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RECONNECTING AGRICULTURE AND FOOD: METHODOLOGICAL APPROACHES FOR THE ANALYSIS OF AGRO-FOOD SYSTEMS IN METROPOLITAN REGIONS

Settore disciplinare AGR/01

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Abstract

Feeding the city is one of the most relevant challenge for modern productive systems, as it concerns food security and safety, the quality of food products, energy consumptions and the sustainability of the urban model in general. Cities have a strategic role in developing sustainable food systems, but are more often affected by several interrelated factors that modify their capacities of food provision - from population increase, to urbanization phenomenon and land use conflicts, to the progressive globalization of food supply and trade. On the other hand, the shift towards demand-driven agro-food systems underlines the key role of consumers and their preferences for more local food, to which the productive system is required to adapt and adjust. Thus, the complex structure of a regional agro-food system should be able to respond to the challenges of domestic supply, to compete in the global context and finally to meet citizens' demand for a direct relationship with food producers through the development of local systems. in this sense, it is therefore needed the enhancement of proximity agriculture, the exploitation of local resources, teh promotion of system's potentialities, in order to diminish the distances between production and consumption sites and support the ties between the supply-demand pattern and the territory.

In practice, this reconnection is ensured by the several existing alternative food systems, also encouraged by the regulatory framework proposed by policy makers. Despite the sectorial and cross-sectoral initiatives accordingly implemented, they provide some opportunities and limits as well. In particular, given the increasing importance of food-related initiatives in urban areas, the integration of policies - both horizontal and at different administrative and territorial levels - is of fundamental importance.

It derives that specific interventions targeted at this, should be based on appropriate cognitive analysis that investigate the capacity of the system and local resources to adequately respond to urban food demand. Thus, it is provided a methodological framework, which on one hand can describe the regional agro-food system and, on the other hand, assess its capacities: a multidimensional approach that

combines productive and economic aspects, and simultaneously returns the compliance and adequacy of food production, their contribution to the regional economic balance and vitality, their market orientation, in order to provide precious information for policy-makers.

Riassunto

Il tema di nutrire la città è una delle più rilevanti sfide per i sistemi produttivi moderni, poiché riguarda la sicurezza alimentare, la qualità e la salubrità dei prodotti, i consumi energetici e quindi la sostenibilità del modello urbano in generale. Il ruolo delle città nello sviluppo di sistemi alimentari sostenibili è indubbiamente strategico, ma più spesso tali contesti subiscono una modifica delle loro capacità produttive, dovuta a differenti ed interrelati fattori: dall'aumento della popolazione, ai fenomeni di urbanizzazione e conflitti d'uso del suolo, alla progressiva globalizzazione dell'approvvigionamento e del commercio dei prodotti alimentari. D'altra parte, il passaggio a sistemi agro-alimentari fortemente guidati dalla domanda sottolinea il ruolo chiave dei consumatori e delle loro preferenze per prodotti locali, ai quali al sistema produttivo è richiesto di adattarsi. Così, la complessa struttura di un sistema agro-alimentare regionale dovrebbe essere in grado di rispondere alle sfide dell'approvvigionamento interno, di competere nel contesto globale e contestualmente di soddisfare la domanda dei cittadini per un rapporto più diretto con i produttori, attraverso lo sviluppo di sistemi locali. In questo senso, è dunque necessario rafforzare il ruolo dell'agricoltura di prossimità, valorizzare le risorse disponibili, nonché promuovere le potenzialità del sistema stesso, al fine di riavvicinare i siti di produzione e consumo e supportare i legami tra le dinamiche di domanda e offerta ed il territorio.

Nella pratica, tale riconnessione è garantita dai numerosi sistemi alimentari alternativi esistenti, altresì incoraggiati dal quadro normativo proposto dai decisori pubblici. Nonostante le iniziative settoriali e trasversali implementate in questo senso, l'insieme delle stesse sembra fornire sia numerose opportunità che alcuni limiti. In particolare, data anche la crescente importanza delle iniziative *food-related* in aree urbane, l'integrazione delle politiche – sia orizzontale e che a diversi livelli amministrativi e territoriali - è un aspetto di fondamentale importanza.

Ne deriva che specifici interventi indirizzati in questo senso debbano basarsi su appropriate analisi conoscitive che indaghino le capacità del sistema e delle sole risorse locali nel rispondere adeguatamente

alla domanda alimentare urbana. A tal proposito viene dunque fornito un quadro metodologico che possa sia descrivere il sistema agro-alimentare regionale, sia valutarne le capacità secondo un approccio multidimensionale, che combina aspetti produttivi ed economici, e restituisce simultaneamente la conformità delle produzioni alimentari, il loro contributo per l'equilibrio e la vitalità economica del territorio ed il loro orientamento al mercato, al fine di fornire preziose indicazioni per i decisori politici.

ACKNOWLEDGEMENTS

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www.foodmetres.eu

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

AAFN – Alternative Agri-Food Networks

AFS – Agro-Food System

AIS – Agricultural Institute of Slovenia

ALBIO – Agricultural Land use and BIOmass flows

BRC – British Retailer Consortium

BSE – Bovine Spongiform Encephalopathy

CAP – Common Agricultural Policy

CER – Cereals

CDO – Controlled Designation of Origin

CGDO – Controlled and Guaranteed Designation of Origin

CIA – Confederazione Italiana Agricoltori

CIRAD-SAR – Centre de coopération Internationale en Recherche Agronomique pour le Développement-Systèmes Agro-alimentaires et Ruraux

Coldiretti – Confederazione Nazionale Coltivatori Diretti

CORES – Consumi, Reti e pratiche di Economie Sostenibili *[Consumptions, networks and practices of sustainable economies]*

DG – Directorate-General

D. g. r. – Deliberazione della giunta regionale (i.e. *Regional Committee Resolution*)

D. Lgs. – Decreto Legislativo (i.e. *Legislative Decree*)

D. M. – Decreto Ministeriale (i.e. *Ministerial Decree*)

EB – Economic Balance

EC – European Community

EIP – European Innovation Partnerships

EF – Ecological Footprint

EFSA – European Food Safety Authority

FAO – Food and Agriculture Organisation

FNS – Food Nutrition and Service

FRU – Fruit

GAMS – General Algebric Modelling System

GAS – Global Agro-Food System

GDP – Gross Domestic Product

GIS – Geographic Information System

GLOBALGAP – GLOBAL Good Agricultural Practice protocol

ICT – Information and Communication Technologies

IFS – International Food Standard

RIS – Relative importance in Supply

RID – Relative Importance in Demand

ISCP – Integrated supply-chain projects

ISO – International Organisation for Standardization

ISTAT – Istituto nazionale di Statistica *[Italian National Institute of Statistics]*

LAG – Local Action Groups

LAS – Local Agro-Food System

LEADER – Liaison entre actions de développment de l'économie rurale

L. – Legge (i.e. *Law*)

L. r. – Legge Regionale (i.e. *Regional Law*)

LP – Linear Programming

MAS – Metropolitan Agro-Food System

MiPAAF – Ministero delle Politiche Agricole, Alimentari e Forestali *[Italian Ministry of Agriculture, Food and Forestry Affairs]*

MMR - Milan Metropolitan Region

MO – Market orientation

NGO – Non-Governmental Organisation

NI – Nutritional Index

NUTS – Nomenclature of Territorial Units for Statistics

OECD – Organisation for Economic Co-operation and Development

OIL – Oil plants

PDO – Protected Designation of Origin

PGI – Protected Geographical Indication

POT – Potatoes

PYO – Pick-your-own

QI – Quantity Index

RDP – Rural Development Policy

R&D – Research and Development

SFSC – Short Food Supply Chain

SMEs – Small and Medium Enterprises

SPG – Solidarity Purchasing Groups

SUG – Sugar beets

TGI – Typical Geographical Indications

TSG – Traditional Speciality Guaranteed

UAA – Utilized Agricultural Area

UNDESA – United Nations Department of Economic and Social Affairs

UNDP – United Nations Development Programme

USDA - United States Department of Agriculture

VEG – Vegetables

VI – Value Index

WIN – Wine grape

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

The interest in issues related to urban food supply is not something new. While major efforts in this direction are addressed to developing countries, where the main problem concerns the need to increase and improve food security (*Gallaher et al., 2013*), the theme is continuously on the rise in the Global North and in Western Countries as well: it emerges in the context of enhancing the productivity, providing high quality food to an increasing number of people (*UNDESA, 2012*) and ensuring agricultural production sustainability and environmental-friendly practices. This theme is tackled in academic and scientific contexts, but also more often actively involves both policy makers and civil society.

A phenomenon emerged since the nineteenth century with the advent of the Industrial Revolution, is that of a progressive globalization of food supply systems and international trade of food products, through which cities worldwide are sourcing to meet their food needs. Food has since then begun to be consumed more and more away from their production site, with a consequent lengthening of the distribution chain (*Giuca, 2012*), the perception of consumers for "placeless" products (*Paül and McKenzie, 2013*) and a progressive disconnection of many cities from surrounding agricultural areas, which until then had been an important source of fresh food, in favour of more profitable land uses (*Perrin et al., 2013*).

However, more recently some evidences of new trends have been observing. In several occasions, unconventional phenomenaaimed at territorially reconnecting food supply occur, which favour a shortening of food chains and therefore a reproaching and a more direct relation between producers and consumers. Despite this represents a simplification of the multiple interdependencies amongst various actors of the agro-food system (*Lamine, 2015*), the reconnection is to be meant not only as a reduced geographical distance (i.e. geographical proximity), but also as more direct (or less indirect) links between consumers and producers, based on a limited number of steps and nodes along the chain (*Watts et al., 2005*). Such an approach inevitably presents relapses and repercussions in terms of sustainability of the urban food provision itself. From this point of view, the innovation needed to support these experiences, rather than process or product innovation, mainly refer to the social sphere, as evident from the emerging of bottom-up initiatives promoted by civil society for greater proximity and interconnection between production and consumption sites. In this way, it emerges on the one hand the social function of agricultural production within cities (e.g. urban gardening) and on the other hand the role of food chains alternative to mainstream channels that traditionally supply urban centres and metropolitan areas: food chains linked with farmers' markets, community supported agriculture, collective buying groups, and even large retail distribution with a strong interest in the territoriality of food products.

This represents the main challenges for a sustainable food provision of big cities and metropolitan areas in the next future. The "reconnection" issue is then an important element to deal with: food supply should rely on the productions from proximate areas and brought closer to consumers' requests, adapting to food demand, providing foods with specific characteristics and in such amounts to meet dietary habits. In reconnecting and readjusting food production and consumption, preliminary analyses and assessments of the context are essential to obtain information about the system's capacities and potentialities in this sense.

1.1 Reconnecting agriculture and food

The processes affecting the structure and the organization of an agro-food system are the result of several pressures of different origins, from institutional drivers to social boosts and utilitarian pressures on both consumers' and producers' side.
Especially for what concerns these latter, the productive choices of farmers are conditioned by pedologic, climatic and environmental conditions, as long as by agricultural, territorial and environmental policies. They are also importantly driven by supply chain conditions, market and other economic instruments. This trend towards globalization had a major boost with the Industrial Revolution and gained pace with the process of trade liberalization that started after the Second World War and have been increasing since the Eighties. Market conditions and trade liberalization following the Uruguay Round Agreement on Agriculture in 1994, have been putting more and more pressure on the potential earnings of agricultural producers. Driven by market rules, they'd prefer to deal with the most convenient choices aimed at the maximization of their profits, according to the producer's rational behaviour paradigm. This way, the comparison between production costs and international market prices generally leads food products to be more often transferred from places where their production is cheaper to other ones that ensure increased and more profitable sales. The increasing dependency on global markets and international trade are thus associated with a parallel augmentation of the spatial disconnection between production and consumption (*Pradhan, 2014; Aubry and Kebir, 2013*), exacerbated by the market opportunity to source necessary inputs further and further away, from remote landscapes and up to the global level (*Porter et al., 2014*). Such a disconnection has augmented over the centuries and farming systems in urban areas have progressively adapted to the opportunities offered by market enlargement, rather than by the food requirements of urban settlements. In addition, the expected increased in urban and metropolitan population (*UNDESA, 2012*) requires quality food and the enhancement of productivity of the agricultural sector, but it must be considered as well that the high food demand expressed in these

contexts is not adequately sustained by the relatively scarce amount of agricultural area. At the same time the metropolitan productive system is more and more threatened by urbanization processes (*Mazzocchi et al., 2013*) and conflicts in land use that intensify both the scarce capabilities of urban food provisioning and the growing dependency on resources at global level.

Despite this, a new awareness is emerging and several different motivations are addressing a possible enhancement of the local dimension of agro-food systems, as a strategy and an opportunity to achieve positive externalities with as many as positive repercussions on the territory. On one hand, global market supply is often not adequately meeting food demand, security and accessibility (*Alexandratos and Bruinsma, 2012*), as well as the long-distance transport of food cannot ensure an environmental sustainability (*Allen and Wilson, 2008*). On the consumers' side, the emerging of the new food equation (*Morgan and Sonnino, 2010*) and the shift of price transmission from the "*push and pull*" mechanism to the demand-driven system (*De Treville et al., 2004*), have been leading them to assuming a key role in the agro-food sector. In this sense, their utilitarian boosts strongly denote their tastes, preferences and perceptions, and make sympathetic food production prevail: consumers' preferences and propensity to local and regional food (*Kneafsey et al., 2013*), traceable and quality food, organic productions, fair trade and productions respecting animal welfare (*Grunert et al., 2007*) are the results of cultural roots, communication actions and strategies, specific lifestyles and other social motivations aimed at building up shared values (social cohesion, trust, solidarity, ethical values, environmental-friendly behaviours amongst others).

Even if very different motivations, they all claim to a higher and closer reconnection between food production and consumption, strongly associated with direct relation and a spatial proximity (*Watts et al., 2005).* In this perspective, the ability of the local agricultural systems in adequately complying with regional food requirements is an aspect of crucial importance, which reveals and supports the ties of the supply-demand pattern with the territory. Likely, this leads to the creation of favourable conditions for enhancing the resilience of the system, improving its ability to cope with external shocks and

stresses, such as food price surge, climate change effects, escalating land use conflicts and rapid urbanization. Within the framework of the relocalisation of production and consumption, closer links between agriculture and food are also good for the environment (*Lamine, 2015*) and determines advantages in terms of sustainability and exploitation of local resources, as well as economic vitality of the area and strengthening the role of proximity agriculture.

1.2 Food as an urban issue

After a period in which the food system has been ignored by regional planners, many political actors all over the world have now been assuming a new awareness. They have been paying more attention to the food as an urban issue, with particular regard to concerns with food security in Developing Countries and system's sustainability in the Developed ones. It is in fact in the global North that the lack of food or problems related to food accessibility are generally not perceived, as the general urban residents consider food for granted:

> "*And why not? More and more supermarkets are open all hours of the day […]. If she thinks about hunger at all, she may be comforted to know that a "hunger safety net" exists in her community to keep the needy from falling into the clutches of hunger. Food pantries, free meal sites, and food banks are there along with food stamps, school breakfast and lunch programs, and meal programs for the elderly and for mothers with young children"* (*Pothukuchi and Kaufman, 1999, p. 214).*

However, more recently, problems of malnutrition, obesity, as well as the phenomenon of food deserts (*Cummins et al., 2010; McEntee and Agyeman, 2010; Gallagher, 2006; Wrigley et al., 2003*), has led to observe urban areas with limited access to fresh and affordable food even in Western countries (*Choi and Suzuki, 2013; Gordon et al., 2011*). Thus, despite many food movements have risen up and this

issue is now well known by the public opinion, most part of population is still not concerned with local food systems and their implications (*Kemp et al., 2010; Aubrun et al., 2005*): food is an urban issue affecting the local economy, the environment, the public health, the quality of neighbourhoods (*Pothukuchi and Kaufman, 1999*). The management of an urban food system in fact relies on a multifunctional activity with strong effects on a wide range of other sectors (*Morgan, 2009*), and that involves all the components of sustainability:

(i) the social aspect: for instance, to the interventions of aid to poor families through the distribution of free meals;

(ii) the economic repercussions at local level. Preserving the productive potential of agricultural areas in the metropolitan context impacts not only on the local agricultural sector, but also on the sustainable management of green areas, through the services offered by the agricultural activity itself;

(iii) the environmental dimension, through water management and conservation of green areas and biodiversity.

The multifunctional aspect of the agro-food system cannot therefore be excluded from the city planning. So far, the food system has scarcely been considered by urban policies, as food-related issues are largely perceived to better concerns with rural areas and agricultural activity, and therefore not to be covered by policy urban agendas (*Pothukuchi and Kaufman, 1999*). However, with the spreading of metropolitan areas worldwide (*UNDESA, 2012*), peri-urban areas, urban-rural fringes and related challenges have significantly increased (*Mazzocchi et al., 2013*). Nowadays issues concerning rural and urban areas are closely connected and must be considered simultaneously by appropriate policies. *Kerr (1996)* suggested that programs of public investments intended for a sustainable agriculture need to be planned and implemented at different territorial levels (village, district, state). All over the world - especially in the Anglo-Saxon countries - several examples of food

planning initiatives to manage local agro-food systems and face related themes can be found. In general terms this is also valid in European contexts, where this kind of interventions is mainly implemented at city- and county-level (Table 1), with examples of both large metropolis, such as London (*Morgan, 2009*), and medium-small cities, for instance Bristol (*Carey, 2011*) and Pisa (*Di Iacovo et al., 2013*).

Table 1: food policy and planning experiences in Europe

		FOOD POLICY AND PLANNING INITIATIVES AND NETWORKS*
1	Almere (NL)	*signatory to the Urban Food Policy Pact*
2	Amsterdam (NL)	*Amsterdam Food Strategy* *signatory to the Urban Food Policy Pact*
3	Ancona (IT)	*signatory to the Urban Food Policy Pact*
4	Athens (EL)	*signatory to the Urban Food Policy Pact*
5	Aubagne (FR)	*Charte pour une agriculture durable*
6	Barcelona (ES)	*signatory to the Urban Food Policy Pact*
7	Bari (IT)	*signatory to the Urban Food Policy Pact*
8	Basel (CH)	*signatory to the Urban Food Policy Pact*
9	Bath and North East Somerset (UK)	*B&NES Environmental Sustainability Partnership*
10	Belfast (UK)	*Belfast Food Network*
11	Berlin (DE)	*signatory to the Urban Food Policy Pact*
12	Birmingham (UK)	*Birmingham Food Charter* *signatory to the Urban Food Policy Pact*
13	BiIbao (ES)	*signatory to the Urban Food Policy Pact*
14	Bologna (IT)	*signatory to the Urban Food Policy Pact*
15	Bordeaux (FR)	*signatory to the Urban Food Policy Pact*
16	Bournemouth and Poole (UK)	*Bournemouth and Poole Sustainable Food Partnership*
17	Bradford (UK)	*Bradford District Food Strategy*
18	Bridport (UK)	*FoodFuture Bridport*
19	Brighton and Hove (UK)	*Brighton and Hove Food Partnership*
20	Bristol (UK)	*Bristol Food Network*
21	Bruges (BE)	*signatory to the Urban Food Policy Pact*
22	Bruxelles (BE)	*signatory to the Urban Food Policy Pact*
23	Bucharest (RO)	*signatory to the Urban Food Policy Pact*
24	Cagliari (IT)	*signatory to the Urban Food Policy Pact*
25	Cambridge (UK)	*Cambridge Sustainable Food City*
26	Cardiff (UK)	*Cardiff Food Council*
27	Carlisle (UK)	*Food Carlisle*
28	Catania (IT)	*signatory to the Urban Food Policy Pact*
29	Cologne (DE)	*signatory to the Urban Food Policy Pact*
30	Copenhagen (DK)	*signatory to the Urban Food Policy Pact*
31	Cordoba (ES)	*signatory to the Urban Food Policy Pact*

32	Cork (IE)	*Cork Food Policy Council*
33	Co. Durham (UK)	*Sustainable Local Food Strategy Co. Durham*
34	Edinburgh (UK)	*Edible Edinburgh*
35	Exeter (UK)	*Exeter Community Food Network*
36	Florence (IT)	*signatory to the Urban Food Policy Pact*
37	Foggia (IT)	*signatory to the Urban Food Policy Pact*
38	Frankfurt (DE)	*signatory to the Urban Food Policy Pact*
39	Geneva (CH)	*signatory to the Urban Food Policy Pact*
40	Genua (IT)	*signatory to the Urban Food Policy Pact*
41	Ghent (BE)	*signatory to the Urban Food Policy Pact*
42	Glasgow (UK)	*Glasgow Food Policy Partnership*
43	Gothenburg (SE)	*signatory to the Urban Food Policy Pact*
44	Greater Manchester (UK)	*Feeding Manchester*
45	Grenoble (FR)	*signatory to the Urban Food Policy Pact*
46	Hackney (UK)	*Hackney Food Partnership*
47	Haapsalu (SE)	*signatory to the Urban Food Policy Pact*
48	Herefordshire (UK)	*Sustainable Food Strategy for Herefordshire*
49	Hull (UK)	*Food4Hull*
50	Kirklees (UK)	*Kirklees Food Programme*
51	Lancashire (UK)	*Sustainable Food Lancashire*
52	Lancaster (UK)	*Sustainable Food City Lancaster*
53	Leeds (UK)	*Feed Leeds*
54	Leicester (UK)	*Leicester's Food Plan*
55	Liverpool (UK)	*Liverpool Food People*
56	Ljubljana (SI)	*signatory to the Urban Food Policy Pact*
57	London (UK)	*signatory to the Urban Food Policy Pact* *Croydon Food Flagship* *Good Food in Greenwich* *Islington Food Strategy* *Lambeth Food Partnership* *London Food Programme* *Merton Food Partnership* *Sutton Food Forum*
58	Lugano (CH)	*signatory to the Urban Food Policy Pact*
59	Lyon (FR)	*signatory to the Urban Food Policy Pact*
60	Madrid (ES)	*signatory to the Urban Food Policy Pact*
61	Malaga (ES)	*signatory to the Urban Food Policy Pact*
62	Malmö (SE)	*Malmö policy for sustainable development and food*
63	Manchester (UK)	*Manchester Food Future*
64	Marseille (FR)	*signatory to the Urban Food Policy Pact*
65	Middlesbrough (UK)	*Middlesbrough Food Partnership*
66	Milan (IT)	*promoter of the Urban Food Policy Pact*
67	Modena (IT)	*signatory to the Urban Food Policy Pact*
68	Molfetta (IT)	*signatory to the Urban Food Policy Pact*
69	Montpellier (FR)	*signatory to the Urban Food Policy Pact*
70	Nantes (FR)	*signatory to the Urban Food Policy Pact*
71	Newcastle (UK)	*Food Newcastle*
72	Oxford (UK)	*Good Food Oxford: Oxford's sustainable Food Network*

73	Palermo (IT)	*signatory to the Urban Food Policy Pact*
74	Paris (FR)	*signatory to the Urban Food Policy Pact*
75	Peterborough (UK)	*Peterborough Food Partnership*
76	Pisa (IT)	*Piano del cibo*
77	Plymouth (UK)	*Food Plymouth*
78	Portsmouth (UK)	*Portsmouth Food Partnership*
79	Riga (LV)	*signatory to the Urban Food Policy Pact*
80	Rome (IT)	*signatory to the Urban Food Policy Pact*
81	Rotterdam (NL)	*Rotterdam Food Council* *signatory to the Urban Food Policy Pact*
82	's-Hertogenbosch (NL)	*signatory to the Urban Food Policy Pact*
83	Sacile (IT)	*signatory to the Urban Food Policy Pact*
84	Sandwell (UK)	*Sandwell Community Agriculture Programme*
85	Sheffield (UK)	*Sheffield Food Strategy*
86	Stockport (UK)	*Stockport Sustainable Food Strategy*
87	Tartu (EE)	*signatory to the Urban Food Policy Pact*
88	The Hague (NL)	*signatory to the Urban Food Policy Pact*
89	Thessaloniki (EL)	*signatory to the Urban Food Policy Pact*
90	Tirana (AL)	*signatory to the Urban Food Policy Pact*
91	Turin (IT)	*signatory to the Urban Food Policy Pact*
92	Tukums (LV)	*Tukums Urban Food Strategy*
93	Udine (IT)	*signatory to the Urban Food Policy Pact*
94	Uppsala (SE)	*signatory to the Urban Food Policy Pact*
95	Utrecht (NL)	*signatory to the Urban Food Policy Pact*
96	Valencia (ES)	*signatory to the Urban Food Policy Pact*
97	Venice (IT)	*signatory to the Urban Food Policy Pact*
98	Villanueva de la Canada (ES)	*signatory to the Urban Food Policy Pact*
99	Vitoria-Gasteiz (ES)	*Vitoria-Gasteiz Urban Food Network*
100	Warsaw (PL)	*signatory to the Urban Food Policy Pact*
101	West Sussex (UK)	*West Sussex Food Plan*
102	Wien (AT)	*signatory to the Urban Food Policy Pact*
103	Zagreb (HR)	*signatory to the Urban Food Policy Pact*
104	Zaragoza (ES)	*signatory to the Urban Food Policy Pact*
105	Zürich (CH)	*signatory to the Urban Food Policy Pact*

OTHER FOOD STRATEGIES^

1	Basel (CH)	Linking different urban food initiatives
2	Copenhagen (DK)	Facilitate urban gardening
3	Piacenza (IT)	Facilitate local agriculture
4	Rennes (FR)	Facilitate local agriculture
5	Rotterdam (NL)	Rotterdam Food Cluster Enhance food literacy of school children
6	Svendborg (SE)	Facilitate local agriculture and urban gardening
7	Wien (AT)	Promote of diversity of food retail
8	Wageningen (NL)	Food Valley

***** http://sustainablefoodcities.org/; http://www.foodpolicymilano.org/le-100-citta-del-milan-urban-food-policy-pact/; **^** *Wascher* in *Sali et al., 2015; Moragues et al., 2013.*

1.3 Aims and purposes

Though the strategic role of cities in developing sustainable food systems, they are being challenged to provide permanent and reliable access to adequate, local, diversified, and nutrient food for its population; at the same time the task of feeding cities will face multiple constraints. Given these several conditions, a higher sustainability of food systems derives from their shortening, increasing the amount of food products from a proximate agriculture close to consumption sites. Especially in metropolitan regions, where millions people need to be fed, diminishing the distance between production and consumption becomes an important challenge. It is then important to assess the capacities of the local agricultural system in responding to urban food demand.

In the first section an original acceptation of the agro-food system according to spatial, logistics and organisation dimensions is introduced, as long as the commitment of alternative and innovative food networks with the local context. On the basis of these assumptions, it is then described how the complex structure of a Metropolitan Agro-food System is able to respond to the challenges of domestic supply, to compete in the global context and to meet citizens' demand for a direct relation with food producers through the development of Local Agro-food Systems.

Further on (Chapter III), it is addressed the reconnection issue under two and interconnected points of view. Therefore, they shall be firstly investigated and recognized different strategies enhancing relocalisation and operating in metropolitan contexts: the alternative and local experiences on one hand, and the mainstream channels that allow the commercialization of products of local origin, on the other. Subsequently, they are introduced the generic tools and the actions for a closer regional reconnection of agro-food production and consumption taken up by public governance.

With particular regard to the case study area of Milan Metropolitan Region, it is proposed a methodological framework

(Chapter IV) that represents an integration to the several estimations of local and urban self-sufficiency provided by literature. The approach tries to overcome both limits and lacks of previous studies, by introducing an economic-based index and combining multiple aspects, in order to obtain an overall description of the agro-food sector under different profiles; indications are given, not only on the capacities of agricultural systems, but also on their own characteristics and on the linkages between local and global systems.
In the same section, economic and policy implications of structural changes and other modifications are determined through a scenario analysis: mathematical programming has been adopted to assess some possible scenarios related to a higher compliance between regional food supply and demand, demonstrating the potentialities and revealing the opportunities for teh agro-food system in adapting and adjusting itself to such modifications.

Finally,the closing section provides limits and opportunities of current regulatory framework in the agro-food sector, and examines how current European rural development initiatives could support the transition to sustainable metropolitan regions.

CHAPTER II

AGRO-FOOD SYSTEM AND LOCAL COMMITTMENT

2.1 The agro-food system

Since the late Seventies, when Malassis proposes its definition, the "*Agro-food system*" (AFS) has been widely recognized as the set of interdependent elements that together concur to satisfy food needs and requirements of a given population in a given space and time (*Malassis, 1979*). An AFS is therefore strongly territorially-based and emerges as the result of several interactions among the spatial dimension itself and the "*from-farm-to-fork*" steps: as already suggested by its own definition, it merges and integrates all the steps related to both agricultural activities and food processing, distribution and consumption (Figure 1).

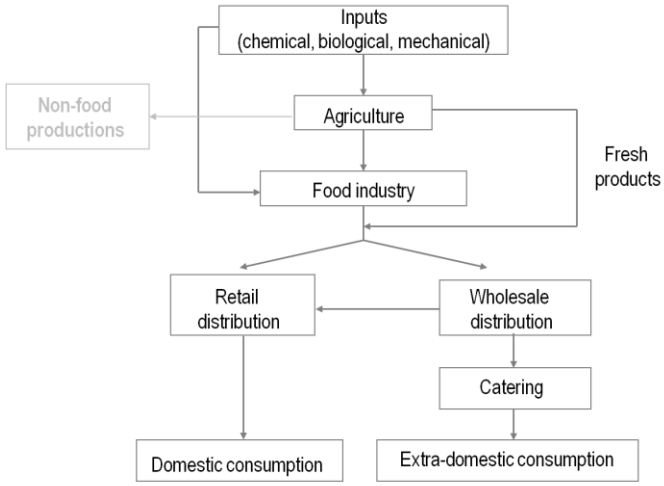


Figure 1: the organization of the agro-food system (*Banterle, 2010 modified*)

Actually, the complexity of this system and the modifications the different components may be subject to, return a strongly dynamic entity. Individual actors of an AFS are differently involved in the system itself and in the relative food chains: each of them has its own goals, either conflicting one another or, at least, affecting the overall performance (*Aramyan et al., 2007*). In addition, it must be considered the territorial dimension an AFS operates in. More precisely, in the specific territorial context two main aspects and acceptations of the whole AFS coexist: a metropolitan and a more local component, each tackled in the next paragraphs. These systems have not to be considered as stand-alone units, but rather as complex structures interconnected and interrelated with an even wider AFS, i.e. the Global Agro-food System (GAS), which ensures food and feedstuff imports from remote locations (Figure 2).

As a deviation from its traditional form, a shortened agro-food system emerges from the modifications in the dimensions of its peculiar elements, components and features, namely

(i) the number of actors involved and their role;

(ii) the relationships amongst them, reflected in the location in a particular territory and in their distance, both physical and along the chain.

More often such a concept is considered equivalent to that of "*short food chains*". In its acceptation of "short" or "shortened", a food chain in fact encompasses a reduced distance (either geographic or organizational) between the production and the consumption phases (*Parker, 2005*), recalling, more properly, what is the structure of the whole system itself, rather than the structure of a single chain. In fact, the reference to "food chain" should be more precisely meant as specific of a single product (e.g. milk food chain, wine food chain, etc.): it represents a breakdown of the agro-food system in the vertical direction, bringing together all the operations that contribute to the formation and the transfer of the product to the final stage and all the related flows (*Malassis and Ghersi, 1995*). Thus, a food chain, either short or not, is a subset of the wide AFS and similarly made of the same elements. Especially in conversational language, the definition is often misunderstood and such a distinction is made unclear: this interpretation of "short food chain" indeed describes as such a more complex system, which refers to not a single product but encompasses – at least in the distribution and commercialization phases, a group of food products. It is this the case, for instance of farmers' markets: they are not properly stand-alone food chains, but rather a way of commercialization (*Mariani and Viganò, 2002*) that variously reduce the distance between the farmers-producers-vendors and the consumers, characterized by the local dimension of commercial transactions. On the other hand, these experiences are not necessarily based on the concept of "short" only. In a more correct acceptation, they better represent Alternative Agro-Food Networks (AAFN) (*Murdoch et al. 2000; Renting et al. 2003*) and deviations from conventional and mainstream systems: in this perspective they rather express a broad set of *production-distribution-consumption* configurations (*Brunori and Bartolini, 2013*) that loose the distinctive vertical dimension typical of the Malassis school. In this acceptation short food chains are commercialization strategies and options characterized by the network structure, being integrated and widespread in the territory, whose presence is driven and supported by producers', consumers' or governance initiatives.

The Global Agro-food System (GAS)

- 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

The Metropolitan Agro-food System (MAS)

- 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 centres (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

The Local Agro-food System (LAS)

- 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
- food chain components are located in spatially confined areas, sometimes single farms or agglomerations of farms that are part of AAFN. 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

Figure 2: features of different declinations of the AFS (*Wascher et al., 2014:4-6*)

2.2 Metropolitan agro-food systems

The issue concerning the definition, the principles and the basic assumptions a Metropolitan Agro-food System (MAS, from now on) is built on, is something scarcely investigated in literature, indeed relatively limited.
Quoting from *Castells (2000)*, *Smeets (2009)* considers the spatial network concepts of "*spaces of place"* versus "*spaces of flow"* to characterize metropolitan regions. *Castells (2000)* defines a place as a locale where *"form, function and meaning are self-contained within the boundaries of physical contiguity…";* on the other hand, the "spaces of flows" are based on the layers of i) electronic network, ii) modes and centres and iii) management and experts.
Several authors, in an even more simplified view of the whole system, limited their attention on the productive dimension only, focusing on agriculture in urban and metropolitan areas. Most of these studies (*Beauchesne and Bryant, 1998; Gardner, 1994; Jarosz, 2008; Paul, 2013*) concern with the possibility of establishing in those areas innovative and alternative forms of systems and networks; metropolitan agriculture therefore becomes a key issue to address the MAS. As *Wascher et al.* (2010) pointed out, it plays a fundamental role for sustainable and largely self-supportive system-networks at the scale of larger metropolitan regions.

The metropolitan area is then the first and most important factor driving to a characterization of the MAS. It represents the spatial base within which the system operates. It is evident that the purposes and the performances of the MAS are strongly affected by the features of this context. In the metropolitan area the coexistence and the interaction of two main elements, different for features and dynamics, appears to be relevant: urban agglomerations on one hand, and less dense areas on the other, closely bound and linked to the urban centre (*Sali et al., 2014b*). Nevertheless, they cannot be considered as separated systems, but as two complementary sides of the food system itself (*FAO, 2011*), as relations and interactions exist both between and within each of them. However, notwithstanding observable interdependencies, identifiable elements are subject to different dynamics and are also the basis of a "continuum" between

rural and urban areas, resulting in competition for natural resources (*FAO, 2011*). These relationships have been recently investigated to provide a spatial description of the "internal structure" of a metropolitan region, through the application of a specific methodology to represent Rural-Urban Regions (*Zasada et al., 2013*).

Given these conditions, two main characteristics of MAS emerge. It may be firstly identified through the concepts used in geographical and planning analyses, from the characterisation of urban sprawl (*Deng et al., 2010; Glaeser and Kahn, 2003*), to – among others - the central place theory (*Christaller, 1933*), the accessibility (*Alonso, 1964; Litman, 2003; Halden et al., 2005*), mobility and transports (*Wascher et al., 2010*). Alternatively, the second criterion defines both the dimension and the shape of the MAS on the basis of capability of agricultural land around the city to satisfy all, or part, of population's food demand. This capability relies on the metropolitan agriculture and varies according to several factors, such as food products, seasonality, convenience to produce one commodity over another one, agricultural productivity, productive inputs and specific agro-climatic variables. It must be pointed out once again that such a definition doesn't catch the complexity of an agro-food system, and matters such as technology, knowledge, infrastructure and functional integration beyond single farm processes are essential components of the MAS to be taken into account as well *(Latesteijn, 2008).* The MAS is then an agro-food system characterized by a high level of complexity in terms of actors involved, logistics, and for large quantity and variety of processed products (Figure 2).

2.3 Local agro-food systems

Within a MAS, small and local businesses, more or less interrelated one another and with the MAS itself, emerge from the relationships amongst the different actors of the territory, and may be intended as Local Agro-food Systems (LAS, from now on) (*Feenstra, 1997; Henderson, 1998; Lacy, 2000; Hinrichs, 2003*):

"Organizations of production and services (agricultural production

units, agribusiness, commercial, services, catering) associated with their characteristics and operations to a specific territory. The environment, products, people, their institutions, know-how, their eating habits, their networks of relationships combine themselves in a territory to produce an agro-food system in a given spatial scale" (CIRAD-SAR, 1996).

Though the authors embark on a spatial delimitation and a geographically defined context (*Kneafsey et al., 2013*), the debate about the concept of *"local"* is still open and a shared definition is far from being achieved.
Here the discussion shares similar definition uncertainties with the debate about urban and metropolitan regions in general. *Zasada et al. (2013)* provides an overview of the existing delineation approaches. More often a radial distance is offered to fix the spatial boundaries of a LAS (*Smith and Mackinnon, 2007; Winterton, 2008*), but a distance as that considered by the American *Food, Conservation, and Energy Act* of 2008, known as Farm Act (*Martinez et al., 2010*) to name "local" a food product (over 640 km), totally loses sense in European context. The concept assumes importance in relation to the specific context it refers to and emerges as a function of socio-economic, political and environmental processes and features (*Qazi and Selfa, 2005; Winter, 2003; DuPuis and Goodman, 2005*). The boundaries of what is assumed to be "local" also depends on the consumers' perception that may vary across locations, amongst consumers and products (*King et al., 2010; Martinez et al., 2011*): a community (*Berry, 1977*) or a region with precise characteristics of people and place (*Barham et al., 2005*), the desire of freshness, food quality and safety, the support to local economy and traditions, the reduction in transportation and processing, the closeness to home or region (*"grown in my state", Pirog, 2003*), a lower cost, a closer relationship with farmers. Local food is defined as a product grown, produced, and processed in the locality or region where it is marketed (*King et al., 2010*), and in this sense it is often referred as a Geographic Indication (*Giovannucci et al., 2010*). Labels, certifications and standards (e.g. organic farming) can play a role as local credence attributes, as well, due to the implication of a connection to land and protection of natural resources

(*Giovannucci et al., 2010*). However, geographic indications refer to a territoriality of production, whereas they are marketed on a much larger, sometimes global scale.

Based on complex relations amongst agricultural production, processing, distribution and consumption in a given place (*Dunne, 2004*), LAS may represent deviations from an agro-food system mainly based on productivism (*Whatmore et al., 2003*), industrialization, and standardized processes (*Allen et al., 2003; Clancy and Ruhf, 2010; Halweil and Prugh, 2002; Hassanein, 2003; Helenius et al., 2007; Hinrichs, 2003*), as well as alternatives to global and globalised systems and their issues (*Kloppenburg et al., 1996*). Despite, in fact, in Western European countries 80% of agricultural production is marketed globally (*Committee of the Regions, 2011*), such a way of commercialization is responsible for negative externalities and inequalities (*Allen and Wilson, 2008*). Nevertheless, "*alternative and conventional food networks"* should be meant *"not as separate spheres, but as highly competitive and relational to one another in and through space*" (*Sonnino and Mardsen, 2006, p. 306*) (*Hinrichs, 2003; Jarosz and Qazi, 2000; Watson, 1997*) because of a not always observable clear demarcation (*Blay-Palmer and Donald, 2006; Ilbery and Maye, 2005*).

Under the name of LAS it is then possible to bring back a constellation of movements, concepts and related definitions, from alternative food systems (*Goodman, 2003; Watts et al., 2005*) and networks (*Murdoch et al. 2000; Renting et al. 2003*), to shortened food chains (*Renting et al., 2003; Ilbery and Maye, 2005*). It is especially in this sense that the European interventions operate. In some outlook opinions of the Committee of the Regions[1], many efforts are suggested to reduce the number of intermediaries and make more dynamic local and regional food chains. This would make possible the creation of LAS, meant as the combination of four main elements, namely:

(i) a shortened food chain;

(ii) a limited physical distance between production and

[1] 2011/C 104/01 Opinion of the Committee of the Regions on "*Local food systems*" (outlook opinion) and 2011/C 192/06 Opinion of the Committee of the Regions on "*Towards an ambitious European policy for agricultural quality schemes*"

consumption sites;

(iii) manufacturing processes that consider different logistics and management elements (e.g. transportation, distribution, waste management, renewable energy, marketing, promotion and quality control);

(iv) the management of manufacturing process at local and regional level.

Nevertheless, despite most of the attention of policy makers, public opinion and researches is focused on shortening food chains, the LAS undoubtedly encompasses traditional chains, as well. A strict correspondence between the "local" and the "short" components is in fact not always evident: usually only few steps of the chain belong to the "local" area or a small portion of food products is of local origin or marketed locally. Similarly, the shortening doesn't necessarily imply a decreased number of nodes along the chain and then a reduced processing of commercialized food products: in conclusion, a local system may be short ("local-short system") or not ("local-long system").

2.4 Alternative Agro-food Systems

The request for alternative food production has been increasing more and more in recent years, following to various factors that strongly influence the public opinion in its thoughts and habits. In particular, people are asking for diverse and distinctive food (*Darby et al., 2008*), they are more and more concerned with sustainability, quality and health (*Kirwan, 2004; Seyfang, 2008; Kneafsey et al., 2008*) and they are afraid of food scandals occurred over the years, e.g. BSE, avian influenza or fraud relating to horse meat. Such a new awareness is driving the development of several initiatives that primarily focus their attention on food quality (*Ilbery and Kneafsey, 1998, 2000; Morris and Young, 2000; Goodman, 2003*), environmental sustainability, social construction (*Ilbery and Kneafsey, 2000*), innovation and localization.

Alternative Agro-food Networks (AAFN from now on) (*Murdoch et al., 2000; Renting et al., 2003*) become the practical strategies to address

these issues. The *"critical process of reconnection" (Ilbery et al., 2005, p. 117)* they are based on, represents the distinctive element from agribusiness and traditional channels, usually defined by a disjunction amongst different actors involved. AAFN bring innovations – and are innovation themselves - in the agro-food sector, whether local or not, that respond to different boosts, with the behaviour of actors and stakeholders affecting their overall dynamics and performance (*Luning and Marcelis, 2005; Aramyan et al., 2007*). AAFN imply a commitment to all the components of sustainability, as examined in several studies (*Marsden et al. 1999; Ilbery and Maye, 2005; Iles, 2005; Pretty et al. 2005; Seyfang, 2006*). From a social point of view, farmers and producers are pushed by social motivations, as opportunities to meet people (*Huges and Mattson, 1995*), create stronger relationships with consumers and the territory (*Feenstra, 1997*), and supporting local system and economy (*Renting et al., 2003*). Some other motivations concern cultural affiliation and "altruism", helping "ethical" agricultural productions linked to fair trade (*Sanchez-Hernandez, 2009*) and, especially in their meaning of shortened and local food chains, they have positive repercussions in improving social interactions and trust (*Sinnreich, 2007*), sense of community (*Chiffoleau, 2009; DeLind, 2011*) and increased knowledge leading to behavioural change, in both North European and American contexts (*Torjusten et al., 2008; Cox et al., 2008; Saltmarsh et al., 2011*). From an environmental point of view, producers involved in AAFN tend to adopt more sustainable agricultural techniques (*Battershill and Gilg, 1998*), also to respond to a greater variety and a higher food quality requested by consumers (*Goodman, 2003*) and to reduce food miles (*Weber and Matthews, 2008*). AAFN and innovative food chains have been demonstrated to lead to economic benefits, both at farm-level (*Pearson et al., 2011; Sage, 2003; Alonso, 2011*) and at a wider level, as an incentive to rural development (*DuPuis and Goodman, 2005*).

The rich literature regarding AAFN mostly investigates their features and implications from a sociological point of view. In this sense, the research tends to frame the networks with regard to the distance between sites of production and consumption, or, equivalently, to the relations linking producers and consumers on a

spatial basis (*Bowen and Mutersbaugh, 2014)*, as long as to alternative distribution schemes.
The internal governance of these networks, whether strong or weak, in fact establishes the typology of relations amongst the main actors and the process that consolidates consumers' trust, essentially through the approaches of "relocalisation" and "certification". These relations can be traced back to three main typologies (*Renting et al., 2003; Mardsen et al., 2000*) (*Jarosz, 2008*):

(i) *face-to-face* AAFN consist in a direct purchase by the consumer from the producer and imply a direct personal interaction between actors, consolidating the concepts of authenticity and quality;
(ii) *proximate* AAFN go beyond the direct interactions; they introduce relations of proximity and refer to the sale of products both in the area of production and close to it, also including intermediary actors;
(iii) *extended* AAFN extend the selling area outside the boundaries of production location through the use of labelling and certification systems to maintain the connection among producers, consumers and sites of production: quality certifications and PDO/PGI schemes are considered a basic type of AAFN (*Sánchez-Hernández, 2009*).

It thus emerges the possibility to differently combine the "alterity" with the "local" component of the agro-food system, underlining the relationship between the spatial dimension and the local food system (*Peters et al., 2008*), whose innovative forms are AAFN themselves. However, AAFN may be defined local or not; in fact, Bowen and Mutersbaugh (*2014*) argue that despite both the perspectives are framed as deviations to conventional and industrialized systems, the "local" in the LAS sense better may assume the acceptation of "localised". This latter concept refers to *"a process, a system that has been localised, which was not always in that place and with no guarantee that it will remain there forever" (Muchnik, 2009, p. 9);* this occurs for instance in the case of products with a denomination of origin, place-based but commercialized globally.
Actually, a more precise representation of the context cannot even

ignore the aspect related to the shortening of food chains and the consequent further simplification of the system. This kind of reduced distance reflects, on one hand, both the social and spatial reconnection of the AAFN within the framework of the "relocalisation paradigm" (*Lamine, 2015*): supply chains with direct relations correspond to short system in the full sense of the term, as they combine both the possible dimensions of the proximity (*Aubry and Kebir, 2013*). On the other hand, indeed, it implies a commitment to the nodes along the production-consumption path, reducing their number or grouping more steps at a single subject. Based on the combination between geographical and organizational proximity, Aubry and Kebir (*2013*) propose a further classification of supply chains (

Figure 3), providing two cases (II and IV respectively) that represent the bases for the provision of local food, just because they ensure a spatial proximity between production and consumption sites.

		GEOGRAPHICAL PROXIMITY	
		Weak	Strong
ORGANIZED PROXIMITY	Weak	***Case I: loose relations*** (selling on international markets and to supply platform) LONG SUPPLY CHAINS	***Case II: indirect relations*** (collective point of sale, selling to local supermarkets and professionals, box schemes sold by intermediaries) SHORT SUPPLY CHAINS
	Strong	***Case III: distance relations*** (direct online and mail order selling) SHORT SUPPLY CHAINS	***Case IV: direct relations*** (farmers' markets, AMAP, on-farm selling, box schemes, fairs) SHORT SUPPLY CHAINS

Figure 3: typologies and examples of supply chains according to proximity relations (*Aubry and Kebir, 2013, modified*)**.**

Within this complex framework, it must be also remarked that the three concepts of "alterity", "locality" and "shortness" may not be totally overlapping one another: the possible local connotation of AAFN, in fact, does not necessarily reflect the organisational, logistic and spatial features that define the LAS. To better clarify this assumption, some initiatives of AAFN from *Sanchez-Hernandez* (*2009*) are taken as examples. Fair trade is undoubtedly alternative to traditional ways of commercialization, but the local component, as well as the geographic proximity is very weak and replaced by a civic proximity, based on solidarity and equity: such an initiative is more organized around the idea of managing local-based productions in a global-scale (*Pascucci, 2010).* On the opposite, urban gardening experiences represent alternatives to conventional supply systems, strongly connected to a specific area, where both production and consumption of locally-produced items occur. In the case of direct sale, finally, though a shortened relational distance between producer and consumer, the local component may partly fail if products of non-local origin are sold as well; similarly, the "shortness", meant as the number of nodes along the chain, may not be fulfilled whenever what marketed, though directly, still requires intermediate processing steps operated by subjects other than the farmer-vendor.

CHAPTER III

ALTERNATIVE FOOD SYSTEMS IN METROPOLITAN REGIONS

Given the described evidences on which the overall argumentation is based, it is possible identifying several initiatives and concrete examples that show an interest in new models of agro-food systems: these models introduce specific features suitable for pursuing sustainability, regional food provision and reconnection within metropolitan contexts. Still according to the categorization of GAS, MAS and LAS provided, some models create productive, logistic and corporate governance structures able to improve food provision in metropolitan areas and, at the same time, deal with the global market in terms of competitiveness. Some others are instead more distinctly local and designed to facilitate the allocation of agro-food products within the production regions. Both the typologies coexist within a territory and interact in a dynamic and heterogenous agro-food system, characterizing the socio-economic viability of the territory itself.

Amongst metropolitan areas, as identified according to *OECD (2006)* criteria – and then amongst the set of specific territorial units, either NUTS2 or NUTS3 – the metropolitan region of Milan is taken as example for the application of subsequent analyses. It is described below from the most purely agricultural and territorial points of view, in order to represent aspects more consistent with the aims of the analyses themselves.

3.1 The case study area: Milan Metropolitan Region

The definition of metropolitan region adopted by OECD (2006) relies on multiple criteria concerning demographic, territorial and functional parameters. The Milan Metropolitan Region (MMR from now on) is thus identified as the set of NUTS3 units (i.e. Italian provinces) across Western Lombardy and Eastern Piedmont regions, Northern Italy (Figure 4).

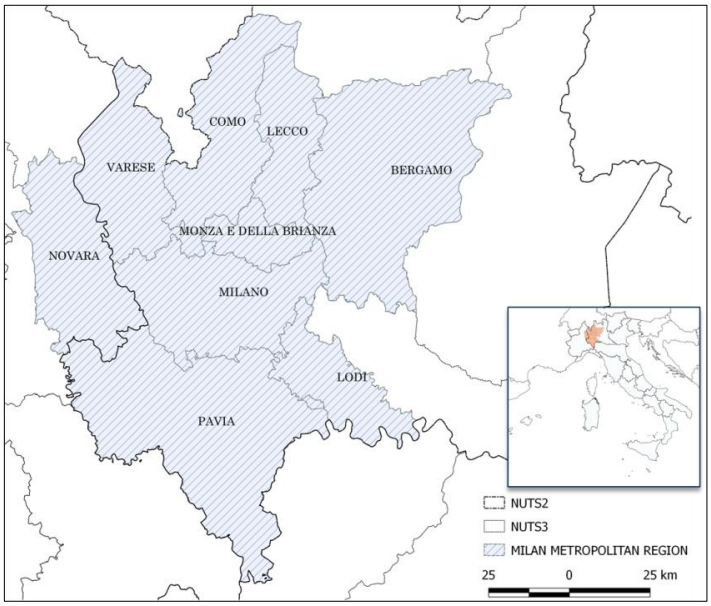


Figure 4: location of MMR and NUTS3 encompassed. MMR covers an area of more than 13,000 km^2 and encloses 1,163 municipalities (14.4% of National total)

With a population of nearly 8 million people, the region is one of the most populated areas in both Europe and Italy (*OECD, 2006*). It is a high-densely populated area (more than 2,100 people/km^2), especially in its Northern part, and this makes it characterized by a poly-centric structure (Figure 5a), distributed along infrastructural networks and including both capital cities and main urban centres close to Milan (*Sali et al., 2014c; Corsi et al., 2015*).

Conversely, a lower density and a higher concentration of

agricultural area are peculiar of the Southern part of the region (Figure 5b). Here, the respective land use reflects the main orientation of the regional agricultural system, mostly devoted to the cultivation of cereals, for both food and feed, and other fodder crops to sustain animal breeding (Table 2). The relations between the two components – the rural and the urban environment – and their respective proportions are however extremely dynamic. Especially peri-urban areas are characterized by strong soil consumption (*Mazzocchi et al., 2013; Piorr et al., 2011*) in favour of urban settlements and infrastructures. These increasing trends have been threatening the persistence of peri-urban agriculture, and consequently affecting the agricultural productive capacities of the region, with a further exacerbation of its scarce capabilities in being food self-sufficient.

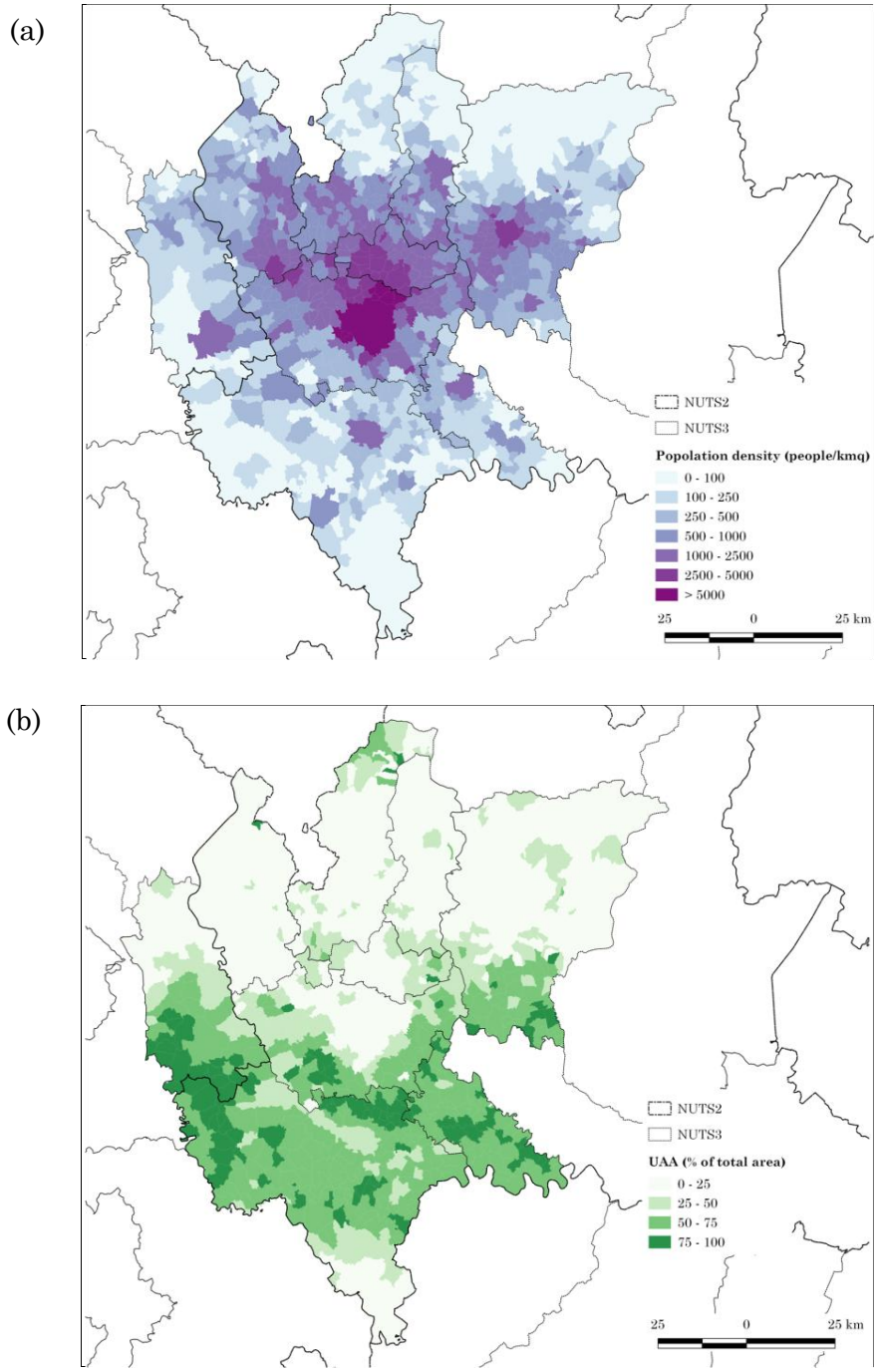


Figure 5: (a) population density in MMR (based on *ISTAT, 2011*) and (b) distribution of agricultural area (based on *ISTAT, 2010*)

Table 2: main features of case study area

Feature		MMR	Italy	% of national total
Land area (km²)		25,200	301,340	8.36
Population (Million people)		7.89	59.43	13.28
Density (people/km²)		602	197	
GDP (.000 USD)		35.6	206.9	17.21
Workers in agriculture (n.)		55,265	3,628,208	1.5
UAA (ha)		490,668	12,782,936	3.84
of which	*fruit*	1,596		0.29
	wheat	44,446		2.27
	barley	2,294		0.88
	oats	77		0.05
	maize for food	2,153		24.19
	rice	140,190		57.03
	vegetables	4,533		1.51
	pulses	1,042		0.75
	potatoes	380		1.40
	olives for oil	425		0.04
	oil plants	3,341		1.10
	wine grapes	15,024		2.26
	sugar beet	6,895		11.76
	maize for feed	109,362		24.18
	temporary grassland	39,030		2.04
	permanent grassland	87,732		2.55
UAA (ha per capita)		0.062	0.047	
Number of farms (n.)		26,289		1.62
Farm dimension (ha/farm)		18.6	7.89	
Animal heads	*dairy cows*	172,644		23.50
	beef cattle	786,060		59.67
	pigs	2,279,849		26.57
	broilers	1,322,993		3.01
	layers	2,756,754		15.30

Source: own elaboration based on *ISTAT, 2010 and 2011*

3.2 Examples of reconnection: the Food Community Networks

Within a regional context, the option to reconnect agriculture and food is realized by concrete initiatives and several configurations of shortened food chains, already undertaken and intended for this. They represent a different approach to global and traditional systems, moving away from them because made of a combination of one or more innovations regarding productive, processing, know-how, social and governmental aspects (*Avermaete et al., 2003)*. It is to be pointed out that such experiences, despite responding to boosts from different subjects, have to be adequately supported by regulatory instruments introduced by public governance: generic actions and policy interventions may act also in favour of food relocalisation. Alternative food chains represent economic organisations in which consumers and producers share both the benefits and the costs of the organisation itself (*Migliore et al., 2014*). This creates a governance structure based on "resource pooling" and the usage of "membership": on one hand consumers provide time, information, knowledge and financial resources by participating directly in the organisation of the production process and they receive leisure, credence foods and decreased monitoring costs; on the other hand farmers, despite having their decision-rights and part of their production reduced, encounter lower transaction costs (*Pascucci, 2010*). In these cases the term "*Food Community Network*" (*Pascucci, 2010; Pascucci et al., 2011, 2013*) may be used to frame all those local-based experiences and initiatives arisen from social boosts with a local scale of action and the clear goal to re-appropriate food at local level (*Fonte and Grando, 2006*) (Table 3). They are characterized by the direct involvement and, in case, participation of consumers in food productions, i.e. the consumer as a co-producer (*Bakudila, 2012*; *Wilkinson, 2001*): Community Supported Agriculture, the farmers' markets movement, local and collective buying groups, farm direct selling.

Table 3: examples of Food Community Network

Type of community	Scale of action	Aims	Stakeholders involved	Key resources
Community Supported Agriculture	Local	Connecting consumers to food productions	Urban consumers and land managers	Land, food, values, leisure time
Consumer Buying Groups		Promoting critical consumption and sustainable productions	Consumers and local farmers	Food and values
Farmers' markets		provide market alternatives to farmers	Local farmers and consumers	

Source: Pascucci, 2010 (modified)

Alternative systems in MMR: the local level

Direct sale of food products represents a valid strategy adopted by a large number of farms, in order to consolidate their active role in maintaining and developing socio-economic and cultural embeddedness of rural areas. The diversification of farm's incomes by introducing such commercialization options (*Van der Ploeg and Roep, 2003*), represents a priority strategy especially for small and medium farms most affected by the so-called "*squeeze on agriculture*" (*Van der Ploeg, 2006*) and by a more scarce competitiveness on the market. The introduction into the productive activity of new goods and services through the implementation of a shortened food chain enables the achievement of a quality improvement, a higher value added, the opportunity to enhance productions in monetary terms and the adjustment to consumers' preferences for fresh, local and organic food and their requests for positive externalities. Furthermore, the reconnection implemented by direct sale occurs in spatial terms, with reduced physical distances, and with the shortening of organizational and logistic path followed by food products – which at least in the

commercialization phase, does not include intermediaries and then allows cost reduction, higher earnings for producers and savings for consumers.

The producer-vendor can choose between different options for a more direct relation with the consumer. The direct sale of agricultural products operated by farmers can be classified according to several criteria (*Tregear, 2011*), or on the basis of the final destination of products and commercialization strategies. This kind of sale is nevertheless not exclusive, but rather operated simultaneously with traditional and mainstream commercialization channels (*Raffaelli et al., 2009*); this can also imply a scarce commitment with the local component, leading to a consequent distinction of different dimensions of agro-food systems where these initiatives operate (Table 4).

Table 4: direct sales according to product destination and commercialization strategy

	To whom		Where	How	Scale of action
Direct sale	To consumer		On farm	Vending machines Farm shops Pick-your-own Roadside sales Farm-based hospitality	Local
			Off-farm	Vending machines Farmers' markets Home delivery Community Supported Agriculture Collective buying groups	
	To other subjects	Other farms Industrial enterprises Commercial enterprises Agricultural cooperatives		Contracts with large retailers	Regional

Source: own elaboration, adapted from *ISTAT, 2010* and *Kneafsey et al., 2013.*

Accordingly, also in the case study area, they are differently spread across the region (Figure 6). Their varied distribution reflects both

the destination of the final product and the variety of products offered by farms; meanwhile, in general terms, population density and the consequent wider market potential, seems to be an important driver for the spreading of direct sale.

In the Pre-alps, farmers who sell their products are more oriented to commercialize them directly to the consumer, relying their outputs mainly on animal production and related processed foods (*Pieri and Pretolani, 2012*): in these areas around 75% of farms choose this option (73%, 76% and 75% in the province of Como, Lecco and Varese, respectively). Here, agriculture suffers from territorial and development disadvantages, scarce ability to compete with other more specialized farms, and more limited output amounts. Farmers then find in the diversification an instrument to be more integrated with the territorial context, while touristic flows may play an important role in the opportunity to develop alternative commercialization strategies: short channels, direct sales, typical production and local food chains represent valid strategies to increase value added and enhance their competitiveness.

On the opposite, in the more rural and plain areas characterized by an intensive agriculture, though many more farms sell their products, direct sale to consumer is the less common form of commercialization, with percentages ranging from 10% to 32% of farms in Lodi and Novara provinces respectively. This orientation may depend on what it is actually produced and on most typical agricultural production. Rice from Novara and Pavia provinces, as long as wine in this latter, are products that are suitable for direct sale to consumers to a limited extent: they are rather conveyed to collecting and processing centres (rice factories, wineries), with a consequent better orientation towards industrial and commercial enterprises, even if some examples of on-farm processing and sale can be found as well.

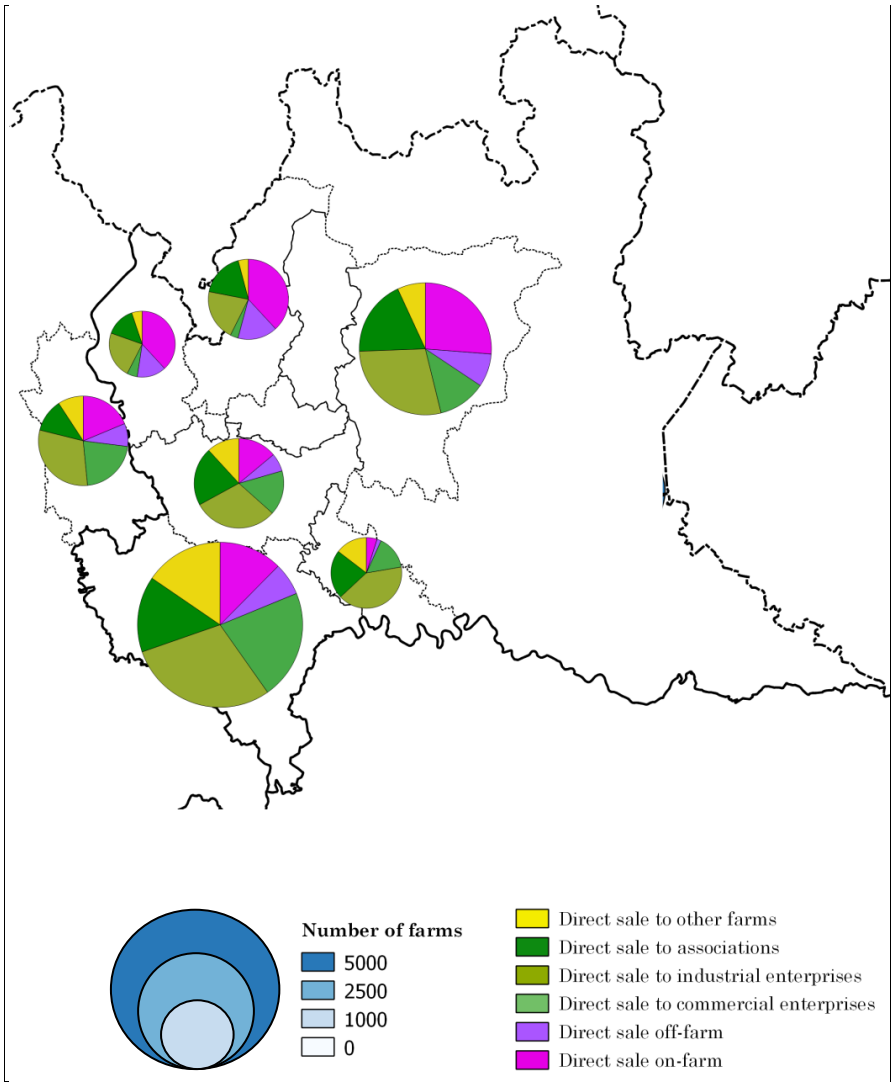


Figure 6: the direct sale in the MMR.
Source: own elaboration based on *ISTAT, 2010*.

On farm sales represent the most spread form of direct sale to consumer. In this case the agricultural producer sales directly to private consumers at the farm site, without any intermediary and preliminary agreements between the two parties.

Farm shops offer a limited range and variety of products to consumers, who face the discomfort to personally go to the point of sale. This kind of connection reduces the asymmetric information and the option to purchase directly at the production site strengthens the recognition of the local origin of products. On the other hand, the producer, despite initial investments (*Cicatiello and Franco, 2008*), take particularly advantages in the easing of farm management, which has positive repercussions in reducing or eliminating transport time and costs. The compensation between the *pros* on the producer's side and the *cons* on the consumer's, allows enhancing and strengthening the convenience of adopting such commercialization strategy. The enlargement of the range of products sold operates in this sense. This not necessarily ensures the ties between the product and a specific territory, nor reflects a shortened system. The purchase of products other than those available to farm[2] may involve non-local producers, exacerbating the physical distance between production and consumption sites: this would imply a longer chain for the products, either in terms of nodes and space.

Amongst the options of direct sale on-farm, agrotourism is one of the activities related to agriculture, which in multi-functional terms operates as a broadening diversification strategy (*Van der Ploeg and Roep, 2003*). The rural tourism is in fact characterized by a wide range of services offered by farms, from hospitality (farmhouse lodges), to leisure, sport practices, educational and cultural activities, direct sale of farm products and catering. In this latter case, the link with the local component is perceived by the consumer and ensured by the national regulatory framework: catering operated in agritouristic structures has to consist predominantly of farm's own products – produced and processed on site – and of those from other farms in the area, with preference for local food, labelled or with a

[2] In this sense the Legislative Decree n. 228/2011 sets some precise limitations for the purchase of agricultural products from third parties.

denomination of origin products (*L. 96/2006*).

Farmers' markets. In contrast to the previous form, the location of the point of sale in the urban area implies the transportation of food products to the city, where private consumers can purchase them. Different forms of off-farm sales exist, to which correspond different modalities for logistics and movement of both actors and products.
Amongst them, weekly markets and market halls are the oldest forms of direct marketing and still very popular across Europe and the world. Consumers and producers converge to a marketplace (open air or indoor) where they have the possibility to personal interact. However, at least in the Italian context, the presence of agricultural producers in this kind of markets has reduced over time, in favour of more competitive wholesalers who can offer a more attractive and a larger variety of products (*Cicatiello and Franco, 2008).* Recent legislative interventions[3] are trying to control this trend by favouring the presence of producer-farmers in such markets, and promoting the constitution of out-and-out farmers' markets:

"multi-stall market at which farmer-producers sells agricultural products directly to the general public at a central or fixed location" (USDA FNS, 2015).

Most of them are periodically organized and managed collectively by farmers or Farmers' Unions; the markets are mainly located in urban centres (Table 5), where the larger population and the presence of infrastructural networks facilitate the existence of a wider potential market, without necessarily reflecting the productive capacities of the area they are located in. Producers can meet consumers' requests and have more chances to sell their products. This way, markets are not only strategies to diversify farm activities, but also for the integration of revenues of small and medium farms that most have likely been suffering from economic crisis. The reduced or cancelled number of intermediaries, implies higher margins and value added for the

[3] D. Lgs. 228/2001 and D.M. 20 Novembre 2007.

producer and interesting saving for the consumer. It is demonstrated that the former benefit positive economic results, obtaining significant revenues (*Brown, 2002*), especially if organic products are sold (*Govindasamy et al., 2003*). Furthermore the farmers' market is a good chance to sell the exceeding production avoiding wastes, ensuring higher margin of gain if compared with large retail distribution.

The reconnection between producers and consumers is mediated by a trust relation built up among them over time, and the role of producer is perceived by consumers as a factor that ensures both quality and fresh products. Farmers' markets enable a better consumer awareness and information about vendors, their food production practices and local knowledge (*Covino et al. 2010; Volpentesta and Ammirato, 2012*): associating to a food product the respective producers and recognizing them ensure a sort of traceability system and the possibility to purchase effectively local products.

Table 5: periodic farmers' markets in MMR and Lombardy Region

Province	Farmers' markets (n.)
Novara	3
Bergamo	11
Como	9
Lecco	1
Lodi	2
Milan	45
Monza e della Brianza	8
Pavia	6
Varese	5
MMR	***90***
Brescia	20
Cremona	12
Mantua	22
Sondrio	4
Lombardy	***148***

Sources: Coldiretti, CIA, Slowfood, Consorzio agrituristico mantovano

Vending machines. This commercialization strategy allows the consumer to purchase food products all day long. The strong orientation of regional agriculture to the dairy sector, has led to a parallel spreading of vending machines for the fresh raw milk of the day. These structures are mainly concentrated in the most populated provinces, where a large number of people can make use of them and ensure the success of the initiative. Despite this, it is mostly in these areas as well that vending machines have been suffering from a constant diminution over time (Figure 7), with a decrease of 33% and 57% in Monza and Pavia provinces respectively between 2011 and 2014.

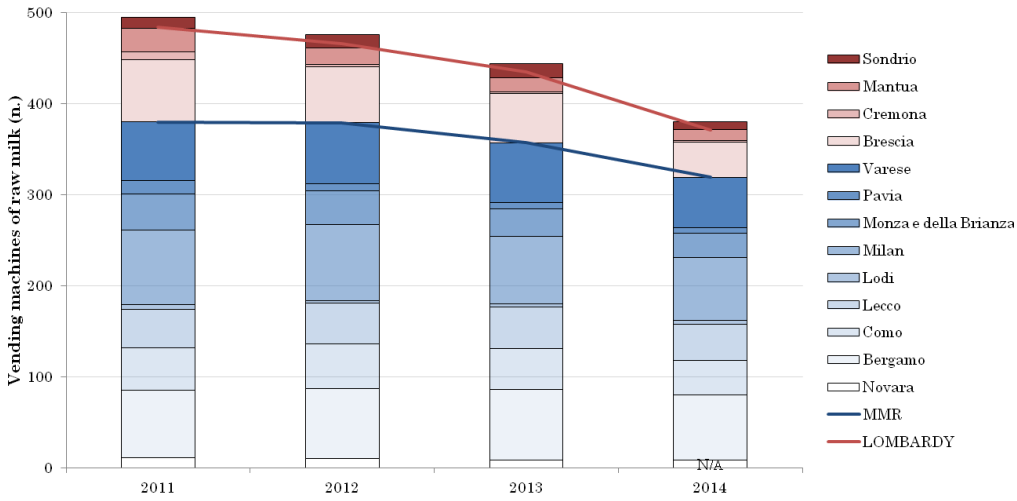


Figure 7: vending machines for raw milk in MMR and Lombardy provinces, 2011-2014 time series (*Sources: Pieri and Pretolani, 2012, 2013, 2014; rapporti ASL Novara*)

The initiative of private farmers to install the machines for vending milk, dairy products or cereals at their own farms, expresses the trust relationship between producer and consumer; on the other hand, vending machines "off-farm" located in strategic places in urban centres easily accessible by consumers, inform them about the origin of the available products, ensuring an immediate recognition of their local origin. In general terms, such a direct sale reduces the

transportation, bottling and packaging costs for producers, making for the consumer the purchase cheaper than at large retailers.

Pick-your-own (PYO). Pick-your-own experiences consist in the collection on farm of agricultural products by consumers involved in the initiative, who require quality, fresh and cheap food and enjoy the collection itself as a convivial moment and recreational experience (*Lloyd et al., 1995*).
Very popular in the U.S.A., in Anglo-Saxon contexts and Western Europe pick-your-own experiences are limitedly spread both at national level (*Coldiretti - Agri2000, 2010*) and in the MMR. In this regard, it is pointed out the presence of some initiatives in the Bergamo province, where 8 orchards allow 7-8 thousand people a year visiting farms and directly collecting fruit, with an estimated turnover of 250,000€ (*Coldiretti Bergamo, 2015*).

Home deliveries imply the provision of food products to consumers – even a group of them – at agreed intervals, with a range of products they have subscribed to. This type of organization favours the aggregation of producers, which allows them to enlarge the variety of cultivated products and meet consumers' request, controlling logistics costs (*Ciannavei et al., 2008*).

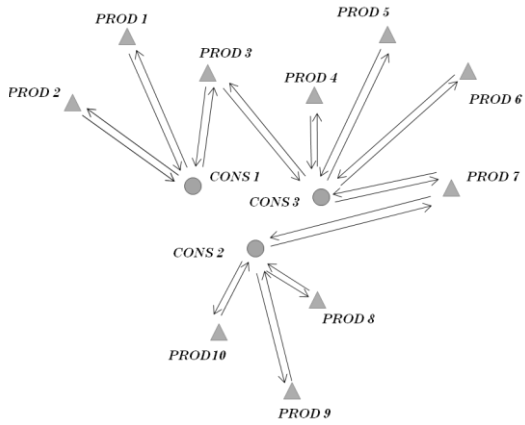


Figure 8: organisation and structure of home deliveries. Consumers (CONS) are supplied with products they subscribe to by one or more producers (PROD). (Own elaboration).

The subscription and the order can be made on-line (e-commerce)

with a further loosening of the personal interaction between producer and consumer. In this case, the consumer may choose to be supplied by local producers who offer their products through a platform on their own website. Of course, this possibility is strictly linked to the level of farms' computerization: e-commerce is a commercialization strategy adopted by less than 1% of Italian farms involved in direct sale, percentage that increases up to 2.3% in the MMR, where little more than half of them prefers the commercialization of plant products (cereals, flowers and nurseries, vegetables and potatoes, wine grapes) (*ISTAT, 2010*). The agricultural vocationality of the territory plays a determinant role in the typology of offered products. This ensures that in the province of Pavia (23%) the main offered products are cereals (likely rice), wine grapes and related processed products; similarly, in the Bergamo province (19%) the on-line marketing concerns animal and processed foods (likely cheese).

Alternatively to the active role of producer, an intermediary may be involved, managing an online platform or a website unrelated to the farm that proposes products from different producers. This could even reflect a non-local component, especially if the intermediate structure collects food products from remote territories and farms.

Solidarity Purchasing Groups (SPG)[4] are operative structures for a collective purchase of food and other goods: several consumers (individuals, families, groups of consumers) gather together in informal structures and cooperate to buy them directly from producers, becoming active participant of the network (*Volpentesta and Ammirato, 2012*):

"*non-profit associations set up to carry out collective purchase and distribution of goods for ethical, social, solidarity and environmental sustainable purposes*" [L. 244/2007, art. 1, par. 266]

[4] In Italian, *"Gruppi di Acquisto Solidale"* (GAS). Similar initiatives in the rest of Europe are those of the *"Association pour le Maintien de l'Agriculture Paysanne"* (AMAP) in France, and the *"Groupe d'Achat Solidaire de l'Agriculture Paysanne"* (GASAP) in Belgium.

Though similar to farmers' markets for the collective dimension, in a SPG the leading initiative is of consumers and a more indirect connection between main actors exists. Producers and consumers are not always physically connected; rather, their relationship is strongly based on trust and on sharing driving principles of equity, solidarity, responsibility, sustainability, environmental-friendly practices and quality products.

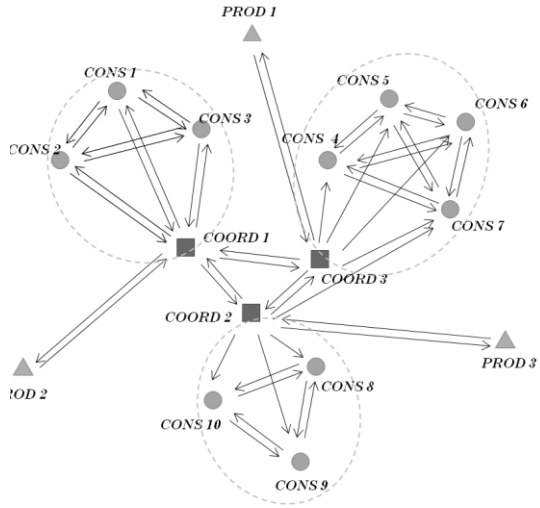


Figure 9: organisation and structure of a SPG. Food products form different producers (PROD) are usually conveyed to a collector (the coordinator, COORD) - normally a consumer or a representative of the group (the dashed circle) - and then sorted according to orders and delivered to the specific reference structure, where consumers (CONS) can pick up their own products. (Own elaboration based on *Brunori et al., 2012,* modified).

The quantitative dimension of the phenomenon goes far beyond the numbers officially collected at National level; a recent monitoring (*Forno et al., 2013*) estimates the presence in Italy of more than 2,000 SPG, for a total of almost 500,000 people involved. The rising of SPG was initially aimed to reach a closer social cohesion and promote a stronger settlement in the local context; however, they have been more often spreading in other and wider contexts: they have been developing as more and more requested systems for the provision of food with specific characteristics (e.g. organic or seasonal products), not necessarily of local origin. The phenomenon of SPG is largely widespread in Lombardy region (where 25% of Italian SPG operate), with a major concentration in the most populated provinces in the north to Milan and an apparent augmentation over both time and space (Table 6). Such an increasing importance leads to consider the

economic aspect as a dimension that is assuming a primary and more and more relevant role: it is estimated that each group can generate 35,000€ a year by commercializing mainly fresh fruit and vegetables (5-7 tons a week).

The number of involved consumers, quantities and variety of purchased products may lead SPG to have various levels of logistics organization, quite similar to commercial structures. Their aggregation into cooperatives or consortia, by sharing the same purchasing structure, strengthens personal interactions and durability of the system and favours obtaining purchase volumes such as to exploit economies of scale in management processes, logistics and relations with producers. Thus, high quantities of food and low logistic and transport costs are ensured, finally returning to more favourable conditions to both producers and consumers, especially if compared with large-retail distribution (*Convegno Nazionale dei GAS[5], 2012*).

Table 6: SPG in MMR and Lombardy region

Province	**Registered on www.retegas.org** (*the author, July 2015*)	**Registered on www.retegas.org** (*Forno et al., 2013*)	**CORES monitoring** (*Forno et al., 2013*)
Novara	6	N/A	N/A
Bergamo	26	24	62
Como	15	14	46
Lecco	8	8	17
Lodi	2	1	3
Milan	103	95	153
Monza e della Brianza	28	23	33
Pavia	11	7	11
Varese	21	18	40
MMR	***214***	***190***	***365***
Brescia	31	23	50
Cremona	9	8	7
Mantua	4	4	4
Sondrio	2	2	3
Lombardy	***260***	***227***	***429***

[5] *Italian National Congress of Solidarity Purchasing Groups,* Mestre, 15th-16th September 2012.

Urban gardening. In several occasions urban gardening and urban agriculture[6] are used as synonymous, but the two terms actually have different acceptations (*Ernwein, 2014*). On one hand, the former closely follows the characterizing features of agriculture as a whole, consistently with the etymology of the term "*agriculture*" itself, which implies the cultivation of a plot; if in this sense it is true that gardening experiences are forms of agriculture, profound differences exist between primary activities carried out for productive and entrepreneurial purposes, i.e. professional agriculture, and gardening for hobby or other purposes, as urban gardening is here considered. Urban gardens are usually small-scale cultivations that don't need extensive landholdings, but can actually survive in *en plein air* urban environment and in contexts with limited inputs and resources, such as the inner city. Despite an intense utilization of the limited available resources, the location of urban gardens represents at the same time a strong constraint to their development. The urban context in fact allows the cultivation of a limited variety of products, mainly intended for fresh consumption at house-hold level (*Dewaelheyns et al., 2014*), and leads to a scarce productivity: horticultural activities are the most representative forms of this phenomenon (*Alison et al., 2007; Smit et al., 1996*), but small orchards and flower cultivations are present as well (*Blaine et al., 2010*).

Urban gardening is the form that better suits with the reconnection of agriculture and food: the sites of production and consumption are extremely close, proximate or even coincide, being the gardening activities carried out within a short-range from home. It also represents the shortest possible food chain from a logistic point of view, with the figures of producer and consumer overlapping on the same subject. Moreover, such activities ensure a total compliance with consumers' preferences, as the gardener grows what it is actually needed at household-level, also according to the preferred

[6] According to one of the most widely recognized definition, urban agriculture is the set of agricultural activities *"located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis"* that *"grows or raises, processes and distributes a diversity of food and non-food products, (re-)uses largely human and material resources, products and services found in and around that urban area, and in turn supplies human and material resources, products and services largely to that urban area" (Mougeot, 2000, p.10).*

cultivation method. At least in Developed and Western countries, urban gardening is not related to food security issues: it is not primarily a form of subsistence agriculture, but rather it concerns the desire to rediscover the possibility of growing quality and fresh products and the ties with land, as long as enhancing social cohesion and interactions. These aspects are even strengthened by initiatives promoted by local administrations for the establishment and the development of gardens and cultivated plots. The development of such municipal allotments is a widespread strategy to support low-income citizens and favours social integration. In Italy, these initiatives are spread in both big cities and small villages and towns, where the public administration offers citizens the possibility to cultivate a garden on municipal-owned land: these areas count for more than 320 ha (Table 7), increased by 40% compared to 2012 (*ISTAT, 2014*).

Table 7: urban gardening in the MMR, Lombardy and Italian capital cities

Capital city	Municipal allotments (m^2)*	Urban gardening lots (n.)^
Novara	0	*N/A*
Bergamo	7,129	63
Como	21,000	154
Lecco	10,800	165
Lodi	1,296	100
Milan	52,000	1,384
Monza	0	100
Pavia	15,700	200
Varese	5,750	137
MMR	***113,675***	***2,303***
Brescia	12,000	212
Cremona	19,000	135
Mantua	8,137	46
Sondrio	5,103	85
Lombardy	***157,915***	***2,781***
Italy	***3,296,148***	***N/A***

Source: *******ISTAT, 2014;* ***^****Coldiretti, 2015*

The urban gardening phenomenon is therefore dynamic, with a quite difficult accurate quantification. As already demonstrated by several studies (*Cognetti et al., 2014; Dewaelheyns et al., 2014; Lupia and Pulighe, 2014; Taylor and Lovell, 2012; Mathieu et al., 2007*), the mapping of urban gardening lots in a GIS-based environment contributes to dimension the phenomenon; such approach is however limited to the period of analysis and doesn't catch its complexity and dynamism in both space and time (*Cognetti et al., 2014*). However, a mapping as much accurate as possible highlights the importance of both public and private forms of this peculiar typology of urban agriculture in developing coherent and effective policies and programs at city-level: the recognition of their locations, used spaces and resources, as long as the consideration of socio-demographic aspects, contribute to drive institutions and policy-makers to identify the needs to enhance the existing or possible sites, to help them introducing proper land use and land management policies to encounter the demand for urban agriculture and green areas (*Taylor and Lovell, 2012*).

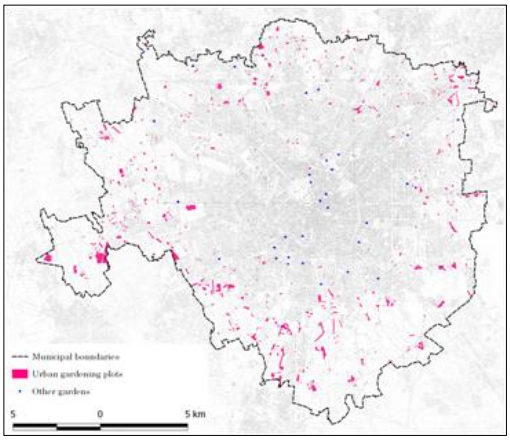


Figure 10: Urban gardening areas in the City of Milan counts for about 193 ha (1.06% of the total municipal land area) (*Glavan et al., 2015a*).

Urban gardening practices range from individual initiatives, such as home gardens and illegal gardens in vacant lots (*Smith et al., 2013*), to "*organized garden projects*", where "*an organized group of people is involved in cultivation*", "*with a clear set of goals*" (*Pudup, 2008:1231*), established both by gardeners themselves or by external private or public organizations, institutions, NGOs and medical centres among others. The individual initiative of easement gardens and private gardens can support biodiversity in cities (*Rudd et al., 2002),* enhance the aesthetic qualities of these areas (*Grove et al., 2006*) and create neighbourhood identity and community cohesion (*Hunter and Brown,*

2012), influencing the form and the content of gardens themselves (*Zmyslony and Gagnon, 2000*). Further on, urban gardening experiences differ each other according to their location: at the city fringe and in the outskirts, in areas with higher land availability, or, conversely, in the inner city, where are concentrated small gardens and activities that require even less space or caissons with vegetables. Gardening plots are extremely different also in terms of dimension - from a large field to a narrow space along railways or roads –, land tenure and management organization (Table 8).

On the other hand, complementary analyses are needed either to profile gardeners or investigate what and how much it is produced. Motivations driving people to start gardening are mainly tackled from a sociological point of view, so miscellaneous and diversified that sometimes come in contradiction each other (*Falletti, 2012*); the recently growing interest in urban gardening depends on the combination of several other factors and influences, from changes in lifestyle, to the rising of social and ecologist movements, the interest in food security issue and the considerations about the socio-environmental quality of urban contexts (*Calori, 2012*). Moreover, are often to be found amongst the expected benefits of the gardening experiences the improved access to healthy (*Brown and Jameton, 2000; Alaimo et al., 2008*) and affordable food (*Milburn and Vail, 2010*) and the promotion of a healthy lifestyle, by getting people to do physical activity (*Zick et al., 2013*). A recent survey that involved the cities of Ljubljana, London and Milan (*Cernic-Istenic et al., 2015*) confirms that gardeners across different regions are driven by the same motivations. In fact, growing own food is mainly oriented to fulfil quality, nutritious, socio-psychological and environmental needs, rather than driven by economic reasons: if on one hand home gardening plays an important role in providing fresh fruit and vegetables in urban areas, the respective household needs are only partly covered by these productions (*Glavan et al., 2015b*), also due to their seasonality. Despite their spreading, the scarce outputs obtained from this kind of agriculture lead gardeners, or equivalently consumers, to rely on other various forms of food provisioning, either local and alternative or not.

Table 8: classification of urban gardening experiences according to land tenure, management organization and people to whom they are addressed (the author, based on *Glavan et al., 2015a*)

Urban garden typology	Land tenure	Management/Target	Description
Municipal allotments	Public (Municipality)	Individuals citizens or associations	Located on municipal-owned land, loaned by the owner to individuals or associations
Public allotments	Public (others)	Individual citizens or associations	Located on public land, loaned by the owner to individuals or associations
Botanical gardens	Public or private	Individuals for the general public	Gardens where plants are grown and/or studied by researchers and gardens' managers, for the exhibition to the general public
Healing and re-educational gardens	Public or private	Specific categories of people (e.g. patients, prisoners)	Gardens and plots cultivated at public structures, with access limited to particular users and categories of people
School gardens	Public or private	School classes	
Community gardens (*Francis, 2003*)	Public or private	Associations or organized group of people involved in a shared project	Public or private areas organized and managed collectively according to agreed initiatives of different subjects and citizens gathered together into informal structures or into legally recognized associations
Linear gardens	Public or private	Individual citizens	Garden plots on abandoned lands, nearby roadsides and along railway tracks (*Vazhacharickal et al., 2013*); the owner doesn't take any part in organising and maintaining such areas, while gardeners don't paid for using the land
Private allotments	Private	Individual citizens	Plots on private land granted by the owner to private parties
Gardens away from home	Private	Individual citizens	Gardens cultivated on public or private land away from home, in agreement or not with the owner
Home gardens (front- and backyard gardens)	Private	Home dwellers	Plots pertaining to the land situated nearby houses managed by their dwellers
Corporate gardens (gardens in workplace) (*Parker, 1992*)	Private	Corporation and employees	Gardens of private companies, whose establishment derives from specific corporate policies, possibly managed by subordinates and employees.
Corporate gardens – extended definition ("business gardens")	Private	Private business, associated to the commercial activity	Gardens at bars and restaurants which products are used for cooking or served to customers

Alternative systems in MMR: the metropolitan level

Amongst the possible alternative experiences in the agro-food sector and in food chains still operating at regional level, initiatives with a higher logistic and organizational complexity can be found; in this case, much stronger are the ties with the metropolitan and global component, rather than with the local one. Despite this, a commitment with either the local level or a specific area is still possible: this is the case of what can be framed under the name of "*proximate*" and "*extended alternative agro-food networks*" (see paragraph 2.4). These set of configurations, though possibly including the presence of traditional production-consumption chains, may become peculiar elements for the introduction of local food, which connotation is mediated by the typology of product, primarily linked to specific characteristics of food itself (e.g. quality, fresh, organic) and its origin (e.g. denomination of origin).

Agroparks[7] represent a concrete implentation of the concept. Such a structure consists of an organizational form in which the supply chain steps are geographically concentrated in mega-structures dealing with issue related to waste, waste water, Energy, in order to optimize environmental efficiency. The Agropark model, imagined in The Netherlands to be implemented primarily in Dutch areas, has a strong orientation to global market and to the optimization of some functions related to the productive process, namely *(i)* production volumes, able to exploit economies of scale, *(ii)* the yield per unit area, through processes with high intensity of chemical and energy input, *(iii)* R&D, closely linked to the production step, *(iv)* logistics, through packaging and shipping platforms.

In Italy a different approach is adopted, due to the more fragmented agro-food system in turn based on small and medium

[7] *"The heart of the concept is an area devoted to both the production and processing of meat, fish, eggs, flowers, fruit and vegetables, all at one and the same location and in such a way as to provide the greatest possible benefits for the environment, the landscape, people and animals. These parks can take on various forms, from multi-storey buildings in a harbour area, to 'green industrial estates' or multifunctional parks in the rural area"* (http://www.ryerson.ca/carrotcity/board_pages/city/agroparks.html).

farms and agricultural enterprises. In this context, other instruments seems to be more promising, such as those that aggregate system enterprises into associative forms to address some production phases: R&D, promotion and communication, relations with the public administration and funding sources, amongst others. This configuration takes the peculiar form of ***agricultural districts***. The economic theory concerning districts draws on the Marshallian assumptions (1927) of concentration of specialized industries in particular places:

"[…] for the present we must turn aside from these broader movements of the localization of industry, and follow the fortunes of groups of skilled workers who are gathered within the narrow boundaries of a manufacturing town or a thickly peopled industrial district"
(Marshall, 1860:6)

This allows a high number of small and medium-sized enterprises, individuals with a high social mobility and public administration contributing to the economic growth of the sector, the territory and the district itself. The support of such an organization is based on flexibility, while the socio-economic structure is ensured by informal rules and, subjected to entrepreneurial risk, distributes profit and losses (*Basile and Cecchi, 2001*).
In recent years globalization and the economic crisis have been pressing the agricultural sector, driving farmers to adopt new tools to deal with the challenges of both globalisation and agricultural policies (*Mazzocchi and Sali, 2012*). In this sense, the Italian legislation allows them joining in organized superstructures derived by the concept of the aforementioned "industrial district", which concretely represent innovative forms of territorial governance and may play a role in developing and enhancing the local system and its agro-food production (*Corsi et al., 2014*). Thus, agricultural district represents a new model of economic organization that aggregates different subjects, with strong interdependencies between farms (or enterprises) and agro-food industries, in closer vertical and horizontal integrations of both resources and functions (production, processing and distribution phases). This relational network of relationships

allows sharing resources and knowledge, through an operative model focused on participation that economically, socially and environmentally characterizes a territory (*Belletti and Marescotti, 2007*). Despite some Community legislation already constitute references regulations for agricultural districts (*Toccaceli, 2012*), such experiences are quite unusual in the rest of Europe. If on one hand they have some similarities with the French *Pays* (e.g. the co-operation amongst different subjects in a homogeneous geographical area that not necessarily coincides with an administrative unit, the promotion of local development, the internal organizational structure), they diverge from them for the ties of these latter with land planning and management, role that Italian agricultural districts are not completely able to hold.

The Italian Agricultural Act (D. Lgs. 228/2001), supports at National level the establishment of agricultural districts and introduces the possibility to make concrete their promotion and development. The concept of agricultural district itself is, however, variously interpreted at regional level, which leads to identify different typologies all over Italy. If on one hand, in fact, the National Decree is limited to the introduction of two types of district only, each Region might integrate it with other specific local regulations, which in turn define further particular examples, according to the peculiarity of both the territory and the regional agro-food sector: namely, supply chain districts, agro-industrial districts (*Iacoponi, 1990*), agro-food districts (Figure 11).

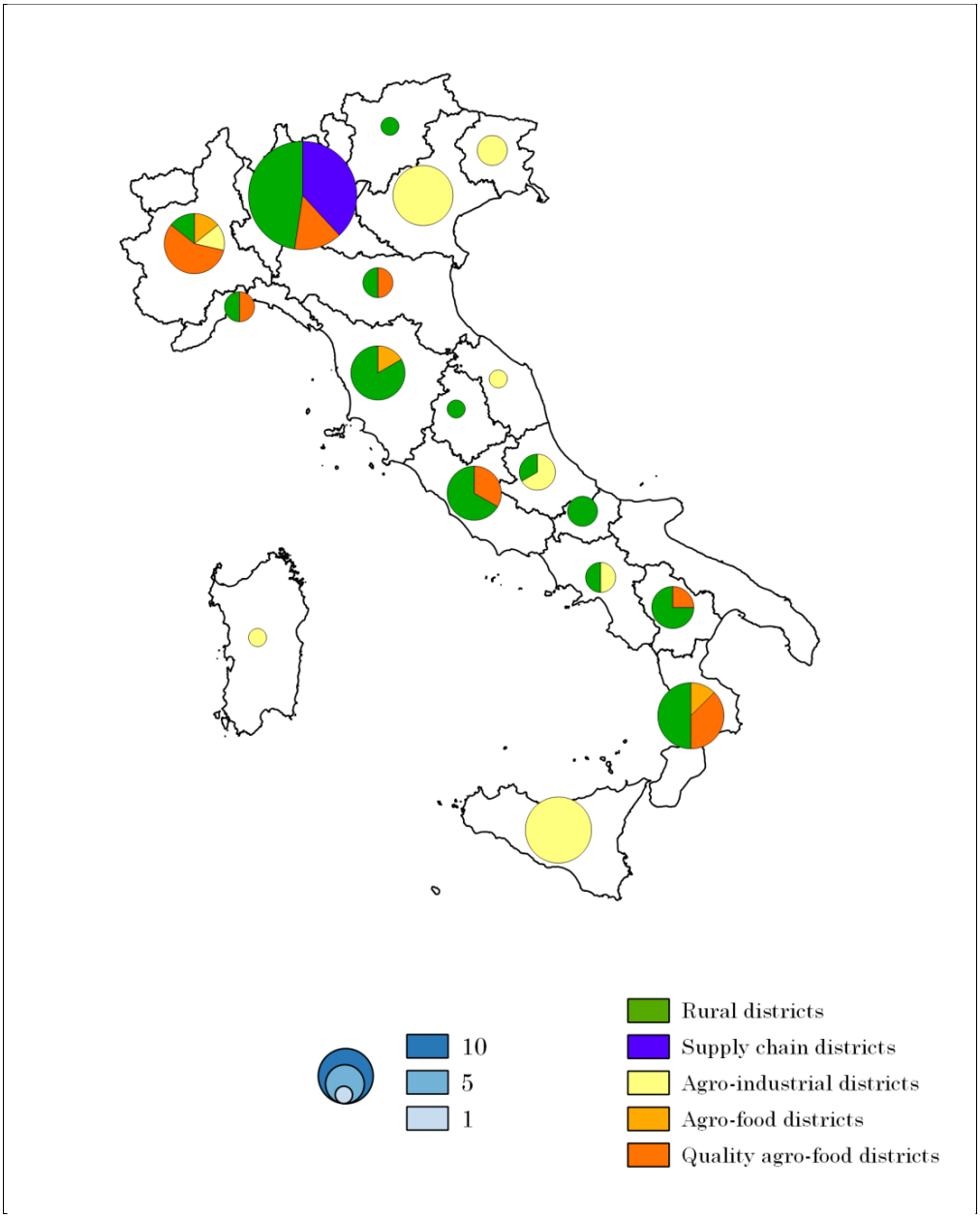


Figure 11: agricultural districts in Italy in 2015 (*Toccaceli, 2015, 2012* and regional regulations)

According to the current regulatory context, in the Lombardy region – partly included in the MMR - three different typologies of agricultural districts can be found (Table 9), differently connected to the territory and the local context, as well as diverging for both main purposes and conceptual approaches.

Table 9: recognized agricultural districts in Lombardy region

Typology	Name	Accreditation Act
Rural district	Distretto Agricolo Milanese - DAM	D.g.r. 624/2010
	Franciacorta, Sebino, Valtrompia	D.g.r. 624/2010
	Riso e Rane	D.g.r. 1810/2011
	Distretto rurale Oltrepo mantovano	D.g.r. 2463/2011
	Distretto rurale ViviAMO Valcamonica scarl	D.g.r. 2463/2011
	Distretto Agricolo del fiume Olona – DAVO	D.g.r. 3592/2012
	Distretto agricolo della bassa bergamasca	D.g.r. 4243/2012
	Distretto neorurale delle tre acque di Milano – DINAMO	D.g.r. 4243/2012
	Distretto agricolo delle risaie lomelline	D.g.r. 900/2013
	Distretto rurale Valle dell'Adda	D.g.r. 900/2013
Quality agro-food district	Po di Lombardia	D.g.r. 624/2010
	Valtellina che gusto!	D.g.r. 624/2010
	Distretto del vino di qualità dell'Oltrepo pavese	D.g.r. 3592/2012
Supply chain district	Ortofrutticolo Lombardo - DORF	D.g.r. 624/2010
	Distretto Latte Lombardo - DLL	D.g.r. 624/2010
	Distretto Plantaregina	D.g.r. 624/2010
	Distretto Agroenergetico	D.g.r. 624/2010
	Filiera della carne bovina	D.g.r. 1179/2010
	Florovivaistico Alto Lombardo	D.g.r. 1179/2010
	Distretto della filiera avicola	D.g.r. 900/2013
	Consorzio distretto suincolo lombardo	D.g.r. 1586/2014

Source: DG Agricoltura Regione Lombardia (May 2014)

(I) ***Rural districts****,* from which it emerges the concept of a multifunctional, locally-based agriculture:

"Local productive systems characterized by an homogenous historical and territorial identity deriving from the integration between agricultural activities and other local activities, as well as from the production of goods or services of particularly specificity, consistent with natural and territorial traditions and vocations" (D. Lgs. 228/2001, art.13)

The aggregation of farms into a company district is aimed at creating a more powerful subject that expresses its own needs and at the same time, it plays an intermediate role for enhancing the synergies between territory, local entities, associations, institutions and local entrepreneurship. The birth of rural districts mainly arises from farmers' initiative, then implemented by regulations, for the valorisation of territorial resources; they also incorporate know-how and social innovations targeted at the promotion of food products and the meeting of consumers' sensibility and requirements for local recognized food. In this sense, in the MMR they are on going some initiatives for the commercialization at local large retailers of products from agricultural districts. Such initiatives allow the enhancement and the promotion of local food products, enabling the recognition of their quality, origin and traceability; meanwhile, it is emphasized the role of local resources and proximity agriculture. Thus, while the retail sector in many European countries is dominated by large enterprises that source goods on global markets, more recently, large-scale retailers have started to sale organic and regional food, traditionally domain of independent local shops and niche markets. Supermarkets and large retailers may create either own brands for this kind of food or offer space for regional and small-scale producers. This is the case of some initiatives activated in the Milan area that rely on the agreements stipulated between local agricultural districts and regional large retailers. They agree upon the possibility for farms member of the districts to commercialize their own products at local supermarkets, using a distinctive brand that facilitates the recognition of such a local origin: thus, the rice of

Distretto Riso e Rane, as well as rice and vegetables from Distretto Agricolo Milanese can be found on the shelves of large retail distribution in the same area.

A rural district: Distretto Agricolo Milanese (DAM)

Established: 2010
Location*:* agricultural areas within the administrative boundaries of the City of Milan
Agricultural area*:* approx. 1,500 ha
Specialization: cultivation and animal breeding
Main productions*:* cereals (rice), oil crops, legumes, milk and dairy products, pig meat

Leading signatory*:* City of Milan
Active signatoris*:* 31 farms
Other subjects (non-signatory): public entities, universities and research centres, farmers' unions, associations, private corporations and enterprises

Aims: the district is aimed at enhancing agricultural activities and enterprises of the primary sector operating in the City of Milan.
The district is a factual interlocutor between the territory and government institutions, with an active role for increasing the synergies between them and integrating different territorial components, in order to promote concrete actions with general repercussions on the territory.

http://consorziodam.com/?page_id=104

(II) Quality agro-food districts

"Local productive systems, even interregional, characterized by a significant economic presence and one or more certified and protected productions […], or traditional and typical productions" (D. Lgs. 228/2001, art.13)

Goal of these aggregations is to further enhance quality productions and improve competitiveness on the market not only for district's members, but also for the whole respective sector. In this case, the link with the territory is not explicit, but rather mediated by denominations of origin, quality certifications and labelled products.

It then emerges the economic significance of productive chains and the global business dimension, which on one hand characterizes them and further looses the ties with a specific area, on the other. In fact, differently from rural districts, the integration of the supply chain, which may rely on interregional areas, reflects the peculiar productive specialization towards certified, typical or traditional products; thus, the ties with the territory is better realized from the product perspective, rather than in the organization structure (*Toccaceli, 2012*).

A quality agro-food district: Distretto del vino di qualità Oltrepò pavese

Established: 2012 (Accreditation Act D.g.r. 3592/2012)
Location: Oltrepò Pavese
Agricultural area: N/A
Specialization: viticulture
Main productions: quality wine

Leading signatory: Camera di Commercio Industria Artigianato e Agricoltura di Pavia
Subjects involved: 86 amongst farms and wine-makers, and 4 (exclusively) wineries

Aims: the district intends to strengthen the competitiveness of the quality wine sector, by promoting the aggregation of local producers and offering them the possibility to have returned both economic and image advantages: initiative for the assistance to members are contemplated, as long as the chance fro producers to adopt a specific brand whose the districts the exclusive holder. Moreover, the district acts for the integration on the territory of several other initiatives that refer to other entities, either institutional or not.

http://xn--oltreppavese-shb.com/

(III) ***Supply chain districts***

"High-specialized and sector production systems, characterized by a strong integration amongst operators of a chain and by significant representation in economic terms at sector and regional level" (L. r. 1/2007)

The main purpose of a supply chain district is related to the improvement and the enhancement of entrepreneurial competitiveness of district members, linked to a supply chain relevant for the regional economic sector. It is characterized by a strong commercial and entrepreneurial nature, as demonstrated by the possibility to include in the company district enterprises and industries operating in a specific sector, other than farms and producers. Moreover, the presence of research centres ensures the possibility in developing innovative and optimized chain pathways. This results in a district form that is the most diversified in terms of involved sectors, ranging from food chains to agro-energy, to flowers and nurseries. In any case, the rootedness with the territory is quite scarce and weak: the members may not be localized in a specific area, but spread across larger interregional and sub-national units (box 3/C). Similarly their related businesses are more oriented to the global market, even if, especially in the food sector, such structures may promote initiative for the valorisation of local products (e.g. local products in public catering).

A supply chian district: Distretto del Latte Lombardo (DLL)

Established: 2010 (Accreditation Act D.g.r. 624/2010)
Location: Lombardy Region
Agricultural area: N/A
Specialization: dairy cattle breeding and milk processing
Main productions: milk (approx. 939,000 t/year) and cheese (PDO cheese amongst them)

Leading signatory: Cooperativa Santangiolina
Subjects involved: 1,000 barns (approx.), 13 enterprises operating in the milk and dairy sector, 7 cooperatives, 1 consortium of manufacturing enterprises, other enterprises and research centres.

Aims: the goal of the district is to create a network of companies in the dairy sector to promote and safeguard regional agricultural products and increase their market competitiveness. In this sense, it aims at fostering and enhancing regional milk production in a supply chain perspective, coordinating and supporting the initiatives promoted by all the actors of the chain itself.

http://www.lifeprefer.it/it-it/Progetto/Prodotti/Latte

Public catering and procurement. Farmers may sale their products to commercial enterprises that deals with the preparation and delivery of meals at large scale for collective consumers, in both private and public sector, from retail, to hospitality industry and collective catering. This results in an indirect relations between the producer and the consumer, as it usually comprehends other intermediary subjects (e.g. wholesalers, manufacturers).
Especially in this latter case, the public entity is usually involved in procurement processes, according to the principles stated in the national and international regulatory framework (*Directives 2004/18/EC and 2014/24/EC*). In this sense, it emerges the role public contracting authorities in taking into account environmental and social criteria of the production process, with the stipulation of the contract subject to the provision of quality products or products with specific characteristics. In Italy this trend has led, especially in the catering for schools, to a gradual conversion from conventional to food products from certified and controlled sectors (e.g. organic food) (*Spigarolo et al., 2010*), with a designation of origin, seasonal and local products (*Galli and Brunori, 2008*). School canteens in fact appeal, totally or in part, to organic food, with an increasing trend over the last 15 years.

Geographical indications. In the case of Geographical Indications, the link with the local component is mediated by a designation of origin or quality attributed to the product itself. Standards, labels and certifications enable the consumer to immediately associate the product with a place of production, even having no direct experience of that locality (*Renting et al., 2003*). Such conventional recognitions lead to a lengthening of producer-consumer networks, with products sold also outside the region of production. In this sense they may be also characterized by a different position on the market: most of them are mainly exported to regional and national markets, others may span large distances at global level (e.g. Grana Padano).

Table 10: denominations of origin in MMR

	Food product	Type	Areas of production (province or region)
Cheese	Bitto	PDO	Bergamo
	Formaggella del Luinese		Varese
	Formai de Mut dell'Alta Val		Bergamo
	Brembana		Bergamo, Como, Milan, Novara, Pavia
	Gorgonzola		Novara, Bergamo, Como, Milan, Pavia, Varese
	Grana Padano		Bergamo, Milan
	Provolone Valpadana		Bergamo, Como, Milan, Pavia, Varese
	Quartirolo Lombardo		Bergamo, Lecco, Lodi, Milan
	Salva Cremasco		Bergamo
	Strachitunt		Bergamo, Como, Milan, Pavia, Novara
	Taleggio		Novara
	Toma Piemontese		
Wine	Bergamasca	TGI	Bergamo
	Collina del Milanese		Milan, Lodi, Pavia
	Provincia di Pavia		Pavia
	Ronchi Varesini		Varese
	Terre Lariane		Como, Lecco
	Oltrepò Pavese Metodo Classico		Pavia
	Moscato di Scanzo	CGDO	Bergamo
	Ghemme		Novara
	Boca	CDO/CGDO	Novara
	Colline Novaresi	TGI	Novara
	Fara		Novara
	Piemonte		Novara
	Sizzano		Novara
	Bonarda dell'Oltrepò Pavese		Pavia
	Buttafuoco dell'Oltrepò Pavese		Pavia
	Casteggio		Pavia
	Oltrepò Pavese		Pavia
	Pinot grigio dell'Oltrepò Pavese		Pavia
	Pinot nero dell'Oltrepò Pavese		Pavia
	San Colombano		Milan
	Sangue di Giuda dell'Oltrepò Pavese		Pavia
	Terre dei Colleoni		Bergamo
Meat products	Coppa di Parma	PGI	Pavia, Lodi, Milan
	Mortadella Bologna		Lombardy region
	Cotechino Modena		Lombardy and Piedmont regions
	Salame Brianza		Monza e della Brianza, Lecco, Como, Milan
	Salame Cremona		Lombardy region
	Salame d'oca di Mortara		Pavia
	Salame Piemonte	PDO	Pavia
	Salame Varzi		Lombardy region

	Salamini italiani alla cacciatora	PGI	Lodi, Pavia, Milan, Varese, Como, Lecco, Bergamo
Olive oil	Olio e.v.o. Laghi Lombardi	PDO	Bergamo, Como, Lecco
Honey	Miele varesino	PDO	Varese
Fruit and vegetables	Nocciola del Piemonte	PGI	Novara

Source: DG Agricoltura Regione Lombardia (updated January 2015), MiPAAF (updated August 2015). https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/2090

3.3 GOVERNANCE ASPECTS

Alternative configurations of food chains represent innovative elements in the agro-food system, due to their counteraction to mainstream channels. These initiatives are often referred to as "niche innovation" (*Wiskerke and Van der Ploeg, 2004; Seyfang and Smith, 2006; Knickel et al., 2009*) and their role in driving wider system and regime innovation is widely recognized, as long as their pressures to make the existing regulation adapting to their features (*Brunori et al., 2012*). Thus, both regulatory framework and normative aspects related to their implementation and support, and, more in general, to the promotion of proper interventions for a greater localisation, may rely on the different sphere of the innovation itself (i.e. product, process, know-how, social and governance innovation) (*Wascher et al., 2013*): agro-food systems are affected by modifications in consumption models, forms of retail, technical progress, international regulations, arisen from the pressures of different subjects; their introduction could lead to a further modification in the relationships among the elements of the system (*Meulenberg and Viaene, 2005*) and involved actors as well adapt themselves to the new condition and respond to it implementing possible further innovations.

With particular regard to public governmental actions, changes in the regulatory context and in the policy of incentives (e.g. the introduction of certification and labelling systems, subsidies, taxes and standards) can be observed. Quoting from *Mulgan et al. (2007)*, the inclusion of new elements in the regulatory framework are functional to *"meet pressing unmet needs and improve people's lives"* (p. 7); in this perspective public government may take up innovative initiatives from one or few subjects, transposes in legislation the demand of civil society (*bottom-up*) and develops schemes and incentives to encourage a broadening of the innovation; on the other hand, public governance may also anticipate and target the needs of society (*top-down approach*).

It must also be reminded that along with the set of regulations implemented by governmental bodies, each alternative network is characterized by its own internal governance. This organisational aspect, explicit or implicit, strong or weak, establishes the typology of

relations among the main actors and the process that consolidates consumers' trust. The governance structure of these configurations is an innovation itself, which rather emerges as the direct consequence of costs optimization (minimization of transaction costs) and social inclusion. It then mainly responds to socio-economic motivations and seems to not affect – or at a limited extent - the possibilities in further enhancing the respective network. Actions that can be taken in order to enhance and strengthen the presence and role of local systems are in fact prerogative of the interventions of public policy-makers; thus, for this reason, though recognizing its importance, the internal governance of alternative networks shall not be considered in detail hereinafter.

Public governance interventions

The regulatory framework adopted by public decision-makers to enhance localisation, relies on both interconnected sectorial policies and cross-cutting interventions (Figure 12).

Figure 12: topics of interventions needed for enhancing localisation *(own elaboration)*

Amongst the generic instruments and actions oriented in this direction, an important role is played by all the implemented instruments aimed at meeting and reaching consumers. Such a re-

approaching is firstly to be interpreted according to a quantitative point of view. This primarily concerns the implementation of proper measures that ensure a sufficient food production (food safety interventions in a broader acceptation). On one hand the productive capacity of the local system is strongly affected by urban policies, from land use options and the adoption of city spatial plans, that determine the area extent intended for agriculture; on the other hand the possibility to produce enough food could be more affected and eventually further constrained by quota schemes and/or other instruments to sustain farms' incomes: such elements might make producers facing market opportunities, which in turn may determine the main orientation of their primary activities, limiting both the variety and the quantity of cultivated and offered products.

The territorial dimension of food production and consumption is the fulcrum of a rediscovery that is involving Europe and interests rural development processes. In a re-approaching perspective, they have to be also considered the existing possibilities to further facilitate food accessibility and affordability. The role of alternative and short supply chains take place in this regard and amongst distribution channels aimed at improving these aspects: while the purchase is more convenient for the consumer, the producer, in the person of the agricultural entrepreneur, can obtain positive variations of income (*Sini, 2009*). It is thus not a coincidence that in recent years, since the outlooks of the Committee of the Regions, the proposal of the new CAP in 2011 and the current programming period of rural development policy (RDP), much importance in supporting these initiatives has been given. In response to market failures linked to economic and environmental sustainability and the need for an effective and efficient delivery of policy outcomes, especially the second pillar of the CAP has subscribed to policy measures to support diversification of economic activities. At the same time the Regulation 1305/2013 identifies them as functional to the achievement of its own policy objectives, so as to include the promotion of "*food chain organization and risk management in agriculture*" amongst the priorities set by the Union in the Rural Development Programme for the period 2014-2020 (Table 11).

Table 11: Union priorities and interventions areas set by Reg. 1305/2013

(I)	Fostering ***knowledge transfer and innovation*** in agriculture, forestry, and rural areas	Foster innovation and knowledge base in rural areas Strengthen research and innovation links in agriculture and forestry Foster lifelong learning and vocational training in agriculture and forestry
(II)	Enhancing farm viability and ***competitiveness*** of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests	Facilitate restructuring of farms facing major structural challenges Facilitate a balanced age structure in the agricultural sector
(III)	Promoting ***food chain*** organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture	Better integrate primary producers into the food chain through quality schemes, promotion in local markets and SFSC, producers' groups and "inter-branch" organisation Support risk management on farms
(IV)	Restoring, preserving and enhancing ***ecosystems*** related to agriculture and forestry	Restore and preserving biodiversity and the state of European landscapes Improve water and soil management
(V)	Promoting ***resource efficiency*** and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors	Increase efficiency in water use by agriculture Increase efficiency in energy use in agriculture and food processing Facilitate the supply and use of renewable sources of energy, by-products, wastes, residues and other non-food raw materials for the bio-economy Reduce emissions from agriculture Foster carbon sequestration in agriculture and forestry
(VI)	Promoting ***social inclusion***, poverty reduction and economic development in rural areas	Facilitate diversification, creation of new small enterprises and job creation Promote local development in rural areas Enhance accessibility to, and use and quality of ICT in rural areas

Member States may additionally include within their development programmes thematic sub-programmes to address specific needs identified and, amongst others, those in relation to the creation of short supply chains, given their commitment with sustainability (e.g. logistics optimization, packaging and loss reduction) and local viability:

> *"a supply chain involving a limited number of economic operators, committed to co-operation, local economic development, and close geographical and social relations between producers, processors and consumers"* (Reg. 1305/2013, art. 2)

With this interpretation it is once again loosen the acceptation of short supply chains as the organisation component, proper of the Malassis school; framing them within a context of geographical proximity and social relations amongst actors, determines a possible general adjustment to consumers' demand, needs and requirements, in terms of diversification strategies and multifunctional agriculture. At the same time the enhancement of food with specific characteristics, accordingly to expectations and needs of consumers, is undoubtedly encouraged by labelling, certification systems and geographical indications that clearly enable the recognition of products. The participation of farmers in quality schemes is considered important from the sustainability point of view: the possibility in ensuring the compliance with qualitative, process, product and environmental standards is certainly a relevant element for this. Along with certification schemes proposed at national and European level, further governance instruments regulate both the distribution and marketing of food products in the private retail sector, from private international certifications (GLOBALGAP, BRC, IFS), to ISO and private standards. These latter provide a traceability system much deeper and more effective than that required by current legislation, asking for a traceability of the supply chain and product that goes beyond what stated by Reg. 178/2002.

Fresh, seasonal, local food attributes are more often associated with authentic and quality food; favouring this type of production, as suggested by interventions included in the RDP (Table 12), relies on their exploitation, which can be further underpinned by brands and labels: they allow on one hand the immediate recognition of the product and on the other to associate it with the characteristics of quality, or better perceived quality. In fact, the organic certification is not related to the final product, but rather it ensures the adoption of a specific production process: the compliance with standards and production regulations needed to get the certification increases most of all the intrinsic qualitative and ethic value of products. The promotion of short supply chains - and direct sales in particular - acts as a proper instrument for marketing organic and integrated-farming products *(Aguglia, 2009).* These strategies and commercialization channels, though recognized as important at Community level, are however more often regulated locally.

In this sense, it is given as example Italian initiatives undertaken since 2001 for regulating direct sales operated by farmers. Legislative Decree 228/2001 regulates the direct retail sale of agricultural products, with respect to food safety and traceability, through agritourism activities, e-commerce and farmers' markets. With subsequent further actions in 2006 (L. 296/2006), the development of these latter has been facilitated once again by recognizing the key role of municipalities in setting up new markets in public and private areas, and in their promotion.

Similarly, Italian legislation has also framed the phenomenon of Solidarity (or Ethical) Purchasing Groups, born as spontaneous initiatives of consumers. L. 244/2007 in fact establishes their specific definition, but does not provide any further related regulation. Rather, quite a few integrations have been adopted at regional level, through the introduction of specific supporting measures: the Umbria Region, with the Regional Law 1/2011, has prepared a support scheme that provides for their definition, the formal constitution of groups into associations, the establishment of a register, the possibility for municipalities to grant SPG operative places and economic contributions.

Still at European level, RDP determines the possibility of supporting a community of economic subjects operating in the territory. Undertaken actions mainly refer to the integration of supply chain as a practical tool for local development:

"the support to co-operation in the supply chain, either horizontal or vertical, as well as to promotional activities at local level, shall favour the economically-rational development of short supply chains, local markets and food distribution structures at local level" (RDP proposal, 2011)

This results in favouring participative instruments for the exploitation of local systems and their resources, as well as for the creation and strengthening of local governance.
As part of the RDP 2014-2020, food chain organization is realised into the *integrated supply-chain projects (ISCP)* and further supported by the Union through specific measures (Table 12), amongst which:
- the setting up of producers groups and organisations (newly introduced);
- the co-operation, which promotes the creation of any form of co-operation between at least two subjects, as long as the creation of poles and networks and the constitution and management of *European Partnership for Innovation (EIP)*. Interventions related to this measure have been revised and strengthened, in order to stimulate innovative actions responding to the different specific economic and territorial conditions;
- the LEADER initiative.

This latter approach is a constant of the different RDP programming periods. Thus, innovative pathways and attitudes have been implemented during time, in a participated and shared perspective amongst actors of the territory, in order to affirm local models of development and exploitation of local resources. The territorial context eligible for the LEADER approach is more often related to intermediate rural areas and disadvantaged areas, where the constitution of public-private partnership in the form of *Local Action Groups (LAG)* tries to solve limitations and weaknesses of the socio-

economic local system. Amongst similar options to enhance the local context, the possibility offered by Italian legislation to create consortia of public and private subject under the form of agricultural district. Despite no explicitly contemplated by the RDP, especially the form of rural district is recognized as an instrument for local governance[8]. Similarly, the district model is based on multi-level governance that ensure the linkages of local initiatives

Finally, it must be considered the rising interest of many cities around the world in developing their own food policies, programmes and planning[9] (an extract of which is reviewed in Table 1), targeting at the combination of sustainable development, food security and social innovation. In the context of urban food strategies, short food chains are more and more taken into account as instruments to promote the relocalisation of food production, even supported by the arise of new awareness in the public opinion and the enhanced relations between the city and the country.

[8] Decision of European Commission C (2008) 7843 10 December 2008 10/12/2008), which has given consent to granting of state aid for the implementation of contracts for district (farm and district contracts).

[9] On 15th October 2015 Milan Urban Food Policy Pact was signed by the Majors of 116 cities all over the world, which "*will work to develop sustainable food systems develop sustainable food systems that are inclusive, resilient, safe and diverse, that provide healthy and affordable food to all people in a human rights-based framework, that minimise waste and conserve biodiversity while adapting to and mitigating impacts of climate change" (http://www.foodpolicymilano.org/il-testo-del-milan-urban-food-policy-pact/).*

Table 12: interventions related to the achievement of the sub-program concerning short food chains in RDP 2014-2020 (*Reg. 1305/2013, annex IV*).

Article	Measure code	Actions
Art. 14 - ***Knowledge transfer and information actions***	M1	*"Support of vocational training and skills acquisition actions, demonstration activities and information actions"*
Art. 15 - ***Advisory services, farm management and farm relief services***	M2	Initiate advisory services and actions targeted to land managers, related to the priorities of rural development, as well as to the economic and environmental performance of farms, including aspects concerning their competitiveness
Art. 16 - ***Quality schemes for agricultural products, and foodstuffs***	M3	Support new participation by farmers and groups of farmers in quality, farm certification and voluntary agricultural product certification schemes
Art. 17 - ***Investments in physical assets***	M4	*"Support [...] tangible and/or intangible investments which [...] concern the processing, marketing and/or development of agricultural products"*
Art. 20 - ***Basic services and village renewal in rural areas***	M7	*" [...] drawing up and updating of plans for the development of municipalities and villages in rural areas and their basic services"*
Art. 27 - ***Setting up of producers groups and organisations***	M9	*"Facilitate the setting up of producer groups and organisations [...] for the purpose of (a) adapting the production and output of producers [...] to market requirements, (b) jointly placing goods on the market [...]"*
Art. 35 - ***Co-operation***	M16	*"Promote forms of co-operation [...] related to [...] (d) horizontal and vertical co-operation among supply chain actors for the establishment and the development of short food supply chains and local markets; (e) promotion activities in a local context relating to the development of short supply chains and local markets"*
Art. 42 - ***LEADER local action groups***	M19	Additional tasks for Local Action Groups, other than those referred to in Art. 34 of Regulation (EU) no. 1303/2013
Art. 43 - ***LEADER start-up kit***		*"Support for capacity building and small scale pilot projects"*
Art. 44 - ***LEADER co-operation activities***		Support of co-operation projects from the ESI Funds for community-led local development

Source: own elaboration based on *Reg. 1305/2013, Annex IV*

CHAPTER IV

ANALYZING AGRO-FOOD SYSTEMS: METHODOLOGICAL APPROACHES

While many of analyses of local or regional systems pay their attention to their territorial component (*D'Amico et al., 2013; van Eupen et al., 2012*) or to ecological issues (*Sun et al., 2010*), the interest in agricultural systems generally focuses on the adoption of two main criteria to define their performances, namely *(a)* the use of productive factors (*Ezcurra et al., 2010; Hernandez-Rivera and Mann, 2008*) and *(b)* the agricultural output dimension, productivity (*Arsenault, 2015; Serrao, 2003*) and diversity (*Remans et al., 2014*). Both of them however, do not take into account the simultaneous combination of performance indicators, nor aspects related to supply-demand dynamics for resources. At the same time, the analysis of adequacy of specific administrative areas in responding to boosts for reconnection is, as such, quite neglected. Foodshed analyses and the estimation of the food self-sufficiency level (better described in the subsequent paragraphs), which more properly address this issue, are more often limited to a spatial or a quantitative analysis focused on a single product, and not on the diet as a whole; this results in a specific element, whether land, mass, nutritional content or even micronutrient, with moreover a scarce interest in the economic component.

This latter topic is indeed much more perceived as related to national trade balance, as demonstrate by studies of international agencies (e.g. FAO). In this way, they indirectly classify Countries as

net importers or exporter, even for specific staple foods and food products, without however studying in depth the interrelations amongst food sovereignty, dietary requirements and international or interregional trade, as *Billen et al. (2015)* did. Using FAO balance sheets, *Porkka et al. (2013*) classified Countries based on their level of food availability, self-sufficiency and trade in terms of per capita caloric supply, production and export. Once again different aspects don't serve for a comprehensive classification of Countries, but they are rather analysed individually.

4.1 The concept of "foodshed"

The term "foodshed" was defined for the first time in 1929, as the geographic area that encompasses the flow of foodstuffs from their origin to consumer markets, driven by economic principles (*Hedden, 1929*). The concept clearly refers to the "*watershed*", as both are portions of territory where resources are conveyed to nourish the region itself.

Nonetheless, a foodshed is not limited only within spatial boundaries and geographic limits, due to the dual nature lying on the concept itself: it brings together cultural and natural aspects, expressing the coexistence of society and nature (*Kloppenburg et al., 1996*), and derives and interacts with the wider context it is located in. It could be then meant as an agro-food system that develops in and insists on a specific area, and in this sense it comprehends all the elements needed to feed population. The foodshed is strongly affected by social, political, economic and environmental contexts (*Qazi and Selfa, 2005; Winter, 2003; DePuis and Goodman, 2005*) and it is better defined as "*a socio-geographic space*" (*Kloppenburg et al., 1996:37*), with a site-specific definition and depending on a territorial component and a socio-economic and relational one. In fact, the geographic and demographic component generating food demand and supply, is linked to land use, urbanisation trend, infrastructural network, agro-climatic conditions, resource availability and quality. These elements interact with a context made of relations built up by different actors involved in the agro-food system.

Permaculturist Arthur Getz (*1991*), in providing a further definition of the foodshed, considered where the food is coming from and how it gets there, or, in other words, the connection between food and its source. On this basis he hypothesized that the "*most rudimentary map of a foodshed might cover the globe*" (*Getz, 1991:26*), like an octopus which tentacles represent extensive global food chains. In fact, in a globalised world, the transfer of agricultural commodities and food products cross the oceans and are distributed in every continent. Getz is pointing here at the fact that GAS have pushed the boundaries of the term foodshed – originally associated with a bio-geographic food-supply region – to encompass the whole world.

4.2 The footprint of food: the "foodprint"

According to Asher (*2001*), a city is not able to feed entirely its population using its own resources; this capacity is actually of the surrounding less urban and rural areas. What initially developed by Von Thünen (*1826*) was meant to describe this relation: he developed an economic-geographic model, arguing that a city tends to be surrounded by several concentric rings within which livestock and agricultural activities providing food are concentrated. Nowadays, the distribution of different activities moving away from the city is changed, but not the dependence, at least in part, on rural areas.
It however must be pointed out that such a relation is affected by various trends occurring in the urban context. In fact, a rising urban growth determines a parallel increase in population needs and in demand for resources, altering the "metabolism" of a city (*Wolman, 1965; Kennedy et al., 2007*). With this trend occurring, resources become more and more limited and limiting and boundaries of supply areas consequently extend, also due to increased commercial trades and improvements in transportation (*Swaney et al., 2012*). The interaction among these factors is the basis for the determination of spatial limit and shape of a city, but at the same time it determines an augmentation in the amount of the demand for resources and in the area required to meet them. This assumption reminds to the

original definition of "foodshed" by Hedden (*1929*), but, in relation to what introduced, some clarifications must be given.
Under the name of "foodshed analyses" several studies and methods can be found (*Horst and Gaolach, 2015*), actually focusing on what is assumed to be the spatial dimension of agricultural land around the city needed for feed population (*Galzki et al., 2014; Peters et al., 2009*), and not on the foodshed as a real bordered region. Thus, most of them aim at studying and estimating the potential of agricultural production needed for the city, rather than specific metropolitan regions and their actual production of food (*Swaney et al., 2012*). This leads to slightly diverge from the classic estimation of a foodshed extent, but rather introduces an approach more similar to what Billen et al. (*2009*) identified as "*foodprint*". This definition can easily recall the ecological footprint (EF) (*Wackernagel and Rees, 1996*), but it differs from this latter concept both semantically and from the methodological point of view. The EF expresses the amount of global hectares needed to produce the consumed resources, not only food, under prevailing world technology and according to carrying capacity. This results in the estimation of the productive land population insists on, even if it does not coincide with the effective land (*Bagliani et al., 2001*). On the contrary, the foodprint approach allows better catching the relationships and the flows of foodstuffs between city and suburbs. This concept is used to describe and quantify the effective area of the surrounding territory required to meet urban demand or produce agricultural goods, with current farming techniques.

4.3 Assessing food demand and supply: state of the art

The capacity of local urban systems in provide required amounts of food, is something literature has been variously exploring. Such analyses, based on the comparison between food supply and demand, operate in relation to land use and investigate the role of urban and peri-urban agriculture in providing food to the city, estimating at what extent they are able to do this. In other words, it is differently expressed the capacity of an urban area to produce, within its physical boundaries (*Morris, 1987*) and with its own resources,

enough food for people living there (*Mok, 2014*) fulfilling food demand (*Timmons et al., 2008*). A rich literature concerns with this topic, tackled in several contexts according to different, though interrelated, models of analysis (Figure 13):

(a) *demand-based models*
(b) *supply-based models*
(c) *demand-supply models*

		DEMAND	
		Actual	Potential
SUPPLY	Actual	***Case c: DEMAND-SUPPLY MODELS*** *FROM* food requirements and agricultural primary products, *TO* coverage of food requirements by local productions	***Case b: SUPPLY-BASED MODELS*** *FROM a*vailable land *TO* people potentially fed by regional agricultural productions
	Potential	***Case a: DEMAND-BASED MODELS*** *FROM food requirements TO foodprint*	Not feasible

Figure 13: approaches for analysing demand-supply relations

Demand-based models. Starting from actual food consumption, this kind of models aims at quantifying the agricultural area needed to obtain such amounts of food. Concerning this approach, *Gerbens-Leenes et al. (2002)* quantified for the Netherlands the specific land requirements per food item in a step-by-step approach, from primary production to the national level. Further on, it is demonstrated that the higher is the level, the more land is required (*Gerbens-Leenes and Nonhebel 2002)*. The same method was adopted by *Zhen et al. (2010)* to analyse land requirements per household in a Chinese district, at two different geographical levels.
Desjardin et al. (2010), in their study for Waterloo Region, Canada, estimated the amount of locally grown products needed to meet population nutritional requirements and expressed them with the land that potentially supplies these productions. Similarly, the assessment of local supplying capacity of Detroit (*Colasanti and*

Hamm, 2010) allowed deepening the capability of local urban agriculture and food production in meeting recommended dietary intake of fruits and vegetables.
It certainly to be mentioned what *Billen et al. (2009*) introduced for the Parisian area with regard to the calculation of its foodprint. The methodology proposed is based on the examination of nitrogen flows: authors firstly analysed if the regions surrounding the Capital city have the ability to meet the urban demand of nitrogen-containing food products, secondly the quantification of the respective area extent is given. A similar analysis was conducted by *Billen et al. (2012),* who estimated the excess of production over local consumption and individuated the effective location of areas participating in Paris food supply.
This group of models also includes scenario analyses. Different nutritional conditions, i.e. different total caloric intakes, were considered by *Darrot et al. (2011)* in their investigation of the available land within the city of Rennes, France, and its productive potential to meet food requirements. Authors drew up a simplified food balance, on which basis they calculated and defined the radius of the area around the city potentially needed to meet urban food consumptions. *Menconi et al.* in 2013 provided a model for determining the area needed in a central Italian context to ensure food self-sufficiency, according to various components, represented by the annual quantities needed to satisfy individual nutritional requirements. More recently, *Billen et al. (2015)* focused on the estimated world population in 2050 and assessed the possibilities of 12 macro-regions of meeting protein requirements, according to various combination drivers related to human diet, regional livestock production and crop fertilization intensity.
A further scenario analysis was made through the ALBIO model (*Wirsenius et al*., 2010) to calculate land area and crop production necessary to provide levels of consumption consistent with dietary changes and increasing livestock productivity in 2030.

Supply-based models indicate the number of people that can be fed with current or future food supply. Realistically, being a city not able to provide resources within its own boundaries, *Porter et al.*

(2014) considered the necessary dependence on productions from remote landscapes. In this sense the authors applied and compared in a time series of three years a methodology for the quantification of food balance, based on five single commodity consumption and production patterns, but also on imports and exports. The analysis finally resulted in the comparison of food self-provisioning across the capital regions of Tokyo, Canberra and Copenhagen, and in the quantification of land required to ensure local consumption of wheat from local sources. More recently *Cassidy et al. (2013)* re-thought the issue of agricultural productivity, shifting the focus from tonnes per hectare to people fed per hectare; their study demonstrates that an agriculture totally intended for food would increase caloric supply by 70% and feed additional 4 billion people.

Demand-supply models. These approaches are based on the comparison between the actual dimensions of food supply and demand, expressing this relation through the concept of "self-sufficiency".

In the vast literature concerning with this issue, the conceptual framework follows the food self-sufficiency as one of the principles of food security in relation to trade and trade policies (*Chandra and Lontoh, 2010*). In this sense, self-sufficiency generally emphasizes the production of various food items, largely relying on domestic production rather than on international marketplace. It is therefore possible to make a first distinction of such methodological approaches in relation to the region of the world that are applied to.

In Developing Countries the food self-sufficiency has been considered a policy objective (*Rask and Rask, 2011*) and an instrument of economic policy strongly linked to country food sovereignty (*Van Oort et al., 2015; Warr and Yusuf, 2014; Diagne et al., 2013; Mosavi and Esmaeili, 2012*). In these contexts the self-sufficiency level of single food items has been analyzed in relation to the use of resources (*Bucago et al., 2014; Hassan et al., 2000*), its determinants and drivers (*Diagne et al., 2013; Gebeltova, 2012*), its variation due to structural modifications of the agricultural, political, economic and demographic context (*Srairi et al., 2013; Gebeltova, 2012; Simelton, 2011; Mahamet, 2006*), as well as for deepening the

role of cropping systems (*Marten and Abdoellah, 1988*).

In developed countries, the interest on the quantification of this capacity is instead more distinctly related to the enhancement of the local agricultural system, whose vitality is more often compromised by several, already aforementioned, phenomena that undermine its potential; at the same time, it represents an element with a growing demand from consumers and arisen food movements, and can support the implementation of territorial policies consistent with the requirements expressed by the context itself.

In this sense, several studies deepen the capacities of regional agricultural systems, through the quantification of a self-sufficiency index defined as the supply-demand ratio, as *Ostry and Morrision* did *(2013).* In the work of *Atamanova* (2013) this index is instead defined "self-efficiency" and, along with other indicators provided, it is only one of the elements for the evaluation of food sufficiency with dairy products in the Russian region of Bryansk.

Another study to be taken into account is that of *Giombolini et al. (2011),* who compared offered servings to total recommended dietary requirements for population, providing the percentage of dietary needs met; *Mohanty et al. (2010)* proposed the comparison between requirements and actual production of grains in the Indian district of Orissa, both quantitatively and through a sufficiency factor, as long as the area required to be cropped. Cropland use associated with dietary patterns has been determined by *de Ruiter et al. (2014),* who combined food availability at household level with land use data for food in a range of 16 European countries.

Such analyses are also aimed to assess the potentialities and the role of the local agricultural systems. *Sali et al. (2014a)* and *Corsi et al. (2015)* proposed a simplified food balance to determine the possibility for metropolitan regions of Ljubljana and Milan and Paris respectively, to be fed by proximity agriculture. *Filippini et al. (2014)* analysed the role of peri-urban livestock farms in the urban region of Pisa in fulfilling urban demand for meat, according to potential, current and actual supply and results of on-farm surveys, calculating the food production capacity of the system. *Knight and Chopra* (*2013*) instead considered the local food capacity for public funded institutions in Nova Scotia, Canada, expression of consumptions as a

percentage of production.

Griffin et al. (*2015*) has recently introduced the concept of "regional self-reliance"[10] and analysed the ability Northeast US regions in satisfying food requirements of their resident populations. Previously *Herrin and Gussow (1989)* determined the level of Montana food self-reliance starting from production and consumption data from marketing and national surveys. The study shows how self-reliance declines over time, but a varied diet and the preference for seasonal products would lead to find locally more food resources. Finally, matching current policies, available area and vacant lots, yield and food consumption, *Grewal and Grewal (2012)* developed three scenarios to estimate the potential level of self-reliance of Cleveland, U.S.A. This capacity is not only expressed by weight, but the expenditure in total food and beverage consumption has been considered as well, leading to economically quantifying the annual retain due to self-reliance. This study represents one of few works considering the economic dimension of self-sufficiency, as this aspect still remains unexplored.

[10] Food "self-reliance" focuses on the availability of food items and thus considers international trade as a fundamental component of food security strategy (*Chandra and Lontoh, 2010*). However, being this dimension not considered in quoted works, in this review it is assumed to have the same meaning of "self-sufficiency".

Table 13: supply-demand analysis approaches: a review

Approach	Author(s)	Scale and geographical level		Aim
Demand-based	*Billen et al., 2015*	World	Macro-regions	Possibilities in meeting protein requirements, according to various combination drivers related to human diet, regional livestock production and crop fertilization intensity
	Menconi et al., 2013	Central Italy	Rural settlements	Determine the area needed to ensure food self-sufficiency of a settlement for 15 commodity groups while varying the number of components and the diet followed
	Billen et al., 2012	Paris	Regional	Estimation of the excess of production over local consumption and individuation of the effective location of areas participating in Paris food supply
	Darrot et al., 2011	Rennes	City	Productive potential of local available land to meet food requirements
	Colasanti and Hamm, 2010	Detroit, MI, U.S.A.	City	Local supplying capacity in meeting dietary intake of fruits and vegetables
	Desjardin et al., 2010	Waterloo Region, Canada	Region	Land needed to meet nutritional requirements
	Wirsenius et al., 2010	World	Macro-regions	Land area and crop production needed to provide levels of consumption consistent with dietary changes and increasing livestock productivity in 2030

[continued]

Approach	Author(s)	Scale and geographical level		Aim
	Zhen et al., 2010	China	District	Land requirement per food-item in a step-by-step approach at household-level
	Billen et al., 2009	Parisian area	Region	Land needed to meet the urban demand of nitrogen-containing food
	Gerbens-Leenes and Nonhebel, 2002	Europe	14 Countries	Specific land requirements per food item
	Gerbens-Leenes et al., 2002	The Netherlands	Country	Land requirement per food-item in a step-by-step approach
Supply-based	*Porter et al., 2014*	Tokyo, Canberra and Copenhagen capital regions	Region	Estimation of food self-provisioning and quantification of local land required to ensure local consumption of wheat from local sources
	Cassidy et al., 2013	World	Country	Determine the amount of human-consumable calories produced across the world
Demand-supply	*Corsi et al., 2015*	Milan and Paris metropolitan regions	Regional and municipal	Simplified food balance and estimation of self-sufficency at diet level
	Griffin et al., 2015	North-East US regions	Federal State	Level of regional satisfaction of food requirements
	de Ruiter et al., 2014	Europe	16 Countries	Determine the cropland use associated with dietary patterns

[continued]

Approach	Author(s)	Scale and geographical level		Aim
Demand-supply	*de Ruiter et al., 2014*	Europe	16 Countries	Determine the cropland use associated with dietary patterns
	Filippini et al., 2014	Pisa urban region, Italy	Region	Urban food production capacity in fulfilling demand for meat
	Sali et al., 2014a	Ljubljana metropolitan region	Regional and municipal	Simplified food balance and estimation of self-sufficiency at diet-level
	Grewal and Grewal, 2012	Cleveland, OH, U.S.A.	City	Scenario analysis to estimate the potential level of self-reliance and the related annual retain
	Giombolini et al., 2011	Willamette Valley, OR, U.S.A.	Sub-regional	Percentage of dietary needs met based on offered servings and total recommended dietary requirements
	Mohanty et al., 2010	Kandhamal district, Orissa, India	Sub-regional	Comparison between requirements and actual production of grains (quantity, sufficiency factor, area to be cropped)
	Herrin and Gussow, 1989	Montana, U.S.A.	Federal State	Level of food self-reliance starting from production and consumption data from marketing and national surveys

4.4 The analysis: methodological aspects

In deepening the opportunities for a specific region to reconnect and readjust food supply and demand, the necessity for a proper cognitive instrument is absolutely encouraged. This way, preliminary analyses and assessments of the context are essential in getting information on current, and future as well, capacities of regional agro-food systems. In this sense, the adoption of a methodological and territorially-based approach serves as a tool to provide results and indications even to support policies and interventions in the agro-food sector.

A proposal: performance indexes

Though evidences in the possibility to differently assess the productive features of agro-food systems, this issue is mainly tackled from a single point of view, typically the quantitative or the nutritional aspect, without they are considered together. It then lacks a repeatable methodology that focuses simultaneously on different aspects and can be used as an analysis tool whose results may drive policy makers in adopting proper interventions in the food and agro-food sector, even contributing to draw territorial food policies.
In this regard, the characterization of the agro-food system of a metropolitan area should be aimed at assessing the possibility to bring food supply closer to demand, either in quantitative, qualitative and spatial terms. A multidimensional perspective represents an adequate approach to describe such a relation (
Table [14]). The simultaneous assessment of multiple dimensions in fact allows obtaining precious information on the quality of the agro-food system as a whole and on its capacities in meeting the regional food requirements.

Table 14: the conceptual framework

Aspect	Description	Research question
Quantitative	Compliance with food habits	*Are the quantities of primary products enough to meet their respective demanded amounts?*
Nutritional	Level of nutritional adequacy	*Does production ensure adequate caloric intakes?*
Economic	Economic balance	*Does the productive system generate a positive economic balance?*

The research questions are addressed through the quantification of a specific element, based on the comparison between food supply and demand, variously expressed, at staple food-level. Both these dimensions, as evident in and better described in the next paragraphs, are in fact converted into proper unit of measures, to better respond to the questions related to the aspects taken into account.

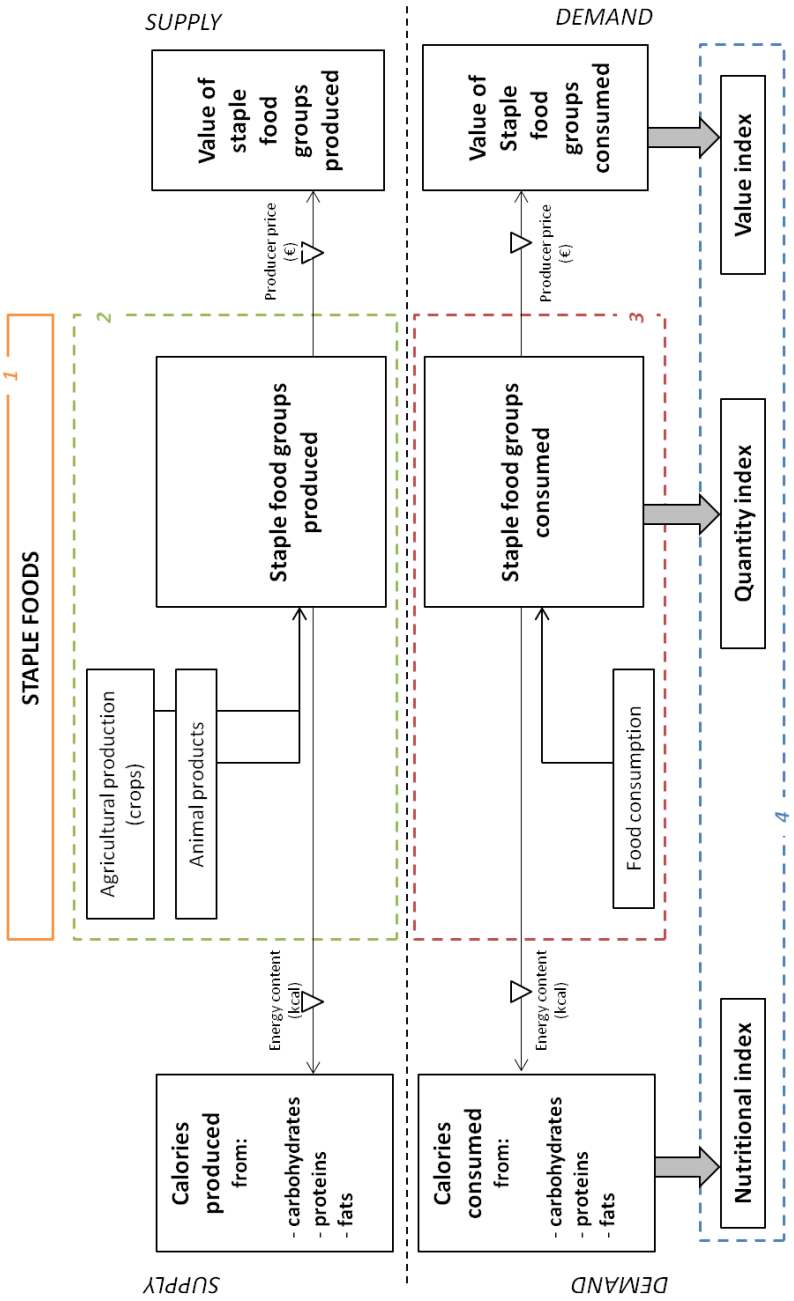


Figure 14: the methodological framework consists of the sequential steps of 1. identification of staple foods, 2 analysis of supply, 3 analysis of demand, 4. indexes calculation

Identification of staple foods

The first step of the approach consists of the identification of agricultural primary products to be considered in the subsequent phases of the analysis. The choice of proper staple foods relies on the necessity to ensure the linkages with the local agricultural context: food of non-agricultural (fish and water culture products) and non-local origin (coffee, tea, cocoa and similar) have been excluded, as long as those not strictly affecting and related to agricultural land use (i.e. fungi and honey). The primary products thus identified (Table 15) have played as benchmarks to which both local food supply and demand have been traced back.

Table 15: primary agricultural products considered in the analysis

Cereals	Wheat (*Triticum aestivum* and *Triticum durum*) Barley (*Hordeum vulgare L.*) Oats (*Avena sativa*) Maize (*Zea mays L.*) Rice (*Oryza sativa L.*) Other cereals [unspecified]
Oil plants	Rape (*Brassica napus oleifera*) Sunflower (*Helianthus annuus L.)* Olive (*Olea Europaea L.*)
Vegetables	Vegetables [brassica, bulb, fruiting, leaf, legume, root and stem vegetables; *unspecified*] Dried pulses [legumes, beans, dried] [unspecified]
Potatoes	Potatoes (*Solanum tuberosum*)
Fruit	Fruit [berries and small fruits, citrus fruits, pome fruits, stone fruits, tree nuts; *unspecified*]
Wine grapes	Wine grapes (*Vitis vinifera L.*)
Animal production	Eggs Milk Meat (beef, pig and poultry meat)

Analysis of food supply

The quantitative analysis of local food supply is based on the current production pattern, as surveyed in National statistics (*ISTAT, 2010*). Two different approaches have been adopted to quantify the supplied amounts of food products, according to their origin.
In particular, the supplied amounts of foods of plant origin S is determined by combining the extent of agricultural area (a) and the productive yield (y) of the p primary product

$$\sum_p S_p = \sum_p (a_p * y_p) \quad \text{(eq. 1)}$$

$$\sum_f S_{p,f} = \sum_{f,p} (a_p * y_p), \quad \text{(eq. 2)}$$

Concerning animal production, the supplied amount of each b animal product depends on the function B

$$\sum_b S_b = \sum_b S\,(B)\,, \quad \text{(eq. 3)}$$

in turn based on the combination of animal heads, productivity per head and slaughtering yield:

- if b = "dairy products"

$$S_b = dc * um \quad \text{(eq. 4)}$$

where
dc number of dairy cows
um the average yearly production of milk per head;

- if b = "meat products"

$$S_b = su_{br} * sy_{br} * w_{br} * gp_{br} + \sum_l (su_l * sy_l * w_l * gp_l) + \sum_m (su_m * sy_m * w_m * gp_m) \quad \text{(eq. 5)}$$

where
su number of animals for slaughter or fattening, with *br*

broilers, l beef cattle and m pigs
sy is the average yield at slaughter
w average weight per head
gp number of growing periods per year;

- if b = "eggs"

$$S_b = ly * w_{egg} * ue \quad \text{(eq. 6)}$$

where
ly number of laying hens
w_{EGG} the weight of an egg
ue the number of eggs per hen

Analysis of food demand

Food consumption pattern has been adopted as a proxy of food demand. Accordingly, its quantitative dimension relies on the quantity of food consumed by adult population, as collected in the EFSA chronic food consumption database (*EFSA, 2011*). It associates the age class with the respective daily food consumption broken down into subcategories (s) (Table 16).

Demanded quantities of each subcategory have been traced back to the respective p staple food previously associated with them, and quantified according to the specific consumption (C), population numerousness (n) in the region and, where necessary, to a suitable conversion factor (ty_s) that expresses how much of the raw product is contained in the final product:

$$C_p = \sum_s C_s * \ ty_s * \ n \qquad \text{(eq. 7)}$$

A further aggregation of primary products into the main f food groups of *i)* cereals, *ii)* fruit, *iii)* vegetables, *iv)* potatoes, *v)* oil plants, *vi)* wine grape, *vii)* sugar beets, *vii)* milk, *ix)* meat and *x)* eggs, has led to quantify their respective food consumptions:

$$C_f = \sum_p C_{p,f} \qquad \text{(eq. 8)}$$

Table 16: Steps of food demand analysis. From final to primary product using EFSA database.

FOOD SUB-CATEGORY (s)	PROCESSING YIELD (ty)	STAPLE FOOD (p)	STAPLE FOOD GROUP (f)
Bread and rolls Fine bakery wares Grain milling products	*Milling yield* *Yield to bread*	Soft wheat	CEREALS
Pasta (raw) Grain milling products	*Milling yield* *Yield to pasta*	Durum wheat	
Beer and beer-like beverages	*Beer-making*	Barley	
Breakfast cereals	-	Oats Maize	
Grains for human consumption Breakfast cereals Rice-based meals	*Yield to paddy rice*	Rice	
Cereal-based dishes	*Minimum content of primary product*	Other cereals	
Vegetable oils [unspecified] Oilseed	*Oil making*	Rape Sunflower Olive	OIL PLANTS
Berries and small fruits Citrus fruits Dried fruits Fruit juice Fruit nectar Jam, marmalade and other fruit spreads Miscellaneous fruits Mixed fruit and vegetable juice Mixed fruit juice Other fruit products (excl. beverages) Pome fruits Stone fruits Tree nuts Cider	*Minimum content of primary product*	Fruit	FRUIT
Brassica vegetables Bulb vegetables Fruiting vegetables Leaf vegetables Legume vegetables Legumes, beans, green, without	*Minimum content of primary product*	Vegetables	VEGETABLES

FOOD SUB-CATEGORY (s)	**PROCESSING YIELD (ty)**	**STAPLE FOOD (p)**	**STAPLE FOOD GROUP (f)**
pods Prepared salads Ready-to-eat soups Root vegetables Stem vegetables (Fresh) Vegetable products Vegetable juice Vegetable-based meals			
Legumes, beans, dried	-	Pulses	
Potatoes and potatoes products	-	Potatoes	POTATOES
Molasses and other syrups Sugars	*Yield to sugar*	Sugar beets	SUGAR BEETS
Fortified and liqueur wines Wine	*Wine making*	WINE GRAPE	
Animal fat Cheese Concentrated milk Cream and cream products Fermented milk products Liquid milk	*Yield to butter and cheese; minimum content of primary product*	MILK	
Eggs	-	Eggs	EGGS
Livestock meat Meat-based meals	*Slaughtering yield*	Beef meat	MEAT
Poultry Meat-based meals		Poultry meat	
Preserved meat Sausages Meat-based meals		Pig meat	

Performance indexes

The comparison between the two dimensions enables the quantification of the indexes related to the capacities of the regional system. In particular:

1. *The compliance with food demand* (**"Quantity index", QI).** In other words, it is revealed how much the local production pattern fits with local food habits (eq. 9), i.e. the level of regional self-provisioning, under the assumption that each p staple food cannot replace one another (eq. 10):

$$1 - \frac{\sum_p (C_{p,f} - S_{p,f})}{\sum_p (C_{p,f})} \quad \text{(eq. 9)}$$

$$\text{for any } p \text{ for which } (C_{p,f} - S_{p,f}) > 0 \quad \text{(eq. 10)}$$

2. *The level of food security* ("**Nutritional index", NI).** It provides indication on how much the local agricultural system can satisfy the dietary caloric intake (eq. 11). In this case, calories are not interchangeable: the caloric surplus from an origin is not suitable to compensate the deficit of other origin, if any (eq. 12)

$$1 - \frac{\sum_o (KC_o - KS_o)}{\sum_o KC_o} \quad \text{(eq. 11)}$$

$$\text{for any } o \text{ for which } (KC_o - KS_o) > 0, \quad \text{(eq. 12)}$$

where

$$KS_o = \sum_p (S_p * K_p * P_o) \quad \text{(eq. 13)}$$

$$KC_o = \sum_p (C_p * K_p * P_o) \quad \text{(eq. 14)}$$

with KS_o and KC_o respectively the amounts of supplied and consumed calories from the o energy source (i.e. carbohydrates, fats, proteins), K_p the energetic rate of the primary product and

P the percentage of the energetic rate imputable to each o source.

3. *The agricultural value at production-level* ***("Value index", VI).*** A simplified economic balance of the metropolitan agro-food system which aims at assessing the capacities of a territory in finding within its own boundaries what it is needed for fulfilling food demand. It is obtained by summing all quantities of each raw product multiplied by their respective producer prices (PP_p) (eq. 15):

$$\frac{\sum_{p,f}\ (S_{p,f} * PP_p)}{\sum_{p,f}\ (C_{p,f} * PP_p)} \qquad \text{(eq. 15)}$$

In addition, the economic dimension of agricultural production allows the identification of a criterion for the classification of the system itself, according to the simultaneous analysis of specific quantitative elements. The comparison of the economic dimension of both agricultural production and food consumption, in fact allows better highlighting the relations between them and their ties with the territory:

4. *Agricultural economic balance at production-level.* The supply-demand ratio (eq. 16) indicates the economic balance (namely, the deficit or the surplus) of each food group:

$$EB = \frac{\sum_f (S_{p,f} *\ PP_p)}{\sum_f\ (D_{p,f} *\ PP_p)} \qquad \text{(eq. 16)}$$

5. *Market orientation of food categories* (eq. 17). From a quantitative point of view, it derives from the comparison between their relative importance on both the supply from the agricultural sector as a whole (eq. 18), and the demand (eq. 19) side

$$MO = \frac{RIS}{RID} \qquad \text{(eq. 17)}$$

$$RIS = \frac{\sum_f \left(S_{p,f} * PP_p\right)}{\sum_{p,f}\left(S_{p,f} * PP_p\right) + \sum_o S_o * PP_o} \quad \text{(eq. 18)}$$

with o the agricultural activity not related to food production (e.g. flower and nurseries cultivation, cultivation of Energy crops)

$$RID = \frac{\sum_f \left(D_{p,f} * PP_p\right)}{\sum_{p,f} \left(D_{p,f} * PP_p\right)} \quad \text{(eq. 19)}$$

revealing the prevalent orientation to global (MO ≥ 1) or local markets (MO < 1).

4.5 The simplified food balance: the results

System performances

The relation between the considered indexes leads to outline the general profile of the agro-food system, which in turn peculiarly characterizes its actual capacities and opportunities to strengthen the local dimension. In general terms, a scarce fulfilment of food demand indicates that the gap between actual and optimal capacity may be reduced by relying on primary products of non-local origin. The lacking amounts of raw materials are in fact to be necessarily sourced elsewhere or even far beyond the boundaries of the region, where likely a more complex, from both a logistic and managerial point of view, agro-food system operates.

The simultaneous combination of different aspects (expressed by equations 9, 11 and 15 respectively) helps describing the regional agro-food system on a more complex and comprehensive basis and even returns indication on its overall quality, according to the specific quali-quantitative characterization of the primary production.

At regional level, the comparison between pairs of indexes enables determining the prevailing aspect that better characterizes the primary productive system. The simultaneous analysis of both the productive and economic dimensions (Figure 15a) describes the prevalent orientation of the system in meeting food requirements rather than in strengthening the regional economic viability. Agricultural production better satisfies dietary habits from a quantitative point of view, but the compliance with the production value is scarce; conversely, a significant production value is generated without, however, totally complying with demanded food amounts. This latter is the case of a very specialized agricultural system that generally produces high-valued food products but is made not able to shape productions to the variety of commodities demanded by consumers. Actually, in presence of poorly varied production pattern, the corresponding value is mostly driven by supplied amounts, and only in second instance by the farm-gate price of staple foods: in this case the agricultural system is in fact characterized by an economic surplus primarily related to an excess of supply, which large

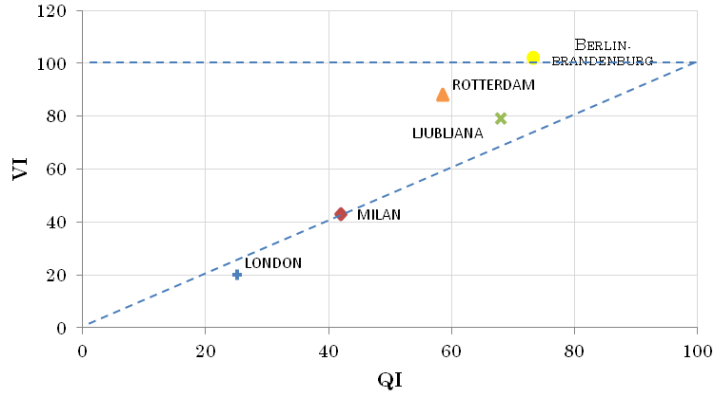
quantities produced contribute to increase the overall value.
A similar trend is to be found in the relation between nutritional and value indexes (Figure 15b). Compared to the previous case, a greater capacity in meeting the total caloric need occurs, according to the conditions the respective index is subject to: several productions, even if belonging to different food categories and with repercussions on the final total energy content, in fact contribute to the fulfilment of the caloric demand from the same energy source.
Finally, the comparison between productions and caloric provision (Figure 15c) only refers to food production, as it shows simultaneously the compliance with the dietary and the nutritional patterns. Likewise, it offers the possibility to distinguish productive systems whereby supplied staple foods, although insufficient to meet the correspondent quantitative demand, allow the provision of more caloric products, with a consequent relative higher level of compliance with energy needs.

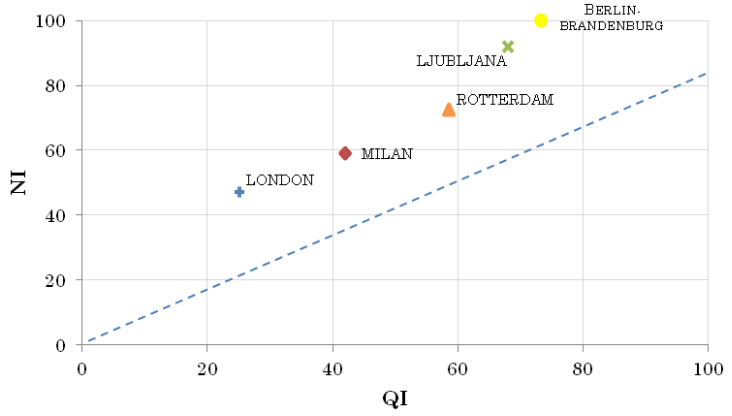
Figure 15: relation between indexes per metropolitan area

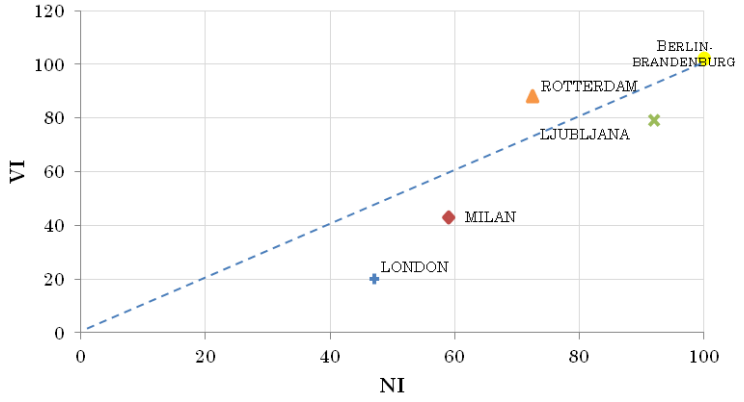
(a) Quantity and value index

(b) Nutritional and value index

(c) Quantity and nutritional index







The joint observation of all the compliance levels, demonstrates how the regional supplying capacity is able to simultaneously ensure quality, nourishing and value staple food. Conversely, agricultural production is generally variously unbalanced in complying with demand from any point of view. For instance, in MMR (Figure 16), a large amount of food (58%) is to be sourced elsewhere, while, at the same time, regional agriculture can generate a scarce value, which fails in adequately vitalize the local economy at farm-level (VI = 40%). Similarly, the specific productive pattern, based on the large amounts of highly-caloric outputs (i.e. cereals and dairy products), ensures a higher compliance with nutritional requirements.

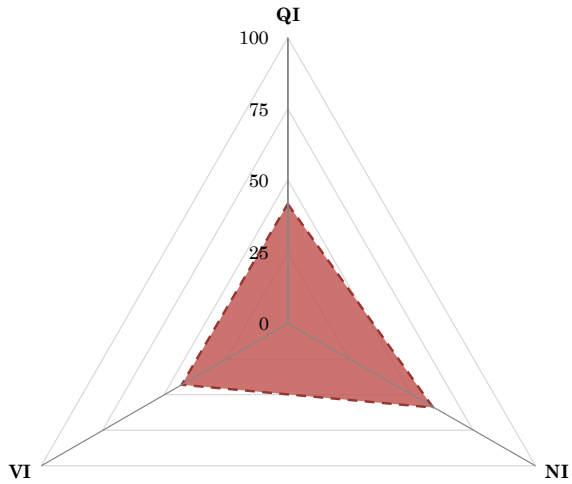


Figure 16: adequacy of agricultural production in MMR.

Given this latter condition, the nutritional adequacy not only depends on the consumed amounts, but also on what is consumed: according to its composition, it variously contributes to the total caloric intake and can unbalance the energy provision towards one or another energy source (Table 17)). The nutritional quality of

Table 17: nutritional index per Energy source in MMR

Carbohydrates	69
Proteins	63
Fats	39

food and the need of a readjustment of the production-consumption balance towards higher levels of adequacy, leads the concept of "food security" to assume a different acceptation, quite far from the recognized definition of the World Food Summit (FAO, 1996). In the global North and in Western European contexts this issue in its traditional terms scarcely emerges: even if in strongly urbanized contexts the agricultural production is traditionally scarce and limited by several factors, an efficient system of accessibility and logistics can ensure the distribution of food across regions and even Countries, with real problems of food accessibility and affordability limited to a minor part of the population.

Depending on such a combination, based in turn on the current conditions of the agricultural system, the different levels of system productivity, security and profitability are revealed. These performances are however strongly affected by both the dimension and the specific features of each region; thus, this kind of analysis undoubtedly leads to different, but peculiar results across different metropolitan regions, as shown in Figure 17.

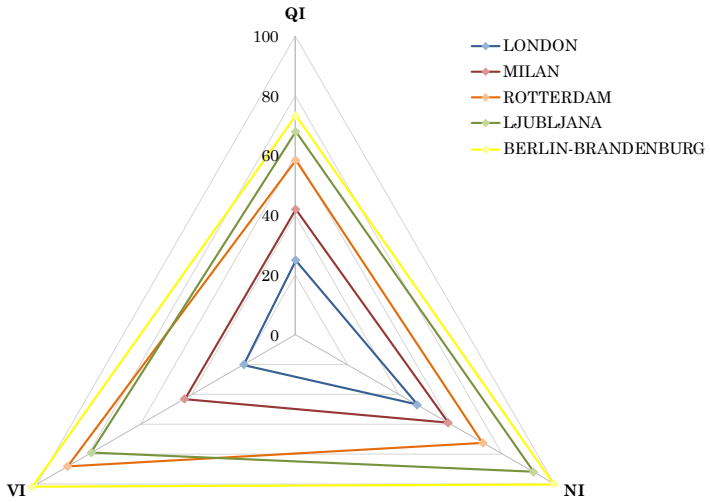


Figure 17: performances of the metropolitan case study areas of the FOODMETRES project (*Sali et al., 2015).*

Accordingly, the "quality" of agro-food systems as a whole also offers the possibility for a further comparison amongst different territories (Figure 18), through the synthetic indicator of their overall fulfilment capacities

$$A = \frac{1}{2} * \sin\frac{2\Pi}{\sum_{j=1}^{m} i_j} * \left[\left(\sum_{j=1}^{m} i_j * \sum_{j=1}^{m-1} i_j\right) - \sum_{j=1}^{m} i_j^2\right], \qquad \text{(eq. 20)}$$

with i the value of the j index

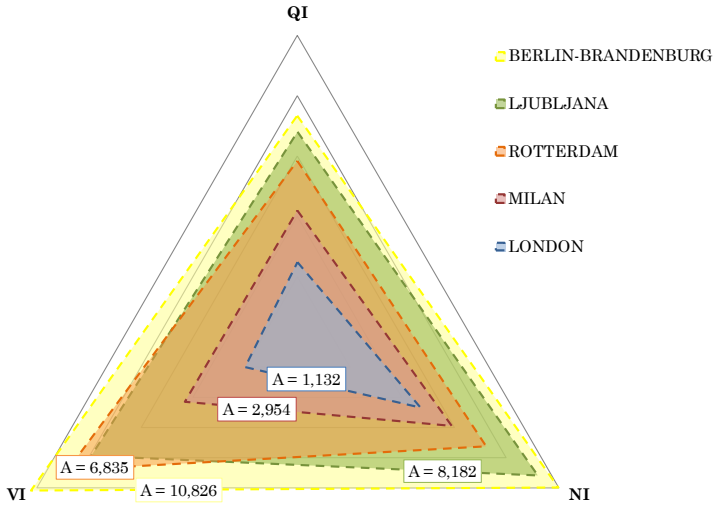


Figure 18: the overall "quality" of urban agro-food systems is shown by the synthetic indicator A

Interdependencies in agro-food systems

If in the previous section the performances of the regional AFS have been described at diet-level, it is worth taking separately into account the different dimensions, or, in other words, each single index developed, enabling the characterization of its peculiar aspects under different points of view. Each index provides specific information about relations between demand and supply and may be broken down into the primary indexes of different raw materials.

Concerning the productive capacity of AFS in metropolitan regions, its productivity depends on the fulfilment of food requirements, i.e. on the value of the "Quantity Index" (eq. 9). The urban nature of the metropolitan region, as well as the specific agro-climatic conditions which favour (or not) the cultivation of specific products, actually affect the results related to specific staple foods (Figure 19) and the possibility of complying with the diet as a whole (see also Figure 16).

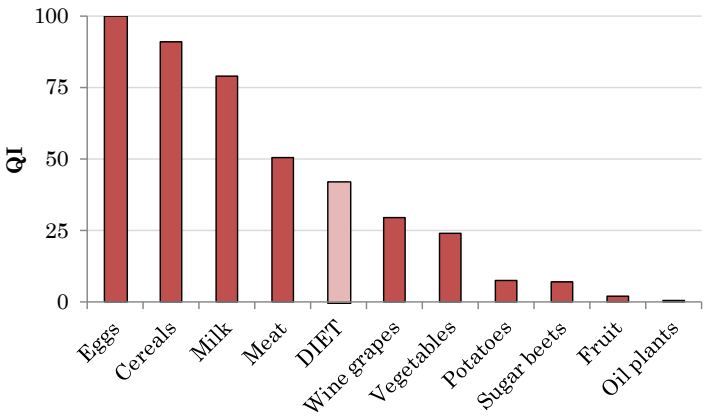


Figure 19: compliance of food production patterns with food demand in the MMR

As a result, peculiar features of the "production-consumption" pattern emerge, giving indications on the capacities of the system in adequately respond to food needs of regional population and providing information on the system's specialization. The main orientation of

agriculture in Milan region allows obtaining substantial amounts of both cereals – due to the remarkable rice and maize productions - and animal-based products, especially eggs and milk. Despite large amounts of these food categories, only eggs shows a potential for commercial export of their overproductions just because a productive surplus is associated with an autotrophic system (*Billen et al., 2009).* Conversely, a productive deficit (QI < 100%) inevitably requires larger amounts of products coming from areas other than the local (regional) context, underlining the necessary dependence on other areas and agricultural systems. The agricultural system here shown, points out the typical features of Western agri-food systems: a marked specialization in some sectors that are strongly developed and mainly oriented to global markets, and other small-sized sectors and targeted to local markets. Amongst food categories with one of the lowest level of compliance, it stands out from the others the category of "wine grape", which reflects one of the typical productions of the Southern part of the region.

Further confirmations of the agricultural specialization derive from the combinations of the relative importance of food groups over their whole production and consumption. Along with the definition of the supply pattern, this latter case indirectly returns the regional dietary habit, more oriented to productions with a higher relative importance over demand. In this way, it is possible to associate the level of compliance with diet with the position of the respective staple food according to this relation.

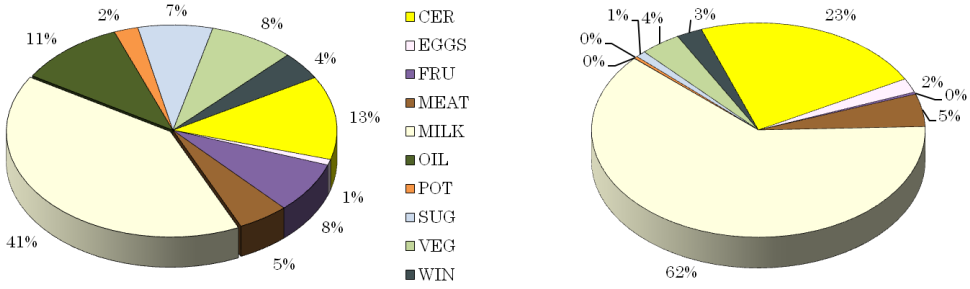


Figure 20: composition of (a) consumed and (b) supplied amounts in MMR broken down per staple food group.

In fact, milk production in the region accounts for 62% of total agricultural production, while 40% of food consumption is due to it. In a very similar way, cereals rank second in importance (13% of demand and 23% of supply respectively), followed by meat (both 5%) and eggs (1% of demand and 2% of total supply), while the contribution of other primary products is scarce (Figure 20a and Figure 20b).

Based on a similar approach, the analysis of the economic dimension emphasizes the market orientation of different staple food groups. The chance/opportunities to be locally consumed or mainly commercialized on and through more global markets depends, in fact, on the relative economic importance of a product in the respective sector compared to the role it plays in the local consumption: a positive (negative) balance indicates the area to potentially be a net exporter (importer) of a specific food product. In this regard, it is possible to distinguish between these two situations (Figure 21), by considering the specific conditions according to the different proportional relations between the variables. The direct proportionality between them plays the benchmark role to make this distinction possible: food categories that show a more than proportional relation are mainly oriented to global markets, while, on the contrary, to local ones.

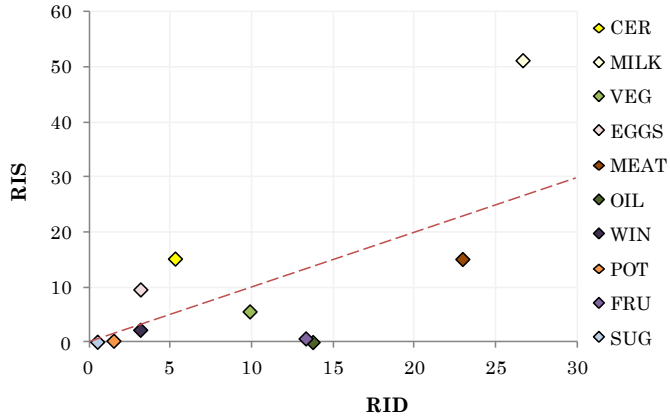


Figure 21: market orientation of food products in MMR.

The approach enables to identify the most remunerative and economically important productions, deriving not only from their farm-gate price but even more affected by the productive pattern and the excess of supply. If on one hand, this approach is very similar to previous one, different results are returned. In particular, it is possible to identify productions that better than others are able to generate value within the territory.

In general terms, simultaneously analysing the performances of the case study areas under both the productive and economic profile (i.e. the market orientation), a correspondence between the aspects exists ($R^2 = 0.61$) (Figure 22), while however, some exceptions evidence the peculiarities of the system. It in fact occurs that some products an economic perspective orients mainly to global markets wouldn't be suitable to commercial exports due to their scarce produced quantities.

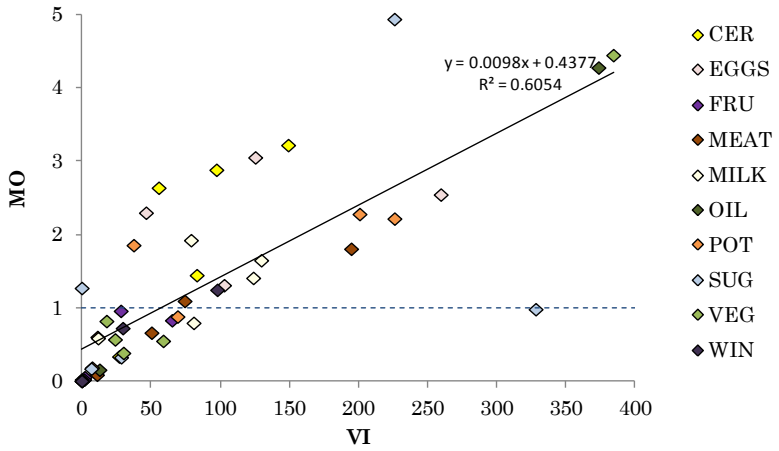


Figure 22: the correspondence between compliance with diet and market orientation is pointed out by the linear regression trend.

At least in the case of MMR (Table 18), this apparent inconsistency is to be found primarily in the specialization of the system and only in second instance in the respective price paid to the producer. It is to be reminded that cereals and milk amounts, although insufficient to meet the respective demand, are largely

higher than the other food products; this makes sure that, in relation to the total value generated by regional agriculture, it is such to ensure them a prominent economic role.

Table 18: relations between potential for commercial export and market orientation of food products. Detail of MMR.

COMPLIANCE WITH DEMAND	*INADEQUATE*	*INADEQUATE*	*ADEQUATE*	*ADEQUATE*
MARKET ORIENTATION	*GLOBAL*	*LOCAL*	*GLOBAL*	*LOCAL*
	CER MILK	FRU MEAT OIL POT SUG VEG WIN		

A key for the classification of regional agricultural systems

The simplified economic balance at food category level, expresses the ties of agriculture with the regional territory, indicating its own economic performances according to the effective productive capacities (reflected by food categories themselves) and population food demand. In this sense, the attention paid to food products is strictly linked with the possibility of achieving a greater localization of agricultural productions and a closer reconnection between them and the consumption dimension. Thus, jointly the indicators, through the comparison of the production-consumption relation, serve as a criterion for the classification of the relation itself. In particular, the combination of economic quantitative elements enables the categorization of all the regional food products into different groups, which reflect their overall positioning with regard to the economic dimensions of the supply-demand system:

(i) *global – deficit* *(MO ≥ 1 and VI < 100)*

(ii) *global – surplus* *(MO ≥ 1 and VI ≥ 100)*

(iii) *local – deficit* *(MO < 1 and VI < 100)*
(iv) *local – surplus* *(MO < 1 and VI ≥ 100)*

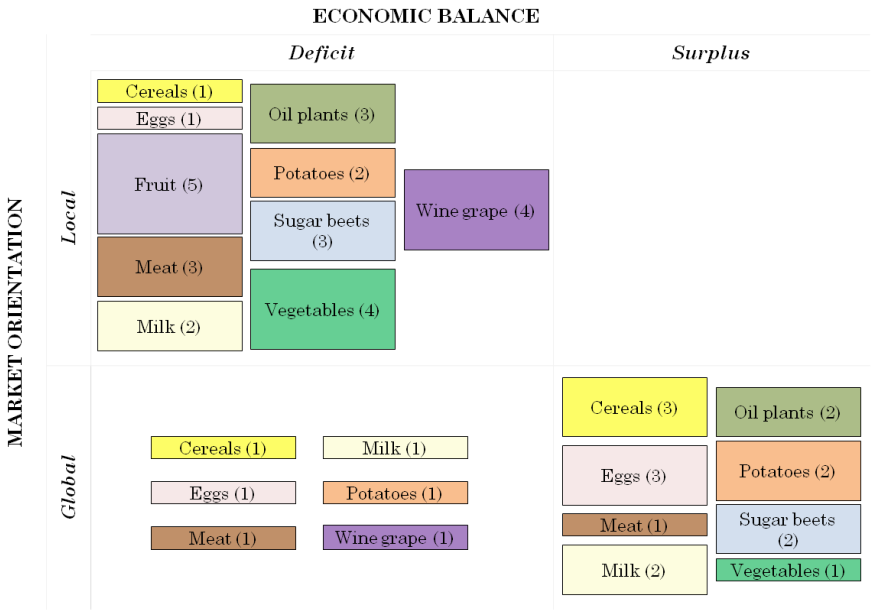


Figure 23: economic dimensions of food categories in FOODMETRES case study areas (N=50). The dimension of the rectangles is proportional to the absolute frequency of staple food groups for each combination of economic dimension

Looking at the performances of MMR (Table 19), it is in fact confirmed the economic importance for the regional agriculture of both cereal and milk sectors. Their productions are mainly global marketed-oriented, as demonstrated by large amounts produced: the regional milk sector ensures more than 10% of national milk production (*Pieri and Pretolani, 2012*), partly intended for the processing into cheese with a denomination of origin, amongst which the most commercialized at global level (e.g. Grana Padano PDO); similarly, it plays a fundamental role the fact that the region is one of the main rice-cultivated area in Italy (and Europe), and productions are intended to meet the respective demand generated elsewhere outside of the production area.

Table 19: economic dimensions of food sectors in MMR

ECONOMIC BALANCE	*DEFICIT*	*DEFICIT*	*SURPLUS*	*SURPLUS*
MARKET ORIENTATION	*GLOBAL*	*LOCAL*	*GLOBAL*	*LOCAL*
	MILK	FRU MEAT OIL POT SUG VEG WIN	CER EGGS	

The application of this kind of approach to compare and the comparative analysis amongst different metropolitan areas reveals that each group is made of heterogeneous products, in terms of both typology and number (Figure 23). In most cases it isn't possible associating a food group with a precise market orientation, nor with an economic balance; rather, indeed, a general behaviour is observed and the presence of some common features across different regions should be noted. In fact, despite different territorial contexts, milk-based and cereals-based products are mostly oriented to global markets, while meat has a lower export potential. On one hand, the economic balance of cereals, potatoes and eggs is positive, highlighting their suitability for commercial exports; on the other hand, fruit and vegetables are quite exclusively associated with the local component of the system. Such a disconnection between production sites (i.e. the metropolitan region) and output categories, evidences that the orientation and the economic dimensions of some productions are not site-specific. They rather depend on the processes the products themselves undergo from production to distribution: the level – or not - of processing and industrialization of some productions affects the whole value generated by the sector in the territory, in terms of both production value and value added. Food processing can in fact contribute in increasing the agricultural value generated in the territory through a further value added, and the economic balance can potentially increase due to this condition. Conversely, more limited amounts of foods to be processed, would scarcely generate further value: it is this the case of animal breeding – and of layers in

particular - for which, however, the large amounts of their respective products are such as to ensure mainly a global market orientation.

At the same time, it similarly emerges a disconnection that puts in opposition pairs of aspects consistent with each other (deficit/local and surplus/global encompass 86% of agricultural products), and dimensions seemingly irreconcilable, namely the "deficit/global" group. In general terms, with a local orientation a deficit economic balance is associated, ensuring ties with the territory and the local component: this combination best interprets the connection between production and consumption, intended as a quantitative approaching and adjustment, and as the possibility of strengthening regional proximity agriculture and its role in providing raw materials to suit consumers' demand. It is moreover quite evident that along with a very positive economic balance a higher openness to the markets is shown. Thus, the inclusion of some staple foods in the "global-deficit" group appears to be something quite unusual. Similarly, the commercial for potential export – represented by the compliance with food demand – may not necessarily be associated with the orientation to global markets; the performances of the local component may then have repercussions on sustainability, due to the possibility to still commercialize amounts of local food through mainstream channels.

On the other hand, the market orientation is profoundly driven by the consumption pattern. This way, it demonstrates the existence of some common features, revealing revealed a similar diet across different areas, mainly based on cereals, animal production and vegetables. Fruit and vegetables (with, in this latter case, the important exception of Rotterdam region) are sectors generally characterized by orientation to local markets and scarce productions; in Milan area the importance of the dairy sector reflects the main orientation of the regional agriculture, but it scarcely counterbalances the corresponding demanded value. Because similar exceptions are not attributable neither to specific products, nor to regions, it derives on one hand the systematic nature of this behaviour, and on the other the existence of peculiar features for each individual system.

A deficiency in the economic performance is mostly driven by the output amounts, rather than the price paid to the producer: this

reflects the specialization of agriculture and the actual possibility of regional systems in intending primary activities for the cultivation of specific products; moreover economic features of the regional systems depend on the specific conditions of the areas themselves. The prevalent urban nature of metropolitan areas limits the extent of agricultural land and its productive capacity, but this can be overcome by a high degree of intensity, which would consequently enable relatively large output amounts. Moreover, the agro-climatic conditions, as well as traditional and cultural issues, drive farmers to adapt their activities to what the territory can effectively sustain, and the economic balance is strongly dependent on such cultivations. It is especially the case of wine grapes, for which needed amounts of non-local origin would further have repercussions on the imported value and the overall economic balance of the system, as long as on sustainability aspects related to transport and logistics.

Similar considerations derive from more specific indications at regional level, as shown in Table 20. From this analysis, it is better returned the link between the capacities of local production and global markets. In particular, to an economic surplus overproductions correspond, which express the potential for commercial export of these same amounts. This is strictly related to the specialization of agriculture. Conversely, a more scarce economic compliance reveals what the system, partly or totally, cannot produce locally and must be find outside the circumscribed regional context, as demonstrated by the large percentage of vegetables (65%) imported by Slovenia (i.e. the Ljubljana metropolitan region) (*AIS, 2014*).

Table 20: economic performances of metropolitan areas

ECONOMIC BALANCE / **MARKET ORIENTATION**	*DEFICIT* *GLOBAL*	*DEFICIT* *LOCAL*	*SURPLUS* *GLOBAL*	*SURPLUS* *LOCAL*	*PRODUCTION EFFICIENCY (€/€)*	*ECONOMIC VIABILITY (€/€)*
BERLIN-BRANDENBURG		FRU MILK VEG WIN	CER EGGS MEAT OIL POT SUG		1	1.03
LJUBLJANA	MEAT WIN	FRU OIL POT SUG VEG	CER EGGS MILK		0.77	0.79
LONDON	CER EGGS POT	FRU MEAT MILK VEG WIN	OIL SUG		0.19	0.20
MILAN	MILK	FRU MEAT OIL POT SUG VEG WIN	CER EGGS		0.41	0.43
ROTTERDAM		CER EGGS FRU MEAT OIL SUG WIN	MILK POT VEG		0.77	0.89

The overall economic performances of a regional system then rely on the combination of both the described aspects. The comparison between economic balance and market orientation reflects either the economic efficiency of staple food production or its level of territorial and economic viability (Table 20). Similarly to the economic balance (eq. 16), the production efficiency indicates the economic role of

agricultural production in a regional context. However, this latter index better expresses and indicates such a role with particular regard to the primary production intended for food only. In this sense, Berlin-Brandenburg region shows the best performances, likely due to the larger extent of agricultural area that can ensure large supplied amounts. The positive balance in Rotterdam metropolitan region is instead related to an excess of supply, namely for milk and vegetables: this is a rather unusual situation for metropolitan areas, where the value of agricultural production is usually much lower than the value of (staple) food required by population. In Ljubljana the specific production-consumption pattern, along with the demographic dimension determines that total demanded amounts – and their consequent associated value – are more limited compared to other areas. The agriculture in Milan area is specialized in cereal and fodder crop cultivation, as well as in animal breeding; these food products are however characterized by lower farm-gate prices and despite their considerable amounts (the metropolitan area comprehends a large part of the Po valley, one of the most productive areas in Europe), this is not enough to radically shift the economic performance towards better results. Finally, in the case of London, the scarce production efficiency is due to the strong demand for food, expressed by more than 15 million people. Even if agricultural practices are concentrated in the areas surrounding the capital city and far beyond, a limited range of production is carried out, determining a quite scarce supply of overall production value.

As already pointed out, the "surplus-global" category highlights the specialization of the different regional system: it seems that the more heterogeneous the productions, the higher the production efficiency, as evident for Berlin-Brandenburg region. The typology of staple food becomes instead important only in second instance, with particular repercussions on the efficiency only: the strong specialization in protected cultivations and milk production generates a considerable value in the Rotterdam region (0.77), equal to the efficiency in Ljubljana, however characterized by different pattern of production and consumption.

A strategy to enhance and improve the economic performances in regional systems may then rely on a diversification of current

agricultural production. They however should be taken into account once again the site-specific pedological, climatic and agronomic conditions that limit the variety of cultivable crops, and that such a diversification may include specific activities (e.g. nurseries) or different final destination of crops (e.g. oil plants as energy crops). These latter don't affect the reconnection and readjustment of production and consumption, as they are not related to the food sector. Nonetheless, with a minor role, they concur to the overall economic viability of the regional systems (Table 20). Their contribution to the total production value generated by agriculture ranges from 2.60% in Ljubljana metropolitan region to 15.6% in Rotterdam area, where most of this value originates from floriculture. This provides insights into the complexity of the agro-food system in urban regions, its relations with wider and external contexts, as long as into the reconnection between supply and demand. Considering the level of food self-provision, it is demonstrated on one hand the adjustment of the productive system to the expression of civil society for food; on the other hand, the spatial distances between production and consumption phases and places are brought closer: productions of local origin that can sustain dietary requirements and don't show potential for commercial exports may be likely retained in the territory close to the places of consumption. This could be strategic not only in economic terms, but also in considering the possibility to maintain and strengthen peri-urban agriculture , as a strategy to enhance farms' resilience and enhance the agro-food system in metropolitan regions as a whole. From an economic perspective, it must be considered that the production value actively contribute to the economic and territorial viability.

Insights on sustainability

Further implications of *pros* and *cons* of regional agro-food system's capacities may arise from the comparison of both quantity (QI) and value (VI) indexes, normalized on population numerousness and extent of agricultural area (Table 21). In general terms, in fact, such a simplification allows a comparison amongst very different contexts,

which is made independent of the spatial (territorial) or demographic dimension peculiarly characterizing them.

As indications provided by QI have already shown and demonstrated, food supply available to individuals can only partially meet their respective demand. Realistically, it is reasonable to assume that agro-food system will face the expected population growth and the urban and metropolitan requirements for food by favouring conditions for a greater food supply. In fact, the current production is the result of agricultural practices with a less intensive productivity than those that, instead, would be needed to adequately meet regional food requirements.

Nevertheless, the more intensive agriculture to achieve the compliance with the dietary pattern, would however lead to repercussions on the whole system itself and, in particular, on its environmental sustainability. A suitable food supply, based on local resources only, should in fact primarily rely on structural modifications of both the primary sector and the related activities. In a very radical way, two main, different and opposite approaches may be adopted in this sense, according to, and always taking into account, their practical feasibility.

On one hand, an "extensive approach" provides that an increase in staple food production originates from an augmented availability of agricultural area, *ceteris paribus* the productive yield. Though ensuring favourable conditions for the reduction of environmental impacts, this is not always a real feasible alternative, especially in metropolitan areas, where soil consumption, urbanization and urban sprawl phenomena represent profound constraints to its implementation. A possible alternative solution, with indeed actually very limited effects, may be represented by urban gardening initiatives. These widespread activities, meant as hobby agriculture in the inner city, may in fact enhance the local food production; it must be also pointed out that they are neither suitable to provide large and varied amounts of food, nor to direct productions to a large number of people and consumers' networks. Again, they may provide positive effects in contributing to the improvement of sustainability in urban environments, also resulting in several socio-economic benefits.

Conversely, still regarding possible solutions to improve productivity

and given the aforementioned conditions, larger mass outputs may alternatively be ensured by increased productive yields, according to the strategy going under the name of "intensive approach". It is mostly in this case that effects and repercussions on the *environmental pillar* of sustainability would occur: stronger pressures and impacts of livestock breeding, greater soil and water pollution following an intensive use of fertilizers and pesticides, the exploitation of natural resources in general, the specialization in some particular crops only (e.g. monoculture), the scarce variation of cultivated products (and consequently in food products) and the loss of biodiversity, the specialization in protected crops that avoids the seasonal availability of food products and allows high-valued productions all over year. Actually, increased yields, regardless the mentioned approaches, can be achieved through the genetic improvement of cultivated varieties or the implementation of agricultural techniques and management solutions. Similarly to the latter approach described, this possibility is strictly related to structural parameters of the regional agricultural sector, the technological level of both R&D sector and farms as long as to their propensity to innovation.

Concerning the economic dimension, the production value corresponding to the dietary pattern is generally higher than the production value generated by the agricultural system as a whole, both in *per capita* and *per hectare* terms. In this latter case, it emerges the relatively scarce profitability of a single unit of agricultural land. This condition reflects the production pattern, and at the same time expresses the intensiveness of agriculture. The generation of value in fact combines not only food- and feed-related practices, but also other agricultural activities; along with the farm-gate price given to producers, in agricultural systems specialized in particular activities, the share of production value they generate can play a decisive role in determining the economic balance of the territory, possibly shifting it to surplus: it is this the case of the metropolitan regions of Rotterdam and Berlin (Table 21), where floriculture and cultivation of energy crops respectively have an active role in this sense.

Table 21: performances of the agricultural systems. Examples from FOODMETRES case study areas

Metropolitan region	**Productivity**				**Profitability**			
	t/capita		t/ha		.000€/capita		.000€/ha	
	Demanded	*Supplied*	*Demanded*	*Supplied*	*Demanded*	*Supplied*	*Demanded*	*Supplied*
Berlin-Brandenburg	0.64	0.53	2.09	1.72	0.37	0.38	1.22	1.24
Ljubljana	0.95	0.64	4.09	2.77	0.56	0.44	2.41	1.90
London	0.54	0.14	11.07	2.96	0.31	0.06	6.38	1.25
Milan	0.78	0.33	12.55	5.36	0.47	0.20	7.60	3.29
Rotterdam	0.59	0.33	15.70	8.72	0.47	0.52	11.69	10.31

4.6 METHODOLOGY TO ASSESS SYSTEM POTENTIALITIES: MATHEMATICAL PROGRAMMING[11]

In the wider context of decision modelling, mathematical programming assumes the role of a privileged instrument for providing general solutions to complex problems. Such method is in fact typically used for solving optimization problems in presence of limited resources, which means allocating them in the most efficient way.

Already in the '40s, the formulation of some complex problems gave a first stimulus to pursue this kind of methodology. Initially it was the "transport problem" (*Kantorovich, 1939; Hitchcock, 1941*), for which it was required the minimum cost to transport goods from warehouses to markets; subsequently the problem of a "proper diet" (*Stigler, 1945*), still at minimum cost, subject to nutritional constraints. Thus, the problem mathematically defined by Stigler, is introduced as a linear programming (LP) model aimed at minimizing (or maximizing) a linear function subject to linear constraints, whether equalities or inequalities.

On these bases, mathematical programming has been variously applied for the operative research in different branches (e.g. economy, land use planning, ecology, agriculture, biology, nutrition science) and with different purposes, from decision-making support systems (*"what-is-the-best"* approach) to scenario analyses (the *"what-if"* approach). A further utilization of LP models in fact relies on the chance to formulate and analyse different simulated conditions, under the hypothesis of an internal redistribution of resources or a recalibration of the imposed constraints, following the modifications of conditions external to context under consideration. The solution of the model then becomes a useful instrument for providing information and driving policy makers to the introduction and support of adequate interventions.

[11] Based on *Paris, 1991*

Analytical aspects

As already mentioned, a linear programming problem aims at solving an optimization problem, by maximizing or minimizing a linear objective function J subject to linear constraints:

Maximize (minimize) $J(x) = [_1 \quad _2 \quad \cdots \quad _n] \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}$

subject to $\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \leq \begin{bmatrix} q_1 \\ q_2 \\ \vdots \\ q_m \end{bmatrix}$

and $\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \geq 0$

with x the n decisional variables to be determined through the model, r and q respectively the n and m known coefficients and a the known coefficients.

or, equivalently,

maximize (minimize) $J(x) = r^T x$
subject to $Ax \leq q$
and $x \geq 0$

with x, r, q the vectors and A the matrix of the corresponding variables and coefficients.

The inequalities $Ax \leq q$ and $x \geq 0$ represent the constraints imposed to the model that specify a convex polytope over which the objective function is to be optimized. The region in the space of the x products for which all the constraints are satisfied, represents the set of feasible solutions, amongst which the optimal one simultaneously

satisfies all the imposed constraints. Its form depends on the number of decisional variables introduced in the model. Whenever only two decisional variables are introduced, the feasible region assumes the form of a bi-dimensional polytope (a polygon) and the optimal solution coincides with one of its vertexes (Figure 24a); in the presence of any number of either decision variables and constraints, the optimal solution is instead to be found in the point on the polyhedron that is on the plane with the highest (lowest) possible value (Figure 24b).

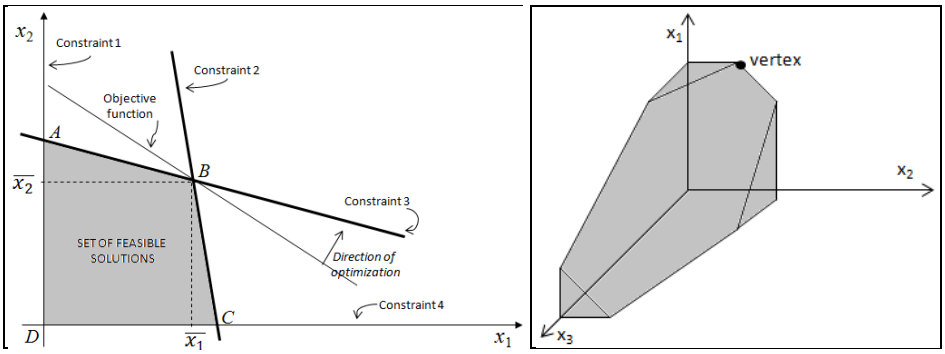


Figure 24: optimal solution of maximization problem with (a) two variables (*Paris, 1991, modified*) and (b) more than two variables (own elaboration).

Especially in the planning and the management of complex interventions, the decision-making process has to rely on a multiple criteria approach. In this sense, the linear programming also offers the possibility to optimize simultaneously two or more objective functions. For this reason, multi-objective optimization is applied in several branches of scientific research - economics and finance, logistics, engineering, environmental sciences – the need to take optimal decisions in the presence of trade-offs between conflicting objectives.

In this category of problems, the respective matrix form is therefore affected by the introduction of further objective functions into the formal model:

Maximize (and/or minimize) $\begin{bmatrix} J_1(x) \\ J_2(x) \\ \vdots \\ J_s(x) \end{bmatrix} = \begin{bmatrix} r_{11} & r_{21} & \cdots & r_{n1} \\ r_{12} & r_{22} & \cdots & r_{n2} \\ \vdots & \vdots & \cdots & \vdots \\ r_{1s} & r_{2s} & \cdots & r_{ns} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}$

subject to $\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \leq \begin{bmatrix} q_1 \\ q_2 \\ \vdots \\ q_m \end{bmatrix}$

and $\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \geq 0$

with x the n decisional variables to be determined, r the n known coefficient of the s objective function, q and a the known coefficients

or, equivalently,

Maximize (and/or minimize) $J(x) = Rx$

subject to $Ax \leq q$

and $x \geq 0$

with x, and q the vectors, R and A the matrixes of the corresponding variables and coefficients.

In this case the identification of optimal solutions is made less immediate and possible only by adopting proper methods, such as[12]:

(i) the *lexicographic method*, assuming that objectives can be ranked in order of importance. It consists in solving a sequence

[12] This very brief description summarizes only a very small part of the possible methods that may be adopted in solving multi-objective problems. Thus, it is not meant to represent a comprehensive overview of the methods themselves.

of single-objective optimization problems, starting from the most important objective function;

(ii) the *linear scalarization*, which allows reducing the multi-objective problem to a single-objective function:

$$\min \sum_{n=1}^{k} w_n J_n ,$$

with w_n the weights of the n objective functions J;

(iii) the *constraint method*, based on the replacement of all the objectives, except, with as many constraints.

Food programming: application to the case study area

If the rigorous methodological approach proposed enables to characterize the actual and current capacities of regional production-consumption dynamics, it is worth considering the role of operational research in providing informations regarding their analysis, through the optimal use of available resources. This means adopting mathematical programming to assess how the regional system is can adapt to more or less structural modifications. In this sense, the use of linear programming modelling to address problems related to nutritional status or dietary preferences, might be framed within the more general context of what can be named "*food programming*"b (Table 22), a perspective that only indicates how limited resources should be allocated, according to the set objective function.

Table 22: main features of food programming and planning

Food programming	*How?* *When?*	• Methodological-based approach; • How limited resources should be allocated according to a specific goal; • Analysis limited to a specific time period; • Results useful to food planning interventions
Food planning	*How?* *Where?*	• Complex, multiperspective and multidisciplinary process taking into account several conditions and elements and organizing all the activities involved in the achievement of a specific aim (forethought), even in spatial terms; • To be implemented in a strategic and medium-long term period

With regard to food nutritional adequacy and dietary pattern, linear programming models have been implemented with different purposes in diverse times and regions.

Ahmed et al. (2011) adopted a linear programming technique to optimize resources use efficiency in North Sudan, where cash and food crops are the main source of household income and poverty alleviation. The authors implemented a model to establish the combination levels of production factors – namely water, land, labour and capital - for a maximization of gross margins from crops. Similarly, *Arsenault et al. (2015)* has recently determined the optimal mix of crops, while minimizing the use of additional agricultural land, to meet the nutritional adequacy of national food supply in Bangladesh, Senegal and Cameroon.

Nutritional requirements that were firstly investigated by *Stigler* in 1945, when he elaborated a model to determine a combination of food products to comply with nutritional requirements of U.S. army staff, while minimizing its respective cost. The minimum cost diet model has also been implemented by other authors. *Moraes et al. (2012)* combined diet formulation for dairy cattle and the presence of environmental policies to examine the effects of these latter on the animal dietary pattern itself. Even more recently, *Ward et al. (2014)* explored,still through the LP approach, different dietary preferences

(i.e. high meat intake and vegetarian diet) and the possibility of urban agriculture in Northern Adelaide, Australia, to contribute to food security, either reducing cost or maximising the dietary contribution.

In a very similar way, and as better described in the subsequent paragraphs, the application of a model applied to Milan Metropolitan Region and its solution through the software GAMS (General Algebric Modelling System) (*Brooke et al., 1985*) is introduced. It aims at identifying the most efficient allocation of locally available agricultural land and animal heads, in order to adequately respond to internal food demand, under different productive conditions and dietary habits.

Formal model and general constraints

The application of LP in the case study area focuses on deepening the possibility of an increased reconnection and a better adjustment between local (regional) food supply and demand. The optimization problem concerns a productive structure able to ensure a greater compliance with food demand. In this sense, the simulations hypothesized return the optimal allocation of both animal heads and agricultural land amongst crops that better fit the internal demand for food, according to possible modifications on either the demand or the supply side, i.e. modelling different scenarios of production or consumption patterns.

The relation (*de facto*) between the two food dimensions has been formalized using a multi-objective model for measuring the gap between the amounts consumed and the quantities produced of each primary product, and which aims at minimizing the sum of the these differences. In this way, given D_p and S_p respectively the demanded and the supplied amounts of each p primary product, food supply is defined as a function of the unknown productive factor x (i.e. land extent, animal heads or amounts of animal products) to be determined through the model:

$$S_p = S_p(x), \qquad \text{(eq. 21)}$$

where the function $S_p(x)$ depends, in turn, on the relation between agricultural production and the processing needed to obtain the p primary product, as more minutely described the previous paragraphs (see *Analysis of supply*, page 92).

The implemented multi-objective model is then expressed in the form:

Minimize	$\sum_p w_p \lvert D_p - S_p(x) \rvert$	(eq. 22)
subject to	$Ax \leq q$	(eq. 23)
and	$x \geq 0,$	(eq. 24)

where x represents the vector of the decisional variables to be determined, q the vector of coefficients used in the function, A the matrix of known coefficients and the w the importance given to each p primary product to meet the respective food demand. The values of the variables included in this latter vector have been set equal to 1, due to the homogenous distances and the consistency in terms of unit of measure.

The model is subject to:

- *land constraints*, ensuring that all, and no more than the available agricultural land is used for cultivation

$$\sum_p x_p + \sum_d x_d = \sum_p land_p + \sum_d land_d \qquad \text{(eq. 25)}$$

with $land_p$ and $land_d$ current land extents intended for the p primary product of plant origin and the d fodder crop respectively,

and imposing the maintenance of areas intended for permanent crops:

$$x_p = land_p \; if \; p = "winegrapes" \; or \; "olive" \qquad \text{(eq. 26)}$$

$$x_d = land_d \; if \; d = "permanent \; grassland" \qquad \text{(eq. 27)}$$

- *fodder units balance*, ensuring that all fodder units provided by forages are consumed by animals bred:

$$\sum_d fu_d * x_d - \sum_g dfu_g * x_g = 0, \qquad \text{(eq. 28)}$$

where fu is the amount of fodder units per hectare of the d fodder crop and dfu the yearly amount of fodder units consumed by the g animal category

- balance for animal productions:

$$x_a - ly_b * x_b = 0, \quad \text{(eq. 29)}$$

where ly is the number of animals to produce a unit of the b animal products.

Simulated scenarios and specific constraints

- *Scenario 0 – the "Baseline"*: current agricultural productions (in tons) are compared to food demand, describing the features of the regional agricultural system in terms of both cultivated crops and livestock numerousness (Table 23);

- *Scenario 1 - "Minimum gap"*: this scenario focuses on minimizing the gap between supplied and demanded amounts of food, returning how the production system should adjust in order to satisfy as much as possible the demand of each staple food. A specific constraint is introduced to ensure that quantities of crop and animal production are enough to meet their respective food demand:

$$S_p(x) = D_p \quad \text{(eq. 30)}$$

$$S_b(x) = D_b \quad \text{(eq. 31)}$$

- *Scenario 2 - "100% fodder"*. The relevant presence of livestock breeding in the region, requires a large amount of fodder and consequently the cultivation of fodder crops, which is currently locally supplied for only 30%; because of this condition, the scenario aims at assessing the consequences of a regional self-provisioning for fodder on the capability of agricultural system in complying with food demand. The inputs related to fodder needs vary according to this, *ceteris paribus* the conditions set in the previous scenario.

- *Scenario 3 - "Vegetarian".* The hypothesis of converting the agricultural system towards practices that satisfy a vegetarian diet is advanced: this allows returning the most cost-effective solution able to replace meat proteins with those provided by legumes, milk and eggs only

$$\sum_p (cal_p * x_p) + \sum_b (cal_b * x_b) = DC \qquad \text{(eq. 32)}$$

  where cal_p and cal_g are respectively the calories provided by the amounts of the p primary product and the g product of animal origin, and DC their total caloric intake;

- *Scenario 4 - "Vegan"* finally represents a more rigorous condition, where animal proteins are not to be provided. The scenario hypothesizes the adaptation of the agricultural system to food needs and demand expressed by vegan consumers; similarly to the previous simulation, legumes only replace all the animal proteins:

$$\sum_p (cal_p * x_p) = DC \qquad \text{(eq. 33)}$$

Table 23: food demand and supply patterns in MMR.

Primary product	Quantities (t/year)		Calories (.000 kcal)		Production value (Mio. EUR)	
	Demanded	Supplied	Demanded	Supplied	Demanded	Supplied
Fruit	480,614	10,182	374,899,943	7,941,746	495,060	10,487
Wheat	662,370	137,048	2,338,166,704	483,777,958	157,313	32,549
Barley	22,457	11,799	87,588,086	37,637,551	5,718	2,457
Oats	1,588	235	5,924,086	944,540	325	52
Maize	1,588	24,619	5,733,499	88,876,150	315	4,889
Rice	77,791	507,720	248,932,523	1,624,705,152	28,213	184,135
Other cereals	17,195	34,686	59,358,272	119,734,801	4,167	8,405
Vegetables	490,376	121,885	142,209,050	35,338,035	328,552	81,643
Pulses	27,401	2,824	80,285,395	8,273,064	38,362	3,953
Potatoes	145,632	10,989	215,535,548	16,127,450	55,340	4,141
Oil plants (olive and others)	648,230	990	922,536,805	2,147,748	511,170	383
Wine graope	265,937	78,901	194,134,142	57,597,623	116,480	34,559
Sugar beet	452,475	31,262	261,088,987	18,038,909	18,099	1,250
Milk	2,484,961	1,964,603	1,202,720,957	950,867,844	991,748	784,073
Beef meat	168,997	1,498	221,386,089	1,961,791	663,917	5,883
Pig meat	79,411	149,348	228,703,749	430,122,361	116,734	219,542
Poultry meat	60,021	4,889	84,629,331	6,893,891	73,225	5,965
Eggs	53,937	67,718	69,039,621	86,679,677	116,864	146,273

Adaptation capacities

The baseline scenario describes the features of the regional agricultural system, confirming its main orientation to cereals (especially rice) and fodder cultivation, this latter to feed the large number of animals bred for both dairy and meat production (

Table 24). This determines a scarcer compliance with other food crops less cultivated, finally leading to an overall inadequate compliance with the dietary pattern as a whole. In fact, the minimization of the gap between food demand and supply, modelled in the first scenario (scenario 1), suggests that increased land extents intended for all food crops are required, except for those which productions already exceed demanded amounts, i.e. rice. With regard to fodder crops, a redistribution of agricultural area amongst fodder maize and temporary grasslands is encouraged. This also impacts, with more pronounced modifications, on the possibility to sustain animal heads: an increase in dairy cows, layers and, even strongly, in broilers is evident, along with a marked decrease in pig heads, historically one of the typical animal breeding in the area. Therefore, such a scenario has repercussions on the total production value: the variation in livestock heads causes, in fact, a diminution in the economic dimension of around 200 Million Euro.

Under the hypothesis of an optimal self-provision of fodder crops (scenario 2), agricultural areas intended for food crops encounter the same redistribution observed in scenario 1; the cultivation of temporary grasslands is however not encouraged at all, in favour of permanent meadows and especially grain maize for feed. Such a productive pattern can sustain all the animal breeding, except beef cattle; at the same time, similarly to the previous scenario, pig heads strongly decrease. Though the profitability of fodder maize, the reduced number of animals leads to a further diminution in the total production value, compared both to scenario 0 (-24%) and 1 (-19%).

It is certainly not a coincidence that these scenarios return a production value lower than the *baseline* one. The current productive pattern in fact results from the laborious process of adaptation to the global economic environment, in order to take advantage of the

competitive factors the regional agricultural system is equipped with. This has thus led to the specialization of agriculture, which modification necessarily implies a reduction of the generated production value.

Scenarios 3 and 4 are instead related to changes in food demand, expressed by the modification in consumers' dietary habits. In the former case, where compliance with a vegetarian diet is needed, results of the model generally indicate increased crop productions, except for rice and maize for both food and feed: amongst food crops, the highest augmentation is related to pulses, which cultivation can rely on more than 90,000 ha. This ensures a fairly good overall correspondence with the food demand. Concerning animal productions, a twofold augmentation in the number of dairy cows occurs, while layers are subjected to an increase up to an order of magnitude, finally determining a complete self-sufficiency for animal products, consistently with the initial condition posed by vegetarian needs. Thus, despite lower incomes from food crops than from fodder or animal production, the total economic value generated, due to larger amounts of milk and eggs, would be further augmented (+122% compared to the current condition).

With the vegan scenario, agricultural areas devoted to temporary forages are redistributed amongst other land uses. The cultivation of minor cereals - particularly barley and oats - and oil plants is not favoured; as long as the strong reduction in rice cultivation, mostly of agricultural area for food (70%) is intended for pulses. In this condition the compliance with food demand ensures an optimal correspondence: on one hand food crop productions allow quantitative surplus, except in the case of olives for oil and wine grape; meanwhile, the system adapts itself to the demand, not returning any area devoted to feed crops and consequently not permitting animal breeding. This situation leads to a reduction in the value generated: in comparison to the current capacities it decreases from 3 to 2 billion Euro (-69%), and such kind of trend is shown also in comparison to the vegetarian scenario, with a reduction of 38%, mostly due to the absence of animal-based products.

Different production values are due to implications not immediately evident from their comparison. In fact, though the lower economic balances of scenarios 0, 1 and 2, it must be considered that the former production patterns include a range of processed foods. This way, the processing itself can contribute in increasing the agricultural value generated in the territory, by producing further value added: in these cases the economic balance returned by simulations can potentially increase due to this condition. Conversely, more limited amounts of foods to be processed, or even their total lack, as in the vegetarian and in the vegan productive system respectively, would scarcely generate further value, finally resulting in the actual potentialities of the system.

It must be reminded that this approach aims at assessing the potentialities of the agro-food system in a regional area in adequately responding to its own food demand. It is quite obvious, as well, that in strongly urbanized contexts such performances are poor, due to exiguous availability of agricultural land and the high food demand expressed by population. This scarce capability is instead balanced by market dynamics and national and international trade in food products, which however don't allow catching the actual potentialities of the agro-food system. It is also clear that the potentialities themselves depend on the regional features of the system under analysis. These peculiarities must be taken into account whenever adopting a simulation model, in order to consider plausible scenarios for the case study area, as well as when conclusions are drawn. In fact, the deterministic nature of the implemented model determines a necessary simplification of the agricultural system, without taking into account other internal and/or external factors that may affect it. As demonstrated by results, especially under modifications in dietary habits, interventions suggested represent a radical choice that certainly affects the system as a whole far beyond economic results: profound structural modifications suggested have strong consequences and repercussions on the agro-food sector. Thus, such results are not to be meant as univocal and absolutely valid, but rather as indications on the potentialities of the regional agriculture, even in terms of sustainability. This requires a more deepened

discussion that takes into account the effective and practical feasibility of suggested indications.

Table 24: overview of results – agricultural land use and animal breeding

	Scenario				
	0	**1**	**2**	**3**	**4**
	Baseline	**Minimum gap**	**100% fodder**	**Vegetarian**	**Vegan**
	Cultivated land (ha)				
Agricultural area	*458,518*	*458,518*	*458,518*	*458,518*	*458,518*
Fruit	1,596	40,053	40,053	40,053	40,053
Wheat	44,446	122,661	122,661	122,661	13,096
Barley	2,294	5,708	5,708	5,708	
Oats	77	478	478	478	
Maize	2,153	155	155	155	155
Rice	140,190	10,297	10,297	10,297	10,297
Vegetables (open field)	3,668	13,658	13,685	13,658	13,658
Vegetables (protected)	865	3,221	3,221	3,221	3,221
Pulses	1,042	9,134	9,134	90,122	250,223
Potatoes	380	5,201	5,201	5,201	5,201
Olives for oil	425	425	425	425	425
Oil plants	3,341	4,633	4,633	4,633	
Wine grapes	15,024	15,024	15,024	15,024	15,024
Sugar beet	6,895	9,432	9,432	9,432	9,432
Maize for feed	109,362	67,443	130,706	49,718	
Temporary grassland	39,030	63,264			
Permanent grassland	87,732	87,732	87,732	87,732	87,732
	Animal heads (n.)				
Dairy cows	172,644	278,583	278,583	Up to 278,583	
Beef cattle	786,060	602,646			
Pigs	2,279,849	241,930	201,510		
Broilers	1,322,993	13,248,520	4,319,331		
Layers	2,756,754	3,154,211	3,154,211	Up to 22,959,140	
Production value (Mio. EUR)	*3,015*	*2,813*	*2,289*	*3,362*	*2,081*

Scenario analysis: the GAMS script of "baseline scenario"

```
set p crops /fruit, wheat, barley_food, oats_food, maize_g_food,
rice, vegetables_of, vegetables_gh, pulses, potatoes, olive,
oil_crops, wine_grape/;

set d fodder crops /maize_g_feed, maize_silage, grassland_t,
grassland_p/;

set g cattle /dairy_cow, beef_cattle, pigs, broilers,
laying_hens/;

set b animal products /milk, beef_meat, pigmeat, poultry_meat,
eggs/;

parameter v (p) production value (€/t) food crops

/  fruit                      1030
   wheat                       240
   barley_food                 208
   oats_food                   205
   maize_g_food                199
   rice                        362.67
   vegetables_of               670
   vegetables_gh               670
   pulses                     1400
   potatoes                    380
   olive                       800
   oil_crops                   257
   wine_grapes                 438 /;

parameter vb (b) production value (€/t) animal products

/  milk             400
   beef_meat       2200
   pigmeat         1470
   poultry_meat    1220
   eggs            2167 /;

parameter a (p) UAA food crops

/  fruit                  1596
   wheat                 44446
   barley_food            2294
   oats_food                77
   maize_g_food           2153
   rice                 140190
   vegetables_of          3668
   vegetables_gh           865
   pulses                 1042
   potatoes                380
   olive                   425
   oil_crops              3341
   wine_grapes           15024 /;
```

```
parameter ad (d) UAA fodder crops

/  maize_g_feed          79911
   maize_silage          29451
   grassland_t           39030
   grassland_p           93220 /;

scalar land UAA in MMR (minimum) /430000/;

parameter lu (g) animal heads

/ dairy_cow      172644
  beef_cattle    795342
  pigs          2279849
  broilers      1322993
  laying_hens   2756754 /;

parameter fu (d) FU/ha

/  maize_g_feed  12600
   maize_silage  11750
   grassland_t    5640
   grassland_p    2640 /;

parameter dfu (g) FU yearly consumption

/  dairy_cow     - 2907
   beef_cattle   -  864
   pigs          -  272
   broilers      -    2.66
   laying_hens   -    2.1 /;

parameter bfu (b) FU to animal products

/  milk           0
   beef_meat      0
   pigmeat        0
   poultry_meat   0
   eggs           0 /;

parameter fcc (p) food consumption (t/year) crops

/  fruit         480641
   wheat         662370
   barley_food    27457
   oats_food       1588
   maize_g_food    1588
   rice           61779
   vegetables_of 355102
   vegetables_gh 135274
   pulses         27401
   potatoes      145632
   olive         428832
   oil_crops     207474
```

```
   wine_grapes   452475 /;

parameter fcb (b) food consumption (t/year) animal products

/  milk          2484961
   beef_meat      168997
   pigmeat         79411
   poultry_meat    60021
   eggs            53937 /

parameter y (p) productive yield (t/ha)

/  fruits           12
   wheat             5.4
   barley_food       5
   oats_food         3
   maize_g_food     10
   rice              6
   vegetables_of    26
   vegetables_gh    42
   pulses            3
   potatoes         28
   olive             2.7
   oil_crops         3
   wine_grapes       7.65 /;

parameter ly (b) productivity per head (animal to product)

/  milk             0.11
   beef_meat         4.15
   pigmeat           2.54
   poultry_meat    251.78
   eggs             58.48 /;

scalar pc calories from protein /0/;

parameter cropscal (p) calorie from crops

/ pulses 0 /;

parameter animcal (b) calorie from animal products

/ milk  0
  eggs  0 /;

scalar wp weight plants /1/;

scalar wd weight fodder crops /1/;

scalar wg weight animal /1/;

scalar gp area permanent grassland /93220/;

scalar oy area oliveyards /425/;
```

```
scalar vy area vineyards /15024/;
variables
xcrop (p)       UAA food crops
xd (d)          UAA feed crops
xanim (g)       animal heads
xprod (b)       animal products (t)
vp              total production value;

positive variables xcrop (p), xd (d), xanim (g), xprod (b);

Equations
ab (p)           balance UAA food crops
adb (d)          balance UAA feed crops
bgp              balance permanent grassland
boy              balance oliveyards
bvy              balance vineyards
landb            balance UAA
forage_needs     balance FU
bg (g)           balance animal heads
prodb1 (d,b)     balance animal products
prodb2 (d,b)     balance animal products
prodb3 (d,b)     balance animal products
prodb4 (d,b)     balance animal products
prodb5 (d,b)     balance animal products
compc (p)        balance compliance food crops
compg (b)        balance compliance animal products
compcal          balance caloric provision
obj              objective function;

ab (p).. wp * xcrop (p) =l= a (p) ;

adb (d).. wg * xd (d) =l= area (fd) ;

bgp .. wd * xd ("grassland_p") =g= gp ;

boy .. wd * xd ("olive") =g= a (“olive”) ;

bvy .. wd * xd ("wine_grapes") =g= a (“wine_grapes”) ;

landb.. sum(p, lcf * xcrop (p)) + sum(d, lcf * xd (d)) =g= land ;

forage_needs.. sum(d, fu (d) * xd (d)) + sum(g, dfu (g) * xanim
(g)) =e= 0 ;

bg (g)..xanim (g) =l= lu (g);

prodb1 ("dairy_cow","milk") .. xanim ("dairy_cow") + ly ("milk") *
xprod ("milk") =e= 0;

prodb2 ("beef_cattle","beef_meat") .. xanim ("beef_cattle") + ly
("beef_meat") * xprod ("beef_meat") =e= 0;

prodb3 ("pigs","pigmeat") .. xanim ("pigs") + ly ("pigmeat") *
xprod ("pigmeat") =e= 0;
```

```
prodb4 ("broilers","poultry_meat") .. xanim ("broilers") + ly
("poultry_meat") * xprod ("poultry_meat") =e= 0;
prodb5 ("laying_hens","eggs") .. xanim ("laying_hens") + ly
("eggs") * xprod ("eggs") =e= 0;

compc (p) .. (xcrop (p) * y (p)) =g= 0 ;

compg (b).. (xprod (b)) =g= 0 ;

compcal ..sum(p, cropscal (p)) + sum(b, animcal (b)) =e= pc ;

obj.. vp =e= sum(p, v (p) * xcrop (p) * y (p)) + sum(b, vb (b) *
xprod (b)) ;

model baseline /all/ ;

solve baseline using lp maximazing vp ;

display xcrop.l, xd.l, xanim.l, xprod.l, compg.l, compc.l, vp.l,
landb.l ;
```

CHAPTER V

CONCLUSIONS

The identification of best practices in the agro-food sector, as well as the assessment of SFSC performances, their impact on sustainability components and their contribution in achieving any other political target, must necessarily be based on adequate assessment and monitoring tools. The importance accorded to short chains by the second pillar of the CAP has been recently introduced and a comparison with the effects of the previous programming periods is then still not possible; nevertheless, concrete, precise, standardized actions for assessing the effects of these initiatives should be already put in place, far beyond and also in function of monitoring and control processes required by the respective regulation. It is also to be enabled more research into the consequences of a transition from global to metropolitan or local food production. In this sense, the use of instruments cognitive of the context and its potentialities is strongly needed. Any political intervention in the food sector or any food planning initiative should, in fact, be based on the knowledge of the agricultural system they operate in and can impact on. Preliminary analyses and assessments of the context are then essential to verify the complexity of an agro-food and obtain indications on its potentialities, strengths and weaknesses; this finally allows assessing the possibilities of an effective reconnection and relocalisation and to shape proper regulations according to the actual conditions and the needs of the territory.

Agriculture in urban contexts, more often threatened by

traditional global supply chains and urbanisation phenomena, gains pace with the alternative networks. Alternative Agro-Food Networks in general, and short food supply chains (SFSC) in particular, focusing on quality, seasonality and origin of products, but also on ethical and social issues, require a limited geographical distance between the sites of production and consumption; thus, the spreading of these configurations acts for supporting the development of agriculture in peri-urban areas

Alternative and shortened configurations of food chains represent innovative elements in the agro-food system, due to their counteraction to mainstream channels. In their acceptation of local systems, in fact, they better allow a reconnection between food supply and demand, both in quanti-qualitative terms and from an economic and environmental perspective. In this regard, the cost-benefit analysis of agro-food systems' relocalisation in relation to alternative strategies, may effectively contribute to deepen the capacities and the opportunities of regional systems. Defining the features of local production (in turn committed with sustainability dimensions), determines the capacities that local agriculture has in being reconnected with food and expresses the potentialities for the enhancement of specific food products, independently on the existence of peculiar short food chains intended for their commercialization. Similarly, the economic characterization of the local agro-food system highlights the importance and significance of some local productions, in the perspective of their strengthening and in order to revitalize the overall economic dimension of the context. The reconnection of the production value has been demonstrated to be mostly linked to the variety of food products of local origin, suggesting that diversified productions would have positive repercussions on both the adequacy in meeting food demand and enhancing system viability. On the other hand, the presence of other agricultural activities not related to food production further contributes to the economic viability of the region; however the suitability to diversify agricultural activities and cultivation relies on multiple conditions, both internal and external (i.e. governance interventions and policies) to the agro-food system, and may benefit from urban-rural relations. At the same time, the capacities of the system to adapt to structural changes and external

factors reveals the possibility to maintain agricultural areas close to cities, as a strategy for further strengthening peri-urban agriculture and the metropolitan/regional agro-food system as a whole, enhancing farms' resilience and favouring positive economic results for the territory. However, as demonstrated by the results of the applied methodology, especially under modifications in dietary habits the interventions suggested represent a radical change for the system, which certainly affects it as a whole and far beyond economic results. Thus, such indications are not to be meant as univocal and absolutely valid, but rather reveal the potentialities of the regional agriculture; at the same time, it must be reminded that the scarce capability in meeting food requirements is instead more often balanced by market dynamics and national and international trade in food products.

The importance of results provided by proper preliminary analyses, in fact emerges in a political perspective addressing the sustainability issue, while useful indications for food-related policies and regulations affecting both agriculture and landscape sectors are provided. In fact, given the condition of dynamics and multi-actor players that operate in an urban environment, a comprehensive territorial policy able to deal with the challenges of urban food supply - likely the food policy - cannot be certainly limited to the agricultural component only. It rather should reflect the complexity of urban and metropolitan systems, by contemplating, considering and integrating the several sectorial policies that act on the system. Such an integration should address rural development issues, regional and sectorial policies; this implies the adoption of a territorial approach able not only to integrate public governance interventions, but also transparency mechanisms and the reduction of information asymmetry (*Lucatelli, 2006*).

It is also clear that the adoption of specific initiatives by decision-makers - from the promotion of SFCS and local products, to the valorisation of specific productive sectors and environmental-friendly practices - determines cascading effects on the territory and on its possible further development, with impacts on entrepreneurs potentially involved and on the civil society that expresses the demand for food. Either stakeholders or policy-makers should take

into account all the preliminary analyses and considerations oriented in this sense, in order to assess and/or favour either well-being or regional territorial and economic viability. The presence and spreading of alternative and shortened networks mainly in urban poles, appears to be extremely disconnected to the aims of RDP and the target of reducing structural differences in rural areas. If on one hand, this is to be better traced back to the possibility in reaching a wider potential market, it is needed to undertaken, in this sense, adequate initiatives to maintain and reinforce their competitiveness. Given the increasing importance of food-related initiatives in urban and metropolitan areas, in such contexts the policy integration - horizontal and at both different territorial levels – is once again fundamental. In order to foster the role of innovative local food systems and the local component as a whole, it then becomes important the integration of different food policies and these latter with other sectorial interventions concerning, amongst others, with territory management, land use options and agricultural policies. In this sense, and still concerning food planning initiatiatives, it arises the chance to further develop both the conceptual and the methodological framework: the use and the inclusion of proposed indicators and scenarios in urban palnning processes.

Interventions to be taken in order to strengthen the role of local systems, are also committed to all those policy options that at European level recognize the commitment of SFSC with rural development. RDP is a complex set of measures and interventions that differently impact on their evolution and sustainability. The definition of SFSC included in the Reg. 1305/2013 highlights a disconnection with the vertical dimension of the agro-food system, but rather it provides a broader acceptation that enables distinguish several experiences. Thus, in this regulatory framework that better focuses on a territorial approach rather on an organizational perspective, it is of crucial importance identifying the beneficiaries of the relative supporting measures. RDP in fact commits to fund economic operators of the territory: they are all the actors that generate revenues and who potentially are better able to maintain and increase environmental, social and economic viability of the area,

in order to reduce structural differences in agriculture. The target group of RDP are traditionally farmers, SMEs or rural actors from other sectors or administration. Yet SFSC are comprised from different and mixed groups, they are dynamic and innovative and so different support measures may be needed.

Interventions with a strong commitment to economy, trade and competitiveness promotion, which support start-ups, are intended to align production to market needs, and encourage the marketing of products: "*Farm and business development*" and "*Setting-up of producers groups and organisations*" in particular, with this latter implemented in order to develop entrepreneurial and commercial skills or the promotion and the organization of innovative processes. This means that through this measure, they may be supported those activities aimed at the development of disadvantaged areas by the introduction of new projects and business skills directly in the local context. On the other hand, "*Knowledge transfer and information actions"*, "*Investments on physical assets"* and "*Setting-up of producers groups and organisations"* are perceived to be the most relevant measures to support SFSC (*Marchesin et al., 2015*), but they need as well to be adjusted for a more diverse user group than the traditional beneficiaries. The intrinsic value of shortened chains mainly relies on social innovation and embeddedness, to which these measures appear to be consistent. New entrepreneurs are in fact an important group of innovation agents, and the RDP offers them relevant measures; however it is necessary to actively convey actors and measures. In many cases short food chains are based on spontaneous experiences and informal networks arisen from consumers' initiative – e.g. urban gardening with commercial purposes or collective buying groups – that leads to the impossibility in considering the actors of these structures amongst the beneficiaries, just because not officially recognized nor legal representatives. The recognition of such experiences from a regulatory point of view, can therefore broaden their skills and action possibilities, further increasing the dissemination and spreading of the initiative themselves (up-scaling) and the social innovations associated with them (e.g. network creation).

Similarly, spatial entities of innovative urban-rural interactions rarely coincide with the target areas and spatial designation rules applied in RDP. In this sense it should be integrated the notion of metropolitan regions into rural development programmes and funding schemes. It is in fact crucial to achieve a common understanding on how metropolitan regions are triggers for sustainable development in rural regions, and that funding instruments and rules require appropriate considerations in territorial eligibility settings. Still, in both the Metropolitan and the Local Agro-food Systems, governance structure doesn't correspond to a specific government body; this requires the integration of regulatory framework amongst different regions or different administrative levels (e.g. region, provinces, municipalities). The partnership model involves different actors in the urban and rural areas in order to organize supply and demand, manage the flows, secure funding and deliver services. Thus any intervention at this scale should be planned and scheduled by a multiplicity of subjects and through both involvement and collaboration of various stakeholders. Although local governance is recognized as a mechanism that should be enabled through RDP design, in reality many hurdles are in the way of this. With the new area settings for LEADER eligibility and the instrument of EIP, first steps are being taken, but the actors in SFSC still insufficiently know them.

Local governance - including networking, objective setting, development of novel chain organisations and solutions - is a characteristic of new SFCS and can provide learning from best practices for other cases. In this regard, some evidences of the interest in adopting the agricultural district model in The Netherlands exist.

Unlike LAG, subject to the territorialisation imposed by RDP, agricultural districts, whatever the typology, are not bound to specific areas and this allows a greater flexibility in this sense; they may be complementary to LAG and their LEADER-framed experience in gathering together different interests and subjects in a local partnership. In fact, the LEADER tool could be driven and coordinated by districts in their territorial scale of action and

accordingly to specific targets (*Pacciani, 2003*). It is then not surprising that in MMR agricultural districts mainly involve areas where LAG are not implemented: four rural districts, for instance, operate in the province of Milan, which is not eligible for the LEADER initiative. In this perspective, agricultural districts find interrelated roles as supporter to organize rural economy, context for territorial-based policies and governance instrument, but at the same time a clear regulation about their role and action possibilities is needed: the definition of roles at regional level should be implemented according to the integration of the structure itself in the whole context.

RDP does not give much importance to agricultural districts, but such experiences may be encouraged by supports for co-operation. The aggregative capacities of multiple subjects operating in the same context are the key element for the development of agricultural districts. Their peculiar structures, being based on both vertical and horizontal integration, are in fact consistent with the interventions proposed in the co-operation measure:

- *pilot projects*: the experience of agricultural district, which is peculiar of the Italian agro-food sector, may either be exported in other foreign contexts or a particular typology of district may be implemented in other Regions;
- *co-operation amongst small operators* in organising joint work processes, sharing facilities and resources, and for the development and/or marketing of tourism services relating to rural tourism;
- *horizontal and vertical co-operation* among supply chain actors for the establishment and the development of short supply chains and local markets;
- *horizontal and vertical co-operation* among supply chain actors in the sustainable provision of biomass for use in food and energy production and industrial processes (supply chain districts, agro-industrial districts).

However, the possibility to include agricultural districts amongst "networks and clusters" beneficiaries is constrained by the fact that they should be "newly implemented"; thus, fostering this kind of initiatives is to be properly and opportunely programmed. As

Toccaceli (2012) underlines, both districts and networks concur to the innovations and in this sense, they should be adequately made available for enterprises and territories as long as supported by European funds.

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