



FORUM CHINA - EUROPE

“Sustainable agri-food supply chains and systems”

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SUMMARY

INTRODUCTION 3

FOOD PRODUCTION 4

LOGISTICS AS A LEVER FOR THE SUSTAINABLE MANAGEMENT OF THE FOOD SUPPLY CHAIN. 6

ANNEX 1 – SUSTAINABLE PRODUCTION 9

 CHALLENGE 5. ACHIEVING SUSTAINABLE FOOD PRODUCTION 9

 Goal 1. Understanding of the sustainability of food production and supply in Italy 9

 Goal 2. Research on scenarios of future Italian food production and supply 10

 Goal 3. Developing sustainable processing, packaging and distribution 11

 Goal 4. Developing and implementing sustainable primary food production 13

ANNEX 2 – FLOW CHART 15



INTRODUCTION

In order to govern globalization, countries need to reconcile natural resource management and concern for the environment with the need to have more growth and employment. This is particularly important in the case of food supply chain management, as environment pollution and climate change do threaten agriculture productivity.

The food industry is the leading manufacturing sector in Europe, in terms of turnover, value added, employment and number of companies. Its turnover was 836 billion euros in 2005 and it employed nearly four million people. Although food industry has a major impact on our lives and economy, it is largely made up of small companies. Of the 283000 food companies in Europe, over 99% are SMEs (Small and Medium Enterprises). These SMEs generate almost half of the industry's food and drink turnover and employ over 61% of the workforce.

Besides strong environment challenges, the food sector must face very important changes related to demographics (ageing, migration) and also lifestyles. The increasing concentration of industries, including food production, transformation, distribution also is modifying economical activities at a local level and is responsible of people migrations towards the cities and rural areas alienation. The change of diet habits (more calories, saturated fatty acids, less fibres etc...) is responsible of increased diet-related diseases such as diabetes, cardio-vascular diseases etc... Obesity is considered by OMS as a true epidemic all over the world, with high costs and large scale health problems. Moreover the extension of food supply chain, including fish and sea food supply chain, with more logistics, energy consumption for transport and risks for food safety.

Food production chains can be organised in a variety of ways. Conventional 'industrial' agricultural practices are based on advanced breeding techniques and major inputs of chemical fertilisers and pesticides. Food produced in this way is transport-intensive, requires high-energy processing, relies on modern retailing systems and demands high-tech kitchens.

Many argue that the industrialised systems should be dismantled and replaced with alternative methods of agriculture, food processing and distribution that emphasise social and environmental sustainability. This paper looks at the environmental and social sustainability of different strategies for food systems by analysing the whole chain of production, processing, distribution and consumption activities.

To face, in a pro-active way, these challenges, a re-design of the whole food supply chain is needed, to improve sustainability. It has to be understood if:

1. Could logistics represent a tool to modify, in a more sustainable way, the interactions between food production and food consumption?
2. Could a shorter food supply chain contribute to the creation of new, healthy and sustainable consumption patterns?
3. Could an improved knowledge about the relation between food and environment modify food consumption habits, towards the consumption of less processed food and changing the present food production trends (i.e. increasing production of functional food)?
4. Which role could (or must) have Public Authorities, who buy each day hundreds thousands of meals for school catering, in influencing the above mentioned choices?

FOOD PRODUCTION

The food industry is composed by transformation companies, using agricultural products to produce food and beverages, breeding and fishing activities. The term "food supply chain" refers to the strict correlation and the functional link existing between the primary sector (agriculture) and the industrial one (transformation industry).

This link develops in a double direction, as agriculture has effects on food transformation and, vice versa, the food industry has a strong influence on food production. In the past, the agricultural component prevailed over food industry.

Today, instead, several factors have pushed agriculture towards the adaptation of transformation industry requirements, as well as to the tastes and needs of the final consumers, target of aggressive marketing campaigns, aimed only at increasing the final product sales.

Different causes have contributed to this change: the transport costs reduction, experienced until a few years ago, allowed a massive company delocalization and an increasing market internationalization; the consumption of organic products increased, on one hand, as well as fast foods diffusion, on the other; also new distribution systems, especially for major companies, were diffused. This evolution has happened regardless of environmental issues, following Fordism ideas, with no interests in sustainable development.

In this situation, a new and more sustainable approach to food production has been developing - organic food production.

Organic producers, due to their approach and organization, have both a social and environmental role of crucial importance, because:

- 1 They obtain healthy and taste appealing products, in an environmental friendly way;

- 2 They preserve vegetation and animal biodiversity, thanks to their ecological infrastructures;
- 3 They promote the landscape values of rural areas;
- 4 They have a direct effect in reducing greenhouse gas emissions, and in improving crop capability of carbon sequestration;
- 5) They could support energy production from renewable sources; water, wind, sun and natural gas;
- 6) They promote social agricultural systems, supporting the employment of disadvantaged categories
- 7) They apply and promote contractual relations shared by social parties, and based on ethical and social principles;
- 8) They promote local food, and don't generate subsidized over-production, increasing dumping behaviour in Developing Countries;
- 9) They promote a fair and sustainable economic system worldwide, a systems granting the food sovereignty of each people and community.

The experiences and results obtained by organic food producers constitute a useful reference and good practice for the whole food industry.

However, organic food production is not on its own enough to grant the whole food chain sustainability, which should be supported by integrated and efficient production systems, allowing the transformation of agricultural products and delivery to final consumers with a lower use of natural resources, and with lower pollution levels.

In this perspective, the concepts of local food and sustainable logistics become two key issues in assuring the sustainability of the whole food supply chain.

LOGISTICS AS A LEVER FOR THE SUSTAINABLE MANAGEMENT OF THE FOOD SUPPLY CHAIN

The concept of SUPPLY CHAIN is fundamental for the understanding of the food sector. The supply chain is a kind of route "from farm to fork": from the agriculture, throughout the agricultural products trading and transformation, up to the distribution (wholesaling or retailing). The supply chain indicates how economic activities are developed and integrated; usually it refers to sequential activities, one pre-ordered to the following, even if self-regulated.

Within a logistic process, it is possible to highlight some methods and organizational functions that could deliver a product to the final consumer, in the way, time and costs required. With regards to food products, the logistics activities are carried out by different operators (manufacturers, distributors, service suppliers, consumers), and could be grouped in seven categories:

- 1) Order Management (order receipt, elaboration, transmission, implementation and invoicing);
- 2) Management and stock control (definition of supply timing and quantity, inventory upload and download, products and packaging codification);
- 3) Warehousing (conservation of goods, qualitative and quantitative controls before shipment);
- 4) Shipment (activities related to product movement and shipment receipt);
- 5) Packaging (pallets);
- 6) Delivery (products delivery from the starting point, to the destination);
- 7) Sales returns management and waste disposal.

The lack of coordination in carrying out these activities could generate inefficiencies: the storing up of too much stock, the rise of lead times, out of time supplying, increasing costs and decrease of the service quality.

In the food sector, three different steps in the evolution of logistics services could be found.

In the first step, logistics was intended as a part of the production system.

In the second step, companies, in order to reduce costs, developed outsourcing strategies, also for logistic activities.

Recently, as a third step, companies are attempting to achieve a better competitive positioning, and give logistics a new strategic role, within cooperative strategies.

It is in this perspective that there could be an evaluation of the coordination and information spread efforts that try to create a stricter connection between production and sales activities,

to satisfy the needs of customers interested in the food qualities and health, as well as in the environment.

A consolidation of contractual relationships, durable and able to satisfy commercial and logistic needs, is necessary in order to establish a new partnership, especially in the promotion of local food diffusion (even if this doesn't necessarily correspond to a shorter supply chain).

The possibility of giving a product value depends, quite often, on the efficiency of the supply chain and on the methods used to measure its performance.

The final stage in granting the pursuit of the service goal (the "perfect order") could only be an efficient Supply Chain Management, allowing the integration and the management of the supplies, the control of materials and information in a global perspective, aiming at granting value for the customer; this could be summarized as to obtain the right product, in the right quantity, at the right time.

In view of the next challenges posed by globalization and EU enlargement, the competitiveness of Italian companies should be maintained thanks to logistics improvement processes, allowing the achievement of growth rate comparably good as in the past.

However, at present, the Italian logistic supply chain has to face a series of problems, which decreases its efficiency:

- 1 The extreme fragmentation of farms and transformation industries makes it difficult to reach a critical mass in logistics activities, as to set up a district logistics.
- 2 The Modern Distribution is more and more engaged in directly controlling and managing the whole food supply chain
- 3 The market doesn't offer logistic solutions able to satisfy the requirements of the food sector, especially for the management of the chill supply chain, and for Door to Door delivery.
- 4 The administrative fulfilments are several and rigid, while the delivery of fresh food requires a high efficiency.
- 5 Customer price for fresh products have been stagnant for many years, while distribution and logistic costs are increasing.

Nevertheless, there are several experiences and good practices that are to be spread in order to increase the efficiency of logistic activities and of the whole supply chain, with a potential costs reduction and the creation of new business opportunities on markets attracted to the "Italian Taste".

It is possible, thus, to start from the diffusion and good reception of Italian products on foreign markets, in particular for typical or DOP products. This property allows Italian export to grow regularly.

The chill supply chain is essential to grant food conservation. Technology could help food producers: railway or maritime transport operators are starting to suggest shipments on refrigerated mobile bulks, allowing for perfect product conservation without breaking the chill supply chain, and also simplifying, where rendered possible by health and duty authorities, administrative procedures.

For instance, Sicilian oranges are delivered from Sicily to the CeDi of COOP in Northern Italy on railways, using mobile bulk with passive refrigeration systems. At this moment the service involves three bulk delivery daily on Trenitalia trains, but if only 15% of all oranges delivered by road would use this service, 3 trains/day could be filled.

Another example about how logistics could support food production comes from maritime transport: MAERSK has, for the first time, has delivered a refrigerated mobile bulk of Sicilian oranges to Japan, a rich market where Tarocco oranges cost 1€ a piece. In this winning case, logistics creates value for Italian agriculture.

Also, the CPR System experience, a Consortium managing reusable green boxes for fruits and vegetables transport, is important: this system has evident environmental advantages (more than 90 million disposable packages per year are avoided), and has also allowed a reduction of 2/3 in packaging costs. CPR System estimations state that 50% of fresh food price comes from logistic costs; thus, possible gains are huge, and advantages are connected to an improvement of the whole logistics chain, with benefits for all operators (producers, distributors and customers).

Therefore, some possible solutions to improve food logistics are available, regardless of all Italian production system weaknesses, caused by its fragmentation.

Logistic providers have to "invent" innovative and affordable solutions as to make demand and offer collide.

ANNEX 1 – SUSTAINABLE PRODUCTION

(Pillar 5 of Italian Technology Platform Food For Life)

Consumers are increasingly motivated to purchase foods that conform to production criteria that are generally environmentally-friendly and conform to their ethical principles. To achieve these, synergies must be created between economic growth, environmental protection and fair social conditions, with a multidisciplinary scientific and technical approach and the integration between public and private research sector enterprises area.

Over the past three generations, food production systems in Europe have developed with a focus on security of supply with low prices to the consumer, whilst at the same time seeking to reduce environmental impact and maintaining economic returns to rural communities. The recent expansion of the EU brings about an increasing diversity of food production systems, affording the opportunity to utilise this diversity for creating and supporting more sustainable food production systems.

Given the highly interlinked nature of food production and the many aspects of 'sustainability' that need to be addressed, it is important to embrace a holistic view of European food production and supply systems. The transition towards more sustainable systems must go hand-in-hand with strengthening the competitiveness of the stakeholders in the European food system.

Challenge 5. Achieving sustainable food production

GOAL 1. UNDERSTANDING OF THE SUSTAINABILITY OF FOOD PRODUCTION AND SUPPLY IN ITALY

A system analysis perspective is essential in assessing the sustainability of food chains since their environmental impacts can occur in different places and different times. Life Cycle Assessment (LCA) has been developed to identify and quantify the environmental impacts of individual products and services (such as collective catering systems). However, food production is a complex inter-linked system, so that the LCA approach must be extended into a more complete and realistic form of system analysis; it should enable products to be examined in the context of the background system in which they are embedded. In addition, the Environmental Product Declarations (EPD), generated by LCA, must correspond to the specificity of the agro-food system and this approach should be uniformed within Europe.

Input/output analysis is likely to be another useful approach and will need to show both the social- and environmental consequences of alternative food supply systems, and must also address fair working conditions, rural development and gender equality.

Models must be constructed to identify sustainability indicators, which can then be validated and used for comparing scenarios. A systematic programme is needed to measure these

indicators so as to monitor progress towards sustainability. To support multi-criteria decisions processes, models should be developed that can be optimised to show the effect that positive changes in one indicator might have on another.

Research challenges:

- Develop a system analysis methodology for describing the essential parameters of sustainability over the whole food chain, using sustainability or extended LCA indicators. The latter should include both production aspects, as well as indirect features that can influence the sustainability of the system;
- Develop dynamic modelling tools;
- Formulate models to describe and evaluate the sustainability of regions and supply chains in the whole European system. This aspect includes both analysis and project development and should be applied to trans-European situations that interact and influence each other;
- Apply LCA methodology and formulate models to describe and evaluate the sustainability of Italian typical productions, to evince their characteristics of environmental, economical and social sustainability. This should favour innovation and development of both agricultural and food enterprises;
- Generate EPD that correspond to the specificity of the agro-food system and uniform this approach within Europe, by applying system analysis methodology and case studies for describing the essential parameters of sustainability over the whole food chain.

Deliverables:

- LCAs performed for a range of regional and commodity food chains; appropriate sustainability indicators developed;
- Sustainability indicators quantified for many food chains and applied to show the scope for improvement;
- Dynamic modelling tools developed and used for rapid identification of more sustainable production and processing systems for a range of products at different geographical levels;
- Uniformed EDP for agro-food systems.

GOAL 2. RESEARCH ON SCENARIOS OF FUTURE ITALIAN FOOD PRODUCTION AND SUPPLY

Scenarios are 'possible futures', intended to provide insight into the consequences of multi-factorial changes (e.g. demographics, environment and world trade), which are expected to be more dynamic than previously.

Global climate change, the heavy dependency on fossil fuels and the political boundary conditions, are some aspects that will also influence the sustainability of the European food supply system, so they should be considered when studying scenarios.

Research challenges:

- Identify relevant factors for the sustainability of European food production systems, their projections into the future and use them to build long-term scenarios, integrating demographics, economy, policy and trade, and environmental change. Evaluate their priority in the Italian context;
- Enforce an holistic genomic approach to ensure sustainability.

Deliverables:

- Presentation of a number of scenarios illustrating the consequences of different "futures", developed out considering the present food production system;
- Selection of general scenarios to be used as a basis for future food production scenarios;
- Presentation of a number of scenarios illustrating new and alternative highly sustainable food production systems.

GOAL 3. DEVELOPING SUSTAINABLE PROCESSING, PACKAGING AND DISTRIBUTION

Current systems of manufacturing and processing, packaging, transportation and distribution, and retail are not necessarily sustainable. The wasteful use of natural resources and food raw materials, as well the policies or markets, may favour unsustainable patterns of production and there is an inequitable remuneration of actors in the system.

Reduction in uses of energy, water and materials will require close links between raw material production, primary and secondary processing, packaging, waste management and reprocessing. Identification of improvement potentials from sustainability analysis will be an important driver for innovations that are directed towards new and novel technological solutions for food processing, packaging and transportation.

As food industries are highly complex and spatially-distributed, research into more sustainable food production systems must explicitly account for this complexity, as does the 'Industrial Ecology' (IE) approach. This aims to restructure production systems into clusters of industrial firms with output-input connections as stocks and flow of materials, energy and information according to the principles of ecosystems. Such an approach will include analysis of complex and interlinked networks of primary food production, food processing, distribution and packaging.

It is necessary an integrated approach towards the identification of the critical points of the process and the sustainability, so as to optimize methods and techniques that lead to an

increase of competitiveness of the enterprises and to sustainable manufacturing and processing, packaging, transportation and distribution systems.

Research challenges:

- Reduce uses of energy, water and materials (food, feed and packaging);
- Identify improvement potentials from sustainability analysis;
- Improve utilisation of food raw materials and reduce waste throughout the production chain.
- Develop side-structures for in-field preliminary food processing;
- Reprocess valuable food waste to food or feed;
- Promote recycling, recovering and management of biomass, organic wastes and by-products;
- Optimise energy production in industry including the development and use of alternative/renewable energy sources;
- Utilise and recycle by- and co-products of food chain as energy and active compounds sources;
- Develop new techniques and new materials for packaging;
- Promote storage and transport with "zero- release" of contaminants;
- Integrate different industrial systems, including food primary production and food industries in 'industrial ecology' relationships, exchanging matter, water and energy and economic value in inter-industrial networks;
- Develop methodologies for value chain analysis;
- Develop methodologies for integrated assessment of sustainability.

Deliverables:

- Methodologies for value chain analysis;
- Identification of wasteful food processing, packaging and transportation operations with potential for substantial improvement;
- Methodology for integrated assessment of sustainability of food production systems developed;
- Scientific approaches underpinning sustainable management of food production systems and clearly-established sustainability measures;
- Development and implementation of novel processing, manufacturing, packaging and distribution methods based on research on sustainable food production;
- Development and implementation of highly integrated sustainable village systems, including food production.

GOAL 4. DEVELOPING AND IMPLEMENTING SUSTAINABLE PRIMARY FOOD PRODUCTION

Within the next few decades, food production in Europe will experience climate change, changing international trade relations and regulations, large-scale shifts in global food production and demand, and stronger demands from society to reduce the environmental impact of food production. Primary food production must adapt to these changes to be sustainable. However, the study and preservation of local plant and animal biodiversity is a fundamental aspect for the development of sustainable production systems. While additional research needs to expand further knowledge on the interactions of biological cycles to enhance traditional food production, radically different primary food production systems may provide additional sources of food to traditional food production.

Biotechnology may be used to produce desired crop biomass in a targeted way, and to provide plants with better sensory, nutritional and production properties. Further fine-tuning of production systems through precision farming and other high-tech solutions could increase the efficiency of primary food production. Alternative systems for animal husbandry should be evaluated, including the dimension of animal welfare.

Fishery systems in Europe must be assessed for their sustainability and alternatives to traditional fishing must be explored, such as aquaculture.

Research challenges:

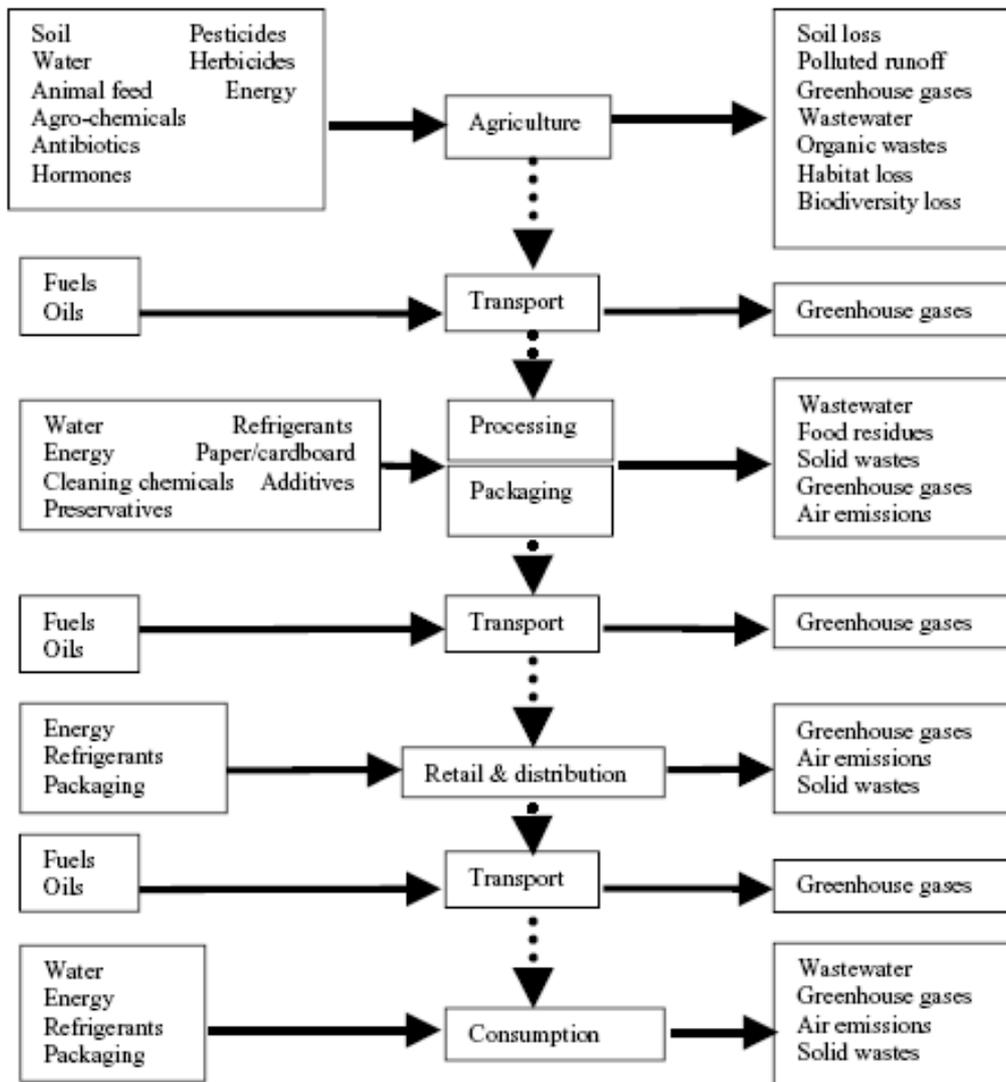
- Identification novel food production systems and evaluation their sustainability;
- Conservation & exploitation of biodiversity for native plant, animal and mushrooms species production, including breeding;
- Rationale use of natural resources: conservation of soil fertility, reduction of contamination of water resources & improved water use efficiency leading to more effective management of nutrients and xenobiotics in primary production systems;
- Alternative production and pest & disease control methods in the frame of ecological services;
- Development and evaluation of biotechnologies in sustainable agriculture
- Development of innovative techniques for the characterization of food according to the geographic origin, typicality components and safety;
- Creation of Indexes and Models of Geographic Characterisation (IGC, MCG) of the products;
- Production of food with better sensory, nutritional and technological properties;
- Ethical aspects of food production related to both consumer well-being and animal welfare, focused on developing alternative systems for food and animal production;

- Utilisation of statistical multivariate techniques to assess the weight of different variables (qualitative, environmental, managerial), on the qualitative and quantitative production of raw materials;
- Utilisation of fine-tuning of production systems;
- Decision making systems based on real-time control of primary production processes;
- Reduction of energy inputs and emissions of greenhouse gases addressing climate change issues;
- Application of system analysis, including performance evaluation, risk assessment of the processes and technologies.

Deliverables:

- Establishment of the knowledge base required to optimise existing primary food production systems, further development of novel systems and assessment of their sustainability;
- Scientific data underpinning the fully integrated management and assessment of sustainable primary food production systems (both established and novel);
- Scientific data on adaptive sustainable management of man-nature systems, including primary food production systems;
- Indexes and Models of Geographic Characterisation (IGC, MCG) of the products;
- Network research-production enterprise.

ANNEX 2 – FLOW CHART



Components of the environmental impacts of a typical food chain



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