Results and lessons from pilot studies and final set of verified indicators for impact measurement of FQS, PSFP and SFSC: Evidence from the Comté PDO cheese, Parmigiano Reggiano PDO cheese, Serbian organic raspberries, County Durham school meals, Locavorium shop and Korycin Cheese

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Strengthening European Food Chain Sustainability by Quality and Procurement Policy

Deliverable 3.4:

Report on pilot studies and final set of verified indicators for impact measurement of FQS, PSFP and SFSC: results and lessons from the *Comté* PDO cheese, *Parmigiano Reggiano* PDO cheese, Serbian organic raspberries, County Durham school meals, Locavorium shop and *Korycin* Cheese

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EXECUTIVE SUMMARY

This reports describes the implementation of a sustainability assessment on six pilot cases: three food quality schemes (Comté PDO cheese, Parmigiano Reggiano PDO cheese and Serbian organic raspberries), one public food procurement (County Durham school meals) and two short food supply chains (Locavorium shop and Korycin Cheese). This sustainability assessment followed the Methodological Handbook of the Strength2Food project (D3.2). Its outcome is two-fold: it provides draft results on the sustainability of the quality schemes studied and it allowed us to ensure that the handbook is operational. Its operability was tested and achieved through numerous revisions of the initial handbook.

At first glance, the three FQS products assessed here seem to be more sustainable than their reference products. This statement needs to be more carefully examined however as several estimations have not undergone an in-depth quality check. The possible explanations for this higher sustainability performance have not yet been explored either. Moreover, there are notable exceptions to this feature: Comté performs worse than its reference in terms of food miles and exports, Parmigiano Reggiano performs worse than its reference in terms of net margin and profit to labour ratio, and Serbian organic raspberries perform worse than their reference in terms of profit to labour ratio.

In public food procurement, having a LOC/ORG model alone does not reduce carbon emissions, for two main reasons. First, the great majority of total emissions are due to meat production and processing rather than downstream transportation, therefore LOC/ORG models supplying high volumes of meat have little impact on emissions. Second, LOC models do not reduce transport related carbon emissions if logistics are not well coordinated. To assess economic impacts, we analysed LM3 of the total Durham school meals service, finding that for every £1 spent by the local Council and parents/carers on school meals, £1.50 is retained within the local economy: a high return. To assess social impacts, we explored skills development, working environment and connectedness of supply chain actors, finding a high degree of commitment to training and good relations between actors in the chain. Overall therefore, the pilot study finds that LOC/ORG procurement models can have sustainability benefits in terms of local economic multiplier effects and social impacts, but to reduce carbon emissions, the focus should be on reducing meat in menus, and encouraging efficient, well-coordinated logistics.

Surveys conducted for the short food supply chain pilots revealed that all farmers use different distribution channels (from 2 to 5 channels per farm in the sample), including both short and long channels. Preliminary, main findings are as follows:

- ✓ all economic indicators are much higher for short than long chains;
- ✓ food miles seem not to differ much, but there are large differences among particular channels;
- ✓ social indicators seem to be similar for long and short chains;
- ✓ generally, there are large differences between particular channels (chains) and between farms within the same channels;
- ✓ relations found in the French and the Polish cases were very similar.

The preliminary results from these pilot case studies, the lessons learnt and the associated revisions for the methodological approach are detailed throughout this report.

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LIST OF ABBREVIATIONS AND ACRONYMS

CoP: Code of Practice

DCC: Durham County Council

FQS: Food Quality Scheme

GC: Generational Change

GE: Gender Equality

LA: Local Authority

LAFS: Local Agri-Food System

LCA: Life Cycle Assessment

PDO: Protected Designation of Origin

PGI: Protected Geographical Indication

P-R: Parmigiano Reggiano

PSFP: Public Sector Food Procurement

RDC: Regional Distribution Centre

SC: Supply Chain

SFSC: Short Food Supply Chain

TSG: Traditional Speciality Guaranteed

WF: Water Footprint

Results and lessons from pilot case studies: Comté PDO cheese, Parmigiano Reggiano PDO cheese, Serbian organic raspberries, County Durham school meals, Locavorium shop and Korycin Cheese

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1. INTRODUCTION

This report presents the results and lessons learnt from road-testing the Methodological Handbook of the Strength2Food project on five pilot cases (Bellassen et al., 2016). The Methodological Handbook provides guidelines on how to assess the sustainability of quality food products, combining case study description and sustainability indicators. Three quality policies are assessed in Strength2Food and therefore covered by the handbook:

- WP5 focuses on Food Quality Schemes (FQS) including Protected Designation of Origin (PDO), Protected Geographical Indication (PGI), Traditional Speciality Guaranteed (TSG) and organic farming;
- WP6 covers Public Sector Food Procurement (PSFP);
- WP7 studies Short Food Supply Chain (SFSC).

Many indicators are common to the three types of quality schemes. However, the method to obtain them is often specific to each work package: the carbon footprint of a singular food product is not estimated the same way as one estimates the carbon footprint of an entire school meal. Accordingly, the results and lessons learnt from the pilot case studies are described separately in this report: section 2 covers the three WP5 pilots, namely *Comté* PDO cheese, *Parmigiano Reggiano* PDO cheese and Serbian organic raspberries, section 3 covers the WP6 pilot, namely County Durham school meals, and section 4 covers the two WP7 pilots, namely the *Locavorium* shop (France) and the *Korycin* Cheese (Poland).

2. RESULTS AND LESSONS FROM WP5 PILOTS: *COMTÉ* PDO CHEESE, *PARMIGIANO REGGIANO* PDO CHEESE AND SERBIAN ORGANIC RASPBERRIES

The feedback from the WP5 pilot cases is globally positive: results were obtained for a majority of indicators and are summarized in section 2.1. Nevertheless, substantial changes were made to the handbook. Some concern the overarching guidelines on how to proceed with a case study in WP5 such as revised guidelines on case study selection, data collection procedure, monograph outline or Excel template for data collection. These general changes and their rationale are presented in section 2.2. Some changes are specific to an indicator. These are presented in section 2.3, together with indicator-specific results.

2.1. Sustainability indicators for the three WP5 pilots

At first glance, FQS products seem to be more sustainable than their reference products (Figure 1). This statement needs to be more carefully examined however as several indicator estimations have not undergone an in-depth quality check and as this results is based on only three products. Moreover, there are notable exceptions to this feature: Comté performs worse than its reference in terms of food miles and exports, Parmigiano Reggiano performs worse than its reference in terms of net margin and profit to labour ratio, and Serbian organic raspberries perform worse than their reference in terms of profit to labour ratio. There hasn't been time yet to analyse the determinants of these results. Beyond the results themselves, Figure 1 is a representative summary of what has been achieved on the WP5 pilots, and of the kind of results that can be expected from WP5.

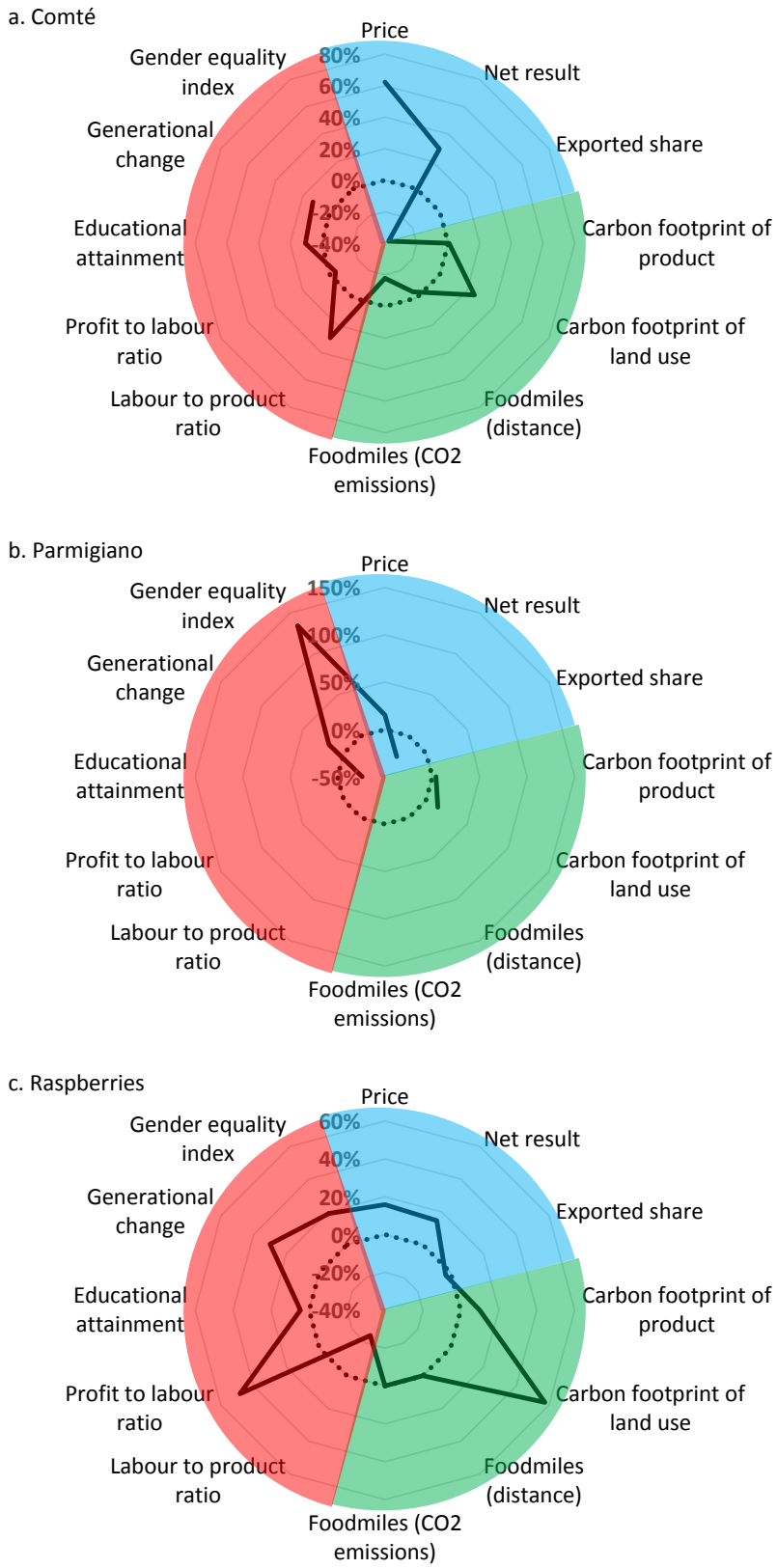


Figure 1. Sustainability performance[1] of the three WP5 pilot case studies

[1] Each indicator is expressed as the difference between the FQS and its reference product. For environmental indicators for which lower is better, the opposite of the difference is displayed (e.g. +20% when the carbon footprint is 20% lower).

2.2. General changes and lessons learnt on how to conduct a WP5 case study

2.2.1. Number of indicators and their use

Three criteria directed the selection of indicators from the initial list:

- Whether results could be obtained for at least two out of three pilots;
- Whether results could be obtained both for the FQS and its reference product;
- Whether the results could be interpreted in terms of sustainability performance.

Accordingly, the following indicators were confirmed for systematic use in all case studies:

- General economic indicators (Ec1);
- Local multiplier effect (Ec2), further adaptation may be required;
- Carbon footprint (En1);
- Food miles (En2), for vegetal sectors[2];
- Water footprint (En3);
- Employment (So1);
- Governance (So2), restricted to the balanced distribution of bargaining power;
- Educational attainment & skills (So3), complemented with an indicator on wage level;
- Gender and age balance (So5).

The bulk of the initial governance indicator (So2) has been modified and is now recommended as a tool to describe the governance of the FQS in the monograph rather than as an indicator. Similarly, the initial indicator on knowledge and know-how transmissibility (So4) can be used as a tool to support the monograph. The Food miles indicator (En2) is turned into a complementary indicator in animal food chains, due to the necessity of primary data collection and the lower relative importance of transportation in the overall carbon footprint of these chains. Finally, some complementary indicators were abandoned.

In addition, all indicators have been revised to ensure their operability on the three pilot cases. For example, most variable requested are now expressed in relative terms (e.g. as a percentage of turnover, on a per hectare basis) rather than in absolute terms (e.g. total value added in the FQS value chain). All these changes and their rationale are described in section 2.3 and the Methodological Handbook has been revised accordingly.

2.2.2. Selection criteria for the case study and its reference

2.2.2.1. Selection guidelines for case studies

The selection of case studies is of course up to the partners who conduct them. However, the experience gained on the pilots allows us to propose the following guidelines to ease out the case study and its interpretation:

- The case study conductor should have a good contact with the key stakeholders in the FQS supply chain;
- The FQS should be large enough (number of operators, volume produced, …) so that the indicators are partly attributable to the FQS (and not only to the peculiarities of a couple of firms/producers);

[2] The assessment of vegetal sectors is generally less resource-intensive because they often contain fewer crops and fewer value chain levels. Therefore, the estimation of Food miles – which requires primary data collection – is only mandatory for these sectors. Animal sectors can nevertheless estimate the food miles indicator if they have enough time to do so.

- The case study should have been documented before S2F (availability of secondary data for the most common variables).

2.2.2.2. Selection guidelines for reference products

The production of an indicator only makes sense if it can be compared with a reference product. Ideally, case study conductors would choose and document a reference product based on stakeholder feedback: to which non-FQS product(s) do producers compare themselves? Note that the default values – usually national averages – provided by INRA can extensively be used to bridge gaps in the documentation of this reference. Indeed, the reference can be a chimera (e.g. price from Emmental and milk yield from national average).

Ideally, one would end up with two references for each FQS product:

- one obtained by the case study conductor: fitted to the case, relevant for local stakeholders; and
- one provided by INRA-D: computed from national averages, objective choice, and ensuring the comparability of references across cases.

Note that the use of the reference is primarily to interpret the results from the case so even if the reference presents some peculiarities, this can be accounted for in the discussion of results. Indeed, although we opted for real *relative references* in Strength2Food, many performance assessments use *normative references*, that is references which correspond to fictive cases or to targets to be reached (Acosta-Alba and Van der Werf, 2011).

2.2.2.3. Which firms belong to the value chain?

When firms are making only part of their turnover from the FQS product – e.g. a freezing plant which is freezing and packaging all kind of fruits, including the FQS (organic raspberries) – criteria are needed to determine whether they belong to the FQS value chain. The key recommended criterion is that the firm makes at least 50% of its turnover from the FQS product. As such, most firms at retail level will be excluded. However, a few systematic or ad hoc exceptions can be made:

- The retail level is included for two economic indicators, namely price premium and export;
- A firm/value chain level can be retained on an ad hoc basis when its impact on an indicator is substantial (e.g. impact of freezing on the carbon footprint of frozen raspberries);
- A firm/value chain level can be retained on an ad hoc basis when stakeholders consider it as part of the value chain despite it making less than 50% of its turnover from the product.

2.2.3. Procedure for data collection and indicator estimation

2.2.3.1. Principles

The most important principle of the procedure for data collection and indicator estimation is an **early and repeated interaction** between the case study conductor and the indicator coordinator (Figure 2). The case study conductor is responsible for collecting the data and ensuring its traceability, which implies creating a repository with all source files and intermediary calculations. The indicator coordinator is responsible for the quality check of the data provided (e.g. verifying, together with the case study conductor, the original source when an order of magnitude seems wrong, etc.) and for providing the case study conductor with the estimated indicator(s). Both are responsible for interpreting the results.

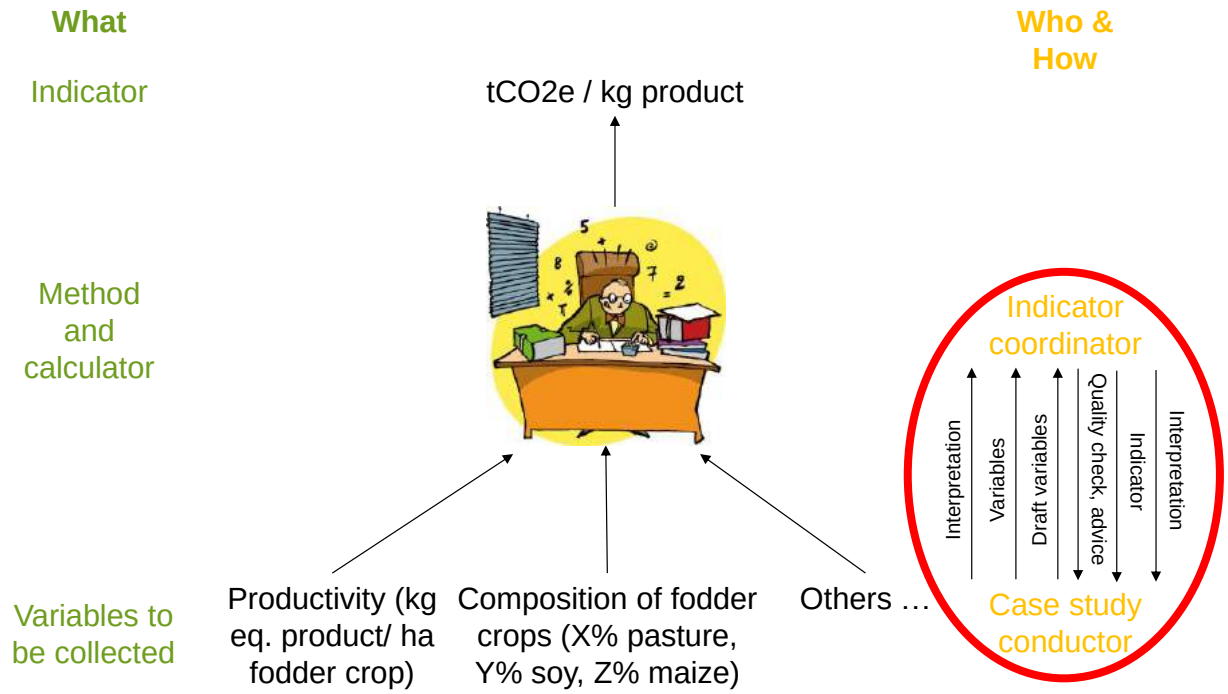


Figure 2. Organisation of data collection and indicator estimation and interpretation

2.2.3.2. Example of data collection agenda

Based on the experience gained on the three pilots, the following agenda is recommended:

- Identify 4-6 key stakeholders likely to know of many and diverse sources of information, **starting with the product syndicate (Defence and Management Organisation for GIs)**;
- Send them an e-mail asking for documents (see Table 1 for example e-mail);
- Look for variables in the documents, following the prioritization strategy (see 2.2.3.3)
- Interview the 4-6 stakeholders, focusing on the key variables still missing and the indicators/variables/levels you are most interested in. An early interview with the product syndicate will likely be helpful for the identification and contact of the other key stakeholders;
- Set up a stakeholder survey if necessary for the variables that could neither be obtained from secondary data nor from expert judgement during the interview;
- **Make use of your WP lead/co-lead and/or the indicator coordinators throughout the process**: to identify possible data sources, to request default values, to avoid misunderstandings on the requested variables or on the method to estimate the indicators, …

Dear …. [expert],

In preparation for our meeting in the coming weeks, could you send us documents (articles, reports, databases, etc.) which you think would contain quantitative information on one of the following 6 themes?

- ✓ **Economy of businesses** (farms, processing plants, and possibly retailers): product price, gross product, added value, net margin, etc.
- ✓ **Localization of inputs, production and consumption**: exported share, distance travelled by inputs and outputs, etc.

✓ **Technical characteristics of farms**: yield, input quantity, dry matter intake by animals, number of animals per hectare, etc.
✓ **Water and energy consumption** at the different value chain levels
✓ **Value chain structure and bargaining power**: number of businesses per value chain level (farmers, processors, retailers), market shares, number of conflicts and trials, share of long-term contracts, etc.
✓ **Employment**: number of jobs, age and gender of employees/business owners, educational level of employees/business owners, etc.

Table 1. Example e-mail requesting documents from future interviewees

2.2.3.3. Tips for data collection

In addition to the road-tested example of data collection agenda presented above, here are a few tips for data collection based on the experience with pilot cases:

- Prioritization:
  - Begin with key variables necessary to compute systematic indicators at key levels of the value chain
  - Make use of default values: begin with variables you think are most likely different from default values
  - Rely on existing sources of information: existing documents (articles, reports, code of practice/technical specifications, …) and databases
  - Conduct 4-6 interviews to obtain more secondary data and/or primary data
- It may be convenient to focus on key areas of production (e.g. three main regions producing Parmigiano Reggiano) or key processors (e.g. the three firms making up 80% of market share) to save time. Indeed, regional authorities of key areas may have readily available data which do not exist for smaller areas.
- Metadata documentation: record the source/reference, the type of value (average, min, max, …) and the time period in the Excel template and deposit the original documents and, where relevant, the intermediary calculations, in a dedicated repository;
- Where data treatment using coding or GIS could be useful, don't hesitate to ask INRA or other partners for help if needed;
- Access to AMADEUS and/or its national counterpart helps a lot with the processing levels for Ec1 and So1 (and Ec2, to a lesser extent);
- Regulators, auditors and accountants are likely institutions with data on the variables sought.

2.2.3.4. Default values

INRA has put together default values at national level for most of the variables required to compute the Strength2Food indicators. Whether a default value has been found for a given variable is indicated in a column of the data collection spreadsheet. These values can then be retrieved either by asking the indicator coordinator or by consulting the online interface designed for this purpose:

https://esrcarto.supagro.inra.fr/shiny/S2F_DEFAULTVALUES/

Default values can be used in three different manners:

- To check that the collected data for the case and/or its reference is of a reasonable order of magnitude;
- To estimate indicators for a "national average" reference product;

- To save time on data collection when there is evidence (e.g. expert judgement) that a given variable is not significantly different from the national average.

2.3. Results and changes specific to each indicator[3]

2.3.1. General economic indicators (Ec1)

2.3.1.1. Draft results

In the French case study, the price premium is increasing along the chain reaching 85% at the downstream level (Table 2). For the Serbian case it is U-shaped, reflecting the low level of processing of the product at stage Processing. It would be interesting to be able to compare profitability at this level. At the upstream level, the price premium for Parmigiano Reggiano is low. But we cannot compare with other levels for Italian cheeses.

In order to be able to compare the profitability between PDO/standard products or organic/conventional products the profitability is defined as the ratio net result/turnover. For French and Serbian case studies the profitability is higher for the labeled product than for the standard/conventional one. The Italian case seems surprising: the profitabilities for Parmigiano Reggiano and standard product are the same, and the profitability is lower for Parmigiano Reggiano at the processing level. Values to compare the profitability at the downstream level are not available for the standard product.

In Serbia, the raspberry market is for export, both for the organic raspberries and the conventional ones. Only 8.5 % of the Comté in volume is exported; the percentage of exports reaches 19% for Parmigiano Reggiano.

More detailed results on economic indicators are available in Appendix 2.1.

Indicators	Upstream		Processing		Downstream	
	FQS	Standard	FQS	Standard	FQS	Standard
Price Premium						
French cheese (U&D: 2015, P: 2014)	*28.76%*		*73.35%*		*84.84%*	
Italian cheese (2014)	6 %		n.a.		*19 %*	
Serbian raspberry (2015)	*20.5 %*		*6.9 %*		*20.1 %*	
Profitability	FQS	Standard	P1 & P2	Standard	FQS	Standard
Net result (% turnover)						
French cheese (U: 2010-2011-2012; P: 2015)	*32.6%*	*24.8%*	*0.8%* *(0.5% & 1%)*	*n.a.*	*n.a.*	*n.a.*
Italian cheese (PDO 2014; Standard 2016)	55%	*55.2%*	*2.5%* *(1.4% & 3.5%)*	7%	4.6%	n.a.
Serbian raspberry (2015)	*≈70%*	*66%*	*P2: n.a.*	n.a.	n.a.	n.a.
Internat. trade (volume)					FQS	Standard

[3] For the detailed explanation of the method to compute each indicator, see Strength2Food deliverable 3.2 (Bellassen et al., 2016).

French cheese (2015)			
Europe		*6 .8%*	*11 .8%*
Outside Europe		*1 .6%*	*2 .2%*
Italian cheese (2014)			
Total		*18.8%*	n.a.
Serbian raspberry (2015)			
Europe		*97%*	*87.3%*
Outside Europe			*12.7%*

Table 2. Summary results for general economic indicators

2.3.1.2. Lessons learnt and changes to the indicator

We have to stress that it is difficult to collect data for all case studies for the same date or period. However, most of the data collected relate to the period 2014-2016.

Moreover, it proves more convenient to request variables as a percentage of turnover, rather than in absolute value (euros year^{-1}). The handbook has been modified accordingly.

2.3.2. Local multiplier (Ec2)

2.3.2.1. Draft results

Table 3 and Table 4 shown below summarises the results from the Comté and Emmental cases. Table 5 compares these results by ratio.

This demonstrates that overall for every euro spent Comté generates €2.79 within the local economy whilst on a comparatively similar area Emmental generates €2.13 a difference of €0.6. If we look at local suppliers comparison we find that the figures are less marked with €2.83 and €2.62 a difference of €0.21. While for non local suppliers this balance is reversed with Emmental non local supplier generating €0.25 more for the local economy. This suggests that while the turnover of Emmental is 2.9 times that of Comté that the higher benefit to the local economy results from the Comté production.

These ration comparisons will become more meaningful throughout the lifetime of the project and the different types of food scheme using them whether this be public sector, short supply chains, or quality schemes.

		Local Suppliers/Payroll		Non Local	
	Round Totals €	**In Area €**	**Out Area €**	**In Area €**	**Out Area €**
Budget/Project	**504,383,745.00**				
Direct Spend		471,131,866.30			13,497,689.70
Payroll + other		24,917,817.28			0.00
Total local	**496,049,683.58**	496,049,683.58			13,497,689.70
Local		382,417,735.87	88,714,130.42	4,385,399.38	9,112,290.32
Payroll/Costs Respending		18,319,918.15	6,597,899.13	0.00	0.00
Total Local	**405,123,053.41**	400,737,654.03	95,312,029.55	4,385,399.38	9,112,290.32
Total Spending	**1,405,556,481.99**				
LM3	**2.79**	**2.83**		**1.13**	
	Project LM3	**Local Supplier**		**Non-Local**	

Table 3. LM3 Breakdown Local versus Non Local Suppliers Comté

		Local Suppliers/Payroll		Non Local	
	Round Totals €	**In Area €**	**Out Area €**	**In Area €**	**Out Area €**
Budget/Proje	**1,950,720,000.**				
Direct Spend		902,793,216.00			833,347,584.
Payroll +		252,198,835.20			6,466,636.80
Total local	**1,154,992,051.**	1,154,992,051.			839,814,220.
Local		469,452,472.32	433,340,743.	400,006,840.	433,340,743.
Payroll/Costs Respending		181,246,515.84	70,952,319.36	2,860,974.72	3,605,662.08
Total Local	**1,053,566,803.**	650,698,988.16	504,293,063.	402,867,815.	436,946,405.
Total	**4,159,278,854.**				
LM3	**2.13**	**2.62**		**1.38**	
	Project LM3	**Local Supplier**		**Non-Local**	

Table 4. LM3 Breakdown Local versus Non Local Suppliers Emmental

	Comté	Emmental	Difference
Project	2.79	2.13	0.66
Local	2.83	2.62	0.21
Non Local	1.13	1.38	-0.25

Table 5. LM3 ratio comparison

2.3.2.2. Lessons learnt and changes to the indicator

The adaptation of the LM3 tool was originally developed to demonstrate socio-economic community benefit, and now widely used in public procurement and major infrastructure projects to calculate public and community value. The use of the online too for FQS has raised three practical questions:

- The generic accounting data does not distinguish between local and non-local suppliers. To use the tool to its full potential collection of empirical data is recommended. This works well in a commercial environment where suppliers are eager to satisfy their client's information requests but is less easy to accomplish in a research one where stakeholders usually have only a limited time to spare with researchers.

- Because the online tool is designed and used widely on a large scale results are calculated continuously and in the background. This required more learning than the other indicators which listed the needed variables in a homogenized data collection spreadsheet.
- Confusion over the reference case and its purpose meant than there was some difficulty in finding standard set of criteria for reference.

Nevertheless, ideas have been put forward to solve these difficulties:

- Asking interviewees to dispatch their intermediate consumption into 4-6 major categories and asking for their expert judgment on the share of each category which is local (often either 0% or 100%);
- Similarly to all other indicators, providing an excel data collection sheet, while the indicator coordinator conducts a quality check on the collected data, transfers it into the online LM3 tool and sends back the results to the case study conductor.LM3 is calculated by adding round 1 spending + Round 2 spending +_ Round 3 spending/Round 1 spending. This generates a ratio which can be used to compare impact. All calculations can be fully reconciled using the report provided by the system and which is produced automatically for each case study.
- Using the database of IMPMENT to estimate the average local share of an expense when case study specific data cannot be obtained. In addition the tool is being used across all work packages and this will generate a set of over 30 different case studies.

The feasibility of these solutions and the meaningfulness of the associated results will require further investigation. As a result, to extent to which this indicator will be used for WP5 is still to be decided.

2.3.3. Carbon footprint (En1)

2.3.3.1. Draft results

Draft results indicate that the carbon footprint of the three pilots is smaller than their reference/counterpart. The difference is small on a per ton of product basis (Figure 3) and substantial on a per hectare basis (Figure 4). These preliminary results should however be taken cautiously: for example, the method used to estimate emissions from nitrogen fertilization in the Cool Farm Tool (Hillier et al., 2011) – the calculator used in Strength2Food – is different from the IPCC default (IPCC, 2006). The consequences of this difference have yet to be analyzed.

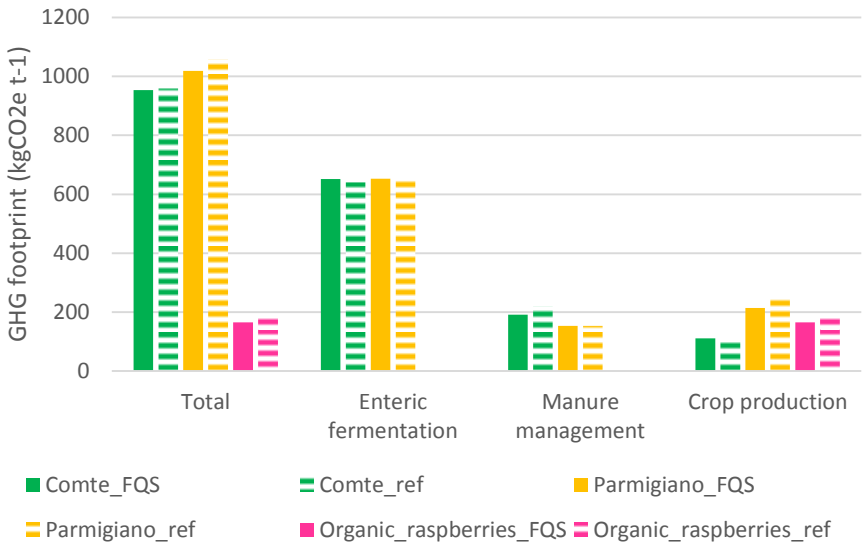


Figure 3. Per ton of product GHG footprint of the three pilot cases

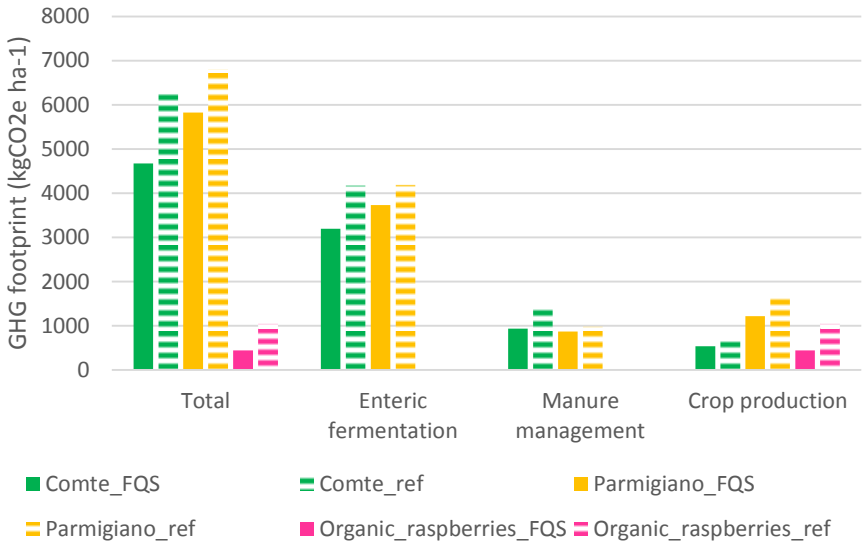


Figure 4. Per hectare of land GHG footprint of the three pilot cases

2.3.3.2. Lessons learnt and changes to the indicator

The number of variables needed is rather high, especially for animal products: 48 variables for *Parmigiano Reggiano*, 50 for *Comté* and 9 for *Serbian raspberries*. However, these variables are rather common ones, and could therefore be obtained from secondary sources (existing reports, FADN database …) or, exceptionally, from expert judgement.

The selected calculator – the Cool Farm Tool – is transparent and free for use. Therefore, despite its deviations from classical IPCC estimation methods and necessary corrections on some items (e.g. enteric fermentation of dairy cows), its use is confirmed for Strength2Food.

No information was found on the pilots on variables pertaining to processing levels. While this is consistent with the "secondary" nature of these levels of the supply chain with regard to carbon footprint, effort is underway to find values for the raspberries pilot. Indeed, for vegetal value chains, the impact of this level, including transportation-related emissions, could be substantial. Also, this information needs to be collected for the food miles indicators (En2). For these reasons, this variable has been changed to "key" for vegetal value chains. Other minor

changes were made to the indicator such as eliminating most requests related to the location of firms, requesting dry matter intake for animal value chains, and moving fuel use from a secondary to a key variable.

2.3.4. Food miles (En2)

2.3.4.1. Draft results

First draft results presented in this section highlight the distance travelled by kg of product, as well as the emissions released by kg of product for two pilot cases: *Comté* and *Serbian organic raspberries*.

In the *Comté* case (and for its reference), values at the retail level were not easily available, and are considered as secondary as only a small share (less than 10%) of the total *Comté* production is exported. In the *raspberries* case (and its reference), most of the distance and emissions are driven by the retail level, which is consistent with the fact that 90 to 95% of the production is exported (Figure 5). A cross comparison between the two FQS cases (*Comté* and *Raspberries*) highlights the importance not only of the distance travelled but also of logistics and transportation patterns on the environmental impact (emissions released). Indeed, *Raspberries* travel shorter distances than *Comté* at the collection stage, but release more emissions (Figure 6).

Not much difference arises from a first comparison of *Comté* cheese with its reference (considering the value for the processing level is still missing for the reference). Similarly, no difference is expected between the *organic raspberries* and its reference.

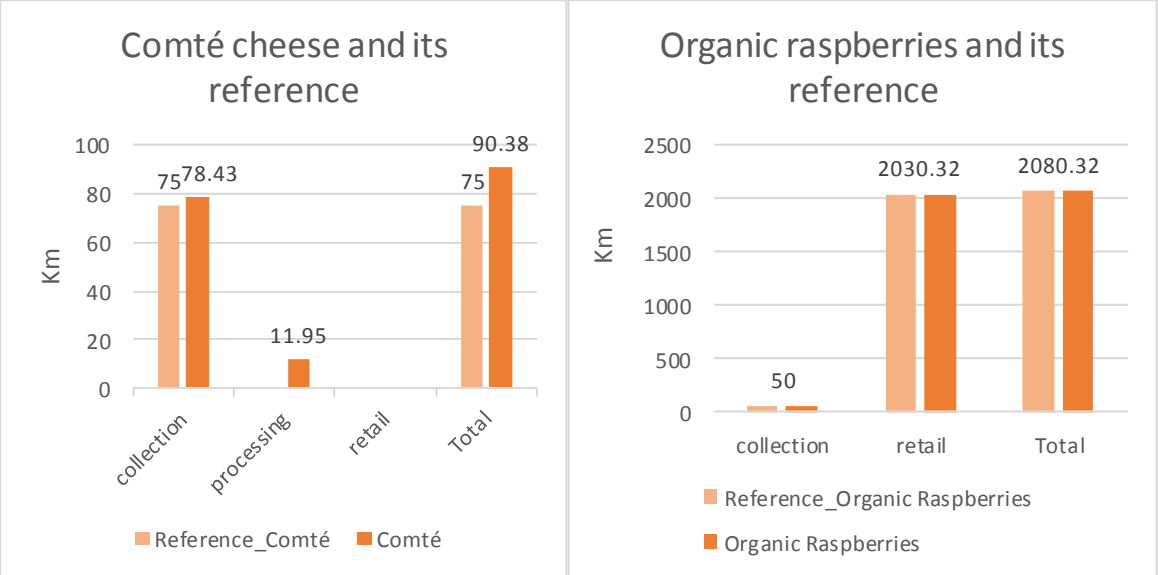


Figure 5. Distance travelled per kg of product (km)

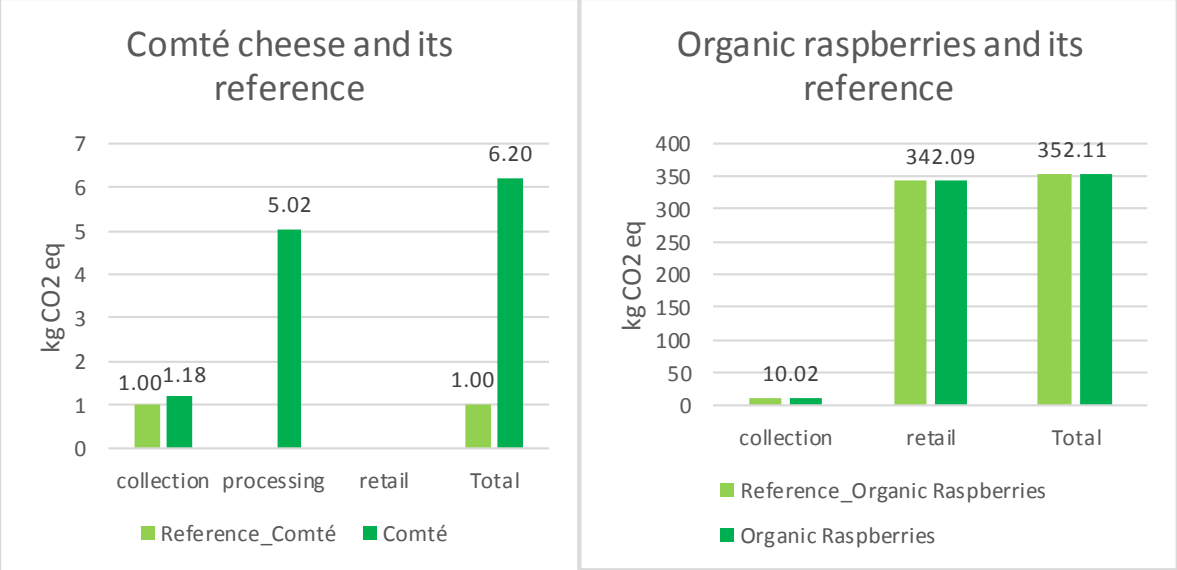


Figure 6. Emissions per tonne of product (kg CO2 eq)

2.3.4.2. Lessons learnt and changes to the indicator

The food miles indicators experienced a slow and difficult take-off, due to the lack of publicly available secondary data, and the difficulty to obtain existing secondary data on location (GPS coordinates). The experience from the *Comté* case tells us not to rely on a unique data source, such as the product's consortium.

Therefore, the data collection strategy changed from location-based to distance-based (km travelled) variables. These data are expected to be collected through expert judgement (field interviews) or possibly through surveys using questionnaires. Additional variables related to the carrying capacity of trucks, the average load, the transportation patterns (returning empty or single journey) and destinations of exports, when relevant, have been added. Moreover, the case study conductor should prioritize its data collection effort towards the upstream part (collection stage, from production to processing), and also towards the downstream part when it applies to a product which is mainly exported. The index card has been modified accordingly in the Methodological Handbook.

In the *Serbian organic raspberries* case, an expert judgement has been obtained, while a questionnaire sent to processing units has been used in the *Comté* case. In the latter case, the response rate amounts to 22% within three days. Data from the *Parmigiano Reggiano* case should come soon, also from expert judgement.

Average distances have been obtained in the *Comté* case from the farm level to the first processing level (U3 to P1), as well as from the first processing level to the second one (P1 to P2).

Similarly, average distances have been obtained in the *Serbian organic raspberries* case from the farm level to the processing level (U2 to P1), while destination of exports have been obtained and used to compute distances from the processing level to the retail level (P1 to D2).

The related emissions released have been computed using emissions values from the Cool Farm Tool calculator, as well as additional information on the carrying capacity of vehicles and on the transportation patterns.

One of the main issues for computing the En2 indicator is related to the reference values. These values proved difficult to obtain and uncertain (as in the *Comté* case), and in both the *Comté* and *Raspberries* cases, no difference was expected or obtained from the reference values.

Finally, the decision has been made to focus the indicator on vegetal products for two reasons: the carbon footprint of animal products is mainly driven by the production stage (e.g. cattle) which makes product transportation less important in this regard and the amount of effort required from animal case studies is expected to be higher as this sector tends to have more levels in their supply chains. Therefore, En2 is a systematic indicator only for vegetal sectors (Fruits & vegetable, Cereals & Bakery and Coffee & Tea). It is turned into a complementary indicator for animal products (Meat and Dairy sectors).

2.3.5. Water footprint (En3)

2.3.5.1. Status of the indicator

To date water footprint (WFP, henceforth) has only been estimated for a single pilot case (Parmigiano Reggiano). Sufficient data have however been collected on the two other pilots and their WFP will be estimated shortly.

In general due to the complexity of the data that WFP requires, we considered mainly the agricultural phase of the products. In the case of Parmigiano Reggiano and Comté this meant focusing on the growing phase of the plants that provide food for animals. For raspberries, this rationale is even stronger as little water is used in the processing stage. Seen in the perspective of the production chain thus the calculation of WFP focuses mainly upon the upstream part.

2.3.5.2. First results

Although the final value for the WFP must consider also the processing phase through which milk is converted into the final products (Comté, Parmigiano Reggiano) and the preparation of raspberries, the following results focus on the upstream part of the production chain.

Parmigiano Reggiano production begins with the cultivation of the crops that enter as main components in the diet of milk producing animals. We have mainly three crops: alfalfa, maize and soybean. This applies as well to the counterpart which is standard milk for industrial cheese.

The computation yielded these values for the three crops:

WFP (m3/ton)	Alfalfa	Soybean	Maize
Blue	**420.5**	**387.2**	**454.2**
Green	**323.3**	**440.2**	**197.1**
Grey	**70037.82**	**307741.95**	**70646.85**

Considering the diet of the animals, according to the Parmigiano Reggiano technical guidelines we have, one ton of food is composed of 60% alfalfa, 29% maize and 11% soybean. However one ton of food used to produce the counterpart is composed of 18% alfalfa, 68% maize and 14% of soybean. According to these compositions we obtain the WFP for 1 ton of food for the animals that produce milk for Parmigiano Reggiano and 1 ton of food for animals producing standard milk for industrial cheese.

So 1 ton of food for milk production yields the following values for the WFP

WFP m3/ton	Parmigiano Reggiano			Industrial cheese		
	Alfalfa (60%)	Soybean (11%)	Maize (29%)	Alfalfa (18%)	Soybean (14%)	Maize (68%)

Blue	252.30	42.59	131.72	75.69	54.21	308.86
Green	193.98	48.42	57.16	58.19	61.63	134.03
Grey	42022.69	33851.61	20487.59	12606.81	43083.87	48039.86
total	42468.97	33942.63	20676.46	12740.69	43199.71	48482.74
	97088.06			104423.14		

The difference is about 7000 m3 in favor of the Parmigiano Reggiano production. This is mainly due to the fact that alfalfa constitutes the greatest share of the food for the animals producing milk for Parmigiano Reggiano and it is grown with less fertilizers and less pesticides. Disaggregated values show that industrial cheese performs better in terms of blue water footprint but it does worse for the grey and the green. Overall the difference from these estimations seems not to be very high.

For the other parts of the production chain computations are still in progress. This phase in fact is made of several steps in which water is consumed. However it must be taken into account that most of the processing phase coincides for both product (in terms of water consumption) and the contribution of this part to WFP could be similar. What makes the greatest difference in terms of WFP between Parmigiano Reggiano and its conventional counterpart is the agricultural phase because what changes in the two supply chains is the composition of fodder. One major difficulty is the collection of data in the lower part of the production chain, from where milk is produced to the processing phase. A survey on some of the most important producers has been conducted but data are not complete yet.

The WFP for organic raspberries is almost completely determined by the growing phase in the field. The comparison has been done considering organic and conventional production. The area of production is central Serbia. The calculation of WFP for the growing phase utilizes for the most part the same data for OR (Organic Raspberries) and NOR (non-organic raspberries). Meteorological data come from the station in Kraljevo which is around 50 km from the centre of production around Arilje. The types of soils were identified using the software available at the web site https://www.soilgrids.org/.

The information from which the WFP is being calculated is presented below.

	Organic	**Conventional**
Meterological data	Kraljevo meteo station (Climwat)	Kraljevo meteo station (Climwat)
Soil type	Luvisol (acid soils and poor in nutrients)	Haplic Cambisols (11%) Haplic Cambisols (14%)
Volume of irrigation water	300 m^3/ha	0 m^3/ha
Root depth	25-30 cm	25-30 cm
Pesticide	Mixture of nettle and water. 1 (m^3/ha)	Queen (http://nationalpesticides.com/Queen.htm) Pirus (http://www.cheminova.es/producto/pyrus-400)

Fertiliser (type)	Manure	NPK 8-5-6 • **8 % Organic nitrogen** • **5 % Phosphorus pentoxide** • **6 % Potassium oxide** • **8 % Calcium oxide** • **5 % Sulfur dioxide** • **25 % Organic carbon** • **50 % Organic substance**
Amount N	170 kg/ha	102 kg/ha (mineral) 20 kg/ha(organic)
Amount P	0 kg/ha	750 kg/ha

Here again it seems that the grey fraction will contribute mostly to differentiate between organic and conventionally-produced raspberries as for their WFP synthetic fertilizers and pesticides are used for conventional raspberries while for the organic raspberries only manure and a mixture of nettle and water are used.

The design of a water footprint method suited to Strength2Food constraints took longer than expected, which has hampered the complete calculation of the water footprint for all the three pilot cases. The calculation for Parmigiano Reggiano is proceeding considering the processing phase, from milk production to cheese production.

As for organic raspberries most of the data are related to the growing phase and computation, although delayed, will not require additional information.

2.3.5.3 Lessons learnt and changes to the indicator

Many variables are necessary to estimate the WFP: climate, soil, etc. Fortunately, proxies for many of them are readily available from international databases so that case study conductors do not need to spend time searching unless they have more precise data readily at hand. Many variables are also used both for the WFP and the carbon footprint estimates. For example, meteorological data that are needed must be collected for the entire cycle of production from seedling phase to harvest and concern several parameters. Only in the case of Parmigiano Reggiano, data were collected in several stations in the area of production. Yet, for Comté and organic raspberries, the CLIMWAT software provides historical data form the stations at Kraljevo and Besançon, that are located in the production area or close to it so that differences may not be considered relevant. The lack of meteorological data could be a serious issue to tackle in the other case studies, if they will not be directly collectable from the areas of production. In that case it could be hard to find reliable information in CLIMWAT.

2.3.6. Employment (So1)

2.3.6.1. First results

2.3.6.1.1. Labour-to-production ratio

Pilot cases		Upstream		Processing		Downstream	
		Labelled	Standard	Labelled	Standard	Labelled	Standard
France	awu.ton^{-1}			0.016	0.014	/	/
	awu.ton_milk_eq^{-1}	0.008	0.006	0.002 (*)	0.001 (*)	/	/
	hours.ton_milk_eq^{-1} (**)	14.69	11.60	2.83	2.15	/	/

Italy	awu.ton^{-1}			P1=0.009 - P2=0.018 P1+P2=0.025	0.020	0.043	/
	awu.ton_milk_eq^{-1}	0.003	/	P1=0.001 - P2=0.001 P1+P2=0.002 (***)	0.001 (***)	0.003 (***)	/
	hours.ton_milk_eq^{-1} (**)	5.77	/	P1=1.07 - P2=2.00 P1+P2=2.85	2.30	4.83	/
Serbia	awu.ton^{-1}	0.08	0.107	/	/	/	/
	hours.ton^{-1} (**)	144.85	192.31	/	/	/	/

(*): Comté > 100 litres of milk to make one wheel of 10kg of Comté ; Emmental > 800 litres of milk to make one wheel of 70kg

(**): 1 annual work unit = 1800 hours

(***): 16 litres of milk to make 1 kg of cheese (http://www.wipo.int/wipo_magazine/en/2011/01/article_0005.html)

2.3.6.1.2. Profit-to-labour ratio (€ awu^{-1})

Pilot cases	Upstream		Processing		Downstream	
	Labelled	Standard	Labelled	Standard	Labelled	Standard
France	31 167	26 316	7 498	10 170	/	/
Italy	30 686	/	P1=13 407 - P2=23 710 P1+P2=19 434	34 475	18 505	/
Serbia	17 484	11 785	/	/	/	/

2.3.6.2. Lessons learnt and changes to the indicator

Employment indicators need common variables such as quantity of production, total labour force and an estimate profit created by the farms or the firms (net value added, net result or net margin). These data are systematically collected, reported and used in agricultural censuses and in farm or businesses structure surveys (Farm structure statistics, FADN, Structural business statistics, etc.).

The quality of variables collected and their degree of comparability are not always clear. The main difficulties concern: firstly, the understanding of labour force quantity and estimated profit; secondly, the comparability of values collected which, sometimes, do not refer to the same statistical entity.

Different basic steps were performed to check and combine data received (collected) into one comprehensive data set, as far as possible:

- For each level, confirm that the data refer to the same statistical entity. If not, evaluate the comparability.

- Check the units of measure collected.

- Check that the orders of magnitude for values collected are consistent with results from Ec1 and/or with external sources of information (statistical databases). If not, assess why they differ?

Minor revision is made for labour-to-production ratio. To "normalise" the results, two equivalence units are added:

- production can be expressed as a metric ton of milk equivalent (normalisation of production of cheese = quantity of cheese * amount of milk transformed for one unit of cheese quantity);

- annual work unit can be expressed as number of hours equivalent (1 awu = 1800 hours)

2.3.6.3. Data gathering

variables : prod_lz ; totlab-awu_l ; ecopro_eur_l						
Pilot cases	**Upstream**		**Processing**		**Downstream**	
	Labelled	Standard	Labelled	Standard	Labelled	Standard
France	X	X	X	X	-	-
Italy	X	-	X	X	X	-
Serbia	X	X	-	-	-	-

2.3.6.3.1. French PDO Comté

COLLECTED DATA

	Comté			Standard milk of Franche-Comté		
	prod_lz	totlab_awu_l	ecopro_eur_l	prod_lz	totlab_awu_l	ecopro_eur_l
Upstream	638 000 t	6 630	318.83	3 180 000 t	95 382	181.3
Processing						
P1	69 636 t	442	328 500	265 000 t	25 291	9 711 049
			436 978			
P2	64 065 t	566.2	2 806 560			
			3 596 640			

2.3.6.3.2. Serbian organic raspberry

COLLECTED DATA

	Organic raspberries production			Raspberries (conventionally produced)		
	prod_lz	totlab_awu_l	ecopro_eur_l	prod_lz	totlab_awu_l	ecopro_eur_l
Upstream	1 809 000	145.57	2 545 172.90	63 919 000	14 172.82	80 480 838.20

2.3.6.3.3. Italian PDO Parmigiano Reggiano

COLLECTED DATA

	Parmigiano Reggiano			Counterpart		
	prod_lz	totlab_awu_l	ecopro_eur_l	prod_lz	totlab_awu_l	ecopro_eur_l
Upstream						
U3	1 533 104 215 litres	4 916	438 369 065			2 390 043 231
		0.07 (awu.ha-1)	438 369.07 (euros.ha-1)		0.06 (awu.ha-1)	5 388.24 (euros.ha-1)
Processing						
P1	113 349 483 kg	1 074	14 399 044	7 088 538	145	4 998 930
P2	85 012 112 kg	1 514	35 900 955			
Downstream						
D2	102 014 535 kg	4 377	80 994 156			
D2	1 926 941 kg					
D2	24 143 440 kg					

2.3.6.4. Data consolidation

2.3.6.4.1. French PDO Comté

DATA CORRECTION/CONSOLIDATION

	Comté			Standard milk of Franche-Comté		
	prod_lz	totlab_awu_l	ecopro_eur_l	prod_lz	totlab_awu_l	ecopro_eur_l
Upstream	638 000 000 litres	5 205.6	163 687 200	~~3 180 000 000 litres~~	3 142.6	82 700 000
at farm level	261 000 litres	1.8	56 600	294 800 litres	1.9	49 700
Processing						
P1	69 636 000 kg	442.0	2 263 166	French standard cheese		
P1	64 065 000 kg	566.2	5 296 029	1 860 000 000 kg	25 291	1 757 699 869
P1+P2	64 179 000 kg	1 008.2	7 559 195			

Sources explored (coming from Ec1):

http://agriculture.gouv.fr/sites/minagri/files/documents//10-51C_Fabrication_de_fromages_2014_cle0314e5.pdf

http://draaf.bourgogne-franche-comte.agriculture.gouv.fr/IMG/pdf/FicheIGPEmmental_cle4f464e.pdf

http://draaf.bourgogne-franche-comte.agriculture.gouv.fr/IMG/pdf/RICA_cle89d3f7.pdf

2.3.6.4.2. Serbian organic raspberry

DATA CORRECTION/CONSOLIDATION

	Organic raspberries production			Raspberries (conventionally produced)		
	prod_lz	totlab_awu_l	ecopro_eur_l	prod_lz	totlab_awu_l	ecopro_eur_l
Upstream	1 809 000	145.57	2 545 172.90	63 919 000	6 828.93	80 480 838.20

Source explored: Statistical Office of the Republic of Serbia

2.3.6.4.3. Italian PDO Parmigiano Reggiano

DATA CORRECTION/CONSOLIDATION

	Parmigiano Reggiano			Counterpart		
	prod_lz	totlab_awu_l	ecopro_eur_l	prod_lz	totlab_awu_l	ecopro_eur_l
Upstream						
U3	1 533 104 215	4 916	430 254 000			2 390 043 231
U3 bis		0.07 (awu.ha-1)	438 369.07 ? (euros.ha-1)		0.06 (awu.ha-1)	5 388.24 ? (euros.ha-1)
Processing						
P1	113 349 483	1 074	14 399 044	7 088 538	145	4 998 930
P2	85 012 112	1 514	35 900 955			
P1 + P2	102 014 535	2 588	50 299 999			
Downstream						
D2	102 014 535	4 377	80 994 156			

2.3.7. Governance (So2)

2.3.7.1. Status of the indicators

This index card on value chain governance is structured around two main sub-indicators: the nature of coopetition, depending on the balance between competition and (vertical & horizontal) cooperation (see Bengtsson and Kock 2000) as well as (vertical and horizontal) asymmetries in the bargaining power at each level of the value chain. Both could be estimated

on all pilots. Yet, only the second makes sense for a reference product and can be interpreted in terms of social performance as lower asymmetries in bargaining power are associated with more balanced distributions of value generated along the supply chain (Coff 1999). As a result, only the indicator on bargaining power is retained as a systematic indicator. The former indicator on competition and cooperation is turned into a tool to describe the governance of the FQS. The use of this tool is recommended for the "governance" section of the monograph. Among other benefits, it allows qualifying and comparing the type of governance in the different pilot cases: *Comté* cheese, *Parmigiano Reggiano* cheese and *Arilje* organic raspberry (Figure 7).

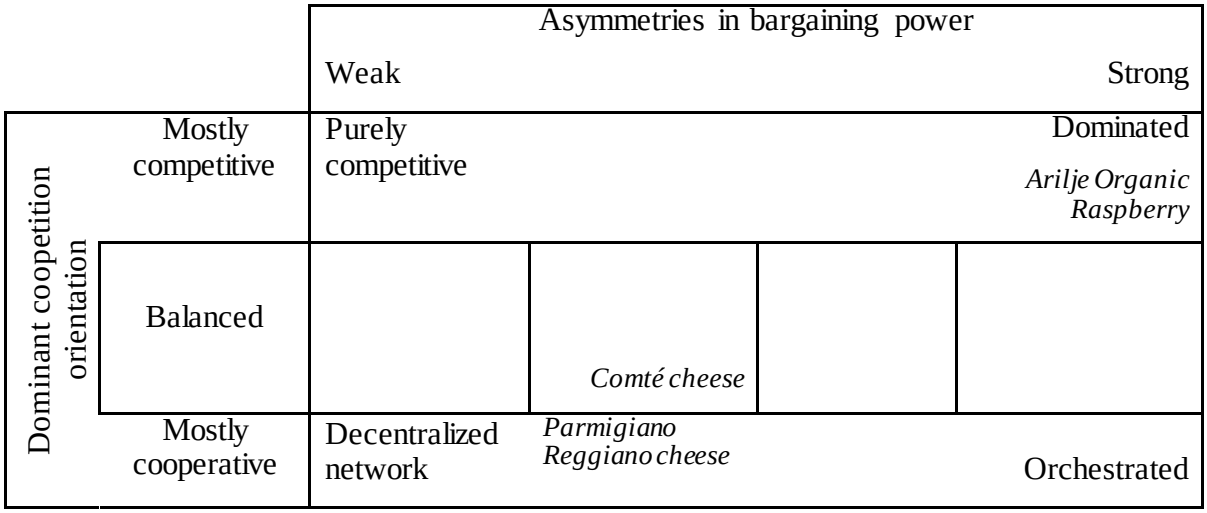


Figure 7. Qualifications of the types of value chain governance according to the value of each of the cooperation, competition and bargaining power sub-indicators.

The asymmetry in bargaining power index was computed for the *Comté* cheese, *Parmigiano Reggiano* cheese and Arilje organic raspberry supply chains. The computation of the index for the PR counterfactual was not possible, due to missing data. All in all, both *Comté* cheese, and its counterfactual and *Parmigiano Reggiano* cheese exhibit a strong balance in the distribution of bargaining power throughout the value chains, as evidenced by the low values reached by their respective indices (cf. table 6). In the Arilje organic raspberry supply chain, bargaining power is rather evenly distributed, even though the upstream level of collection benefits from a slight advantage over storage facilities. This advantage vanishes for its counterfactual.

Supply chain	Asymmetry in bargaining power index	
	Supply chain value	Counterfactual
Comté cheese	0.0055	0.008
Parmigiano Reggiano cheese	0.04	-
Arilje organic raspberry	0.08	0.02

Table 6. Values taken by the asymmetry in bargaining power index for different supply chains

2.3.7.2. Lessons learned from the pilot cases

Feedbacks from the pilot cases show that conclusions driven by the computation of the indicator are consistent with the reality of the supply chain. This is the first evidence of its relevance as a proxy. Furthermore, it adds to the existing literature on supply chain governance, which has traditionally focused on vertical relations (see e.g. Gereffi, Humphrey, and Sturgeon

2005; Sturgeon, van Biesebroeck, and Gereffi 2008), by taking into account the possibility of horizontal, *coopetitive* relations (Bengtsson and Kock, 2014, 2000). However, this indicator has to come with a caveat. Indeed, the structure of governance of supply chains is always the outcome of actors' economic actions. Its shape is therefore path- and institution-dependent (Notteboom et al., 2013). Therefore, rather than devising a performance indicator concerning governance, the choice has been made to devise a descriptive indicator aimed at categorizing supply chain governance.

Furthermore, this indicator is not free from some limitations:

First, the indicator doesn't allow grasping the peculiarities of supply chain governance. More specifically, the indicator is only designed for catching formal aspects of a supply chain's governance regime and falls short in accounting for informal aspects of governance. As pinpointed in the *Comté* case, the absence of long-term contracts between cheese manufacturers and cheese ripeners is balanced by the fact that they rely on long-standing, trusted relationships (Nooteboom, 2005). This possibility has been notably accounted for with a new definition of the prop_contract variable.

Second, the value of some variables (spec_content, spec_res) relies on experts' assessment, which entails some subjectivity. Those two remarks call for the need to confront results obtained through the computation of the index with supply chain monographies. This remark may certainly hold for most social indicators.

Third, and together with the first observation, the indicator is best suited for well-developed and structured supply chains. Besides the fact that data may be more easily accessible, they are more likely to rely on formal governance mechanisms than other supply chains.

Fourth, as shown in the case of Arilje raspberry, we were forced to consider only the level of production / collection because actors in downstream stages are only marginally involved in the supply chain. Conclusions of the governance indicator in those supply chains might therefore be less reliable.

Finally, due to the possibility of missing data for some variables, we opted for a construction of indicators based on ratios over the maximum possible value obtained through the calculus of available variables.

2.3.7.3. *Comté* cheese

This value chain has four main levels: milk production (2580 farms), milk collection, cheese manufacturing (153 *fruitières*) and cheese ripening (16 ripeners). The downstream levels of export, wholesale distribution and retailing are discarded from the analysis because *Comté* cheese represents a marginal part of their turnover and direct selling represents only a marginal share of total sellings. The dominant system of cheese manufacturing refers to that of « *fruitières* » (80% of total production), which correspond to agricultural coops. A defining characteristic of the cooperative system is that farmers are involved in *fruitières*' strategic decision making and management, thus leading us to remove them from the analysis and to focus on the production stages of cheese manufacturing and cheese ripening. Cheese manufacturers usually collect milk. Finally, only a few firms vertically integrate cheese manufacturing and ripening activities, thus leading both levels to be considered distinct.

The cheese manufacturing level can be considered as fairly competitive. Even though the number of "competing" *fruitières* is quite high (153), the level has witnessed only few entries and exits over the past years. Furthermore, they are relatively spread throughout the territory and, thanks to their dominantly cooperative status, they have developed strong local ties with

milk producers. This contributes to prevent potentially detrimental competition in milk provision. Finally, market shares are quite evenly distributed among operators.

In the meantime, operators of this level have developed strong cooperative ties at the supply chain level, as evidenced by the fact that specifications concerning this level are quite precise and put significant constraints on production (thus evidencing a capacity to find a common agreement with other operators of the supply chain). Cooperatives process most volumes and they belong to the CIGC (the interbranch union in charge of defending the product) and to the FDCL or the FNIL, which are professional unions. All in all, the coopetitive behaviour of cheese manufacturers can be qualified as predominantly cooperative, even though it leaves room for competition.

Finally, this level is characterized by average market power. Even though no operator in this level enjoys significant market share, this level significantly contributes to the differentiation potential of Comté Cheese. Moreover, their business relies on the mobilization of significant cultural and historical specific resources.

The cheese ripening level can also be considered as fairly competitive. Even though most operators are privately-owned firms, they are much fewer than cheese manufacturers, thus securing the provision of cheese. Finally the supply chain has witnessed only few entries and exits over the last years.

Besides, this level has developed fairly strong cooperative ties at the supply chain level: specifications concerning this level are quite precise and put a significant barrier to the entry of potential competitors. Furthermore, they are represented in the CIGC through the FNIL. Finally, relationships between cheese manufacturers and ripeners are confidence-based and historically embedded, thus securing commercial relations. In conclusion, as for cheese manufacturers, the behaviour of cheese ripeners can be qualified as mostly cooperative, but without excluding the possibility of adopting competitive behaviours.

Finally, ripeners enjoy strong bargaining power. Even though no operator enjoys a significant market share, this level significantly contributes to the differentiation potential of Comté Cheese. Moreover, their business relies on the mobilization of significant cultural and historical specific resources.

Summing up at the supply chain level, even though this supply chain is fairly competitive, it is also characterized by strong horizontal and vertical cooperative relations. Bargaining power is quite fairly distributed between operators, even though at the slight benefit of ripeners. It follows that this supply chain can be considered as mostly orchestrated but with room for decentralized decision-making.

2.3.7.4. Parmigiano Reggiano[4]

This supply chain has four main stages relevant to governance analysis: milk production, milk collection, cheese manufacturing and cheese ripening. As in the case of *Comté*, the downstream levels of export, wholesale distribution and retailing are discarded from the analysis because *Parmigiano Reggiano* (P-R) cheese represents a marginal part of their turnover and direct selling represents only a marginal share of total sellings.

Along those four stages, one can identify two main categories of productive actors: farms (2798 in 2015), which are in charge of producing milk and dairies (306 in 2015), which are quite

[4] The analysis is based on data for the provinces of Parma, Reggio Emilia and Modena and excludes the provinces of Mantua and Bologna.

vertically integrated because they are in charge of collecting milk and of manufacturing and ripening cheese.

The farm level can be described as fairly competitive. Even though milk production is highly fragmented (numerous producers with very low market share) and the number of milk producers decreased by 10% between 2015 and 2017, a majority are members of dairy coops (63%). By way of contrast, competitive pressure at the dairy level can be qualified as weak: they are significantly fewer than milk producers and the majority of them are coops. This status allows them to secure the provision of milk. However, the dairy business is highly fragmented and no big player has emerged.

At the same time, the supply chain shows intensive horizontal and vertical cooperation, as evidenced by the fact that specifications for the production of P-R cheese are very precise and put heavy constraints on the production process. This indicates the strong capacity of supply chain actors to successfully negotiate and implement commonly agreed production rules (Filippi and Muller, 2013). This is reinforced by the fact that 100% of processed milk has been contractualized between farmers and dairies. Besides, all dairies are members of the consortium for the protection of P-R.

Finally, the bargaining power is rather balanced between diaries and farmers. First, both categories of actors significantly contribute to the differentiation of P-R from other cheese. Furthermore, the absence of dominant players prevents any one of them from exerting significant bargaining power.

All in all, due to its strong cooperative character, combined with a relatively balanced bargaining power among players, the P-R supply chain may be qualified as a "decentralized network" type of governance, although with the slightly higher capacity of dairies to orchestrate the supply chain.

2.3.7.5. *Arilje* organic raspberry

The Arilje organic raspberry supply chain has three main stages: raspberry production and collection, their refrigeration and the downstream stage of distribution and retailing. As in the case of *Comté* and P-R cheese, the distribution stage is not taken into account because most of the selling is done by wholesalers in fruits and by general retailers. Besides, one also has to remove the refrigeration stage from the analysis because players of this stage are not specialized and *Arilje* organic raspberry only represents a marginal share of their turnover.

Raspberry production and collection is mainly operated in small-scale familial farms. This supply chain is mainly competition-based: it is highly fragmented (numerous small-scale farms without any dominant player), it doesn't show any product management consortium. Furthermore, relations with downstream levels are mainly market-based. However, farms may rely on the fact that their product is highly specific and enjoys a high reputation among consumers, thus ensuring market power on the side of farmers. Even though a more thorough analysis has been made impossible because we only got data concerning the collection stage of the supply chain, we can qualify it as dominated by farmers. A summary of these analyses is displayed in Figure 7.

2.3.8. Educational attainment (So3)

2.3.8.1. Draft results

Draft results indicate that the difference of educational attainment between the three pilots and their references is specific to each case. At the farm level we have three different models: for organic raspberry we can see a little difference between the pilot and the reference (1%), for

Parmigiano Reggiano the difference is very important and it is the reference which has a higher educational attainment, for the Comté we can see a difference and it is the pilot which has the highest educational attainment (Figure 8). At the processing level it was more difficult to collect data and it seems that data are less good quality. We can make a comparison between the pilot and their reference only for Parmigiano Reggiano and, even if the difference is less important than at the farm level, it goes in the same direction (Figure 9). These preliminary results should however be taken cautiously because we must check more precisely the nature of the reference/counterpart.

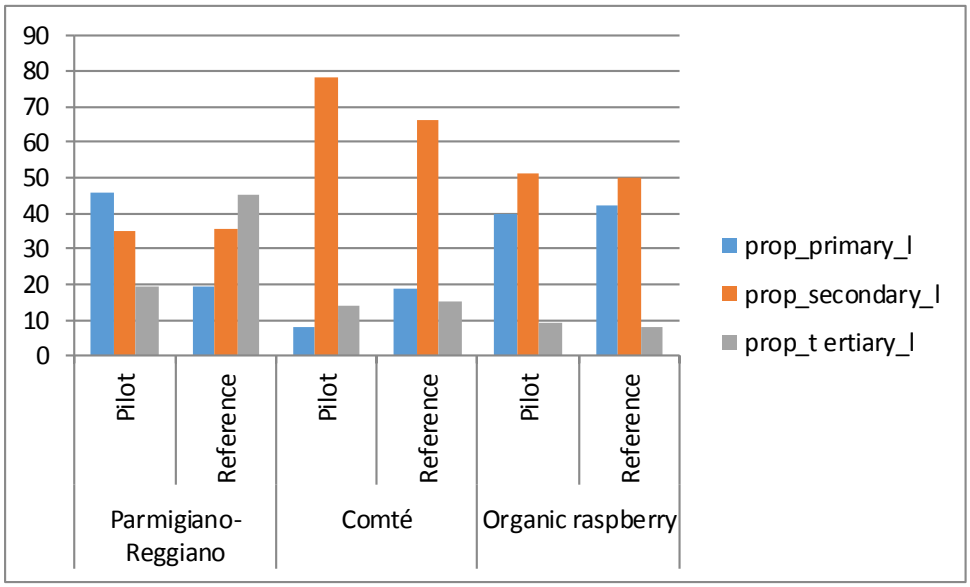


Figure 8. Educational attainment at farm level

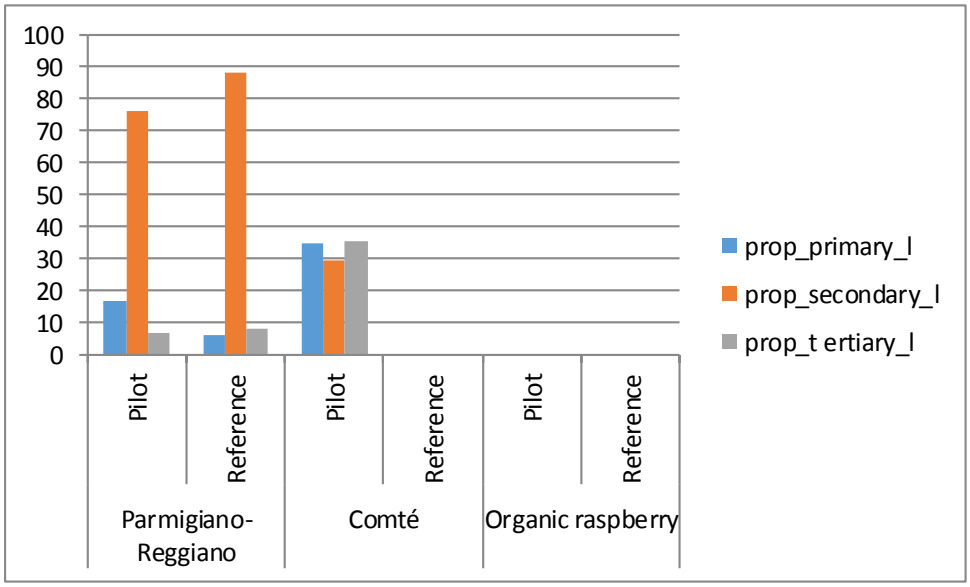


Figure 9. Educational attainment at processing level (cheese manufacture for Parmigiano Reggiano and Comté)

2.3.8.2. Lessons learnt and changes to the indicator

The main lesson learnt from the pilot is the difficulties in collecting data for the processing level. It seems easier to have these data for the farm level. The question of reference/counterpart is also difficult.

To answer the first difficulty we propose to add a second indicator based on average salary for farm and processing level. This will allow us to take account indirectly of the vocational education and the skills which are needed for workers. In this sense it will complete the educational attainment and replace it for processing level if the difficulties for collecting data are too strong. The second indicator doesn't need additional work because data are already collected. However, it needs a discussion with the people responsible for index cards Ec1 and So1 to be able to propose an appropriate method of calculation.

For the second difficulty, the best solution is to have a specific counterpart/reference but if it is too difficult we can propose more general reference which is based on the Census 2011 and EU Labour Force Survey.

2.3.9. Knowledge and know-how transmissibility (So4)

2.3.9.1. Status of the indicator

The pilot case studies were conducted to test whether it was possible to collect data easily enough before applying the methodology to all case studies planned in the Strength2Food research program. With regard to the So4 indicators, pilot cases were somehow disappointing: data collection proved difficult in most cases and the interpretation of results in terms of sustainability performance is also problematic. As a result, the So4 indicators were abandoned. Nevertheless, knowledge and know-how make a difference and appear as an underlying dimension of sustainability. Therefore, the lessons learnt from the pilots – described below – were used to provide guidance on how to discuss this topic in the monograph. The monograph outline in the Methodological Handbook may thus be revised accordingly.

2.3.9.2. Data collection

According to the framework provided by Wenger (1998), we aimed to find whether there is or is not an equilibrium between reification – the formalization of rules – and participation, in order to account for the continuity of significations and for sustainability of knowledge and know-how. But the collection of data relating to this index card remained incomplete or absent. Only reification variables were collected (number of traced data and number of audit/ton of product). Among these, only the number of traced data allowed a comparison with a counterfactual variable. It supports indeed, the hypothesis of reification, understood as a formalization process, which accompanies the production, and the processing.

Unfortunately, there is no measure of participation variable. We may approach this with the involvement in unions, but the only counterfactual here gives no evidence of an enhanced participation in a FQS initiative. Within the Wenger Frame, we have no indication of participation and there is a need to find some.

2.3.9.3. Knowledge, know-how and specifications: a qualitative approach from literature and monographs

At the same time as the collection of data, we enquired: where does knowledge and know-how stand? Especially for processed products, the specifications provide rules related to a collective discipline. The collective rules allow an organization to maintain production that may be more costly (expensive) but which can be verified and which preserves a level of quality. However,

specific knowledge and know-how remain implicit: they are mentioned but they are not described. Hereafter some illustration of this proposition:

- In the Comté monograph, from the pilot study, the aromatic richness of the Comté is related, inter-alia, to the know-how of master cheese makers and ripeners, who adapt their manufacturing technique to the milk they receive. Also from the Comté case study, interviews pointed to knowledge that was difficult to transmit. A cheese ripener, when interviewed, said it takes five years of training to become a ripener cellar master.

- According to the Comté specification: *The notation of the grinding wheels by the ripener and of the portions by the pre-packer, is carried out under their own responsibility, according to a rating scale of qualitative criteria. The Cheeses which no longer comply with the definition or the quality criteria can't be marketed under the designation of origin "Comté"*.

- According to the Parmigiano Reggiano specification: "*For anything not directly provided for herein, reference is made to the practices set by fair and constant local usages*" and : "*Before affixing the grade selection marks, each single wheel of Parmigiano Reggiano cheese shall be inspected by a Committee appointed by the Consortium, consisting of experts on the relevant list that is kept by the Consortium and communicated to the Control Body*".

For the two cheeses benefiting a PDO, knowledge and know-how appear related with the ability to recognize the expected taste and with the ability to manage the manufacturing and ripening, in order to reach this expected taste. And this becomes a strategic challenge, if we follow the works of Caciatori and Jacobides (2005; 2006) who find that in a value chain, the one who mastered the quality recovers the value. About Comté cheese, Jeanneaux et al, (2009) noted a shift in the production of differentiation of Comté. In the eighties, differentiation would rely on the empirical know-how of cheese makers (the taste would result from various intrinsic characteristics resulting from the place, the manufacturers and the know-how of ripeners, these aspects altogether leading to the idea of developing some local criteria of differentiation, subdividing the denomination area for instance); while in the 2010s, a banalization of the cheese making know-how was achieved, and the ripeners have taken over, by promoting two ways of valuing Comté. First: ageing of the cheese became a criterion of quality, controlled by ripeners; second, the initiation, followed by a marked development of the pre-sliced and packed Comté, promoted the "deregionalization of the sales" generating a rise of the volumes of marketed Comté[5] (ibid). This second way also promoted the power of ripeners, managing the non-refined wheels, choosing those that are flawless to be sold on a large scale. We find that some specific Know-how has moved from one player to another, and this might have an impact on sustainability of the Food quality scheme.

Regarding Arilje Organic Raspberries, a need of know-how is implied in two ways. First, upstream, the monograph underlines a need for the supply of good quality seedlings. Second, downstream, the need of Knowledge and know-how stands in the social field: the monograph ends explaining that "there exist a limited number of organizations/cooperatives that can help farms to sell their raspberries at wholesale/green markets. The Federation of Associations of raspberry producers of Western Serbia exists from 2012. Its goals are a single purchase price on the whole territory of Serbia, construction of cold storages in municipalities where they do not exist, the direct contacts of this organization with foreign buyers and lobbying for the state subsidies." The know-how for sustainability is getting built, and relies on social organization.

[5] from 1990 to 2011 Comté marketed in this form rose from 20% to 60% of the sales, which is a rise of more than 25 000 t.

2.3.9.4. Some leads to address this issue of knowledge transmissibility

- Following the rate of manufacturers becoming directly managed by cooperators

Within the Wenger frame comparing reification and participation, literature available like the one cited (on Comté) can help. Jeanneaux et al (2009) point out that in parallel with the shift in the criteria for differentiation of the Comté, there has been a movement of disengagement of farmers from cheese processing. The producers initially involved in the management of cheese manufacturing have therefore gradually withdrawn. Now, the way in which cheese manufacturers are managed is indicative of the implication of the members of the cooperative (i.e their participation). In that way, we could follow the rate of manufacturers becoming directly managed by cooperators or indirectly managed through subcontracting. The indication of a trend of participation would result from the comparison between two dates.

- Follow the evolution of the specifications

We might track changes in specifications revealing the livelihood of the FQS and indirectly its transmissibility. For instance, the Evolution of specifications traced in the *Door* data base shows that since 1996, the date of registration of these PDOs, specifications of both were amended twice.

Comté cheese : 14/03/2014 and 13/02/2015

Parmigiano Reggiano : 05/09/2003 and 08/08/2011

- Tracking actual transmission of knowledge and know-how

It was suggested by the students who conducted the pilot case on Comté Cheese (at the processing level), to look at the number of apprentices compared to the size of the FQS consortium, (a kind of equivalent upstream, could be the number of new farmers compared to the total number of farmer members) in order to produce a ratio to be compared with the conventional sector. This would be an actual measure of transmission.

2.3.10. Age and gender balance (So5)

2.3.10.1. Italian PDO Cheese: Parmigiano Reggiano

2.3.10.1.1. Milk producers

The first supply chain stage considers the dairy farmers. For both the PDO and the Reference product data were retrieved from the FADN database. This allows for specifying which farmer produces milk destined to the Parmigiano Reggiano (P-R), as the Code of Practice (CoP) specifies a different (and strict) feeding regime. While the Generational Change (GC) indicator resulted in the same value for both production schemes, the Gender Equality Index (GE) reports a substantial difference between the two (Table 7. Age and gender equality in Parmigiano Reggiano and its reference (milk producers)

). Lower values indicate more equality. The main differences lie in the female ratio with a secondary education and female's entrepreneurship. In the P-R case, the level of women education is half that of men, whereas the reference – generic industrial cheese – presents a different figure. In the latter, the proportion of women with a secondary education diploma was threefold that of the men. Moreover, female entrepreneurship in the non-FQS reference was double that of the P-R case. Finally, the GE value for the P-R was double that of the non-FQS reference, meaning that regarding this agricultural stage the PDO scheme provided half the gender balance of its counterpart.

Italy - PDO Parmigiano Reggiano Cheese		Italy - Generic Industrial Cheese	
Supply chain stage: P-R Milk Producers		Supply chain stage: Generic Milk Producers	
Indicator	Value	Indicator	Value
Generational change	33%	Generational change	33%
Gender equality index	0.81	Gender equality index	0.37

Table 7. Age and gender equality in Parmigiano Reggiano and its reference (milk producers)

2.3.10.1.2. The Cheese Producers

Regarding P-R, the GC index reflects a more dynamic picture in which the share of the youngest workforce is slightly smaller than the oldest. For the counterpart, otherwise, experienced workers were almost double the youngest (Table 8. Age and gender equality in Parmigiano Reggiano and its reference (cheese producers)

).

Looking at the GE index, the figure is much the same as in the upper level: the P-R reflects a much more inequal situation, consequence of a low female entrepreneurship.

Italy - PDO Parmigiano Reggiano Cheese		Italy - Generic Industrial Cheese	
Supply chain stage: P-R Producers		Supply chain stage: Industrial Cheese Producers	
Indicator	Value	Indicator	Value
Generational change	79%	Generational change	79%
Gender equality index	0.66	Gender equality index	0.26

Table 8. Age and gender equality in Parmigiano Reggiano and its reference (cheese producers)

2.3.10.1.3. The Cheese Ripeners

This stage refers to the PDO production only, since in the industrial cheese production the ripening phase is carried out within the same firm's facilities, though it does not involve a new stage represented by different actors. Nevertheless, we reported in Table 9 the results for this particular stage as it could be useful in comparison with other PDO cheeses. Moreover, we accounted for these values in the average calculations (see section 2.3.10.2.2).

Italy - PDO Parmigiano Reggiano Cheese	
Supply chain stage: P-R Ripeners	
Indicator	Value
Generational change	55%
Gender equality index	0.39

Table 9. Age and gender equality in Parmigiano Reggiano (cheese ripeners)

2.3.10.1.4. Conclusions and comments on Parmigiano Reggiano

On average, while the P-R SC reflects a more dynamic GC, it is largely unequal when compared with its counterpart; indeed, it is double the counterpart's GE value.

We did not include the results for the Distribution stage as this would have been the same value for both products. The P-R, as its industrial counterpart, is broadly sold through modern distribution channels (hyper, super, discounts) and only 2% of total P-R sales go through the

direct-sale channel (i.e. directly sold by cheese manufacturers in facilities nearby the production site).

2.3.10.2. French PDO Cheese: Comté

2.3.10.2.1. The Milk Producers

Comparing the GC index, this was more dynamic for the Comté SC. Moreover, the value of the GE index is lower than its reference, pointing to more gender equality regarding this specific SC stage.

France - PDO Comté Cheese		France - Industrial Cheese	
Supply chain stage: Comté Milk Producers		Supply chain stage: Generic Milk Producers	
Indicator	Value	Indicator	Value
Generational change	45%	Generational change	34%
Gender equality index	0.16	Gender equality index	0.20

Table 10. Age and gender equality in Comté Cheese and its reference (milk producers)

2.3.10.2.2. The Cheese Producers

Again, the GC indicator shows a much more dynamic behaviour of the Comté Producers, despite the high value its reference presents. This highlights the high share of the young labour force. However, when looking at the GE indicator, while the industrial cheese SC shows a very high gender equality, the Comté value reflects an opposite situation. The latter seems to be caused by the extremely low female entrepreneurship and the far lower value for women's education.

France - PDO Comté Cheese		France - Industrial Cheese	
Supply chain stage: Comté Producers		Supply chain stage: Industrial Cheese Producers	
Indicator	Value	Indicator	Value
Generational change	91%	Generational change	65%
Gender equality index	0.77	Gender equality index	0.04

Table 11. Age and gender equality in Comté Cheese (cheese producers)

2.3.10.2.3. Cheese Ripeners

Data were not available at the counterpart level, since this step, as mentioned in the P-R case, characterizes the PDO-SC only. The GC value is the same we found in the Producers level, as the value used was the same. On the other hand, the GE index presents a much lower value, pointing to a greater equality in this step of the Comté SC.

France - PDO Comté Cheese	
Supply chain stage: Comté Ripeners	
Indicator	Value
Generational change	91%
Gender equality index	0.39

Table 12. Age and gender equality in Comté Cheese (cheese ripeners)

2.3.10.2.4. Conclusions and Comments

Generally speaking, the Comté SC shows more dynamicity when one compares the GC values for all the steps considered. This may reflect a younger SC. On the other hand, with the

exception of the agricultural stage (where the difference between the two GE values is quite small), the GE values show the industrial cheese industry relying on greater equality between genders. This situation reflects what we described for the Parmigiano Reggiano case.

2.3.10.3. Serbian Arilje Organic Raspberry

2.3.10.3.1. The Small Producers

Albeit the GC index indicates a more dynamic Organic SC, both values are tremendously low, showing the lion share of the workforce is elderly (Table 13). Regarding the GE index, the difference between the two production schemes is negligible, and both rely on a good gender-equal agricultural stage.

Serbia - Arilje Organic Raspberry		**Serbia - Generic Raspberries**	
Supply chain stage: Organic Raspberry Producers		Supply chain stage: Generic Raspberry Producers	
Indicator	Value	Indicator	Value
Generational change	13%	Generational change	10%
GE	0.24	GE	0.21

Table 13. Age and gender equality in Serbian organic raspberries and its reference (farmers)

Appendix 2.1

Economic Indicators

Sylvette Monier-Dilhan (coordinator)

French PDO cheese: Comté

Elise Maigné, Sylvette Monier-Dilhan, Thomas Poméon
Remi Courbou, Lisa Delesse, Elisa Husson, Amaury Paget, Emilie Toque

Italian PDO cheese: Parmigiano-Reggiano

Federico Antonioli, Filippo Arfini, Michele Donati, Mario Veneziani

Serbian organic raspberry

Jelena Filipović, Bojan Ristic, Žaklina Stojanović

In part 1, for each case study, descriptive statistics are given followed by economic indicators. In part 2, we provide more details on the variables used to calculate the indicators. Figures for labeled products (PDO, organic) are shown in green. The economic indicators are summarized in section 2.3.1.

1. Indicators

1.1. French PDO cheese: Comté

French PDO cheese: Comté							
	Upstream		Processing			Downstream	
	PDO	*Standard	PDO P1	PDO P2	**Standard	PDO	**Standard
Production	2014		2015		2014	2014	
	645 106 litres	3,180 10^6 litres	69,636 10^3 kg	64,065 10^3 kg	265,000 10^3 kg	54,257 10^3 kg	265,000 10^3 kg
Turnover 10^3 €	2010-2011-2012		2015		2014		
	309,000	1,183,000	452,633	504,384	1,220,000		

Some descriptive variables

*At upstream level, standard = Franche-Comté standard milk
** At processing level and downstream level, standard= Emmental

French PDO cheese: Comté			
Indicators	Upstream	Processing	Downstream

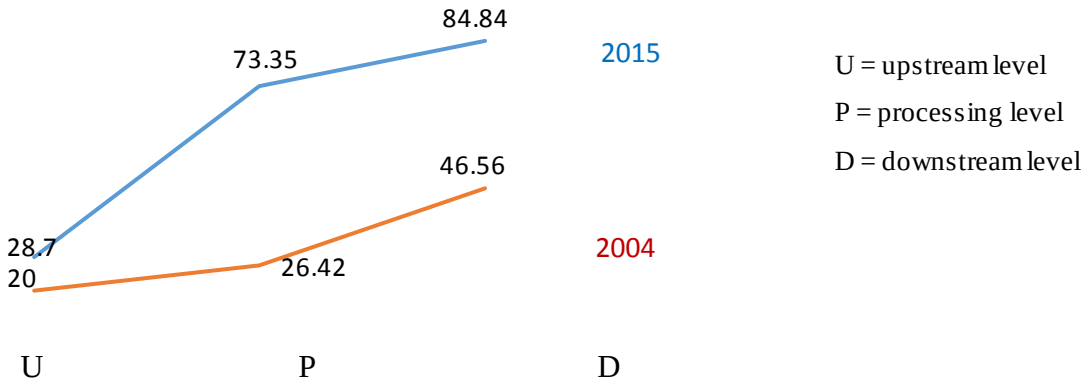
	PDO	*Standard	PDO		**Standard	PDO	**Standard
Price Premium	2014		2015			2014	
	28.76%		73.35%			84.84%	
Profitability	2010-2011-2012		P1 2015	P2 2015	2014		2O14
Gross value added	*34.7%*	*27.5%*	no	no	no	no	no
% turnover	*55.4%*	*47.4%*	no	no	12 %	no	31%
Gross operating margin	32.6%	*24.8%*	0.5%	1%	no	no	no
% turnover	517,063,800		2,263,166	5,296,029			
Net result							
% turnover							
Euros							
Internat. trade (volume)						2015	
Europe	/	/	/		/	*6 .8%*	*11 .8%*
Outside Europe	/	/	/		/	*1 .6%*	*2 .2%*

Economic Indicators

*At upstream level, standard = Franche-Comté standard milk

** At processing level and downstream level, standard= Emmental

The **price premium** increases throughout the chain, with a large gap between upstream level and processing level. This feature has been reinforced between 2004 and 2015. Note that at downstream level, only domestic prices are taken into account.



Price premium (%) at each level for the years 2004 and 2015

At upstream level, **profitability indicators** are calculated at farm level from the management accounts of dairy farms located in the Franche Comté area. At this level **profitability** is better for PDO cheese than standard cheese. This result concerns farms located in Franche Comté. For farms of PDO sector, 75% of the turnovers come from milk, compared to 50% for farms in the standard sector. Farms in PDO sector have lower cost for (1) Seeds, seedlings, (2) fertilizer, amendment, and to a lesser extent for fuels.

The international market for Comté and Emmental is the European one, with prevalence for Emmental.

1.2. Italian PDO cheese: Parmigiano-Reggiano

Italian PDO cheese: Parmigiano-Reggiano							
	Upstream		Processing			Downstream	
	PDO	Standard	PDO P1	PDO P2	Standard	PDO	Standard
Product 10^3 kg	2014						
	1,533,104		113,349.5	85,012		GDO: 102,014.5 Direct sales: 1,927 Export: 24,143.5	
Turnover 10^3 €	2010-2011-2012		2015		2014		
	783,397	4,636,546	1,008,923.7	1,009,944	113,771	GDO: 1,745,582 Direct sales: 30,831 Export: 952,135.6	

Some descriptive variables

Italian PDO cheese: Parmigiano-Reggiano						
Indicators	Upstream		Processing		Downstream	
	PDO	Standard	PDO	Standard	PDO	Standard
Price Premium	2014				2016	
	6 %		no		19 %	
Profitability	2014	2014	2014	2016	2014	2016
Net result % turnover	55%	55%	P1: 1.4% P2: 3.5%	7%	4.6%	n.a.
euros	430,254,000€	2,558,457,544€	P1: 14,399,044€ P2: 35,900,955€	7,859,937€		
Internat. trade					2014	
Kg	/	/	/	/	18.8%	n.a.
euros	/	/	/	/	31.8%	n.a.

Economic Indicators

It may be assumed that the **price premium** increases throughout the chain. Note that the downstream price takes into account the international price (twice the internal price).The markup is much smaller than in the French cheese case.

The **profitability** is the highest at upstream level. At upstream level, the ratio net result/turnover is identical for PDO cheese (Parmigiano-Reggiano) and counterpart product. This is another difference with the French case.

International trade represents 19% of the quantities and 32% of the turnover.

1.3. Serbian organic raspberry

	Upstream		Processing		Downstream	
	Organic	Conventional	Organic	Conventional	Organic	Conventional
	2015					
Production 10^3 kg	1,809	63,919				
	2015					
Turnover 10^3 €	3,618	106,105.5	4,372	144,463.3	/	/

Some descriptive variables

Serbian organic raspberry						
Indicators	Upstream		Processing		Downstream	
	Organic	Conventional	Organic	Conventional	Organic	Conventional
Price Premium	2015		2015		2015	
	20.5 %		6.9 %		20.1 % (export price)	
Profitability (% turnover)	2015					
Gross value added	84%	80%				
Gross operating margin	80.6%	75%	n.a.	n.a.	n.a.	n.a.
Net result (without other operating income)	70%	59%	n.a.	n.a.	n.a.	n.a.
Net result	n.a.	61%	n.a.	n.a.	n.a.	n.a.
Internat. Trade (volume)					2015	
	/	/	/	/		

Europe Outside Europe	/	/	/	/	*97%*	*87.3%* *12.7%*

Economic Indicators

The **price premium** is U-shaped, with a common value (around 20%) at upstream level and downstream level.

At upstream level **profitability** of organic product is higher than profitability of conventional product. In both cases the ratio margin/turnover is high.

Serbian raspberry are intended for **export**, whether organic or conventional raspberries.

2. Data

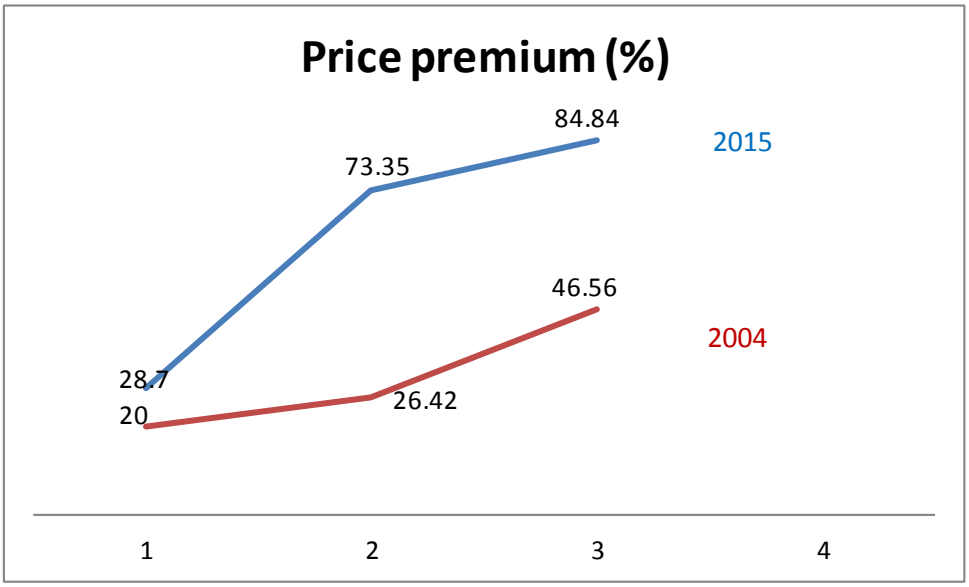
2.1. French PDO cheese: Comté

2.1.1. Price Premium

$$\text{Price Premium} = \frac{\text{Price FQS} - \text{Price Benchmark}}{\text{Price Benchmark}}$$

Year	Price		Price premium
	Comté	Emmental	
Upstream (€/ *litre*)			
2014	0.479	0.372	28.76 %
2004	0.36	0.3	20.00 %
Processing (€/ *kg*)			
2015	7.87	4.54	73.35 %
2004	5.55	4.39	26.42 %
Downstream (€/ kg)			
2014	13.53	7.32	84.84 %
2003	9 .6	6.55	46.56 %

Price premium



Price premium evolution 2004/2015

2.1.2. Production

	Comté	Emmental
Upstream	2015/16 : 650 millions L (expert) 2014* : 645 millions L 2014/15 : 638 millions L (expert)	2014 : 3,180 millions L (265,000 t *12)
Processing	P1 2015 : 69,636 tonnes de fromage en blanc (expert) P2 2015 : 64,065 tonnes (expert) 2014 : 64,179 tonnes de Comté (*http://www.comte.com/decouvrir/economie-les-marches-du-comte/le-marche-du-comte.html*)	2014 : 265,000 tonnes *(Panorama des IAA 2014 http://agriculture.gouv.fr/panorama-des-iaa-fabrication-de-produits-laitiers Fabrication de produits laitiers 2014, p34)*
Downstream	2014 : 54,257 tonnes (*http://www.comte.com/decouvrir/economie-les-marches-du-comte/le-marche-du-comte.html*)	2014 : 265,000 tonnes

Production

***2014 : Agreste Franche comté, les chiffres du lait : 62,299t soit 96 .6% p° France = 64,492 t (value from students = 64,179 t) = 641,790 000 litres.
http://agreste.agriculture.gouv.fr/IMG/pdf/R4316A01.pdf (page 41), soit 645 millions litres

****650 millions L** transformés en Comté (2015/16) (sur 700 millions L produits dans la zone AOP Comté)

2.1.3. Turnover

	Comté	Emmental	Lait France entière
Upstream	2015/16 : 650 millions L 2014 : 645 millions L 2014/15 : 638 millions L 2014 : 0.479 € * 645 10^6 litres = 309 10^6 € * cow milk gross product = 123 .9 10^3 € (2892 farms in Franche Comté, that is 96.6% =>2994 'Comté' farms)	2014 : 0.372 € * 3 180 10^6 litres = 1,183 10^6 € * cow milk gross product = 102 10^3 € (1654 expl in Franche Comté)	
	*Production net of livestock purchases 172.7 10^3 €/**farm** Turnover =172.7 10^3 € * 2994 = 517,063,800 €	* Production net of livestock purchases (standard milk sector in Franche Comté) 200.9 10^3 €/**farm** Turnover =200.9 10^3 €* 1,654 = 332,288,600 €	* Production net of livestock purchases 227.4 10^3 €/**farm** **Turnover =227 .4 10^3 € * 72,143 = 16,405,318,200 €
Processing	P1 : 2015 452,633,10^3 € P2 :2015 504,384 10^3 €	2014 : 1,220 10^6 €	
Downstream			

***** *http://draaf.bourgogne-franche-comte.agriculture.gouv.fr/IMG/pdf/RICA_cle89d3f7.pdf*
** This calculation includes milk produced for other PDO.

Turnover

At upstream level, Comté turnover accounts for 3.2 % of total milk turnover.

2.1.4. Costs

a. Upstream (at farm level)

Costs 2010-2011-2012	Upstream		
	Comté	Franche-Comté standard milk sector	France
-Animal feed	- 27,400 €	- 27,650 €*	-89,000 €
-Fertilizer, amendment	- 8,400 €	- 12,600 €	
-Seeds, seedlings, phyto	- 4,900 €	- 13,600 €	
-Fuels, lubricants	- 5,900 €	- 8,700 €	
-Veterinary charges,	- 4,000 €	- 3,700 €	
-Other operating expenses	- 49,300 €	- 66,650 €	- 60,200 €
-Rent, tenant-farming	- 12,800 €	- 13,200 €	- 13,300 €
(sub-total 1)	*(- 112,700 €)*	*(- 146,100 €)*	*(-162,500 €)*
-Taxes and other dues	- 1,700 €	- 2,000 €	- 2,100 €
-Wages paid	- 2,400 €	- 2,600 €	- 4,600 €
+Subsidies and insurance indemnities	+ 39,700 €	+ 44,600 €	+ 42,100 €
(sub-total 2)	*(+ 35,600 €)*	*(+ 40,000 €)*	*(+ 35,400 €)*
-Provisions for depreciation	- 35,400 €	- 40,200 €	- 39,200 €
-Financial charges	- 4,600 €	- 5,500 €	- 7,300 €
+other operating income	+ 200 €	+ 200 €	+ 300 €
+financial products	+ 300 €	+ 500 €	+ 700 €
(sub-total 3)	*(- 39,500 €)*	*(- 45,000 €)*	*(- 47,500 €)*
Total costs/farm (2010-2011-2012)	**116,600** €	**151,100** €	**227,400** €

Mean 2010-2011-2012

Source: Agreste Franche Comté n°201- avril 2015

http://draaf.bourgogne-franche-comte.agriculture.gouv.fr/IMG/pdf/RICA_cle89d3f7.pdf

b. Processing : Comté

2015	P1	P2
Total Charges	450,369,986	499,087,716
Wages	27,485,101	19,754,189

Source: Diane

Margin

a. Upstream

At farm level

2010-2011-2012	Upstream		
	Comté	Franche-Comté standard milk sector	France
Gross value added	*60,000*	*54,800*	
Gross Operating Margin	*95,600*	*94,800*	
Net Margin	*56,600*	*49,800*	*54,700*

Margin

At global level

2010-2011-2012	Upstream		
	Comté	Franche-Comté standard milk sector	France
Net Margin	*56,600*2,994= 169,460,400*	*49,800*1,653=82,319,400*	*54,700*72,143= 3,946,222,100*

Margin

Comment: At upstream level, Comté turnover accounts for 3.2 % of total milk turnover. At the same level Comté net margin is 4.3% of global France milk sector.

b. Processing : Comté

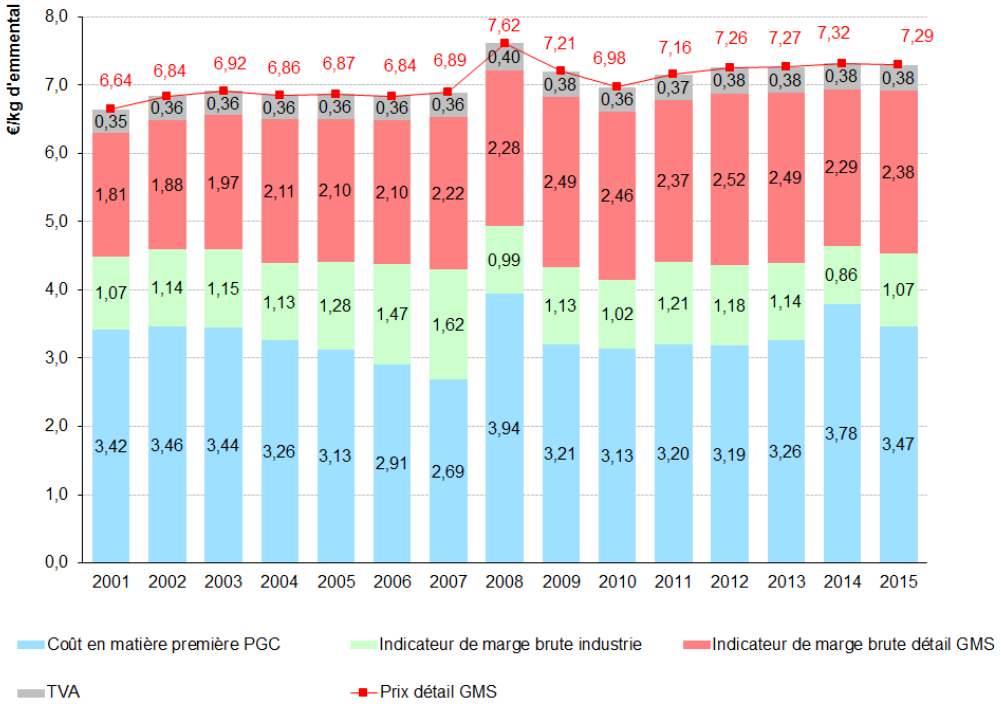
2015	P1	P2
Turnover	452,633,152	504,383,745
Total Charges	450,369,986	499,087,716
Net margin	2,263,166	5,296,029

Source: Diane

Emmental: Gross margin processing and downstream levels (https://observatoire-prixmarges.franceagrimer.fr/resultats/Pages/ResultatsFilieres.aspx?idfiliere=6&sousmenuid=594&type=Tableau)

Emmental 2014:
Gross margin processing:
0.865 € /kg
12 % retail price
Gross margin downstream:
2.29 € /kg

31.3 % retail price



2.1.5. International trade

	Comté		Emmental	
	kg	%	kg	%
Export Europe (kg) 2015	3,715.6 10^3	**6.8 %* (=3 715 .6/54,257)	31,186.8 10^3	*11.8 %* (31,186.8 /265,000)
Hors Europe (2015)	861.6 10^3	**1.6 %* (= 861.6 /54 2,57)	5 852 .2 10^3	*2 .2 %* (5,852.2 /265,000)

International trade

* % with respect to total production 2014

2.1. Italian PDO cheese: Parmigiano-Reggiano

2.2.1. Price Premium

Level	Year	Price		Price premium
		Parmigiano-Reggiano	Benchmark	
Upstream (€/ *litre)*				
	2014	0.4868	0.4593	6 %
Processing (€/ *kg)*				
P1	2016	8 .8		
P2	2016	9.9		
Downstream (€/ *kg)*				
GDO (77%)	2016	20	16.05	19 %
Direct sales (2%)	2016	16		
Interior price (97.47% * 20 + 2.53% * 16)	2016	19.89		
Foreign countries (21%)	2016	40		

Price premium

2.2.2. Production

	Parmigiano-Reggiano (kg)	Benchmark (kg)
U3		
Total Produced Milk for P-R	1,533,104,215 (2014)	
Processing P1		
Total Labelled Kg of Cheese	113,349,483 (2014)	7,088,538 (2016)
Processing P2		
Total Kg of Cheese sold to P2	85,012,112 (2014)	
Downstream		
GDO	102,014,535	

Total Kg of Labelled Cheese sold in	(2014)	
Direct sales Total Kg of Labelled Cheese sold directly within the zone of prod	1,926,941 (2014)	
Foreign countries Total Kg of Labelled Cheese sold outside Italy	24,143,440 (2014)	

Production

2.2.3. Turnover

	Parmigiano-Reggiano (euros)	Benchmark (euros)
Upstream U3	(2014) 783,396,791	4,636,546,210
Processing P1 P2	(2014) 1,008,923,748 1,009,943,893	(2016) 113,771,036
Downstream GDO Direct sales Foreign countries	(2014) 1,745,582,038 30,831,059 952,135,657	

Turnover

2.2.4. Costs

Costs			Parmigiano-Reggiano (euros)	Benchmark (euros)
Upstream U3				
inter_ cons_l	Total intermediate consumption	Total Cost of Production for Milk destined to P-R - Cost of Labor	(2014) 339,052,162	2,156,086,564

wages_l	Sum of wages paid for family workers and employees …	Average Labor Cost per 100kg of produced milk *total milk p°	(2014) 65,174,116	298,077,330
subsid	Farm subsidies	Total Milk production *Subsidies €/t (34 €/t)	(2014) 51,083,487	376,075,228
Processing P1				
inter_ cons_l	Total intermediate consumption …	Total Cost of Production for P-R - Cost of Labor	897,325,897 (2014)	96,847,710 (2016)
wages_l	Sum of wages paid for family workers and employees …	Average Labor Cost per 100kg of processed milk *total milk processed	97,198,807 (2014)	9,063,389 (2016)
Processing P2				
inter_ cons_l	Total intermediate consumption …	Total Cost of Production for Storage&Ageing - Cost of Labor	(2014) 963,551,764	
wages_l	Sum of wages paid for family workers and employees …	Average Labor Cost per tonne of P-R * total tonnes of Aged P-R in P2 level	(2014) 10,491,175	
Downstream				
inter_ cons_l	Total intermediate consumption …	[(Total Costs - Labor Cost)/Revenues Esselunga] *Total P-R GDO Revenues	(2016) 1,536,240	
wages_l	Sum of wages paid for family workers and employees …	Revenues by worker/Total P-R GDO Revenues]* Average Labor Cost for Worker	(2016) 128,347,586	

Costs

2.2.5. Margin

	Parmigiano-Reggiano (euros)	Benchmark (euros)
Upstream U3	*(2014)* 430,254,000	(2014) 2,558,457,544
Processing P1 P2	(2014) 14,399,044 € 35,900,955 €	(2016) 7,859,937 €
Downstream GDO Direct sales Foreign countries	(2016) 80,994,156 €	

Net margin

2.2.6. International trade

	Parmigiano-Reggiano		Benchmark	
Export	(2014)			
Kg	24,143,440	18.8 %		
€	*96,573,760	31.8 %		

International trade

*export value= Quantities 2014 * Prices 2016 (If price ratios are the same in 2014 as in 2016, it is ok)

2.3. Serbian organic raspberry : arilje raspberries

2.3.1. Price Premium

Level	Price		Price premium
2015	Organic	Conventional	
Collection (€/ *kg)*	2	1.66	20.5 %
Processing (€/ *kg)*	2.49	2.33	6.9 %
Downstream (€/ *kg)*			
Europe countries	3.70	3.08	20.1 %

Price premium

2.3.2. Production

2015	Organic	Conventional
Collection	1,809,000	63,919,000

Production

2.3.3. Turnover

	Organic	Conventional
Collection	3,618,000	106,105,540
Processing	4,372,069	144,463,332

Turnover

2.3.4. Costs

a. Collection

Costs 2015		
	Organic	Conventional
inter_ cons_l	108,540	3,183,166
wages_l	507,442	17,775,616
+ subsid	49,832	1,851,792
tenant-farming	0	1,949,255
(sub-total 1)	*(566,150)*	*(21,056,245)*
Insurance paid	108,540	3,183,166
Social security costs of the owner to be paid	28,121	328,356
(sub-total 2)	*(136,661)*	*(5,460,777)*
Provisions for depreciation	184,934	5,423,587
Financial charges	185,082	5,427,924
+other operating income	?	1,052,597
(sub-total 3, without other operating income)	(370,016)	(16,312,288)

Costs

2.3.5. Margin

a. Collection

Margin 2015		
	Organic	Conventional
Gross value added	3,051,850	85,049,295
Gross Operating Margin	2,915,189	79,588,518
Net Margin (without taking account for other operating income)	2,545,173	63,276,230 64,328,827

Margin

2.3.6. International trade

2015	Organic		Conventional	
		%		%
Export Europe kg Euros	1,754,730 6,485,482	*97 %*	55,801,287 171,867,964	87.3 %
Extra Europe kg Euros	0 O	/ /	8,117,713 19,096,440	12.7%

International trade

3. RESULTS AND LESSONS FROM WP6 PILOT CASE: COUNTY DURHAM SCHOOL MEALS

3.1. Key results & methodological lessons learned

This pilot study investigated the environmental, economic, social and nutritional impacts of the primary school meals service in County Durham, north east England. Environmental impacts (CO_2 emissions) were assessed by comparing the procurement channels to two schools: VillageSchool (representing LOC/ORG model) and TownSchool (representing mainstream counterpart). Results show that having a LOC/ORG model alone does not reduce carbon emissions, for two main reasons. First, the great majority of total emissions are due to meat production and processing rather than downstream transportation, therefore LOC/ORG models supplying high volumes of meat have little impact on emissions. Second, LOC models do not reduce transport-related carbon emissions if logistics are not well coordinated. To assess economic impacts, we analysed LM3 of the total Durham school meals service, finding that for every £1 spent by the local Council and parents/carers on school meals, £1.50 is retained within the local economy: a high return. To assess social impacts, we explored skills development, working environment and connectedness of supply chain actors, finding a high degree of commitment to training and good relations between actors in the chain. Overall therefore, the pilot study finds that LOC/ORG procurement models can have sustainability benefits in terms of local economic multiplier effects and social impacts, but to reduce carbon emissions, the focus should be on reducing meat in menus, and encouraging efficient, well-coordinated logistics.

Overall we found that the general methodological approach for WP6 is sound. The adjustments to the Methodological Handbook include (i) in case selection, aiming for reasonable commonality across schools in terms of geographic location and deprivation profile (ii) in carbon footprint analysis, conducting 'sense-checking' process of results from two different sets of emissions factors (iii) in economic analysis, using estimates of commercially sensitive information (turnovers, expenditures) from published sources where these are not obtainable from interviewees, (iv) to pursue a targeted sampling approach in the plate waste/nutritional analysis, in order to manage the data collection burden for partners.

3.2. Introduction & case monograph

3.2.1. Methodology of this pilot study

This report presents the methods and results of the WP6 pilot study, on the impacts of public sector food procurement. The study was conducted in County Durham, a region in the north east of 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. 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.

The methodological approach of WP6 is to identify, and compare, a LOC/ORG procurement model with a LOW model, in terms of environmental, economic, social and nutritional impacts. For the purposes of this pilot study, we selected the procurement chains of two schools in County Durham to examine in-depth: one which has a very high LOC/ORG status ("VillageSchool"), and one with a procurement profile more typical of schools generally within the county ("TownSchool"). In this report, we compare the environmental and nutritional impacts of these two procurement chains, whilst presenting the results of economic and social analysis at the whole county level.

The fieldwork for the 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. There were three main components. First, we undertook face-to-face interviews with a total of 11 informants, including from the LA and main catering firm supplying meals, wholesaler managers, farmer/processors, school headteachers and kitchen staff (Table 14). These interviews provided the main sources of information about economic and social impacts of the school meals chains, and, to some extent, environmental and nutritional impacts. Interviews also allowed us to understand better the relationships between actors in the chains and how the systems generally worked. Second, we undertook a plate waste study following guidelines provided by ZAG (details given in Chapter 5), which gave us data to explore nutritional impacts. Finally we 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. Overall, we spent approximately 4 person months and £2,000 in the process of undertaking this pilot study.

The remainder of this Chapter describes the geographic and socio-economic profile of County Durham, the arrangements and practice of the school meals service. It also gives an explanation of the shape of the supply chain and the key actors involved in delivering to VillageSchool and TownSchool, respectively.

Identity	Interview Date & Duration
LA Procurement Officer and Catering Responsible	15-11-16, 2hrs
General Manager, 'SchoolCater' (catering firm currently holding school meals contract)	17-01-17, 2hrs
Headteacher, 'VillageSchool' Primary School	18-01-17, 2hrs
Catering Supervisor, 'VillageSchool' Primary School and Area Manager, SchoolCater	18-01-17, 0.5hrs
Headteacher, 'TownSchool' Primary School	19-01-17, 0.5hrs
Catering Supervisor, 'TownSchool' Primary School	19-01-17, 0.5hrs
Manager, 'FreshGrocer' (wholesaler currently supplying fruit, vegetables, eggs and milk to schools)	01-02-17, 2hrs
Manager, 'FreshMeat' (wholesaler currently supplying meat to all schools except VillageSchool)	01-02-17, 1.5hrs
Manager, 'LORG Dairy' (dairy farm/processor supplying organic milk to schools in north east England)	14-02-17, 1hr
Manager, 'ECO Farm' (organic beef/pork producer supplying 100% organic meat to VillageSchool)	14-02-17, 1.5hrs

Table 14. Profile of interviewees in the WP6 pilot study

3.2.2. Profile of County Durham

County Durham is an administrative region located in the north east of England (Figure 10). 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, 2017).

Figure 10. Map of County Durham*

**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, 2017). Although levels of social deprivation have decreased 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 the highest quartile), and is the most deprived area 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. The population profile is also 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.

3.2.3. 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. 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.

3.2.4. The school meals service contract in County Durham

Until 1994, DCC undertook school meal provision in-house, employing kitchen staff on-site in schools, and contracting directly with suppliers. Some years previously, it took a policy decision to install full kitchen facilities in all primary schools, a resource that all schools continue to have to the present day. Currently, each school pays c£700 per annum to DCC to cover the cost of all maintenance and upgrading.

In 1994, the meals service was put out to tender for the first time, and was won by a multinational catering firm. This firm operated the contract until 2008, when DCC issued the new tender document with a range of health and sustainability criteria, including requirements for meals to meet specific nutritional guidelines, engage in staff training and up-skilling, and procure from local suppliers (Appendix 3.1). These criteria were mapped to a corresponding list of Key Performance Indicators (KPIs) which the successful bidder was required to report on annually (Appendix 3.2). 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[6], holding a bronze Catering Mark across all schools. This requires, for example, that all eggs are certified free range, all meat is Red Tractor approved, and all fish is Marine Stewardship Council certified. SchoolCater has also supported individual schools pursuing silver and gold awards (which require, for example, greater purchasing of certified organic food).

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 (c45-50%).

3.2.5. The current school meals supply chain in County Durham

Figure 11 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 TownSchool 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, "Egglay Farm" and "RegDairy" respectively), fresh meat is supplied by the wholesaler "FreshMeat" (sourced from local abattoirs) 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 VillageSchool differs from the normal situation in two important ways. First, rather than sourcing from RegDairy, it procures milk from a 100% organic dairy farm

[6] http://www.foodforlife.org.uk/schools.

("LORG Dairy", also located in the region). This organic milk is delivered as normal by FreshGrocer. Second, rather than sourcing from FreshMeat, VillageSchool procures all its fresh meat exclusively from a local organic farm ("ECO Farm"). The manager of this farm delivers orders directly to VillageSchool from the farm.

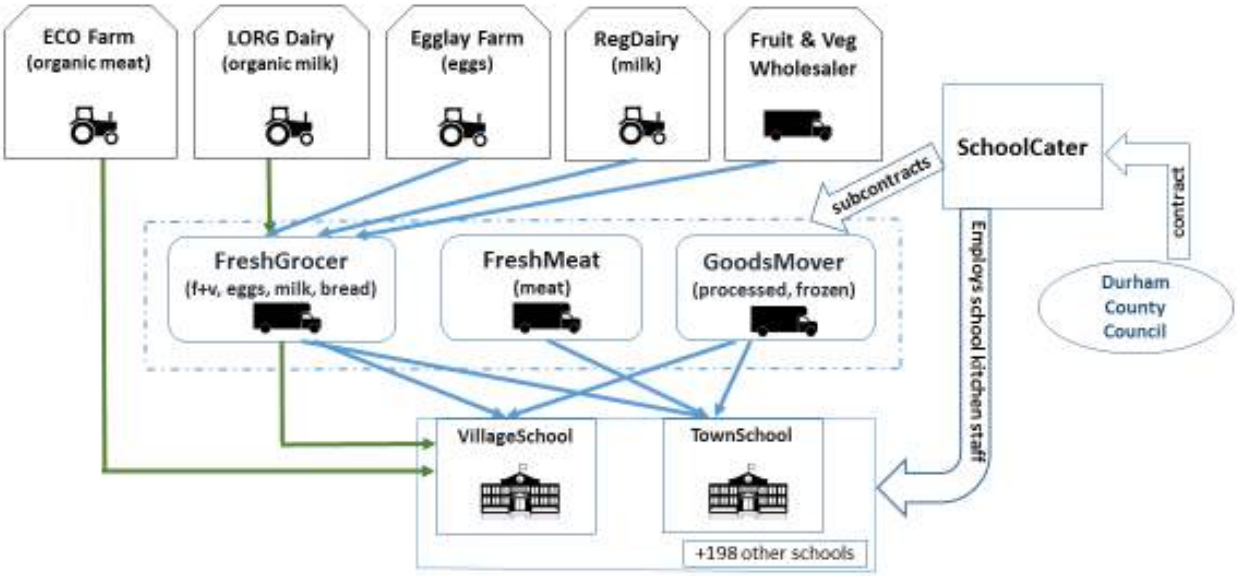


Figure 11. Organisation of the Durham school meals supply chain

The next sections give short descriptions of some of the key stakeholders in the chain.

3.2.5.1. 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 represent a turnover of approximately £10million, and it employs 620 staff (of which 600 are the kitchen staff based on school sites).

3.2.5.2. 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 as 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, and employs 77 staff.

3.2.5.3. FreshMeat

FreshMeat is a third generation meat processing and distribution company with strong roots in the north east. Like FreshGrocer, it supplies to several public sector contracts in the region as well as a range of private customers, and has experienced significant growth in recent years. As per the Food For Life scheme requirements, all the meat it supplies to County Durham schools is Red Tractor certified[7]. FreshMeat has a turnover of c£9million, and employs 60 staff.

3.2.5.4. 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 two delivery depots in the region. In total, the GoodsMover Group has a turnover of £3.3billion and employs c7000 staff in the UK.

3.2.5.5. 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 VillageSchool 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 current turnover of c£700k, and employs 30 staff.

3.2.5.6. TownSchool

TownSchool 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 TownSchool 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 TownSchool 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.

3.2.5.7. VillageSchool

VillageSchool 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 c35 have school meals (70% uptake). The local community is agricultural with relatively low levels of deprivation (c10% 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 the 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.

3.3. Environmental impact of school meals service in County Durham

3.3.1. Indicators used to measure environmental impact

Our core measure of environmental impact was carbon footprint, expressed as the kgs$C0_2$e emitted from the production, processing and transportation of selected food items purchased by TownSchool and VillageSchool, over a 38 week school year, to cook and serve to their

[7] http://assurance.redtractor.org.uk/.

pupils. Hence, we took into account all stages of the production process from growing/rearing on-farm to the point at which items were delivered to school premises. Our calculations did not include emissions from storage and cooking of food in school kitchens, but did include the disposal of food waste from school kitchens. Below we explain in more detail the indicators we used for the separate parts of the supply process.

3.3.1.1. Production-related carbon emissions

To estimate the emissions from the agricultural production of food items supplied to the schools, we used the emissions factors proposed by Audsley et al (2009). These give estimates of kgs$C0_2$e for kgs of specific food items, including a large range of fruits and vegetables, meats and dairy products produced in the UK, EU and rest of the world (Row). As the analysis of public procurement chains involves capturing several types of food items, and at least some of these food items are sourced from different origins over the seasons (e.g. fresh vegetables), this level of detail suited our purpose well. These factors include the emissions caused by all the activities arising from the production of food items up to and including arrival at the regional distribution centre (RDC) level. In our study, the RDC level equates to wholesalers.

Our exceptions to the use of Audsley et al's (2009) estimates were for meat and dairy items. To estimate the production-related emissions for these items, we adopted Williams et al's (2006) factors, because these encompass estimates for both conventional and organic meat and dairy products. As we had both conventional and organic meat and milk items in our analysis, use of these factors improved the consistency of our calculations between these alternative production methods. However, the factors of Williams et al (2006) do not include any processing that happens between the farm gate and arrival at the RDC, therefore we have added the processing-related carbon emission estimates of Hamerschlag and Venkat (2011) for the three main types of meat products included in this study - beef, pork and chicken.

3.3.1.2. Water footprint

The factors proposed by Audsley et al (2009) include all emissions relating to activities from agricultural production to transport to the RDC. Therefore we have assumed that the factors include estimates for water footprint.

3.3.1.3. Waste footprint

In her working paper produced for the Food Climate Research Network, Garnett (2006) estimated that the average food waste from public sector catering outlets is c20% of the food served. Thus, we used this percentage to estimate the amount of waste from all food purchased and served by the schools in our study. Beyond this, we calculated the waste emissions from different food types (i.e., fruits, vegetables, milk, eggs and meat) using the estimates of Jan et al (2013).

3.3.1.4. Transport-related carbon emissions

To estimate the emissions involved in the transportation of food items supplied to TownSchool and VillageSchool, we distinguished between (i) transportation from farm to the RDC (or wholesaler) tier, and (ii) transportation from RDC/wholesaler to the schools. Emissions from (i) are included in the emissions estimates of Audsley et al (2009) and Williams et al (2006). For (ii), we combined distance calculations from Google maps with delivery round information from FreshGrocer to estimate the average distance of rounds to TownSchool and VillageSchool.

3.3.2. Methodology to measure environmental impact

Our goal was to calculate total emissions ($kgsC0_2e$) from the production, processing and transportation of selected food items purchased by TownSchool and VillageSchool respectively, for a 38 week school year. We selected food items on the basis that - in our judgement - emissions from their production and/or transportation might vary according to the type of procurement model adopted by the chain (i.e. LOC/ORG vs LOW). This led us to select fresh fruit and vegetables, milk, eggs and meat for our analysis. (We therefore excluded for example, bread, processed and frozen items.) Thereafter, the measurement process was as follows:

First, we used a small sample of completed order forms sent by TownSchool and VillageSchool kitchen staff to FreshGrocer and FreshMeat/ECO Farm respectively to estimate the average weekly purchase volumes (kgs) of all selected food items to the two schools. (Through interviews with school kitchen staff we established that purchases do not vary significantly over the school year due to the set school menu cycle, hence we judged it reasonable to extrapolate from a small sample of forms). We 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 (incl. wastage) of these items. To do this, we used Audsley et al's (2009) per kg emissions factors, and multiplied these by the total volumes calculated in the first step. To select the most appropriate factor from the options of UK, EU and ROW origin, we used information from the FreshGrocer manager as to the points in the year when specific items switch from local/UK sourcing to EU/ROW. We took account of different emissions attached to organic production by applying factors from Williams et al (2006) to the volumes of organic milk and meat supplied to VillageSchool.

Finally, we calculated the emissions ($kgsC0_2e$) relating to the transportation of the food items from wholesaler (FreshGrocer, FreshMeat and ECO Farm) to school (TownSchool and VillageSchool). To estimate the emissions for fresh fruit and veg, eggs and milk, we used delivery round information supplied by FreshGrocer to estimate the frequencies of deliveries to VillageSchool and TownSchool respectively over 38 weeks, and combined this with Google maps data to estimate the km distances involved. Following the approach recommended by 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 TownSchool/VillageSchool[8]. We used delivery information supplied by ECO Farm to perform the same calculation for the organic meat to VillageSchool. As we did not obtain detailed delivery information from FreshMeat, we used the organisation of FreshGrocer's delivery rounds as a proxy to estimate the transportation emissions for meat to TownSchool.

3.3.3. Total carbon footprint of food items supplied to TownSchool and VillageSchool

Based on the calculation process described above, Table 15 and Table 16 present the total carbon emissions associated with producing, processing and transporting the selected food items to TownSchool and VillageSchool respectively, for a 38wk school year.

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

	Total quantities purchased (kg/ltr)	Production related emissions ($kgCO_2e$)	Transport related emissions (kgCO2e)	Waste related emissions ($kgCO_2e$)	Total emissions ($kgCO_2e$)
Potatoes	1900	656.5	84.8	334.4	1075.7
Other veg*	393	143.7	17.5	69.1	230.3
Salad veg**	304	591.7	13.6	53.4	658.7
Fresh fruit	456	262.6	20.4	34.7	317.6
Milk	196	207.4	8.7	39.1	255.3
Eggs	30	89.4	1.4	6.1	96.8
Beef	304	5282.3	54.8	319.2	5656.4
Pork	570	4781.6	102.8	598.5	5483.0
Chicken	228	1566.3	41.1	239.4	1846.8
Total	4380	13582	345	1694	15621

Table 15. Carbon emissions from supply of food items to TownSchool (38wks)

*Onions, carrots, broccoli, cauliflower, swede

**Tomatoes, cucumber, lettuce, peppers

	Total Quantities purchased (kgs/38wks)	Production related CO_2 emissions ($kgCO_2e$)	Transport related CO_2 emissions (kgCO2e)	Waste related CO_2 emissions ($kgCO_2e$)	Total CO_2 emissions ($kgCO_2e$)
Potatoes	437	151.0	139.9	76.9	367.8
Other veg*	148	170.3	47.5	26.1	243.9
Salad veg**	89	195.4	28.4	15.6	239.5
Fresh fruit	158	105.5	50.5	12.0	168.0
Milk***	157	192.6	50.1	31.3	274.0
Eggs	7	20.6	2.2	1.4	24.2
Beef***	93	1845.6	44.8	97.8	1988.2
Pork***	104	791.8	50.8	109.2	951.0
Chicken***	10	88.1	4.6	10.0	102.7
Total	1202	3561	418	380	4359

Table 16. Carbon emissions from supply of food items to VillageSchool (38wks)

*Onions, carrots, broccoli, cauliflower, swede

**Tomatoes, cucumber, lettuce, peppers

***Organic

There are several points to note from Table 15 and Table 16. First, it can be seen that the total carbon footprint related to TownSchool is approximately three times that of VillageSchool. This was expected, given the greater number of meals served at TownSchool over the school year. Second, and also as expected, it can be seen that for both schools production-related emissions (which in our calculation include 'upstream' transportation), far outweigh emissions from downstream, or local transportation. Third, and again as expected, we find that of all production-related emissions, it is those pertaining to meat - and beef in particular - that represent the greatest carbon burden. At TownSchool beef production comprises one third of total carbon emissions, whilst at VillageSchool it represents 40%.

Beyond these results, Table 15 and Table 16 also show areas of food supply where the carbon footprint for VillageSchool appears out of proportion to that of TownSchool. For example, VillageSchools's emissions for 'other veg' and milk are comparatively high, whilst transport-related emissions at VillageSchool actually exceed those of TownSchool (418 vs 345 kgsCO_2e). To facilitate visual comparison of these differences, Figure 12 shows the percentage contribution of fresh grocery item production (fruits, vegetables, eggs and milk), and their associated transportation/waste, to total carbon footprint at TownSchool and VillageSchool, respectively. Figure then shows the breakdown for meat-related emissions, again for each school in turn.

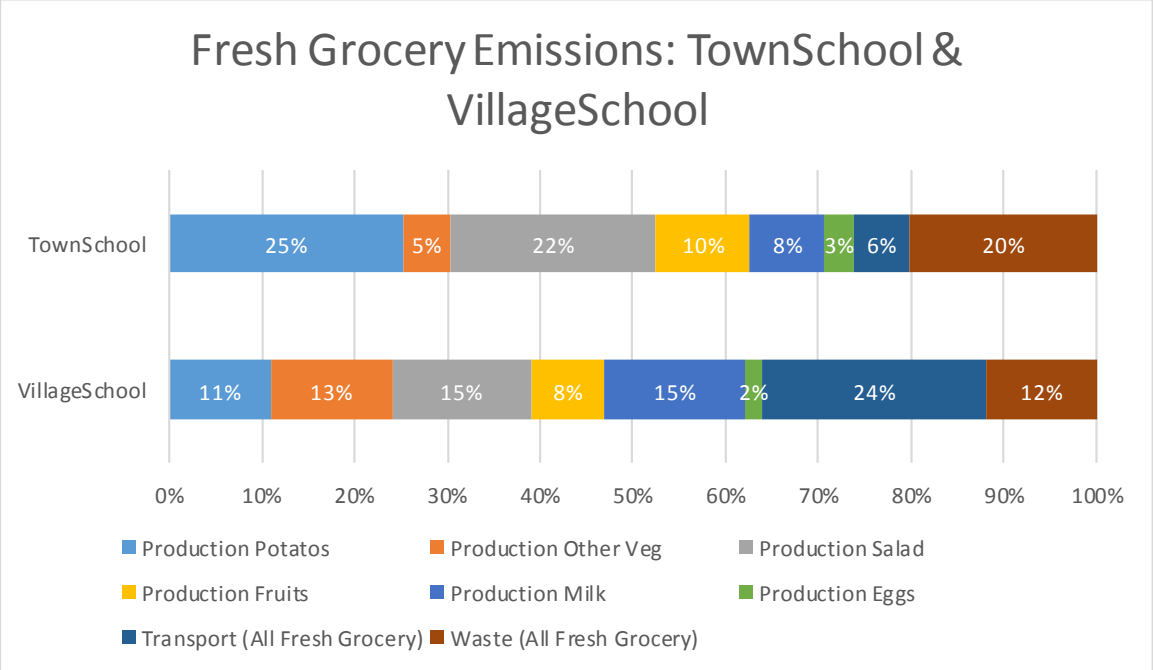


Figure 12. Breakdown of carbon footprint of fresh grocery items at TownSchool & VillageSchool

Figure 12 confirms the comparatively high contribution of local transportation of fresh groceries to total carbon emissions at VillageSchool, together with milk, salad and 'other' vegetable production. Whereas at TownSchool it is emissions from the production of potatoes and salad, and the waste from all fresh groceries, which make the largest contributions to its carbon footprint.

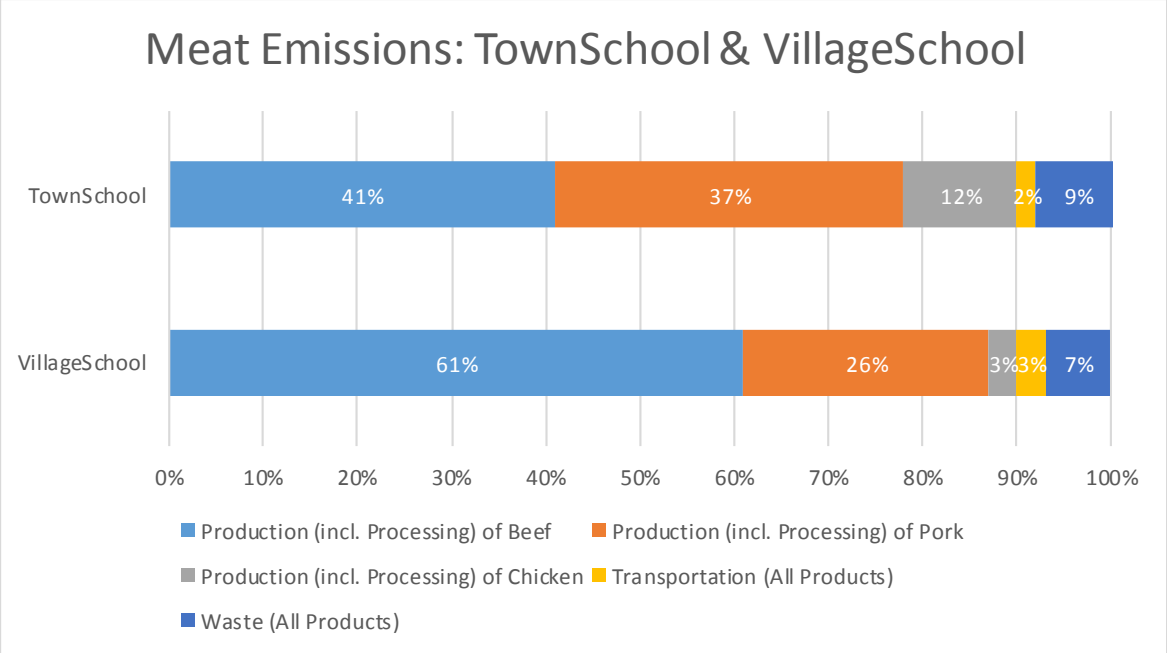


Figure 13. Breakdown of carbon footprint of fresh meat at TownSchool & VillageSchool

Figure 13 shows that beef production constitutes a large proportion of the carbon footprint at VillageSchool, whereas at TownSchool, beef and pork production exhibit relatively similar contributions to emissions.

3.3.4. Carbon footprint of food supplied to TownSchool and VillageSchool (per meal)

To futher explore the distinctions in the composition of carbon emissions between TownSchool and VillageSchool, we calculated the emissions associated with each school on a per head basis, in order to conduct a like for like comparison. To do this, we divided the emissions results by the total number of meals served over 38wks at TownSchool and VillageSchool respectively, to arrive at average emissions per meal served. Table 17 shows the results.

	TownSchool ($KgCO_2e$)	Average per Meal	VillageSchool ($KgCO_2e$)	Average per Meal
Fresh Groceries*				
Production	1951	0.063	835	0.117
Transport	155	0.005	331	0.046
Waste	537	0.017	163	0.023
Total	2643	0.085	1330	0.186
Meat**				
Production	10002	0.321	2434	0.341
Processing	1628	0.052	291	0.041
Transport	206	0.007	99	0.014
Waste	1157	0.037	217	0.030
Total	12993	0.417	3042	0.426
Grand Total	15636	0.502	4371	0.612
Average per meal	0.502		0.612	

Table 17. Emissions to supply food to TownSchool and VillageSchool (average per meal)

* Fresh fruit, vegetables, eggs and milk

**Beef, pork and chicken

Table 17 shows that on average, carbon emissions per meal at VillageSchool are greater than at TownSchool, despite VillageSchool operating a LOC/ORG procurement model. There are three areas of food supply which appear to contribute most to this result:

First, it can be seen that production-related emissions per meal for fresh groceries at VillageSchool are almost double those of TownSchool. We inspected again the total volumes of fresh groceries ordered by both schools and this confirmed that VillageSchool was supplied with proportionately greater volumes of fresh veg and milk (in particular), which would account for the disparity. In order to make a full and fair comparison between the schools' grocery production emissions however, one should also record volumes of processed and frozen groceries purchased, which were not measured in this study. It is possible that VillageSchool orders comparatively smaller volumes of these items than TownSchool, which could offset the greater production emissions from fresh groceries.

Second, it can be seen that transport-related emissions per meal for fresh groceries to VillageSchool are five times those to TownSchool. This can be attributed to the remote rural location of VillageSchool and much greater distance of the delivery round from FreshGrocer's depot.

Finally, it can be seen that transport-related emissions per meal for meat at VillageSchool are double those of TownSchool, despite VillageSchool being supplied organic meat by ECO Farm, which is located less than 15km away. The result can be attributed to the exclusive and frequent ordering and delivery arrangements between VillageSchool and ECO Farm. Although FreshMeat's delivery round to TownSchool covers a much greater distance, the round takes in multiple drops to other customers, hence only a small proportion of emissions are attributable

to TownSchool. In contrast, ECO Farm's deliveries to VillageSchool are the only ones in the round, therefore 100% of emissions are attributed to it. This result reveals the hidden emissions burden of exclusive procurement arrangements, even in situations where distances between suppliers and customers are small.

3.3.5. Procurement management scenarios to reduce carbon footprint

To conclude our analysis of the environmental impact of the Durham school meals service, we report some preliminary explorations of different procurement management scenarios and their effects on carbon emissions. We stress that these are very much exploratory in nature and do not take full account of all factors which could influence the outcomes. Nevertheless, they give an indication of the possible direction of effects on carbon footprint.

3.3.5.1. What if FreshGrocer delivered meat from ECO Farm to VillageSchool?

In the preceding section, we revealed the relatively high carbon burden associated with the transport of meat from ECO Farm to VillageSchool. As FreshGrocer already makes weekly deliveries to VillageSchool (of fresh grocery items), we explored the effect on carbon footprint if FreshGrocer were to take in the collection of meat from ECO Farm within its delivery round. Crudely, we estimate the meat transportation to VillageSchool would drop from 99 kgs$C0_2$e per school year to 8kgs$C0_2$e. As a result, the per meal emissions related to meat transportation to VillageSchool would switch from being double those of TownSchool, to being one seventh.

3.3.5.2. What if meat is delivered only once per two weeks to VillageSchool?

Another alternative to reducing emissions from meat transport to VillageSchool is to reduce the frequency of deliveries. Crudely, this would halve the transport emissions. However, in order to make this procurement management switch, meat would need to be stored in frozen form at VillageSchool's premises, adding to carbon emissions. We have not yet been able to conduct a suitable estimation for this, but would expect the burden of freezing and storing items to be not insignificant. There may also be practical restrictions on making this procurement management switch: twice monthly deliveries of frozen meat were made by ECO Farm to VillageSchool when the supply arrangement was first set up. However, the school switched to weekly deliveries due to lack of storage capacity for frozen items on-site.

3.3.5.3. What if FreshGrocer did not undertake supply of milk and eggs?

Our comparison of the carbon footprint to deliver food items to VillageSchool and TownSchool highlighted the carbon burden associated with less efficient, uncoordinated transportation (i.e. the exclusive delivery arrangements for fresh meat at VillageSchool). We explored the impact of coordination further, by estimating what would happen to the carbon footprint to supply both TownSchool and VillageSchool with eggs and milk, if these items were transported by separate producers, rather than being undertaken by FreshGrocer. Crudely, we estimate that in total, fresh grocery transportation (fruit and veg, milk and eggs) would increase from 155 KgCO2e to 350 KgCO2e to TownSchool (152 for fruit and veg, 59 for milk, and 139 for eggs) and from 331 KgCO2e to 751 KgCO2e to VillageSchool (324 for F&V, 207 for milk and 220 for eggs). Although crude, the estimations highlight the value, in terms of emissions reduction, of having good coordination amongst the participants of the downstream supply chain.

3.4. Economic impact of school meals service in County Durham

3.4.1. Indicators used to measure economic impact

Our pilot study sought to understand the economic values generated in the local area, and amongst members of the local supply chain, as a result of the Durham school meals contract being operated in its current form. The specific indicators that were used to assess this were (i) local multiplier analysis (LM3), (ii) the size and growth rate of supply chain members' businesses, (iii) the proportion of supply chain members' total business dependent on the school meals contract, and (iv) amount of new business won as a result of the contract. It was more meaningful to conduct these analyses at the whole county level rather than for the specific chains attached to our two featured schools, hence it is at the whole county scale that the results are reported.

3.4.1.1. Local multiplier analysis (LM3)

The goal of the local multiplier analysis was to trace expenditures by organisations/businesses in the school meals supply chain, in order to identify what proportions of the monies from the contract were retained within the local area. To calculate this, we used the 'Local Multiplier 3' (LM3) methodology[9]. In practice, this involved tracking retention/leakage of monies from the original budget generators (Durham County Council and parents/carers) to the immediate budget recipient (SchoolCater) to next tier suppliers/wholesalers subcontracted to deliver specific goods (FreshGrocer, FreshMeat, GoodsMover and ECO Farm). The proportion of monies retained at each stage is calculated as follows:

- LM1 = the proportion of the total budget received by the immediate budget recipient (i.e. SchoolCater) that is retained in the local area. This is determined by the geographic location of the recipient's HQ, as given for accounting purposes.
- LM2 = the proportions of the expenditures of the budget recipient (i.e. SchoolCater) on staff, upstream suppliers and direct costs, that are retained in the local area. Retention is determined by the geographic location of staff, suppliers and direct cost expenditures.
- LM3 = the proportions of the expenditures of the next tier suppliers/wholesalers (i.e. FreshGrocer, FreshMeat, GoodsMover and ECO Farm) that are retained in the local area. Retention is estimated as a single % of overall expenditure, with default rates applied according to whether or not the supplier is located within the local area.
- In terms of calculation outcome, LM3 is expressed as a figure between 1 (indicating that no value has been generated within the local area) and 3 (indicating that 100% of values have been retained).

3.4.1.2. Economic value to members of the supply chain

To explore what economic values are enjoyed by members of the school meals supply chain from being involved in the contract, we asked all interviewees 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. (In practice, all interviewees were willing to give these estimates - if they had not been, our fallback source of data would have been the FAME database[10]). We also asked interviewees to estimate the proportion of their business dependent on the Durham school meals contract, and the size of any new business won as a direct result of the contract.

[9] Full explanation of the method is available at www.lm3online.com.
[10] http://www.bvdinfo.com/en-gb/our-products/company-information/national-products/fame

3.4.2. Results of local multiplier analysis of Durham school meals service

Following the method described in 3.1.1, we estimated that the local multiplier effect of the Durham school meal service is 2.50. This means that for every £1 spent by the initial budget generators (i.e. Durham County Council and parents/carers), an additional £1.50 is generated within the local area. Compared with average LM3 ratios for the food sector, this can be regarded as a high return. Figure 14 below gives a graphical depiction of our estimation, followed by an explanation of what data we used and how we sourced them.

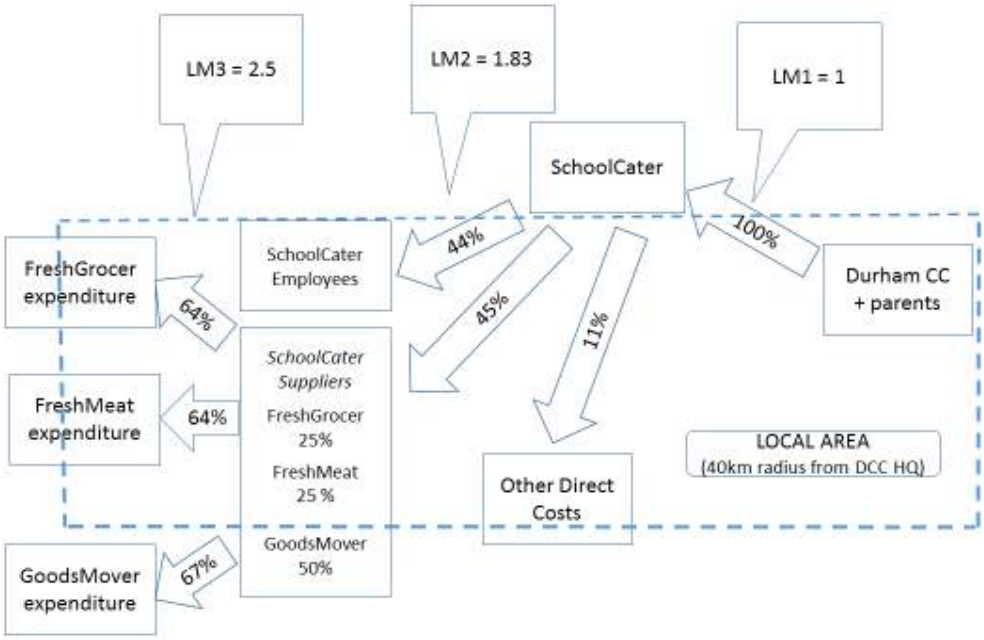


Figure 14. Local multiplier analysis (LM3) of Durham school meals service

To undertake LM3 analysis, the researcher must first define what constitutes the local area. In our case, we defined a 40km radius from Durham County Council offices, in Durham City, as local. This area takes in all County Durham plus small areas of Tyneside to the north and neighbouring counties to the south and east. (A smaller radius of 35km would have excluded small areas of county Durham itself, which would have been inappropriate). Using this radius, FreshGrocer, FreshMeat and ECO Farm are defined as 'local' suppliers, while GoodsMover is defined as a 'non-local' supplier. This distinction also accorded with the views expressed by interviewees as to which suppliers were local/regional and which not.

Our next step was to calculate LM1, which refers to the total budget SchoolCater received from DCC and parents/carers to provide school meals. We calculated this figure by multiplying the total number of meals served in 2015 by the fixed price per meal set out in the contract. (Both pieces of information were publicly available from the DCC website). SchoolCater's registered HQ for accounting purposes is in the north west of England, outside of the local area. Hence at LM1, we estimated that 100% of values 'leak' out from the local area.

Next, we calculated LM2, which refers to the proportion of SchoolCater's expenditures on staff, suppliers and direct costs that are retained in local area. Using publicly available accounts information from the FAME database[11], we estimated that 44% of SchoolCater's expenditure

[11] http://www.bvdinfo.com/en-gb/our-products/company-information/national-products/fame

is on staff (this estimate was subsequently confirmed as accurate in a post-hoc discussion with the SchoolCater manager). As all SchoolCater staff are located within the local area, we inferred that all this expenditure was retained locally. Second, we estimated that 45% of SchoolCater's expenditure is on suppliers[12], which we broke down as follows: FreshGrocer = 25%; FreshMeat = 25%; GoodsMover = 50%[13]. As FreshGrocer and FreshMeat are located in the local area, we inferred that all of this expenditure was retained. However, as GoodsMover's HQ is in southern England, we inferred that all of this expenditure was leaked. We estimated that the remaining 11% of SchoolCater's expenditure was comprised of direct costs. We applied the default local multiplier (66%) for the proportion of direct costs retained in the local area. Therefore, at LM2, 69% of values were retained in the local area.

The last step was to calculate LM3, which refers to the proportion of the expenditures of FreshGrocer, FreshMeat and GoodsMover that are retained in the local area. The LM3 tool applies a default estimate that 67% is spent by local suppliers in the local area, compared with only 33% spent by non-local suppliers in the local area. Following this calculation, we arrived at our final LM3 estimate of 2.50.

3.4.2.1. What happens to LM3 if all suppliers are located outside the local area?

We thought it would be interesting to explore what would happen to the LM3 figure if FreshGrocer and FreshMeat were deemed to fall outside the local area. In this scenario, the LM3 result drops from 2.50 to 2.14. We note that this would still represent a relatively high figure, particularly for the food sector, and attribute this to the fact that the budget recipient (SchoolCater) employs a large workforce in the school kitchens in the local area: all this expenditure ends up being calculated as local.

3.4.3. Economic value of the school meals service

Using the indicators described in 3.1.2, we asked interviewees about how important the Durham school meals contract was to their business. As the absolute number of supply chain members was small, we report the results descriptively.

In terms of business size, we found suppliers employed between 30 and 80 staff, and had turnovers of between £700k and £11m. 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 suppliers, the Durham school meals contract represented only a relatively 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 18 summarises the data. SchoolCater occupies a somewhat different position, in economic value terms, to the next tier suppliers, as discussed below.

[12] Source: calculated from FreshGrocer's target food cost per meal, communicated via interview.
[13] Source: we initially estimated this breakdown by extrapolating from the total values of orders delivered to TownSchool and VillageSchool by each of the suppliers, as presented in the small sample of order forms we viewed. Subsequent discussion with the SchoolCater manager revealed that we had overestimated the volumes of orders to GoodsMover. The breakdown in Figure 7 is the correct one.

	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	Almost 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	60	£9m	10%	50%	Negligible
ECO Farm	30	£700k	1%	Business started in 2011, hence grown from £0 to £700k turnover, and from 0 to 30 employees	Negligible

Table 18. Economic value of Durham school meals contract to supply chain members

As Table 18 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 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 10% 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. The contract is not likely to lead to large amounts of new business, because of FreshMeat's current presence in the region and no desire to expand outside of 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 VillageSchool, 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 VillageSchool is the communitarian ethos of ECO Farm: the business has an orientation towards supplying locally, and also to embed itself in the community.

3.5. Social impact of school meals service in County Durham

3.5.1. Indicators used to measure social impact

The goal of the social impact analysis was to assess what social values were generated by operating the Durham school meals service. The indicators we took into account to measure social impact were (i) employment-related criteria, and (ii) criteria relating to the working environment of the service chain and connectedness of people within it. As with economic impact assessment, it was more meaningful to conduct the analysis at the whole county level, although we include some observations about community vibrancy impacts linked specifically to VillageSchool's supply chain. Given the small sample size of informants, we give a descriptive reporting of the results relating to both indicators.

3.5.1.1. Employment-related indicators

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.

3.5.1.2. Working environment and connectedness of people in the supply chain

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.

3.5.2. Employment-related social impact

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 did specify criteria relating to skills/development and training in the contract tender). Table 19 summarises the findings, and below some more descriptive detail is given on each of the key suppliers.

	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 82% M	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. Additional for some staff: NVQ and accountancy training
ECO Farm	50%	50%	66% F	0%	100%	Mandatory for food staff: hygiene training.

Table 19. Job, employee and training profiles of Durham school meals suppliers

SchoolCater employs 620 staff. Of these, 20 FT staff are the support team who have management, finance and administrative roles, working mainly out of the Durham City office. The 600 PT staff represent the kitchen staff located entirely on school sites. Most of the kitchen employees work between 12 and 25 h per week, depending on their grade and the number of meals they are responsible for serving. SchoolCater has won awards for its training programme, and devises a training matrix for every member of staff. 100% of staff hold mandatory certificates in food safety, health and safety, manual handling, safeguarding and allergen training. In addition, all staff take non-mandatory courses as Table 19 illustrates (SchoolCater developed the sustainability course itself). Reported rates of staff absence (4%) and staff

turnover (7-8%) are very low, particularly for this sector, and much lower than the rates SchoolCater inherited when it won the contract in 2008.

FreshGrocer employs 77 staff. All staff are employed FT and fully by the firm, a deliberate policy on the part of the MD not to employ any agency staff. Admin/office staff tend to be female, whereas depot and delivery staff tend to be male. 100% staff hold relevant mandatory certificates, and in addition, all staff take 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 employs 60 staff. The manager explained that the firm had run apprenticeship schemes in the past but recently had had difficulty recruiting to them: on the production line, jobs are low skill, under not very pleasant working conditions, and involve fairly antisocial hours. However, FreshMeat has worked with a local council to offer placements and apprenticeships to the long term unemployed, young offenders and individuals with learning difficulties, activities that the manager was clearly proud of.

ECO Farm employs 30 staff. In general all kitchen staff are female, whilst restaurant casuals are a mixture of male and female, usually students who live locally and return during the busier seasons out of term time. All staff have 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 VillageSchool. ECO Farm clearly appreciated this initiative.

3.5.3. Working environment and connectedness

To explore how the Durham school meals contract impacts 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 all the suppliers' testimonies was a very strong sense of rootedness in, and commitment to, their positions in the region. All interviewees spoke very positively about the working relationships they have 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 and community-oriented outcomes. Interviewees 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 VillageSchool interviewees, 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.

3.5.3.1. Working environment and connectedness at SchoolCater

The SchoolCater manager explained that the firm did a lot of work on health and nutrition awareness raising amongst school pupils. A specific example was to undertake 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 runs 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. A specific example given was the willingness of local suppliers such as FreshGrocer and FreshMeat to adjust 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 were going to cause problems in sourcing potatoes in spring/summer 2017. As a result of this information, SchoolCater had adjusted its forthcoming spring menu to reduce reliance on potatoes, substituting these with other carbohydrates.

To explore working environment more at SchoolCater, we developed a short questionnaire designed to be administered for a kitchen staff survey. However, as we only spoke to a very small sample of kitchen staff and received only one completed questionnaire, we have not reported the results here. We mention the experience as it was valuable for learning lessons from this pilot study.

3.5.3.2. Working environment and connectedness at FreshGrocer

The FreshGrocer interviewees explained that FreshGrocer 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 has 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 are arranged with schoolchildren, involving a tour round the depot and conversations with staff. In terms of links with others in the supply chain, the FreshGrocer MD 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. Recall also that FreshGrocer chose to take on the distribution function for eggs and milk suppliers in the Durham schools contract, which we estimated as a significant carbon footprint saving.

3.5.3.3. Working environment and connectedness at FreshMeat

The FreshMeat manager gave one example of how the firm engages with schoolchildren, this being an annual 'invent your sausage' event at a local primary school, originally to coincide with national sausage week. The manager did not convey more regular interaction/initiatives with primary schools, but clearly was more involved with employment skills initiatives with local high schools. The manager also conveyed an impression of close working relationships with local abattoirs, the result of FreshMeat's three generation history and long-standing orientation to be rooted in the region. The manager explained how these relationships had helped the firm through the crisis period of the horsemeat scandal, where British beef became in very short supply in the region and prices increased dramatically. As FreshMeat had trustful

relations with local abattoirs, and could guarantee relatively high volume orders, the abattoirs were willing to be flexible and work harder to source supplies for the firm.

3.5.3.4. Working environment and connectedness at ECO Farm

The manager at ECO Farm conveyed a very strong commitment to local community and sustainability issues. Although it was clear that the meat orders to VillageSchool were a very small part of ECO Farm's overall turnover, she explained that the contract mattered because engaging in such local supply networks was part of ECO Farm's ethos. It was clear that ECO Farm had worked closely with VillageSchool in a range of community and educational activities, specific examples being the hosting of a pizza night for VillageSchool staff, children and parents at ECO Farm, and getting children to visit ECO Farm at the start of the growing season at ECO Farm's greenhouses.

3.6. Nutritional impact of school meals service in County Durham

3.6.1. Purpose and scope of nutritional impact analysis in this pilot study

In WP6, the nutritional impact of school meals procurement is being managed by ZAG, under the methodological guidelines being developing for WP6.2. The main empirical work intended for WP6.2 is a study of schoolchildren's plate waste. Although the software earmarked for the analysis of plate waste was not ready to use for this pilot study, we nevertheless undertook a modest amount of data collection of plate waste in TownSchool and VillageSchool, to trial the WP6.2 data collection and analysis guidelines.

In order to undertake nutritional analysis from plate waste data, it is necessary to have information about the recipes and portion sizes underpinning the meals on the plate. Unfortunately, we were not able to obtain this information from SchoolCater. We have attempted to estimate portion sizes and nutritional composition using secondary data sources, and have used these estimates to make a calculation of nutritional (calorific) impact for the plate waste relating to one meal at TownSchool. We offer this result for illustrative purposes.

In the following sections, we present the pilot protocol we followed, based on the WP6.2 Guidelines, followed by our findings.

3.6.2. Plate waste study protocol

Each year, the average primary school in England is estimated to generate 55,408 tonnes of food waste, of which 36% is categorised as plate waste - food left behind by children (Cordingley et al., 2011; Eriksson et al., 2017). Numerous causes of plate waste have been identified including: variation in children's appetites and energy needs; differences between food preferences of children and the food served; time available for lunch and other associated scheduling constraints; on-/off-site preparation of hot meals; availability of substitute foods from competing sources (e.g vending machines, tuck shops, off-site retailers); and food ordering protocols (i.e. pre-ordering or real time ordering) (Erikkson et al., 2017; Mirosa et al., 2016; Buzby and Gutherie, 2002). Given these situational and behavioural contexts of school canteens, it is highly challenging to analyse accurately the actual food intake and associated plate waste in schools, especially with young children.

Operationally, the challenges are primarily associated with the diversity in school canteen service protocols and menus, resource costs (staff and time) required for direct observations, time and other environmental constraints associated with collecting data in school cafeteria settings, and the unpredictablity of young children. Methodologically, challenges come from the range of methods used, their strengths and weaknesses, the associated data and resource implications (from whom, how, the type and amount of data collected, sampling approaches and staff and other resources needed) and the analytical options available. Alternative methods

for recording plate waste include weighed food records; school meal recall studies (data primarily gathered through questioning of school staff), on site meal observations, digital photograph observations; and estimated food recall studies (self-completion by children) (Tugault-Lafleur et al., 2017; Eriksson et al., 2017; Todd et al., 2017; Niaki et al., 2016; Hanks et al., 2013; WRAP, 2011; Swanson, 2008)[14].

Taking these methodological, operational, situational and behavioural factors into consideration, and in consultation with the ZAG team, we developed the following protocol for the Durham pilot study. It involved collecting digital photographic data, (before and after digital photographs of main meals/desserts). The protocol was followed for data collection in both TownSchool and Village School, involving 8 pieces of equipment and 3 distinct stages of data collection.

Equipment used	• 1 high resolution digital camera; • 1 laminated A3 place mat with ruled edge; • soluble markers (for recording participant numbers); • tissues (to clean laminated mat between children); • number and reward stickers for children; • digital scales for weighing sample portions of each main meal and dessert; • notebook and pen for taking field notes in the school canteen. • digital voice recorder for recording interviews (formal and informal)
Stage 1: Interviewing of key stakeholders	• Depth interviews with Headteacher (and where appropriate other members of leadership team), Unit Manager (Head Cook), and where appropriate SchoolCater. • Informal discussions with kitchen staff (who support the Unit Manager) and lunchtime supervisors and teachers (who are present in canteen during lunch) before and after school lunch observations (See 2 below).
Stage 2: Researcher-led observations of school lunch service	• Detailed researcher-led observations of School lunch service at each school. • Two researchers observed and documented 1-2 school lunch services per school • Detailed field notes, photographs and/or drawings were made of each service, key personnel involved, canteen layout, furniture and food waste station (if any). • (Stage 2 activities complement interviews and informal discussions, advise all are conducted on same day).
Stage 3: Digital photography of before and after plates for main meal and/or dessert	1. Drawing on advice provided in WP6.2 handbook and using insights from the interviews, informal discussions and lunch service observations, a photographic station was set up in a part of the canteen that was easy for children to get to, and which caused minimal disruption to the normal lunch service. Two researchers undertook the data collection. 2. Children were randomly selected and given a number sticker (odd numbers for boys, even numbers for girls). The selected children were advised (by a teacher or researcher) to get their lunch as usual then go to the photographic station before they sat down. 3. At the photographic station, children placed their plate on a pre-arranged laminated mat. One researcher photographed the plate while the other helped

[14] For a detailed summary on the different methods used refer to Table 2 in very recently published systematic review by Tugault-LaFleur et al. (2017). A full version of the paper will be distributed to all partners.

	the child and noted the participant number on the mat. Each child was then told to enjoy their meal and to return to the photographic station when they had finished their meal and/or had permission to return. On return, the photography procedure was repeated with careful attention to noting the child's number so before and after plates could be matched. The procedure was repeated in full for the dessert service, giving two before and two after plate photographs (4/child) for each sampled child. Once a child had completed their set of photographs, they were thanked and rewarded with a sticker. 4. On completion of the data collection, and after leaving the school, one researcher matched the before and after photographs (using the participant numbers in the photographs) and prepared the data set for analysis.
Weighing of sample meals/dessert	• Using digital scales, the total plate weight for a sample of each of the main meals offered on the day of data collection were obtained and the weight noted.

Table 20. Protocol adopted for plate waste data collection

3.6.3. Results of lunchtime observations

Both TownSchool and VillageSchool had well-designed and well-understood school lunch systems. All the key actors (kitchen staff, lunchtime supervisors, teachers/teaching assistants and children) knew what the system was and what they had to do within it. This included the youngest children who all ordered their own food, carried it to their table, fed themselves and brought their plate to the waste station. Key areas of difference between the two schools were the canteen layout (size, furniture), the queuing systems used, the number of kitchen staff involved in service, the number of children per table, the amount of space each child had at their table, the time available to order and eat, the atmosphere in the canteen before and during service and the role of the lunchtime supervisors in managing and encouraging children to eat their lunches and in giving children permission to go to the waste station.

3.6.4. Results of plate waste analysis

3.6.4.1. Examples of plate waste photographs

To illustrate the photographic data resulting from the plate waste study, Table 21 presents a set of paired photographs from the observations made at VillageSchool.

Observation Code and Meal Type	Main Meal – Before and After
11- Before & After – Main Meal; Roast Chicken	
14 – Before & After – Main Meal; Sandwich	
17 – Before & After – Main meal; Omelette	

Table 21. Examples of paired before and after main meal photographs

3.6.4.2. Plate waste analysis at TownSchool

TownSchool serves on average 160 school lunches per day. Lunches are served across three services between 11.45 and 1.45pm. Table 22. Summary of lunch service at TownSchool

outlines the student numbers and year groups for the service in which plate waste observations were made.

Lunch Time Service	Time slots	Year Groups	No of students/service

1	11.45-12.30	1 & 2	92 (+ 1 lunch box student)
2	12.30-13.15	3 & 4	47 (+ 12 lunchbox students)
3	13.00-13.45	5 & 6	Approx. 60 (+ 12 lunchbox students)

Table 22. Summary of lunch service at TownSchool

For TownSchool, the lunches (main meal and dessert) of 8 children (years 5/6) were observed during Service 3 on Tuesday 31st January 2017. Table 23 presents a summary of the 15 food items served, demonstrating how many portions of each item were served, the number of children that left waste behind/item (in total and by quartile), and the average % waste/item across the observations.

Food Items	No of Obs/item	No of Obs/item with waste	No of Obs/item as % of sample	25% Waste	50% Waste	75% Waste	100% Waste	Average proportion of waste/item
Oat Cookie	8	0	100%	0	0	0	0	0%
Extra Slice of Bread	7	0	88%	0	0	0	0	0%
Tinned Apple	4	2	50%	0	1	1	0	31%
Pasta Bolognese	3	1	38%	0	1	0	0	8%
Cauliflower	3	0	38%	0	0	0	0	0%
Green Beans	3	3	38%	0	0	3	0	75%
Pork Casserole	2	1	25%	1	0	0	0	13%
Half Baguette Sandwich	2	0	25%	0	0	0	0	0%
Salad	2	2	25%	2	0	0	0	50%
Mashed Potato	2	0	25%	0	0	0	0	0%
Fresh Fruit	2	0	25%	0	0	0	0	0%
Cheese Roll	1	1	13%	1	0	0	0	25%
Grated Cheese	1	0	13%	0	0	0	0	0%
Bolied Egg	1	0	13%	0	0	0	0	0%
Raisins	1	1	13%	0	1	0	0	50%

Table 23. Summary of plate waste analysis for TownSchool

Table 23 shows the most popular item of all meal items was the oat cookie, with all the children observed eating an oat cookie with no waste left behind. The most wasted item in TownSchool was green beans. While only three children choose green beans, all wasted 75% of the beans they were served.

3.6.4.3. Plate waste analysis at VillageSchool

VillageSchool serves on average 40 school meals per day. There are two lunchtime services between 11.45 and 13.00. Table 24 outlines the number of meals served by year group for both services.

Lunch Time Service	Time slots	Year Groups	No of students/service
1	11.45-12.15 (some cross over with service 2)	3/4/5/6	16 (+ 15 pack lunches)
2	12.15-13.00	1/2	22 (+ 5 lunchbox students)

Table 24. Summary of lunch service at VillageSchool

14 food items were served on the observation day at VillageSchool (8th February 2017). Table 25 presents the number of children who ordered portions of each food item, the number of children that left waste behind per item (in total and by quartile), and the average % waste per item across the observations.

Food Items	No of Obs/item	No of Obs/item with waste	No of Obs/item as % of sample	25% Waste	50% Waste	75% Waste	100% Waste	Average proportion of waste/item
Roast Potatoes	16	4	94%	3	1	0	0	8%
Sweet Corn	15	5	88%	1	2	1	1	20%
Carrots	11	1	65%	0	0	1	0	11%
Flapjack	11	1	66%	1	0	0	0	2%
Roast Chicken	7	2	41%	2	0	0	0	7%
Omelette	7	1	41%	1	0	0	0	4%
Custard	7	0	41%	0	0	0	0	0%
Gravy	4	0	24%	0	0	0	0	0%
Fresh Fruit	4	0	24%	0	0	0	0	0%
Roll	3	1	18%	1	0	0	0	8%
Green Beans	3	0	18%	0	0	0	0	0%
Cucumber	2	0	12%	0	0	0	0	0%

Tomato	1	0	6%	0	0	0	0	0%
Yoghurt	1	1	6%	1	0	0	0	25%

Table 25. Summary of plate waste analysis for VillageSchool

Table 25 shows the most popular food item was roast potatoes, having been chosen by 16 students (94% of total observations). This item was chosen to accompany both hot main meals and a roll. Of these 16 children, only 3 were judged to have left roast potatoes behind and the waste for all of these fell into the 25% waste quartile (25% of portion left behind). On average, 8% of the total amount of roast potatoes served across the 16 children was wasted. One of the most wasted items in VillageSchool was sweetcorn. It was the second most popular item with 15 observations, but of those 15, 5 children left sweetcorn behind on their plates with varying levels of estimated waste (25%-100%).

3.6.5. Nutritional analysis

Using the VillageSchool plate waste data, a very preliminary calorific analysis of plate waste was conducted. In the absence of recipe information from SchoolCater, we used the School Food Standards (England) portion guidelines (Adamson et al., 2013; School Food Standards, 2015) and calorific estimates drawn from the United States Department of Agriculture (USDA) (USDA), and the Food Standards Agency UK Nutrient Databank. The portion guidelines were used to estimate a baseline portion size for each of the observed meals, and the calorific and nutrient databases were used to estimate total calories per portion. We then subtracted the appropriate volumes of food (and corresponding calorie estimates) left behind by children in the after plates. Table 26 presents the total estimated Kcals wasted/item and the total weight (g) wasted/item for TownSchool and VillageSchool respectively. This preliminary analysis illustrates how the quantity of food, and associated calories, lost due to plate waste can be calculated for each food item.

Food Item	Recommended Max Portion Size (g)/Item	Kcal/100g of item	Available Kcal/max portion	Average proportion of waste/item	Estimated Total Wasted (kcal)/item	Estimated Total Weight wasted (g)/item
Roast Potatoes	70-100g	149	149	8	186	125
Sweet Corn	40-60 g	23	14	20	45	192
Carrots	40-60 g	30	18	11	23	75
Flapjack	25-30g	493	148	2	37	8
Roast Chicken	60-85g	190	152	7	76	43
Omelette	1 egg	195	195	4	49	16
Custard	80-100g	95	95	0	0	0
Gravy	20-30g	30	18	0	0	0
Fresh Fruit	75-100g	62	62	0	0	0
Roll	50-70g	264	185	8	46	18
Green Beans	40-60 g	22	13	0	0	0
Cucumber	40-60 g	10	6	0	0	0
Tomato	40-60 g	17	7	0	0	0
Yoghurt	80-120g	154	185	25	46	30

Table 26. Summary of calorific analysis of plate waste at Village School

3.7. Explaining the pilot study results: an institutional theory approach

3.7.1. Purpose of this section

A key objective of Strength2Food is to generate findings which are publishable in high quality journals. To facilitate this, our empirical work should be anchored in strong theoretical contexts, linked to on-going debates and conversations in the literature. In relation to public procurement and supply chain management literatures, institutional theory is a well-used and well-respected theoretical context, which has strong explanatory potential for the dynamics of school meals supply chains. The theory lends itself to qualitative methodology, and we propose it may be possible to gather data relevant to an institutional theory perspective, in the context of WP6, with only modest extra effort on the part of WP6 partners.

The purpose of this section is therefore to give a brief introduction to institutional theory as an approach to analysing and explaining supply chain dynamics, and how data relevant to it may be collected. We conclude with a short section applying institutional theory to our findings of the Durham school meals service, to illustrate – in a very simple, preliminary way – how the theory offers a way of framing and explaining the hows and whys of the impacts identified.

3.7.2. Institutional theory and what it proposes about supply chain dynamics

Institutional theorists seek to explain and predict the dynamics of institutions, enterprises and/or actors operating in organisational 'fields', that is, spheres of organisational activity which "in aggregate, constitute a recognised area of institutional life: key suppliers, resource and product consumers, regulatory agencies and other organisations that produce similar services or products" (Meyer and Rowan, 1977; DiMaggio and Powell, 1983). Early researchers proposed that institutions and enterprises within organisational fields have a tendency towards common alignment of their practices (or 'isomorphism') as a result of specific external pressures, for example coercive (such as when firms comply with a new law or regulation in a field), normative (such as when actors fall in with practices implicitly accepted as appropriate within a profession) and mimetic (such as the tendency of some firms in an uncertain market to copy their competitors' strategies) (March and Olsen, 1984).

Since this early work, other researchers have introduced the concept of institutional logics, defined as actors' "assumptions and values, usually implicit, about how to interpret organisational reality, what constitutes appropriate behaviour, and how to succeed" (Thornton, 2004). Proponents of this concept contest the view that activity in organisational fields tends towards common alignment, by arguing that the individual institutions, firms and actors in a field interpret reality in different ways (i.e. have different institutional logics), which creates a tendency towards heterogeneous practices and behaviours. The tensions between existing logics in a field, and the pursuit of alternative logics by firms or actors, then creates what is known as institutional complexity (Greenwood et al, 2011). How individual organisations deal with this complexity can then be predicted based on factors such as the salience of the issues to their strategies, and/or the organisation's position in the field relative to others.

Concepts from institutional theory lend themselves very well to studies of supply chains, including those relating to the public procurement of food. Researchers have recognised that such chains, as networks of relations between different entities, embody very well the concept of organisational fields (Wooten and Hoffman, 2008), and numerous studies have sought to explain the behavioural dynamics of entities within supply chains from the point of view of the types of external pressure mentioned above. Thus for example, the tendency of entities within a supply chain to make common improvements on sustainability is explained with reference to increasing legislation or customer demand (i.e. coercive pressure) (Zhu and Sarkis, 2007), the desire of actors (e.g. employees) to affiliate themselves with sustainability advocacy groups

(i.e. normative pressure) (Tate et al, 2011), and the imitation by follower firms of leading firms' practices (i.e. mimetic pressure) (Wu et al, 2012). At the same time, other researchers have pointed out the possibility, and likelihood, of supply chains containing organisations and firms that possess different institutional logics, leading to a situation of institutional complexity (Sayed and Hendry, 2016). It can be argued that public food procurement chains may be particularly prone to the expression of different and conflicting logics due to the diversity of organisations they contain (public institutions, regulatory bodies, for-profit firms, social enterprises). As such, the concept of institutional logics may be a powerful one for explaining and predicting (and ultimately intervening to improve) the engagement of actors in a school meals procurement chain in LOC/ORG models, or other sustainability initiatives.

3.7.3. Applying institutional theory to explain the results of the Durham pilot study

The empirical work required for an institutional theory analysis of a supply chain involves depth interviewing of a range of participants from different parts of the chain. Participants are encouraged to talk freely about their experiences of working within the chain, to express how they 'see the world', and to reflect on the barriers and facilitators to changes in practices. Within the constraints of the pilot study, we set aside some time in our interviews with the actors in the Durham school meals chain to explore these topics. Here below we offer some very preliminary analysis of the ideas expressed by the interviewees. (NB analysis would normally involve full transcription and coding of interview data, and would be conducted over a longer timeframe. The analysis offered below is therefore for illustrative purposes, to show how an institutional theory perspective would explain the positions of actors in the service chain, and the overall tendencies of the chain with respect to sustainability.)

It was clear from the preliminary analysis that there is a strong emphasis on implementing sustainability in the school food procurement and catering services in County Durham. There are different social, environmental and economic requirements that have been written into the catering contract and are encouraged by DCC such as sourcing from local suppliers, encouraging healthy and nutritionally-balanced food, and applying for different sustainability certificates and accreditations (e.g. Food for Life accreditation). The desire to improve the sustainability impact of the school meals service comes strongly from DCC, however the individual schools, SchoolCater and food suppliers also play an important role in employing, implementing and even developing this desire, by going further than the minimum requirements in some cases.

The data indicate the existence of coercive pressures from DCC to SchoolCater to implement sustainability requirements throughout their service. In other words, the contractor is obliged, through its supply chain, to implement the minimum sustainability requirements/KPIs specified in the contract in order to avoid termination or non-renewal of the contract (examples of KPIs are in Appendix 3.2). On the other hand, the data also indicate the presence of more normative and memetic pressures, on the part of the individual schools to engage and facilitate the implementation of sustainability on their premises. We found the headteachers of both TownSchool and VillageSchool are influenced/inspired by the idea of incorporating sustainability into their food procurement and catering services (e.g. by growing food on site, having Fairtrade certificates) and into the learning processes of their children (e.g. by developing knowledge of where food comes from, increasing children's international awareness and collaboration with other nations). Also, the headteachers are keen to join different food sustainability initiatives, for example participating in the school sustainability association Eco-Schools. We found that the headteacher of VillageSchool is particularly oriented towards involvement in the local community, due at least in part to the remote location of the school, its small size and the majority of the children from farming families. This

headteacher has pushed sustainability practices at VillageSchool beyond the norms of the organisational field by achieving Gold Food for Life status.

From the preliminary analysis, the data suggest multiple institutional logics that may exist in the Durham school meals supply chain. Two examples are a sustainability logic and a commercial logic. In the individual schools, we found the sustainability logic is more dominant than the commercial logic, as although school leaders must work to tight budgets, the remit of their organisations allows them to be more focused on sustainability outcomes. On the other hand, SchoolCater, as a contractor, operates within commercial realities which influence the way that sustainability matters are approached. For example, when the VillageSchool head teacher pushed for Gold Food for Life status, SchoolCater agreed to support the switch to the organic meat supply only because VillageSchool's small size made the cost implications manageable.

Ultimately, the multiplicity of institutional logics in the Durham school meals service may increase the institutional complexity of implementing sustainability initiatives through the supply chain, especially within the existing form of the chain of authority. Whatever their aims and desires towards implementing different sustainability initiatives, the schools don't have direct control or authority over SchoolCater and kitchen employees. Instead, it is DCC that has the main influence, but its approach to sustainability may be at odds with the schools'. DCC still has to be driven by schools' ambitions and requirements however, otherwise the schools will not choose to be supplied by the appointed contractor. In the midst of this delicate balance is the dilemma of the limited, predetermined price of £2 per meal. This adds to the restrictions of the contractor and suppliers in achieving all schools' wishes. All these factors and others can contribute significantly in increasing the complexity of implementing sustainability throughout the public school meals supply chain. We propose these are worth studying in more depth in the main WP6 case studies, using the lens of Institutional Theory.

3.8. Reflections on the pilot study experience and lessons to learn

3.8.1. Introduction

In this Chapter, we offer reflections on the process of undertaking the pilot study generally, and then specifically in relation to selection of case studies, and conducting each of the environmental, economic, social and nutritional parts of the analysis. For each of these, we also suggest lessons to take forward in the planning of the full WP6 case study work.

3.8.2. General methodological approach

Overall, our experience has been that the general methodological approach for WP6 is sound, in the sense that meaningful and useful results can be obtained from it. The methodology also gathers a greater range of data on specific public procurement cases than has been undertaken by previous studies, therefore the approach does add value. At the same time, the quality of the analysis, and ensuing results, are very dependent on the clarity with which the case areas/supply chains can be defined, which has implications for WP6 case study selection. Quality of analysis and results are also very dependent on the researcher's ability to obtain specific data from informants, which has implications for data collection procedures in environmental, economic, social and nutritional analysis. We consider each of these in turn.

3.8.3. Case study selection reflections

The methodological basis of WP6 is to investigate the school meals service in two contrasting cases, one LOC/ORG model, and a LOW comparator model (specifically collecting data on 5 schools in each case). In the pilot study here, all data were collected in one LA area, which can

be regarded as having pursued a LOC model based on the sustainability criteria written into the school meals contract tender. Our reflections on this are:

- In the UK, school meals are generally organised by LAs, therefore the unit of analysis can be the LA area, with all schools in the contract in that area comprising the sample population. This makes data collection quite efficient, and also makes aggregation of data to the case level possible, as typically all schools on the contract are supplied by the same firms, thereby reducing the possibility of confounding factors in the analysis. Decisions about the units of analysis, and how to collect and aggregate data, are different/harder in countries where meals contracts are organised individually by schools (e.g. in Serbia).
- In our Durham pilot study, we focused on the chains to two specific schools – VillageSchool and TownSchool – to bring a dimension of comparison into our analysis. We found that the carbon footprint of VillageSchool was high, in part because of its remote location. This highlights the value for case selection to aim for reasonable commonality across schools, in terms of geographic location, deprivation profile, etc. If 'outlier' schools are included in a sample, this needs to be done with clear acknowledgement of likely effects, and the consequences for comparability of results across cases thereafter.
- Although the pilot study area, and the specific schools we investigated, contained informants who were already enthusiastic about sustainability, we were not able to obtain all the data we would ideally have liked. This raises issues about obtaining data in a LOW model case.

3.8.4. Carbon footprint analysis reflections

In the pilot study, the carbon footprint analysis comprised the largest part of the work in terms of data analysis. A reasonable amount of time was taken up in identifying the most recent, relevant and specific emissions factors to apply to the food items we wanted to analyse, and checking the suitability of these – and our interpretations of them – with local experts. However, possibly the greatest amount of time was spent developing the formula to estimate local transport emissions to supply food items to each of the schools (again was conducted with advice of local expert), and calculating the total quantities of food items purchased. Our reflections on this are:

- The carbon footprint analysis for WP6 relies heavily on the availability of data on total quantities of food items purchased by case schools over one school year. In the Durham pilot, we unfortunately did not obtain actual orders for VillageSchool and TownSchool over a year. Instead, we extrapolated from a small sample of order forms, covering 2-3 weeks, obtained whilst on-site at the schools undertaking interviews. As the Durham meals service operates a 3 week menu cycle, and we were informed that orders do not vary much over the school year, we felt reasonably confident that our extrapolation was a fair representation of actual orders. We propose that this methodology could be adopted by partners in the full case studies, where similar menu arrangements exist. However, in cases where menus have more variability over the school year, extrapolation would be less accurate, and it would become more important to gather full records. (Of course, where full records are obtainable, it would be preferable to use these regardless of menu arrangements).
- The WP6 carbon footprint analysis also relies heavily on accurate estimations of local transport arrangements. Again in the Durham pilot, we did not obtain direct information about the actual distances involved in the delivery rounds to VillageSchool and

TownSchool, nor the exact number of drops to other customers. We estimated these on the basis of general information provided by the FreshGrocer MD as to the shape and size of delivery rounds. We intend to undertake some sensitivity analysis to identify how much variations in estimated distances/drops makes to the overall emissions result. However, in the meantime we propose that WP6 partners may use a similar estimation technique for local transport emissions, based on information from local suppliers/wholesalers.

- Heavy reliance is also placed on the availability of factors to estimate the agricultural production-related emissions of supplying food to case schools. During the course of our analysis, we identified several reports/databases, each proposing factors based on slightly different measures and levels of aggregation. Our experience reinforces the need to develop a refined list of emissions factor sources which can be used by WP6 partners. It also highlights the value of 'sense-checking' any results obtained from the use of one set of factors with those from another set, to establish what the effect on carbon footprint would be following alternative methods of calculation/aggregation.
- Finally, in the Durham pilot we only included fresh grocery items in our carbon footprint analysis, on the basis that non-fresh items (processed, ambient, frozen..) were unlikely to vary between a LOC/ORG model and a comparator. However, what we found from our analysis was a much greater purchase of fresh vegetables by VillageSchool compared with TownSchool. This leads to a potentially misleading impression of a higher carbon footprint at VillageSchool, because we did not measure any offsetting as a result of potentially higher quantities of non-fresh items being purchased by TownSchool. We propose that in the full cases, it would be interesting to include substitutable non-fresh items in the analysis, in order to explore this comparison. It could be that one of the less appreciated benefits of a LOC/ORG model is the greater use of fresh foods, which may result in a lower carbon footprint. (In contrast, we may wish to exclude items such as eggs or milk, where the emissions difference between models may not be significant).

3.8.5. Economic impact analysis reflections

In the pilot study, the economic impact analysis comprised a medium level of time and effort. The main challenges were in ensuring we had entered and interpreted data appropriately in the LM3 tool, and in estimating values where we had been unable to obtain these directly from interviewees. We anticipate that use of proxy values may be necessary for partners in the full WP6 case studies, due to reticence of interviewees to share commercially sensitive information. Our specific observations are:

- To undertake LM3 analysis, researchers are required to identify what proportions of budget recipients' expenditures are made on staff, suppliers and other direct costs. In the Durham pilot, we were not able to obtain this information initially, as it was seen as commercially sensitive. We obtained an estimate of expenditure on staff/payroll using the FAME database[15], which also has representation in other EU countries, so may be a source for other WP6 partners to use. To estimate expenditure on suppliers, we calculated the total cost of food purchased by SchoolCater using information about per meal food costs given in interview, and assumed this represented the expenditure on food suppliers. We then estimated the breakdown by individual suppliers using the small sample of school order forms. In practice, the SchoolCater manager corrected our estimation in a post-hoc discussion where we shared the results of our analysis, and

[15] http://www.bvdinfo.com/en-gb/our-products/company-information/national-products/fame

explored ways in which the research could be of benefit to the firm. We offer these experiences as possible approaches for other partners to take to estimate values for the LM3 analysis. In particular, we emphasise the value of seeking to work with informants in a spirit of a two-way conversation, to promote reassurance and trust about the intentions of the research.

- For the analysis of economic impacts beyond LM3, we adopted a qualitative, narrative reporting of results, on the basis of the small sample size of businesses involved. Our experience confirms that this is the appropriate approach, and so propose to retain it for the full WP6 case studies.

3.8.6. Social impact analysis reflections

In the pilot study, the social impact analysis represented a modest amount of time and effort. This was not a reflection of the relative importance of social impacts, rather the phenomena and means of gathering and reporting data were more familiar to us. Our specific observations are:

- As with the non-LM3 economic analysis, we adopted a qualitative, narrative reporting of social impacts in view of the small sample sizes of people involved. We propose this is the most appropriate approach to take forward for the full WP6 case studies.
- To explore social impacts in the pilot study, we found particular value in encouraging interviewees to speak in depth about particular examples of relevant events, initiatives and projects, as well as to speak about their own motivations and orientation. We propose to encourage WP6 partners to do this in the full case studies, and in the reporting, to reproduce verbatim parts of testimonies to bring the examples to life.
- Our original intention in the pilot study was to undertake a survey of kitchen staff's job satisfaction and well-being. We developed a questionnaire but did not administer the survey due to lack of time and access to a sufficient sample. We will discuss with WP6 partners the possibility of taking forward this part of the social impact analysis, and whether it would be feasible to undertake. In practice, we gathered rich insights about perceptions of working environment and job satisfaction from the depth interviews with kitchen staff.

3.8.7. Nutritional impact analysis reflections

As we have emphasised previously, in the Durham pilot we undertook some modest data collection and analysis of plate waste at TownSchool and VillageSchool, for exploratory purposes, and an illustration of a nutritional analysis. Despite the modest scale of the data collected, we judge that the plate waste study was the second most time-consuming activity in the pilot study, after the carbon footprint analysis. If the plate waste study were to be conducted on a scale intended by WP6.2 guidelines, it would far outweigh the time and resource commitment of all other tasks in WP6. Two key reasons for the resource intensity of the plate waste study are:

- Requirement for preparatory work to gain cooperation of schools to permit intervention in lunch services, to speak with school kitchen staff and catering supervisors to make arrangements for data collection to be conducted, and to observe at least one full lunchtime service prior to commencing data collection. Our experience is that all these steps were necessary to ensure smooth process of data collection, and to maximise the number of observations made.
- There is a limit to the number of observations that can be made during one lunchtime service (either because of limit on total number of students and/or short timing of services). Based on our experience, we would estimate 20-30 observations is a feasible number to achieve in one occasion, using 2 researchers.

To reinforce the point about resource needs/intensity, we present below (Table 27 and Table 28) our estimation of what equipment and protocols would be needed to conduct the pilot study, as currently intended by WP6.2 Guidelines, based on our experiences in the Durham pilot. Overall the lessons we would put forward for the main WP6.2 study are:

1. The need for a continuing conversation about how to manage the resource needs of the plate waste study, in order to make the study feasible within the resource constraints of the WP6 partners, whilst still generating useful, publishable results.

2. The need for a continuing conversation about the design of the plate waste study, in particular the basis for selection of meals/meal components for observation. Our experience suggests that random observation of all meals and components at every service is inefficient and could lead to large quantities of unanalysable data. We propose that a more targeted sampling approach, which focuses data collection on a specific set of meal components (e.g. vegetables accompanying a main meal) would result in generation of higher quality data, and represent more effective use of time and resources.
3. The value of analysing the plate waste data in context of the school and lunch service environment. In our experience of collecting data at VillageSchool and TownSchool we saw many opportunities to link the % levels of plate waste observed to different contextual factors, including the ways in which the lunch service was organised, the canteen environment, even the school's approach to food and eating more generally. We therefore encourage the possibilities to link data collection for WP6.3 (interviews with school head teachers, kitchen staff..) to the plate waste study, as a way of increasing the explanatory potential of the results.

Data Type	Rationale	When?	WP6.3
In depth Interviews			
Head Teachers	To discuss how the school meal service has developed and how it fits within the wider school ethos and curriculum. To discuss, and agree, observation of school lunch service and the options for collecting photographs of before/after plates that minimise disruption to school lunch service	Incorporated into planned interviews with Head Teachers in WP6.3	Yes
Unit Manager/ Head School Cook	• To discuss how the kitchen, food preparation, school meal service (including clean up and waste management) processes and practices. • To discuss, and agree, options for collecting photographs of before/after plates that minimise disruption to school lunch service.	Incorporated into planned interviews with Unit Managers/Head School Cook in WP6.3	Yes
Catering Provider (Private or Municipal authority)	To discuss the development and management of the kitchens, food preparation and school meal service including menu development; food ordering and delivery schedules; staff training and development; school events and initiatives, and waste management.	Incorporated into planned interviews with Catering provider in WP6.3	Yes

Informal Discussions			
Other Kitchen Staff	To capture additional insights from others involved in the meal preparation and service	Before and After School Meal Time Observation	Yes
Lunchtime Supervisors	• To discuss the processes and practices for managing children in the school canteen including their pre-service role (canteen set up) and how they direct, encourage and support the children during lunch service. • To discuss, options for collecting photographs of before/after plates that minimise disruption to school lunch service	Before and After School Meal Time Observation	No
Supervising Teachers	As for lunchtime supervisors above and only if teachers are actively involved in the school meal service	During School Meal Time Observation (where appropriate)	No
Observation of School Meal Service			
School Canteen	• To observe a full school meal service in order to build up a practical understanding of what a full school lunch service involves from numbers of services and meals served, timings, canteen layout, queuing, supervision, ordering, eating, to waste management and clear up. • Take detailed field-notes, pre and post service photographs and have informal discussions (as detailed above) with kitchen staff and lunchtime supervisors.	On same day as in-depth interviews with Head Teacher and Unit Manager	No
Plate Photograph			
School Meals	To collect matched before and after photographs of main meals and/or desserts for the sample of selected children in each school and for each data collection day (Full details will be provided in final Methodological Handbook prepared by WP6.2).	Dedicated Plate Data Collection Days	WP6.2
Documentary Data			
All Key Actors	To complement, and support, sustainability and nutritional analysis of school meals. Recommended documents include: 1. Food ordering and delivery schedules and associated paperwork 2. Menus (and associated recipes);	During and after in-depth interviews, observations and plate photograph.	Yes

	3. Meal uptake figures (in total and by meal type if available); 4. Waste figures (Canteen); 5. Relevant School policies (lunch; drinks; lunchboxes), 6. Accreditation applications (Food for Life accreditation applications), 7. Quality assurance reports (OFSTEAD reports in England), 8. School newsletters/social media feeds (TownSchool has a very active twitter feed).		

Table 27. Data collection needs for a plate waste study (for discussion)

Equipment	Role and Specification
1. Digital Camera(s) and memory card(s)	• Require one/two high resolution digital camera(s) and memory card(s)
2. Tripod(s)	• Tripod to hold and position digital camera at a 45°
3. Portable Table	• Table for A3 laminated place map that plates are placed on (Recommended as a suitable table may not always be available)
4. Digital Scales	• A digital scales for weighing sampled meals, and if possible, all photographed plates. We identified a number of possible digital scales that are suitable for capturing the before/after photograph and meal sampling.
5. Tray or Place Mat	• Laminated placement (as per final instructions from WP6.2 Methodological Handbook)
6. Field note Diary	• Diary for taking field notes before, during and after lunchtime service
7. Number and Reward Stickers	• Stickers to number the selected children and reward them for participation in the plate waste study.
8. Soluble Markers and Tissues	• To record, and clean off, the codes for each child on the laminated place mats for matching the before and after photographs.

Table 28. Equipment requirements for a plate waste study (for discussion)

Appendix 3.1

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%

Appendix 3.2

Indicative list of Key Performance Indicators (KPIs) successful contract holder to report on annually (Durham County Council, 2008)

Category	KPI	Threshold
Uptake	Free and paid meal uptake	Not specified
Staff Performance Indicators	Number of meals served per staff hour	Not specified
Staff absence	Days or hours lost as result of sickness	Not specified
Staff training	Number of staff with Level 2 in Food Safety and Catering	Expectation that all staff hold Level 2 certificate
	Number of staff with certificates in Health & Safety, Manual Handling, Environmental Issues, Safeguarding Children, Food & Nutrition	Not specified
Nutrition & Healthy Eating	% of meals cooked fresh from raw ingredients, on site	Expect minimum of 80%
	% of schools with bespoke, nutritionally analysed menus	Not specified
	% of schools providing special diets within 2 wks of request	Expect 100%
Sustainable & Environmental Performance Indicators	% by value of foods served which originate from primary producers in County Durham, and North East	Not specified
	Total waste produced from delivery of contract	Expect contractor to reduce total waste produced
	% of the above waste being diverted from landfill	Minimum 15% in Yr1 of contract, 30% Yr 2, 45% Yr 3, 60% Yr 4.
	C02 emissions resulting from delivery of the contract	Contractor required to have carbon management plan, reported at end of Yr3
Additional	Staff to have CRB checks	All staff to have current CRB enhanced disclosure
	% of schools where annual review meeting held with headteachers	Target 95% per year

4. RESULTS AND LESSONS FROM WP7 PILOT CASES: LOCAVORIUM SHOP AND KORYCIN CHEESE

Results of WP7 pilot cases confirmed the correctness of the methodological approach. Surveys conducted in several "Locavorium" and "Korycin" farms revealed that all farmers use different distribution channels (from 2 to 5 channels per farm in the sample), including both – the short and long channels. For all identified chains, sustainability was assessed with the use of selected indicators. The majority of indicators was adopted from the handbook with minor adjustments, reflecting specificity of supply chains (e.g. in the assessment of food miles and carbon footprint, distances travelled by producers and consumers were combined). Additional indicators were proposed: food waste, chain value added and self-assessment-based social indicators.
Preliminary, main findings are as follows:

- all economic indicators are much higher for short than long chains;
- food miles seem not to differ much, but there are large differences among particular channels;
- social indicators seem to be similar for long and short chains;
- generally, there are large differences between particular channels (chains) and between farms within the same channels;
- relations found in the French and the Polish cases were very similar.

The pilot cases showed that the reality is much more complex than it was assumed. The cases were helpful for clarifying the methodological aspects of the research. The main lessons regard such issues as the integration of surveys for qualitative and quantitative assessment, construction of indicators and refining the farm survey questionnaire, the need to prepare detailed guidelines for all WP7 surveys.

4.1. Introduction

The main objective of the Work Package 7 – "Evaluation of the Impact of Short Food Supply Chains (SFSC)" – is to better understand the impact of Short Food Supply Chain (SFSC) on rural territories by evaluating concrete case studies in six European countries and identifying factors that support or deter the development of SFSC. This involves both understanding the role, motivations, attitudes and practices of actors already engaged in different types of SFSC and evaluating the impact of, and interrelation between, the chosen food chains and social, environmental and economic dimensions, in given territories. The specific objectives of this WP are:

- 7.1 To provide an assessment of motivations, practices and organizational development of SFSC by collecting, analyzing and comparing qualitative data from 12 SFSC case studies divided amongst six selected countries;
- 7.2 To provide an assessment of economic, environmental and social impacts of SFSC by collecting, analyzing and comparing quantitative data from the same 12 SFSC case studies.

The WP7 methodology combines **qualitative and quantitative approaches** based on the fieldwork in the participating countries (in-depth interviews and documentary analysis) and a selection of 12 case studies for selected product and types of SFSCs.

For gathering primary data, questionnaires have been constructed:

- to interview consumers that allows us to identify drivers, motivations and barriers among consumers for acquiring food through SFSCs as well as testing a food mile/carbon footprint indicator at the consumer level..
- to interview farmers in a quantitative approach (within task 7.2), that allows us to collect data and information required to calculate indicators used for assessing sustainability of supply chains.

For quantitative analysis, a set of economic, environmental and social indicators was proposed and discussed with WP7 partners.

The key contributions of partners to the realization of task 3.4. "Pilot Studies of Impact Assessment for WP7 Short Food Supply Chain" were as follows:

- Ecozept (F) – conducting pilot test, comments and suggestions on methodologies of the analyses;
- Consumption Research (SIFO, Norway) – constructing questionnaire and methodology of consumer surveys;
- SGGW (PL) – developing the set of indicators for quantitative analyses, constructing questionnaires and methodology of farm surveys, conducting pilot tests in the sample of farms (cheese producers) in Poland, Calculation of indicators for the sample of test farms;
- Other WP7 partners who participated in the e-mail or Skype discussions.

In the report we focus on the methodological assumptions for WP7 quantitative assessments and pilot tests, including an additional test conducted in Poland, not planned in the original WP3 task assignments.

Details of pilot studies conducted by Ecozept (France), as well as methodology for the customer study developed by the team from Consumption Research Norway (SIFO) are provided in the attached full texts of respective reports.

4.2. Customer survey

In the pilot a customer survey with 60 respondents was undertaken in order to test the method to gather data for calculation of food miles and carbon emissions for the consumer level of SFSCs. The survey also included questions about the customers' background as well as purchase practices and motives for visiting the Locavorium food store. The interviews were conducted with computer-assisted personal interviewing (CAPI), and took place by the counter of the store, where every person who purchased something was approached (no further sampling/picking protocol).

4.2.1. Results about the SFSC customers

The respondents could state to what extent they agree or disagree with statements related to how they experience that shopping in this specific shop has changed them. Most of them agree that as a result of shopping there, it has increased their knowledge about food production (85%). They also thought food quality had become more important (77%), and that they cook more with seasonal food than before (77%). Many also experience that they cook more "from scratch" (58%). About half of them also agreed that the amount of waste from the household had decreased (48%). The respondents state that the most important reason for them to shop there is to support the local farmers (28%), followed by to get food of high quality (24%) and because they trust the shop (14% and it gives access to fresh food (12%). On average, the customers drove 6.15 km to get to the store (one way). The distance varied from one to 40 km. The average CO_2 output of the respondents' car models was 140 g/km. Average CO2 emissions of newly registered cars in the EU was 123 g/km in 2014.[16] Taken into consideration that the average age of the cars among the respondents was eight years (from 2009) it is reasonable that their average emissions are above those of new models. If we take into account that 70% of the

[16] ICCT (2015/16). European Vehicle Market Statistics Pocketbook 2015/16. http://www.theicct.org/sites/default/files/publications/ICCT_EU-pocketbook_2015.pdf See also Coley et al., 2008)

trips had also another purpose than solely the food shopping, a smaller share of the environmental impacts should be accounted for by the food.

As described in the methodological section the fuel consumption and carbon emission of each respondent's trip was calculated by the information on their cars' brands and models.[17] For some cases it was difficult to trace the exact model in the calculator in spite of the detailed information given. Other food system analyses often use an estimated average of fuel consumption and carbon emission from cars based on secondary statistical data (e.g. Coley et al. 2008), thus, this is also applicable for our purpose.

Based on the experience with collecting detailed data on the respondents' cars as well as identifying the same models in the calculator we will consider to change the question on the car's brand, model and year. One suggestion is to differentiate only between different segments of cars, for instance: Large (SUV, Van, Offroad Sports- and Luxury), medium sized and small[18] in addition to hybrid and electric cars. The calculation of CO2 emissions may then be done on the basis of average statistical data on different segments of cars.

4.2.2. Summary of main findings for design of questionnaire and calculations of indicators

- Consider changing some of the questions especially about the type of car used
- Secondary data on average fuel consumption and carbon emissions can be obtained for different segments of cars
- Collect or take pictures of the cash vouchers to register purchases
- The prices on the products may also be obtained from the cash vouchers, but also directly from information in the shop
- If available, counterpart data on food purchases, shopping trips and travel distances may preferably be obtained from secondary data (national statistics or transport (food miles)/consumer studies).

4.3. Methodology of quantitative analyses (task 7.2) – SGGW (PL)

4.3.1. Types of Short Food Supply Chains

There are several types of supply chains that may be distinguished depending on the final destination of the produce (type of client or end consumer), type and number of links in the chain or type of products (raw materials or processed foods). It was assumed that single farmers may belong to several chains that differ not only in the length (measured as distance, as well as the number of intermediaries), but also such characteristics as labor input, costs of sales, etc. Basing on these assumptions, as well as literature review and practical experience the following types of chains are taken into consideration in the Farm Survey:

a. Pick your own
b. On-farm sales to individual consumers
c. Sales to retail shops (1 intermediary)
d. Direct sales: internet deliveries
e. Direct sales: delivery to consumer
f. Direct sales on farmers markets (fairs)
g. On-farm sales to intermediaries

[17] https://car-emissions.com/

[18] A (mini-cars) B (small cars) C (medium cars) D (large cars) E (executive cars) F (luxury cars) J (sport utility cars) M (multi-purpose cars) S (sport coupes); (see for instance: https://en.wikipedia.org/wiki/Euro_Car_Segment)

h. Sales to wholesalers or wholesale market
i. Sales to retail chain (2 intermediaries)
j. Sales for processing

Chains a-f are considered short, while g-i are treated as long distribution channels. In the analysis comparisons will be made between all the chains, however the key counterpart for SFSCs will be "retail chain" (i).

Sales for processing, if applicable, is included only for the reason of balancing the farm sales, especially in cases where a farmer participates in different chains.

4.3.2. List of indicators adopted for SFSC

Based on the analysis of usefulness of indicators presented in the Handbook the set of indicators for quantitative assessments of economic, environmental and social sustainability of SFSCs was proposed by the SGGW team. The majority of indicators is adopted from the Handbook, however there are also new (additional) indicators suggested that are supply-chain specific. The indicators were discussed on WP7 skype meetings and with an extensive e-mail communication.

Factors that can be emphasized as relevant and important for selection of indicators for WP7 are related to how we best can measure the economic, environmental and social impact of SFSCs. In the selection of indicators, suggestions of the Methodological Handbook were followed. Some indicators were adapted with no or only small modifications. For other indicators we have made some major revisions including taking out or adding new variables, and some indicators we decided to take out as irrelevant for SFSC.

The final selection of indicators will take place after an evaluation of the results of the pilot test study.

ECONOMIC INDICATORS

Ec1: Price premium, profitability and value distribution

Price premium / Price difference

Adapting this indicator to the SFSC perspective we suggested to call this "price difference", that will be calculated as: *Price SFSC – Price Benchmark* (price benchmark stands for prices in a reference, conventional retail chains). This indicator will be calculated basically at 2 stages of the value chain:

- Farmgate (direct sales)
- Consumer (retail sales) (see Appendix 4.2; items 1,2).

We calculated also price premium in % as:

price difference at the farm gate divided by farm gate price for retail chain (see Appendix 4.2; item 3.)

Profitability and value distribution

Three indicators were calculated for SFSCs:

- Chain Value-Added, calculated as:
  - *price difference at farm gate minus packaging and sales costs.*
- Retailer margin, as the percentage of the retail price:
  - (*Retail price – purchase price)/Retail price [%].*

- Chain Margin at food stores and at hypermarket levels, as:
    - *(Retail prices in Retail chains – Farmgate prices for Retail chains) / Retail prices in Retail chains* (see Appendix 4.2).

ENVIRONMENTAL INDICATORS

Two of the suggested environmental indicators were adopted for WP7:

En1: carbon footprint (GHG) and En2: Extended food miles

Food miles and carbon footprint are among the most common environmental indicators for impact assessment and in the literature often mentioned to define the sustainability of a food system.

Adaptation of indicators to SFSC:

a. The calculation is limited only to transportation of products in different chains;
b. An attempt to integrate consumer considering mileage and consumption of fossil fuels associated with the use of different chains by consumers will be made. Total Food Miles will be a sum of Food Miles Product (delivery from the initial stage to retailer or final consumer in direct sales) and Food Miles Consumer (distances traveled by consumer to retail outlets).

New: FOOD WASTE (environmental indicators) for SFSCs

Food waste may be defined as the food loss during production, post-harvest and processing, marketing and consumption level. The minimization of food waste is included in the sub-theme E5.3 on 'waste reduction and disposal' of the FAO SAFA guidelines, and follows some default types of indicators and targets, specifically:

- Waste Reduction Target

Has the enterprise set a target in reducing the generation of waste, as well as the hazardousness of this waste, in or by its operations?

- Waste Reduction Practices

What practices and activities have been implemented that effectively reduced waste generation in the enterprise's operation?

- Waste Disposal

How much solid waste does the enterprise generate that is not segregated, stored and in such a manner that it is rendered non-hazardous to humans and environment at the point of release from the enterprise?

- Food Loss and Waste Reduction

What is the share of food that is lost or wasted in the enterprise's operations and what share is reused, recycled or recovered?

Relevance for SFSCs

Some of the environmental benefits associated with SFSCs mentioned in the literature concern the reduced use of packaging and food waste (King et al., 2010; Mundler and Laughrea, 2016; Galli and Brunori, 2013). It has been suggested that farmers generally provide only the amount of food that is actually needed (and specifically ordered). For instance, in box schemes, consumers pay in advance costs that are set beforehand, and producers are sure to sell their products at a given price (Brunori et al., 2011), which may have a positive effect on resource savings and reducing food waste. From the consumption side, buying fresh ingredients implies a higher quality of products, with a potential for lower food waste.

Indicator and variables

The food waste indicator will be calculated for the retail level only depending on data availability.

The following equation quantifies the amount of wasted food:

$$Food\ waste\ (\%) = \frac{amount\ of\ good\ purchased - amount\ sold}{amount\ of\ good\ purchased}$$

This indicator mirrors resource efficiency, since it relates the amount of wasted food to the volumes produced (or more specifically, sold). In particular, based on Møller et al. (2014), the key indicators at different levels of the value chain include:

Sector	Indicator	Unit
Primary production	Amount of food waste or any fraction of it / sold unit	Tonnes/ Euro
Processing	Amount of food waste (tonnes) / total manufactured food sold (tonnes)	Tonnes/ tonnes
Wholesale and logistics	Amount of food waste in mass per year / total input of food products in mass per year (kg food waste per kg input)	Kg/ kg
Retail and markets	Amount of food waste generated per year	Kg
	Amount of food waste / turnover	Kg/ Euro
	Amount of food waste per year / total input of (food) products in mass per year	Kg/kg
Redistribution	Amount of food waste generated per year	Kg
	if applicable, Amount of food waste / turnover	Kg/ Euro
	Amount of food waste per year / total input of (food) products in mass per year (kg secondary resources per kg input)	Kg/kg
Food service	Amount of food waste in food service *storage* / produced amount food in food services per country	Kg/kg
	Amount of food waste in food service *preparation* / produced amount food in food services	Kg/kg
	Amount of food waste in food service for *serving (plate leftover and display waste)* / produced amount food in food services	Kg/kg
Households	Amount of *total* food waste in household per person	Kg/ person
	Amount of *edible* food waste in household per person	Kg/ person

However, there are several drawbacks. First of all, measurements on food waste in production seem to have been rarely performed or to have not been recorded (FUSIONS, 2016). Moreover, data collection and field sampling are time and money consuming. Certainly it will not be possible to capture household food wastes, which probably make the largest contribution to total amount of losses.

SOCIAL INDICATORS

So1: Employment

Labour-to-production ratio will be computed for the farm level only. Input of labour for packaging and sales will be considered only in order to capture differences between chains.

So2: Value chain governance

This indicator is interesting and certainly relevant for SFSCs. As emphasized by the literature, 'fairer' power relations characterize SFSCs, in contrast to conventional food systems whereby producers tend to be more passive and subordinated (Schermer et al., 2011; Galli and Brunori, 2013). Moreover, the minimal number of intermediaries involved in SFSCs also imply that producers can enjoy a higher degree of independence in production and marketing decisions (Wittman et al., 2012; Schermer et al., 2011). Therefore the indicator on **value chain governance** is crucial and should really capture the balance of power between the actors.

With regard to the specific adaptability of this indicator for SFSCs, we suggest additional indicators based on producers' self-assessment:

- **bargaining power of producers in different food chains**;
- **chain importance according to selected features;**
- **co-operation level (for producers belonging to producers groups, associations, co-ops etc**.);
- **leadership (as above).**

Concerning the indicator on "Bargaining power distribution", the Methodological Handbook offered some indicators, which mostly were considered as not truly applicable for SFSCs. Such variables as "prod_proc 1" (product differentiation) may apply to FQS only. In case of another variable suggested by the handbook - "marketshare-l" it is rather not relevant for SFSC and certainly impossible to estimate.

So5: Social indicators (Population dynamics, generational change and gender equality)

Of these three indicators, only gender equality is taken into account for SFSC and estimated as the participation of women in packaging and sales activities.

4.3.3. Farm Survey questionnaire (Excel file)

The Farm Survey questionnaire is constructed in the form of a self-calculating Excel file. It is assumed that providing all requested data and information will allow for the calculation of all farm-related indicators. After discussions with the Ecozept team, other partners in the WP7 and based on experiences from the pilot tests (France, Poland) the final release of the questionnaire will be prepared by the end of March 2017 for use in the fieldwork in all countries that participate in WP7.

The file SFSC Farm Survey which is the template of the questionnaire is attached to the report as an Excel file WP7 FARM SURVEY TEMPLATE.XLS.

In Appendix 4.1, the list of indicators and key variables used in the calculation of indicators is presented. The list corresponds with the Farm Survey Questionnaire and provides detailed information on the mode of calculation, including formulas that are used in the Excel file computations.

4.4. Pilot Tests – quantitative analyses (task 7.2.)

In accordance with the DoW of Strength2Food, the partner responsible for the pilot test in WP7 was Ecozept (France). Because the detailed methodologies of quantitative analyses (farm survey) were developed by SGGW (Poland), an additional pilot test was conducted in Poland.

4.4.1. Results – Locavorium (France)

Full report from the pilot tests conducted by Ecozept (France) are presented in the separate Word document: "Task 3.4: Pilot Studies of Impact Assessment for WP7 Short Food Supply Chain". In this report only the basic description of the Pilot case and key results are included.

4.4.1.1. Locavorium Pilot Case Description

"Locavorium" is a shop located 5 km from Montpellier, southern France, which only deals with local products. The concept of its supply is based on:

- the **number of intermediaries**: delivery through maximum one intermediary between farmers and consumers,
- the **concept of proximity**: the majority of products come from within a radius of 50 km around the shop and the maximum distance allowed is 150 km.

Figure 15. The "Locavorium" food store

The project started in 2014 and the shop opened in November 2015. The investment reached 250 000 € and was financed by bank loans, grants and crowd-funding using the PickandBoost platform. Thanks to 209 contributors, Locavorium collected 9 323 € on May 2014.

In the Farm Survey, suppliers of the following products have been investigated:

- fresh products: apples, lettuce, carrots and eggs (free-range)
- 2 processed products: goat cheese and boiled ham.

A regional goat cheese made from raw milk (the "Pélardon") has a certificate of "Protected Designation of Origin" (PDO). The pork carcass is sold for 75% in the form of salted products. Boiled ham represents the largest volume of these products in GMS (about a quarter).

Surveyed farms are located in the Languedoc-Roussillon region, which is divided into two contrasting sub-areas:

- a coastal fringe that concentrates population in high demographic growth urban areas;
- rural mountainous hinterlands with very low population density.

Agriculture in this region is experiencing deep restructuring, especially in peri-urban areas like around Montpellier. Traditionally, agriculture around Montpellier has been highly specialised in viticulture and vegetable growing, targeting long distribution channels: viticulture through big cooperatives and vegetables through big farms specialised in dispatching/distribution (Aubry, Chiffoleau 2011). These two sectors have faced deep crisis for years now. At the same time, there is an extensive decline in the number of agricultural holdings – 10% between 2010 and 2013.

SFSCs have historically been regenerated around Montpellier at two periods of time, in the 70s and in the 90s, by "neo-rural populations", settled in remote rural areas and creating alternative distribution channels (box schemes, farmers markets, etc.) mostly with long distance transactions between rural areas and the densely populated coastal fringe. Nowadays, SFSCs also develop more locally in peri-urban areas, with diversification of the types of chains (markets, boxes, internet, local farmers markets, shops, partnerships with retailers, etc.).

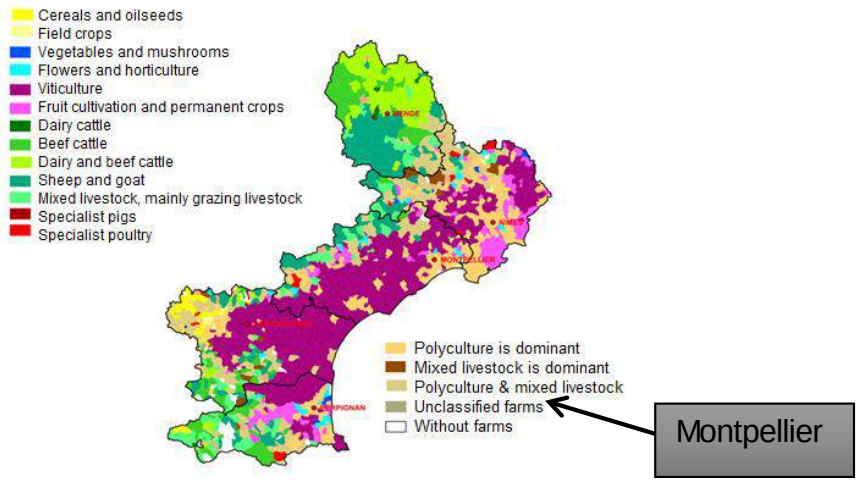


Figure 16. Type of farms in the region

Source: AGRESTE, 2010 Agricultural census

Table 29 provides the basic characteristics of surveyed farms.

Product	Unit	Apple 1	Apple 2	Carrot	Lettuce	Eggs	Cheese	Ham
Total area of agricultural land	ha	65	6.5	300	12	5	80	87
Area dedicated to the product	ha	25	2.5	50	3	-	-	-
Number of animals	Nb/yr	-	-	-	-	6000 laying hens	220 goats	600 pigs
price_l	€ / unit	2.04	1.48	0.29	0.50 / unit	0.18 / egg	13.75	17.23
Total farm turnover	'000 € / year	2000	117	2318	250	300	430	590
Turnover linked to the product (turnover_l)	'000 € / year	1 600	60	255	170	300	250	53
Share of product A in the total farm production in 2016	% of total value	80	52	11	68	100	58	9
Volume of production (prod_lz)	t/yr	900	90	1500	340 000 units	2 000000 units	96*	4.5

Table 29. Characteristics of farms surveyed in the Locavorium pilot test case

*The production of goat milk is 160 000 litres / year, 60% are used to make Pélardon = 96 000 litres (1 litre of goat milk ~ 1 kilo)

4.4.1.2. Indicators for Locavorium Pilot Case

The Locavorium pilot test allows us to calculate some of the indicators finally proposed for WP7 quantitative assessments. However, because of several changes made both, in the questionnaire and formulas to compute indicators which were introduced after the first version of the Farm Survey questionnaire was tested, making the full calculation of indicators will be possible after providing additional information by the Ecozept team, as recently requested. At this stage of the analysis of the Locavorium test case results, the structure of sales through different distribution channels is presented in Table 30.

Sales of product by channels	Number of farmers	Share of fruits & Vegetables [%]	Share of eggs & processed products [%]
Short channels	**6**	**88.2%**	**89.1%**
Pick your own	1	1.4%	-
On-farm sales to individual consumers	6	6.8%	2.3%
Direct sales - internet deliveries	1	1.0%	-
Direct sales - delivery to consumer	3	5.2%	4.3%
Direct sales on farmers markets (fairs)	1	0	0.6%
Sales to retail shops (1 intermediary)	6	73.7%	81.9%
"Long" channels	**5**	**11.8%**	**10.9%**
On-farm sales to intermediaries	-	-	-
Sales to wholesalers or wholesale market	5	3.7%	10.9%
Sales to retail chain (2 intermediaries)	1	8.1%	0.00%
Total	**28**	**100.0%**	**100.0%**

Table 30. Sales of products tested in the Locavorium case through different distribution channels (share in the total value of sales)

The Locavorium farmers participated in 8 out of 10 chains originally distinguished in the Farm Survey Questionnaire. Farmers from the sample were using mainly Short Food Supply Chains (nearly 90% of the value of sales) and retail shops were the main customers. Five farmers out of 7 participated in the "long" distribution channels (about 11% of the value of sales) selling their products through wholesale market or directly to the retail chain (1 farmer).

4.4.2. Pilot Results – Korycin Cheese (Poland)

4.4.2.1. Korycin Pilot Case Description

Korycin is a commune *(gmina)* in the Podlaskie region in the North-Eastern part of Poland (Figure 217).

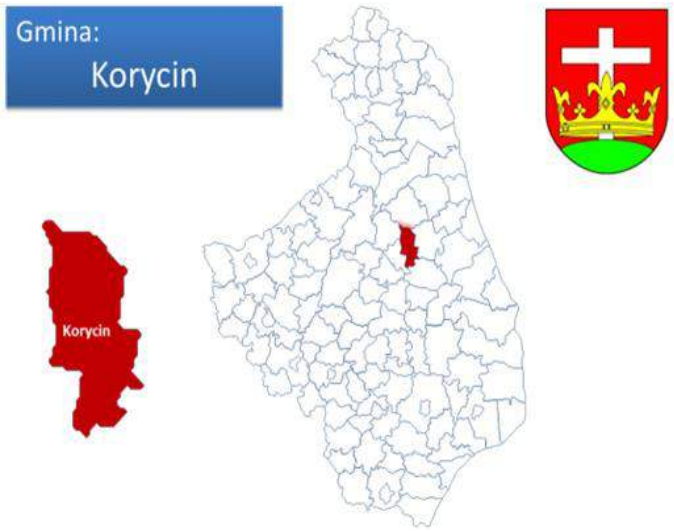


Figure 17. Location of Korycin commune on the map of Podlaskie region

Source: http://www.rops-bialystok.pl/problemyspoleczne/?page_id=330 (accessed 12.01.2017)

Korycin is located in the high value nature area, between two large complexes of forests belonging to National Parks. The area of the commune is 117 km^2 and the number of inhabitants is about 3500. Agriculture is the main industry of the region, as well as of the Korycin

commune. Agricultural land which constitutes about 85% of the total area (about 60% in the Podlaskie region) belongs to individual, family farmers. Productivity of land is relatively high as well as livestock density - much above the regional averages. The Korycin commune is famous for basically 2 products: strawberries, grown by 750 farmers and Korycin Cheese.

Korycin Cheese is a local variety of rennet cheese, maturing, produced from unpasteurized cow milk based on a traditional, old recipe (Figures 18 and 19). There is a group of 12 farmers who in 2012 registered the Korycin Cheese as a product of Protected Geographical Indication (PGI). The average farm size in the group is 29 hectares, ranging between 11.5 and 70 hectares. In total, farmers produce about 125 tonnes of registered PGI cheese annually.

According to a local legend the inhabitants of Korycina learned cheese production from the Swiss, whose fierce military units, engaged on the Polish side during the Swedish Deluge (1655-1660), took part in the fighting in Podlaskie region. After the war, some wounded soldiers stayed in Kulia farm near Korycin. The news is that some of them have been permanently in Poland, giving the local population the secret to producing the cheese.

Figure 18. Korycin natural cheese

Source: http://palcelizac.gazeta.pl/palcelizac/51,110783,10005987.html?i=3 (accessed 12.01.2017)

Figure 19. Korycin cheese with Provençale herbs

Producers of the Korycin cheese participate in a variety of distribution channels, ranging from on-farm sales, through SFSCs (direct sales, sales on farmers or food markets, own retail outlet) and long chains involving a number of intermediates (wholesale markets, sales to hypermarket chains).

The stand of the Gremza family on one of the popular food markets is shown in Figure 20.

Figure 20. Stand of the Gremza family at the food market

Source: http://serkorycinski.com/index/index.php/galeria/galeria-zdjec/15-galeria-galeria-zdjec/17-jarmarki (accessed 09.01.2017)

A pilot test of the farm survey questionnaire was conducted by the SGGW team through a series of interviews with 9 of the 12 Korycin Cheese producers. Farmers from the sample participated in 8 distribution channels, of which 4 may be considered as Short Food Supply Chains (Table 31).

Each farmer participated in at least one SFSC. The participation in SFSCs ranged from 2 farmers per channel (on-farm sales) to 7 farmers selling regularly or occasionally at farmers and/or food markets.

Seven of the 9 farmers participated in "long" channels involving at least 2 intermediaries.

Sales of product by channels	Number of farmers	Amount [kg]	Share [%]
Short channels	21	30871,5	38,3%
On-farm sales to individual consumers	3	5014,0	3,9%
Direct sales - Internet deliveries	4	10501,0	8,1%
Direct sales - delivery to consumer	1	4380,0	3,4%
Direct sales on farmers markets (fairs)	7	10976,5	8,4%
Sales to retail shops (1 intermediary)	6	18969,0	14,6%
"Long" channels	8	80335,0	61,7%
On-farm sales to intermediaries	2	14700,0	11,3%
Sales to wholesalers or wholesale market	4	50335,0	38,7%
Sales to retail chain (2 intermediaries)	2	15300,0	11,8%
Total	29	130175,5	100,0%

Table 31. Korycin cheese sales through different distribution channels

The share of sales of cheese through both types of channel was about equal. Long channels were attractive for larger-scale producers.

It is important to emphasize that Korycin Cheese is a specific product processed by a small group of farmers from a small commune located in a remote area of the country. However, the demand for Korycin Cheese is concentrated mainly in large urban centers in different parts of

Poland. About 8% of cheese is sold through the internet, delivered directly to consumers all over the country, small quantities are even sold abroad. But delivering this product to a large number of consumers beyond the region requires using intermediaries.

Another observation is that for different reasons farmers tend to diversify distribution channels. Only 2 smaller-scale farmers don't participate in "long" channels. Most of the farmers sell cheese through 3 or 4 channels, both short and long.

4.4.2.2. Indicators Korycin Pilot Case

Selected indicators calculated as weighted averages for all distribution channels used by Korycin Cheese farmers are presented in Table 32.

The whole set of indicators for all surveyed farms is presented in Appendix 4.2.

Sales of product by channels	Amounts of cheese sold through the channel (kg)	Economic				Environmental	Social			
		Price difference _Farm Gate	Price Premium	Chain Added Value	Chain Margin	FOOD MILES km/unit TOTAL	Labour to production ratio	Bargaining power	Gender equality	Chain importance
Short channels										
On-farm sales to individual consumers	2057	1,05 *(0,70)**	0,20 *(0,13)*	-0,36 *(1,17)*		6,56 *(0,17)*	0,28 *(0,25)*	3,78 *(0,35)*	0,93 *(0,22)*	3,66 *(0,40)*
Direct sales - Internet deliveries	2625	1,99 *(0,85)*	0,38 *(0,16)*	1,03 *(1,27)*		0,25 *(0,06)*	0,07 *(0,06)*	3,46 *(0,45)*	0,93 *(0,07)*	3,41 *(0,26)*
Direct sales - delivery to consumer	7792	0,51 *(1,0)*	0,10 *(0,10)*	0,22 *(0,50)*		1,78 *(5,0)*	0,04 *(0,03)*	3,24 *(0,82)*	0,31 *(0,25)*	3,28 *(0,81)*
Direct sales on farmers markets (fairs)	1568	2,14 *(1,29)*	0,41 *(0,25)*	0,54 *(1,77)*		5,61 *(4,55)*	0,19 *(0,21)*	3,18 *(0,64)*	0,65 *(0,27)*	3,54 *(0,62)*
Sales to retail shops (1 intermediary)	5070	0,56 *(0,66)*	0,11 *(0,13)*	0,17 *(0,54)*	0,34	2,54 *(1,60)*	0,11 *(0,08)*	2,69 *(1,14)*	0,49 *(0,12)*	3,05 *(0,95)*
Long channels										
On-farm sales to intermediaries	5994	0,03 *(0,96)*	0,01 *(0,18)*	-0,44 *(0,64)*		5,21 *(4,25)*	0,05 *(0,20)*	3,87 *(0,29)*	0,99 *(0,01)*	3,91 *(0,44)*
Sales to wholesalers or wholesale market	18880	0,93 *(0,23)*	0,18 *(0,04)*	0,68 *(0,25)*		2,84 *(0,66)*	0,03 *(0,02)*	3,55 *(0,29)*	0,36 *(0,07)*	3,73 *(0,30)*
Sales to retail chain (2 intermediaries)**	4500	0,80	0,15	0,51	0,38	5,05	0,04	3,29	0,33	3,00

Table 32. Selected indicators for supply chains used by Korycin Cheese farmers (average values weighted by the volume of sales in the channel)

** population standard deviation*
*** 1 observation only, standard deviation not calculated.*

4.4.2.3. Analysis of Korycin Cheese pilot test results

The main objective of the pilot was to test the usefulness of the Farm Survey Excel questionnaire for gathering data and testing the computation of selected sustainability indicators in the self-calculating tool. Based on our own practice with the tool, as well as considering comments and suggestions from the Ecozept team that resulted from the experience gained in the Locavorium pilot test several corrections and improvements have been made to the original

version of the Farm Survey questionnaire, allowing us to offer an applicable, final version of the tool that will be used by partners in WP7 case studies.
Our experience from interviews with Korycin Cheese farmers and preliminary quantitative analysis of the results allow us to formulate a number of observations and conclusions.

Regarding the technical part of the Survey:

- The Farm Survey Questionnaire is a complex tool constructed as a questionnaire for data collection and the self-calculating Excel file that allows computing of the majority of indicators considered in the WP7 quantitative analyses. The paper form of the questionnaire can be used, but the electronic version of the questionnaire is highly recommended as it may help to identify missing or incorrect data during the farm visit.
- The face-to-face interviewing technique is recommended for the Survey. This is due to the complexity and detail level of the questionnaire, but also to reduce misinterpretation of questions and lacking data or information, that may be generated even on a "best guess" basis during conversation of the interviewer with farmers.
- An alternative for farmers highly skilled in using computers (Excel in particular) would be sending the electronic version of the file to be filled in by the farmer. This can be supported eventually by a phone conversation.
- Face-to-face interviews in the Korycin Cheese case took about 2 hours per farm. There were some missing information identified after the visits, because the questionnaire was being re-constructed and new questions and indicators were added. Required additional data and information were collected from phone conversations.
- It should be emphasized that any missing variable (data), makes calculating the whole set of indicators impossible. In such a case, the questionnaire with data from a particular farm should be rejected. There were indications from the pilot test that farmers were not providing all the required information. This is the role of the interviewer to help farmers with making estimates or even "best guess" information and make sure that all indicators may be calculated.

Regarding results (indicators):

- The survey revealed, that Korycin Cheese farmers participate in a number of different forms of distribution chains (between 2 and 4), in most cases in SFSCs and "long" distribution channels. This is not unique, as the Locavorium case also shows, but in the Korycin case this is partly due to the specificity of the product which is produced locally, but is distributed to all over the country, mainly to the urban centers where the demand for this product is concentrated.
- All except 2 indicators (emissions from transportation and carbon footprint) have been calculated in the pilot test. In the case of the 2 missing indicators, the methodology still needs to be decided.
- The value of most indicators varies strongly both between the supply channels and within specific distribution chains. This is partially because of the small sample of farms, with some forms of distribution channels being represented by only 1 or 2 farms.
- There are 2 key factors that influence values of the key economic and environmental indicators: distance travelled by the product and amount of product transported (sold) in one delivery. This is noticeable in such channels as "sales at farmers market" – depending on their location and the amount of the product, also in counterpart chains, e.g. "on-farm sales to intermediaries".

- Economic indicators for Short Food Supply Chains are slightly higher on average than for counterpart,"long" chains, although because of the small size of the sample results this cannot be generalized.
- The environmental indicator Food miles varies significantly even between farms. Apart from distances and amounts travelled by the product, distances travelled by consumers, which were also taken into account in the calculation, influence the value of the indicator, specifically in the chain "on-farm sales".
- Internet sales seem to be a very attractive channel from the perspective of all economic, environmental and social indicators.

4.5. Recommendations for improvements in the WP7 methodology

4.5.1. Comments with regard to the technical issues

- Guidelines are needed on how to conduct the fieldwork (size of samples, types of interviews, on-line/face-to-face, etc.)
- Instructions regarding collection of primary and secondary data at the retail level are needed.
- The face-to-face interviewing technique is recommended for the Survey. Good and confidence-based relationships with the interviewees are crucial for good quality.
- Intermediate operating costs are easy to obtain in face-to-face interviews at the farm level, but not at the single product unity level (would be very time consuming, need for "techno-economic" approach).
- Food miles: the concept of "delivery round" may be used for calculations (several spots of delivery are more frequently observed than one-spot-delivery).

4.5.2. Comments with regard to the research questions raised

4.5.2.1. SFSC as an obligation for small holdings

One of the hypotheses to be tested is that part of the farmers explain that the willingness to suppress any intermediary is legitimately explained by the situation of their farm: their small size and/or small capital capacities don't allow them to produce big volumes at low price to the mass market offered by distributors. They thus find in SFSC the only market opportunity that fits to the production system they have. This was the case for the Locavorium farms "Lettuce" and "Apples 2".

4.5.2.2. SFSC does not always provide an economic enhancement

The farmer of "Apple 1" insisted on the fact that the **SFSC does not automatically give him an economic advantage** each year compared to a sale to the cooperative:

- in times of excess supply, prices are low and SFSC are economically advantageous
- but when the market is buoyant, a producer selling through SFSC may have less value and net result than in a long circuit.

4.5.2.3. Producers and supermarkets without intermediary: an expanding model of SFSC?

The "Cheese" farmer from the Locavorium case sells 70% of his production to supermarkets without any intermediary. He considers it advantageous to deal with this type of retail, as contracts are usually clear. On the contrary, some small shops are seen as bad payers. Producers of eggs, carrots and lettuce are also selling to supermarkets without an intermediary. Supermarkets are now more interested in local and seasonal products and ask producers for pictures of the farm, in order to promote this direct way to obtain supplies of a product. In fact,

direct sales to supermarkets, without going through central purchasing, seem to be spreading (Aubry and Chiffoleau, 2009). This supports our approach – identifying all possible Food Supply Chains in which producers participate, instead of focusing on specific chains only.

Appendix 4.1 WP7 formulas for indicators

Sustainability pillar	Indicators	Formula
Economic	**Price difference – farmgate**	= Farmgate price in the channel – Average Farmgate Price in Counterpart Retail chains (e.g. hypermarket)
Economic	**Price difference – consumer**	= Retail price in the channel – Average Retail Price in Counterpart Retail Chain
Economic	**Price premium**	= Price difference_Farmgate / Farmgate Price in Counterpart Retail Chain
Economic	**Chain Added Value**	= Price difference_Farmgate – Packaging and sales costs €/unit
Economic	**Retailer margin (%)**	= (Retail prices in Food stores – Purchase prices for Food stores) / Retail prices in Food stores
Economic	**Chain Margin:** **1. Food stores** **2. Hypermarket**	**1.** = (Retail prices in Food stores – Farmgate prices for Food stores) / Retail prices in Food stores **2.** = (Retail prices in Retail (hypermarket) chains – Farmgate prices for Retail (hypermarket) chains) / Retail prices in Retail (hypermarket) chains
Economic *(Variable)*	*Turnover*	Turnover – information from producer **2. Turnover Estimate** = Product Value / Share of product in the total farm production [% of total value]
Economic *(Variable)*	*Product Value*	= Sum (Volumes * Prices for all channels)
Economic *(Variable)*	*Packaging and sales costs €*	= (Man hours used for preparing for sale * Average salary: hired labour €/hour * Number of deliveries) + (Man hours for transport and selling * Average salary: hired labour €/hour * Number of deliveries) + (Packaging materials €/kg/piece/l * Amounts of product A delivered through channels [tonnes] * 1000) + (Other costs € per 1 delivery * Number of deliveries) + (Other costs € * Number of deliveries)
Economic *(Variable)*	*Packaging and sales costs €/unit*	= Packaging and sales costs € / (Amounts of product A delivered through channels * 1000)
Economic *(Variable)*	*Labour costs / delivery*	= (Man hours used for preparing for sale + Man hours for transport and selling) / Average salary: hired labour €/hour
Economic *(Variable)*	*Fuel costs*	= Fuel consumption l/unit * Price of fuel (€/litre)
Economic *(Variable)*	*Packaging and sales including fuel €/unit*	= Packaging and sales costs €/kg + Fuel costs

Environmental *(Variable)*	*Distance P-1 delivery_1 way* *(Distance travelled by product to retail outlet: per 1 delivery, 1 way transportation)*	**Channels:** a. = Approximate distance (km) travelled by product: On-farm sales to intermediaries (mean from part II table A) * coefficient transport from wholesale to retail b. = sum (table B % of sales in the channel; table B Distance km) * Coefficient_courrier transport **e.** = Approximate distance travelled by product (km) for Direct sales delivery to consumer **f.** = Approximate distance travelled by product (km) for Farmers markets (mean) **g.** = Approximate distance travelled by product (km) for Retail shops (mean) **h. – j.** = Approximate distance travelled by product (km)
Environmental *(Variable)*	*Distance C_1 delivery_1 way (Distance Consumer: distance travelled by product from retail outlet (including farm in channels a and b) per 1 delivery, 1 way transportation)*	= Best guess on average distance travelled by customers (km) for channel
Environmental *(Variable)*	*Number of deliveries*	**Channels:** **a. – d.** = Amounts of product delivered through channel [tonnes] * 1000 / Average amount per customer sold (unit) **e. – i.** = (Amount of product delivered through channel [unit] * % of the product delivered with the use of 1rst mean of transportation * 1000) / Average amount in 1 delivery (unit) + (Amount of product delivered through channel [unit] * % of the product delivered with the use of 2nd means of transportation * 1000) / Average amount in 1 delivery (unit) **j.** = Amounts of product delivered through channel [tonnes] * 1000 / Average amount per customer sold (unit)
Environmental *(Variable)*	*MILES transport All Products (km)*	**c. – j.** = (Distance P_1 delivery_1 way) * Number of deliveries * Coefficient_deliveries to retailer,consumer
Environmental *(Variable)*	*Food Miles Product (km)*	**c.** = MILES transport All Products (km) * share of the product (%) if other products transported **d.** = (MILES transport All Products (km) * Share_travel from Pick-up point (%)) * (Average amount / Use of capacity (Van) / Capacity (Van)) + (MILES transport All Products (km) * Share_travel from Parcel Centre (%)) * (Average amount / Use of capacity (Truck) / (Capacity Truck)) **e. – j.** = MILES transport All Products (km) * share of the product (%) 1st means of transportation + MILES transport All Products (km) * share of the product (%) 2nd means of transportation

Environmental *(Variable)*	*Miles Consumer Farm (km)*	**a.**= (Distance C_1 delivery_1 way) for pick your own * Coefficient_return way * Number of deliveries for pick you own **b.** = (Distance C_1 delivery_1 way for On-farm sales to individual consumers) * Coefficient_return way * Coefficient for "passing by" * Number of deliveries for On-farm sales to individual consumers **c., f. – i.** = (Amounts of product [tonnes] * 1000 / Coeff._average amount purchased in unit) * Average Distance travelled by consumer by car * Coeff. % consumers by car
Environmental *(Variable)*	*Miles Consumer Product (km)*	**a. b.** = Miles Consumer Farm **c. , f. – i.** = (Amounts of product [tonnes] * 1000 / Coeff._average amount purchased in unit) * Average Distance travelled by consumer by car * Coeff. % consumers by car * Coefficient: share of product in total purchases
Environmental *(Variable)*	*Food Miles Product km/unit*	**c. – j.** = (Food Miles Product km / Amount of Product * 1000)
Environmental *(Variable)*	*Food Miles Consumer km/unit*	**a. – c., f. – h.** = Miles Consumer in the channel / (Amount of product delivered through the channel [units] * 1000)
Environmental	**FOOD MILES km/unit TOTAL**	= Food Miles Consumer km/unit + Food Miles Product km/unit
Environmental *(Variable)*	*Total Fuel Product*	c. = Food MILES All Products (km) / 100 * Average fuel consumption (litres/100 km) Intermmediary **d.** = Food MILES Product / 100 * Average fuel consumption (litres/100 km) "VAN" + Food MILES Product / 100 * Average fuel consumption (litres/100 km) "TRUCK" **e. – j.** = Food MILES Product / 100 * Average fuel consumption (litres/100 km) "Own No 1" + Food MILES Product / 100 * Average fuel consumption (litres/100 km) "Own No 2"
Environmental *(Variable)*	*Total Fuel Consumer*	**a. b.** = Miles Consumer Product (km) / 100 * Fuel consumption by consumer
Environmental	**Fuel consumption l/unit**	= (Fuel product + Fuel consumer) / (Amounts of product delivered through channel [tonnes] * 1000)
Environmental	**Emissions from transportation**	To be added
Environmental	**Carbon Footprint**	To be added
Environmental	**Food Waste**	To be added
Social	**Labour to production ratio**	= (Man hours used for preparing for sale + selling per 1 average delivery * Number of deliveries) / (Amounts of product delivered through channels [tonnes] * 1000)

Social	**Bargaining power**	= based on self-assessment: average of :My position in the chain; Level of trust in relations with other chain actors; Relations with other farmers; Relations with customers
Social	**Chain importance**	= Average of Ratings chain
Social	**Cooperation level**	= applies to members of producers groups, associations, co-operatives, etc.
Social	**Leadership**	= applies to members of producers groups, associations, co-operations, etc.
Social *(Variable)*	*Sales – labour input*	= Number of deliveries in the channel * (Man hours used for preparing for sale + man hours for transportation and selling)
Social	**Gender equality**	= % of the total labour input (women %)
Social *(Variable)*	*Labour input*	= Labour input * Gender equality (hours worked by women)

Distribution channels:
a. Pick your own
b. On-farm sales to individual consumers
c. On-farm sales to intermediaries
d. Direct sales: Internet deliveries
e. Direct sales: delivery to consumer
f. Direct sales on farmers markets (fairs)
g. Sales to retail shops (1 intermediary)
h. Sales to wholesalers or wholesale market
i. Sales to retail chain (2 intermediaries)
j. Sales for processing

Appendix 4.2. Selected indicators for distribution channels used by Korycin cheese farmers

CHAIN RELATED INDICATORS	Amounts of cheese sold through the channel (kg)	Economic				Environmental	Social			
Sales of product by channels		Price difference_ FarmGate	Price Premium	Chain Added Value	Chain Margin	FOOD MILES km/unit TOTAL	Labour to production ratio	Bargaining power	Gender equality	Chain evaluation
On-farm sales to individual consumers	**4114**									
Farmer 4	1314	0,10	0,02	-3,31		6,33	1,27	4,25	0,79	4,20
Farmer 6	2800	1,49	0,28	1,02		6,67	0,13	3,56	1,00	3,40
Direct sales - Internet deliveries	**10501**									
Farmer 4	4526	2,19	0,42	0,76		0,34	0,04	3,75	0,83	3,60
Farmer 6	350	2,89	0,55	2,70		0,23	0,02	2,56	1,00	3,00
Farmer 7	1125	0,56	0,11	-0,77		0,23	0,17	3,56	1,00	3,60
Farmer 9	4500	2,08	0,40	1,62		0,17	0,09	3,22	1,00	3,20
Direct sales - delivery to consumer	**23376**									
Farmer 1	7200	0,33	0,06	0,33		4,00	0,10	2,75	0,40	2,60
Farmer 4	4380	2,19	0,42	0,70		0,60	0,04	3,75	0,82	4,20
Farmer 3	819	-0,13	-0,03	-0,50		12,50	0,06	4,75	1,00	4,40
Direct sales on farmers markets (fairs)	**10977**									
Farmer 2	1500	2,19	0,42	1,14		7,12	0,30	3,00	0,20	3,60
Farmer 3	819	-0,13	-0,03	-3,43		11,92	0,04	4,75	1,00	4,40
Farmer 4	4380	2,19	0,42	0,70		1,32	0,04	2,75	0,82	3,40
Farmer 5	1200	0,56	0,11	-0,42		12,39	0,25	3,25	0,50	2,80
Farmer 6	1400	2,89	0,55	0,50		10,84	0,68	3,00	0,50	3,00

Farmer 7	438	2,19	0,42	1,80		1,13	0,09	3,89	1,00	3,80
Farmer 8	1240	4,05	0,77	2,40		3,85	0,13	3,75	0,58	4,60
Sales to retail shops (1 intermediary)	**25950**									
Farmer 1	10800	-0,13	-0,03	-0,14	0,34	0,92	0,04	1,50	0,56	2,20
Farmer 6	2450	1,26	0,24	0,25	0,34	4,12	0,30	2,11	0,33	2,20
Farmer 7	2500	0,33	0,06	-0,26	0,34	4,92	0,16	4,11	0,63	4,40
Farmer 9	5400	1,73	0,33	1,14	0,34	2,12	0,13	3,29	0,33	3,60
Farmer 5	4800	0,56	0,11	-0,10	0,34	4,88	0,14	4,50	0,50	4,20
On-farm sales to intermediaries	**23975**									
Farmer 2	8500	-0,37	-0,07	-1,25		5,07	0,05	4,00	0,98	4,20
Farmer 7	8375	0,33	0,06	0,21		1,53	0,00	3,89	1,00	3,80
Farmer 8	6200	-0,13	-0,03	-0,33		11,12	0,04	3,75	1,00	3,80
Farmer 9	900	2,08	0,40	0,39		0,12	0,50	3,25	1,00	3,00
Sales to wholesalers or wholesale market	**37760**									
Farmer 8	8060	0,56	0,11	0,29		3,88	0,06	4,00	0,47	4,20
Farmer 9	29700	1,03	0,20	0,78		2,56	0,02	3,43	0,33	3,60
Sales to retail chain (2 intermediaries)	**4500**									
Farmer 9	4500	0,80	0,15	0,51	0,38	5,05	0,04	3,29	0,33	3,00

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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.

www.strength2food.eu