grew from £6m in 2008 to £42m in 2018	Negligible direct impact

As Table 16 shows, even though ScotVeg is a small firm, the Inverclyde school meals contract comprised only 1.3% of turnover. However in interview, ScotVeg managers conveyed that public sector contracts, as a whole, were important to the business (currently worth 40% of total turnover), and have contributed to ScotVeg's high growth rate over the last 5 years.

Furthermore, although very little new business could be attributed to holding the Inverclyde meals contract, ScotVeg directors explained that every customer is regarded as important, and having the Inverclyde contract fits with the firm's wider strategy. The Inverclyde contract has indirectly helped win new business, as the firm has used material developed for the tender to support a bid for another Council tender.

For ScotMeat, also a small firm, the Inverclyde school meals contract comprised a very small % of turnover. Like ScotVeg, ScotMeat also serviced contracts for other LAs, such that public procurement contracts, in total, amounted to a reasonable proportion of total turnover. Therefore, the Inverclyde Council contract had strategic importance to the business. ScotMeat had exhibited relatively small growth in the past 5 years, and directors conveyed that the Inverclyde contract had led to negligible new business won directly. Nevertheless, directors were of the view that having already won council contracts did help with future bids, as it showed that the firm could meet standards and do the job, which acted as a reassurance to the tenderer.

ScotDairy is a large enterpise, and part of even larger parent company. It held many public sector contracts in Scotland, hence although the Inverclyde contract represented a tiny proportion of total business, as a whole the public sector contracts were regarded as economically valuable. ScotDairy had undergone recent large investment in expansion and upgrading of a processing plant, hence the estimate of 5% growth rate over 5 years. Management conveyed that no new business had been won directly as result of the Inverclyde contract. Indeed at the time of interview, ScotDairy was at the limit of the number of contracts held in Scotland from a competition law perspective, so it was not looking to win additional new contracts.

Like ScotDairy, ScotMover is a large enterprise and part of multinational company. It also held many public sector contracts in Scotland. No new business had been won directly as result of the Inverclyde contract, however Inverclyde was regarded as economically good contract because of its compact size and accessibility. Like ScotDairy, ScotMover was at the limit of the number of contracts it could hold from a competition perspective, so it was not looking to win additional new contracts at the time of interview.

5.3.3 Comparison of economic values in Durham (LOC) and Inverclyde (LOW)

As the preceding sections have shown, there were many similarities between LOC and LOW cases in terms of economic value. In both cases, with the exception of School Cater, the school meals contract represented only very small proportions of suppliers' total turnovers, and had contributed a neglible direct impact on winning new business. This was the situation even for the smaller firms in each case. Nevertheless, suppliers in both cases spoke positively about their involvement in the Durham and Inverclyde school meals contracts, as contributors to a portfolio of public sector supply contracts. Therefore in both cases, the school meals services were strategicalyy important to suppliers rather than of high, direct, economic value.

6 SOCIAL IMPACT OF SCHOOL MEALS SERVICES

6.1. Methodology to measure social impact

The goal of the social impact analysis was to assess what social values were generated by the operation of the Durham (LOC) and Inverclyde (LOW) school meals services. The indicators we took into account to measure social impact were:

(i) employment-related criteria. Under this heading, we gathered data on the number and types of jobs linked to the school meals service, and the diversity profile of staff and levels of training/skills development in place within the businesses participating in the supply chain.

(ii) criteria relating to the working environment of the service chain and connectedness of people within it, including rural communities. Under this heading, we gathered data on the well-being and job satisfaction of interviewees, and their testimonies relating to how much they engaged with others in the supply chain, and what kinds of activities/occasions such engagement represented. Within this, we explored the extent to which the school meals procurement brought caterers and schools into contact with rural and farming communities that produce food items.

Given the small sample sizes of informants in both Cases, we give a descriptive reporting of the results relating to the above indicators.

6.2. What are the employment-related impacts of school meals services?

6.2.1 Employment related impact in Durham (LOC) service

In terms of the types of employment offered by suppliers, we found a substantial proportion of full-time positions, in primarily medium or relatively low skilled work. The ethnic profile of suppliers' workforces tended to reflect the wider profile of the region, with the vast majority of staff being of white British ethnicity. The gender split was representative of the food supply/catering sector more generally, with almost all depot and delivery jobs being filled by male employees, and almost all staff working in school kitchens being female. Office staff were also predominantly female. All suppliers conveyed a strong commitment to training and skills development beyond mandatory standards, with frequent reference to support for NVQ level qualifications. (It may be recalled that DCC specified criteria relating to skills/development and training in the contract tender). Table 17 summarises the findings, and below some more descriptive detail is given on each of the key suppliers.

Table 17: Employment related impact of school meals service in Durham (LOC)

	Job Type		Employee profile		Skills/Training Development	
	FT	PT	M/F	Ethnic minority	% staff on training/with qualifications	Types/levels of qualifications
SchoolCater	3%	97%	99% F	1-2%	100%	Mandatory for all staff: food safety, health and safety, manual handling, safeguarding, allergen training Additional for all staff: nutrition awareness, first aid, sustainability, customer care, MSC training. Optional for cooks: NVQ Professional Cookery, NCFE Nutrition and Health, Customer Care
FreshGrocer	100%	0%	18% F	1%	100%	Mandatory for all staff: health and safety Additional for all staff: relevant NVQ (e.g. Distribution, Warehousing, Telesales)
FreshMeat	100%	0%	10% F	0%	100%	Mandatory for all staff: health and safety, food safety, machine operations, driver training Additional for some staff: HACCP training, administrative training,
GoodsMover	-	-	35%F	2%	100%	Mandatory for all staff: health and safety, depot is operational site so training oriented accordingly, e.g. manual handling, driver training, and apprenticeships in warehousing and HGV driving, leading to qualifications/licences
ECO Farm	50%	50%	66% F	0%	100%	Mandatory for food staff: hygiene training.

SchoolCater employed 620 staff. Of these, 20 FT staff were the support team who have management, finance and administrative roles, working mainly out of the Durham City office.

The 600 PT staff represented the kitchen staff located entirely on school sites. Most of the kitchen employees worked between 12 and 25 hrs per week, depending on their grade and the number of meals they were responsible for serving. SchoolCater has won awards for its training programme, and devises a training matrix for every member of staff. 100% of staff held mandatory certificates in food safety, health and safety, manual handling, safeguarding and allergen training. In addition, all staff took non-mandatory courses as Table 17 illustrates (SchoolCater developed the sustainability course itself). Reported rates of staff absence (4%) and staff turnover (7-8%) were very low, particularly for this sector, and much lower than the rates SchoolCater inherited when it won the contract in 2008.

FreshGrocer employed 77 staff. All staff were employed FT and fully by the firm, a deliberate policy on the part of the MD not to employ any agency staff. All admin/office staff tended to be female, whereas all depot and delivery staff tended to be male. 100% staff held relevant mandatory certificates, and in addition, all staff took relevant NVQ level training. FreshGrocer has also made a very strong commitment to staff improvement and quality management, a reflection of the personal management approach and style of the MD.

FreshMeat employed 75 staff, of which 10% were female and no ethnic minorities at the time of interview. The manager explained that employees on the production line undertook mandatory health and safety and food safety training, which would be augmented if the employee took on more responsibilities for management/administration of processes. FreshMeat was British Retail Consortium accredited, which meant that a suite of standards had to be met in terms of working processes and employee training.

GoodsMover employed 196 staff, of which 35% were female and 2% were ethnic minority. The GoodsMover parent company places a strong emphasis on staff development, including running a suite of apprenticeships at different levels. The regional depot near Durham is an operational site, hence training and qualifications were tailored to the types of work at the site, this included apprenticeships in warehousing and HGV driving.

ECO Farm employed 30 staff. In general all kitchen staff were female, whilst part-time restaurant staff were a mixture of male and female, usually students who lived locally and returned during the busier seasons out of term time. All staff had relevant mandatory training in hygiene. The ECO Farm manager explained that a recent round of training was delivered to staff on-site by SchoolCater, an event that was the direct result of ECO Farm being subcontracted to deliver meat to NorthSchool A. ECO Farm clearly appreciated this initiative.

6.2.2 Employment related impact in Inverclyde (LOW) service

The employment profiles and staff training activities of members of the Inverclyde school meals chain were very similar to those found in the Durham case. Hence, a substantial proportion of positions were full-time, in primarily medium to relatively low skilled work, and the ethnic and gender profiles of the workforces reflected sectoral norms. Like Durham case, all suppliers conveyed strong commitment to staff training and skills development, and offered many examples of the ways in which employees were being supported to upskill. Table 18 summarises the findings, and below some more descriptive detail is given on each of the key suppliers.

Table 18: Employment related impact of school meals service in Inverclyde (LOW)

	Job Type		Employee profile		Skills/Training Development	
	FT	PT	M/F	Ethnic minority	% staff on training/with qualifications	Types/levels of qualifications
ScotVeg	96%	4%	13% F	9%	100%	Depot workers are supported in taking mandatory forklift training and then work towards forklift licence. Staff also supported to take driving test if interested in becoming drivers.
ScotMeat	95%	5%	11% F	0%	100%	Depot workers are supported in taking mandatory qualifications for forklift truck driving. Quality Assurance/technical staff, are supported in taking food hygiene courses. Office staff supported (£2k per person) to take college courses in accountancy
ScotDairy	-	-	15% F	4%	100%	Van drivers have on-the-job training. ScotDairy parent firm offers suite of certificates that employees can work towards. ScotDairy parent firm sponsors/funds student placements on relevant degree courses.
ScotMover	-	-	7% F	4?%	100%	Central Scotland depot is operational site so training oriented towards those staff members. Currently coaching and mentoring 2 graduates within site, both being taken through a shadowing programme of Managing People whilst in control of day to day running of operations. Prepared and delivered fully documented pack for a private

						training academy graduate programme.

ScotVeg employed 23 staff, of which 13% were female and 9% were ethnic minority. In addition to supporting staff with mandatory qualifications such as forklift truck licences and driving licences, ScotVeg also gave opportunities for career progression, for example, a staff member who started working in the depot had progressed to working part-time in the market and part-time in the office, whilst another employee originally taken on as a van loader had progressed to a sales team position. ScotVeg reported strong staff retention.

ScotMeat employed 55 staff, of which 13% were female and 0% ethnic minority (at the time of interview, although in the past the Directors explained that they had had employees who were ethnic minority). As Table 18 shows, staff in different parts of the business were actively supported in gaining qualifications. One exception to this was employees on the production line: the Directors explained that the only formal qualification there was 'time served butcher', but this was hard to achieve in ScotMeat's current orientation, because most work was cutting on pre-prepared product rather than whole carcases. ScotMeat's Directors spoke with pride of their supportive training and development environment, for example, buddying of new drivers with experienced ones to ease on-the-job training, supporting office staff to undertake a college course in accounting, and recent creation of a new 'meat cutters' position, to bring on interested staff from simple packing to more skilled butchery.

ScotDairy employed 946 staff in its Central Scotland processing plant and satellite depots. Staff were supported in obtaining mandatory qualifications, e.g. van driving licences. ScotDairy's parent firm also offered an active certification programme: employees can choose and work towards these certificates on a self-selecting basis. ScotDairy's parent firm also sponsored placements on agricultural and food technology degree courses, with funded students then having the opportunity to work with the firm.

ScotMover employed 329 staff at its Central Scotland depot. These staff were supported in obtaining mandatory qualifications, which were operational in nature. In addition, ScotMover had a coaching and mentoring programme: at the time of interview, 2 graduates were being coached and taken through a 'Managing People' shadowing programme, whilst being in control of day to day running of operations. ScotMover was also active in creating training materials, for example, it had prepared and delivered a fully documented pack for a private training academy graduate programme.

6.2.3 Comparison of employment impacts in Durham and Inverclyde

Overall, the employment profile and staff training activities in Durham and Inverclyde supply chains were very similar, with gender balances and ethnic minority representations that reflect sectoral norms, whilst in both cases, suppliers demonstrated considerable commitment to staff development, with a range of activities and support for upskilling and obtaining qualifications. Rather than differences being observed between the cases, the main difference was between the large and small firms in both cases was that the larger suppliers in the cases (i.e. GoodsMover, ScotDairy and ScotMover), in addition to supporting employees to gain recognised third party qualifications, also offered their own study and training programmes, linked to internal career progression. Meanwhile, although the smaller firms had less elaborate training programmes, they gave examples of flexible and bespoke training/qualifications created specifically to fit the needs of certain employees and roles. It is notable that the larger suppliers in the cases (i.e. GoodsMover, ScotDairy and ScotMover), in addition to supporting employees to gain recognised third party qualifications, also offered their own study and training programmes, linked to career progression within the firm.

6.3. What is the working environment and connectedness in school meals services?

6.3.1 Working environment and connectedness in Durham (LOC) service

To explore how the Durham school meals contract impacted on working environment and suppliers‘ sense of connectedness to others in the chain, we asked interviewees to talk about their experiences working in the supply chain and to describe any events or occasions which brought them into contact with other members of the chain. A striking finding from SchoolCater, FreshGrocer and ECO Farm, in particular, was a strong sense of rootedness in, and commitment to, their positions in the region. These interviewees spoke positively about the working relationships they had developed with each other and in the local supply chain. These were linked to perceived commercial benefits (e.g. improved flexibility of service, more tailored customer response, better ability to negotiate ways through problems or crises, development of trust), as well as civic and community-oriented outcomes.

In interview, the members of the Durham school meals chain also conveyed involvement in a substantial amount of voluntary and outreach activity, sometimes in the form of direct charitable donations and activities, other times in the form of giving their time and resources to support council or public agency-run initiatives, such as participating in job readiness skills sessions for local school leavers, or hosting site visits and tours for community groups. Engagement with local schools was a key part of such activities, including giving presentations and talks to schoolchildren about their businesses and taking part in educational activities to improve understanding of different foods and where they come from. We found a particularly strong sense of community engagement amongst interviewees connected to NorthSchool E (headteacher and ECO Farm manager), where very strong links had been built between the school and ECO Farm, through several high profile local events (e.g. social evenings, farmers' market). The following sections offer more illustrative detail about working environment and connectedness for key supply chain members.

At SchoolCater, the manager explained that the firm did a lot of work on health and nutrition awareness raising amongst school pupils. A specific example involved undertaking sessions in schools to explain the dietary reasons for a new government policy limiting the serving of chips to a maximum of once per week, as a way of addressing pupil protest about the measure. SchoolCater also ran cookery classes for children, and tasting sessions during parents' evenings. The SchoolCater manager also spoke very positively about the relationships developed with local suppliers, which were conveyed as extremely helpful to the smooth running of the service. Strong relationships were characterised as allowing for greater flexibility and the development of trust. For example, FreshGrocer and FreshMeat were described as willing to adjust their delivery schedules in the event of bad weather, to ensure schools did not run short of items. Another example was the sharing of information by FreshGrocer about forthcoming shortages in the potato harvest, which would likely cause problems in sourcing potatoes in spring/summer 2017. As a result of this information, SchoolCater adjusted its forthcoming spring menu to reduce reliance on potatoes, substituting these with other carbohydrates.

At FreshGrocer, managers explained in interview that staff go into schools to give talks and do tasting sessions, to help raise awareness about healthy eating, and to introduce children to more unusual vegetables. FreshGrocer had also arranged off-site events where school kitchen staff and children are invited to find out about the nature of FreshGrocer's business, and to try out different foods. A few times a year, site visits to FreshGrocer's premises were arranged with schoolchildren, involving a tour round the depot and conversations with staff. In terms of links with others in supply chain, the FreshGrocer manager conveyed a strong, community-minded orientation. For example, he spoke enthusiastically about sourcing locally, to help suppliers grow their businesses, and gave numerous examples of charitable donations to local social causes (e.g. donating items and fruit baskets to care homes and local charities at Christmas). He also mentioned getting involved in wider social initiatives, for example finding customers through FreshGrocer's buyer network for greenhouse produce grown by inmates of a local prison, in a rehabilitation project. FreshGrocer had also chosen to take on the distribution function for the eggs and milk suppliers in the Durham schools contract, which (as highlighted earlier) contributed a saving in transport-related costs and emissions for those items, as well as contributing to local economic multiplier effect of the chain.

At FreshMeat, the FreshMeat manager conveyed a commitment to building and maintaining strong relations with customers, for example by demonstrating flexibility over delivery schedules and routes, and drivers being assigned to the same routes so good relations are created with the catering staff in schools. FreshMeat also maintained relations with a preferred set of known suppliers, although none of these were based inside the region, partly because local suppliers were seen to have insufficient capacity to service FreshMeat's needs, and partly due to the need to fulfil contract requirements for Red Tractor certified meat, which was not readily available locally. The manager conveyed that FreshMeat would participate in activities such as school visits and other community-related events on the request of LAs, however this had not happened for some time. To this extent, FreshMeat appeared the most passive of the Durham chain members in relation to community engagement.

At GoodsMover, the parent company has a sustainability and corporate social responsibility strategy and targets which include supporting initiatives in community health and education.The parent company has produced a guide for schools on how to set up, and get the most out of breakfast clubs, and depots across the UK have been involved in numerous fund-raising activities and in-kind food donations for community charities. In the depot near Durham, a major fund-raising action took place in 2016 to support a charity for disadvantated children.

At ECOFarm, the manager conveyed a very strong commitment to local community and sustainability issues. Although it was clear that the meat orders to NorthSchool E were a very small part of ECO Farm's overall turnover, the contract mattered to ECOFarm because engaging in such local supply networks was part of ECO Farm's ethos. It was clear that ECO

Farm had worked closely with NorthSchool E in a range of community and educational activities, for example, the hosting of a pizza night at ECO Farm for NorthSchool E's staff, children and parents, and arranging children visits to ECO Farm at the start of the growing season at ECO Farm's greenhouses.

In NorthSchools A-E, headteachers spoke positively about SchoolCater's service, and there was a strong impression of the catering staff in each school being very much part of the school 'family', notwithstanding their status as employees of SchoolCater rather than the school itself. Headteachers also spoke appreciatively of SchoolCater's activities in pupil tastings, parent and child cookery classes, and communications over menu design.

6.3.2 Working environment and connectedness in Inverclyde (LOW) service

To explore how the Inverclyde school meals contract impacts on working environment and supplies' sense of connectedness to others in the chain, we asked interviewees to talk about their experiences working in the supply chain and to describe any events or occasions which brought them into contact with other members of the chain. The most striking finding was that although all suppliers reported having materials and/or resources available for community benefits, including those specifically tailored for education/school engagement, none had undertaken any of these activities at Inverclyde. The suppliers explained that although Inverclyde Council's contract tender required them to detail the community engagement work they could do, post-award, the Council did not follow these possibilities up. Hence, a big opportunity existed to develop more connectedness in the chain, particularly as suppliers and schools, at the time of interview, had little to no contact/exchange with one another, beyond physical deliveries. The following sections offer more illustrative detail about working environment and connectedness for key supply chain members in Inverclyde.

At ScotVeg, managers spoke in interview of a range of school and community engagement activities that they undertook. Strikingly, the firm had recently won a sustainability award (Resource Efficiency Pledge) for waste reduction and recycling activities: the first firm in Scotland to win this award at Gold level. In relation to food, the firm had a staff member who made visits to schools to give talks and demos about fruit and vegetables and healthy eating. These sessions included fruit tastings and recipes for creative art/preparation with fruit (e.g. banana 'dolpins'), and nutritional presentations (e.g. discussion of Eatwell plate with stickers). ScotVeg had developed its own range of materials to support these visits and presentations. ScotVeg managers also reported that on winning new council contracts, farmers and growers in the area would be researched, to explore whether any local producers could be sourced from to supply the schools in the area (the managers explained that they could mix produce from the local growers with produce from other origins to achieve the correct volumes and continuity of supply to meet the needs of the schools). ScotVeg also explained that they could share their materials with Council nutritionists or equivalent, then follow up to arrange school visits on health/nutrition theme, e.g. during each school's Healthy Week. ScotVeg also pledged a percentage of the total value of each LA contract to deliver community benefits. However, at the time of interview, none of these opportunities had been taken up at Inverclyde.

At ScotMeat, the directors conveyed two main types of community engagement activity that the firm got involved with. First, staff visits to schools to give presentations during Healthy

Eating weeks (in connection with fruit and vegetables: ScotMeat supplies fruit and vegetables as well as meat under some LA contracts (not Inverclyde)). The ScotMeat directors also spoke about working with some councils at menu development time, to help produce items that are tailored to the local schools' preferences/needs. For example, ScotMeat had produced a bespoke sausage with a higher meat content for one Council, and a bespoke meatball for another (which had proved very popular). At the time of interview, there had been no follow up on educational, menu development or community/social benefit projects post- contract award at Inverclyde.

At ScotDairy, The ScotDairy manager reported that there was often a good relationship between ScotDairy van drivers and school cooks: the same drivers worked the same rounds, so the individuals involved got to know one another other well. The ScotDairy manager also explained that a proportion of profits from each LA contract was pledged for community benefit projects. Examples of these included providing LAs with information and access to ASSIST, a knowledge exchange and enhancement forum for LS facilities managers (ScotDairy's parent firm was also a sponsor of ASSIST), and also providing funding for 'Inch By Inch', an online resource for childhood obesity reduction. ScotDairy also had a scale model 'milking cow' which could be taken to schools, events and shows for demonstrations and educational sessions, and the firm also provided funds for conservation-related education (e.g. school trips to zoos) and cultural experiences (e.g. Christmas pantomimes). ScotDairy had also worked with certain Scottish LAs to support 'Young School Cook of the Year' and 'Dragon's Den' (new business venture) competitions. However, the ScotDairy manager commented that, to date, none of these activities had been undertaken at Inverclyde.

At ScotMover, the manager in interview gave several examples of community engagement activities with local Councils, with more being provided by a colleague by email after the interview. First, both highlighted that Scotmover had been involved with supplying/delivering items for Scottish 'Meals and More' projects (clubs run on school premises during summer vacation period to target holiday hunger amongst children in deprived communities). In practice, ScotMover's role in these clubs had involved undertaking the distribution/delivery work to the clubs at not-for-profit pricing, as well as encouraging its own staff to engage in fundraising and donating efforts, including equipment, and surplus stock. More generally, ScotMover also provided free stock to food banks around Scotland. ScotMover was also actively engaged in job creation and back to work initiatives, for example, school leavers from the local area had recently visited ScotMover's site to take part in cooking skills and touring the depot, and a group of unemployed candidates had recently successfully completed a bespoke coaching and mentoring programme to full employment at the depot. As with the other Inverclyde suppliers, the ScotMover manager conveyed that often, councils (including Inverclyde) did not follow up the opportunities for community engagement, and at the time of interview, there were few interactions with schools in the form of visits/educational activities, or development work with other suppliers, in any Council area. The ScotMover manager reported that in the past, he had undertaken development days at the depot, where council staff had come to learn about different products and experience a cooking school. He explained these had been very positive experiences, and that in future, ScotMover would welcome more involvement with councils around menu design time.

At Inverclyde Schools, headteachers commented that they had no liaison activity with the current suppliers of their school food (beyond the physical handover of goods between delivery drivers and catering staff), and in general they felt they lacked knowledge about who suppliers were and where the food for meals came from. This was in spite of the fact that most of ScotSchools A-E were active in pursuing projects in healthy eating and diets, including 'growing, cooking, eating' projects which explored food provenance. For these schools, it seemed a missed opportunity that current suppliers were not involved in such initiatives. Within schools, catering staff did not always seem to have the same degree of integration into the school 'family' as was found in Durham LOC case, and teaching staff appeared to be less involved/consulted over the meals service. To this extent, it seemed that the food-related classes, clubs and activities spearheaded by teaching staff, and the main meals service provided by IC, tended to operate in isolation of each other, rather than in a complementary or synergistic way.

6.3.3 Comparison of working environment and connectedness in Durham (LOC) and Inverclyde (LOW)

In the Durham school meals chain, strong relations existed between key supply chain members, particularly FreshGrocer and SchoolCater, which facilitated positive community outcomes in this case. All the smaller suppliers in the chain exhibited flexibility and good communications in dealing with SchoolCater and individual schools, while all except one supplier was actively engaged in school and/or community-related projects in the region at the time of interview. Relations between SchoolCater and school headteachers were also good. In terms of the links between the schools and rural communities supplying foods, our analysis indicates that the Durham school meals service did promote strengthening of these links particularly for the most rural schools in the sample, and promoted awareness-raising of these links within other schools. The local supply orientation of FreshGrocer, and the presence of mixed farming in the County (albeit not extensive), helped to facilitate the links between schools and rural communities supplying foods.

In Inverclyde, the relations between the members of the school meals supply chain appeared less strong than in Durham LOC case. First, no interactive or coordinating activity (such as that of FreshGrocer) appeared to exist between Inverclyde suppliers. Second, and most strikingly, there was no joined up activity between the Inverclyde suppliers and the schools they provide food to, beyond the functional transfer of goods between delivery drivers and catering staff. This was despite suppliers having ready access to educational materials and resources, and at least some schools placing priority on food-related issues in the curriculum. The links between the school catering service and other food and health activities in the schools were also quite weak. Our analysis indicates a big opportunity for Inverclyde Council to promote better integration between suppliers, the meals service, and the schools. At present, the meals service does not promote strengthening of links between schools and rural communities supplying foods. However, the lack of farming and absence of suppliers currently within the Inverclyde region are two factors inhibiting the development of these links.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This study investigated the environmental, economic and social impacts of two different models of PSFP in the UK: a LOC model (in County Durham), where the procurement contract specifies sustainability criteria and targets for local sourcing, and a LOW model (in Inverclyde), which does not have these contract specifications. The research sought to measure and compare the sustainability impacts in both cases, and explore the reasons for any differences identified.

In the results, we found that the Durham (LOC) model had a lower carbon footprint than the Inverclyde (LOW) model, and also a (marginally) higher local economic multiplier effect. However, our analysis reveals that factors other than the degree of localisation of the procurement model were most important in explaining the difference between the two cases. Specifically, although the kms travelled by foods in the Durham case were fewer than those in Inverclyde (which was helped by the shorter distances between suppliers and schools), the smaller carbon footprint in Durham was overwhelmingly due to the composition of the menu and the types of foods ending up on the average plate (i.e. more fruit and vegetables and less dairy products in the Durham menu). In terms of local economic impact, we found that a greater proportion of the supplier budget in Durham was spent on local firms compared with that of Inverclyde, and this did explain why the local economic multiplier ratio of the Durham meal service was greater than Inverclyde's. However, the difference between the ratios was reduced by a budgetary feature unrelated to supplier location: catering staff payroll. Specifically, in both Inverclyde and Durham all catering staff were local residents, but a much greater proportion of Inverclyde's total meals service budget was spent on these staff, thereby increasing its multiplier ratio almost to the same level as Durham's, despite a much smaller spend on local suppliers.

For the remaining impacts, the research found no real differences between the cases in terms of the value of the school meals contract to suppliers, or the employment and training profiles of the firms involved. However, we did find evidence of stronger supply chain and community connectedness in Durham (LOC) case, and the localised procurement model appeared to play a role in this. The presence of local suppliers was linked to good communication and the development of flexible, trustful relations, which in turn supported wider community activities and social connectedness. The Durham meals chain also benefitted from key individuals who were enthusiastic about engaging with each other, with school leaders, and the wider community, as well as the presence of a critical mass of agrifood producers in the region. In Inverclyde, the main finding was a lack of connectedness between suppliers and school leaders (despite the existence of resources and enthusiasm on both sides for joint initiatives), and less integration of the meals service into the 'families' and pedagogical activities of individual schools. A current lack of agrifood producers in the region is a barrier to the future development of the school meals service as a tool to link schools with rural communities. Overall, the research indicates that a localised procurement model, where supply chain members are headquartered close to one another, can facilitate social connectedness between those members, and schools and communities, but other contextual and person-related factors also play a key role in supporting connectedness.

7.2 Recommendations for Policy and Local Practice

From a policy perspective, the research indicates there is merit in encouraging localised PSFP models as these can build supply chains capable of leveraging positive economic and social impacts. However, for these benefits to be maximised, policy attention also needs to focus on more fundamental socio-economic development within regions, including the building of supportive infrastructures (e.g. support to agrifood business start-ups, support to local fora, associations and hubs, support for food, health and sustainability initiatves in schools and communities). Procurement policies pursued in isolation will have less sustainability impact than those which are integrated into wider regional strategies for health, education and economic development. For environmental impacts, the research indicates that localised models have a relatively neutral effect, because transport emissions represent only a small component of the carbon footprint of school meals services. To enhance the environmental impacts of PSFP, policy attention should be focused more on actions such as setting guidelines for low carbon menus (that still meet nutritional requirements), and devising interventions that minimise food and packaging waste, regardless of procurement model.

From a local practice perspective, we propose the following recommendations to enhance the sustainability outcomes of PSFP:

General enhancement:

Contract design, tendering and post-award processes. In the Durham case, the commitment of the contract holder (SchoolCater) to continuous improvement in various aspects of sustainability, was encouraged by the writing of these activities into contract award criteria and converting them into Key Performance Indicators (KPIs) on which the contract holder was then monitored on an on-going basis through the duration of the contract. In Inverclyde, although at contract tendering stage, bidders were asked to submit evidence of their sustainability activities (e.g. community engagement), there was no follow up with Inverclyde Council post-award. Therefore, to enhance general sustainability outcomes, LAs should aim to specify more sustainability criteria in contracts (as encouraged by the provisions of EU Regulation 2014/26 and GPP), and put in place post-award monitoring/dialogue with contract holders.

Budget allocations. For LAs facing budget pressures, the preceding recommendation may be perceived as challenging, on the basis that added sustainability criteria in a contract increases the size of the necessary budget for school meals (which is typically allocated from the education department budget). However, we argue that as the added sustainability criteria make it possible for LAs to address goals that cut across a range of departments and remits (e.g. health, environment, local economic development), there is an opportunity for LAs to reorganise the funding streams for school meals accordingly from other departmental budgets. With this kind of creative and long-term thinking, more funds may be legitimately released for school meals services, rather than continued reliance on historic sources.

Integration of school meals service into wider school activities on food, health and sustainability. In Durham case, we observed that catering staff were generally considered part of the school ‘family’, and the meals service was something that school leaders felt consulted on, and that it was coherent with wider food and health initiatives undertaken with pupils and families. As a result, the meals service contributed to schools' wider sustainability strategies and also contributed to a sense of community building and generation of goodwill. In Inverclyde, the meals service tended to operate more in isolation of wider school activities, hence opportunities were missed to combine efforts in complementary ways for sustainability outcomes. Hence, our recommendation is that catering service managers work actively with school leaders to integrate meals services better with broader school activities on sustainability, as well as enhancing opportunities for consultation and dialogue on the meals services themselves. Training and development activities with catering unit staff could also be considered, as the shift in orientation of the services implies also adjustments to the role/remit of catering unit staff, at least to some extent.

Environmental enhancement:

Waste disposal. Both Durham and Inverclyde cases used the anaerobic digestion method of food waste disposal, which is low carbon emitting and so represented a very small component of total emissions in both cases. However, in other countries the research found that if a school meals service is using landfill as its disposal method, this is very carbon intensive and can constitute around one third of the service's total emissions. In this situation, the single most carbon reducing action is to switch to a more environmentally friendly method (e.g. anaerobic digestion, composting, animal feed, donation). Of course, identifying ways of minimising food waste would also be important here (e.g. reviewing portion sizes, improving canteen environments and pupil supervision during the service, as described in D6.2 Report).

Menu design. After switching from landfill waste disposal, the most important component of carbon footprint of school meals services is the composition of the menu, in particular the amount of red meat and other processed animal products that are purchased for consumption. To reduce environmental impact, we recommend meals service managers draw from information and advice about red meat substitutes, and low carbon foods and diets, and take these on board into future menu designs, alongside nutritional and taste criteria. Other product innovations can also be researched, to explore whether more environmentally friendly solutions exist to obtain the same food item (e.g. Durham has trialled the use of EasiYo yoghurt-making kits in schools, which eliminates the use of plastic yoghurt pots).

Transportation. In Durham and Inverclyde, transportation comprised a very small proportion of total emissions relative to menu composition. However, even small reductions in emissions are desirable, and identified as possible in our scenario analysis which showed the effect on emissions of consolidating transport in the Durham case. Therefore, we recommend meals service managers explore ways to reduce transport emissions, for example by (i) encouraging suppliers to switch to low-emissions vehicles, and/or coordinate distribution to reduce kms travelled (such as FreshGrocer did in Durham supply chain), (ii) explore the feasibility of establishing a distribution hub or warehouse in the region, that could reduce the number and length of trips taken by individual suppliers (a model used by catering firms in Italy), (iii) review and improve food storage facilities on school sites (especially chilled storage), to reduce the frequency of deliveries of suppliers.

Economic enhancement:

Contract design. The results of the research showed that PSFPs which spend larger proportions of their budget on local suppliers gain a greater economic multiplier effect compared with PSFPs that spend a lot on non-local firms (albeit the effect can be moderated by payroll expenditure). Local firms create within-region employment and upstream business opportunities, and such firms may have greater motivation to engage in collaborative logistics (as described above), or local community engagement. To encourage this effect, more local firms could be encouraged into the meals supply chain by splitting contracts into smaller lots, and/or using ‘delivery only’ contracts. Meals service managers may also wish to consider the types of food items procured for menus, and how these affect the options for reaching out to local firms (e.g. procurement of fresh fruits and vegetables may give more scope to involve local suppliers and stimulate within-region upstream business activity, compared with frozen/processed items).

Engagement with local economic development initiatives. The research showed that the potential for local economic multiplier effects in a school meals service is affected by the size and nature of the agrifood sector within the region. In Inverclyde, the lack of agricultural production and few established food businesses is a barrier to the development of a local school meals supply chain. However, the economic development agency Riverside Inverclyde has recently begun a programme of funding and business development activities to grow the food and drink sector in the region[46], including investment in business incubator units, development of a local food network, and support for initiatives and events. Catering managers could usefully engage with this initiative to identify ways of working together for mutual benefit.

Social enhancement:

Engagement with suppliers. The research showed that in Durham, there were strong levels of connectedness between key members of the school meals chain, and strong levels of community engagement, whereas in Inverclyde those links were less strong. One reason for the difference was that in Inverclyde there was little engagement with suppliers post-contract award to encourage their interactions with each other, with the community, and with the food and health related activities within schools (e.g. Healthy Eating weeks, gardening and cookery clubs). We recommend that catering managers work more actively with suppliers post-award to capitalise on the skills and resources they can bring to communities. Managers should also consult with school leaders to identify opportunities for supplier involvement, and then find ways to connect both parties. Such activities would also be a way of expanding the social role of the school meals service and integrating it better into the wider life of the schools.

[46] https://www.tasteinverclyde.co.uk/about

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APPENDIX 1.

List of contract award criteria in tender for Durham County school meals service (Durham County Council, 2008)

Essential Criteria (bidders are required to submit):

	Threshold
A three weekly menu cycle which meets the Government Nutritional Standards	Pass/Fail
The nutritional analysis chart that validates the three weekly menu cycle	Pass/Fail

Technical Criteria (evaluated on score from 0-4)

	Weighting
Customer Satisfaction	5%
Management Support and Staffing	10%
Staff Training and Development	10%
Supply Chain Management	5%
Menu Provision	15%
Health & Safety	5%
Marketing and Service Improvement Strategy	15%
Creating Opportunities	5%
Final Weighting for Technical Criteria	**70%**

Price	30%

The Strength2Food project in a nutshell

Strength2Food is a five-year, €6.9 million project to improve the effectiveness of EU food quality schemes (FQS), public sector food procurement (PSFP) and to stimulate Short Food Supply Chains (SFSC) through research, innovation and demonstration activities. The 30-partner consortium representing 11 EU and four non-EU countries combines academic, communication, SMEs and stakeholder organisations to ensure a multi-actor approach. It will undertake case study-based quantitative research to measure economic, environmental and social impacts of FQS, PSFP and SFSC. The impact of PSFP policies on nutrition in school meals will also be assessed. Primary research will be complemented by econometric analysis of existing datasets to determine impacts of FQS and SFSC participation on farm performance, as well as understand price transmission and trade patterns. Consumer knowledge, confidence in, valuation and use of FQS labels and products will be assessed via survey, ethnographic and virtual supermarket-based research. Lessons from the research will be applied and verified in 6 pilot initiatives which bring together academic and non-academic partners. Impact will be maximised through a knowledge exchange platform, hybrid forums, educational resources and a Massive Open Online Course.