D3.1

Indicators, Tools and Scenario Formulas for Assessing Food Chain Logistics

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1. Introduction

When looking at food chains it is possible to observe a move away from 'conventional' supply chains towards 'alternative' chains, which take a variety of forms but are structured according to new market requirements regarding environmental sustainability, economic performance and ethics in food systems. Different drivers of change play a role in this respect. The most important are: changes in the types of market, methods or production systems, new products, new ways of working together within the chain and different ways of organizing the supply chain. Supply chain management and logistics can, in that sense, been seen as both driver and enabler of change. When changes related to the market occur this can lead to changes in the way the distribution of the existing products in this new market must be organised. In this case , logistics and/or supply chain management is the enabler of this change. On the other hand the decision to deliver a product directly from the producer / farmer to the end user / consumer (with the underlying idea of connecting the consumer more to the farmer, or to being able to deliver a better quality product, or to bring the added value closer to the farmer,) focusses 'from the start of the innovation' on the redesign of the supply chain. In this example, it can be questioned if supply chain management / logistics is the driver of the change or if change is motivated by the underlying ideas as stated above.

One way to look at shifts from the 'conventional' supply chain is to utilize a supply chain management (SCM) perspective . The analytical starting point within the FoodMetres project focuses on innovations driven from market changes, changes in production systems, et cetera. When these 'settings' change, the supply chain will change. Supply chain management is also likely to be one of the main enables of successful innovations so, taking this into account is of upmost importance. Furthermore, the importance and strength of the SCM approach is that it emphasizes the whole food chain structure, including logistics. This gives insights into the interactions between different entities within the supply chain and emphasizes the fact that successful innovations are innovations that are adopted with the whole supply chain.

The focus of this work package, therefore, will be on logistics and performance indicators in the supply chain. The deliverable D3.1 focusses on food chain logistics from this point of view.

Logistics in the conventional food chain must be considered as offering a substantial contribution to making the food system more sustainable. Logistics can become more effective by introducing new distribution centres and retailers in the chain or can be changed by using new concepts. Opportunities for innovation range from citizen-driven approaches such as Community Supported Agriculture (CSA) to the development of Metropolitan Food Clusters (MFC). MFCs, for instance, use tightly knit networks and preferred supplements[1] to link production with distribution and consumption. Demands and resources will then be used in a different way e.g. coming from a pushing to a pulling, demand oriented, network, providing more customer satisfaction and resulting in less waste. Using new communication technologies and transport modalities, new approaches to small scale production networks are possible.

In the course of the FoodMetres project, the potential of implementing 'alternative' logistics in food chains in metropolitan regions will be explored, as well as their corresponding

[1] This is a socially defined tight community with special preferences regarding food items.

impacts on sustainability, quality of life and resilience (WP5). This will be done by evaluating alternative scenarios of the chain for the case study areas. In order to enable proper comparisons in the case studies of WP5, this task (3.1) aims to develop a general analytical framework for assessing food chain logistics. In order to develop the framework, specific objectives were to:

- Select specific food-chains per test case region with 5-8 key commodity groups
- Define scenario story lines with groups of commodities
- Identify the redesign principles for logistics of food chains

Identify performance indicators for food chain logistics for each

2. Methodology

The analytical framework, described by Van der Vorst et al. (2005), was used as the starting point for the development of our approach. The framework differentiates the managed versus the managing logistic system, the information system used and the organisational structure. The redesign principles, described in Van der Vorst et al. (2005), were linked to the FoodMetres approach towards innovation domains.

Implementation of the redesign principles will be different for the various agro-food systems LAS, MAS and GAS (for explanation see below) and, therefore, the redesign principles were applied separately to each of these agro-food systems. Based on the redesign principles, the scenario story lines were defined. These imply the innovative logistics of the agro-food system, in a general way. Performance indicators for comparison of the performance, in terms of Supply Chain Management redesign principles, of the innovative agro-food system to the reference situation were identified for each innovation.

Next, specific case studies with their indicators are identified for selected innovation targets and agro-food systems. In the following we provide a short overview of the characteristics of the three agro-food systems. For more detail, please see also the table in ANNEX 1.

Explanation LAS, MAS and GAS

To use the analytical framework of Van der Vorst et al. (2005) effectively within FoodMetres, an incorporation with the proposed definitions of GAS, MAS and LAS of WP2 is needed.

Global Agro-Food System (GAS)

Today's food consumption relies to a large degree on food imports from remote locations. This is the case for products such as exotic fruits, coffee, tea and chocolate, spices, marine animals as well as region-specific goods such as wines, olive oils or cheeses. Beside these import goods for direct consumption, meat consumption is largely based on the import of feedstuff such as soya, which is entering Europe via the Rotterdam harbor. Being part of our daily diet, GAS products will continue to play a role and given their substantial impacts on the ecological footprint require special attention.

The characteristics defining GAS are as follows:

- food production can include diverse commodities as well as monocultures/bulk food targeted at processed goods for large urban retailers (supermarkets) as well as for whole-sale markets;
- food chain components are spread across several countries, sometimes across the whole world.

- food chain activities are characterized by a large distance between the different operating units as well as highly efficient transport and cooling systems;
- system innovation is geared towards resource efficiency with regard to transport volumes, energy, speed and fresh keeping devices.

Metropolitan Agro-Food Systems (MAS)

According to a recent review by Sali et al. (2013), there are two main characteristics for MAS: "First, a MAS may be identified referring to concepts used in the geographical and urbanistic analyses, such as the characterization of urban sprawl (Glaeser and Kahn, 2003, Deng et al., 2010), central place theory (Christaller, 1933), accessibility (Litman, 2003, Halden et al, 2005), mobility, transports, etc.. Alternatively, the second principle defines both dimension and shape of MAS on the basis of capability of agricultural land around the city to satisfy all or part of population's food demand." Expending on the concept of agricultural supply, the Dutch think-tank Transforum specifies metropolitan agriculture as "*a deliberately designed system of intelligently connected* [agricultural] *production sites that uses the available resources, conditions and infrastructure in metropolitan areas to produce material and immaterial demands for the same metropolitan area "*(Latesteijn 2008). This definition goes beyond the mere bio-physical potential in terms of soil quality, elevation and climate of a region, but considers matters such as technology, knowledge, infrastructure and functional integration beyond single farm processes as essential components of MAS. MAS can be linked with both GAS and LAS.

The characteristics defining MAS are as follows:

- food production can include diverse commodities as well as monocultures targeted at processed goods for large urban retailers (supermarkets) as well as for whole-sale markets;
- food chain components are spread across the whole metropolitan region surrounding one or a cluster of urban centers (polycentric urban structures)
- food chain activities are characterized by a large degree of specialisation, large distances between the different operating units , and centralised transport logistics;
- system innovation is geared towards increasing both resource efficiency and the value chain in the whole food system, in terms of higher productivity (quantity) and value creation (quality) with less resource input, applying principles of industrial ecology and decreasing the ecological footprint of urban food consumption;

Local Agro-Food Systems (LAS)

According to Sali et al. (2013) consumers associate local food with products grown, produced, and processed in the locality or region where it is marketed. Related concepts and definitions are alternative food initiatives (*Allen et al., 2003*), alternative food systems (*Goodman, 2003; Watts et al., 2005*), Local Food Systems (LFS, *Hinrichs*, 2000) and Alternative Agro-food Networks (AAFNs). AAFNs are defined by a spatial proximity between producer and consumers, promoting rural development objectives (*Renting et al., 2003*) and associated with a commitment to all the components of sustainability along the chain, from production to consumption, as examined in several studies on sustainability potential of AAFNs (*Marsden et al. 1999; Ilbery & Maye, 2005; Iles, 2005; Pretty et al. 2005; Seyfang, 2006*).

The characteristics defining LAS are as follows:

- food production includes diverse commodities as well as larger quantities of region-specific goods, targeting at farmers markets, food cooperatives, direct sales as well as at 'local food' marketing campaigns which are getting increasingly popular among big operators (e.g. supermarket chains), which, however, focus strongly on 'locality

food' which are of special origin, but not necessarily in the market region (see Ilbery et all. 2006)

- food chain components are located in spatially confined areas, sometimes single farms or agglomerations of farms that are part of AAFNs. These networks – also because they frequently produce under strict ecological farming regimes - are typically not linked up with farms and food chains that do not belong to the same or similar LAS farms;
- food chains are typically rather short with little numbers of elements or elements controlled by a few, sometimes by even only one, actor, managing the food chain. Though high-tech can be employed, these food chains rely more on non-technical production processes, conventional and manual farming methods.
- System innovation is targeting mainly at social and environmental issues at the farm level; key is the consumer's experience of understanding and even contributing to the food chain management, as well as the reduction of environmental impacts associated with conventional farming such as the excess application of fertilizers, pesticides, soya feed and irrigation measures.

3. Supply Chain Redesign principles

3.1 Key Performance Indicators

The pressures and incentives for sustainability in food supply chains are legislations, customer demands, response to stakeholders, competitive advantage, pressure groups and reputation loss (Seuring and Muller, 2008). As a consequence, increasing sustainability awareness of stakeholders (Bettley and Burnley, 2008a) inevitably affects the (logistics) decision making process and operations in food supply chains. As such, the concept of sustainable SC design has emerged and aims to incorporate economic, environmental as well as societal decisions (the triple bottom line, TBL) into SCs in the design phase (Chaabane et al., 2012; Wang et al., 2011). It is apparent that this change evokes the need for an integrated approach that links food supply chain (FSC) logistics decisions to the TBL of sustainability (Chaabane et al., 2012) and at the same time manage product quality; an approach called sustainable food logistics management (SFLM). The sustainable developments have stimulated the considerations of multiple Key Performance Indicators (KPIs) such as cost, perishability and sustainability in food logistics management (FLM) projects. Companies often have to invest in a redesign of their logistics network to manage those KPIs simultaneously. As a result, the traditional performance indicator "cost" is replaced by the emerging triple bottom line concept in which Profit, People and Planet are the simultaneous drivers towards performance.

The TBL concept evokes the need for an integrated approach that links supply chain design decisions to all three pillars (economic, environmental and social pillars) of sustainability. This is supported by the literature review of Tang and Zhou (2012), who indicate that there is a need to fill the gap between practice and theory; i.e. to integrate sustainability issues with traditional performance indicators as costs, responsiveness and product quality. Or as Van der Vorst et a. (2009) state, investments in food supply chain design should not only be aimed at improving logistics performance, but also at the preservation of food quality and environmental sustainability.

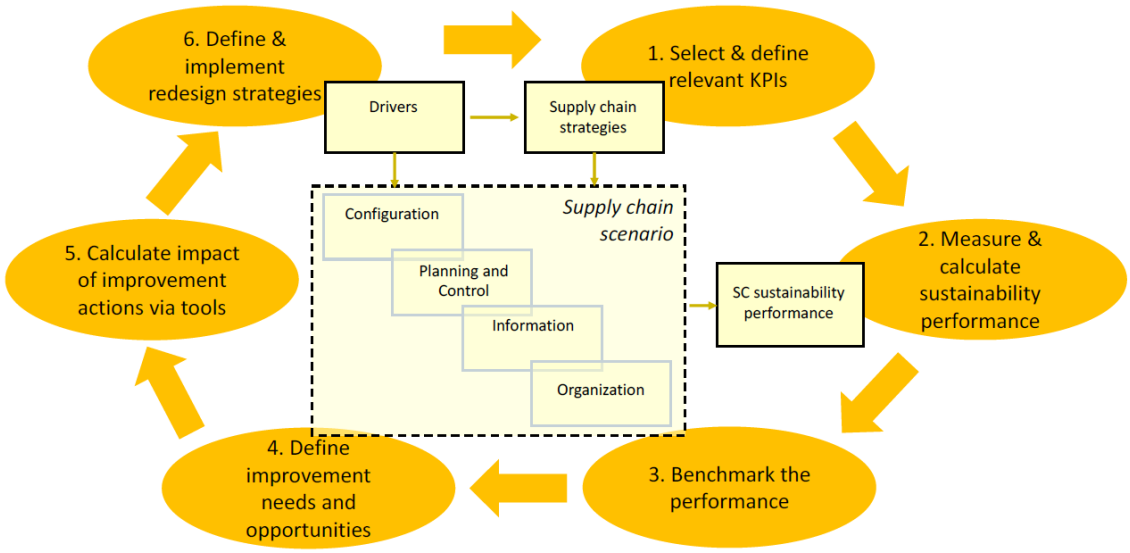

Figure 1: Sustainable assessment framework for food supply chain (van der Vorst et al., 2013)

Based on extensive studies on literature and practice, Van der Vorst et al. (2013) proposed for the first time, a framework for sustainable assessment aiming for the re-design of food supply chains. They stated that well-defined set of supply chain KPIs can establish benchmarks and assess changes over time. This is done respectively in step 2 (where the current performance is measured) and step 3 (where the performance is benchmarked). The benchmark results in improvement needs, which can be aligned to available improvement options. These are defined in step 4 and assessed in step 5 using sophisticated modeling tools. Finally, redesign strategies can be defined that – after implementation – improve the sustainability performance on the chosen indicators (step 6). After such an assessment, redesigns can be proposed, piloted and finally implemented.

Structured sustainability assessment framework comprises six steps, starting with the selection and definition of the relevant sustainability Key Performance Indicators depending on the re-design strategy (step 1). KPIs can be used to measure whether targets have been realised in practice; KPIs refer to a relatively small number of critical dimensions which contribute more than proportionally to the success or failure in the marketplace (Gunasekaran and Kobu, 2007).

3.2 Food supply chain redesign principles

Derived from an extensive literature review by Van der Vorst and Beulens (2002) and several other studies on sustainable food supply chain design (see Linton et al. 2007, Soysal et al. 2012, Gebresenbet and Bosona, 2012), a generic list of redesign strategies to facilitate the redesign process and attain sustainable supply chain objectives is as follows:

- Redesign the roles and processes performed in the supply chain (e.g., reduce the number of parties involved, reallocate roles such as inventory control, and eliminate non-value-adding activities such as stock keeping).

- Reduce lead times (e.g., implement information and communication technology (ICT) systems for information exchange and decision support, increase manufacturing flexibility or reallocate facilities).
- Create information transparency (e.g., establish an information exchange infrastructure in the supply chain and exchange information on demand/supply/inventory or work-in-process, standardise product coding).
- Synchronise logistical processes with consumer demand (e.g., increase frequencies of production and delivery processes, decrease lot sizes).
- Coordinate and simplify logistical decisions in the supply chain (e.g., coordinate lot sizes, consolidate goods flows, eliminate human interventions, introduce product standardisation and modularisation).
- Emphasis on redesigning processes in order to reduce greenhouse gas emissions and energy consumption

Besides, there are also specific process and product characteristics of food supply chain that impact the redesign process (Bourlakis and Weightman, 2004 and Jongen and Meulenberg, 2005), including the following:

- Seasonality in production, requiring global sourcing.
- Variable process yields in quantity and quality due to biological variations, seasonality, and random factors connected with weather, pests, and other biological hazards.
- Keeping quality constraints for raw materials, intermediates and finished products, and quality decay while products pass through the supply chain. As a result there is a chance of product shrinkage and stock-outs in retail outlets when products' best-before-dates have passed and/or product quality level has declined too much.
- Requirement for conditioned transportation and storage means (e.g., cooling).
- Necessity for lot traceability of work in process due to quality and environmental requirements and product responsibility.

Based on these strategies, taken into account the product characteristics and the conceptual model developed by van der Vorst et al., (2000,2013), for FoodMetres, we have extended this list because the aim is to create more sustainable supply chains instead of reducing uncertainty in supply chains. The main typology of these redesign principles are represented in the next table.

Table 1: Typology of generic supply chain management redesign principles (SCM-RP)

SCM concept element	*SCM redesign principle*
Managed system	① Redesign the roles and processes in the supply chain
Managing system	② Reduce customer order lead times
	③ Synchronize all logistical processes to the consumer demand
	④ Co-ordinate logistical decisions
Information system	⑤ Create information transparency in the supply chain
Organizational structure	⑥ Jointly define objectives and performance indicators for the entire supply chain

These redesign principles can be used in the *system innovation domains* put forward in WP1. The five innovation domains (product-, process-, social-, governance- and system innovation) cannot be linked one on one to the redesign principles but give an insight in what redesign strategies as described below can be used in order to have an impact on the food chain performance indicators and what type of scenario formulas can be created.

The first redesign principle (SCM-RP1) uses the following basis in order to change the roles and processes in the supply chain: work should not be done more than once and work should be done by whoever is in the best position to do it. Related to the managed system this may imply:

- change or reduce the number of parties involved
- change the location of facilities,
- re-allocate the role actors perform and related processes and
- eliminate non-value-adding activities in the supply chain

For the second redesign principle (SCM-RP2), reduce customer order lead times the following strategies can be used in order to have a positive or negative impact on the food chain performance indicators:

- change the position of the customer order decoupling point
- implement ICT systems for information exchange and decision support
- reduce waiting times
- create parallel administrative and logistical processes) increase manufacturing flexibility
- improve reliability of supply and production quantity and quality.

When synchronizing all logistical processes to the customer demand process (SCM-RP3) we can use the following strategies:

- increase the number of events per time unit for all supply chain processes
- decrease the lot sizes

Redesign strategies for coordinating logistical decisions, the fourth redesign principle (SCM-RP4), are:

- coordinate and redesign policies
- eliminate or reduce human interventions[2]
- differentiate to products, systems and processes
- simplify structures, systems, processes and products

Creating information transparency in the supply chain (SCM-RP5) can be done by

- establish an information exchange infrastructure in the SC and exchange demand supply or inventory information
- increase information timeliness by implementing real-time information systems
- develop a common database and standardize bar coding where appropriate

[2] The reduction of human intervention should not be considered as an aim by itself but as a means of avoiding labour that does not contribute to the specifics of the product quality. In many cases of LAS, human interaction is considered as part of the product quality and is priced accordingly.

For redesigning the organizational structure (SCM-RP6) by jointly defining objectives and performance indicators for the entire supply chain, the following strategies are identified by Van der Vorst (2000);

- jointly define logistical supply chain objectives and corresponding supply chain performance indicators
- agree on how to measure logistical performances in the supply chain
- align employee's incentives with supply chain objectives

3.3 Connection redesign principles with agro-food system

For each of the redesign principles, the innovations will be different for the different agro-food systems LAS, MAS and GAS, and some of the principles may not be relevant for a particular agro-food system. For instance, a LAS is more likely to start with a different organizational structure than to start with changing the location of facilities. A new relation between consumers and producers are the start of a pathway towards an innovative change. Of course this might lead to changing facility locations or processes, the one does not exclude the other, but the starting point for redesign is different. A concept like Metropolitan Food Clusters starts with the idea of clustering of activities leads to more effective and efficient food chains. Therefore, this relates more to starting with redesign principles from the managed system and managing system.

4. Scenario story lines, commodity groups and performance indicators

4.1 Scenario story lines

Application of the different redesign principles to the three agro-food systems will lead to scenario story lines, i.e. alternative innovations regarding supply chain logistics on the conceptual level. Groups of commodities can be associated to these scenario storylines, as well as performance indicator themes. Later on, for each scenario story line and group of commodities, specific cases studies with products and performance indicators can be selected.

Scenarios storylines have the purpose to provide a narrative of how the identified innovation approach towards more sustainable food chains is supposed to unfold. While the storyline is by nature descriptive, it needs to follow a pre-designed script book which is structured along the innovation concepts laid out in this report. The reason for maintaining a high degree of control over the way storylines are being developed, is to make sure that we can achieve comparability between related cases (innovation types) and to establish transparent references for proper impact assessments. The overview on the different case study approaches has shown, that without a rigid reference base, it will be impossible to properly frame the resulting effects and performance changes.

The table indicates how the Case Study relates to a metropolis, at what level an innovation can take place, what elements of the food chain differ from the current situation and how this is measured. This enables a comparison between the Case Studies and it gives an

indication which innovation is the most sustainable. The level of sustainability is expressed in WP5.

Table 2: Storyline Structure to be followed for each commodity group innovation

Name of Commodity Group and specific commodities within it.	Type of agro-system where the commodity group is targeting at (LAS, MAS or GAS)	Innovation Domain that is being addressed	Type (s) of re-design principles (SCM-Rps) where the innovation is related to	Performance Indicators that are relevant (see Section 3.2)	Benchmark information for scenario

4.2 Groups of commodities

(Short) food supply chains are strongly related to the type of commodity (group) of interest. The commodity is defined as a consumer good within its commodity context and as a physical-material object. Commodities need to be distinguished into ready-to-use end-products and agricultural produce without its up- and downstream fields (Ermann, 2005). Therefore, the selection of commodities has a strong impact on the establishment of SFSC and their impacts. Different types of commodities are characterized by varying ability to be supplied (produced and marketed) locally depending on regional demand and supply.

On the *consumer side* the selection of commodities is relevant as there is a strong differentiation among commodity groups regarding consumer trust (von Alvensleben, 2002). Consumers share certain values, motives and attitudes to be merged into food cultures. Regional origin is for instance particularly important for commodities with a low degree of processing (meat, eggs, fruits, vegetable, milk). With increasing degree of processing positive consumer association is decreasing (Czech, 2002). The production of different types of commodities accounts for different local conditions, their supply for different organisational and logistical requirements.

From a consumption point of view it might be logical to talk about individual consumer products that can be bought in a shop. The way food is produced, processed, packaged or transported is mostly unknown by the average consumer. In other words, the way the food chain is organized is not known by the average public. As different consumer goods have different or the same food chains it is difficult to use this consumer's viewpoint as a starting point for food chain characterization. The risk might be that a list of food chain scenarios is created which is that extensive it is not workable for comparison.

On the *production side*, the local produce of commodities is influenced by regional concentration of forms of cultivation and crops, which might limit the possibility of local food supply chains as not all regions can produce all the food commodities they need and by implication regions cannot consume all the food they produce (Sauter & Meyer, 2003).

From the producer's view it makes more sense to think about food in terms of produced items as milk, pigs, cauliflower, apples or bananas. This also is not the best option for food chain characterization. A food chain with for example apples as produced item can include for example fresh, cut and processed apples. Analysing the processes and elements of these

three food chains is likely to point at different innovative pathways for each of them which in turn can affect each other.

Now when we look at for example fresh pears and fresh apples they have quite similar food chains from farmer until consumer. In this way new innovative concepts related to a food chain defined at this group of commodities can be chosen without excluding or contradicting part of the chain.

Looking at carefully chosen groups of products results in better innovative pathways for redesign of the food chain than looking from a consumers or producers commodity level.

Examples of these groups of commodities can be dairy, fresh meat, processed meat, fresh preservable fruit, soft fruit, imported fruit, processed fruit, fruit juice, fresh leafy vegetables, preservable vegetables, cut vegetables, exotic vegetables, etc.

In close cooperation with the different case studies the following product(group)s are chosen to be relevant for all cases: dairy, fruits

Each case study has the opportunity to choose several product(group) for their specific case as well. Therefore the complete list of product(group)s per case study becomes:

Rotterdam: Dairy, potato, exotic vegetables, water culture, tomato
Berlin: Dairy, meat, fruit, vegetables
Ljubljana: Dairy, salad, fruits, cabbage
London: Dairy, herbs, vegetables, mushrooms, fruits
Milano: Dairy, rice, fruits, vegetables
Nairobi: Dairy, tomato, spinach, kale, bananas, onions, potatoes, eggs

4.3 Indicator themes

Indicator themes, like food safety, are generic and applicable to every scenario story line/case study. For specific case studies, specific (relevant) indicator within each theme should be selected. In previous studies, indicator themes and gross lists of individual indicators have been established.

The food chain logistics indicators are directed to the efficiency or effective use of the resources in the food supply chain, taking into account the objectives for the partners in the supply chain, such as economical margins, as well as food safety and quality.

The conventional routing, using more distribution links/centres and retailers in the chain can be shortened by using new concepts as given for instance by incorporation of the Metropolitan Food Clusters (MFC) using closely knit networks and preferred supplements, to link production with distribution and consumption. Demands and resources are used in a different way with different effects on sustainability themes. Most studies refer to the three dimension of sustainability of People, Planet and Profit (P-P-P, or triple P). The translation of this triple P concept into the indicator list for food chain logistics is implemented and listed in Table 3.

The redesign principles of Van der Vorst (2000) can be used with these indicators. Each redesign principle has an effect on the food chain indicators. This positive or negative effect can be used in the assessments of WP5.

Table 3: Food Chain logistics Indicators

Sustainability Dimension	Indicator	Method of calculation
Profit	Type of market	Descriptive e.g.
Planet	(Potential) Share of regional food on markets	Percentage/volumes/value
Planet	(Potential) Market share in city for regional food	Percentage/volumes/value
Planet	Distances from farm processor, retailer, geographical location, etc.	km
Profit	Total cost per chain actor and transport movement	€
Profit	Prices at all levels/step of the chain	€
Profit / People	Accessible (geographic access, affordability)	
People	Socially inclusive for all people in society	

5. Outlook: Towards specific cases and scenarios

5.1 The Story Lines for Groups of Commodities

In our first approach we have focused on demonstrating the feasibility of the story lines approach for the dairy sector as a common group of commodities. Further groups of commodities will be developed as the project implementation proceeds. Using the criteria put down in Table 2 on story lines must be considered as a learning process which will be refined as we move towards other groups of commodities.

The six story lines (see Annex 2) show us that all countries produce substantial amounts of milk of which a large part is exported. Farmers on the GAS and MAS level mainly focus on high yields. The Region of Milano is an interesting example where the regional produced milk is processed into world famous and protected (branded) global market products like Parmesan and Gorgonzola cheese. Interesting is the initiative of forming the institution of "district of milk" in the Milano case. This represents a new way to make farmers more competitive and create relationship with the dairy industry.

There is a relatively high dependency on concentrates for feed in addition to locally produced roughage. Many of the innovations focus on substitutes for the concentrates by producing local alternatives or by using nearby grounds like nature reserve for substitute cattle feed. Many innovations focus on making the dairy farming more sustainable. This is done through focus on cattle feed and nutrient cycles but also by introducing dual breed cattle (dairy and meat) and organic farm settings.

The dairy cooperatives appear to be a crucial factor in the organisation of the whole dairy chain. They form a highly specialized organisation that provide efficient logistics and processing facilities. These organisations often limit innovation driven initiatives by locally organised connected farmers. Also (EU) legislation on food safety prohibits some innovations, especially when raw milk products are involved.

Berlin-Brandenburg
An interesting case is that the German dairy production equals German consumption. Surprisingly still 46 % is exported. Value adding is taking place outside Germany and they import more expensive dairy products. Locally (LAS) operating farmers focus more and more on specializing and selling to consumers in the cities. This direct selling is in most cases just a very limited part of the total dairy production in the country. Sometimes exotic innovations take place like the Berlin Brandenburg Buffalo cattle farm where they make local mozzarella and Buffalo meat. A whole new food chain in itself. In the London case dairy farming is struggling with suboptimal water conditions. To put it in perspective, the London MAS is more water stressed then Spain.

London
The majority of milk produced in the UK is sold to large dairies which either sell direct to consumers or are contracted to supply the major processors or retailers. Around 3.5% of milk available in the UK is exported, and about 50% is consumed as liquid milk, with the rest being processed into various dairy products. The UK is the 9th largest producer of milk in the world (France and Germany being the other EU members of the global 'top ten'). Given the structure of the dairy supply chain, it is difficult to identify regionalized or localized milk supplies to London. There are a few examples of small producers retailing high quality dairy products directly to customers in London (e.g. West Horsley Dairy). However, the South East

region faces some challenges in producing milk due to suboptimal water conditions: to put it into perspective, the London MAS is more water stressed than Spain. As such, there are significant barriers to increasing the supply of milk produced in the MAS. The UK dairy industry overall has placed a high emphasis on efficiency, animal welfare concerns and sustainability and has begun to recognize the growing market opportunities to develop dairy products of 'provenance' for certain groups of consumers (Milk Development Council, 2007).

Milano

In the Milan table (see Annex 2), the Lombard production of milk is considered as a whole (first column, first row) because the total production is part of global market. This does not mean that the spatial level of GAS is a regional level, but the regional milk production is destined not only to the local market but also to the national and international market. Regarding the MAS we considered an association of producers and processors that operate primarily at the regional level. Of course they contribute to the entire production of Lombardy, but their target is mainly the regional market.

Causality relations are critical to analyse how innovations can contribute to shortening chains. In "benchmark information for scenario" for Milan milk case we assumed that shortening chains is the way to increase sustainability. So, if we assume that the demand for milk is satisfied: 75% from the GAS,23% from the MAS and 2% from the LAS (data are not real, but we are finding them and want them to include in D2.1), a scenario could be characterized by the following benchmarks: demand satisfied by MAS: more than 30%; by LAS: more than 5%. In order to frame the research according to the objectives laid down in the DOW, innovations need to be more related to shortening supply chains rather than production methods.

Some examples product and process innovations introduced in horticultural farms which produce ready-to-eat vegetables (all the production process is finalized to facilitate the processing and commercialization phases). Regarding the second point, sustainability means maintenance over time.

Rotterdam

For the case study in the Rotterdam area there is an example for the local trail. The project '*Kringloopboeren in Midden Delfland'* works to strengthen the farmers as the main carrier of the typical landscape. More than 30 farmers participating in the project with total milk flow of more than 15 million liters of milk. To guarantee a sustainable income for these farmers and keeping the typical landscape there more necessary than done at this moment. The farmers already anticipate on this by setting up other activities with a focus outside the milk flow. These activities do not strengthen the link between 'landscape – cow in the meadow – milk – and consumer'. Some farmers are able to do this by producing cheese but for the majority this is not the case. Strengthening this link makes Delflandse farmers structurally different from farmers elsewhere in the world. The innovation should be in the chain of milk linking sustainable (good) farming practice with the region. This project will act as a data source and experience for the (im-)possibilities of the local trail and the effect on local trail.

There are options to increase the amount of hectares in the region. E.g. the use of "nature land" for the farm/dairy production. This maybe means a new "land consolidation" process.

Interesting is that provinces quite easily mark area's as "green" as "agricultural use" but not looking at the actual situation of land ownership and the farmer behind the land. In many cases land is not used for food production anymore but for recreation purposes, like horses.

Nairobi
Nairobi has one of the largest share of the rising middle income earners in Kenya and Sub-Saharan Africa, that has resulted in higher demand for dairy products, and expected to result in large demand for processed milk products like yoghurt, cheese, butter, creamers and powders. However, supply of this is very low, as the value addition of milk products is still very low and poor. Apart from processed milk and yoghurt, processing of cheese, butter, creamers and milk powders is very low. Only a few large farmers on the outskirts of the main city process milk products, and even then, this is very low. Most cheese, creamers and powders are imported from New Zealand , The Netherlands and several EU countries. The Kenya Dairy Board has been trying to encourage milk products processing industries to produce more in response to local needs. However, the financial and technical capacity for small farmers in the sub-urban region to process such products other than drinking milk may be very limited.

On the whole, however, dairy imports – particularly for processed drinking milk – have gone down. Despite importing less, the prices of milk have been rising rapidly over the last few years. This has been attributed to increased production versus what is actually processed, increased local demand for processed milk in line with the rising middle income earners, expensive inputs and animal feeds (usually imported) and slow improvements of dairy cattle breeds. The Kenya dairy board is in the process of trying to formalize the informal sector (important for public health reasons) and is currently encouraging farmers to organize themselves at the national level to lobby and advocate for issues affecting them . This efforts might help in finding solutions to low levels of production of milk products like cheese, creamer and powders, which are currently monopolised by the big firms like Brookside (private corporation) and Kenya Cooperative Creameries (state owned corporation).

5.2 The observed role of innovation within the storylines

The complexity characterizing the agro-food system leads to create ties between:

- environmental and economic sustainability: a non-profitable system leads to the abandonment of economic activity;
- environmental and social sustainability: social and cultural embeddedness are crucial to maintain the vitality of local communities and agricultural activities;
- environmental sustainability and food sovereignty (or food security): maintaining the ability of a region to produce food means reducing dependence on other regions or countries.

These relations are components of the food triangle approach.
From this point of view, and inside a global competitiveness market, every innovation able for example to maintain or improve competitiveness of a regional agro-food system also works for keeping alive that specific agricultural system.

Therefore, from an economic point of view (which is the prevalent angle that will be assumed by D2.1), innovations are introduced in an economic system if decision makers inside the system (consumers, producers, traders, others) can take advantage from the new situation. This lead us to recognize that externalities are not crucial in the process of

diffusion of innovations, namely reducing negative externalities or improving positive externalities (that allow the achievement of environmental sustainability) are goals not much interesting to economic actors having a short term view. A topic is then how internalize externalities in order make actors of chain interested to taking into account environmental sustainability.

Building on this approach, we can assume that the first innovations needed are social innovation and public governance innovation. Rather than innovations, we can consider them as preconditions for innovation to take place or, better, the creation of a socio-economic environment favorable to introducing innovations for sustainability.

Public governance innovation may follow or precede social innovation. In the first case, governance transposes in legislation (or other forms of regulation, programming, planning) the demands of civil society. In the second one, public governance may anticipate and target the needs of society.

5.3 Linking Food Chain Story Lines to Scenarios

As basic framework conditions for FOODMETRES scenarios the following needs to be considered:

- There will be two distinctive approaches for FOODMETRES scenario types, namely the centrally developed urban footprint based Metropolitan land use scenarios , and the storyline driven LAS-MAS-GAS food supply chain scenarios
- Relevance for key themes of FOODMETRES: metropolitan food supply and demand, innovation, chain and distance aspects, governance, transition, impact on climate change, ecosystem services
- Integration of the system innovation approach, and conceptual framework laid down in D1.1
- Applicability to the developed analytical approaches for the MAS delineation based on commodity demand (UniMi, ZALF) and land use supply area and accessibility delination and mapping (WUR)

The two approaches for FOODMETRES scenarios:

(1) Metropolitan land use scenarios that make use of the MAS & LAS spatial data developed under 2.1 and focusing on large *food classes* (fruit, vegetables, staple food, milk & meat) and making use of GIS modeling techniques. For these food classes, we intend to arrive at both food demand and supply data at the level of the case studies. These scenarios are going to be rather generic in terms of the assumptions and will form the Metropolitan Footprint Tool (3.3). The objective of these scenarios is to tell the 'big picture' in terms of the case study regional setting: how much land is available for food production? Which main food classes are located where? How well is it accessible? What does this mean with regard to the demand of both the urban centre as well as the other population living in the metropolitan region.

We are considering to use these land use scenarios to perform impact assessments for a selected set of indicators and to possibly focus on two distinct innovation models, namely MFC as the techno-logistic, high-production approach on the one hand, and on local-regional food-networks as the social-ecological approach on the other hand.

These assessments will provide the larger spatial-functional references for interpreting the detailed food chain innovation scenarios outlined under (2). Offering these

metropolitan land use scenarios will also help stakeholders to put the proposed innovation perspectives for certain groups of food chains in only specific locations into perspective and to decide how up-scaling these can best be achieved.

(2) LAS, MAS and GAS food supply chain scenarios covering the full spectrum from LAS to GAS where appropriate. These scenarios will focus on selected food chain types as put forward by the Case Studies. These scenarios will be based on qualitative and selected sets of quantitative data, validated by the case studies and their stakeholder networks in participatory workshops.

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ANNEX 1: Comparison of LAS, MAS and GAS according to different criteria (working definitions)

	LAS	MAS	GAS
Leading Food Chain Type	Alternative / Short / Local food chains	Regional short / long conventional chains	Global long conventional chains
Location & market	Inner-city direct urban fringe or rural with high market orientation to the city open lots, temporary sites, street markets, local market places Import role of functional connections especially in peri-urban (and even well accessible rural) regions.	concepts used in the geographical and urbanistic analyses, such as the characterization of urban sprawl (Glaeser and Kahn, 2003, Deng et al., 2010), functionally connected with metropolitan centres; accessibility through road networks is key to defining the metropolitan region urban fringe (peri-urban) and rural	No spatial or functional boundaries, production places and retail/consumption as well as food processing places can be distributed across the whole world; though many long distance export food goods are packaged in the countries of origin;
Mission/purpose	• Providing high-quality (fresh) food for affordable prices • Social responsibility and networking • Support and training for disadvantaged, disabled or marginalized communities • local/regional opportunities for linking rural with urban populations; • Create added value • Create close ties with conscious, critical and committed consumers	• Largely commercial production, processing and marketing of products. • Focus on innovative, high-tech, efficient production systems; • Logistics, communications and infrastructure are key • aiming at large consumer groups/distributers;	• Largely commercial production, processing and marketing of products. • Focus on innovative, high-tech, efficient production systems; • Logistics, communications and infrastructure are key • aiming at large consumer groups/distributers;
Food Chain Characteristics	• Mainly small scale • food chain in single farms or agglomerations of farms that are part of AAFNs.; • typically rather short with little numbers of elements or elements controlled by a few, sometimes by even only one, actor, managing the food chain. Though high-tech can be employed, these food chains rely more on non-technical production processes, conventional and manual farming methods.	• Mainly middle, large scale • spread across the whole metropolitan region surrounding one or a cluster or urban centers (polycentric urban structures) • relatively large degree of specialisation, large distances between the different operating units, and centralised transport logistics; • Often part of the GAS, to a lesser	• Mainly large scale • components are spread across several countries, sometimes across the whole world. • large distance between the different operating units as well as highly efficient transport and cooling systems;

		extend part of LAS.	
Type and size of farming	• Focus on small-scale farming; • Changing production schemes • small lots and small amounts sometimes only temporary (urban gardening) • Labour intensive • Often organic, always based on sustainability principles • Largely visible and accessible (though backyard farming less) • If commercial, generally small scale, characterized by niche production, rather than mass market production	• Includes intensive conventional farming, including large-scale dairy farming ('megastallen'), glasshouse cultivation, vital clusters/greenports • Labour extensive • Metropolitan context not always clear (footloose, indoor, markets unclear)	• All sizes and intensities of of farming
Products	• Direct consumption • Vegetable & fruit production dominates (high diversity) • Season- and region-dependent, but most of the year •	• Wide range of agricultural products, in fact all supermarket products where there is demand for; • Highly diverse in terms of product, specialization and niche function • •	• include diverse commodities as well as monocultures/bulk food targeted at processed goods for large urban retailers (supermarkets) as well as for whole growth markets;
Actors	• Urban dwellers, neighbourhood initiatives • Co-operations • Interest groups (NGOs) & social initiatives • Farming animators, • Environmentalists • Government: municipal,	• Little, but highly specialized (trained) workforce • Entrepreneurs, engineers, horticulturists, managers • Farming	• Depending strongly on the countries of origin – can hence differ largely; • Large scale, vertically integrated agribusinesses dominate many

	state, and/or national • Health agencies and local authorities	lobby/associations • Government/landscape protection agencies	commodity markets • At the end of the food chain, MAS-style actor groups prevail; • Also not-food sector is increasingly involved (financial speculations)
Business dimension	• Generally seek to develop sustainable business models rather than focus purely on profit maximisation(frequently subsistence) • Link between restaurants and farming – new networks and business opportunities; • Farmer's markets as a trendy urban phenomenon;	• Generally driven by profit maximisation and international competition-seeking cooperation with equally big commercial partners (e.g. supermarket chains, energy companies) • Experimental, science-oriented	• Like MAS, sometimes mixed with or linked up with MAS business structures • International trade organisations
Land use and landscapes	• Agricultural land in urban and peri-urban fringe • Also lots and vacant places inside city boundaries	• Open agricultural landscapes around and within peri-urban surroundings and rural areas • All levels of intensities (crop, grassland), including footloose production systems • Cultural landscapes that are managed to serve urban needs; • Multi-functional peri-urban or quasi-rural landscapes	• All kind of land use sectors are involved; • At the global level, monoculture land use dominates GAS • all levels of intensities (crop, grassland), including footloose production systems •
Sustainability	• Multi-functional urban land use (thereby addressing PPP aspects) • focus on regional products, direct consumption) • support of habitat and biodiversity • 'Greening' of the city	• Energy landscapes (biofuels, wind- and sun energy installations) • Many assets and potentials (resource efficiency, industrial ecology, bio-based economy • Current status very heterogeneous	• Current status very heterogeneous • Most GAS-production regimes are related to conventional farming and hence not very sustainable (high use of resources in both production and transport) • Exceptions exist: small ecological footprints of highly efficient export farming systems, or bio-regional conditions provide natural resource efficiency (e.g. through availability of sunlight and water).
Innovation domains	• targeting mainly at social and product innovation at	• geared towards process and product	• Mainly process and product innovation

	farm level with strong environmental assets; key is the consumer's experience of understanding and even contributing to the food chain management, reduction of environmental impacts	innovation at farm-, transport and retail level, aiming at higher productivity (quantity) and value creation (quality) with less resource input. Trends towards system innovation appear likely. However, MAS is very heterogeneous, the closeness to the urban food market as the main driver in terms of land prices and demand orientation.	with emphasis on optimizing transport volumes, energy, speed and fresh keeping devices.
Institutional dimension	• In Europe only occasional governmental support • Tradition of allotment gardens build into some national legislations (e.g. Germany's "Kleingartengesetz)	• National (spatial) planning agencies • Financial sector (banks, investment funds) • Regional stakeholders from private enterprise and governance	• International organisations such as FAO, CAP and OECD are drivers. • Oil prices • Free Trade Agreements

ANNEX 2: Storyline Tables for the dairy sector in 6 Case Studies

1. Dairy Story Line Rotterdam

Name of Commodity Group and specific commodities within it.	Type of agro-system where the commodity group is targeting at (LAS, MAS or GAS)	Innovation Domain that is being addressed	Type (s) of re-design principles (SCM-Rps) where the innovation is related to	Performance Indicators that are relevant	Benchmark information for scenario
Milk in the Netherlands 18500 dairy farmers producing 11,8 MLD kg milk total (6,5 MLD cheese, 0,5 consumption milk, 1,7 milk powder)	**GAS** 89% milkexport in The Netherlands In total cattle is responsible for roughly 13,8 million tons of dry matter (13,800,000,000 kilogram) concentrate. This is fed in addition to the own grown roughage (grass, maize). In concentrates a wide diversity of raw materials is used, 54% are grains and grain products and 11% consist of soya (especially soya is being questioned with respect to the ecological footprint). Nevedi is member in several committees' with the focus to make soya more sustainable.	- general greening of the milk production (PRODUCT) - On-Farm thickening of milk (PROCESS) - Re-optimization of the milk processing facilities in The Netherlands (PROCESS) Closing nutrient cycles, reducing foodprint (feedprint) increasing milk production of own privately owned (grasslands) (PROCESS / GOVERNANCE) a new tool that calculates efficiency at farm level and is being took over by dairy companies, farmers organisations and governments (PROCESS)	SCM principles ***3, 5 and 6*** *Kringloopwijzer* (annual nutrient cycle) a new tool that calculates efficiency at farm level and is being took over by dairy companies, farmers organisations and governments In total cattle is responsible for roughly 13,8 million tons of dry matter (13,800,000,000 kilogram) concentrate. This is fed in addition to the own grown roughage (grass, maize). In concentrates a wide diversity of raw materials is used, 54% are grains and grain products and 11% consist of soya (especially soya is being questioned with respect to the ecological footprint). Nevedi is member in several committees' with the focus to make soya more sustainable. Can reduce transport costs and miles within the milkchain	N, P and C efficiency kg concentrate/kg milk (this can be calculated as external hectares) % Energy (MJ) used of own land feed kilometres CO2 emission in the dutch dairy chain % soja importated	Dairy Sector: -20 % import of soja On farm: > 40% of N efficiency > 80% of P efficiency > 80% produced MJ of own land Transport kilometres (Nevedi = Dutch organisation that calculate this feed imports)
Initiative Milk in Midden	**MAS**	Closing nutrient cycles at	***1*** Can be realised: for an average Midden-	Level of organisation in the	Regional optimalisation

Delfland (Delflandsgroen) 30 farmers = 15.000.000 kg milk (regional co-operation) www.boerinmiddendelfland.nl/	Main part still export, partly (looking for) selling regional milk, but still too big for regional markets II the Netherlands there is gab between small scale and big scale…and MAS is not really excising for dairyproducts. There are examples where 10 farmers working together (near Utrecht) and make yoghurts, but these yoghurts are exported throughout the whole of the Netherlands, Belgium and Germany.	regional level, increasing amount of feed from the region used for dairy/milk production (SOCIAL, GOVERNANCE) Land use planning (GOVERNANCE) More 'nature' and privately owned land available for the dairy production (GOVERNANCE, SOCIAL) More collaboration with "neighbours" e.g. maize or growing concentrates (SOCIAL) Making new steps in scale by merging farms (on paper and by new forms of collaboration) (PROCES)	Delfland dairyfarm 2,570 Kg dry matter of concentrates and by products is fed per cow each year. ***1*** Local initiatives like addressing the problem, organizing multi stakeholder processes in this region. Introducing a "kringloop" certificate to benchmark and reward farmers for taking initiative reducing feedmiles (less concentrate use and better land use in the region) SCM principles (***1), 4, 5, 6***	region % hectares participating Kg N and P from regional land (regional cycles) Kg concentrate imported in the regiona	Regional goals (x% of soy less imported)
Urban farmer / local butter, cheese or yoghurt 1 farmer or 2+ farmers working together in Midden Delfland and accessing new markets	**LAS** Local markets	Making new products (cheeses, yoghurts) (PRODUCT) Selling raw milk of fresh milk (milk tap in the supermarket) (PRODUCT, GOVERNANCE) Reduce harvest losses on farm (PROCESS) Increase production of own	SCM principles ***1, 2, 5, 6*** If a farmer decides to process the milk on their own farm into products then distributing these products is allowed following regular food regulations. Most farmers of the Midden Delfand area in the case study are member of FrieslandCampina. They have regulations concerning farmers that process their own milk besides their deliveries to the cooperation. If a farmer processes more than 10.000 kg of milk annually he/she is obligated to request an exemption and pay € 500, - each year for the exemption.	- % feed from own land - kg concentrate use - % soy fed - type of concentrate use (eg soy beans) - % of co-operations with neighbours	Chain optimalisation "from farm to consumer", added value

		land by improving soil fertility (PROCESS) Decrease number of young stock per dairy cow (PROCESS) Changing on farm “crop rotation planning” (PROCESS) Buying concentrates with low food meters e.g. lupine vs soja (PRODUCT)			

2. Dairy Story Line London

Name of Commodity Group and specific commodities within it.	Type of agro-system where the commodity group is targeting at (LAS, MAS or GAS)	Innovation Domain that is being addressed	Type (s) of re-design principles (SCM-Rps) where the innovation is related to	Performance Indicators that are relevant	Benchmark information for scenario
Milk in England/UK 14,549 dairy farmers in the UK (125 cows average herd size) producing 12,974 Million litre Source: http://www.dairyco.org.uk/resources-library/market-information/dairy-statistics/#.Uo9Cg91FDDd	GAS High quality milk from free-range systems with high animal welfare is exported across Europe (conventional and organic) Above average welfare is an major selling point "The UK's climate and topography are among the best in the world for ruminant livestock production" (www.dairy2020.com)	- Adoption of organic farming systems with increase of grass feed and animal welfare (free-range) (PROCESS) - Alternatives to destroying male calves at birth (animal welfare and livestock ethics) (PROCESS) - Adoption of dual breed to increase use of meat and veal products and avoid killing of animals at birth (PROCESS) - Capping hearth size (no mega-dairies) for animal welfare and social interaction among cows (PROCESS) - Adoption of feed systems able to reduce both nitrate leaching and greenhouse gases emissions (PROCESS) - Removal of imported GM crops as feed which also can cause rainforest clearance (PROCESS) - Increasing of home production of concentrates	Since innovations for sustainability involve the production process rather then food chains it is not possible find relations with SCM	Animal welfare index Use of hormones, vaccines and antibiotics (for animals and in products for humans) N and P leaching in groundwater and drinking water Herbicide and pesticide contents in soil, ground water and in the end products milk, yoghurt, chesses CO_2 equivalent emissions in the atmosphere Carbon sequestration in the soil Effect on landscape amenity value and diversity of land use Milk quality (Omega 3, pesticide residues, GM content not declared on label Reuse and recycling of by-products, dirty water, manure, bedding material	Dairy Sector: Comparison conventional and organic Comparison within nations and regions of UK Comparison with other EU countries

		(protein crops field and soy beans, peas lupines) (PROCESS) - Recovery of the energy content and agronomic value of manure (composting AD, Pyrolysis (PROCESS) - Developing Decision Support Systems which are able to identify and verify the technical and economic viability of green manure and dairy manure (PROCESS, SOCIAL) - enhancement of nitrogen use efficiency by plants through improved knowledge of nitrogen behavior in the soil. (PROCESS)			
Milk in the London MAS South East Region • 620 dairy farmers in the London MAS (South East Region)	**MAS** The milk is part of the England/UK supply chain. As the South East Region is less favourable for free-range milk production (climate getting too dry, water-stress) the number of producers has more then halved in the last 10 years (from 1312 in 2002 to 620 2012). This trend could continue and large scale dairy production move to more favourable climate in England and UK where	Same as for GAS For mixed organic farming there is an opportunity to remain in the MAS as organic mixed systems require grassland and arable and can better cope with dryland conditions - below 600 mm/year, please note per person the London MAS (South East Region of England) is more water stressed then Spain)	Same as for GAS	Same as for GAS	Same as for GAS

	there is enough rainfall to support pastures and free-range systems.				
London LAS Farms who sell directly milk and dairy products in various ways	**LAS** Local markets	Selling speciality milk (Organic milk, raw milk, milk with high fat content 5.5% from Jersey cows) through vending machines (PRODUCT, PROCESS) Selling dairy products through: farmer's markets (PROCESS, SOCIAL, GOVERNANCE) Box schemes (dilivery to doorstep or at community collection point (mosque, church, pub...) (PROCESS, SOCIAL) CSA milk production (PROCESS, SOCIAL)	1, 5	- % milk and dairy sold through different types of local food chains - % metropolitan citizens that buy directly from producers - Number of farms involved in direct sale - Type of milk and dairy products sold (raw, cheese, organic)	It is likely that less then 5% of dairy products are sold through local food chains. We have no data how much exactly Have no information on (1) how large the potential for local supply chains is (scenario modelling) and (2) how this potential can be reached and what is necessary to happen

3. Dairy Story Line Milano

Name of Commodity Group and specific commodities within it.	Type of agro-system where the commodity group is targeting at (LAS, MAS or GAS)	Innovation Domain that is being addressed	Type (s) of re-design principles (SCM-Rps) where the innovation is related to	Performance Indicators that are relevant	Benchmark information for scenario
Milk in Lombardy 6500 dairy farmers producing 4,3 MLD kg milk total (40% of Italian production). First buyers use milk for: • consumption (0,7 MLD kg) • cheese (2,5) • trade (1,1)	**GAS** The milk produced in Lombary is bought by 253 regional firms (their catchment area is regional), 1 national firm and 3 multinational companies. The own grown roughage amounts to 3,4 MLD feed units and consists in: . corn silage (56%) . permanent grassland (19%) . alfa alfa (12%) . other forage crops (13%) Breeders use 1,1 MLD kg of feed concentrates in which there are many raw materials, mainly cereals and soya.	- Adoption a feed systems able to reduce both nitrates and greenhouse gases (PROCESS) - Increasing of self production of concentrates and forages (PROCESS) - Recovery of the energy content and agronomic value of manure (PROCESS) - Developing Decision Support Systems which are able to identify and verify the technical and economic viability of manure management innovative solutions as, for exemple: • improvement of solid-liquid separation efficiency (to support the transport of the solid fraction outside surplus areas, typically after composting); • algae production (to remove nitrogen from	Since innovations for sustainability involve the production process rather then food chains it is not possible find relations with SCM	N, P and C efficiency	Dairy Sector: +20 % rate of energy self-sufficiency On farm: > 40% of N efficiency > 80% of P efficiency > 80% produced MJ of own land - 20% emission of CO2 equivalent - 20% emission of ammonia

		waste slurries and obtain a value-added biomass suitable for further use, such as energy production. • biological nitrogen removal technologies • enhancement of nitrogen use efficiency by plants through improved knowledge of nitrogen behavior in the soil. (PROCESS)			
"District of milk" • 600 farmers (500.000.000 kg milk) united in 4 cooperatives; • 18 dairy firms • 2 research institutions	**MAS** Main part of milk is processes and sell as PDO cheese (grana padano, parmesan, provolone, gorgonzola, etc.) on the global market. Fresh milk and part of cheese are sold on regional markets	A recent governance innovation is the institution and recognition of a new collective entrepreneurial subject called "agro-food district". (PUBLIC GOVERNANCE INNOVATION) The institution of "district of milk" represent a new way to make farmers more competitive and create relationship with the dairy industry. (PROCESS INNOVATION) A better integration of supply chain between farmers and dairy industry could be obteined by involving breeders in the governance	1, 4, 5, 6	Number of breeders that join the district % of dairy production having the entire supply chain within the MAS % of the dairy demand having the entire supply chain within the MAS	>30% of milk produced in the region is handled by the district

		of dairy industry (for example, facilitating the entry of representatives of the breeders into the board of the dairy companies) (CORPORATE GOVERNANCE)			
Local food chains Farmers who sell directly milk and dairy in various ways	**LAS** Local markets	Selling raw milk through: • vending machines (PRODUCT, PROCESS) Selling dairy products through: • farmer's markets (PROCESS, SOCIAL, GOVERNANCE) • EPGs (PROCESS, SOCIAL) • Online storefronts (PROCESS) • CSA (SOCIAL) Decrease inputs in production and distribution process: - optimization of delivery; - promote energy self sufficiency of farms	1, 5	- % milk and dairy sold through local food chains - % metropolitan citizens that buy directly from producers - Number of farms involved in direct sale	>5% of dairy products sold through local food chains

4. Dairy Story Line Milk Berlin

Name of Commodity Group and specific commodities within it.	Type of agro-system where the commodity group is targeting at (LAS, MAS or GAS)	Innovation Domain that is being addressed	Type (s) of re-design principles (SCM-Rps) where the innovation is related to	Performance Indicators that are relevant	Benchmark information for scenario
Milk in Germany 91.550 dairy farmers produce 29.6 Mio. tons milk per year. Self-supply in Germany: 101% (2009), among them butter: 95%, cheese: 121%	**GAS** Within European Union Germany is the largest producer as well as market for milk products. 46% of the production is exported (MIV 2013). While German producers provide a lot of standardized products with low prices, processed products with higher prices were imported. Value adding and processing of milk takes place to a high extent in foreign countries (e. g. cheese from the Netherlands, Italy). The share of organic production on the whole production amounts only 2.2% (MIV 2013). 15% of organic milk comes from outside Germany (mainly Denmark and Austria, BÖLW 2012). But the domestic production of organic milk arises significantly within the last years (Statista 2013).	PROCESS/PRODUCT: quality and safety, delivery and technology): ESL-milk extended shelf life for conventional and organic milk GOVERNANCE/SOCIAL: different fair milk initiatives (conventional and organic producers)		Higher energy input for production of ESL-milk due heating and possible longer transport distances =>transport distances =>energy efficiency Availability of fresh milk for the consumers Number of processing units using this process and related output (amount of ESL milk)	Regional optimization Share of milk produced and processed in B-BB Share of ESL milk produced in Berlin-Brandenburg???
Farm enterprise takes	**MAS**	GOVERNANCE/SOCIAL:	???		Regional maximization

over various functions within the regional food system (production, milk processing, bundling) and take over the function of a regional food hub by bundling pathways for different organic commodities.	B-BB represents only 4% of the German dairy cow husbandry and milk production and there are no large processing units in this area (MIV 2013). In 2012: 158 960 milk cows. Number of milk cows has fallen about 23% within the last two decades (1999-2012). Dairy farms in Brandenburg have a good economic performance and the average milk yield is higher than the German average (around 9.100 kg/cow/year). *There is no data available how much milk from Brandenburg is processed and consumed in the region.* From the regional market there is a notable rising demand for organic milk which amounts around 26 m kg/year. The regional output of organic milk amounts around 20-23 m kg/year. In the past the two existing dairies (Brodowin and Gläserne Molkerei Münchehofe) processed only 2.8 m. litres. Recently they expand their capacities	regional brand Founder and member of the fair & regional initiative (http://www.fair-regional.de) LOGISTIC: improvement of direct marketing / box scheme by opening a new storage place on the way from Brodowin to Berlin =>reduces transport distances PRODUCT / PROCESS / SOCIAL Organic farming, box scheme, farm shop Packaging: eco-friendly returnable bottles and one-way-package with reduced weight =>reduces waste, resource use (water, energy)			

	and new (smaller) processing units for organic milk in the region were generated (e. g. Lobetal) The Ökodorf BRODOWIN Ltd. (ca. 75 km from Berlin) is an agricultural enterprise with a high degree of diversification and takes over the function of a regional food hub for organic commodities (mainly dairy and vegetables). The own dairy is located on the farm and process actual 3.5 m litres organic milk per year (only organic farming assoc. Demeter). 1.9 m litres comes from the own cattle breeding, rest from 3 farms in the region (max. distance 120 km). Fresh milk has high importance: offer also no homogenized milk and reject ESL-milk. Feed comes from the region. Distribution: 80% Berlin-Brandenburg / 20% Germany. Distribution channels: 70% wholesale, 10% box scheme (private households, kinder-				

	gartens, restaurants), 10% farm shop, 10% others (weekly markets…)				
Local farmer produces speciality milk products with high value and sell it mainly to consumers in Berlin.	**LAS** BOBALIS (70 km from Berlin) produces organic water buffalo milk in order to process it to cheese like Mozzarella (Italian type) and yoghurt. They set up their own cheese dairy on the farm in order to process the milk of the 60 buffalo cows. 50% of the products were sold to organic stores and hotels in Berlin. There is a rising demand for real organic Mozarella.	PRODUCT: lifestock breeding with water buffalos and products of buffalo milk are new in Berlin-Brandenburg region. PROCESS / MARKETING: BOBALIS offers its products (milk, meat) also via an onlineshop and offers guided tours on the farm.	1 (creation of a total new chain)	Relation demand-supply Feed from own land	Regional maximization

5. Dairy Story Line Milk Ljubljana

Name of Commodity Group and specific commodities within it.	**Type of agro-system where the commodity group is targeting at (**LAS, MAS or **GAS)**	**Innovation Domain that is being addressed**	**Type (s) of re-design principles (SCM-Rps) where the innovation is related to**	**Performance Indicators that are relevant**	**Benchmark information for scenario**
Milk in Slovenia 6.883 dairy farmers producing 600,000 tons milk total. Yearly production relatively constant. Dairy milk in process: 530.573 tons total (356,372 tons processed in SLO -17,994 tons cheese, 2,585 tons butter, 33,915 fermented products) Export is mainly a consequence of higher prices of milk in neighbouring countries (Italy). Self-supply in SLO: 120%. Consumption: 219 kg/person Milk price: 30 €/100 litres Farmers are mainly organised in big cooperatives (zadruga) covering local entities or region. http://www.mko.gov.si/si/delovna_podrocja/kmetijstvo/kmetijski_trgi/	**GAS** 33% milk exported out of Slovenia GAS is in Slovenia difficult to reach due to small scale productions. Only the biggest companies in processing food are enough competitive on the market. However, when they became players on the market are privatised and sold to international food groups. The grass production is not exploited at its full capacity. However the terrain is not favouring dairy production but suckler cows for later meat production. Dairy cow production due to its intensive technology, to reach its highest added value, ousted grain production from flatlands.	Merging of small cooperatives in one big to become major player on the market capable of negotiations with big Dairy Milk processors. Organic production of milk. GMO free production of milk.	Redesigned roles between producers, cooperatives and milk processors. **(1, 4)** Jointly defined objectives and performance for all producers if they are organised in one cooperative or if they produce organic or GMO free milk. **(3, 4, 6)** Creating information transparency and consumer secured. Consumer gets organic milk and products produced without artificial plant protection products, mineral nitrogen, animal are welfare is at its maximum, etc. Tracing the origin of the milk and feed products from the farm to the shelves. **(1, 5)**	Number of cooperatives. Price of milk. Share of organic or GMO free milk on the market.	Highly expressed GAS in milk production would cause environmental problems with groundwater resources. These influences are already seen through high levels of nitrates in all major alluvial plains and karst sources. Concentrations of nitrates are at certain points well above guide levels of Water Framework Directive. The main cause is intensive forage production for dairy cows.

Name of Commodity Group and specific commodities within it.	**Type of agro-system where the commodity group is targeting at (**LAS, **MAS** or GAS**)**	**Innovation Domain that is being addressed**	**Type (s) of re-design principles (SCM-Rps) where the innovation is related to**	**Performance Indicators that are relevant**	**Benchmark information for scenario**
Ljubljanske mlekarne 200,000 tons mil k/year Milk, yoghurt, cheese, ice-cream (buying milk from local co-operatives in wider Ljubljana metropolitan region) http://www.l-m.si/en/domov.html **Mlekarna Celeia** 93,000 tons milk /year Milk, yoghurt, cheese GMO free. http://en.zelenedoline.si/	**MAS** Main part sold in Slovenia. Export partly in ex-YU Too big for only metropolitan market. From 2013 part of Lactalis group. The gap between small scale and big scale production originates in the management of the super markets chains. They require regular supply and uniform quality of products which is difficult to reach. Lately almost all super markets offer nationally, regionally produced commodities - at least one (e.g. milk, eggs, bread, meat, fruits, vegetables) MAS is exercising for dairy products. Hofer super market offer only milk, eggs produced in Slovenia. Mercator supermarkets offer only meat produced in Slovenia and bread baked only from Slovenian wheat. Mlekarna Celeia (Celje dairy) produce only dairy products without GMO (genetically modified organisms) and only from milk produced in one region. MAS is easily reachable for dairy products because of production going on all year around and constant quality and quantity	Standardised quality and looks of the product with regional/metropolitan origin. Integration of producers on regional metropolitan level is preferred. Central metropolitan region Food Hub for food products exchange. Food hub is part if the Regional Agricultural Development Park which offers education of producers and consumers about production technologies, production planning, standardisation, marketing and importance of integration between all food chain links. Unified knowledge and its transfer in to practice.Directed/focused in providing constant food supply with the possibility of the sale/export of surpluses. Fewer producers on larger farms.	Common/uniform action/looks of the producers on the market. Better visibility on the market. **(1, 2, 6)** Buyers/wholesalers get good and constant quality. Unity of the producers facilitates the supermarkets, customers. **(2, 4, 6)** Merchandisers satisfied with regular supply of steady quality regardless of the producer. **(2, 4, 6)** Due to production planning can consumers choose between wide range of species and cultivars of products from variety of production technology (organic, integrated, and conventional). **(2, 3, 5)**	Number of common action groups of the producers. Number of producers included. Easier to control quality of the food. Quality is not variable which facilitates customers, supermarkets. Regular orders. Wide numbers of regionally produced commodities are regularly included in supermarkets offers to consumers. Customers become trough common action of producers aware of what can be regionally produced and about importance of seasonality.	Establishment of common regional trade mark/brand. Food hub established. Farms are larger and economically more efficient. Due to the common action and standardisation of the processes and technologies is regionally produced food better in quality and at least equal in prices.

Name of Commodity Group and specific commodities within it.	**Type of agro-system where the commodity group is targeting at (LAS**, MAS or GAS**)**	**Innovation Domain that is being addressed**	**Type (s) of re-design principles (SCM-Rps) where the innovation is related to**	**Performance Indicators that are relevant**	**Benchmark information for scenario**
Pustotnik Farm Milk and cheese production http://www.kmetijapustotnik.si/?___store=en **Mis farm** Milk production http://www.kmetija-mis.si/	**LAS** At farm (Cheese centre, Local Markets, Local Caterer, Restaurants Raw Milk Vending Machines (Local Markets, Residential areas) Average size of the Slovenian farm is 6.4 ha of agricultural land (grassland and fields). Small farms are generally oriented to local market.	Variety, variability, diversity in commodities for the consumer. Direct contact of the local producer and the consumer. Seasonality is advantage. A direct sale is predominant mode for the supply of the market (local markets, sale at farm, boxes). Individualism of the producers is still present. Integration of the producers on sub-metropolitan region is desired. Establishment of several smaller food hubs in different parts of the metropolitan region. Joint management of the integrated producers. Joint comparisons between producers offer and joint action on the market. Seasonal surpluses in the production not sold in food	What and how to produce/grow and how to market products. Joint management of the food hub and agricultural development parks by producers.**(1, 3, 4, 5, 6)** Although the size of the production is still limiting factor for the buyers/wholesalers it is due to better integration of the local market easier to plan purchasing and supply of the local products to the consumers. **(1, 2, 3, 4)** Merchandisers of the super markets don't have constant supply as all system is based on the direct sell on the market (food hub) or home. **(5)** Better informed consumer and integration of producers facilitates customers with diverse offers, safety when purchasing, and belief in the correctness of the purchase. **(1, 5)**	Number of jointly managed food hubs. Share of local food in public institution of the metropolitan region. Joint action lowers the costs and stabilise the production and income. Consumer express confidence and trust in locally produced food.	Chain optimisation "from farm to consumer", as added value

		hub could be bought by wholesalers for the supply of the metropolitan region public institution (schools, hospitals) or restaurants. Education of food chain links should take place in newly established agricultural development parks at sub-metropolitan region. Main purpose of these parks is transferring latest knowledge into practice through innovative and model farms. Making new products (cheeses, yoghurts) Widening of the milk vending machines network) More producers on smaller farms.			

6. Dairy Story Line Milk Nairobi

Name of Commodity Group and specific commodities within it.	Type of agro-system where the commodity group is targeting at (LAS, MAS or GAS)	Innovation Domain that is being addressed	Type (s) of re-design principles (SCM-Rps) where the innovation is related to	Performance Indicators that are relevant	Benchmark information for scenario
Milk in Kenya 1 million dairy farming households in Kenya (5 million heads of dairy cattle); 3 billion litres of annual milk output (70% from dairy cattle). Rift valley and central Kenya regions are the main dairy production zones (accounts for over 80% ofproduction) Smallholder producers (average 3-5 acre farms with 2-3 animals) account for >70% of marketed production Low milk yield (1,000 kg per year per cow)	**GAS** Kenya has the largest and well-developed dairy herd in sub-Saharan Africa, accounting for 24% of market share. Levels of milk consumption in Kenya are among the highest in the developing world (per capita consumption is 4 times the average in sub-Saharan Africa) 85% of marketed milk is sold raw through informal channels subject to weak enforcement of safety standards. >60% of processed milk is sold as fresh whole milk Insignificant international trade in dairy products. Kenya is a net importer of dairy products and imports constitute only 0.5% of total production Dairy products are exported in countries within SSA, and dairy	Improvement of animal breeds/ genetic makeup/ introduction of new breeds (PROCESS). Intensification of dairy production due to reducing space (e.g. stall-based/'zero' grazing) (PROCESS) Improvement of quality of fodder/pasture and animal feeds (PROCESS) Value addition; processing of milk, processors seeking to increase capacity utilization (PROCESS) (PROCESS/SOCIAL) Enforcement of milk safety standards and regulations, including traceability issues especially for the export market (PROCESS, GOVERNANCE) Harmonization of milk and dairy standards across the East African region (PROCESS, GOVERNANCE)		Effect on milk production/productivity Use of artificial insemination (AI), animal genetic makeup Regional market share for Kenyan milk and other dairy products Milk quality Fair trade practices	

	products imported mostly from European Union and the East African region.				
Milk in the Nairobi MAS Former Nairobi Province • 24,700 milk animals (22,800 dairy cattle) in the former Nairobi Province. • Data on the areas around Nairobi are not available (to be disaggregated from county statistics, once these become available)	**MAS** Many urban farmers on the fringes of Nairobi city especially in central Kenya highlands are increasingly taking interest in dairy farming due to growing demand for dairy products and favourable climatic conditions for dairy production.	Same as for GAS (except issues related to East African region and export market)		Same as for GAS (except issues related regional market and fair trade)	
Nairobi LAS Smallholder individual dairy farmers (keeping an average of 2 dairy animals on small urban plots) producing for the local market. An insignificant number of large producers and farmers producing through cooperatives	**LAS** Local markets Land available for dairy farming rapidly declining Dairy production has previously been constrained by anti-urban farming policies and legislation and, as such, lack of official support.	Value addition through processing due to higher demand for processed milk and other milk products (yoghurts, fermented milk) (PRODUCT, PROCESS) Selling raw milk directly to buyers and through local kiosks, milk bars, informal traders, and direct supply to neighbours and restaurants (PROCESS) Selling processed dairy products through local kiosks, and supermarkets (PROCESS). Legalization of, and official support for urban dairy		% milk and dairy sold through different types of local food chains % metropolitan citizens that buy directly from producers Reuse and recycling of urban waste and dairy by-products % of milk sold raw/processed No. of informal traders involved in handling milk and other dairy products Type of milk and dairy products processed/marketed	

		production (PROCESS, GOVERNANCE) Recycling of dairy by-products (PROCESS)			