

Food production potential of periurban agriculture : contribution of periurban farms to local food systems

Rosalia Filippini

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Food production potential of periurban agriculture: contribution of periurban farms to local food system

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Food production potential of periurban agriculture: contribution of periurban farms to local food systems

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Non vivere su questa terra
come un estraneo
e come un vagabondo sognatore.

Vivi in questo mondo
come nella casa di tuo padre:
credi al grano, alla terra, al mare,
ma prima di tutto credi all'uomo.

Ama le nuvole, le macchine, i libri,
ma prima di tutto ama l'uomo.
Senti la tristezza del ramo che secca,
dell'astro che si spegne,
dell'animale ferito che rantola,
ma prima di tutto senti la tristezza
e il dolore dell'uomo.

Ti diano gioia
tutti i beni della terra:
l'ombra e la luce ti diano gioia,
le quattro stagioni ti diano gioia,
ma soprattutto, a piene mani,
ti dia gioia l'uomo!

Nazim Hilkmet

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Abstract

Periurban agriculture (PA) is becoming a central topic in research, involving debates from farming system's scholars, urban planners, economists, geographers, and others. Agriculture performed in periurban areas is mobilized in order to have a territorial development and to give farmers a chance to maintain their activity. In Italy, analysis on PA have been especially done for in metropolitan cities, while few studies have assessed PA under the influence of medium-sized cities, which are the most affected by the recent urbanization. While the debate has started in valorizing the multifunctionality of PA, the recent claims on food security have arisen reflections on its potential contribution in feeding urban consumers, even in developed countries. The connection between PA and local food system (LFS) has been mobilized by several organizations and researchers, highlighting the environmental, economical and social benefits of such "proximal" production. Nevertheless several authors have claimed for in-depth analysis about the effective participation of farmers in LFS' experiences. Moreover, few studies have been focused on the practices put in place at territorial level by periurban farmers, in order to assess how productive strategies are integrated with farmers' local commercial strategies. For this reason an agronomic analysis at territorial level is required.

The overall purpose of this research is to develop a methodology for the assessment of the potential food production provided by PA to the LFS. We

will answer to three questions: What current food production is performed by periurban agriculture of the urban region? How do farmers produce for the local food system? Under which conditions periurban agriculture can produce for the local food system? The analysis is based on the interaction of two approaches: the farming system and the food system approaches. The case study is the PA located around the city of Pisa, a medium-sized city located in Tuscany (Italy). The periurban area's border consists of six municipalities, characterised by a recent urban sprawl and representative of Mediterranean coastal farming systems evolution. The analysis is based on interviews to farmers and the local buyers of their productions.

The analysis shows that PA is composed by an heterogeneous composition of farms in terms of produced food considering intensity, quantity, and quality food. There's a high degree of heterogeneity of intensity's production which is linked to heterogeneity of commercial choices between local and global food chains. This choice seems to be characterised mainly by indicators on farm management and land use, more than indicators on social characters of farmer, as age or formation. Considering the quantity of food production, the difference among potential, effective and real food capacity outlines the difference in estimates based on statistical and territorial analysis; moreover it quantifies the lack between what is effectively produced and what is really available for the LFS. This lack between effective and real food capacity reflects different farmers' strategies in participating in alternative and local food chains; especially most of the farmers coordinate hybrid strategies between alternative/local and conventional/global food chains. The network analysis highlights by one side that even in LFS, farmers hybrid different typologies of local food networks; by the other side the parallel analysis of other LFS' actors (principally processors and final sellers) demonstrates the difficulty in approaching a PA involved in such hybridisation of commercial strategies. If local buyers principally asserts that not all the production produced in periurban area is available for LFS, farmers reply that the

capacity of producing for LFS is affected by several constraints mainly linked to regulation and commercial networks.

Periurban farmers are thus adapting to the new opportunities of the geographical proximity to urban area, but an effort in coordinate such individual initiatives is needed. This coordination should integrate the territorial dimension that affects periurban food production, in order to better address issues on territorial development of such areas.

1. Introduction

1.1. General introduction

The global food system is facing several challenges: the population growth, the resource scarsity, the environmental change, as for example the climate change (Godfray and Garnett, 2014). Among the others, the population growth is characterized by demographic changes, which expect by 2050 two-third of world's population to live in cities, almost 6 bilions of people (FAO, 2010). This phenomena is usually associated with a growing demand of resource intensive food, and more population which depends on global market's price volatility, which has characterized the last decades. In this context several political actions are claimed by several researchers and organizations in order to be able to respond to future crisis, for example by mobilizing the local resources (Fraser et al., 2005). FAO (2010), argue for the development of more localised food system, which is able to put in contact urban dwellers and rural farmers, with benefits for both the side of the food networks. Especially this will benefit the general territorial development, which now needs to involve urban and rural areas together in a wider perspective.

In this perspective, Sonnino (2014) argued that urbanisation has deeply changed the geography of food insecurity, not only because of the increasing urban population that needs to be fed, and the creation of situations of "food

desert", but also because agriculture production operates under ecological pressure, caused by an urbanisation that had degradated soil and coinsumed fertile land (Sonnino, 2014). According to EEA (2006), in the European Union discontinuous agricultural areas have been growing four time faster than continuous one, affecting agriculture not only for soil consumption but also for fragmentation and loss of rural character of farmed areas (EEA, 2006). This discontinuous urban sprawl in Italy has also taken specific forms which have been called urban shrinkage (ISPRA, 2015). The agricultural activities taking place in the large fringe spaces generated by this form of urbanization have been called under the large buzzword of "periurban agriculture".

Periurban agriculture appears as a topic where different stakes of territory's sustainability (agronomical, environmental and economical) are concentrated in a dynamic process. At the same time it is perceived as the key element through which it is possible to address and resolve several of these stakes. Studies about periurban agriculture in developed countries in fact have highlighted the social and environmental functions of farming activities (Zasada et al., 2011), while in developing countries they have been concentrated in addressing the food security's stakes (De Bon et al., 2009).

Nevertheless, to our knowledge, there are few contributions on the farming systems of periurban areas, their functioning, their capacity to provide ecosystem services (e.g. food and biomass provision, water regulation) and to adapt to the urban environment. Several studies in Europe and US have highlighted the presence of constraints and conflicts among farmers and other urban actors (Henderson, 2009; Dairly and Torre, 2013) but also the drivers for periurban farming development (Ansaloni, 2009). Studies on periurban farming systems in Europe are especially concentrated in metropolitan areas (e.g. Baldini, 2008; Grillenzoni, 2009; Sali et al., 2014; Darly and Torre, 2013; Busck et al., 2006) while literature has assessed that medium–sized cities have potentials for developing short and local networks between urban dwellers and farmers (Arnal, 2012).

According to FAO (2010), PA needs to be involved directly all over the world in the localisation of food system, in order to respond to food security's challenge. According to Fish et al., (2012) in Europe the debate on food security which traditionally was addressed for an increasing of food production, now is more connected to the limits of sustainability both in its social characters (access of enough production), and its environmental and economical components (good prices and more ecologically produced). Especially, farmers seem to connect to the food security debate several critics which oppose the imperative of production' maximisation to their need to be independent from global conventional food systems. According to farmers, even if it is based on maximising the production, and it can thus provide enough food to global population, global food system has failed in guaranteeing economical and social sustainability for farmers, and environmentally sustainable production. In the framework of food security debate, farmers thus ask the reinforcement of local food supplies that are seen as more sustainable, both for farmers and consumers, in social, economical and environmental ways.

Local Food System (LFS) appears thus central in addressing periurban farms' contribution to local food security. Moreover literature confirms the growing consumers' preference in supporting local production (Adams and Salois, 2010). However LFS remains an uncertain term, both at political level and academic research (Eriksen, 2013). The advocators of LFS' development involving periurban farmers based their assumption on the proximal relationships, without questioning the exact extension of such "proximity" in terms of influence in periurban agriculture; moreover the studies are more focused on the farming systems that already participate in such experiences, without a territorial perspective. As several authors have asserted, more studies are needed about the real motivations, the strategies, and the conditions that drive farmers' participation in LFS (Tregear, 2011; Venn et al., 2006). This is especially true for periurban farmers.

For this reason it appears urgent the development of studies which formulate how the integration of periurban agriculture and LFS is possible.

This research is organized as follow: in the first part there will be a state of art, followed by the research question and the explanation of methodology and case study; in the second part, through scientif papers, the different analysis wiil be developed in order to characterize both the periurban farming systems and the LFS they participate in; finally a brief conclusion which will highlight the main elements of relevance of the research proposed, which will pose the bases for future projects.

1.2. Overall Framework : periurban agriculture and the local food system

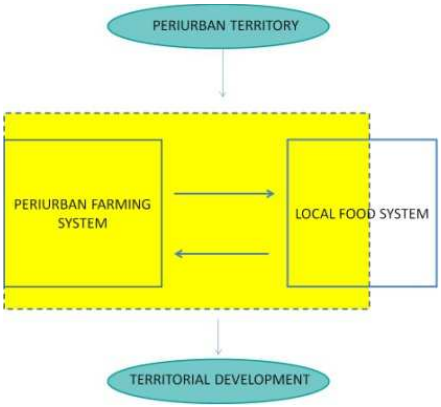


Figure 1 Overall framework of the thesis

Periurban areas are emerging as areas at stake for the territorial development both for the urban and the agriculture sectors. Several authors and institutions have begun to investigate which contributions agriculture can offer to the sustainable territorial development of urban and periurban areas (FAO, 2010). These debates ask to clarify what is periurban agriculture and what kind of periurban agriculture is desirable in such areas, considering the

stakes and opportunities provided by agriculture. Among the opportunities periurban agriculture can provide, agriculture can contribute to the LFS's security and in this way it is argue that it can contribute to the territorial local development. But how can farmers localize the food chains? By which condition farmers participate in such food chains? What does LFS ask to periurban agriculture's adaptation? Literature offers different approaches that I will combine to analyze the contribution of agriculture in periurban areas to the food supplied to cities. I have tested my approach on the periurban area of Pisa (Italy), a medium-sized city in Tuscany.

In this study in order to properly assess this contribution we will make interact two approaches: the farming system and the food system approaches, in a global framework of territory agronomy (Benoit et al., 2006; Lardon et al, 2012).

1.2.1. Periurban agriculture

1.2.1.1. Urban growth and new patterns of territorial development: which place and contribution from agriculture?

It is agreed evidence that urban population is growing (UNFPA, 2007) and urbanization has significantly affected the territories (EEA, 2006; EEA, 2010; Kabish and Haase, 2011). With the term *urban sprawl* literature refers to a rapid and unregulated urbanisation, a very low-density development outside of city centres, usually on previously undeveloped land (Snyder and Bird, 1998). The dynamic of rapid urbanization has followed different cycles in Europe. As Antrop (2004) has shown, these cycles have been activated by the industrial revolutions and the economic development. The first phase is characterized by a concentration of people in the city centre from the countryside, followed a phase of growing population in the urban fringe; thus the "counterurbanization" is characterized by the loss of population both in city centre and in the fringe, while the "reurbanization" is characterized by an increase of the population in an early stage in the city centres and then in the

urban fringes. According to this author after the Second World War the increasing use of the car and the infrastructure's development have allowed a fast urban sprawl, with the consequent creation of suburbs, metropolitan villages, edge cities. "*Consequently, the relations between the urban and the rural changed deeply."* (Antrop 2004, p. 13). In the 70's a counterurbanization has started, creating increased speed in urbanization never seen in the past centuries.

The urban growth is associated with the "periurbanisation", a process of dispersive urban growth, which creates a fragmentized landscape characterized by a "patchwork" of rural and urban areas (Adam, 2001; EEA 2006). As Couch (2007) pointed out, while urban growth is characterized by a either growing population or economic activity in an urban area, urban sprawl is recognizable by the change in urban density at different distance to the city-centre; while the growing of cities is determined by the increasing of population, the urban sprawl has nothing in common with the increasing population, but it is caused by other social and economical factors, as the increased individual mobility, the preference for individual housing, and the action of the policies on land use change. For this reason the assessment should integrate the land use patterns of change, and the demographic data (Schneider and Woodcock, 2008). According to Ewin et al. (2002) urban sprawl is especially defined by other elements beyond the dispersed low density population: the urbanization is characterized by the separation of buildings for residential and commercial purposes and workplaces, thus lacking in the definition of a centre, and by a block of roads' network, perceivable as an obstacle and thus poorly accessible. Several terms have been used to describe the different forms of urban sprawl: scattered development, strip development, leapfrog development (Schneider and Woodcock, 2008; EEA 2006). Urban sprawl does not refer to just the transformation of the land use for urban purposes: it is first of all "a matter of degree" (Johnson, 2001; Schneider and Woodcock, 2008). In their worldwide study Schneider and Woodcock (2008) have recognized four typologies of

urban sprawl: *frantic-growth cities*, *high-growth cities*, *expansive-growth cities* and *low-growth cities.* While the first two trends cause and increasing fragmentation, the second two trends seem to follow a trend of decreasing fragmentation, by the infilling of plots left empty. Thus according to the authors urban sprawl has different characters due to the urbanization process and regional development, and depending on this, it is necessary to adapt policy action to the different types of urban growth.

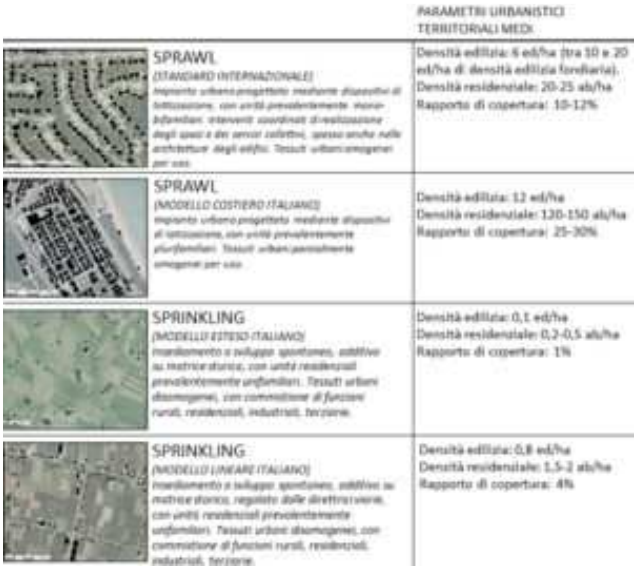


Figure 2 Different types of urban sprawl (Romano et., 2015)

In Europe urban expansion has expanded more rapidly (75%) than urban population (only 35%) throughout all the European continent, without showing any drop, driven by several factors (Table 1). However, several researches have shown a significant difference between the cities in the North and in the south of Europe (Couch et al. 2007; EEA, 2006). EEA assessed that urban tradition in Northern and Western European cities is less strong, and for this reason urban development has historically authorized the

creation of disperse and less compact suburbs, with a low density population's development. In Mediterranean cities the urban evolution has been slower and thus supporting compact cities; therefore here, urban sprawl is a more recent phenomenon and especially it is less regulated (EEA 2006; Salvati et al. 2012). Moreover according to EEA the relatively small and medium size of cities (especially in North Italy) have supported more urban sprawl than bigger cities: "*In smaller cities, in general, densities are lower as the population pressure is lower and in many cases the planning regulations are more permissive allowing more low density building than in large cities.*" (EEA, 2006, pag. 16)

Table 1 Drivers of urban sprawl (EEA, 2006)

Macro-economic factors • Economic growth • Globalization • European integration
Micro-economic factors • Rising living standards • Price of land • Availability of cheap agricultural land • Competition between municipalities
Demographic factors • Population growth • Increase in household formation
Housing preferences • More space per person • Housing preferences
Inner city problems • Poor air quality • Noise • Small apartments • Unsafe environments • Social problems • Lack of green open space • Poor quality of schools
Transportation • Private car ownership • Availability of roads • Low cost of fuel • Poor public transport

Regulatory frameworks
• Weak land use planning • Poor enforcement of existing plans • Lack of horizontal and vertical coordination and collaboration

The urbanization process in Italy has created a special scenario, usually called in the Italian literature *Città diffusa* (Indovina et al., 1990)*, diffusione urbana* (Bertuglia et al., 2003), *campagna urbanizzata* (Becattini, 2001). These types of urbanisation are usually associated to the "little overarching regional land-use planning" (Calafati, 2003). In other words, the tendency in Italy has been in delegating to the municipal level the decision on the transformation of land use. Considering this phenomena in Italy authors have begun to refer to "shrinking cities", in order to highlight the fragmentized municipal-based urbanization (Salvati et al., 2012). The consequence has been in a redundancy of infrastructure and settlements for industrial, commercial and residential purposes (ROMANO et al., 2015) . This phenomena was caused also by the process of decentralization, began in the mid-1980s and accelerating in the 1990s (Governa and Salone, 2004).

According to ISPRA (2015) Italy has a percentage of artificial surface higher than the Community's average: 7.8% versus 4.6%. Especially Italy seems to have an average soil consumption of 90/ha per day, similar to Germany trend; nevertheless Germany has introduced several strict rules to control the land use change, while in Italy regulations are very fragmentized and depending on local authorities. The urbanization have been especially with infrastructures (41%) – especially in rural (11%) and agricultural areas (15%) – new settlements (30%) – especially in low density's (11%) and rural areas (11%) – while the last 28% consists in parking, construction yard, mining area, landfill, and others (ISPRA 2015). Urbanization has especially undermined plan areas, valley bottoms and coastal areas (ISPRA 2015). According to ISPRA (2015) almost 60% of the urbanization process between 2008 and 2013 has taken

place in agricultural areas, especially on arable land (48%), while 22% has been in open urban areas, and 19% in natural and protected areas.

Urban sprawl is usually associated with degradation of rural landscape, negative environmental externalities, and higher social and public costs, for example in the dealing with public transports network (EEA 2006). The impacts are thus social, economic and environmental (Table 2). Especially several researches have highlighted the loss of ecosystem services, highlighting those impacts that are verifiable in short term and those impacts that is not possible to assess in the short term (Johnson, 2001).

Table 2 Environmental impacts of urban sprawl (Johnson, 2001)

Loss of fragile environmental lands;
Reduced regional open space;
Greater air pollution;
Higher energy consumption;
Decreased aesthetic appeal of landscape
Loss of farmland;
Reduced species diversity;
Increased stormwater runoff;
Increased risk of flooding
Excessive removal of native vegetation;
Monotonous (and regionally inappropriate) residential visual environment
Absence of mountain views;
Presence of ecologically wasteful golf courses;
Ecosystem fragmentation.

Several projects have thus indicated this as a new problem for the local territorial management. The data collected at national and European level confirm how urban sprawl and the consequent periurbanization are an important phenomena affecting especially agricultural areas. Pascucci, (2007) observed that the perception is that urban sprawl is simply an urbanization “against” agricultural land management; urban sprawl especially have caused marginalisation of agriculture. Several authors have thus answer to this

observation, by proposing a new vision of periurban areas, which development should integrate agriculture activity. Agriculture is seen here in a new way, due to its potential special relationship with urban areas and urban citizens. In Italy and in France such integration has been put in place with the definition of Agricultural Parks, and other agri-urban projects (Branduini and Sangiorgi, 2005). Vanier and Lagarje (2010) have proposed several priorities and actions to take in periurban areas depending on several scenario of urbanization and regulation of land use change, and in which the different forms of agriculture have a central part. In the framework of the integration of agriculture in urban planning, Torreggiani et al (2012) have observed the risk of the promotion of an ideal image of agriculture, disconnected to its main functions and ambitions, or that can be practiced only in distant areas, with more nature at disposition than in periurban areas. For this reason authors claim for a deeper knowledge of the periurban farming systems, in order to properly assess its contribution to the territorial development.

1.2.1.2. Definition of periurban agriculture: Which borders? Which specifities?

In the study of the periurban agriculture a first methodological stake comes out: the definition of periurban agriculture and periurban farming system is not univocal (FAO, 1999), and it is not defined in literature only considering the agriculture operated in an area of urban sprawl, or proximal to cities. Considering the evidences from the literature, it is possible to detect two approaches for the definition of periurban agriculture. The first one tries to define the periurban agriculture, by defining its spatial borders, a demarcation between urban, periurban and rural areas, and thus urban, periurban and rural agricultures, while the second one assign a demarcation considering the functional relationship with urban area and agricultural activity.

1) Localisation/Distance

Even though it recognizes the difficulty in giving a unique and clear definition of urban and periurban agriculture, FAO (1999) provides a criterion indicating as "Urban Agriculture" the agriculture *within* the city, and "Periurban Agriculture" the farms units *close to* the urban area. FAO definition is especially addressed to developing countries. Its purpose is to give value and importance to all the farms' activities that can support the food security of a rapidly growing urban population; speaking of urban and periurban agriculture means to speak about the agriculture performed in "*proximity to large settlements of people*" (FAO, 1999). This agriculture creates several stakes, especially environmental ones, but it provides also several opportunities, as the contribution to the food provision or urban dwellers.

"What these diverse activities have in common - and in some cases what sets them apart from rural agriculture - is proximity to large settlements of people, thereby creating opportunities as well as risks". (FAO,1999)

For several authors and several projects the borders of periurban agriculture coincide with certain administrative borders (e.g. Paül and McKenzie, 2013). This approach has been often taken in projects with an involvement of institutional actors, or with institutional and political targets. The purpose is to understand the dynamic of agriculture in recently urbanised area in reason to properly propose ideas of development. For other authors it is not possible to assign a strict border between urban, periurban and rural agriculture. Iaquinta and Drescher (2000) for example have built typologies of urban and periurban agriculture that depending on the relations of proximity and the community's composition, agriculture activities and urbanization process, designed different pathways of the "*lumpy*, multidimensional continuum" between rural, periurban and urban areas, in which the *periurban* has elements both from urban and rural contexts. A continuum between "Urbanities in Agriculture" and "Agriculture in Urbania" is suggested in order

to include a link between agriculture and urban activities, actors, functions (Giacche and Toth, 2013).

According to FAO (2007) urban agriculture is characterised by small farms or generally defined small areas part of the city, for raising horticultural crops, small livestock production, for the own consumption or the sale to neighbours. Periurban agriculture seems to operate an intensive fully commercial production, and in the definition of such productions there is no the attribution of the adjective "small".

The "proximity" in the sense of spatial proximity with urban area, has been more characterised. For example, Pascucci (2007) points out that it is not only the proximity to an urban area that defines periurban farming system, but the proximity to a recent urbanized area: in this way they are included those farming systems located in rural areas (so, far from the main urban centre, both in geographical and functional terms), that have been affected by a process of urbanization, for infrastructure or residential purposes. This definition seems to reflect the specific attention that in Italy needs to be paid to the polycentric "shrinking" urbanisation (Salvati et al., 2012).

2) Functional relationship

Nahmías and Le Caro, (2012) present a critique to the definition of periurban agriculture's borders taken only considering the location "inside" or "outside" the urban area done by FAO (1999). Fixing a spatial buffer seems inappropriate especially considering the different process of urbanisation of each agglomeration. Especially this definition lacks in considering the possible functional links between the farming system and the urban area. According to the authors, a starting point in the definition of urban and periurban agriculture is to observe the actors. This observation shows how actors naturally link together farming system and urban system. In their contribution they take into account the urban ecology approach, and they demonstrate how farming system is connected to the urban system providing ecological

functions and landscape. The definition of borders is thus related to the functional relationships between agriculture and urban area: for example farmers that participate in urban farmers' markets, or farmers that provide environmental functions. The stakes recognised by Nahmias and Le Caro (2012) are thus related to the definition of the distance until which agriculture can be considered as periurban or urban. This is the case of farms located in rural areas which products are consumed by urban consumers. In these cases authors assigned an "urban character" to agricultural activities, which are apparently not related to the city in spatial term, but somehow they provide urban services. The same case is for agriculture activities located near the urban area, which product is not locally directly consumed and which apparently don't provide environmental services to urban citizens: a certain "urban character" is recognisable when urban citizens take benefit of the countryside's landscape. Authors concluded that for characterising urban agriculture it is necessary to observe three criteria: the localisation, the reciprocal functional relationships with the urban area, and the integration of agriculture in the urban planning. Following the same perspective Fleury and Donadieu (1997) go further: when periurban agriculture has functional bidirectional relationships with the urban system, it becomes automatically urban agriculture. Nevertheless their main interest is to re-evaluate agriculture operated close to urban areas or inside urban areas that has been marginalised. The spatial proximity of periurban agriculture is thus a condition for a stronger functional proximity, in order to become an urban agriculture.

According to Nahmías and Le Caro, (2012), urban agriculture is characterised by part-time and hobby farmers, while periurban farmers even though they do not accept to become urban gardeners, they are professional farmers that have the possibility to live the city both as farmers and inhabitants. Some authors have also suggested that this functional relationships with urban areas, since it Is characterised by alternative food supply chains, supports more sustainable farming practices (Aubry et al., 2008).

Considering the issue of this analysis, Opitz et al. (2015) claim for a more precise and inclusive definitions of periurban agriculture, especially in developed countries and despite the two main approaches just exposed. According to the authors' review about the debate between urban and periurban agriculture, such different systems of food productions contribute in different ways to the local food security. While urban agriculture is usually performed inside cities or by hobby farmers, usually on household level in an unregulated way, periurban agriculture is usually defined as the agriculture performed by traditional professional farmers, which bigger obstacle is related to the security of land, logistics, and general stronger network in LFS.

1.2.1.3. Agriculture and urbanization: mutual benefits and constraints

Several authors have assessed how periurban farming systems in periurban areas have been affected by the process of urbanization; at the same time urban system is influenced by the presence of agriculture in its fringe, leading to reflections on the vantages and disadvantages on periurban agriculture.

Influence of urbanisation on agriculture

Several authors have pointed out that the "periurbanisation" of agriculture has created opportunities for farmers to have new possibilities in extending the asset composition, regarding the land as a real estate capital. According to Pascucci (2007) this element has two important consequences: on the one side, it may ensure an easier access to credit and so it enable farm's investment, considering the land assets and the collateral warranty in relationships with lenders; on the other side the risk of the enterprise's devaluation decreases, and therefore the loss of well-being over the years for the farmers and his family.

The proximity to urban consumers can be a condition for maintaining agriculture in periurban areas, or in other words they can be conceived as new economic opportunity (Aubry et al., 2008). According to Heimlich (2001)

farms located in periurban areas have other advantages, linked to the proximity (organizational and geographical) to urban markets, urban enterprises (in industrial areas), and infrastructures; especially periurban farmers can benefit from less transactional costs, considering the proximity with other stakeholders, that are usually concentrated on urban and periurban areas. Moreover periurban areas seem to be more dynamic for the farm enterprise, than rural areas due to heterogeneity of actors and initiatives that characterize a territory with recent economic changes. The proximity with urban areas may also offer a possibility for wage differentiation among the members of the family farm, between farm and off-farm jobs. At the same time it can help part-time labors, especially for low income agricultural activities and in this way it may sustain the preserving of agricultural activity in periurban area, while rural and marginalized areas are characterized by the abandonment of agriculture (Heimlich, 2001).

As the functionalist approach highlights the possibility to provide different functions may lead by one side to a reassessment of the agricultural activity in front of urban people and consumers, and in this way by the other side it can reinforce more sustainable practices, both on the environmental and social sides.

Nevertheless other studies on periurban farming systems have demonstrated that the process of urbanisation marginalises agricultural activities: agriculture becomes a residual activity (Ansaloni, 2009; Grebeníček, 2012; Bernetti et al., 2013; Darly and Torre, 2013) in a territory where its position was traditionally predominant. A periurban farming system is characterized by specific environmental, economical and social pressures, due the urban shadow (Tolron, 2001). Periurban farming system is a farming system characterised by a process of *adaptation* of the farming practices (Fig. 3): the process of urbanization has caused the change of external condition and it has also impacted the internal condition of the farm, since with urbanisation some practices are no more sustainable. One first consequence of

urbanisation is the competition for natural resources, especially land and water, both for housing, infrastructures and industrial purposes. This competition came from the loss of agricultural land but also from the fragmentation of land and agricultural areas.

Beyond the loss of UAA due the increasing of urbanisation, the loss of agricultural land means also the less accessibility of soil for periurban farmers due to possible further urbanisation, which influences the price of land both to buy and to rent, sometimes at the limit of land speculation (Quon, 1999). This phenomenon creates also land insecurity (Tolron, 2001), for which the answer is shorter rent contracts in prevision of the more rentable urbanisation. This point also can influence crop sequences and the crop management.

The fragmentation means several things: the reduced size of the plots (Cavailhès and Wavresky, 2007), that leads to a more difficult rationalisation of the practices; the increasing distance of the plots with related costs of transportation and waste of time (Tolron, 2001); in this way the fragmentation may reduce the sustainability of existing farming systems (Van Veenhuizen and Danso, 2007). Considering these evidences, the competition for natural resources in periurban areas tends to create at the same time a process of intensification of agricultural practices, due to the need of saving the scarce natural resources and a process of "delocalisation" of agricultural activities, which can lead to stopping the farming activity (Pascucci, 2007).

At the same time some positive externalities of farming practices are limited as the control of flooding. All this because agriculture is practised in a strongly anthropic environment and its practices needs to cope with modified external conditions (Fig.3). As several authors have pointed out (e.g. Henderson, 2005; Darly and Torre, 2013), there are also social components to take into account related to the conflicts and constraints that come from the coexistence in the same area of different community's interests and activities. In this

perspective, authors have observed that few authors have analysed the character of "periurbanity" of the farming practices. In other words, while the "external factors" of periurban agriculture have been recognised, as the constraints, the urban pressure, competition and so on, the effort now should be on how this adaptation has been technically put in place by farmers. As Tolron (2001) stated there's a lack in the analysis of the "*deformation of the agricultural production system"*. Following this approach the interest shouldn't be in distinguishing urban, periurban and rural agriculture, considering their localization and/or their functional relationships, but to interpret periurban agriculture according to the urban influence that it needs to cope with. Especially, such influence causes a process of *adaptation* of agriculture: the process of urbanization has caused the change of external condition and it has also impacted the internal condition of the farm, since with urbanization some practices are no more sustainable (Pascucci, 2007; Tolron, 2001; Heimlich, 2001) (Fig.3).

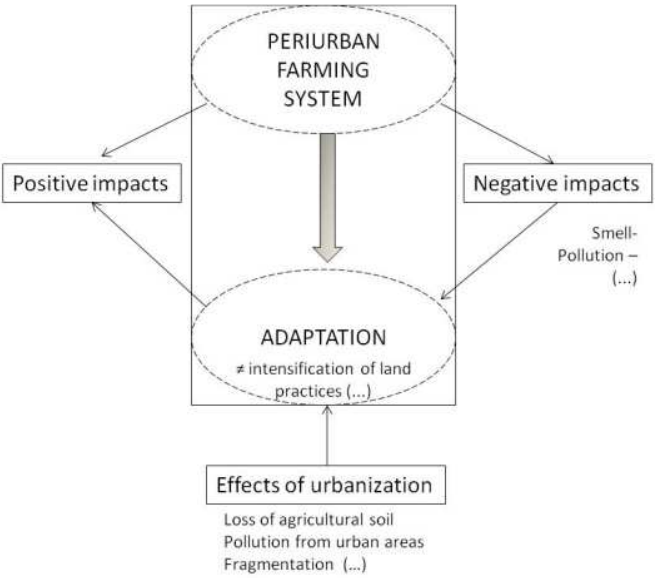


Figure 3 Periurban farming systems that need to adapt to their own possible negative impacts and to the external conditions imposed by urbanization

Influence of agriculture on urban areas

As Grimm et al. (2008) asserts agriculture can be functional to the urban metabolism of cities. The same case is for agriculture which provides food to urban consumers.

Pascucci (2007) listed several negative effects of having agriculture on periurban areas. For example the production of smell, the possible percolation of pesticides and animal effluent; moreover the periurbanization may also amplify the negative externalities of the traditional farming practices on urban residents and areas: the noise of tillage, the pollution caused by pesticides and animal wastewater. All this negative impacts need to be adaptable to the new land use change (Fig.3).

Even though their study is concentrated in developing countries, Lerner et al. (2013) pose an interesting and not trivial question: considering all the stakes and conflicts that periurban farming systems need to face, why should we need agriculture in urban fringe? And above all, why does agriculture still remain in periurban areas?

According to literature, among the positive effects there are: the conservation of the landscape, the conservation of biodiversity, and the soil protection; agriculture can provide different social and educational functions. The functional approaches offer to research many examples of functions that periurban agriculture can provide to urban areas. Periurban agriculture can participate in the urban metabolism (Grimm et al., 2008), environmental services, fruition of open spaces, landscapes quality (Nahmías and Le Caro, 2012), as well as fresh food products available through short food supply chains (Aubry et al., 2008; Brunori et al., 2012), or the public procurement for school canteen (e.g. Galli and Brunori, 2012; Porro et al, 2012) and thus

contributing in the urban food capacity, as above all in the urban food security.

Studies on food production capacity and urban food security have been done especially in developing countries (Mawois et al., 2011; Komakech et al., 2013). Studies regarding periurban agriculture in developed countries have pointed out the attention to the social and environmental functions of farming activities (Busck et al., 2006; Aubry and Chiffolau, 2009; Zasada et al., 2011; Soulard and Aubry, 2012; Mok et al., 2013; Orsini et al., 2013).

1.2.1.4. Which research approaches in the analysis and assessment of periurban agriculture?

In the analysis of production's system it is possible to recognize different approaches, reflecting different scale of analysis; different analysis' purposes as well as they can result in different outcomes on the agriculture dynamic and composition. These approaches are not specific of periurban agriculture but are developed within the agronomic approaches from the field to the territorial levels as highlighted in Figure 4 (Marraccini et al., 2012). Four approaches are reviewed: the cropping system, the farming system, the land use and the territorial approaches. The main research objectives of such approaches are the characterization (all), the sustainability assessment (mainly on cropping, farming system and land use approaches) and the contribution to territorial development (land use and territorial approaches).

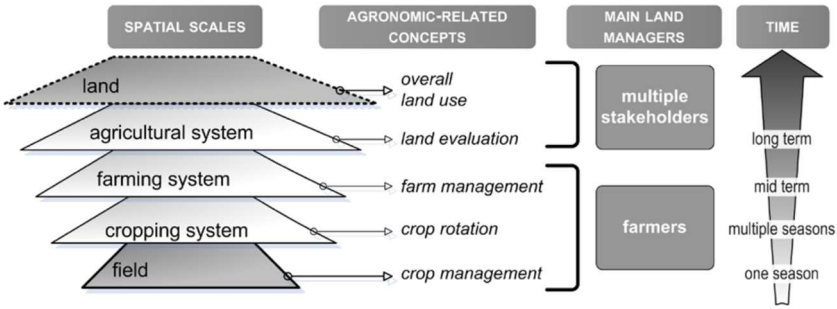


Figure 4 Different levels of analysis on agricultural systems: concepts, spatial and temporal scales, main actors involved (Marraccini et al,2012)

Cropping System Approach

Based at the field and farm level, the cropping system approach analyse the performance of crops production, including crop management, crop rotation, farming practices. These studies are mainly at the farm or the group of farm levels and are particularly performed in developing countries. We identified two main groups of papers in this field. On the one side, the quality of the food produced in an urban environment (e.g. related to heavy metals or wastewater irrigation). An example is the paper from (Petit, 2013), which analysed the effect on the crop management of adapting "isolation distances" from the main roads in agricultural lands included in the Ile de France metropolitan area. Another example is from Antisari et al. (2015) which measured heavy metal accumulation in urban gardens in the city of Bologna (Italy) under different crop management. On the other side, other studies deal with the intensification of urban and periurban cropping systems. For example, Mawois et al. (2011) analyzed the possibilities for horticultural farms in Madagascar to expand their land based on a fine analysis of the on-farm vegetable crop management and its resource use. In North America, Wortman and Lovell (2013) have emphasized the need of studies assessing how to improve the "space-intensive production system" for cropping systems with less availability of land than traditional ones.

Farming System Approach

The purpose of the farming system approach is to analyze the farm as a *system*. This means that instead of studying each element of a farm separately, as traditional agronomic approach do, the farming system approach considers each farming element (e.g. crop management, environmental resources, manpower, marketing) in relationships with the others (Darnhofer et al, 2012). Moreover farming system approach does not consider the actors as alone in the decision-making process, but it tries to understand how farmers interact with other stakeholders, and how farmer's decision-making is influence by these interactions (Roling and Jiggins, 1998).

There are several examples of application of farming system approach in periurban agriculture's analysis. Usually these approaches, even if they are able to integrate multidimensional of farming activity, are focused on farming system as such horse-keeping (Zasada et al., 2013), vegetable (Huang et al., 2006) and cereal one (Capillon and David, 1996). The outcomes of such analysis are usually the characterization of periurban farming using as main tool farms typology (Dossa et al., 2011) or the sustainability assessment of these farms. This approach is applied both in periurban and rural farming systems, bottlenecks to its application of periurban agriculture is often the lack of data.

According to Darnhofer et al. (2012), the farming system approach should also be a territorial-based approach, rather than only a sectoral approach, in the sense that it integrates in the analysis the context where farmer is working, and thus his integration in landscape management, as well as local food system.

Land Use Approach

The land use approach recognizes how dynamics of land use change may affect the farming practices, leading to the adaptation, the conflict or the

abandonment of agriculture in periurban areas. These approaches are mainly used for the assessment of land use and cover changes dynamics, the assessment of ecosystem services for a perspective of urban planning and urban design. This approach is often in the fields of geography or landscape ecology or landscape planning, and here agriculture is seen as a land use rather than a crop or a cropping system (Salvati et al., 2012; Lange et al., 2013).

Territorial Approach

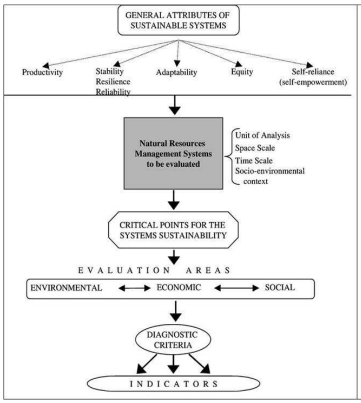
The last approach is the territorial one. In this case, there is an interest in all the forms of agriculture within a periurban area, going beyond just a representative farming system but considering all as participating to the local agricultural system or its contribution to local development. Soulard and Thareau, (2009) have tried to characterise the territorial periurban farming system. They have for example recognised differences in the production's system: cereals and industrial crops participate less to periurban farming systems, than horticultural, or livestock production, and in periurban farms the farming system seems to be generally more intensive. In this contribution it is interesting the fact that different types of periurban farms are recognised in the territories: this means, first to recognize that the periurban farming system is composed by an heterogeneity of farming practices and experiences, and second that all have in common to be influenced by the fact to be somehow "periurban", despite for example the farms' characteristics or the functional relationship with urban area.

1.2.1.5. Sustainability of periurban farming system

Several researches proposed to delineate a specific framework to assess and properly address the sustainability of periurban farming systems that also includes the farming practices and the production's intensity. Usually the sustainability of farming system is assessed for its capacity to satisfy

economical, social and environmental stakes proposed in a certain area. Several studies have thus proposed analysis on such perspective: for example Bockstaller et al., (1997) tries to assess the environmental performance of a farming system and Andersen et al., (2007) propose to combine environmental and economic indicators.

When the production's system is seen like an agro-ecosystem, the assessment of its sustainability is defined as its capacity to adapt to the change of external conditions. The adaptability has been considered by López-ridaura et al. (2005) as one of the attributes of sustainable systems, alongside with productivity, equity, self-empowerment, stability-resilience-reliability; from this general attributes it is possible to derivate the indicators in assessing the critical social, economic or environmental issues of an area (Fig. 5). *Productivity* is defined by the authors as the capacity of a system to produce a specific combination of outputs, while *stability* refers to its capability to reproduce the processes necessary to keep such productivity. While *resilience* has been identified as the capability of the system to remain at and/or return to stable states of equilibrium after 'disturbances', the *reliability* is expressed as the capacity of the system to keep its productive and stable state of equilibrium when facing 'normal' variations; finally the adaptability is defined by Lopez-Ridaura et al. (2005) as the aptitude to continuous production of goods and services when facing long-term or permanent changes in its internal functioning, its environment, and/or its interaction with co-existing systems.



Attribute	Criterion	Possible indicators
Productivity	Farm production	Yield (kg/ha)
Stability		Yield gap (kg/ha)
	Farm profitability	Benefit/cost ratio (–)
		Income ($)
	Food self-sufficiency	Maize production/maize consumption (–)
	Returns to labour	Income generated per unit labour ($/hr)
		Food produced per unit labour (kg/hr)
	Independence from external inputs	External inputs/total inputs (–)
		Forage self-sufficiency (–)
		Period of forage deficiency (months)
	Soil degradation	Organic matter incorporated into the soil (kg)
		Nutrient balances (kg/ha)
		Nitrogen fixed by leguminous species (kg)
Resilience	Off farm income	On farm income/total family income (–)
Reliability		Added value of production by household transformation ($)
Adaptability	Risk of crop loss	Minimum yield in driest years (kg/ha)
		Frost probability after sowing
	Time to recover from production loss	Time to recover from catastrophic events (crop loss, forest fire, animal death or robbery) (years)
	Yield variability due to weather variability	Yield variation with temperature variation (kg/°C)
		Yield variation with rainfall variation (kg/mm)
	Number of activities in NRMS (#)	Yield Std Dev (kg/ha)
	Diversity of activities	
		Income generation per activity ($)
	Initial investments	Costs of investment ($)

Figure 5 General attributes of sustainable systems (Lopez-Ridaura et al., 2005) and some of the indicators coming from them (Lopez- Ridaura et al., 1995)

This framework of analysis has been used also for periurban agriculture (see for example, Van Veenhuizen and Danso, 2007). If we compose the previously explained approaches on production system's studies we can have interesting propositions for the analysis of periurban agriculture' sustainability.

As said, several authors have proposed adaptability as one of the characters of periurban agriculture (Tolron, 2001): periurban farmers need to adapt the production to a space where a complex urban environment is approaching, in a very anthropic space where its positive externalities are marginalized and the negative ones are intensified (Pascucci 2008), and all this in an uncertain future threatened by climate change and insecurity of land (Diaz-Ambrona and Maletta, 2014; Wortman and Lovell, 2013). Most of the literature has linked this adaptation's process especially to the new patterns of food production's intensity (Cavailhès and Wavresky, 2007; Wortman and Lovell, 2013). Clark et al., (2007) for example have linked the "pattern of adaptation" of the periurban farming system to several process: the change in the intensity's production, the growth or the decline of production, as well as the off-farm and the on-farm diversification, where the former reflecting the possibility to have off-farm family's wages and the latter the change in the

internal farms' structures urban-oriented to urban expectations both in term of food products, and in term of change to minimize conflicts with urban neighbours. In this study referring to farmers from US, authors highlight that the main trajectory of periurban farmers is *intensification*. This means that farmers have first of all increased the production outputs, without increasing their cropped land, but the capital investment for equipment and buildings. In Europe, Ven der Sluis et al (2015) assessed differences in the farming system's intensity, by comparing case studies of rural and periurban farming system and also different types of farmers. He concludes that the intensification of farming practices is more relevant in periurban areas and that is caused to the land use change. Similarly Zasada et al., (2013) added evidences on the high adaptability of periurban farms in northern Europe, since farms in periurban areas are more specialized in high-value production and in intensive horticulture for which they have recently activated local food chains. These studies have based the assessment of the intensity's production of periurban farming system, especially on land use system and cropping system approaches, since the indicators mainly refer to the land use intensity (van der Sluis et al., 2015), conceived as inputs for yields per ha (Herzog et al., 2006), or on the influence of land use patterns in influencing the periurban production. Coming from an economic perspective of production, the concept of intensity may not be only referred to yield and production growth, but also to the condition the productions' organization (Morrison, 1994). In the case of periurban agriculture the conditions of production for example are reflecting in the new demands farmers are facing, and thus in the new effort on developing new strategies. For this reason research should investigate other elements linked for example to the effort in valorising products through local food system or the innovation in structures and machineries for participating in local food chain: these are other elements of the complex adaptation which distinguish periurban agriculture. This perspective asks a wider farming system's approach, which includes also social dimension (Dossa et al., 2011).

In other words, the intensity's assessment seen as a key-element of the adaptability of periurban sustainable agriculture, needs to include a complex system of indicators. Moreover in their contribution, Zazada et. al (2013), highlight that the high degree of adaptability in the periurban farming system's intensity assessed in Northern Europe is however connected to a more vulnerability. This vulnerability is due to the need to rent land, that characterises more periurban farmers than farmers not located in periurban areas, and which causes short-term production projects. This vulnerability revoke the need of studies that align the adaptability to other factors of sustainability, for example stability and reliability, in order to assess the sustainability of the periurban agriculture in the long-term, as suggested by Lopez-Ridaura et al, (1995).

Finally, in the assessment periurban's agriculture sustainability there's another element of complexity: at territorial level urban dynamic creates a process of diversification of farming activities linked with different urban demands and urban influence on agriculture activity (Jarrige 2004; Soulard et Aubry, 2011). In this way, the adaptation previously exposed varies a lot, depending on the different "replies" that different farms organize in the same territory. So, for example, if professional farmers increased practices' intensification in order to produce more in less space, other studies have pointed out that in periurban areas hobby and part-time farmers are increasing. These phenomenaare usually linked on one side to a process of emergence of new agricultural actors (Barroso and Pinto-Correia, 2014), and on the other side, a process of extensification, which can lead to land abandonment. Furthermore authors have assessed that farmers present hybrid adaptation to urban demands, for example considering hybridization of marketing's opportunity both for food provision (Filippini et al, 2015) or for services (Zasada et al., 2013). Similarly the complexity of the different definitions of periurban agriculture explained previously, have demonstrated that the views on periurban farming systems differ a lot. This confirms the complexity and heterogeneity of the farms' experiences in dealing with

periurbanization. For this reason, on one side more farm-based studies are necessary, because the farm unit is the final decision-maker about its practices and thus the landscape management (Andersen et al., 2007); on the other side the farm-based analysis should be integrated in a territorial approach which enables to understand this hybridization of farming systems, crops systems and land uses put in place in a certain periurban area in order to properly address its territorial development.

1.2.1.6. Territorial development and periurban agriculture

In order to develop new strategies opf territorial development of periurban areas, scholars have conceived the periurbanisation as the creation of a "third area" that is not urban and it is no more rural "*a third space between urban and rural spaces" a "hybrid spaces"* that is necessary to collectively rule and build up (Vanier, 2003). By this starting point new perspectives emerge, supporting the *agriurbanism* approach (Vidal and Vilan, 2008). The purpose of this approach is to include agriculture in the urban planning of urban and periurban areas. Especially authors recognized that periurban territory, the "third area", consists of a complexity of actors, functions and usages, different from urban and rural areas; thus they need to be analyzed in their proper characters (Torquati and Giacché, 2010). The objective is not just to integrate agriculture in urban planning, but to build up a territory around agriculture. Here other approaches come along such as *agricultural urbanism*, *agrarian urbanism* (Dunay, 2009), where the objective is to establish a new vision of agriculture in urban and periurban areas.

The concern of several authors, as Torreggiani et al (2012) is that stakeholders need to acquire awareness of what means to speak about periurban agriculture. This is the base for the elaboration of new development' projects of periurban areas. The purpose is to avoid an urbanization that is just "against agriculture" (Pascucci, 2007), as well as to avoid projects promoting a farming system that is just the reflection of an

ideal imagine of agriculture. In the previous paragraph the controversial elements which characterize periurban agriculture and its analysis, have been exposed. The inclusion of periurban agriculture in territorial development processes thus means to consider the complexity of periurban agriculture in a dynamic perspective; it should consider both farm-based analysis and territorial farming systems, as well as the multifunctional characters of periurban farming system and so the multi-sectorioal stakeholders periurban farmers work with. In the Territory Agronomy approach (Lardon et al., 2012) the aim is to operate such integration of multidimensional and multilevel elements characterizing agricultural system of production. In this approach the interest goes further than the simple study of the farm territorial cropping system or the land use dynamic, as well as it is not just the analysis of the farming system. The purpose is to conceive a reciprocal relationships between the farming system, the cropping system, and the land use all together with the dynamic of the *territory*. This leads for examples to integrate the farming system with other context, not immediately linked to agronomic interests or agricultural activities, such the development of local food system, or the different environmental functions provided at territorial level by several farming systems. In Territory Agronomy approach it thus analyzing the reciprocal influence between activity and the *territory*, that in this case can be seen as the periurban area. What is *territory*? Without going in depth in theoretical factors linked to its definition, we consider it as "territorial local system" (Governa and Salone, 2004), as an aggregate of actors that collectively acts to influence the development of the area. The territorial local systems are not defined just because either there is a group of actors acting together, or these actors are acting in a specific geographic area. The term refers more to attitudes, experiences, sense of place and territorial resources that all together address the development of a certain area (Governa and Salone, 2004). Especially for the development of agriculture, the concept of *territory* is defined as "coordination's place" among different actors, coming from different territorial level, with heterogeneity of interests

and different sectors' approaches, which learn to have a common view, to share objectives in an integrated organisational level (Caron, 2010). A concretization of such multilevel and multiple elements integration has been conceived in the triptych actors-activities-places formulated by Benoit et al. (2006). This triptych formalizes the various dimensions of integration that go through a different spaces, the combination of activities, coordinated and promoted by different actors, to meet the challenges of the territory, in order to address the territorial development (Lardon et al, 2015).

The *territorial development* is thus defined considering this perspective: it needs to be defined as a process which is based on such integration of different and even opposed elements that are integrated together, creating something new. In this perspective *agro-urban projects* are defined as projects where different stakeholders integrate together the urban dimension with the agricultural one (Marraccini et al., 2013). The management of periurban areas is not thus delegated to projects that define the space and regulate land use systems or productive schemas, but in the governance of the different possibilities of agro-urban projects (Galli et al, 2011).

1.2.2. Local Food Systems approaches

1.2.2.1. Which benefits for "localisation"?

Several institutions have claimed for a localisation of the food chains. The Rural Development's pillar of the Common Agriculture Policy (CAP) 2014-2020 puts the "development of short supply chains and local market" as a priority. Local market is defined as 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*". The development of such food system is possible through a "*vertical and horizontal coordination among supply chains actors"*.

Moreover the development of SFSCs is possible through actions of activities' promotion in local context. According to the document, this operation *"should catalyse the economically rational development of short supply chains, local markets and local food chains."* In general terms, *"the support of short food chains include the support of all the local activities that may help the sustainable development of the economic activities of the holding and local processing and marketing issues, linked to the economic, agricultural and environmental performance of the holding or enterprise."* (European Parliament, 2013).

The CAP 2014-2020 assigned to "short supply chains and local market" the power of bringing together different benefits. First of all there are economic benefits, because it gives economic opportunities to farmers, but also it may create job opportunities, and new markets based on local products; it also creates social benefits, considering the new opportunities of connections between consumers and producers. By the reduction of food miles, Short Food Supply chains will help in the reduction of emissions, supporting Europe to achieve its objectives of combating climate change (Opinion EU). (Comitato delle Regioni, 2011)

European Parliament recognizes also the importance of such food chains for the development of periurban agriculture (European Parliament), as well as several governments in Europe and US have been activated in supporting and monitoring these initiatives. The French government adopted a law in 2014 for the support of short food supply chains, able to reinforce the connection between local producers and local consumers (LegiFrance, 2014). USDA monitoring reports assert that while the number of farms has decreased the experiences of direct selling and other AFNs have increased. In US for example, direct-selling marketing has more than doubled between 1997 and 2007 (USDA, 2010), while the amount of farmers 'markets has grown from around 1.755 in 1994 to around 8.000 in 2014; especially the farms more involved in this food systems seem to be farms located in or near urban areas

(USDA, 2014). In Italy 76% of the CENSIS' sample declares to prefer local products in the choice of food expense (CENSIS e COLDIRETTI, 2010), and assess to prefer the quality rather than the quantity of products consumed. Even though supermarkets represent the main marketing channel for everyday food shopping and expenditure (70% CENSIS e COLDIRETTI, 2010), Italian consumers are more and more participating in local food system through farmers markets, on-farm direct sale, *Gruppo d'Acquisto Solidale*, as well as consumers valorize local productions as those labelled IGP and DOP, even for housing consumption (INEA, 2012). On the other side, farmers' participation in such food chains is increasing. In the last National Agricultural Census the direct sale represents the third marketing channel with 26% of farms, after the sale to traders (43%), the sale through cooperatives (31%) and it is followed by the sale to other farms (15%) and to industrial firms (12%), while labelled farms (e.g. IGP, DOP) are about 9% and 14% on the total, respectively on crop and livestock productions, while organic farms represents 3% and 4% respectively (ISTAT, 2013).

1.2.2.2. State of the art of different approaches

In the framework of European Policies, Kneafsey et al., (2013), have proposed a definition of Local Food System (LFS).

"A local food system is one in which foods are produced, processed and retailed within a defined geographical area." (Kneafsey et al, 2013; p. 23)

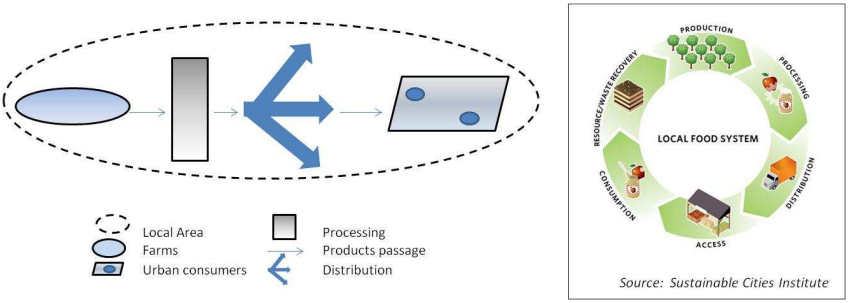


Figure 6 Main components of a Local Food System

This definition implies that the boundaries of local coincide with the territory where all the food chain's steps are put in place (Fig.6). Literature has recognised that there is a strong and political desire at both European level and national scales to "*relocalize*" food production and to encourage such systems as a tool to sustain local development through endogenous resources (Maye and Ilbery, 2006). What exactly identify a food as a "local food" is a matter of debate (Eriksen, 2013).

SYAL Approach

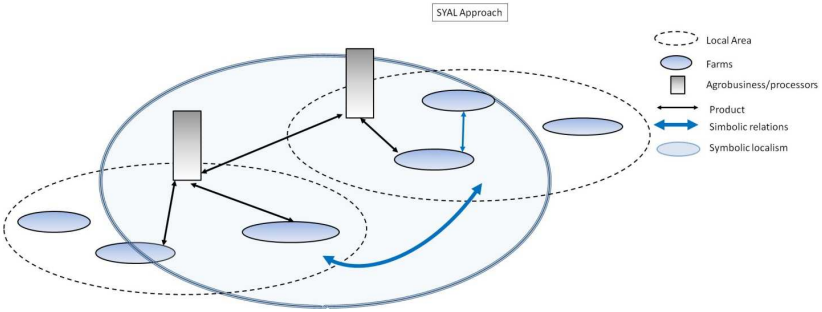


Figura 7 SYAL Approach

The Systèmes Alimentaires Localisés (SYAL) (Fig.7) approach *"intends to valorize the local resources and to understand the territorial embeddedness of agricultural and agro-food productions, considering the local territorial specificities of products derived from them, the local socio-economical organizations, involved in the production process, the methods of valorization of products the consumers' representations and the symbolic value of products".*

As Fournier (2010) stated, it could be also as a tool of action for the development of territories, relying on the identification and activation of local resources.

The origin of this approach is based on the development of the food district, derivate from the "cluster" (McCann, 2000) and "industrial district" approaches (Rabellotti, 1995). As Fournier (2010) stated, in the concept of SYAL the geographical proximity is not a *sine qua non* condition: different local roots are possible not only linked to the "terroir", but also linked to the geographical and institutional proximity. While the terroir can produce forms of local specification of primary produces, the second one gives more meaning to the symbolic values of agrifood products. Moreover while in the concepts of cluster and district the "territory" is taken as it is, as a delimited space where farms, enterprises, and other different actors are concentrated,

and the relations between these actors remains unclear, in the notion of SYAL the territory is something that is possible to create with the economic and social interactions of actors. Nevertheless the interest remains the territorial and temporal development of these place-based agro-food activities.

The SYAL approach is also seen as a methodological tool to study case studies (Muchnik, 2007): at local level studies look for dynamics "SYAL-like" in order to reinforce them, as experiences of craft agro-food sector, against the agro-business. Moreover it is seen as a possible alternative to the "top down" model of rural development's policies put in place in the '70s and '80s, considering the sustain to the endogenous resources.

Critics moved against this approach concern the clear determination if different regions are an unic LFS or not (Fournier, 2010); moreover according to Chiffoleau and Touzard (2014) the system of relationships between actors that participate in a SYAL is an important matter, but it has not been enough studied in dept. These relationships are in fact seen in their work as condition of innovation.

Foodshed Approach

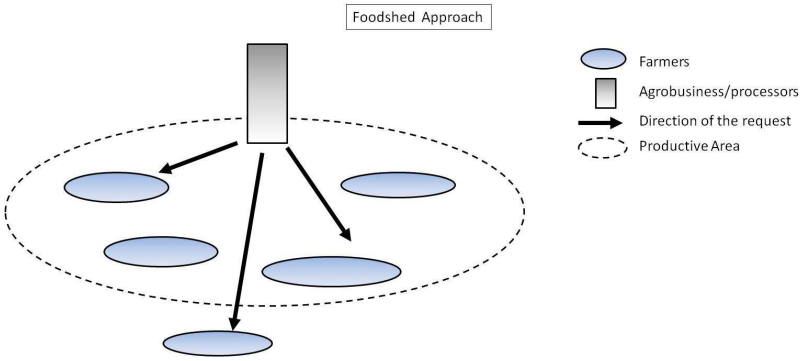


Figure 8 Representation of the Foodshed Approach

While in the SYAL approach the territory of the agricultural activities is above all an institutional and organisational construction based on common symbols and interactions between actors and products, the concept of "*foodshed*" seems to be firstly based on a specific area where natural and cultural aspects are together and work together for the offer of primary produce for consumers, interacting with the wider context in which is located (Fig. 8). Initially thought by Hedden (1929) as a "*economic flow of foodstuff*", the concept has been reformulated by Kloppenburg et al., (1996). The "foodshed" is first of all a tool of analysis to understand "where our food is coming from and how is getting to us", which final objective is to determine an alternative food system to the "intense commodification and accelerating distancing from each other and from the earth", characterising what in the 90's was the "global food system". That is why the foodshed is based on both geographical and socio-economical proximities. Because of the former, the foodshed aims to be based on the natural resources of a particular local food system. Considering the latter, no precise geographical boundaries are possible, because they are functions of the variable and overlapping flows of material and immaterial resources. As he stated the foodshed is a *"socio-geographic space: human activity embedded in the natural integument of a particular place."* (Kloppenburg et al., 1996). A concept that emerges in this analysis is

the concept of “proximate self-reliance” and it is linked by the authors to the first examples of food policy councils, analysis of regional diets and sustainable food consumptions (Kloppenburg et al., 1996) as they are moving in similar directions than foodshed’s analysis.

In opposition to the SYAL approach, in this approach food production is not assigned with any symbolic value; the territorial embeddedness seems to be more based on the food capacity of the natural resources of the space. By the assessment of this food capacity is based the possibility of creation of an alternative food system, more sustainable, also because it can more connect producers and consumers. Peters et al. (2008) use the concept to define a ‘foodshed’ as the “geographic area from which a population derives its food supply” and in this way “a ‘foodshed analysis’ refers to study of the actual or potential sources of food for a population, particularly those factors influencing the movement of food from its origin as agricultural commodities on a farm to its destination as food wherever it is consumed.” (Peters et al., 2008)

The concept *has been linked* to the concept of “provision basin” (Deverre and Lamine, 2010), where by the identification of a specific “user” of the agriculture products, an area of provisioning is defined. This area is based on the singles plots where it is possible to grow productions needed by the users (Le Gal et al., 2004). Le Gal (2004) conceptualizes a foodshed where the user is a processor of primary produces. In his analysis the connection between the farmer and the processor helps the coordination’s effort in order to have regular provision and elaborate future scenario of development, as well as it helps to properly assess of production’s performances of agriculture based on natural resources.

Urban food system approach

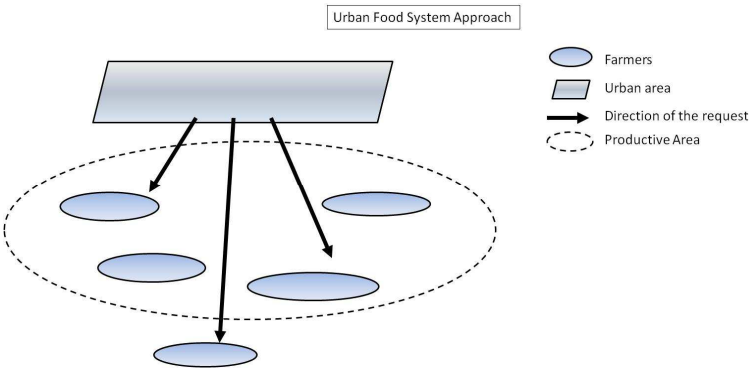


Figura 9 Urban Food System approach

The urban food system approach is based on the concept of foodshed, when it has the objective of connecting a concentration of food consumers and their suppliers. In the urban food systems the approach started from the consumers concentrated in an area: residents, workers, tourists, buyers, and what they ask for their nourishment. On the contrary of the provision basin defined by Le Gal et al. (2004), it means diversity of consumers, but also of potential suppliers. On the contrary of the foodshed of Kloppenburg (1996), but coherent with the foodshed of Peters et al. (2008)bit does not need to be based on the geographical proximity: it means that it asks for dense social relationships, but it accepts the distance between consumers and producers (Touzard et al., 2013). The attention is on the health of food consumption, food solid waste management, the local land use and transportation (Pothukuchi and Kaufman, 1999). Moreover the urban food system approach is concentrated in assuring which potential or existing institution can control, regulate, influence, “take action” on the current urban food system. In this way a specific attention is paid to the urban food security.

Food capacity's approaches

The interest in "feeding the city" characteristic of this urban food system approch is strictly connected to the literature concentrated on the assessment of food capacity. The assessment of the food production capacity has been carried out considering different approaches and techniques. These techniques have linked the values of potential food production to the amount of hectares (Gerben-Leenes and Nonhebel, 2005), to the production's intensity (Colasanti and Hamm, 2010), to the calories produced (Sali et al., 2014), to the potential and/or effective yields, the season availability of primary produces (Colasanti and Hamm, 2010), the presence of commercial relationships that can help local food supply chains, the local consumption patterns, or the local expenses for food. Moreover the assessment of food capacity of periurban agriculture or local agriculture has been linked to specific projects as the public procurement for school canteen (e.g. Porro et al, 2012).

The heterogeneity of techniques elaborated by researches reflects the complexity of such assessment based on the complexity that means food production, distribution, and consumption. Especially it has been linked to the evaluation the urban foodprint (e.g. Billen et al., 2009), as the evaluation of the environmental impact of urban food production, or urban food miles (Torquati and Taglioni, 2010). These approaches on the one side can help in giving quantitative measures of the possible environmental, economic and social balance between food demand and food supply, on the other side, they refer to a meaning of local defined by an urban perspective, for example taking into account administrative border. Moreover they usually project the food capacity on some ideal diets (average consumption of calories), ideal rate and expense for consumption, as well as ideal amount of hectares, and ideal crop yields.

Alternative food networks and short food supply chains

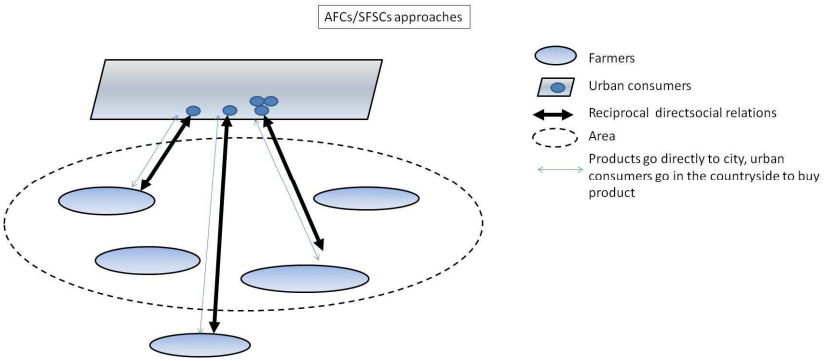


Figura 10 AFNs and SFSCs approaches

Conversely to approaches explained previously, Alternative Food Networks (AFNs) and Short Food Supply Chains (SFSCs) are first of all focused on the relationships among farmers and consumers (Fig.10). As a reaction to the dominant agro-industrial model, the so-called conventional food chains (CFCs), they intend to restore the connection of consumers and the place of production, the production methods and farmers (Ilbery et al., 2005; Marsden et al., 2000; Jarosz, 2008). At the same time these networks are seen by farmers as a possibility to *"being known", identified* by local consumers" (Aubry et al., 2008), as well as a way to economically distinguish his own product to the mainstream product. AFNs include a diversity of initiatives and organizations (Deverre and Lamine, 2010; Duram and Oberholtzer, 2010) and they are often associated with questions on safety food, on degradation of natural resources, the rural poverty or on the deterioration of relations between the different chain actors (Murdoch et al., 2000; Renting et al, 2003). More generally, these AFNs may be considered as a means of promoting sustainable development across the global food system (Sundkvist et al., 2005) and for rural development (Renting et al., 2003). Sundkvist et al. (2005) have linked the development of such food chains to more sustainable farming practices. Especially it has been assessed the benefit of these food

chains in influencing the intensification process; moreover they avoid the farming system specialization and in this way they promote a more reliable farming system, providing more ecosystem services; AFCs are also connected to less distant transaction with benefit for the quality of food, that are fresher, the quality of air, because of less pollution, as well as more profit for farmers, since there are less transport's cost as well as less transactional costs. Finally AFNs creates opportunities for diversification of products with benefit of traceability for consumers.

Aubry et al., (2008) have interpreted SFSCs' experience as a passage from a simple network among consumers and farmers to a way to maintain agriculture in urban and periurban areas, while Vecchio (2010) has also highlighted the capacity of SFSCs and AFNs to assure consumers about the traceability, the quality, the price and a certain idea of contributing to local development.

Some drivers were identified by authors to explain the development of short supply chains and direct marketing in peri-urban areas: the accessibility to local markets of consumers (Aubry et al., 2008; Jarosz, 2008); the importance of social contacts between producers and consumers motivation differences among farmers to participate, and the role of different modes of distribution (Holloway et al., 2007); the proximity that encourages farmers to identify market niches, innovate and adapt to new demands (Le Grand & van Meekeren, 2008). Kirwan (2004) insists on the influence of the question of the "regard" in the choice of farmer's market by producers. More generally, periruban agriculture is perceived as an innovative milieu in which AFNs can develop (Bryant, 1995; RUAF, 2008). Some empirical studies have showed that commercialization is quite the only factor of adaptation to periurban in a French periurban area, more than land strategy (Houdart et al., 2012).

Nevertheless, authors temper the positive role of peri-urbanization in AFNs' emergence and development. This process is in fact seen also as a constraint, especially for small farms active in AFN because "*agro-industry continually*

relocates in search of cheaper land, labor and water farther from densely urban centers to rural areas located both within and outside national borders. Increasing urbanization and gentrification fuel demand for organic, seasonal, and locally grown food and different modes of food provisioning such as farmers markets—especially from wealthy and middle class consumers—as development and residential construction changes the landscape and triggers farmland preservation activities, zoning regulations, and urban growth management policies. These politically infused activities create both opportunities and challenges for small-scale family farms active in AFNs, because as the urbanization and agrarian restructuring create both opportunity and demand, they also increase labor time and the potential for burnout, while revenues do not necessarily or consistently increase" ((Jarosz, 2008 p.232). As said before, more than allowing the development of alternative ways of production, perurbanization enforces production intensification or the sale of land. Paül and McKenzie (2013) even argue that AFNs in peri-urban areas "are only possible if farmland preservation is guaranteed, and that the former does not come as a direct consequence of the latter".

A consistent part of literature has also criticized the notions of AFNs. Authors especially doubts their effective capacity in creating sustainable territorial development, not only in periurban areas (Goodman, 2004a). Tregear (2011) stressed that farmers' motivations in AFCs are not always compatible with more sustainable practices, but that they are seen just as a short-term and fashion market's opportunity. On the other side Venn (2006) emphasizes that AFCs and SFSCs are not always driven by food producers. Their goals are not necessarily to maximize farmers' profit or market penetration, and thus they are not in line with sustaining farmers' entrepreneurship, highlighting the potential negative impact on farmers' profit (Venn et al., 2006). Watts et al. (2005) stated that a *"detailed scrutiny of the social and environmental consequences of strong AFCs would be welcome"*.

These criticisms are maybe due to the fact that literature has adopted a broad definition of AFCs and SFSCs (Marsden et al., 2000; Renting et al., 2003; Holloway et al., 2007) to include *"anything that is not conventional"* (Venn et al., 2006) and not questioning the differentiation of practices, networks, farmers' motivations, and thus the real impact they produce in a given territory (Tregear, 2011).

Several studies have also proposed examples of hybridization between conventional and alternative food chains. These studies are in some cases based on the farmers' motivations in participating in such SFC (Tregear, 2011), or on the fact that farmers "have not really moved from one system to another", creating "the new arrangements" with benefit come both from AFCs and CFCs (Ilbery and Maye, 2006). Other literature on hybridisation has shown several examples of "contamination" of AFCs' values in CFCs: as agro-business companies that invest in organic products, or traceability (Forney and Häberli, 2015).

Localisation, Proximity, Network and Hybridization

As demonstrated *Local* is an ambiguous term. In all the approaches previously presented there's a characterisation on how define the locality of the food system.

LFS is a broad term used in literature to identify all the alternative experiences to the global-dominant model, in the so-called "quality-turn" approach (Feagan, 2007). As Goodman (2004) stated the term "local" has been used in the sense of "traceability", and so "quality's controls", but also "trust", because of the new possibilities of connection between producer and consumers; the term means also "*embeddedness*" in the sense that this new food system is alternative to an "aspatial" industrialised food production and consumption. In other words, speaking of "local" means *"a transition from the 'industrial world,' with its heavily standardized quality conventions and logic of mass commodity production, to the 'domestic world,' where quality*

conventions embedded in face-to-face interactions, trust, tradition and place support more differentiated, localized and 'ecological' products and forms of economic organization." (Goodman, 2004a). According to Adams and Salois (2010), this may be one of the factors why consumers' willingness to pay has switched from organic production to local products. Even though consumers think organic production as safer, they assigned higher quality to local food: there's the perception that "local foods are better for society" and organic movement lacks of social vision, confirmed by the increasing organic production put in place by agro-business firms. The stakes related to the sustainability of local productions are solved by consumers considering the reduction of food miles, and the general dissatisfaction with the environmental impact of the modern and industrial agricultural systems "that have co-opted the organic food market".

In this debate around the *Local*, Ilbery and Maye, (2006) propose to analyse the food systems not because of the food chain, but because of the production famers do. In their study, they selected famers in a specific area in the Scottish-English border and producing a specific production (livestock production). They assess that a polarity between local/alternative and global/conventional it is only theoretical, and they propose to "re-localise" the analysis of food production.

In other words what has been commonly associated with *Local*, it's only partially real: farmers adopt hybrid marketing strategies, both for buying inputs and for selling the outputs.

With this process of "*re-localisation*" they propose two views of *Local*: the first one, refers to the shorten link/the new *embeddeness* between producers and consumers, that can be spatial, functional, organisational and that is linked to all the approaches that tries to give new values of each element of the food chains: foodshed, urban food system, short food supply chains, etc.. (Feagan, 2007); the second one refers more to the place/the area where the

production is produced, commercialised, consumed. This second one, out coming from a process of a re-localisation, has shown the deep vagueness of the first one.

Another ambiguous term is "*Proximity*" (Torre and Rallet, 2005). While this term in the common language may simply express "spatial vicinity", effectively it does not. In their research Torre and Rallet (2010) proposed two types of proximity: the *geographical proximity* and the *organised proximity*. The first one determines whether one is far from or close to, the second one define the proximity that "make the members interact" (p.49). This last one can be defined by two logics: the logic of belonging and the logic of similarity.

Considering the relationship between *proximity* and *localisation* (in the sense of *embeddeness*) Torre and Rallet, (2005, page 52) state that "*the search for geographical proximity does not always lead to a process of localization*" But "*the intersection of both types of proximity (geographical and organised) provides a grid of analysis of the different models of geographic organizations of activities. Thus industrial districts, innovation milieux or localized systems of production (LSP) are characterized by the existence of both types of proximity."*

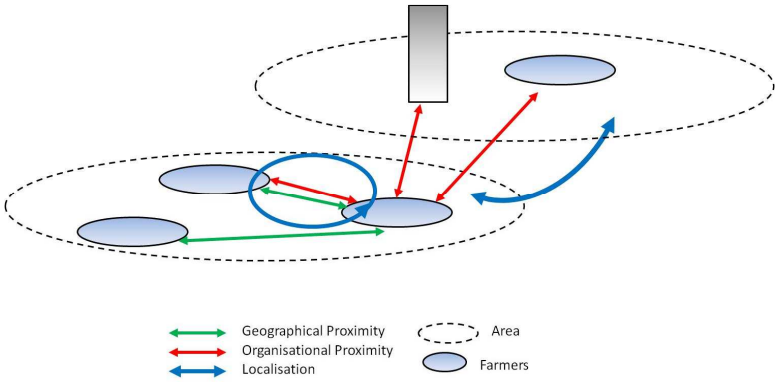


Figure 11 Interpretation of the relationships between proximities and localization (Torre, 2005)

In other words the success of clusters is not only depending on spatial proximity, but on the fact that between actors a certain network esists. "*The problem is no longer to determine where an actor is localized (in relation to the localization of other actors) but to understand how the action of actors develops simultaneously at different spatial scales."* (Torre and Rallet, 2005; pag.53)

Applied in local agro-food system, it enables to recognize two local systems (Fig. 11):

- the first one is the case of PGIs or PDOs, where the groups are *based on both geographical proximity (the belonging to the same area, often identified by a common productive territory) and an proximity organizational link of (belonging to the same union of producers)"* (Torre, 2000; pag. 4);

- the second one is the case of the geographical proximity – based relationships which purpose is the physical management of a delimitated area.

In this sense "local" is when a "territory" is build up, and this is possible only by the integration of geographical (intended as the spatial delimitation of an area) and organizational proximity (the creation of a network between the actors). In other words what makes local a territory is the capacity of relationships, which gives emphasis to the social networks established between actors.

Murdoch (2000) assigned to social networks the role of third element in the rural development process, among endogenous and exogenous resources. Nevertheless networks can vary a lot, especially they can be vertical or horizontal. Vertical networks can be food-chains, determined by power relationships. Power relationships are interpreted both from a perspective of actor's power (firms *versus* farmers for example), and with actor – network theory (ANT), where the power is more related to the links among actors, and

especially it considers all the links between all the enrolled entities (Murdoch, 2000). Instead of being sectoral, as agro-food chains are, horizontal networks are spatial. Horizontal rural networks enable local actors from different economic sectors to promote and benefit from the same territorial rural development. It is not just the fact to be in a certain area that helps innovation, but the fact to activate horizontal networks. Clusters and district are thus connected to this type of network. *"The emphasis on innovation indicates that the most appropriate associations or networks are not those that are just amalgams of pre-existing institutional arrangements but are those that enable new ways of orchestrating economic development"* (Murdoch, 2000; p. 413). Following this reflection *hybrid networks* do not exist: they are condition of horizontal networks, condition of rural development.

According to Torre, (2000) the link between *localisation*, *networks* and *proximity* is applicable in the relationships between rural, urban and periurban areas. Periurban areas are characterized by the search of a localization. When actors need more organizational (and thus relational) proximity they allocate them self in urban areas, where the density of networks is higher. When actors have the need of more space, so they give more values to geographical proximity, they prefer to stay in rural areas. When actors want to benefit from both geographical and organizational proximity they located themselves in periurban areas. With the purpose to contribute to this debate, Eriksen (2013) have thus proposed a taxonomy of proximity, by studying the definition of local product. Three domains of proximity are found: *Geographical proximity*, *Relational proximity*, and *Values of proximity*. The first one refers to explicit spatial reference, where food is produced, processed, retailed and so on. Relational proximity refers to the relationships between actors that go beyond the fact to be close to each one; for example, alternative food chains group actors for their specific relationships, more than their localization. Values of food chains refer to the

different values that actors attribute to local food, for example, the origin or the freshness.

1.2.3. Conclusion: which approach to combine periurban farming system and local food system?

Considering the high degree of heterogeneity which distinguish the analysis of both periurban agriculture and local food system, and the relevance that each approaches provide on the subject, the approach of this analysis is the result of a mixed composition of the approaches presented above (Fig.12).

The analysis will be based on a farming system approach, since it conceives the farm as a complex system, where the different elements, (e.g. crop management, environmental resources, manpower, marketing) are in relationships with the others; the farm is thus open to the different social, economical, territorial contexts it is in relation with. Moreover I assume a territorial approach, since I will study all the farming systems that are mobilised in the periurban area, with a perspective on the land use system approach and thus the influence that this phenomena has on the territorial farming system. Nevertheless the analysis will be farm-based, and in this sense with elements from farming system approach, since I will be focused on farming practices, considering farmers as the final decision-makers on their territorial management.

In this analysis the agro-food system is conceived as territorial organizations « that integrate actors, activities and spaces » (Benoit *et al.*, 2006). This is especially true for periurban farming systems, where the share of common territorial issues, makes periurban farmers a system of actors sharing a common “territory” not only because of the spatial proximity, but also as a the level where common symbolic values can be the starting point for the construction of a territorial development. This means that in opposition to

SYAL approach, the territory is a space well defined not only symbolic, where both the physical and the symbolic features of territory influence the farming practices and the primary produces commercialised locally; especially the production is selected not because of the production, but considering the localisation. In the foodshed there is first the definition of a food demand and then the suppliers are searched in a specific area, “where the food is coming or it might come from”: in the approach of this thesis the process is opposite: the interest is not in the supply basin, but in a demand basin, that is able to buy and valorise the local (periurban) production. While in Urban Food System approach the starting point is what the urban food system asks, here the starting point is what the periurban food system can produce, and can provide. Especially the analysis is not only the potential Food capacity, but the effective one as well as the production that effectively is locally consumed. The local food system is thus an alternative approach on food networks, but the starting point is not the food chain, as it is in AFNs’ approaches, but the territorial farming system that tries to integrate in alternative and especially local food systems. The territory is local in both geographical and organisational way: at territorial level farmers are proximate, and they share the same concerns about the fact to be in periurban areas; at level of food system they definite the networks they established to commercialize locally. In the case of periurban farming system the geographical proximity has value because farmers need to face a special environment with special issues (Fig.12).

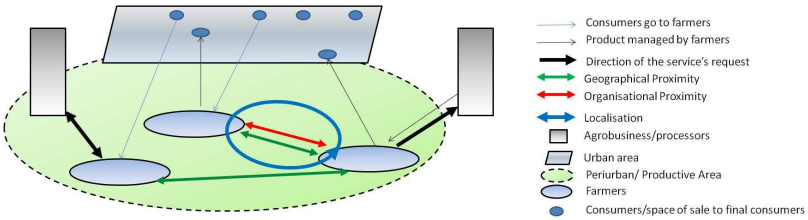


Figure 12 Approach on local food system in this thesis

For the purpose of this analysis the LFS is thus defined by the local commercial relationships that famers need to organize to sale locally the product (Fig.13). Especially we recognise different levels of locality: the local production and local buyers or consumers have the borders of the periurban area, while processors are located also outside the periurban area (Fig.12).

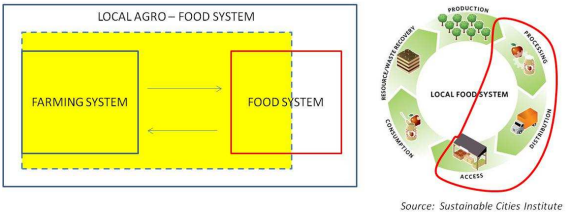


Figura 13 LFS include the farming system of periurban area and the first steps of the food chains: especially processing and distribution. For the purpose of this analysis a special enphasis is put on the production step, while no analysis will be done on final consumption.

1.3. Hypothesises

The general framework of this analysis considers the special relatioonship that is possible to establish between periurban farming system and LSF, which can be a ressource to address the territorial development of ares unders the influence of urban sprawl.

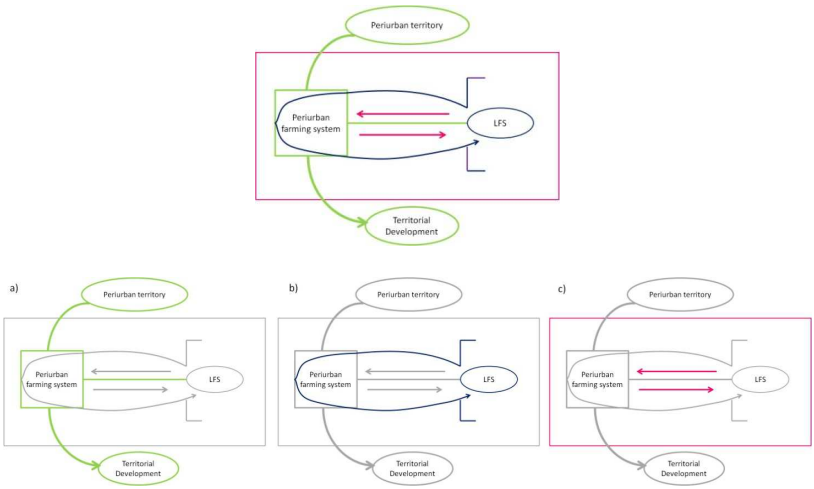


Figure 14 Hypothesis. a), b), and c) refer to the different composition of the genarl hypothesis

The analysis is based on three main hypothesises (Fig.14).

The first hypothesis (Fig.14a) has its starting point on the concern about the sustainability of periurban areas: the traditional equilibrium between urban area and its proximal agriculture-based area has changed. New patterns of sustainability need to be established, which ask agriculture to adapt in order to endure in the area, and it may ask the inclusion of the multifunctional character of agriculture activity in urban planning. Agriculture can be a tool of sustainable territorial development and LFS can be seen as a new economic possibility for periurban farmers.

The second hypothesis (Fig.14b) revokes LFS' debate. The growing demand of "local" food by final consumers reflects a growing interest in the food origin, assigning also a social value to local food productions. At the same time farmers are driven to free themselves of the traditional conventional food chains and followed the opportunities and new markets given by alternative FSC. The meeting between supply and demand has a great space in research, but it lacks of territorial perspective, and empirical evidences. The hypothesis

is that this perspective will enable research to better assess the effective participation of farmers, the conditions that affect farmers in participating in such food chains.

For this reason, in the third hypothesis, we need to consider the complexity of the farming system that participates in the local agro-food system; this means to consider not only the production that is in the LFS, but also the production produced by farmers LFS that is not included in local food supply chains (Fig.14c).

1.4. Purpose, research questions and methodological path

The overall purpose of this research is to develop a methodology for the assessment of the local potential food production's contribution offered by periurban agriculture to the local food system.

To reach this objective, several questions have been raised.

Q.1 What current food production by periurban agriculture of the urban region?

Q.2 How do farmers produce for the local food system?

Q.3 Under which conditions periurban agriculture can produce for the local food system?

To answer to these questions a methodological path has been built.

What current food production by periurban agriculture?

The objective is to describe and characterize the food production put in place by the periurban farming system (PuFS). This has been done through several steps.

In this study the analysis has been based on past interviews on the case study I have participated to (DAUME project, etc.), maps that consider the change in the soil use (CORINE Land Cover) and the statistical data in time series about the dynamics of the agricultural system and the population.

With the help of this study it has been possible to understand the principal dynamics of PuFSs, to select its periurban area's border and its main farming system. On the base of this study, it has been possible also to organize the sampling of the farming system, and so to do the interviews (Fig.14).

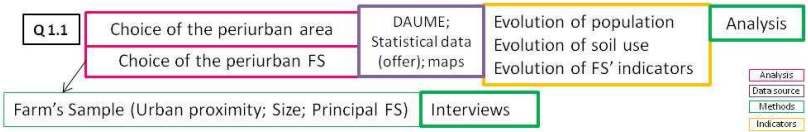


Figure 15 Q.1.1 Choice of periurban area case study

Thus, the choice on the PuFS has been done at two levels: a typological analysis of food production of PuFS (Q.1.2) and an analysis of the intensity's production of the farm level considering different commercialisation (Q.1.3) (Fig.15).

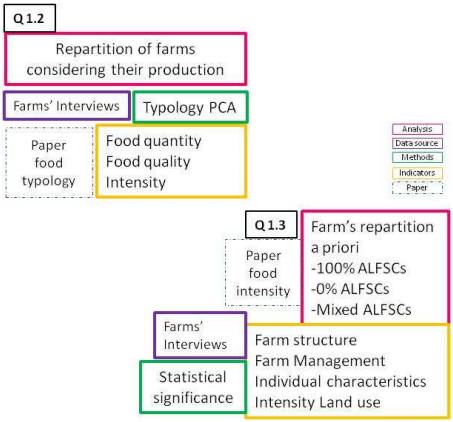


Figure 16 Q.1.2 Types of periurban farms considering the production and Q.1.3 Differences in intensification considering the commercialization

In both cases the data's sources are the interviews on the case study, and in both case the idea is to use the data to create categories of analysis able to describe the diversity of the production systems at the territorial level. This process from the local – the farmers – to the territory – the periurban farming system, has been done through different statistical analysis and different indicators, reflecting the different purposes of the analysis.

In the first case the statistical analysis is a multivariate analysis for the creation of typologies based on the PCA analysis: the purpose is to create categories/groups of farms considering only the farming practices and the management of the farms. In the second case there's *a priori* distinction of farms considering the different commercial orientation, and the analysis' purpose is to see which factors characterize the most each group of farms: for this reason the statistical analysis is based on the assessment of the statistical significance between the averages of the three groups' values.

In the analysis of food typology, the indicators refer especially to agronomic indicators, as the farming practices and something related more to the farm management. In the analysis of the production's intensity related to the commercialization, the indicators open to other aspects of the farming system approach, such as the individual farmer characteristics and farm territory. For this reason the typological analysis is only concentrated in the farming system's production moment, while the second one is more "opened" to the relationships with local food system. Especially in the second case there is the first distinction of the farms considering the grade of local commercial orientation, even if the analysis considers only the production side.

After the characterization of the food production of Pisa's PuFS, the purpose is to quantify its contribution to the local supply basin, the production capacity (Fig. 17).

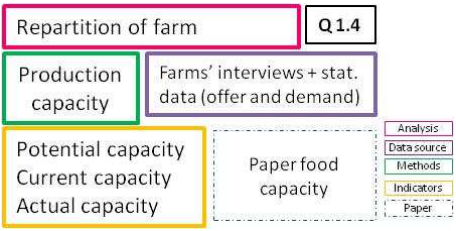


Figure 17 Q.1.4 : Food capacity

To do so, we need to bring together both the data about the offer and the data about the demand of production. For this reason the analysis calls at the same moment both the production system and consumption system, even if the study remains focused on the supply side. For the supply side the data's sources are both the farms' interviews and the statistical data from agricultural census, while for the consumption side the data are based on the national statistical dataset. Even in this case, the objective is to bring farm and national data to an intermediate level, the territorial level.

In this way it is possible to create three indicators able to assess different aspects of the production capacity: the potential, the effective and the efficient food capacity. The first one is based only on national statistical data, the effective food capacity is based on all the sample's production, while in the efficient food capacity the supply consist only in the sample's production sold in the territory.

Considering the differences between these three indicators, and especially between effective and efficient food capacity, I asks how and why farmers organize a local food chain, or they are involved in it, making available the product at local market/local food system.

How farmers produce for the local food system?

The differences in the production capacity's indicators, open the analysis to the different strategies farmers put in place to approach local markets (Q.2.1) (Fig. 18). The objective is to understand in which way farmers' production is available in LFS.

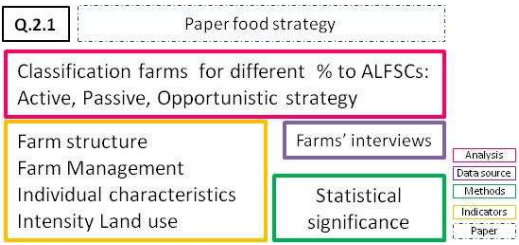


Figure18 Q.2.1 Farmers strategy

This study considers only farmers that participate in local food system thorough alternative food supply chains, what in the study it has been called as Alternative Local Food Supply Chains (ALFSCs) and it classify them *a priori* considering the percentage of production devolved to ALFSCs. Thus, several groups of indicators from agronomical and economical approaches are applied, associated with a statistical analysis based on the assessment of the statistical significance between the averages of the three groups' values. In this way it is possible to understand which elements characterize the most the three strategies.

Even in this case the data's sources are based on the interviews, and the scope is to raise a territorial analysis from local based data.

The analysis of the strategies is associated with a network analysis of the food supply chain (Q.2.2) (Fig. 19). This analysis is based on the spatialisation of the commercial network for the farming system.

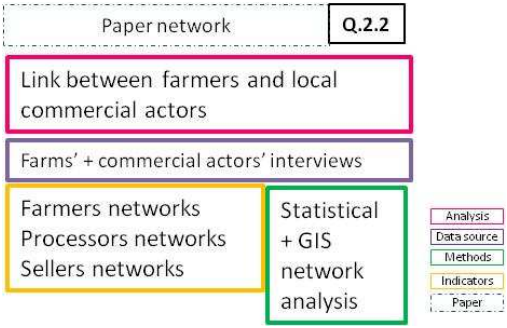


Figure 19 Q.2.2 Network analysis

This analysis is more focused on the relationships of the PuFS with the wider local food system, and not just the PuFS in itself. As for the production capacity's analysis, the network analysis calls at the same time the supply and the demand of local product. In this case the demand is not the final consumption but the very first step of the food chains, the first actors of the local food chain that use the product and thus they have a commercial relationships with periurban farmers ("commercial actors"). In this way, different systems of food chains are possible, and the objective of this analysis is to understand which possibilities farmers have to maintain the production at the local food system.

In this analysis it is possible to develop the networks from three different perspectives: one from the main productions of the PuFS that links producers and commercial actors, in order to see how the production is distributed at the local level; a farmers' networks, in order to understand similarities of farmers considering the strategies they put in place; a commercial actors' networks, in order to understand the supply basin of the first step of the local food system.

In order to carry out this study different analysis are possible. First of all a spatial analysis based on *Geographical Information System*, in order to understand the role played by space in supporting the local food system; this

analysis is based on the calculation of the distance but also the attraction and the accessibility of a certain actors' network. Considering the differences in these three different network's perspectives another statistical analysis is needed, with the aim to characterize better the networks. This can be done by the development of the network table that tries to quantify and qualify the networks considering different indicators.

Finally the networks' characterization opens to the analysis of the constraints and the conditions that make these local food chains possible.

Under which conditions periurban agriculture can produce for the local food system?

The objective is to understand what kind of constraints and opportunities farmers face when they try to approach local food system (Q3) (Fig. 20).



Figure20 Q.3 Farmers and commercial actors' constraints

Several indicators have been found in both sides, and a simple descriptive statistical analysis has been carried out in order to understand the importance of each constraints/conditions for the PFS. The analysis is carried out only on the farmers that participate in the local food system.

This analysis is associated with an analysis of the constraints that commercial actors face when they approach the PuFS, in order to assess the possibilities to develop this system. The indicators are different, because the interests of the actors are different. This analysis opens to future perspectives to analyze better commercial actors' side.

Moreover the constraints' analysis opens to the contribution of the public policies in reducing these constraints and contribute to the territorial development of the PuFS and the local food system.

Methodological Pathway

Finally it is possible to have an overview of the methodological pathway in Fig.21. This methodological path has been built considering two levels of analysis the farming system in itself and in its relationship with the "territory". Moreover the first question consider all the production produced in the area by the periurban agriculture, while the second and third questions take into account only the production allocated in the same area of production. The methodological path combines different indicators regarding the farming system, and different statistical analysis has been used in order to properly answer to the research questions.

It is also possible to identify methodological analysis and analysis that give results also for the case study (Fig. 22).

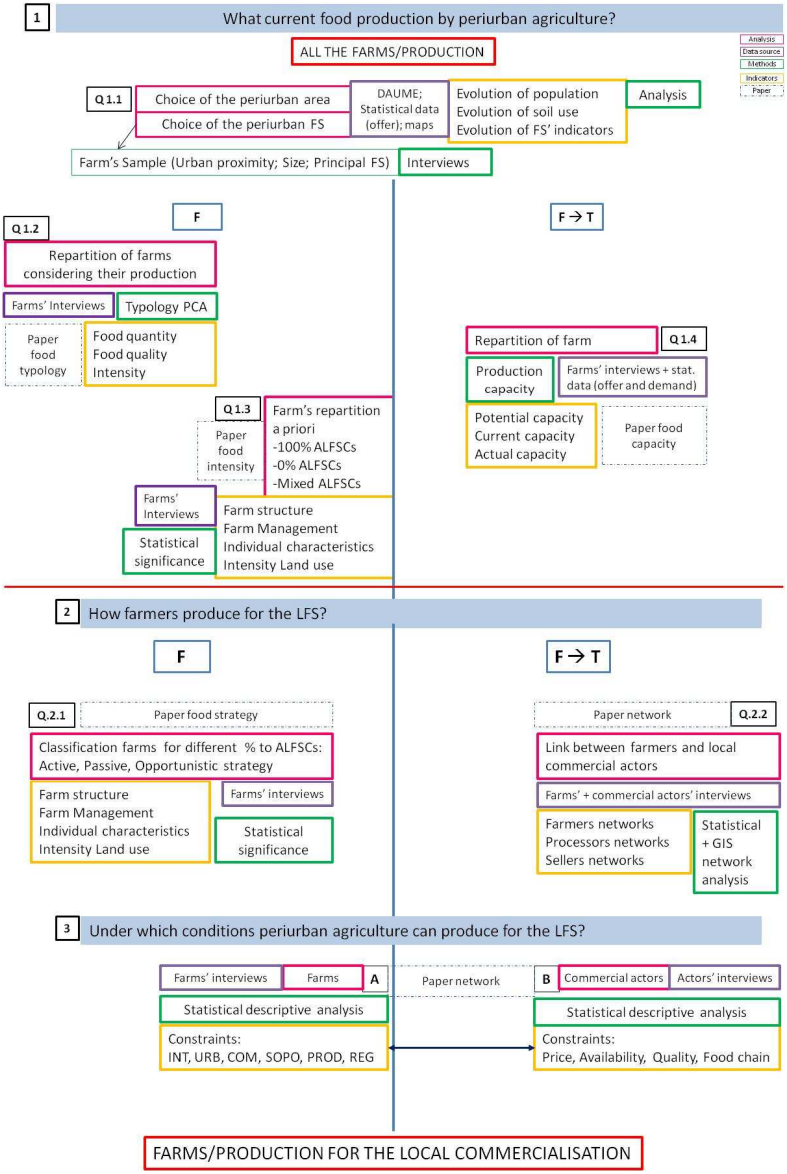


Figure 21 Composition of the Methodological Pathway

Figure 22 Methodological pathway

Link between research questions and hypothesis

In the first research question, the assessment of the complex development of the wider periurban farming system (Q.1.1 –Q.1.2) replies to the first hypothesis, as well as the assessment of farming system that participate in LFS (Q.1.3 –Q.1.4), since it considers the effective possibility of LFS as a tool for periurban farming system's development (Fig. 22a). Moreover it replies to second hypothesis since it considers the farms not because of the food chain, but their (even minimal) participation in LFS with a territorial approach, and assessing how the connection is done (Fig.22b).

Similarly the second research question (Q2) questions the H3, by assessing the complexity of the farming system that participates in the LFS, with a starting point from the food chains farmers are involved (Fig.22b).

Finally the third research question (Q3) questions all the 3 hypothesis, by considering the periurban faming system, that has commercial relationships with local food system (H2/H3) in a wider territorial development's perspective (H2) (Fig.22c).

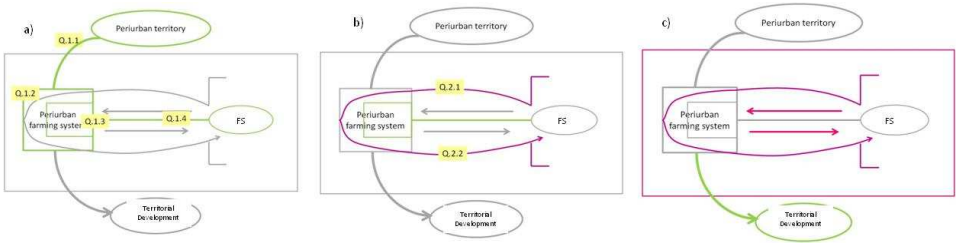


Figura 22 Hypothesis and research questions

1.5. Case study – Selection of periurban farming system

The case study is the urban region of Pisa in Tuscany Italy. The area consists of seven municipalities: Pisa, Cascina, Calci, Vecchiano, Vicopisano, San Giuliano Terme and Buti (Fig.23). The first 6 municipalities are commonly known as the "Area Pisana" geographically encircled by the coastal area in the east side, the Monte Pisano in the north, the Province of Livorno and the hills in the south part, and in east part by the Valdarno plain. These municipalities are part of an intermunicipality's plan, Piano Strutturale dell'Area Pisana, which main objective is to integrate municipal local policies on public services (educations, healthy, public transport) and territorial management. Among the main concerns, the document includes the urban sprawl caused by the urbanization and the loss of population in the main urban center (Pisa), the loss of agricultural soil, and the decline of the traditional rural functions (Comune di Pisa, 2013). The municipality of Buti has been included because it's part of Monte Pisano, so it shares several territorial and so farming issues with the other Monte's municipalities.

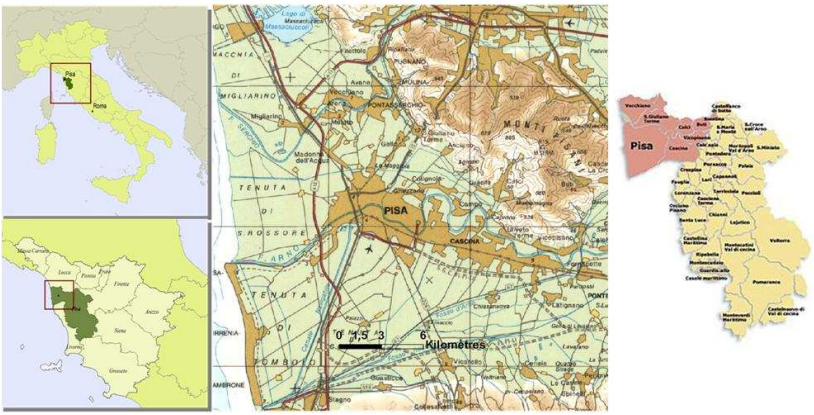


Figure 23 Area Pisana, inside the Pisa's provincial territory

1.5.1. Territorial and demographical data

The region has a surface of 500 km^2 and it is crossed by two rivers, the Arno and the Serchio, along with a dense network of land reclamation channels and ditches. The climate is Mediterranean, with an average rainfall ranging from 800 mm nearby the coast to 1100 mm in Monte Pisano and an average annual temperature of around 15°C (Fig. 2). Soils are mainly sandy and clay in the coastal area, with more silty loam in the Serchio river plain. The plain between the Arno and Serchio rivers has mainly sandy-loam soils.

The area is characterized by a territory with heterogeneous local issues. The area is particularly interesting for this analysis, considering the specific stakes that agriculture faces at territorial level.

The North part of the area borders with the Massaciuccoli lake (Fig.24); the area is characterized by several dramatic issues connected to the water drainage and the soil subsidence, which at the long term can heavily constraints the agricultural practices in the area (Pistocchi et al., 2012; Silvestri et al., 2012)

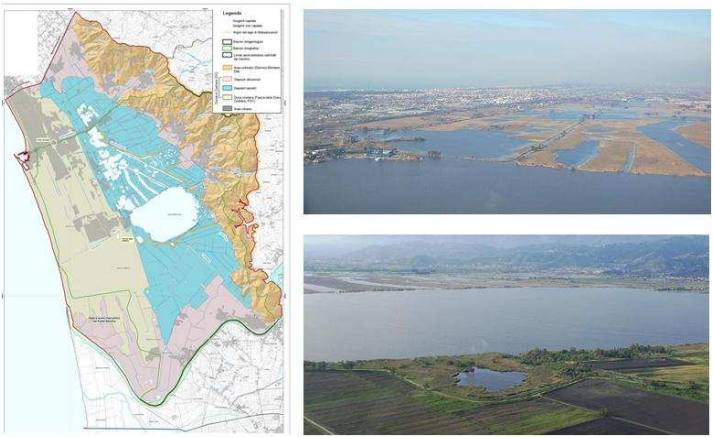


Figura 24 Masacciuccoli Area

The West side of the plain is a coastal area where a regional natural park is established, *Ente Parco Regionale di Migliarino San Rossore Massaciuccoli*. The main purpose of this park is the natural protection of the coastal environment. The Park's area is composed by 23.115 ha, which about 600 ha are UAA in Pisa's province. Around the park's border it has been established a buffer zone where private farms are located, called *area contigua* and having the same rules regarding agricultural management practices than the core area of the park (Fig. 25)

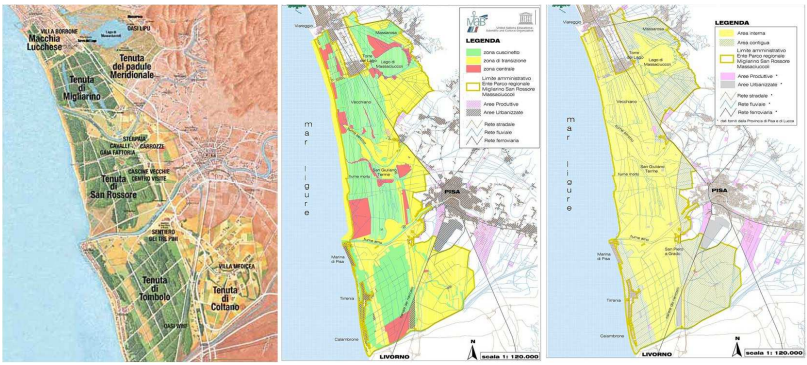


Figura 25 Area of the Parco Regionale (Source Ente Parco, http://www.parcosanrossore.org/conoscere-il-parco/cartografia)

The Monte Pisano (917 m a.s.l) in the North-East side of the area (Fig.26) is characterized especially by olive oil productions, above all maintained by hobby farmer s; the area is living an important phenomenon of land abandonment (Rizzo et al., 2009; Rizzo et al., 2013). A consequence is also the abandonment of terraces for the olive trees. These dynamics are associated with soil erosion, landslides, fire risk (Marraccini et al., 2013)

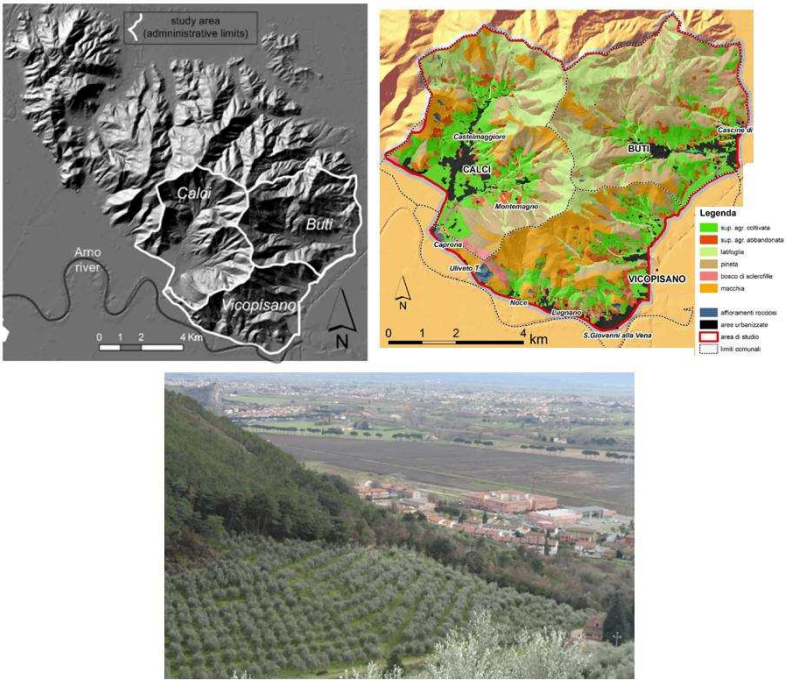


Figura 26 Monte Pisano (*Source*: Rizzo, 2009 and Marraccini, 2013)

The plain area is characterized by an increasing urbanization, due especially to infrastructure, industrial and residential purposes. The urbanization has been polycentric, following the main road network especially in the axes Pisa – Florence, but also following the roads towards Monte Pisano (Fig. 27).

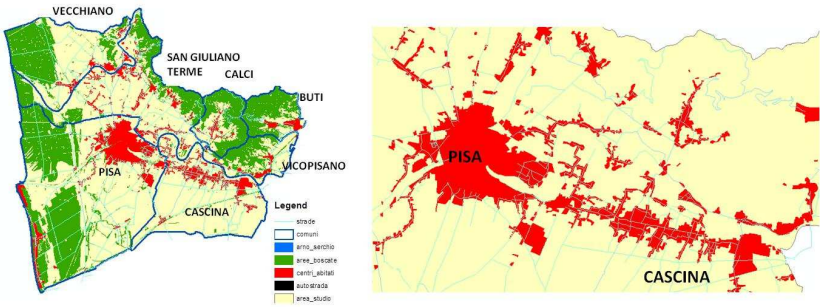


Figura 27 Urban areas in the plain. ***(Source: personal elaboration)***

The area has a population density of almost 400 inhabitants per km^2 and represents the second largest metropolitan area in Tuscany. This area follows the European urban demographic trend for the last decade: in the last national census (ISTAT, 2011) while the number of citizens has decreased in the city (- 4%), the nearby urban centers have increased their population on average by 8% (Fig. 28). The urban area is thus illustrative of the Italian urban sprawl in medium-sized towns, also defined with the term “urban shrinkage”.

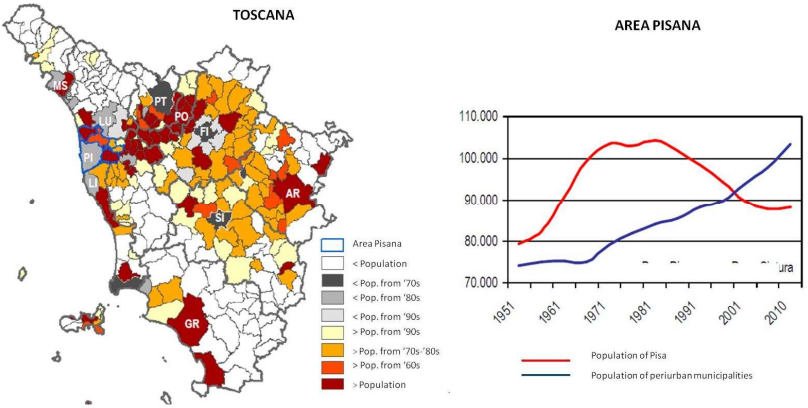


Figure 28 Demographic Dynamic in Tuscany and in the Area Pisana 1951-2010 ***(Source - Comune di Pisa, 2013)***

In this area there are thus several issues concerning the role of agriculture and its relationships with urban areas and urban dwellers.

1.5.2. Agriculture

The case study appears relevant due to the heterogeneity of the farming systems that characterize agricultural sector of the area (Fig.29). In this way it enables the analysis of the possible different implications that LFS and periurban agriculture's development for different farming systems.

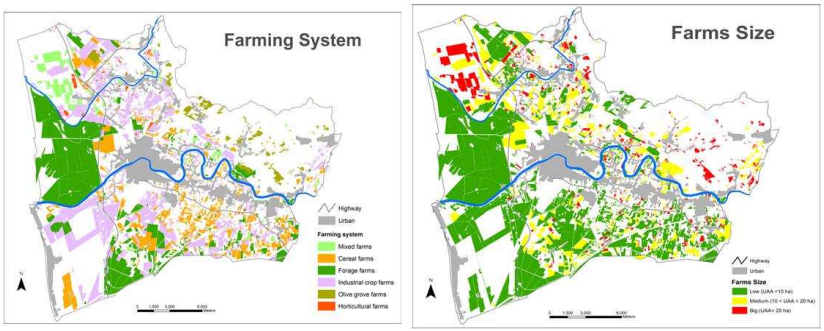


Figure 29 Farming systems and farms size ***(Source: Institute of Life Sciences on LPIS – Land Parcel Identification System 2012 data from ARTEA)***

As the last National Agricultural Census has shown, agriculture activity has lived important changes in the last decades (Fig.30).

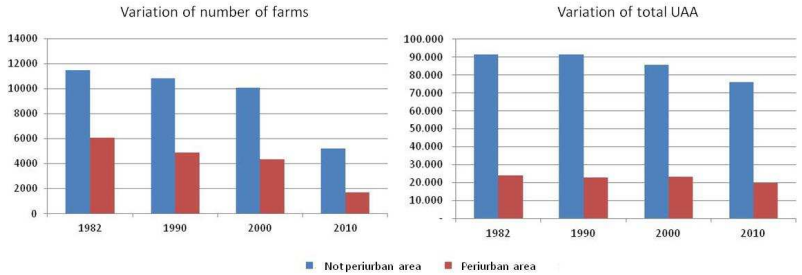


Figure 30 Changes in the farm number and total UAA from 1982 in periurban and not periurban areas (*ISTAT 2011*). The not periurban area are the remaining municipalities of the Provinces apart the Area Pisana (31 municipalities)

The total UAA is decreased both in periurban and not periurban areas, with few differences (average rate of 6,2 % versus 5,9%); at the same time the numer of periurban farms has decreased 30% (average) while in not periurban areas about 20%. In both cases the decrease of farms has been especially in the last decade. In the years 2000-2010 periurban area of Pisa has lost 60% of the farms surveyed in 2000. The UAA more lost is concentrated in the municipalities of Monte Pisano, while it seems to resist in Cascina and partially in the municipality of Pisa.

Livestock was once at the basis of the traditional farming in the area, in small-scale mixed farms. From 1982 the total Area Pisana's LU (Livestock Units) has decreased of 66% while in the total province the decrease has been of 48% (Fig.31); however it is in the periurban area that the decrease was shorter in the last decade (48% vs 54%) (Fig.21). In the Area Pisana, the main livestock productions are cattle, sheep, and horses. Among the total LU the percentage of sheep and cattle breeding has increased, while horses have decreased, conversely of what is expected in literature (Zasada et al., 2011a). However In the last three decades, the number of livestock farms has decreased significantly, by 84% of the cattle farms and 73% for sheep farms.

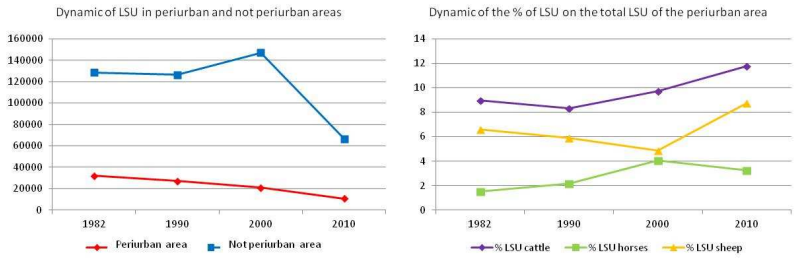


Figura 31 The total LU includes cattle, sheep, pigs, goat, winged animals, and rabbits. ***(ISTAT, 2011)***

Current livestock production is located in the plain, with 52 cattle farms and 32 sheep farms, 2% and 1% respectively of the total local farms according the last agricultural census (ISTAT, 2011).

Livestock production benefits from a number of labels in addition to organic agriculture, such as the protected designation of origin “Vitellone Bianco dell’Italia Centrale” (veal), the local label “Carne Bovina di Pisa” (beef) and “Pecorino del Parco” (sheep cheese) run by the local livestock producer association and the Province of Pisa (APA, 2013).

Horticultural production, traditional of the area, has decreased in number of farms, as well as total UAA. At the moment it is mainly located in the fragmented area around Cascina and especially it has been done a connection between the high fragmentation of urbanization and the loss of horticultural UAA. At the moment several horticultural farms are still connected to conventional food chains (Fig.34).

Olive oil production have decreased more the percentage of UAA, than the number of farms: since olive production in the area is characteristic of the Monte Pisano’s municipalities, this result confirms the progressive abandonment of surface (Fig.34).

In the periurban area there has been a process of progressive intensification of productions, especially with fodder and cereal production. Usually fodder

productions were connected to the horses' breeding, but it is also exported (Fig.34). Wheat and industrial crops (especially sunflower) have increased in the last decade both in UAA and number of farms.

1.5.3. Agro-urban projects

The area is characterized by interesting dynamic in agriurban projects (Marraccini et al, 2013). Especially in the area it has been developed the *Piano del Cibo della Provincia di Pisa* (Di Iacovo et al., 2013). The Piano del Cibo is a framework of discussion, proposition and research around the topic of urban consumption of food. The main topic is to know, socialize and change the way the culture of food supply is perceived (Provinicia di Pisa, 2012). In this framework reflections are open about the role of periurban agriculture in the contribution of urban food security. The operational tools put in place thought were:

1. Carta del cibo, where the main objective of the projects are indicated;
2. Strategia del cibo, which aim is to identify the critical issues of Pisa's LFS and the possible solutions;
3. Piano del Cibo, as a tool of *coordination* of the existing experience

At the moment initiatives link to this experience are *Food Councils* (Consigli del Cibo), organized in Pisa's municipality with the participation of citizens and other local stakeholders, especially schools.

1.5.4. Selection of actors and interviews

The actors interviewed for this research are farmers, commercial actors and intermediate actors.

Farmers were selected in the framework of DAUME project (*Durabilité des Agricultures Urbaines dans le Mediterranée*, for more information see http://www1.montpellier.inra.fr/daume/?p=2&t=project). The 57 farmers interviewed were selected considering the main farming system; the size; and the distance from urban center (Fig.32). The interviews were semi-structured and were design to inquire several elements concerning the farming practices (rotations' cycles, input, livestock productions), the farm structure (building, manpower, machinery), the farm social composition and origin (family's support, education, ages), as well as farm's commercialization (buyers, prices, quantity of production), and farms relations with urban area, focusing especially on constraints and opportunities coming from urbanization.

Commercial actors are the first local buyers of farmers, excluding final consumers. They have been selected because cited in the interviews, and because they are part of the food chains of the main farming system of the area. In total 15 actors were interviewed (Fig.33). Interviews were semi-structured and aim to understand the function of the actor within the local food system (processing, sale or distribution), the number of farms, origin and typology of contracts, along with the constraints and drivers of local periurban agriculture.

Intermediate actors have been selected considering the interviews done in DAUME project, they have been defined considering their function to sustain agri-urban projects or specific food-supply chain projects.

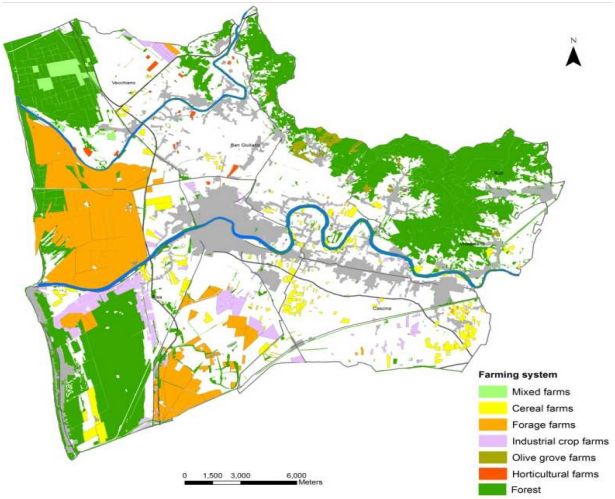


Figura 32 Principal farming system of the farms interviewd

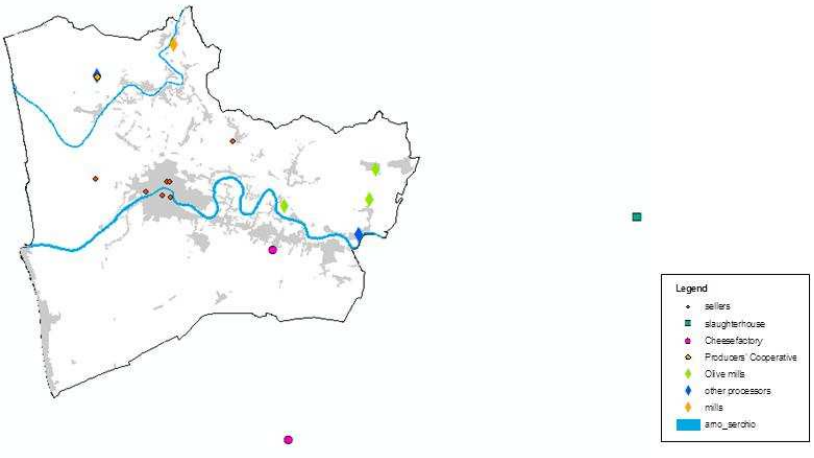


Figura 33 Localisation of the commercial actors interviewed

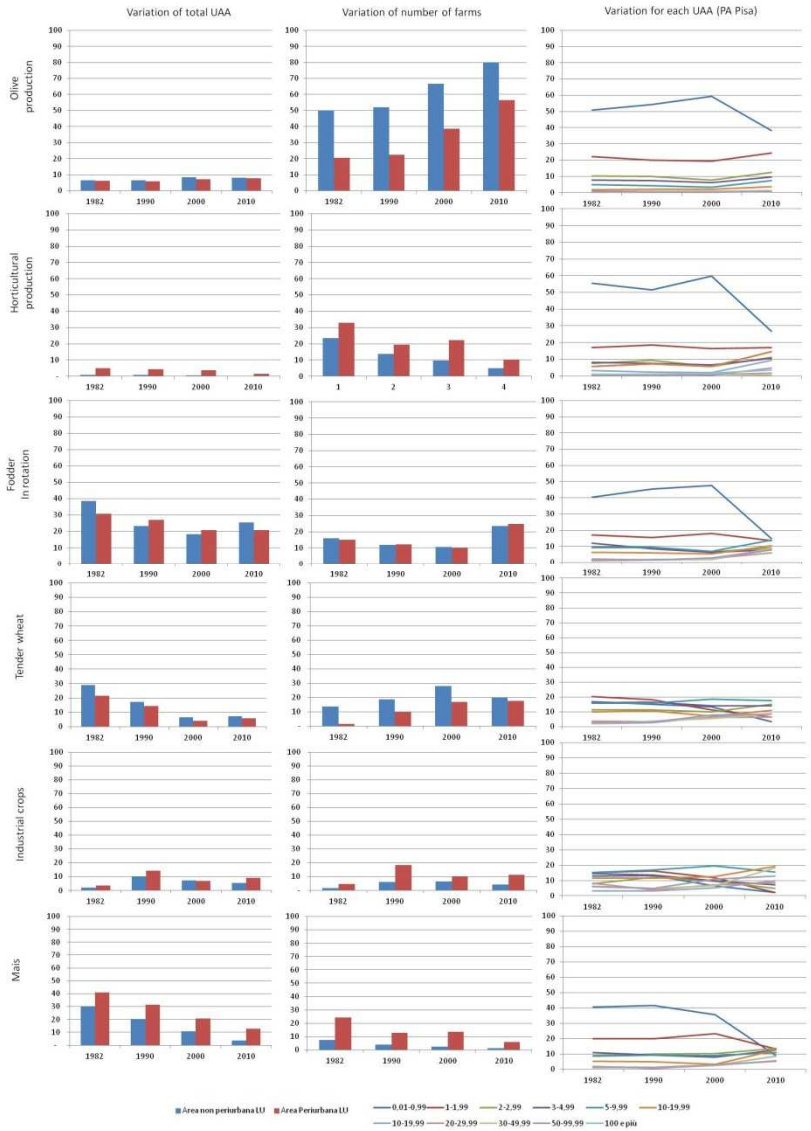


Figure34 Changes in number of farms, percentage of UAA for periurban and not periurban municipalities, and variation of UAA's classes for periurban agrculture. Data from the principal productions and for the last 30 years (ISTAT, 2011).

2.

3. Food production typology of farms: an assessment of periurban farming systems' contribution to local food system (Italy)

Paper in preparation, to be submitted to Agricultural Systems

Q.1.1

This paper provides data on the composition of farm's food production, trough the creation of farms' types considering three classes of indicators: the quality, the quantity and the intensity of farms' food production. The analysis considers all the production of farms at the territorial level, in order to have evidence of the production at potential disposition of the LFS, and data on farms' food production performances.

Food production typology of farms: an assessment of periurban farming systems

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1. Introduction

A more complex understanding of what "food security" means is needed (Godfray and Garnet, 2014). As Sonnino (2014) stated, the debate is not only on the efficiency in allocating a sufficient quantity of food production for a growing urban population, but also in combining this efficiency with the stakes of environmental and social sustainability. In other words it means to analyse together both the quantity and the quality of food production along with the ecosystem services provided by the intensity of food production (FAO 2010).

In this context, the debate around the stakes of periurban farming systems, has been seen as a possible link with the stakes of food security. Periurban agriculture has been differently defined. Several authors and institutions have pointed out the stakes of sustainability concerning periurban farming systems (FAO, 2010). Considering the specific constraints and conflicts that periurban farming systems need to face, a specific attention has to be paid on what kind of food production is possible around the cities.

1.1. The stakes of periurban farming system in terms of quality, quantity and intensity

Periurban agriculture has been defined considering different perspectives: from a geographical-spatial perspective where periurban agriculture is just the agriculture activity put in place in a defined area *close to* the urban area, to a functional perspective that defines periurban agriculture considering the functional link between agriculture and urban area and its citizens. In this perspective especially the social, economical and environmental positive externalities of periurban farming systems have been assessed (Allen, 2003; Zasada, 2011), offering new views on the innovative link between urban and periurban areas, between urban consumers and local producers, between food consumption and periurban farming practices. More recently the debate on food security and the emergence in several countries of food policies and plans (Sonnino, 2014) have raised questions about the capacity of agriculture to assure food provision to urban consumers. In this context, the authors have considered the food production function of agriculture in periurban areas, considering its geographical proximity to urban area and its citizens-consumers (Clark et al., 2010). The assessment of the food production capacity of periurban farming system (Filippini et al., 2014), has been carried out considering different approaches and techniques. These techniques have linked the values of potential food production to the amount of hectares (Gerben-Leenes and Nonhebel, 2005), to the production's intensity (Colasanti and Hamm, 2010), to the calories produced (Sali et al., 2014), to the potential and/or effective yields, the season availability of primary produces (Colasanti and Hamm, 2010), the presence of commercial relationships that can help local food supply chains, the local consumption patterns, or the local expenses for food (Filippini et al., 2014). Especially in Filippini et al. (2014) authors have demonstrated a gap between the potential food capacity and the actual food production that is delivered to local markets. The heterogeneity of techniques elaborated by researches, follows the complexity

of such assessment that needs to include a complex system as the farming system.

Following these contributions both on developing and developed countries, the relevance of preserving agricultural activities in the periurban fringe has been demonstrated (Lerner and Eakin, 2011; Zasada, 2011).

Nevertheless studies have pointed out that the same geographic proximity causes several stakes to periurban agriculture. In this sense periurban agriculture has been also defined not only because of the functions that link urban and agriculture activities, but also because of the "urban shadow" with which agriculture needs to coexist. The dynamic of *periurbanization*, defined as the dispersive urban growth, which causes a *patchwork* of rural and urban areas (Allen, 2003), imposes to periurban faming system to *adapt* (Pascucci, 2007; Tolron, 2001) its farming practices and its attitude on farm activity. Pascucci (2007) has highlighted that the location in an area under urban pressure, may cause negative externalities on traditional farming practices. The process of urbanisation may cause the loss and the fragmentation of agricultural land, the rise of prices for the rent or the purchase of land, more possibilities of pollution from industrialised areas and infrastructures, urban smog, theft, vandalism (Heimlich, 2001). Moreover several studies have assessed the growing social conflict between the new residents and the farmers (Darly and Torre, 2013). The periurbanization may also amplify the negative externalities of the traditional farming practices on urban residents and areas: the noise of farming activities, the pollution caused by pesticides and animal wastewater. At the same time some positive externalities of farming practices are limited as the control of flooding. In this context the adaptation of the farming practices (Pascucci, 2007) dealing with an urbanized area, asks for new patterns of food production's intensity (Cavailhès and Wavresky, 2007; Wortman and Lovell, 2013). Few studies has been focused on the assessment of this adaptation process (Tolron, 2001;

Akimowicz 2012), and especially in the characterization of farms' system in the periurban farming system.

In fact this adaptation asks periurban farming system that asks for new patterns of food production's intensity and evaluation of food quality (Cavailhès and Wavresky, 2007; Wortman and Lovell, 2013). Wortman and Lovell (2013) for example have emphasized the need of studies assessing how to improve the "space-intensive production system" for farming systems with less availability of land than traditional ones; Ven der Sluis et al. (2015) assessed differences in the farming system's intensity in Europe comparing case studies of rural and periurban farming system and also different types of farmer, and concludes that the intensification of farming practices is more relevant in periurban areas. Zasada et al (2013), added observations on the high adaptability of periurban farms however connected to a more vulnerability. Nevertheless studies have pointed out that in periurban areas hobby and part-time farming is increasing, linked to an extensification of the farming practices, especially consequence of land abandonment. Most of these studies are statistical-based, and there's a place for more empirical analysis of intensity of farming system production.

1.2. Farms' types-based analysis to evaluate the diversification of periurban farming system

According to Soulard and Aubry (2011) the urban dynamic creates a process of diversification of farming activities linked with different urban demands and urban influence on agriculture activity. For this reason, analysis based on farm's type are needed in order to highlight the heterogeneity of each periurban farming systems at territorial level. The creation of a farm's typology can help research in understanding the characteristics of the periurban farming systems in itself, the identification of the production's possibilities and opportunities, and in this way it can help the development of

recommendation and specific actions for the development of periurban farming systems (Dossa et al., 2011; Köbrich et al., 2003).

Moreover several authors have remarked that the permanence of agriculture in periurban areas is strongly influenced by the presence of farms: farmers are the final decision-makers on the use of farm's land and other natural resources, influencing the landscape's management of the area (Andersen et al., 2007; Bocchi, 2013).

Several studies on farms' typologies have been made. These analysis are mainly focused on developing countries, in order to assess the contribution of agriculture to urban food security, in context of rapid growth, social instability (Bidogeza et al., 2009; Siegmund-Schultze and Rischkowsky, 2001; Dossa et al., 2011; Köbrich et al., 2003) at the base of the so-called "food desert". In Europe studies on periurban farm types are especially qualitative analysis (e.g. Soulard and Thareau, 2009), while quantitative methods allow researchers to compare different case studies (Dossa et al., 2011), as well as they allow to show the relationships among the farm's type (von der Dunk et al., 2011). Quantitative methods were used for the creation of farm types at European level (Andersen et al, 2007), in order to assess macro regional differences in the farm performances, or at more local level to assess performance in marginal-rural areas (Gaspar et al. 2008), but not in periurban areas. Moreover they are concentrated in analyzing different performances of farms for specific productions, like livestock productions (Kostov and McErlean, 2006) or cereals crops (Capillon et David, 1997), but they do not combine different farming systems in the same area.

Moreover the farming system approach asks for a multidisciplinary approach able to assess in a more complete way the complexity of the farming dynamic on the food production. This is especially true if we refer again to the complexity of the concept of food security promoted by Sonnino (2014), where different stakes of sustainability are mobilized on how the food

production should be organized. Recently several authors have thus proposed to create farm types that involving different dimensions of the food production: for example, Andersen et al. (2007) proposed to add environmental indicators, based on the intensity's production, to the EU farm typology, based on the distribution of the farming income from the different production sources. This new "extended farm typology" should better explain the environmental pressure of farms, and the link between the quantity of produce, measured by the income gained, and the environmental performances. Considering a specific area, Gaspar et al. (2008), assessed together technical, economic and productive aspects, creating types of livestock farms with a less or more intensive production, less or more profitable production, and bigger or smaller farms only in terms of UAA. Dossa et al (2011) combine together social indicators referring to the farmer, and technical indicators of production, to describe farms. Huynh et al. (2014), proposed the creation of farms types with quantitative method that refer to social and productive indicators of the farm structure, and they interpret the results with qualitative analysis.

To our knowledge there are no studies that create types of farms considering the quantity, quality and intensity of food production. This topic is timely considering the debates on food security and the potential role of periurban agriculture as one of the possible solutions to this issue, even in Europe.

1.3. Aim of the study

The purpose of this contribution is to develop a methodology for the characterization of the food production by periurban farming systems through farm typologies. The food production will be assessed in terms of quantity, quality and intensity of the on-farm food production. The integration of quantitative, qualitative and intensification's indicators will offer us a more complex understanding of the periurban farming systems and thus its effective role in fulfill the food security's demands.

We hypothesize that different patterns of food production can be possible in periurban areas, and that these patterns do not exclusively depend on the main orientation of the farming system the farm belong to. In other words, we will test if there are differences among the same farm's productive orientation, and how these differences depends more on the different integration of quality, quantity and intensity of farm's food production. Especially we test how this relationship is in place.

Furthermore, we hypothesize that the labelled production is not always correlated with the production intensity: this means a less intensive production is not always correlated with quality labels, and that a more intensive production doesn't mean a less certified quality production. The presence of labels that assess the quality of the production indicates a choice of the farmer to have a stronger market power, and it certifies external controls from the farm on the production cycle and the farm management. Considering the debate around the food capacity, we would like to test the link between the quantity of food's products and the local destination, considering the possibility that the more they produce, the more they can contribute to the local food security. Several authors have observed a link between farming practices and the product's market destination; especially we test if for produces devolved to local markets the intensity's production is lower than for products sold through conventional food chains (cooperatives, traders, agro-industrial enterprises), where the interest is more in the quantity, and so the production's intensity is higher.

2. Materials and Methods

2.1. Case study

The case study is the periurban farming system of Pisa, a medium-sized city of Tuscany (Italy).

The area is representative of the main dynamics of periurban agriculture in coastal plains of Mediterranean areas. This urban area follows the European urban demographic trend for the last decade: in the last national census (ISTAT, 2011) while the number of citizens has decreased in the city centre (-4%), the nearby urban centers have increased their population on average by 8%. The area is also representative of the Mediterranean small-scale farming where the most important farming systems are olive groves oriented (34%), winter cereals oriented (26% of cereal oriented farms on the total farms) horticultural oriented (8%), and forage/livestock oriented (16%). The last agricultural census has revealed a decrease in the number of farms (-36% since 2000), especially for the horticultural production (-92%), traditional farming system of the area; the average size has slightly increased for all the farming systems (Marraccini et al., 2012). Moreover in the area local institutions have developed a food plan, *Piano del Cibo della Provincia di Pisa*, which one of the purposes was to recognise the contribution of local farming system to the local food demand (Di Iacovo et al., 2013).

2.2. Farm Sampling and interviews

The methodology of this analysis is based on interviews to 51 farmers, done in the year 2013. Farms were selected considering 3 criteria: the main production among the most representative productions of the area (ISTAT, 2010), which are fodder and cereal crops, horticulture, olive groves, industrial crops; the farm's size, adapted to the farming system's production; the distance of the farm field blocks from the main urban centre, in order to have closer or farer farmsteads from the main town of Pisa. In Table 1 an overview of the main characteristics of the farms selected. In Fig. 1 we provided a map of the main location of the surveyed farms considering the main farming system.

Table 1– Main Characteristics of the farm sample. UAA indicates the Usable Agricultural Area. Local Food System (LFS) is defined following the definition of Kneafsey et al. (2013). Org. Prod. means the presence (1) or not (0) of organic labels

Farm	General type	UAA	Principal farming system	% of LFS	Org. Prod
J7_0	Family farm	284	Livestock/Fodder crops	95	1
J7_1	Family farm	11	Olive	70	1
J7_4	Family farm	10	Olive	60	1
J7_5	Family farm	11	Olive	90	1
J7_6	Family farm	1,6	Olive	80	1
J7_7	University experimental farm	420	Livestock/Industrial crops	80	1
J7_8	Family farm	3	Olive	50	1
J7_9	Family farm	22	Horticulture	2	0
J7_10	Family farm	126	Livestock/Fodder crops	80	1
J7_11	Family farm	380	Livestock/Fodder crops	0	1
J7_12	Family farm	140	Livestock/Fodder crops	90	0
J7_13	Family farm	242	Cereal crops	0	0
J7_14	Family farm	224	Cereal crops	0	0
J7_15	Family farm	64	Cereal crops	0	0
J7_16	Family farm	150	Cereal crops	0	0
J7_18	Family farm	440	Industrial crops	0	0
J7_19	Family farm	220	Cereal crops	0	0
J7_20	Family farm	14	Horticulture	100	1
J7_22	Family farm	9	Olive	0	1
J7_23	Family farm	230	Cereal crops	0	0
J7_24	Family farm	77	Cereal crops	0	0
J7_25	Family farm	310	Fodder crops	0	0
J7_26	Family farm	250	Horticulture	5	0
J7_27	Family farm	10	Livestock/Fodder crops	0	0
J7_28	Family farm	5	Olive	2	0
J7_30	Family farm	250	Livestock/Fodder crops	2	0
J7_31	Family farm	65	Livestock/Fodder crops	100	1
J7_32	Family farm	290	Livestock/Fodder crops	0	0
J7_33	Family farm	17	Cereal crops	0	0
J7_35	Family farm	145	Cereal crops	65	0
J7_36	Family farm	40	Cereal crops	0	0
J7_37	Family farm	1,8	Olive	100	0
J7_38	Family farm	7	Horticulture	50	0
J7_39	Family farm	11	Horticulture	50	0
J7_40	Family farm	30	Livestock/Industrial crops	90	0
J7_41	Cooperative	595	Industrial crops	2	1
J7_42	Family farm	200	Industrial crops	0	0
J7_43	Family farm	4	Olive	0	1
J7_44	Family farm	120	Industrial crops	0	0

J7_45	Family farm	5	Horticulture	0	0
J7_46	Family farm	150	Cereal crops	0	0
J7_47	Family farm	200	Industrial crops	0	0
J7_48	Family farm	20	Industrial crops	0	0
J7_49	Family farm	29	Livestock/Fodder crops	50	0
J7_50	Family farm	400	Industrial crops	0	0
J7_51	LTD	240	Livestock/Fodder crops	0	0
J7_52	Family farm	215	Industrial crops	0	0
J7_53	Family farm	6	Horticulture	60	0
J7_54	Family farm	38	Livestock/Fodder crops	100	0
J7_55	Family farm	80	Cereal crops	50	0
J7_56	Family farm	50	Industrial crops	0	0

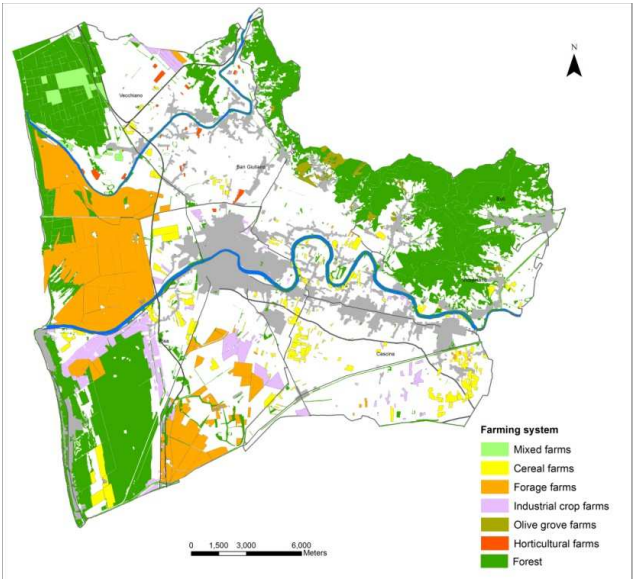


Figure 1. Location of the surveyed farms' fields considering the main farming system

The interviews were semi-structured. The purpose of the interviews was to understand the structure of the farms, the characteristic of the farmer, his relationships with the urban area and the countryside, the commercialization and the production cycle.

2.3. Indicators' grid

50 farm-gate indicators were identified and calculated to estimate the food quality, the food quantity and food production intensity (Table 2) of the periurban farming system of the Pisa urban region.

By "quality" here we refer to the quality of the farming system, and not the chemical properties of food; in this way quality's indicators refer to the labelled crops or agricultural practices, the controls on the production's system, and the degree of self-sufficiency. Quantity's indicators refer to the estimate of the amount of food product depending on several parameters: hectares, yield, the percentage of the 5 classes of main productions, the percentage of hectares with product locally allocated, and the gross earning from the productions. Finally by "intensity" here we refer to the farming practices and especially to the organization of rotations, the use and the amount of inputs, the livestock density.

Table2. Indicators dataset used in the analysis

	Code	Definition	Hypothesis	Explanation	Val.
QUALITY	OrgProd	Organic labels	Farmers' valorisation of sustainability process	Presence/absence of organic labels	0/1
	POrg	% of organic production	Amount of hectares valorised	Percentage of surface under organic procedures	%
	OthLab	Other labels	Other types of valorisation linked to the territory or the producing process	Presence/absence of other labels	N.
	ContrQual	Controls on food quality	Farmer's control over his own production	Presence/absence of control over the production	1/0
	ContrProd	Controls on production's quality	Farmer's control over his own management	Presence/absence of control over farms' management	1/0
	Self100 Self>50 Self<50	Self-sufficiency (3)	Territorial management	Use of internal resources to feed animals completely, partially or marginally	0/1
INTENSITY	NRot	Number of rotation	Agronomic control of the territory	Number of different rotation on the total farm's surface	N.
	UAA<3Y	Percentage UAA with rotation < 3 years	Agronomic control of the territory	Percentage of surface with rotations briefer than 3 years on the total	%
	PFodd	Percentage of forage cultures	For livestock farms food self-sufficiency; for horticulture, less intensive production	Percentage of surface with forage cultures on the total	%
	ann_perm	Ratio annual and poliannual production	Quality of production cycle	Ratio between annual and poliannual productions	%
	LSU_UAA	Livestock density	Intensity for livestock farms	Ratio between LSU and UAA	%
	NTreat	Number of treatment	Use of external resources	Number of treatment maximum on the most treated production	N.
	Irr	Irrigation	Use of external resources	Percentage of Organic Manure	%
	PUUAManure	Application of Manure and other organic fertilisers	Use of internal resources; *il fatto che manure è più ricco di nutrienti rispetto a ferilizzanti chimici*	Percentage of UAA with manure or other organic fertilisers	%

QUANTITY	NFood	Number of food primary produces	How much part of the production directly for human food destination; variety of production as a indicator of vulnerability control	Sum of the different food primary produces	N.
	PFood	Importance of food primary produces	Relative effort of the farm for direct food production; internal use of livestock productions	Percentage of food primary produces (NFood) on the total products	%
	Plocal	Production locally allocated	How much part of the food production is for local food consumption	Percentage of the total production sold il local food chains (Filippini et al, 2015)	%
	LocHa	Hectares for the local market	Territorial representation of the production for the local market	Percentage of UAA for the local markets	%
	PUUAInd	Use of the farm territory of industrial crops	Importance of industrial crops	Percentage of UAA for the principal area's product	%
	PUUACer	Use of the farm territory of cereals	Importance of cereals		
	PUUAOl	Use of the farm territory of olive	Importance of olive		
	PUUAHo	Use of the farm territory of horticulture	Importance of horticulture		
	PUUAFodd	Use of the farm territory of fodder	Importance of fodder		
	Qt	Quantity of principal area's product	Potential offer for 36 productions	Qt = hectares*yields	Qtl
	R	Quantity of revenue for each production	Potential gain for 36 productions	R=(Qt*price)/ha where the price is different for organic or not organic production, local and national markets	€
	TR	Total Revenue	Total revenue	Sum of all the R	€

2.4. Statistical analysis

The statistical analysis has followed several steps. The first step had the purpose to select the more variables most explaining the sample variance. First among the 50 indicators, a correlation analysis have been carried out, in order to remove one of the indicators with a correlation greater than 0.70. Thus a Principal Component Analysis (PCA) has been performed with the software CANOCO, which has been developed for ecological multivariate statistical analysis and is able to consider both dummy and numeric variables in classifications (Lepš and Šmilauer, 2003) (Fig. 2a). During the process two farms were recognised as outliers and excluded from the analysis (Fig. 2b). On the two first components we have firstly selected 13 indicators, considering the values of their components' correlation greater than 0.9. We have then reduced the indicators to 7, in order to reduce the redundancy: these 7 indicators explain 59 % of the total sample's variance (Fig.2c)

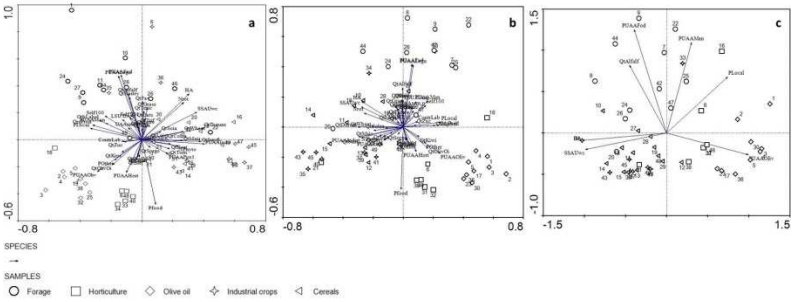


Fig. 2 Steps of the methodology

With these indicators finally selected, the second step was to create groups of farm with similar characteristics about food quality, quantity, and intensity. We have performed a hierarchical cluster analysis using the Ward's method and a Euclidean distance under the XLStat software. The number of classes have been decided in order to have groups with at least 2 members.

3. Results

3.1. Selection of indicators

The PCA analysis described in the methodology has two main results: the first one is that two samples were recognised as outliers: sample 1 and 6 in Fig. 1a. The second result was the selection of the 7 indicators for the creation of farms' clusters.

The PCA analysis' results are summarized in Fig. 3.

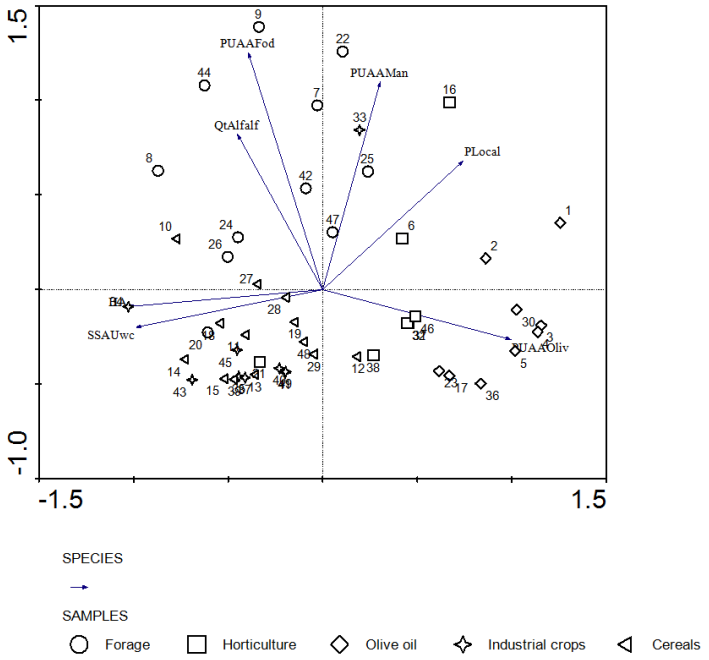


Figura 3 Results of the PCA performed over 7 indicators of quantity and intensity of food production.

As it is possible to notice among the 7 indicators finally selected, there are no quality's indicators. The less significance of quality's indicators among the

farms may suggest that labelling is not always related with the farms' performances in terms of intensity and quantity. The indicators explaining more the total variance of the sample are referring to quantity and intensity. Especially, among the quantity's indicators we can find the percentage of food production devolved to local market (PLocal), the percentage of olive production (POliv), the total UAA of the farm (Ha), and the quantity of alfalfa in the rotation (QAlfa). Among the intensity's indicators we can find the percentage of winter cereals in the rotation (PUAA wc), the percentage of fodder in the rotation (PUAA Fod) and the percentage UAA fertilised with organic manure (PUAA Man).

In Fig. 3 there is also a characterisation of the sample considering the main farming system's production: fodder, horticulture, olive production, cereal and industrial crops. Olive and Horticultural productions seem to have similar dynamic, as well as industrial and cereal crops, while forage's farms have a more dispersive dynamic.

At the same time the percentage of olive production (POliv) is negatively correlated with the farm's UAA and the percentage of UAA with winter cereal (SAUwc), the quantity of alfalfa (QtAlfa), while it seems to be more correlated to the percentage of production locally allotted (PLocal). Especially PLocal has a negative correlation with the farm's UAA: this result suggests that bigger farms are less involved in local markets than smaller ones. Moreover these results may imply that there are potentialities of the farm's production not exploited in the local food system. This seems to be less true for forage farms. Considering that most of the forage farms are livestock productions, this result may suggest that for specific production as livestock ones, the percentage of local markets can be higher.

3.2. Cluster Analysis

We identified from a cluster analysis five groups of farms. The cluster analysis enables us to better specify the factors that are characteristic of each group. In Table 3 it's possible to see the averages value of the indicators selected.

Table 3. Classes' average values for indicators whole dataset. For the indicators' explanation see Table2. The highlighted indicators are the indicators selected for performing the cluster analysis.

		Averages' values for each groups				
	Groups	**G1**	**G2**	**G3**	**G4**	**G5**
	Amount of farms	21	2	3	14	9
Indicators of Food production Intensity	**Nrot**	0.90	1,50	1.67	1.93	1.89
	SSAUwc	12.95	35,00	24.33	41.57	29.78
	PUAARot3y	40.68	39,58	0.00	53.06	14.61
	PUAAFod	5.08	55,16	47.83	13.73	35.59
	UAAsem.plu	2.27	0,75	3.09	0.37	16.34
	LSU.UAA	0.71	0,93	0.35	0.11	0.53
	NPhyto	0.90	1,00	1.00	1.36	1.00
	PUAAMan	14.94	83,73	3.57	3.96	36.01
Indicators of Food Quality	**OrgProd**	0.33	0,50	0.33	0.07	0.22
	OthLabel	0.38	0,00	0.33	0.00	0.33
	ContrLab	0.10	0,50	0.00	0.07	0.00
	Self0.50	0.05	0,50	0.00	0.00	0.00
	Self50.100	0.14	0,00	0.33	0.07	0.11
	Self100	0.19	0,50	0.33	0.14	0.33
Indicators of Food Quantity	**HA**	19.40	183,00	254.00	264.57	102.11
	Pfood	86.98	20,00	25.71	78.76	46.77
	PUAAIndu	11.25	15,63	8.53	37.20	14.36
	PUAALegum	6.06	38,69	50.61	9.92	33.65
	PUAAOliv	35.47	0,00	0.00	0.10	0.00
	PUAAHort	25.14	0,00	0.00	0.71	10.39
	POther	4.56	0,00	0.21	0.00	1.14

	PLocal	34.00	40,00	30.00	0.64	50.56
	QtDurum	55.50	2000,00	1300.00	2477.50	1375.00
	QtWheat	218.10	375,00	925.00	1628.29	249.33
	QtBarley	27.62	0,00	180.00	75.43	15.56
	QtOats	0.00	350,00	0.00	45.71	187.33
	QtRye	0.00	0,00	0.00	17.86	0.00
	QtFarro	0.00	0,00	0.00	50.00	0.00
	QtTritic	0.00	0,00	0.00	0.00	13.89
	QtMais	103.33	2062,50	858.33	2200.54	272.22
	QtSorgo	28.57	0,00	0.00	0.00	0.00
	QtSunfl	78.57	0,00	384.00	1649.00	476.67
	QtBeet	0.00	0,00	0.00	1110.71	0.00
	QtColza	0.00	0,00	0.00	106.07	0.00
	QtTrif	0.00	600,00	0.00	880.00	0.00
	QtAlfalfa	2.86	1500,00	3153.33	8.57	335.00
	QtSulla	0.00	0,00	26.67	0.00	15.67
	QtFav	9.31	0,00	153.33	15.71	51.11
	QtLoiet	0.00	0,00	2000.00	0.00	0.00
	QtSoia	25.71	0,00	0.00	58.93	0.00
	QtGrass	0.00	1250,00	0.00	357.14	111.11
	QtOlivOil	8.35	0,00	0.00	0.00	0.00
	QtKiwi	4.76	0,00	0.00	0.00	0.00
	QtTom	41.43	0,00	0.00	857.14	0.89
	QtZuc	0.00	0,00	0.00	0.00	0.44
	QtSpin	21.43	12,00	0.00	1.71	0.00
	QtWatM	239.76	0,00	0.00	0.00	0.04
	QtCaul	46.19	0,00	0.00	0.00	0.00
	QtBiet	6.19	0,00	0.00	0.00	0.00

Table 4. Other information about the groups. For the indicators' explanation see Table1.

Groups	% of Livestock prod.	% of Forage's farms	% of Industrial crop farms	% of Olive oil farms	% of Horticultural farms	% of Cereals farms
G1	5	5	10	43	24	19
G2	100	100	0	0	0	0
G3	67	67	0	0	0	33
G4	13	13	47	0	0	40
G5	44	44	11	0	11	33

In Table 3 for each groups are listed the average values, while in Table 4 are summarised information about the farms considering the main farming systems of the farm's sample. As it is possible to notice, in many cases the principal farming system does not define the groups. Livestock productions for example are in all the groups (Table 4); at the same time farms with prevalence of cereals crops are in all the groups except group 2 that is 100% livestock production, as well as industrial crops' farms are involved in 3 groups out of 5. On the contrary olive farms are concentrated in only one group (Group 1), where also most of the horticultural farms are included. Group 1 and 5 are in general the more heterogeneous in terms of diversity of productions.

Group 1 is characterized bythe small size and the relatively lower rate of production sold in local markets. This group is composed especially by all the olive farms and most of the horticultural farms (Table 4). The cereals and the industrial crops' farms included in this group are usually smaller than the farms in the other groups (19 Ha.), and they have a low or zero percentage of local food system. These results show a certain negative correlation between the farm's size and the percentage of production locally sold, especially for horticultural and olive productions, that as said are traditional in the area. By comparing Group 1 and 4, we can suggest that the percentage of produce

locally allotted is not correlated with the farm's size and with the production of fresh products as horticulture.

Group 2 distinguishes a particular type of livestock production. Especially a livestock production that uses a higher percentage of manure on the soil considering the other farms, especially considering for example Group 3, that has the higher percentage of livestock farms among the other farms; Group 2 have also the higher percentage of fodder. Considering these indicators livestock productions in Group 2 can be considered as less intensive, than livestock farms in Group 3. Farms have also a higher percentage of winter cereals on the UAA, as well as the percentage of UAA with a rotation less than 3 years, and one of the less number of rotations on UAA. Following these indicators farms in Group 2 seems to be more intensive than the farms in Group 3. These results may suggest that for livestock productions different dynamics of intensity are possible. The percentage of production locally allocated is relatively high (40%), but considering that the group is composed by only two farms, and one farm has not local markets, this means that the other farm doesn't sell the total production in local food system.

Group 3 is composed by big livestock farms. Considering group 4 that has similar values of average UAA (252 ha), farms in group 3 distinguish themselves because of the higher percentage of legumes (PLegum), and of alfalfa (QAlfa); even though one farm has not livestock production, generally the percentage of fodder's UAA is important in the three farms. This is linked to a production with a longest cycle, and in fact the value of PUAA3y is 0: considering farms in Group 2 and 4, generally the annual crops are in rotation with polinannual ones, as such alfalfa. Moreover there is a really lower value of UAA's percentage fertilised with manure.

Group 4 is composed by the bigger UAA's average (264 ha) Moreover this group is characterised by the lowest percentage of food allotted in local markets. This confirms a certain negative correlation between two indicators

of food quantity: the percentage of production locally allocated (PLocal) and the percentage of food production in the farm (PFood). The indicators on food production intensity, are the higher ones, as well as they have the higher amount of production for most of the productions. These results may suggest an intensive production, especially considering Group 3, which have a similar average of UAA. These farms have also the lower rate of production sold in local markets, while the percentage of food production directly for human consumption (PFood) is one of the higher ones, confirming a certain trade-off among quantity of food production and marketing in local markets. Especially it confirms a negative correlation between local markets and industrial and cereal productions. It is also interesting to notice that the percentage of tomatoes' production in this group is the higher one. This is a traditional production in the area, classified as an industrial crop and commercialised thorough conventional food chains outside the region to be processed. This result may suggest a certain trade off between traditional food production and conventional food chains, especially for some horticultural production, cereal and industrial crops. Moreover it confirms a food potential not exploited for the local consumption. The group is one of the largest representing the 28% of farms, and especially more than the 50% of the total sample's hectares.

The negative correlation between certain production and local markets is confirmed by the characteristics of Group 1On the contrary Group 5's farms are characterised by the higher percentage of production sold in local markets. The unique horticultural farm of this group sell 100% of the horticultural production in local markets; moreover unlike the other horticultural farms in Group 1 this farm has a high percentage of fodder in its UAA's rotation. The other farms of this group are not involved in local markets but they share with the other farms of the group, a relatively high percentage of fodder in the rotation even if they don't have livestock production. Livestock productions represent the 44% of the farms;

considering the high percentage of PLocal, we can conclude that for livestock productions are better locally allocated.

3.3. Quality

As it is possible to see in Table 3 considering the certified production there are no significant differences among farm's groups. In other words the presence of any kind of label does not seem to differentiate so much the sample's farms. The less labelled farms are in Group 2 and Group 4. The first one has the higher farms' percentage with organic production of the total farm's sample, but since it's composed by only two farms, and only one is organic, intensity's indicators seem to distinguish more this farm's groups from the other farms. It also has only organic production and not other labels (as IGP, DOP or others). Group 4 has the lowest percentage of organic production, but it has other labels. This group has also the less percentage of production sold locally, while group 5 has the higher percentage of production locally allocated, but a relatively low percentage of labels. These results may suggest that local market sustains the presence of labels more than conventional and/or global markets, but the participation of farmers to local markets is not always correlated by labels.

4. Discussion and Conclusions

The first result of this contribution is the selection of the indicators able to explain more the samples' variation: here especially indicators on quantity and intensity's indicators were selected, and no one of the quality's indicators. In our sample a less intensive production is not always associated with a labelled production; moreover considering our results, labelled productions are expected in all farm's groups, and for this reason they don't seem to differentiate the sample. Labels are less important in distinguishing farming practices and farms' behaviour, than intensity's production indicators and quantity's indicators. This may suggest the need to consider the quality of

productions of periurban farms beyond their labels. If we assume that the presence of labels assessing the quality of the production is also a guarantee that external controls from the farm are made on the production cycle and the farm management, other tools of controls of local production's quality need to be developed. This is especially true considering the renovated interest for local production, beyond the presence of a certification (Adams and Salois, 2010).

Also considering the hypothetical link between certification and local markets, our results don't show a strong significance of quality's indicators considering the percentage of food production sold locally. Considering our hypothesis about the possibility of labels to give a stronger market power to farmers, we can conclude that for periurban farmers trying to locally allocate the products, the presence of labels doesn't seem to be so necessary. In global markets the presence of labels is a way to distinguish themselves among the global concurrence, while in local markets, this is not necessary due to the proximity between farmers and consumers, which facilitates relationships based on trust, and make the farmer unique (Adams and Salois, 2010). However if the presence of label is an indicator that controls are made and our results suggests that a part of the production locally sold it is not supported by such controls, we can assume that the hybridization of food chains between global and local commercialisation may guarantee system that there are controls through the use of certifications normally used in the global market. The second result is about the five groups created: the CA has especially delineated association between olive and horticultural production, which common element is the small size, and a certain hybridisation of commercial strategies between local and other food chains, linked to the historical traditional farming systems. Moreover the CA has made three main distinctions considering the livestock production, where Group 2 and 3 share different intensity's indicators, and Group 5 livestock farms are mainly concentrated in local food chains. In general the main farming system do not

define the groups, but the groups are defined by the performing in terms of quantity and intensity. In this sense this study has helped in clarify the need of a more accurate farm-based classification which integrates multidisciplinary view (Andersen, 2006) for the analysis of specific farming system in order to understand better the variety of the responses of the farms to external changes (Clarcks 2010), such as periurbanisation. This study have not the purpose to analyse dynamic of change, but can offer indications of possible indicators to be taken into account in such analysis.

Further studies could also study deeper the performances in terms of intensity, considering the high heterogeneity of practices put in place by periurban farmers, and their importance in designing the farms type, as it is shown in our analysis.

Considering the debate around the food capacity, our results show a certain negative correlation between the percentage of food production of the farms and the percentage of production allocated in local markets. Moreover the farms with more hectares are the farms less involved in local food chains. This result is contrary to the hypothesis. This is possible since many farmers in commercialising local food needs to be more specialised in few productions, in order to have enough food to commercialise. Moreover farmers who produces more types of productions are especially cereals, industrial crops or they have industrial horticultural productions: for these types of productions, there's the need of processing as well as the commercialisation is affidato a cooperatives with auim is to place the product in the best markets, that most of time is not the local valorisation. Here the profit's interest is on the quantities, rather than the local valorisation. Also farms with horticulture and olive oil productions seems to be less engaged in local markets, than livestock producers. In the case of olive oil production this is probably due to the global valorisation through local label GPI. In the case of horticulture farms stay connected to the traditional food chains, where the sale of the production is in wholesalers, even if they have organised local food chains.

Our results may suggest that some constraints are linked to the local markets, which make less effective the contribute of periurban farms to the local food system: these constraints may be linked to the capacity of local market to absorb all the local production; the constraints may also be linked to constraints in make available at local level the local production.

Even though several scholars have valorised the potentiality of food production in periurban fringe in the contribution of local food system, further studies should focus on how this potentiality can be effective, by studying the effective constraints and drivers in localised farmers' production.

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4. Is the choice of a farm's commercial market an indicator of agricultural intensity? Conventional and short food supply chains in periurban farming systems.

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Q.1.2

The result underlines the different grade of intensity's production in the PuFS. A broader definition of production's intensity is used, linked not only to farm practices, but also to farmers' characteristics; moreover the farms are grouped considering the alternative, conventional and mixed commercialisation. The analysis shows that the PuFS is characterised by an heterogeneity of intensity's production, and that there is a link between the intensity's production and the farms' commercialisation, especially considering the farming practices linked to the farm management and the land use intensity. However this link is not more complex than what is stated by traditional literature.

Is the choice of a farm's commercial market an indicator of agricultural intensity? Conventional and short food supply chains in periurban farming systems.

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Abstract

Short food supply chains (SFSCs) have been identified as an economic opportunity for farming systems affected by urbanisation and as more sustainable in terms of production than conventional approaches. However, few studies have focused on the intensity of periurban farms that participate in such food chains, compared with the performance of farms in conventional food chains, or that mix both conventional and short food chains. We examined the relationship between agricultural intensity and the market orientation of farms in a representative sample of farms in the urban region of Pisa (Italy). We define 'agricultural intensity' as the intensity of land use and its main drivers (e.g. farm management or the individual characteristics of farmers), and 'market orientation' as the ratio of farm produce within conventional, short or mixed food-chains. The results of the analysis suggest that the market orientation of periurban farming systems is highly correlated to the indicators of farm management and the intensity of land use of farms, more than the individual farmer's characteristics. This result provides the first evidence that market orientation is a driver of intensity, and that an individual farmer's characteristics are not significantly different in the three

groups of market orientation. These findings could be generalised to other urban regions and correlated with the main orientation of farming systems in order to support both the evaluation of farming systems and the implementation of innovative urban food policies.

Key-words: periurban agriculture, food supply chains, farm management, Tuscany

Introduction

The European Environmental Agency (2010) has highlighted that periurban agricultural areas are affected by urbanisation not only in terms of losses of farmland, but also due to fragmentation of agricultural fields. Urbanization has thus affected not only ecosystem services (Foley, 2005; Zasada et al., 2011), but also the potential productivity of agricultural areas by impacting on farmers' choices and environmental resources (Agrawal *et al.*, 2003; Akimowitz, 2012). These dynamics are thus threatening agriculture in periurban areas. However, several studies have also pointed out how urbanisation has redesigned the economic relationships in these areas, offering new opportunities for agriculture.

More recently the function of periurban agriculture in terms of food production has been studied, linked to the opportunities offered by short food supply chains (SFSCs) (Paül and McKenzie, 2013). SFSCs are defined as innovative food chains characterised by a restored and more direct connection between producers and consumers (Renting *et al.*, 2003). Especially in periurban areas, the adoption of SFSCs has been seen as an indicator of the farmer's adaptation to being in proximity to an urban area (Lamine and Perrot, 2008). It is generally stated within the literature on SFSC that these farming systems are beneficial for the environment (Renting *et al.,* 2003; Cleveland *et al.,* 2014) and they are generally associated with more sustainable rural development (Sundkvist *et al.* 2005, Marechal and Spanu,

2011; Forrssel and Lakoski, 2014). Although SFSCs could represent a real market opportunity for periurban farmers, and thus prevent agricultural abandonment in urban areas, periurban farming systems oriented to SFSCs have often been neglected by the mainstream agronomic literature. Indeed traditional approaches on SFSCs are more focused on how the relationships are established, and their social and economical benefits. A more in-depth study on the productive system of agriculture is thus necessary in order to properly assess their real level of sustainability (Goodman, 2004a; Simoncini, 2015).

The aim of this study is to understand the possible relationship between the market's orientation and the agricultural intensity of periurban farming systems. We define the agricultural intensity of farming systems as both the intensity of land use and its drivers, i.e. the farm structure, farm management, and the individual farmer's characteristics. We define market orientation according to Renting et al. (2003), i.e. as the conscious market destination either locally in short food chains (SFC) or in conventional food chains (CFCs) where the producer relies on traders, or producer's cooperatives.

The paper is organised as follows. In Section 2 we describe the methodology developed in terms of indicators, case study and statistical analysis. In Section 3 we discuss the main results obtained in the case study of the urban region of Pisa. Finally, we discuss our main results and the method used and draw conclusions on the agricultural intensity of periurban farming systems.

Methodology

The urban region of Pisa (Italy): a representative region of Mediterranean urbanized coastal plains

The case study is the urban area of Pisa, a medium-sized city in Tuscany (Italy). As already described by Filippini *et al.* (2014), this region has a surface

of 500 km^2 and consists of six municipalities located in the coastal plain of the Arno river and on the hilly area known as the Monte Pisano (917 m u.s.l). The area has a population density of almost 400 inhabitants per km^2 and follows the European urban demographic trend for the last decade: a decrease in the city-center inhabitants (-4% in the last decade) and a significant increase in the periurban areas (+8% in the last decade). Local farming systems are typically Mediterranean and oriented to cereal production, livestock, industrial crops or specialized crops such as horticultural or olive groves (Marraccini *et al.*, 2013). The case study is representative of the transition of the main farming systems: a decrease in hectares of UAA (%) and above all in the number of farms particularly in more intensive productions such as horticultural and fruit groves (-94%), while cereal and industrial crops farms has decreased less (-50%).

The case study is also relevant considering the interest of local institutions in developing a food plan of the area, which included the contribution of local food production to local food (Di Iacovo *et al.*, 2013).

Analysis of the relationships between agricultural intensity and the market orientation of farms: a territorial approach

The analysis was based on a farm database built through 55 semi-structured farm interviews, almost 10% of the total number of farms in the area according to the last agricultural census. The sample was selected through a territorial approach, aimed at representing the trends arising from the last agriculture national census, considering three criteria: the farming system defined through the dominant land use e.g. industrial crops, cereals, fodder, olive groves and horticultural crops; the size of the farm's usable agricultural area (UAA); the distance of the farmstead from the main city centre. Farms were then also classified considering the commercial destination of the farm products: conventional (CFC), if the farm produce is allotted totally to CFCs; short (SFC) if devolved totally to SFSCs; mixed (MFC) if it is devolved to both

CFCs and to SFSCs. The agricultural intensity was assessed with four groups of indicators (see next section), however no overall score of intensity was provided. The relation between each indicator of agricultural intensity and the three market orientations was assessed using a Kruskal-Wallis test, since the indicators generally had a non-normal distribution.

Indicators of agricultural intensity

A total of 32 indicators were applied to each farm, referring to four classes of production intensity: Farm structure; Farm management; Land use intensity; Individual Farmer characteristics.

Indicators were selected by first considering the literature (Dumanski and Pieri, 2000; Herzog *et al.*, 2006) and then depending on their capacity to discriminate between farms in our sample using analysis of the variation coefficient (cv) and excluding those indicators with a cv lower than 0.30 (little diversity).

Table 1 provides a list of the main indicators used in the analysis.

Table 1. List of the main indicators used in the analysis

Type of indicator	Indicator	Code	Content	Unit
Farm structure and land use	Usable Agricultural Area	UAA	On farm surface used for arable and permanent crops	ha
	Share of the UAA owned	SUAAp	Percentage of the UAA owned by the farms	%
	Number of landowners	Np	Number of different landowners on the farmland	Value
	Share of UAA in winter cereals	SUAAwc	Percentage of winter cereals in UAA	%
	Share of UAA in horticultural crops	SUAAho	Percentage of horticultural crops in UAA	%
	Share of UAA in olive groves	SUAAog	Percentage of olive groves in UAA	%
	Share of UAA in fodder	SUAAf	Percentage of fodder in UAA	%
	Number of farm blocks	Nblocks	Number of adjacent groups of fields belonging to the same farmer and managed in the same way	Value
	Distance between blocks	Dblocks	Maximum distance of blocks between different on-farm blocks	Km
	Distance from the city	Durb	Distance of the farmstead from the main city centre	Km
Farm management	Livestock unit	UGBT	Number of livestock units on the farm	Value
	Type of machinery	Equip	Main types of machinery available on the farm	Value
	Share of full-time workers	Nftw	Share of full time workers out of the total workers of the farm	%
	Number of seasonal workers	Nsw	Number of seasonal workers per farm	Value
	Number of food chains	Nfc	Number of different food chains of the farm (on-farm direct selling, shops, cooperatives..)	Value
	Number of cultivated products	Nsp	Number of different crops cultivated on the farm	Value
	Number of labels	Nlabel	Number of different labels on one or several farm produce	Value
	Number of other activities	Nact	Number of different on-farm activities	Value
	Innovation dynamics	DynInn	Dynamics of innovation on the farm	0/1/2
	Organic production	Org	Presence of organic production	0/1
Land use	Irrigation	Irr	Irrigated or rain-fed farm	0/1

intensity	Livestock intensity	LivDen	Number of livestock unit per hectare	Value/ha
	Tree density	DTrees	Number of trees per hectare	Value/ha
	Manure/organic fertiliser	OrgFert	Application of manure or other organic fertilisers	0/1
	Number of pesticide applications	Nphyto	Number of pesticide applications on the more intensive crops	Value
Individual farmer's characteristics	Number of years	Nyears	On-farm work experience	Value
	Type of education	Tedu	Type of educational background (0=no; 1=basic no agri; 2=advanced no agri; 3=agri; 4=advanced agri)	0 to 4
	Age	Age	Age of the farmer or the main farmer manager (0= <40; 1= 40-65; 2= >65)	0/1/2
	Number of networks	Nnet	Number of networks the farmer belongs to	Value
	Agricultural background	Agri	Agricultural background of family	0/1
	Type of enterprise	Tjury	Type of farm (0=family; 1=cooperative; 2=enterprise; 3=technical agricultural; 4=other)	Value

Results

Characteristics of farms and localisation for the three market orientations

Considerable differentiation was found in the number of farms belonging to each group: only 10% of the total production of farmers' sales in SFSCs, versus 47% of farms that sell exclusively in CFCs. An interesting result was the huge percentage of farmers (43%) that combine short and conventional food chains. We also found a difference in the type of farms belonging to each group. In fact, farmers that are exclusively in CFCs generally grow cereals and industrial crops (respectively 26% and 34%). On the other hand, horticulture seems to be more represented by farmers selling exclusively or partially in SFSCs, although in both groups this represents only about 20%. Both groups have a greater percentage of producers of fodder – livestock orientation and olive groves: 29% in MFCs and 40% in SFCs. The only difference between the two groups is that in the MFC group, there are producers of industrial and cereal crops (16%), while no cereal or industrial crop farms participate exclusively in SFSCs.

The distance from the urban area does not seem to affect the three groups, producing close to the urban city does not affect the market orientation of farms.

Indicator analysis: land use intensity and farm management provide statistically significant differences in the market orientation of farms

Figure 1 shows the main results of the statistical analysis.

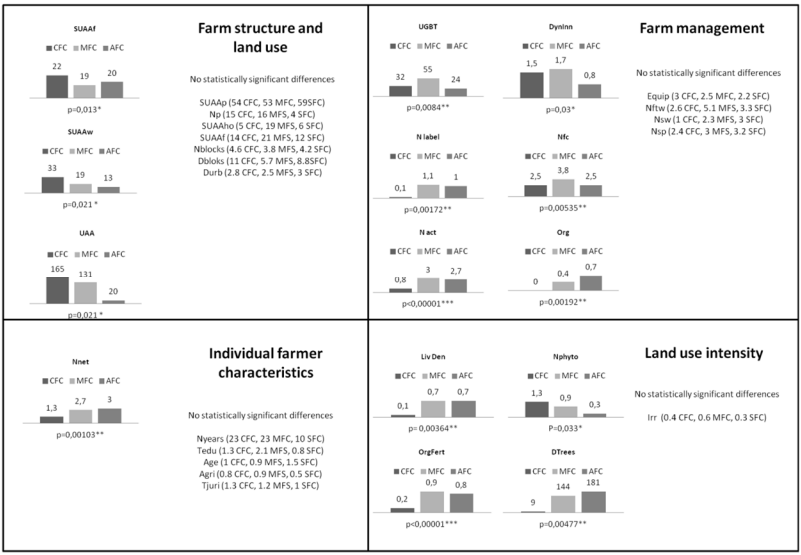


Figure 1. Main results of the statistical analysis. For each indicators' code see Table 1.

The main results concern both the groups of indicators with significant differences between market orientation and the different behaviour per indicator depending on the market orientation. Concerning the group of indicators with significant differences depending on the market orientation, we found that land use intensity (4 significant indicators out of 6) and farm management (6 indicators out of 10) were the agricultural intensity groups most related to market orientation. However, farmland use and individual farmers' characteristics were less related to market orientation (respectively 3 out of 10, and 1 out of 6).

This result is important for two reasons. First, it is the first evidence that market orientation could be a driver of agricultural intensity. Farms exclusively in CFCs generally have higher values of intensity, but this is not the case for all the indicator values. Livestock density, and tree density for olive groves, have higher values for farms exclusively in alternative food chains,

thus suggesting that even farms exclusively in SFSCs can have an intensive farming practice or land use. However, since an overall score was not calculated, we were not able to predict which market orientation was more or less intensive. This opens up a new research area for the assessment of the agricultural intensity of periurban farming systems.

Second, we demonstrated that in this case study, the farm structure or the individual farmer's characteristics are not significantly different in the three groups of market orientation, in fact this is more related to the type of farming system.

Regarding the differences in the indicator values within each market orientation group, we found very different dynamics unrelated to the indicator group. In fact, in some cases, there is a regular gradient between the indicator values within each group (e.g. the ratio of cereal surface within the UAA, which decreases from the CSC farms to the SFCs), or a similar value in two out of the three groups (e.g. the average number of multifunctional activities, which has almost the same value in MFCs and SFCs whereas it decreases for CFCs).

We hypothesised that this result may depend on the nature of the MFC, which was not completely defined in this work. In fact, MFC may be related to a different food chain for different farm produce (e.g. cereals and milk or meat for livestock farms) or for a market diversification strategy for each kind of produce (e.g. a market orientation in SFCs and CFCs for vegetables in horticultural farms). An in-depth analysis of MFCs is needed in order to understand their type and frequency within each farming system.

Conclusions

In this preliminary study, we have demonstrated that there is a relationship between market orientation and the agricultural intensity of periurban farming systems. The nature of this relationship needs to be further

investigated, since there is no evidence from our research that a farming system that markets its produce in a conventional food chain is more intense than a farming system oriented to a short supply chain. We suggest two possible ways of improving this study. Firstly, to assess a single agricultural intensity index and secondly, to extend the statistical analysis using a multivariate model in order to consider other environmental and agricultural variables. We finally suggest that further agronomical research on periurban agriculture should be more focused on periurban farming systems, in order to assess their intensity, the services they provide, and their real contribution to local food policies.

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5. Assessing the food production capacity of farms in periurban areas

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Q.1.3

The result is related to the creation of different values for the assessment of the periurban farming system's food capacity, despite what traditional literature on the topic has usually tried to do. Moreover the result shows that is not only the production's system that may increase the periurban agriculture's food capacity, but that other factors not linked to the production's system may make the difference, like the possibility to have specific projects of valorisation of local product, and so forth. This result confirms the analysis of Q.1.3. where the only significant indicator of farmers characteristic indicators' group is the farmers' number of networks and not other social indicators, like age, origin, formation.

Assessing the food production capacity of farms in periurban areas

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Abstract

We present a method to assess the food production capacity in periurban areas, which was tested in relation to meat production (cattle and lamb) in the urban region of Pisa, a medium sized city in Italy. The assessment of food production capacity is particularly important in small and medium sized cities where there are greater chances to develop local periurban farming. The literature has to date focused on restricted sectors of the food market, such as alternative food networks, public procurement for school canteens, but less attention has been paid to urban food production.

The capacity of periurban livestock farms to produce meat that fulfils the urban demand was assessed as the share of meat supply and demand. Meat demand was evaluated using statistical data, whereas for the meat supply we developed three estimates (potential, current, actual meat supply) taking into account statistical and on-farm survey data. The potential meat supply was estimated from the slaughtered livestock from statistical data; the current meat supply was estimated from meat production data derived from on-farm surveys and the actual meat supply was estimated from the amount of meat sold by farmers for the local market and also from on-farm surveys. For the urban region of Pisa, we estimated that the potential meat supply met 16% and 62% of the meat demand for cattle and lamb respectively. These data

could change when taking into account the on-farm data in the current supply, which was the case of the lamb, which decreased (37%), whereas the cattle meat remained almost the same (14%). Finally, the actual meat supply was 70% and 10% of the current supply for cattle and lamb. Some gaps appeared between the three estimates particularly for lamb production, suggesting that there might be some constraints in terms of its production and commercialisation.
Our results contribute to the assessment of local food systems and their levers at the farm level. These results support the need for an agronomical approach to food systems based on the analysis of farm activities located in periurban areas in order to quantify the food supply which is actually produced for the local market. Food planning policies, as well as studies at territorial level, could take advantage of this method.

Keywords: food balance, food systems, livestock farms, periurban agriculture, Tuscany

1. Introduction

In Europe, agricultural land is being increasingly exploited or fragmented for housing purposes as well as economic and infrastructural development (EEA, 2006; EEA, 2010). At the same time, there has been an unequal growth in the urban population especially in small and medium urban areas (Kabish and Haase, 2011). These two trends impact on the amount and the management of Usable Agricultural Areas in periurban regions (Bernetti et al., 2013). Firstly, the decrease in farms and farmland affects food security especially given the increase in the world's populations (Satterthwaite et al., 2010). Secondly, the fragmentation of farmland and agricultural areas reduces the sustainability of existing farming systems (Van Veenhuizen and Danso, 2007). Thirdly, land use conflicts and constraints for periurban farming are increasing because of different community interests and activities (Henderson, 2005; Darly and Torre, 2013).

Agriculture has thus changed its predominant position in periurban areas, and sometimes has become a residual activity (Ansaloni, 2008; Grebeníček, 2012; Bernetti et al., 2013; Darly and Torre, 2013). Although the farming system in periurban areas is weaker, on the other side there is a growing demand for local agricultural products by urban consumers (Vecchio, 2010; Zasada, 2011b). Short food supply chains have thus appeared as a way to connect urban consumers to agricultural production (Renting et al., 2003; Ansaloni, 2009). For these reasons, the role of agriculture around cities, for food production, is at stake in Europe and all over the world.

Studies regarding periurban agriculture in developed countries have paid more attention to the social and environmental functions of farming activities (Busck et al., 2006; Aubry and Chiffolau, 2009; Zasada et al., 2011; Soulard and Aubry, 2012; Mok et al., 2013; Orsini et al., 2013), while in developing countries more research on food production capacity has been developed related to food security and sovereignty (Mawois et al., 2011; Komacech et al., 2013). Few studies have been carried out on periurban farming systems in developed countries (e.g. Soulard and Thareau, 2009). Instead, the focus has been on investigating agro-environmental issues (e.g. Silvestri et al., 2012), short supply chains (e.g. Marsden et al., 2000; Renting et al., 2003; Brunori et al., 2012) or the public procurement for school canteen (e.g. Galli and Brunori, 2012; Porro et al, 2012).

We have developed a framework for the analysis of the food production capacity of periurban agriculture. Food production capacity is hereby defined as the capacity of the food supply to fulfil food demand in a given area (e.g. Timmons et al., 2008). We investigated the capacity to produce meat (cattle and lamb) in the periurban area of Pisa, a medium sized city in Tuscany (Italy). In small and medium sized cities we can assume a higher proximity between producers and consumers, creating a new market that can support both a higher food production capacity alongside the sustainability of periurban farming.

Knowledge of the food production capacity of agriculture in periurban areas is a starting point for policy-makers in public procurement strategies or in supporting local farmers (Harper et al., 2009; Di Iacovo et al., 2013). Studies on the capacity to feed urban areas follow different approaches such as the urban metabolism (e.g. Grimm et al., 2008) or the urban foodprint (e.g. Billen et al., 2009). Besides the advantage of a clear and unambiguous message, these approaches are mainly based on measures of global hectares (gha) that are affected by humans per capita under a standardised diet (e.g. Colasanti and Hamm, 2010). Little distinction is made between hypothetical land use and real land use, and the analysis usually takes into account only the administrative boundaries (Van den Bergh and Verbruggen, 1999; Moffatt, 2000). The data analysed mainly come from national census statistics (Colasanti and Hamm, 2010; Morrison et al., 2011). A number of issues has thus been raised: the need to consider the fresh and processed products (Colasanti and Hamm, 2010); seasonality and the possibility of including public land for urban feeding (Timmons et al., 2008), the calculation of food miles (Torquati and Taglioni, 2010) or foodshed identification (Le Bail *et al*., 2006; Peters et al., 2008). Certain issues have been underlined such as the more explicit inclusion of crop management in local food supply (Van den Bergh and Verbruggen, 1999; Arcusa et al., 2011) or the need for a more local analysis to explain gaps in statistical-based assessments (Morrison et al., 2011).

The goal of this research is to contribute in this debate on the assessment of food production capacity, by defining a method that measures and studies the effect of a statistical-based and on-farm based analysis of the food supply. In section 2 we describe the methodology to assess the capacity for food production and present our case study, meat production in the urban region of Pisa (Tuscany, Italy). We describe the food supply as the rate of three estimates: potential supply, current supply and actual supply. In section 3 we show the results of the three estimates and of the related capacities calculated for meat production. Finally, we discuss our main results and the

method used and provide conclusions regarding the analysis of the food production capacity of periurban areas.

2. Materials and methods

2.1 Case study

The case study is located in the urban region of Pisa, Italy (Fig. 1). This region has a surface of 500 km^2 and consists of six municipalities located in the coastal plain of the Arno river and on the hilly area known as Monte Pisano (917 m u.s.l).

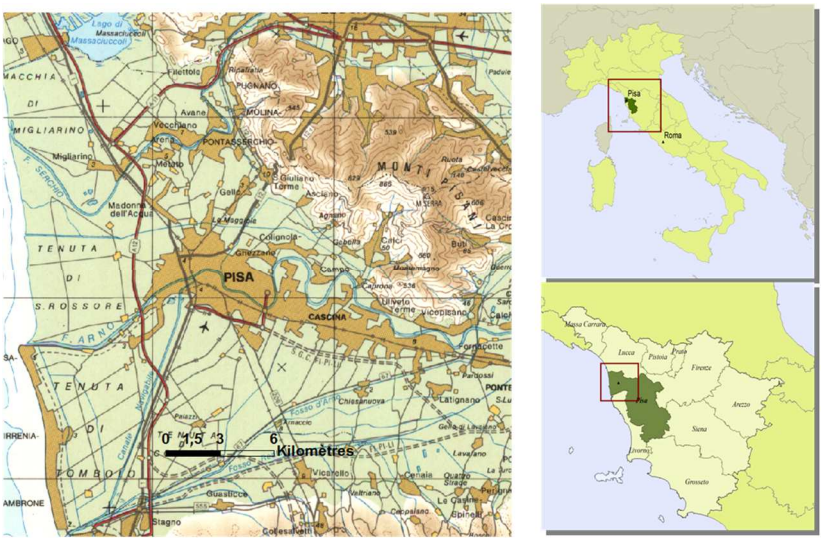


Figure 1: Location of the study area

The area has a population density of almost 400 inhabitants per km^2 and represents the second largest metropolitan area in Tuscany. This area follows the European urban demographic trend for the last decade: in the last national census (ISTAT, 2011a) while the number of citizens have decreased

in the city (- 4%), the nearby urban centers have increased their population on average by 8%.

The area is crossed by two rivers, the Arno and the Serchio, along with a dense network of land reclamation channels and ditches. The climate is Mediterranean, with an average rainfall ranging from 800 mm nearby the coast to 1100 mm in Monte Pisano and an average annual temperature of around 15°C (Fig. 2).

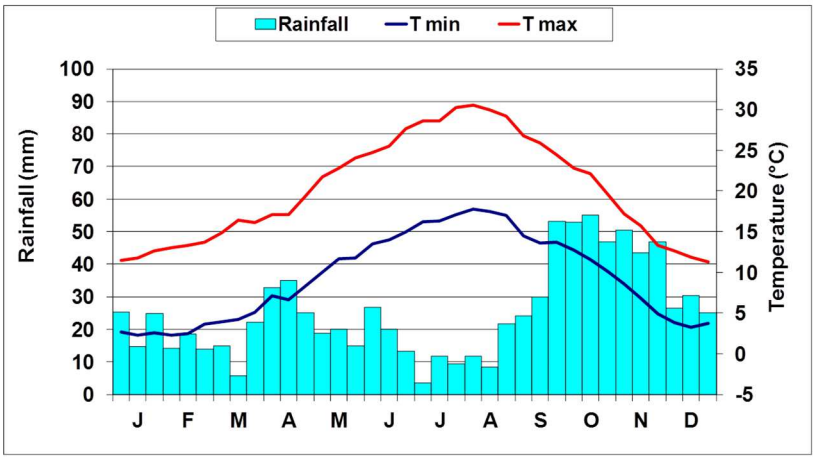


Figure 2: Diagram of Bagnouls and Gaussen showing the maximum, minimum and average temperatures and the monthly rainfall calculated from 10 years of data.

Soils are mainly sandy and clay in the coastal area, with more silty loam in the Serchio river plain. The plain between the Arno and Serchio rivers has mainly sandy-loam soils. Livestock was once at the basis of the traditional farming in the area, in small-scale mixed farms. In the last three decades, the number of livestock farms has decreased significantly, by 84% of the cattle farms and 73% for sheep farms. Such a decrease has been described throughout Europe (Hocquette and Chatelliert, 2011) although it seems more pronounced in the studied periurban area. Current livestock production is located in the plain, with 52 cattle farms and 32 sheep farms, 2% and 1% respectively of the total

local farms according the last agricultural census (ISTAT, 2011b). Livestock production benefits from a number of labels in addition to organic agriculture, such as the protected designation of origin “Vitellone Bianco dell’Italia Centrale” (veal), the local label “Carne Bovina di Pisa” (beef) and “Pecorino del Parco” (sheep cheese) run by the local livestock producer association and the Province of Pisa (APA, 2013). These labels confirm the interest of local authorities and consumers in the production of local meat.

2.2 Food production capacity as a balance between food demand and supply in periurban areas

We define food production capacity as the amount of food supply that is capable of fulfilling the urban food demand, which therefore can be calculated as a ratio between supply and demand, expressed in total kilos per inhabitant of the studied area. We define food demand as an average value of food consumption per inhabitant based on the annual reports of statistical institutes in Italy (ISTAT, 2010a). A more exact estimation of food demand is beyond the scope of this paper, as our contribution is more focused on the food supply. The food supply can be potential, current or actual depending on the focus. Potential supply is an assessment based on simplified hypotheses (the estimated quantity of food that is produced), the current supply is based on direct or indirect measurements leading to an indirect evaluation (the known quantity of food that is produced), whereas actual supply is a direct evaluation (the known quantity of meat that in reality is supplied). Food supply was therefore respectively based on statistical data on the main territorial yield for the potential supply, on-farm surveys on the crop yields for the current supply, on-farm surveys of farm crops aimed at the urban market (mainly through alternative and short food networks) for the actual supply. In the case of livestock, this is more complex because of the procedures to obtain meat or milk from livestock depend not only on farm management but also on the local organization of the supply-chain, e.g.

presence of slaughterhouses. Figure 3 shows the overall method to assess the food production capacity.

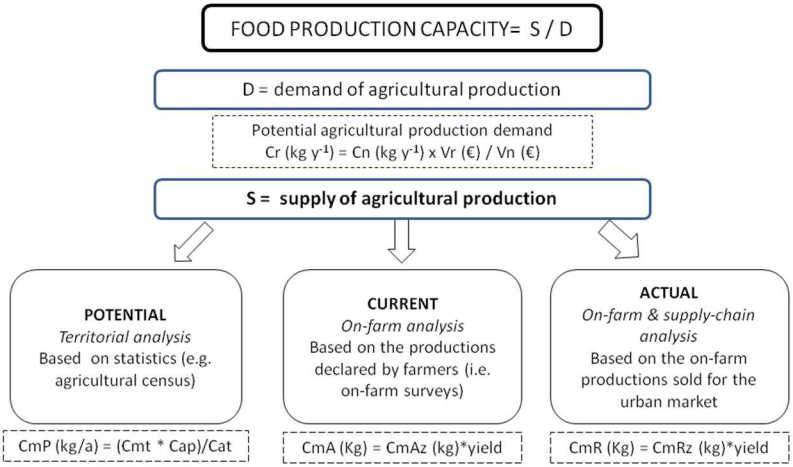


Figure 3: Methodological framework of the study. Cr is the Regional potential consumption (kg), Cn the national potential consumption, Vn the national expenditure for meat (€ month-1), and Vr the regional expenditure for meat (€ month-1), Cmp is the meat slaughtered in the urban region, Cap the meat produced in the urban region of Pisa, Cmt the meat slaughtered in Tuscany, and Cat the meat produced in Tuscany.

Finally, the food production capacities evaluated from potential, current and actual supplies are compared in order to assess whether there are any gaps for each meat type and whether there are any differences between the meat types.

2.2.1 Meat demand

Despite the growing interest in food issues, worldwide, little is known on the extent of local food consumption. In our case study, there are few data on meat consumption and such data are mainly based on surveys with a limited geographical coverage and a specific focus (e.g. Fastelli, 2011). This meant we

had to make some approximations. Firstly, we approximated the local demand as being equal to the regional meat demand (Timmons et al., 2008). Because no regional information is available, the regional meat demand can be calculated from the national meat demand by the following equation:

$$Cr = (Cn \times Vr) \times Vn^{-1} \quad \text{[Eq. 1]}$$

Where *Cr* is the regional (i.e. Tuscany) potential consumption (kg), Cn is the national (i.e. Italy) potential consumption, *Vn* the national expenditure for meat (€ month^{-1}), and *Vr* the regional expenditure for meat (€ month^{-1}). Data on *Vn, Vr* and Cn are provided in Table 1.

Food type	Potential consumption in Italy (Cn) kg y^{-1}	Expenditure in Italy (Vn) € month^{-1}	Expenditure in Tuscany (Vr) € month^{-1}
Cattle meat	23,4	42	46
Lamb meat	1,4	33	29

Table 1. Data used to determine meat consumption in Tuscany. Data source for national potential meat consumption come from ISMEA (2013); data on national and regional expenditures come from ISTAT (2010).

The second approximation was to consider the same consumption for all the population in the area, without distinguishing between drivers of meat consumption (Kearney, 2010), e.g. age, consumer behaviour or income. Therefore, to calculate the total meat demand in the study area we multiplied the regional potential consumption by the total population living in the area.

2.2.2 Meat supply

For the potential meat supply, we mainly worked with the most recent agricultural census data (ISTAT, 2011a). However, data for the territorial level of our case study only concerned animal breeds in local farms, whereas no

information was available on the number or type of animal slaughtered. Complete data were only available for Tuscany. Therefore, we estimated the potential meat supply for the urban region of Pisa with the following equation:

$$Cmp = (Cap \times Cmt) \times Cat^{-1}$$

[Eq. 2]

Where *Cmp* was the meat slaughtered in the urban region of Pisa, *Cap* the meat breed in the urban region of Pisa, *Cmt* the meat slaughtered in Tuscany, and *Cat* the meat breed in Tuscany. *Cap, Cmt and Cat* data come from the national agricultural census. In order to define the kilos of meat produced in the studied area, Cmp was multiplied by the average live weight per livestock type in order to obtain the total live weight, then multiplied by the slaughtering yield. All the data are summarized in Table 2.

Table 2. Main data used to estimate the meat production supply in the pisan urban region (ISTAT, 2010b; ISTAT, 2011a).

Meat production		**Breeded in the pisan urban region (Cap)**	**Animals raised in Tuscany (Cat)**	**Slaughtered in Tuscany (Cmt)**	**Average live weight (q)**	**Slaughtering yield (%)**
Cattle	Veal	770	29577	9034	2,6	58,7
	Bullock	697	40533	62552	5	57,9
	Bull	21	1725	336	6,9	54,6
	Cow	1015	25196	751	6,5	48,7
Lamb	Young Lamb	485	14776	299952	0,13	60,2
	Lamb	971	29533	2659	0,29	54,8
	Ewe and mutton	4774	528345	40791	0,51	48,6

For the current meat supply, we used data recorded on 14 real farms through on-farm surveys (2012-2013). The farm sample was representative of the livestock farms of the area, covering 80% of the cattle and sheep livestock units from the most recent agricultural census (ISTAT, 2011a). Dairy cattle farms were also included as contributors to the meat supply despite meat not being their primary production. During the surveys we defined the origin of the meat (cattle or sheep), the breeds (local or not) along with the type of sold animals (i.e. veal, bullock, cow, lamb, ewe). From the literature, we identified the average live weight at slaughter per breed as well as the yield (Succi, 1985; Boggia et al., 2009). Of the five on-farm recorded breeds, three were local (*Pisana* and *Chianina* cattle and *Massese* ewe). Livestock for home consumption was not considered in the analysis since it is not part of the commercial supply chain. Again, in order to define the total meat supply we multiplied the total breeds by their respective live weight and their respective yield.

The assessment of the actual meat supply is quite similar to the current supply, since it is also based on on-farm data. However, for this estimation each supply is multiplied by a coefficient indicating how and how much meat was sold in the case study area, e.g. on-farm direct selling, selling to local groceries and restaurants. This information was also surveyed as part of the on-farm surveys.

3. Results

3.1 Local livestock systems

Three livestock systems were surveyed: beef cattle and dairy cattle farms producing beef and veal (cattle meat), and sheep farms producing lamb meat – see Table 3 (farm characteristics) and Fig. 4 (location). Despite the variability of farm characteristics, we found that the average livestock density is quite small (less than 1) for dairy cattle and sheep farms, and remains low

for beef cattle farms (1.4). Forage is quite important in the crop rotation, and for all the farm types represents on average more than 50% of the UAA.

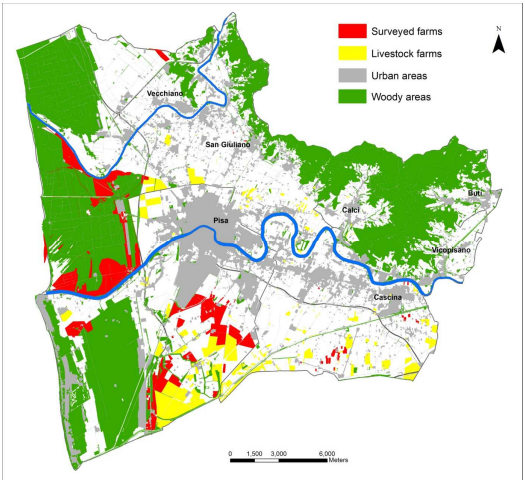


Figure 4: Spatial distribution of the livestock farms and the surveyed livestock farms in the study area.

However, considering some intensification indicators (Table 3), in all the types of livestock farms annual forage crops are more important than multiannual forage crops. This indicates an intensification of the forage system, which is particularly high for cattle farms. The share of grain crops on multiannual crops also shows that the current composition of forage in the crop rotation consists mainly of annual forage, except the interesting case of beef cattle farms. Beef farms are also mainly organic. Surprisingly, few farms belong exclusively to a conventional supply chain, indicating the interest of these farmers in local or direct supply chains.

Table 3. Main characteristics of the surveyed farms (n=14): average Usable Agricultural Area (UAA), average Livestock Units (LU), main crop yields and number of farms under conventional food-supply chain. UAAfc indicates the share of annual forage in the UAA, UAApc the share of multiannual forages, UAAgc the share of grain crops. Values in brackets are the minimum and maximum values.

Livestock farms	UAA (ha)	LU/UAA (n/ha)	Forage surface (%)	UAAfc/ UAApc	UAAgc/ UAApf	Organic farms (%)	Farms under conventional supply chain (%)
Beef cattle farms (n=7)	179 (10, 700)	1.3 (0.2, 1.7)	66 (45, 100)	2.1 (0.0, 10.0)	1.4 (0.0, 5.2)	57	14
Dairy cattle farms (n=4)	120 (30, 265)	0.8 (0.4, 1.4)	55 (38, 54)	3.5 (0.0, 11.5)	3.7 (1.3, 9.0)	0	25
Sheep farms (n=3)	143 (126, 290)	0.6 (0.2, 1.1)	78 (72, 93)	1.3 (0.2, 1.1)	2.3 (0.1, 1.2)	33	33

In terms of local breeds (Table 4), farms are mainly specialized i.e. very few cases of mixed livestock except for home consumption in family farms (cf. dairy cattle farms). Interestingly, within the beef cattle farms, local cattle breeds represent 37% of the total beef cattle heads. For dairy cattle and sheep farms, only one breed is represented (Fresian Holstein and Massese sheep, respectively).

Table 4. Main breeds (heads) of the surveyed farms (n=14). Pisana, Chianina and Massese are local breeds.

Livestock farms	Farms (n)	Pisana breed	Chianina breed	Limousine breed	Fresian Holstein breed	Massese breed
Beef cattle farms	7	424	226	2100	0	0
Dairy cattle farms	4	120	0	0	907	0
Sheep farms	3	0	0	0	0	2717
Total	14	544	226	2100	907	2717

3.2 Assessment of meat production capacity

3.2.1 The meat demand was higher than the national average

The meat demand in the area in accordance with Table 1 (census data) and Eq. 1 was equal to 26.0 kg y^{-1} per inhabitant for cattle meat and 1.6 kg y^{-1} per inhabitant for lamb. This indicated that in the area, the cattle meat consumption was higher than the national average, whereas the lamb consumption was almost the same.

3.2.2 A different potential supply between cattle and lamb meat

In terms of supply, in accordance with Eq. 2 and Table 2, we derived a total amount of produced meat in the area of 4.2 and 1.0 kg y^{-1} per inhabitant for cattle and lamb respectively. Therefore, according to Eq. 3, cattle meat supply was 16% of the local demand and lamb meat 62%. These results indicate that there is a good potential capacity for lamb production (more than a half) from local production, whereas this potential capacity is smaller for cattle production.

3.2.3 Current supply was quite different from the potential supply for lamb

Using on-farm data, we identified the number of different breeds in the surveyed farms (Table 5). Then, using Eq. 2, we derived a total amount of produced meat of the farm sample in the area of 3.7 and 0.5 kg y^{-1} per inhabitant respectively for beef and lamb for the surveyed farm sample. Therefore, following Eq. 3, the cattle meat supply of the farm sample was 14% of the local demand and lamb meat 31%. These results indicate that there is a good potential for local farms to produce lamb (more than a half) from local production, whereas it is smaller for cattle production.

Table 5. On-farm meat production in Pisa urban region, according to the on-farm surveys (n=14).

Origin of the meat	Breed	Type	Total breeds yearly slaughtered on the farm sample	Live weight at slaughterhouse (kg)	Yield	Total supply (kg)
Beef cattle	*Pisana*	Bullock	228	516	0.64	75,295
	Chianina	Bullock	73	550	0.60	24,090
	Limousine	Bullock	2062	425	0.64	560, 864
		Veal	52	165	0.63	5,405
Dairy cattle	Fresian Holstein	Veal	87	450	0.60	23,490
		Cow	76	600	0.49	22,344
Sheep farming	*Massese*	Lamb	1,000	13	0.55	7,150
		Ewe	60	65	0.49	1,911
Total			*3,638*			*720, 549*

Since our sample represented 80% of the livestock units in the area, we can generalize our results by increasing the total supply per type of meat by 20%. This may lead to 4.4 and 0.6 kg y^{-1} per inhabitant respectively for cattle and lamb meat, thus indicating an approximate current meat capacity of 17% and 37% respectively.

3.2.4 Actual meat supply for cattle was similar to the current supply

Table 6 summarizes the meat which is sold in the local area by the surveyed livestock farms. Following the same procedure as in the calculation of the current supply, we obtained an actual meat supply for our sample of 3.1 and less than 0.01 kg y^{-1} per inhabitant respectively for cattle and lamb meat, leading to a fulfillment of the meat demand of 12% and 0.6% respectively. Again, we can approximate these data by comparing the livestock units of our sample to the total livestock units of the area: this give a supply of 3.7 and 0.001 kg y^{-1}, thus representing 14% and 0.6% of the demand. With respect to the current supply, surprisingly in our farm sample, 70% of the cattle meat produced in the area is also marketed locally, whereas the lamb is almost completely sold outside the urban region.

Table 6. On-farm meat production marketed in the Pisan region, following the on-farm surveys (n=14).

Origin of the meat	Breed	Type	Total breeds yearly slaughtered on the farm sample	Live weight at slaughterhouse (kg)	Yield	Total supply in the Area Pisana (kg)
Beef cattle	*Pisana*	Bullock	168	516	0.64	55,480
	Chianina	Bullock	26	550	0.60	8,580
	Limousine	Bullock	1982	425	0.64	539,104
		Veal	52	165	0.63	5,405
Dairy cattle	Fresian Holstein	Veal	8	450	0.60	2,160
		Cow	0	600	0.49	0
Sheep farming	*Massese*	Lamb	0	13	0.55	0
		Ewe	35	65	0.49	1,115
Total			*2,271*			*611,844*

4. Discussion and conclusions

We compared different results of meat production capacity of periurban farming. In the urban region of Pisa, we focused on meat production, but we believe that our method would also be suitable for other food productions, such as vegetables, bread, or milk.

Results showed that food capacities based on potential, current and actual food supplies give different outcomes. These outcomes need to be analyzed in order to understand the capacity of local farming to fulfill the urban food demand. Since it is based on statistical dataset, the potential food supply not only enables different urban regions to be compared but also different methods, such as those developed by food system studies (Timmons et al., 2008; Colasanti and Hamm, 2010). However, our approach has some limitations. Firstly, it depends on the availability of datasets. These datasets are often not annual and cannot be either updated or compared, as also highlighted by our calculations, which needed some approximations. Secondly, the spatial level of datasets is usually national or regional. In our

opinion, a more locally-based dataset would help the analysis regarding the food production for a more actual food policy (Van den Bergh and Verbruggen, 1999). Thirdly, demand and supply were estimated using different sources of data, thus limiting their comparability.

The capacity of the current food supply is based on on-farm data, e.g. the stated number of livestock units and animals slaughtered. For this analysis, slaughterhouses could represent other sources of data (Fastelli, 2011), although they are often far from the urban areas. Livestock producer associations could also be consulted. Considering the high number of very small-scale livestock farms for home consumption and the decreasing number of farms since the last agricultural census in 2010, we concluded that the sample is representative of the local livestock farming system. However, using a farm sample, we reduced the livestock units taken into account, hence generating a bias between the sample meat supply and the total farm meat supply in the area. We thus approximated the final result by adding 20% more to the sample supply.

Regarding the comparability of current food supply and demand, an important limitation is the lack of up-to-date data on food demand. The assessment of food demand at a local scale was beyond the scope of this paper; however, other methods studying food consumption at a local level (Hallström and Börjesson, 2013) could improve the accuracy of the analysis.

The capacity from the actual food supply was also based on the same procedure as the current capacity, however it only considers the amount of food that is really sold in the local markets. Because the farm sampling was not initially based on such criteria, our sample may have excluded for example other farms aimed at local productions, especially small-scale farms. However, because food capacities estimated on the current and actual supplies are assessed on the same sample, it could help to understand the rate of food production locally which is devoted to the urban market. In our sample, 64% of the farms were included in the local commercial network, of which 67% have various labels (organic, local origin). This confirms a

relationship between the local market and labels, which has been highlighted in other studies (Ansaloni, 2009; Arfini 2009; Tregear et al., 2007).

Our results for meat production in the urban region of Pisa showed a different behavior for cattle and lamb. For lamb, the potential supply was higher than current and actual supplies. On the one hand, the difference between current and actual supplies indicates a small place for lamb in local markets, which can be explained by the fact that meat is not the main production of these farms (*Massese* is a milk breed). This therefore suggests that these periurban farms probably do not completely exploit meat and there is room for promoting such production.

The difference between the potential and current supply seems to suggest that there is an overestimation of lamb production in the statistical data. This can be explained by the fact that in local slaughterhouses, the lamb also comes from outside the area, confirming that in this urban area there is a higher demand for lamb than can be met by local farmers. For cattle, even though the meat supply was low for the three supply estimates compared to the demand, there were a few differences between the current and actual supply, showing a higher capacity of such farmers to be in short food supply chains. This is probably related to the presence of local meat labels and several initiatives regarding locally-produced cattle meat, as well as the presence of public and private actions to support cattle and not lambs.

Therefore, future analysis could focus on the importance of local supply chains in farmland protection in periurban areas. This means understanding the agro-food paradigm, which is more related to the embeddedness of products, actors, different supply chains (Sonnino and Marsden, 2006). In addition, our results show that only a few farms (14% of the sample) are exclusively part of a short food supply chain, and there is a tendency for the coexistence of conventional and short or alternative food chains that also involve a new and more complex understanding of the relationships between conventional food chains and alternative food chains (Renting et al., 2003;

Sonnino and Marsden, 2006; Holloway et al. 2007; Halliday, 2012; Chazoule et al., 2013).

Generally speaking, we believe that gaps between potential, current and actual food supplies do not completely depend on the different databases. In our opinion in periurban areas, some on-farm constraints and conflicts (Dairly and Torre, 2013) exist, which block, limit or make it more expensive to produce and sell to local markets (Filippini et al., 2013; Giacchè et al., 2013). An analysis of the on-farm constraints would therefore be an interesting next step for this study.

We did not analyse the fodder autonomy of the surveyed farms. However, future studies could include an assessment of animal feeding not only by analyzing on-farm fodder autonomy, but also in order to include the non livestock periurban farms that now produce and sell cereals and fodder outside the local area, and that could potentially contribute to sourcing animal feed from the local area.

Our results showed that the meat production can be increased in order to satisfy urban food demand. From an agronomical approach, the difference between the potential and the actual meat supply, seems to suggest the need for an examination of the quantity of new livestock units required to fulfil this demand. This may also be a question of hectares, however, the main point is still the yield and this depends on several factors, for example the intensity of livestock management, or the presence of local breeds that has a slower growing. Focusing on the yield seems to go against the classic foodprint approach (Billen et al., 2009), or other studies on the potential food capacity (eg. Timmons et al., 2008; Colasanti and Hamm, 2010), which have been more interested in the amount of hectares needed to satisfy the food demand of the city, considering an ideal diet and an ideal yield based on hypothetical crop/livestock management.

Our study confirms the need for more on farm analyses, since we have demonstrated that estimates based on statistical data do not reflect the actual food capacity of farms in the studied area. In our opinion, however,

both the on-farm and the statistical territorial data are needed in order to examine the factors affecting the food production capacity. Hence, there is a need for a more agronomical approach that should also take into account food planning policies (Morrison et al., 2011) and territorial analyses. We thus recommend that local authorities in charge of food and land planning, should include real farm data in their assessments (Tassinari et al., 2013), and that partnerships should be created between private and public stakeholders from urban, periurban and rural areas, in order to support food production in periurban areas through new agri-urban projects.

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6. Food production for the city: hybridization of farmers' strategies between alternative and conventional food chains

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Q.2.1

In the second question, only farms producing partly or completely for the LFS are taken into account. First the farms are grouped considering the percentage of food production sold in local food system. The most important result is that the contribution to the ALFSCs needs to pass by hybridization of commercial food chains; moreover between the indicators, significant results are related to the participation to specific network and the typology of product, confirming the tendency of previous results, even if the indicators are different.

Food production for the city: hybridization of farmers' strategies between alternative and conventional food chains

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Key words: Food Supply Chains, Periurban Agriculture, On-Farm Surveys, Indicators, Tuscany

Abstract

Alternative and local food supply chains (ALFSCs) have been indicated as drivers of territorial development through increasing the food security of local food systems. In this context, the permanence of periurban agriculture is a relevant issue. However, few studies have analyzed the contribution of periurban farmers to such ALFSCs. In this study, we characterized strategies that periurban farmers adopt to contribute to local urban food provision through ALFSCs. We surveyed a sample of 55 farmers in the urban region of Pisa, Tuscany (Italy). Three farmers' strategies emerged depending on the percentage of production they allotted to local markets: few/passive, intermediate/opportunistic, entire/active. The main factors influencing each strategy were personal and professional bonds, diversification of the commercial network, the number of products in ALFSCs, and diversification of products sold in ALFSCs. Even though farmers can allocate 100% of their

production to ALFSCs, most farmers combine ALFSCs with conventional food chains, which suggest that hybridization has advantages for the sustainability of these farms. Farmers who adopt these opportunistic strategies are more dynamic and adaptable to local opportunities and constraints. This analysis will offer empirical evidence about the participation of farmers in ALFSCs and especially about the hybridization between conventional and alternative food chains, contributing to the characterization of the supply's networks of local produce, with benefits for community food security.

Introduction

Recent international debate has renewed interest in the food production function of periurban agriculture. The FAO reports that the growth of urban populations raises concerns about food security and the kind of food production possible in areas surrounding cities in terms of quality and quantity (FAO, 2010). From this perspective, several local and international institutions recently have begun to discuss and develop food plans and urban food strategies. As stated by Sonnino (2014), the interest of such strategies lies both in the efficiency of the supply side in terms of logistics and quantity, but also increasingly in how production can be reconciled with the limits of sustainability (Sonnino, 2014). Several institutions and researchers have linked this debate to the possibilities offered by alternative food networks and short food supply chains by considering their potential to promote more environmentally sustainable modes of production (Renting et al., 2003). In their report for the European Union (EU), Kneafsey et al. (2013) studied the implication of Alternative Food Chains (AFCs) and Short Food Supply Chains (SFSCs) as a possible sustainable tool to support the Local Food System (LFS)(Kneafsey et al., 2013). By assessing the number of research projects financed by EU funds over the past 15 years, they also demonstrate the interest in LFSs and SFSCs (Kneafsey et al., 2013). The Rural Development pillar in the 2014-2020 Common Agricultural Policy has placed the "development of short supply chains and local markets" as one of the 6

priorities, with a variety of economic, social and environmental benefits. Institutions' interest in such experiences agrees with several reports that assert that while the number of farms has decreased, direct selling and other AFCs have increased. In the United States, for example, the farm's direct sale has more than doubled between 1997 and 2007 (USDA, 2014), while the number of farmers' markets has grown from around 1.755 in 1994 to around 8.000 in 2014. The farms more involved in this food system are especially those located in or near urban areas (USDA, 2010). In light of this evidence, project's reports define these food chains as an "emerging European sector in the food-related economy" (FAAN, 2013).

Considering these worldwide sources of evidence and the emerging debate on the contribution of periurban farming systems to local food security, we explore in this study the effective participation of periurban farmers in LFSs through AFCs and SFSCs. This contribution has three sections. First, we introduce the debate about the concepts of AFCs and SFSCs, and the debate about their benefits. We discuss the concepts of hybridization between AFCs and conventional food chains (CFCs). Finally, we present evidence from the literature about farmers' strategies in commercialization choices between AFCs and CFCs. In the second part we present a case study, the method for choosing sample farms, indicators, and the analysis methods applied. In the third part we discuss the main results from qualitative and quantitative analysis of farmers' strategies and conclude with reflections on the hybridization of farmers' strategies.

1. Analysis of farmers' strategies between alternative and conventional food chains

1.1 Debate about AFCs and SFSCs in periurban areas: a potential tool for territorial development

In general, AFCs intend to restore consumers' connection with food producers (Ilbery and Maye, 2006) (Marsden et al., 2000), which is counter to the dominant agro-industrial model of CFCs (Deverre and Lamine, 2010). Included in AFCs, SFSCs (Renting et al., 2003) were promoted for their importance in reducing food miles (Smith, 2008) and their ability to maintain agriculture around urban areas (Aubry et al., 2008), which provides value to local food (Duram and Oberholtzer, 2010) and local producers. This is due to their capacity to "re-spatialize" and "re-socialize" food provision (Marsden et al., 2000) and the support for the embeddedness of the food supply (Winter, 2003). In the literature, "SFSCs" is a broad term in which multiple degrees of locality emerge: from extended value, in which a product is sold outside its region of production, to food provision based on a face-to-face relationship between consumers and producers, or on the spatial proximity of the sale of farmers' produce, where periurban agriculture can play an important role (Marsden et al., 2000).

The development of such SFSCs is seen as an indicator of entrepreneurship and innovation for periurban agriculture because of agriculture's adaptation to new demands from the city for local food (Lamine and Perrot, 2008) or as farmers' "positive" reaction to urban competition (Paül and McKenzie, 2013). Authors have identified several drivers that explain the development of these supply chains in periurban areas, such as the accessibility of local consumer markets (Jarosz, 2008), social contacts between producers and consumers, different kinds of distribution (Holloway,* et al., 2007), and proximity, which encourages farmers to identify market niches, innovate and adapt to new demands (Le Grand and van Meekeren, 2008).

Within these contributions, the local dimension is perceived both as a reason for the success of SFSC development and as a space where it is possible to have the best benefits of such innovative experiences. Many authors have insisted that these AFCs are operational tools for territorial development (Lamine, 2014), and they are frequently associated with the promotion of sustainable development across the global food system (Sundkvist et al., 2005).

Nevertheless, several authors have discussed the real capacity of such food chains to be innovative drivers of the new rural social economy (Goodman, 2004b). This is also due to the literature adopting a broad definition of AFCs and SFSCs (Holloway,* et al., 2007) to include "anything that is not conventional" (Venn et al., 2006) and not questioning the differentiation of practices, networks, farmers' motivations, and the real impact they produce in a given territory (Tregear, 2011). For example, Venn (2006) emphasizes that AFCs and SFSCs are not always driven by food producers. Their goals are not necessarily to maximize farmers' profit or market penetration, and thus they are not in line with sustaining farmers' entrepreneurship, highlighting the potential negative impact on farmers' profit (Venn et al., 2006). Tregear (2011) stressed that farmers' motivations in AFCs are not always compatible with more sustainable practices (Tregear, 2011), and Watts et al. (2005) stated that a "detailed scrutiny of the social and environmental consequences of strong AFCs would be welcome"(Watts et al., 2005).

1.2 Hybridization of CFCs and AFCs

Several studies have demonstrated that SFSCs and AFCs cannot be possible everywhere or under every condition and that farmers' personal motivations, market constraints and other external conditions they encounter may determine the success and maintenance of such alternative commercialization (McElwee et al., 2006). Empirical analysis has identified several constraints. In Denmark, for example, Eriksen and Sundbo (2015)

analyzed barriers and drivers that may affect development of such food networks (Eriksen and Sundbo, 2015). In Latvia, Grivins and Tisenkopfs (2015) observed that in individual actors' practices, *conventional* and *alternative* discourses "often overlap" and are connected (Grivins and Tisenkopfs, 2015). Through analysis of livestock producers in the Scottish-English border region, Ilbery and Maye (2006) recognized that "a straightforward polarity between (…) mainstream food systems and (…) locally dedicated food systems is unlikely". According to their study, local farmers combine local/alternative and CFCs, i.e., farmers "have not really moved from one system to another – the new arrangements are part of the one overall system" in which farmers have created a "niche" market (Ilbery and Maye, 2006).

The debate on the "hybridization of food chains", initially proposed by Ilbery and Maye (2006) has undergone further analysis that explore the exact boundaries between the "conventionality" and the "alternativity" of food chains. For example, Forney and Häberli (2015) assess the potential transformative power of AFCs in CFCs, e.g. big agribusinesses that establish a process of "conventionalization of organic production" or adopt policies for social inclusion of local farmers (Forney and Häberli, 2015). Similarly, Tregear (2011) discussed the capacity of AFCs to promote sustainable development through sustainable farming practices by observing that motivations and practices of farmers in participating in AFCs linked more to the short-term profit of being in a new market than any real intention to promote sustainable production practices or food chain systems (Tregear, 2011). Considering this debate, many authors have asked for deeper knowledge about the relations between farming systems and food systems within the framework of AFCs. This will highlight the variability in AFCs (Venn et al., 2006) and help research to properly place these experiences in the sustainable development process (Izumi et al., 2010). According to Sonnino and Marsden (2006), this means operating a "new process of re-localization of economic activities and practices"(Sonnino and Marsden, 2006).

While the literature on AFCs usually has its starting point in the food chain itself (Aguglia et al., 2008; Brunori et al., 2012), we begin with the producers to recognize the "hybrid and creative character of the solutions orchestrated by farmers" within different types of food chains (Sonnino and Marsden, 2006). This means overcoming the "unlikely rigid distinction" between AFCs and CFCs (Ilbery and Maye, 2006), which promotes a more extensive and complex understanding of farmers' experiences. This should particularly facilitate understanding of farmers' motivations and strategies for participating in and promoting AFCs, which will benefit urban food policies and assessment of impacts of such experiences on local development.

1.3 Farmers' strategies

Some of the literature focuses more on farmers' commercial strategies in developing countries and on transitions from subsistence to market agriculture rather than on different marketing strategies (Jarosz, 2008; lópez-ridaura et al., 2005; Pingali and Rosegrant, 1995a; Zasada et al., 2011b). Regarding the debate about farmers' choices of AFCs and CFCs (e.g. on-farm direct sales, farmers' markets), some of the literature focuses on "commercial strategies", "marketing strategies", "strategic response", or "marketing decision-making" (Andreatta, 2000; Kirwan, 2004; Poole, 2000; Uematsu and Mishra, 2011; Wen-fei). In general, these contributions only consider specific products (Poole, 2000) or a specific farming system, such as organic farming (Andreatta, 2000; Poole, 2000), or they characterize one type of food chain, such as direct marketing (Uematsu and Mishra, 2011). Nevertheless, we find interesting elements in the literature that aid in understanding why farmers develop a strategy that includes AFCs and SFSCs. In general, it seems that the "farmer strategic response" (Poole, 2000) is due to a specific set of "skills and abilities" (Wen-fei) or more generally to internal and external "factors influencing farmers' production and marketing strategies" (Poole, 2000; Uematsu and Mishra, 2011). See Table 1 for a list of contributions from the literature.

Table 3 Suggestions from the literature of drivers of marketing strategies adaptable for developing AFCs and local marketing strategies.

1.4 Aim of the study

We aim to characterize strategies that periurban farmers adopt by understanding specific factors that distinguish farmers who are part of a local commercialization network through ALFSCs. Considering the debate previously mentioned about the definition of AFCs/CFCs/LFSs, we define ALFSCs as food chains in which farmers have knowledge and/or control of the final destination of the product, and therefore they are able to restore their food-chain relations. In this way, the food chain is alternative (Renting et al., 2003). Instead of using the term "short", which the literature uses to refer to different degrees of locality (Marsden et al., 2000), we use the term "local" to refer to the area where the product is produced and sold. Regarding the definitions of "short" by Marsden et al. (2000), we refer to face-to-face and "spatial-proximity" sales.

Because of our interest in the contribution of periurban agriculture to the LFS through ALFSCs, we grouped into one class all the food chains that are not solely for local consumption. By this class, "Other Food Supply Chains" (OFSCs), we mean food chains in which a farmer's produce is not explicitly sold for local consumption. In other words, we refer to CFCs, as defined by Renting et al (2003), as well as AFCs that are not for local consumption (e.g. direct on-farm sales for tourists) (Renting et al., 2003).

As previously mentioned, a farmer's strategy is a complex mechanism affected by multiple factors and may require many indicators to be explained. We offer an initial analysis of the complex mechanisms of factors that enable farmers to implement their strategies. Study of these factors highlights the variety of farmers' experiences that result from adapting to their territory.

In particular, the empirical analysis in this study offers evidence about factors that may characterize farmers' "hybrid" strategies related to the choice of

ALFSCs and OFSCs. For this reason, we include indicators that can consider both ALFSCs and OFSCs to overcome the methodological polarity between ALFSCs and CFCs (Sonnino and Marsden, 2006).

To better understand hybridization of strategies based on a combination of factors, and the impact that this effect can have on periurban farming systems, we adopted a place-based or territorial approach that considers farmers by the territory where they work (Lardon et al., 2012) and not just the food chain to which they contribute. We hypothesize that diversified territorial food production in many farming systems can match the hybrid strategies of commercialization. This is especially true for periurban farming systems, which have new dynamics linked to the new urbanization (Pascucci, 2007). Periurban farmers can take advantage of the new proximity to urban consumers and at the same time still participate in CFCs linked to previous conventional farming systems, or they can have easier access to global markets because of the proximity to infrastructures and services. For this reason, we consider farmers who participate exclusively in ALFSCs and farmers who participate in OFSCs and ALFSCs, even for a small percentage of their production. This will help to assess the effective contribution of such food chains to the sustainable development of periurban areas, as well as to local food security.

2. Materials and methods

2.1 Case study: periurban farming in the urban region of Pisa

The case study is the urban region of Pisa (Fig. 1), a medium-sized city of 86,000 inhabitants in Tuscany, Central Italy. This urban region has a surface area of 500 km^2 and consists of six municipalities associated with an inter-municipality (Area Pisana) located in the coastal plain of the Arno river and in the hilly area known as Monte Pisano (917 m a.s.l.). As a common trend of European periurban areas, population has decreased in the main city since the eighties and increased in the proximal small towns (Fig. 2). Also local

agriculture follows the main trend of Mediterranean agriculture: the number of farms decreased from 1990 to 2010 (-56%), especially for vegetables (-92%), while mean farm size slightly increased for all the farming systems (Marraccini et al., 2012). This periurban area is relevant for our analysis not just because of its administrative borders and distance from the largest and most important city, but also because of its geographic borders, which have created a unique social identity compared to nearby areas. The territorial production system of Pisa seems different from that of other areas: agriculture is neither specialized nor specific to one food chain, mixed farming systems still persist in the area (ISTAT, 2011) and farmers rely on several types of commercial organization. This enabled us to study the multiple strategies possible for different types of primary produce.



Fig. 1 Location of the case study of the urban region of Pisa in Tuscany (Italy)

2.2 Method

The method used to assess farmers' strategies is divided into four steps: selection of a representative sample of farms, interviews, development of an indicator grid, and statistical and qualitative analysis.

2.3.1 Farm sampling and selection

Farms were selected considering three criteria: the main farming system, the farm size, and the geographic distance of the farmstead from the urban center (Fig. 2). Farms were selected to represent the territorial production system of the periurban area of Pisa as described in the 2010 national agricultural census (ISTAT, 2012).

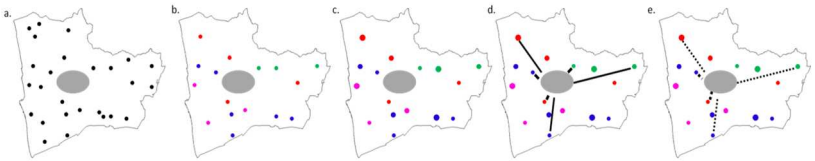


Fig. 2 Method for farm's sampling and selection in the case study area In order to represent the territorial production system (a), we have firstly selected farms, considering the most important farming systems of the area: Livestock, Crops, Vegetables, Olive (b) three classes of UAA: Big Farms, Medium Farms, Small Farms (c) the geographical distance with the urban area (d) the ALFSCs: commercial relations with the periurban area (e).

The initial sample contained 55 farms representing four main farming systems, whose frequency in the sample reflected the existing territorial farming system: extensive crops (65%), livestock (14%), vegetable (13%), and olive-groves (8%) oriented systems. We directly contacted farmers to conduct interviews. Among the 55 farmers interviewed in 2013, we selected the 29 farmers who had local commercial relationships with the urban area of Pisa (Fig. 2d). We then excluded three farmers whose relationships with the city were too difficult to evaluate due to a lack of data and frequency of commercialization. Consequently, all 26 farmers surveyed produced food for local urban consumers.

2.3.2 Farmer interviews

We conducted semi-structured face-to-face interviews with 55 farmers in 2013 as part of a larger project on the knowledge and evaluation of the sustainability of periurban agriculture in Mediterranean areas (DAUME project). Based on the interviews, we divided the farmers into three groups based on the percentage of production sold in different food chains. The farmers in the first group were mostly involved in conventional or global food chains, but a small percentage of production was sold locally in AFCs and for local consumption. The farmers in the second group attempted to combine OFCs and ALFSCs. The third group consisted of farmers who were exclusively involved in ALFSCs.

We explored the main characteristics of these three groups of strategies and the factors that distinguish farmer membership in them. The analysis was both quantitative, using indicators that differentiate the groups, and qualitative, by describing the nature and reason for adopting a certain strategy.

2.3.3 Developing an indicator grid

All indicators came from the literature. The first set of indicators refers to "Farm Structure", which included specific land use, human labor and tools (machinery and buildings). Since we focus on local commercial relationships, we included indicators about farms' location. We also assessed the importance of multifunctional activities (Table 2). Based on the literature, we included indicators of "Farmer Characteristics", such as the degree of innovation, participation in networks, and the personal importance of factors such as the workplace, the products, the involvement in stakeholder networks, and the added value from ALFSCs (Table 3). Indicators in the set "Products Sold" refer to the differences in product processing, quality, and destinations between ALFSCs and OFSCs (Table 4). By including the principal production, we also assessed which products are sold in ALFSCs and OFSCs.

The last set of indicators refers to “Commercial Network”. We particularly wanted to assess the markets that farmers have organized, which should depend on their personal bonds, their client relationships, the relations between food networks they have organized, and their perception of constraints (Table 5). We also added their participation in commercial networks. The 66 indicators were applied to analyze the marketing strategy in ALFSCs of the 26 farmers ultimately selected.

Table 2 Indicators of farm structure describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains

Table 3 Indicators of the farmer characteristics describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains

Table 4 Indicators of products describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains.

Table 5 Indicators of commercial network describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains.

2.3.4 Qualitative and statistical analyses

Farmers’ interviews were analyzed qualitatively to understand their motivations for developing their marketing strategies. Then, we characterized each marketing strategy at the farm level using the indicators and analyzed whether significant differences existed in mean indicator values. Since distributions of the indicators were generally non-parametric, we analyzed differences in mean indicator values using the Kruskall-Wallis one-way analysis of variance test to identify which indicators define the three groups of strategies. This enabled us to respond to our hypothesis that the choice of

allotting different percentages of production to ALFN depends on specific common elements among farmers of the same group. The null hypothesis is that the difference is random among the three groups. A discourse analysis of the interviews helped us to interpret and explain the results of the quantitative analysis.

3. Results

3.1 ALFSCs around Pisa: high farm diversity

Farming systems were not randomly located around Pisa (Fig. 3). Olive oil is mainly produced northeast of the periurban area (Monte Pisano), while horticultural production is mainly to the north, and cereals and livestock more to the south.

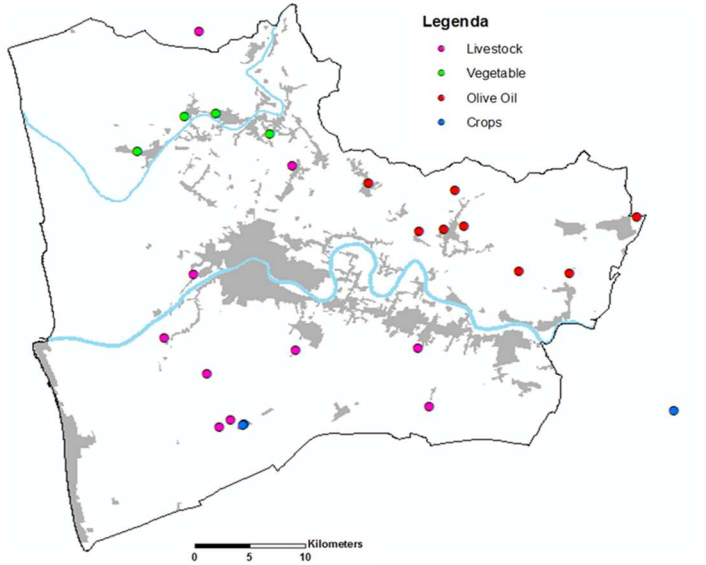


Fig.3 Farm sample, considering the principal farming system's production.

Livestock production represents 38% of the farms in the sample (Tables 6 and 7). These farms were mainly specialized in meat production (7 farms), dairy

cattle (3 farms), and goat production for milk (2 farms). Their mean size was 134 ha (±76%), with a mean of 85 livestock units (LSU) (±82%). The purpose of olive production (31% of the sample) is only for producing olive oil, as is typical in the area. Vegetable production (19% of the sample) had a mean size of approximately 12 ha, while cereals (12% of the sample) had a larger mean size of 273 hectares, but with high variability. Most farms family farms, except for two: a co-operative (F24) and a public farm belonging to the University of Pisa (F10).

Table 6 Main Characteristics of the farm sample. UAA indicates the Usable Agricultural Area, LSU indicates Livestock Units, ALFSCs Alternative Local Food Supply Chains.

Table 7 Main Characteristics of the sampled farming systems, considering the numbers of farms, the corresponding percentage, the average of hectares, the percentage of production delivered to Alternative Local Food Supply Chains (ALFSCs).

3.2 ALFSCs in the periuban area of Pisa: high variability of farmer strategies

Different strategies emerged for the commercialization of products within local and alternative food supply chains. In the first group (4 farmers, 15% of the sample), a small part of production is provided to ALFSCs. One farmer from each main production type is in this group. Based on analysis of farmers' interviews, the main reasons to sell in ALFSCs are proximity to buyers (e.g. neighbors, friends), the opportunity for special professional bonds (through local institutions), and personal bonds. For this reason, we called this group the "Passive Strategy". One follower of this strategy is farmer F04, who sells nearly all (98%) of his sheep milk through conventional commercialization to a regional milk factory, but the remainder is sold to local consumers and the nearest milk factory.

"I sell milk to the local cheese factory in case they lack sheep's milk." (F04)

Another farmer (F24) has extensive organic crop production sold through national traders in northern Italy, but decided to dedicate a small percentage of production to organic vegetables to directly sell through door-to-door sales.

"There's a guy who takes care of the garden; he began while he was at the university...and so he knows a lot of students and formed a kind of informal GAS [Solidarity Purchasing Group]." (F24)

In the second group (17 farms, 65% of the sample), despite the higher percentage of production delivered to AFN/SFSC and OFSCs (from 15% and 69% on average), farmers try to maximize the benefits of both commercialization strategies. They combine OFSCs, with ALFSCs. Livestock is the main production (41% of the group), followed by olive oil (29%), vegetables (18) and cereals (12%). Under this strategy, great variability exists in both the quantity delivered to local markets and in the organization of commercialization. Some farmers deliver the same products to both ALFNs and CFNs, so the same product goes to different food chains, while others deliver different products to different food chains. There are many reasons farmers practice this double strategy of commercialization: e.g. to maximize profit, to use pre-existing conventional food chains already developed by the family, and to take advantage from new networks. Because this strategy seems to take advantage of the many opportunities farmers encounter, we called this group the "Opportunistic Strategy". For example, farmers F16 and F08 (vegetable farmers) began to directly sell on-farm or in local markets and also invested in new structures or in the diversity of products offered to clients. Nonetheless, they also sell at the small wholesale market where they used to deliver products to ensure that everything will be sold.

"I would like to do more and more direct selling. The profit is higher…but with the wholesale market it is sure that you will sell everything." (F08)

Several farmers (F19, F22, and F23) need to produce fodder and crops to maintain a particular crop rotation. This production is not easily sold in the local market; in most cases 100% of main production (meat, milk, and cheese) is sold in local and AFNs, while the crops and fodder are sold through cooperatives that collect the product and sell it in national and international markets.

In the third group (5 farmers, 19% of the sample) 100% of the production is sold through ALFSCs. In this group, sale strategies are actively for local consumption through alternative food chains, which is why we call this group the "Active Strategy". We observed that the motivations of its farmers for adopting ALFSCs are shared with the farmers of the Opportunistic Strategy group who sell in ALFSCs. The main reasons for adopting ALFSCs are the higher control over product destination and quality. ALFSCs seem to assure more independence in farm management for the farmer.

Farmers participating in ALFSCs usually express personal satisfaction as a reason for doing so, which is also connected to a certain social meaning of the farming activity.

"Direct sales enable us to produce more sustainable production for the city than the big farms" (F20)

A few farmers' mention the opportunity of being close to the city:

"[Direct sales] is one of the options you can have if you have a green area close to the city" (F20)

Most farmers express the benefits of shorter food chains as the simplification of procedures, crop management, negotiating, and the possibility of added value of products. Some farmers would like to avoid supermarkets, which require relatively constant production, with the consequent problem of disposing of unsold production. Through ALFSCs, it is often possible to have a higher price and more immediate payments.

"The sale of the produce directly to the consumer is a very important simplification. It is possible to avoid difficult administrative management" (F20)

"Supermarkets impose strict rules for products, and there was uncertainty in the amount of product they want from me...and if by chance I couldn't sell everything, I did not know where to take it." (F22)

"The wholesale markets don't pay immediately when you bring the product" (F16)

"The real added value is obtained by directly meeting the consumer" (F23)

3.3 Main differences in farm management among the three strategies

In Table 8 it is possible to see the results of Kruskall – Wallis analyses, for the indicators resulting with a significance statistical differences among the averages' values of the three groups of farmers.

*Table 8 Kruskall Wallis results for significant values for indicators: * OPP-PAS indicates significant difference only between the groups' opportunistic and passive strategies; * ACT/PAS-OP indicates significant difference between the groups active and passive by one side and opportunistic strategy by the other side; * ACT-PASS indicates significant difference between active and passive strategy; * ACT-OPP/PASS indicates significant difference between the groups active by one side and passive and opportunistic strategy by the other side. Results illustrate the average values of indicators and standard deviation.*

3.3.1 Farm structure: high variability among strategies

None of the "Farm Structure" indicators are significantly different among the three groups (Table 8). However non-significant differences can be meaningful and they will help the analysis of the three strategies. Usually coefficients of variation (CV) tend to be high, especially for mean UAA (Usable Agricultural Area), indicating high variability within each group. Even Distance

from the largest urban centre (DIST BIG) and Distance from the closest urban centre (DIST CLOS) have similar values in all three groups, with higher variability for active and opportunistic strategies than the passive strategy.

Indicators for the perception of constraints (CONSTR) and opportunities (OPPORT) associated with proximity to an urban area are similar among the three groups. For the three strategies, producing close to the city is an opportunity because clients are closer; but it is also a source of constraints due to the use and presence of infrastructures, or the need to manage conflicts with new urban neighbors. For both active and passive strategies, the values of perception of constraints and opportunities coincide, even though at two different levels (Fig. 4). Active – strategy farmers have the highest perception of opportunities, which coincides with the highest perception of constraints, while for passive-strategy farmers, the values of perceived constraints and opportunities are the lowest among the three groups. In contrast, perception values are not similar for opportunistic-strategy farmers, whose perception of opportunity is higher than that of constraints. Their perception of opportunity is lower than that expressed by active strategy farmers, and they have the lowest perception of constraints. These results suggest a tendency to maximize the opportunities that location offers. The possibility to also market in OFSCs may help farmers consider opportunities more and constraints less, or to adapt to constraints by selling products to OFSCs, while farmers whose profit depends completely on ALFCs consider constraints more. For example, opportunistic strategy farmer F8 is located in the center of a village, which enabled him to establish on-farm direct sales for local inhabitants. Regarding possible conflicts with neighbors, F8 states: *"We have to adapt to urbanization; now we can't start work with tractors at 5 in the morning.* "

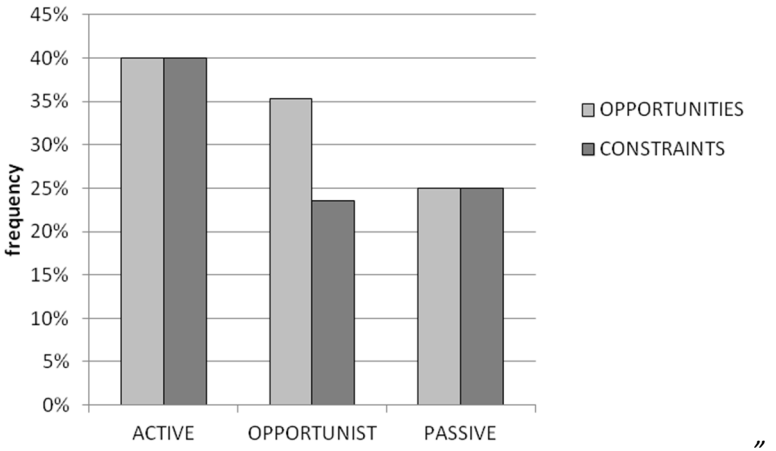


Figure 4 Opportunities and constraints linked to urbanisation perceived by farmers in the case study area. ACTIVE, OPPORTUNISTIC, PASSIVE indicate respectively the three groups of farmers "Active Strategy", "Opportunistic Strategy" and "Passive Strategy".

3.3.2 Farmer characteristics

For farmer characteristics, we found a significant difference in the Innovation's indicator Change in the production strategies in the last 15 years (CHANGE <15y) (Table 8; Fig. 5). It might suggest certain adaptations since previous generations; however, passive-strategy farmers appear to be more static. The difference is greater between opportunistic and passive strategies ($p = 0.03$) than between passive strategies and active and opportunistic strategies combined ($p = 0.02$).

The importance of specific bonds in participating in ALFSCs seems to be confirmed when among the Factors affecting farmer involvement in ALFSCs, Network (NETWORK) indicator shows a significant difference between the three groups: to be part a certain network is a key element in the choice of an ALFSC. This indicator was significantly different between active strategies and opportunistic and passive ones ($p = 0.02$).

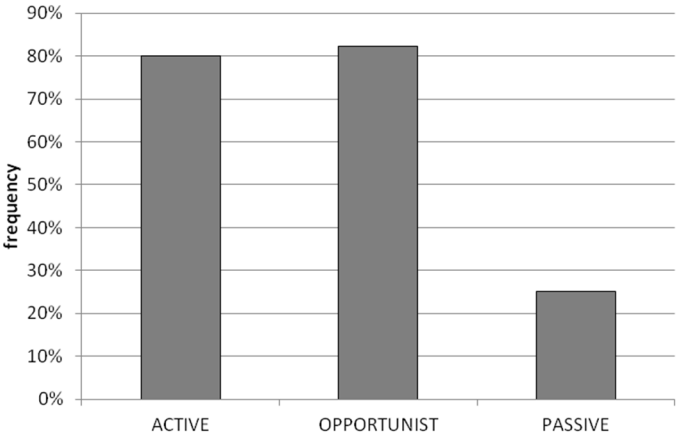


Figure 5Innovation – General change in the production strategies in the last 15 years. ACTIVE, OPPORTUNISTIC, PASSIVE indicate respectively the three groups of farmers "Active Strategy", "Opportunistic Strategy" and "Passive Strategy".

3.3.3 Farm products

For indicators about farm products, significant differences exist among the three groups for the indicators Number of products in ALFSCs (N. PROD in ALFSCs) and Number of products in OFSCs (N. PROD in OFSCs) (Table 8). Other significant differences exist in the sale of grain and crops in OFSCs among active, and opportunistic and passive strategies, and in the diversification of products between active and passive strategies vs. opportunistic strategies. To characterize the three strategies, other indicators can be interpreted, such as farming system production, product quality, product processing and other product-related activities.

Types of farming system production in the three strategies between ALFSCs and OFSCs

Differences in the products sold in ALFSCs and OFSCs exist among the three strategies that enhance the strategies (Figs.6).

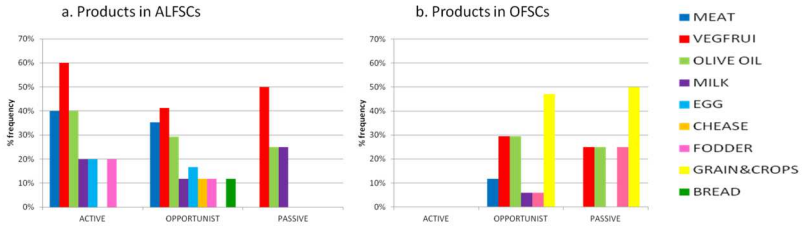


Figure 6

Types of farming system production in the three strategies for ALFSCs (a) and OFSCs (b). ALFSCs indicates Alternative Local Food Supply Chains, OFSCs indicates Other Food Supply Chains; the productions considered are meat (MEAT), vegetable and fruits (VEGFRUI), olive oil productions (OLIVE OIL), dairy productions (MILK), eggs (EGG), fodder (FODDER), grain and crops productions (GRAIN&CROPS) and bread (BREAD)

For the three strategies, vegetables and fruits are the products sold most in ALFSCs (Fig. 6a), representing 46% of type of products sold; however, this indicator does not differentiate in a significant statistical way the three strategies. Although olive oil and meat share the same percentage (31%), they have different dynamics. Among the farmers sampled, olive oil is also sold in OFSCs, while meat is mainly sold in ALFSCs. Olive oil is sold in both ALFSCs and in OFSCs in all three strategies. In general, olive oil is sold locally through personal bonds, in the international market and to foreign consumers through tourism, for which commercialization is based on tourism promotion in the area.

Meat is sold only in active and opportunistic strategies. Most production is sold through ALFSCs, while only 25% of production is sold through OFSCs (Fig. 6b). For the opportunistic strategy, meat represents 40% of the total production sold by farmers, which is relatively high, considering that 75% of livestock producers follow the opportunistic strategy. Even though they sell 100% of meat production in ALFSCs, they sell their remaining crops and grain in OFSCs. Most of the farmers have a private slaughterhouse and sell directly on-farm or through local markets. This result suggests an interesting local market for locally produced meat, but not for crops and grain. Similar results are found for milk production.

Farmers usually sell crops and grain in OFSCs (Fig.6b) through traders and cooperatives. Only for crops and grain (GRAIN&CROPS) there is a significant difference among active, passive and opportunistic strategies ($p = 0.05$). This is possible because all active-strategy farmers either use all their production to feed animals or sell crops and grain to neighbors in local markets, while few opportunistic-strategy farmers sell some of the fodder locally. The difference between active breeders versus opportunistic and passive ones is probably because production for most of the opportunistic farmers is more necessary, because it is too difficult to find local buyers, and conventional food chains are easy to adopt.

Bread and cheese are sold only by farmers following the opportunistic strategy. In both cases, farmers sell 100% of the main production (BREAD and CHEESE) in ALFSCs but have problems finding local markets for other products, especially grain. For this reason, they adopt opportunistic strategies instead of active ones, like livestock producers following the opportunistic strategy. Results from the bread and cheese indicators show some market constraints, since there seems to be not enough space for local products. Farmers producing bread produce too much grain; thus, some is sold to cooperatives through conventional food chains. Among farmers producing cheese, farmer F17 stated that *"there is no local market for organic goats"* as there is for grain and crops.

Number of products sold in ALFCs and OFSCs

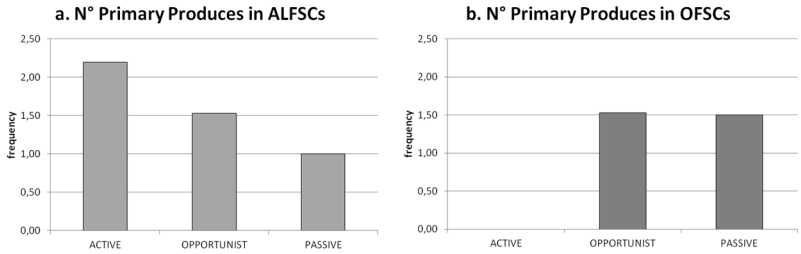


Figure 7 Number of products sold in ALFCs (a) and OFSCs (b). ALFSCs indicates Alternative Local Food Supply Chains, OFSCs indicates Other Food Supply Chains.

Active-strategy farmers sell more produce in local food chains (by number) than the other two groups (Fig. 7). Thirty percent of opportunistic-strategy farmers sell different products between the two food chains, while about 40% of farmers sell the same products. The remaining 30% of farmers sell their main production to both food chains but do not sell some products in local markets. Passive-strategy farmers sell the same products in both markets except for one farmer (F24) who designates some land for locally marketable vegetables, while the remaining production was crops and cereals for the global market.

Quality

Farms with at least one label make up 58% of the sample, 35% have quality labels linked to the territory (IGP labels, *Carne Bovina di Pisa*), while 50% of farmers have quality labels linked to primary product production (organic labels, and the low-input agriculture label *Agriqualità Toscana*). No significant difference for these indicators exists among the three groups (Table 8); however, results suggest that different labels may help develop ALFSCs for different products. For example, organic olive oil labels are sold through ALFSCs, while olive oil reaching international markets through OFSCs preferably have IGP, or both organic and IGP labels. Conversely, for meat

production ALFSCs seem to demand that farmers combine more labels: 50% of farmers combine at least two labels both for the products and for the region.

Food processing and other product activities

In general, external processing of products is preferred. Among producers who process their own products, 65% employ external processes, because internal processing requires a high investment costs to meet hygiene requirements. In this set of indicators, results are similar between active- and opportunistic-strategy farmers, while most of the indicators (i.e. Internal processing, New technology, Use of external resource, Diversification from the same primary produce, Regulatory constraints) have null values for passive-strategy farmers (Fig. 8). These results suggest that participation in OFSCs encourages producers to have primary products with lower resource investment and diversification. Values for opportunistic-strategy farmers are higher than those for active-strategy farmers (Fig. 8), which suggests that opportunistic strategies require more entrepreneurship in working with primary produce than active strategies do. Opportunistic-strategy farmers seem to place more effort on working with produce offered to local consumers. Among farmers who produce vegetables (46% of the sample), only 15% process them, but 75% follow the opportunistic strategy. For example, farmer F16 organized a contract with a local processing company to differentiate his products from others at the farmers' market in which he participates. Consequently, he also avoided the high investment of internal processing, which is not justified by the small percentage of production he allocates for processing. The "Diversification" indicator was significantly different between active- and passive-strategy farmers vs. opportunistic-strategy farmers.

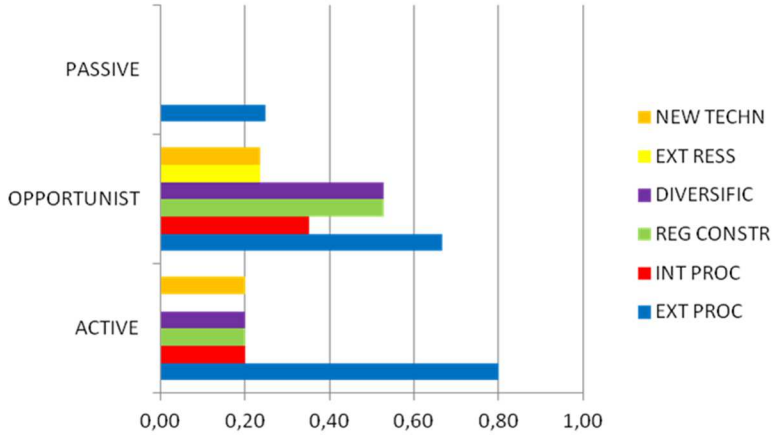


Figure 8

Food processing and other product activities between the three groups of strategy. ACTIVE, OPPORTUNISTIC, PASSIVE indicate respectively the three groups of farmers "Active Strategy", "Opportunistic Strategy" and "Passive Strategy". Internal processing (INT PROC) External processing (EXT PROC) Regulatory constraints (REG CONSTR) Diversification for the same primary produce (DIVERSIFIC) Use of external resource (EXT RESS) New technology (NEW TECHN).

3.3.4 Commercial Networks

Among commercial network indicators, the Food networks and Farmers' bonds indicators had particularly interesting results (Table 8).

Food networks

Regarding food networks, a gradient exists in the number of local alternative food networks farmers participate in to sell their products (N. ALFSCs), with a significant difference between active and passive strategies ($p = 0.04$). Comparing the numbers of ALFCs and OFSCs, both opportunistic and passive strategies rely less on networks when they sell in OFSCs. This is particularly apparent for opportunistic-strategy farmers, who have more types of networks when selling products in ALFSCs than in OFSCs (Fig. 9). This result may suggest that conventional chains offer less variability for commercial

actors. This indicates that farmers selling in local AFNs have a greater ability to choose between competing food chains than those who sell in OFSCs.

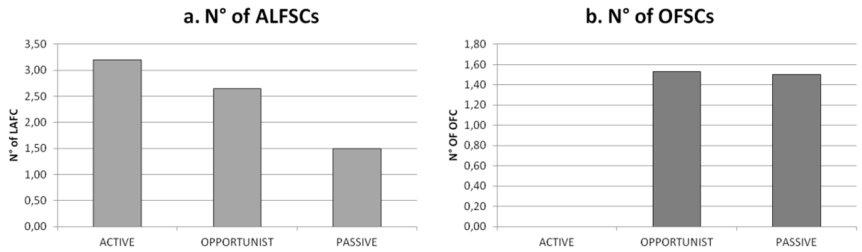


Figure 9 Number of food chains farmers adopt in participating in ALFCSCs (a) and OFSCs (b). ALFSCs indicates Alternative Local Food Supply Chains, OFSCs indicates Other Food Supply Chains.

Significant differences were found in the indicator for selling the same produce in both ALFSCs and OFSCs, as well as the indicator for selling a different percentage of products in ALFSCs (Fig. 9). Interestingly, the opportunistic strategy seems to sell different products in ALFSCs and OFSCs more than does the passive one.

Farmers' bonds

Results highlight that personal bonds (PERSON) play an important role for all the groups, but especially distinguish the active strategy from the passive and opportunistic strategies. Institutional (INSTITUTION) and professional (PROFESSION) bonds did not play a role in the active strategy, while professional bonds distinguish the three strategies greatly, particularly opportunistic strategies.

3.4 Opportunistic strategy: a reasoned choice or a transition to an active strategy?

We can note a certain partitioning between passive strategy's farmers and opportunistic strategy's farmers (Fig. 10). This partitioning is less defined in the passage between opportunistic and active strategy's farmers. This may

lead to reflect to the possibility of passage between conventional food chains and alternative and local food chains. Moreover our data show that most of farmers have at least 50% of the production in ALFSCs and only one farmer has less than 50%. This result may suggest that when farmers invest in ALSFCs, they need to move quickly to at least 50% in order to have a significant offset to 50%. This is probably confirmed by the fact that they have the higher average values of innovation (CHANGE <15y) and diversification of food products (DIVERSIFIC) (Table 8), demonstrating a stronger effort in the ALFSCs than active strategy's farmers.

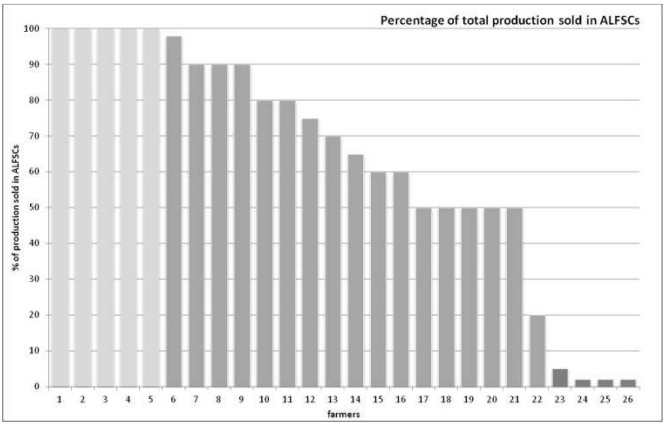


Fig.10 Percentage of production sold in ALFSCs for each farmer

By analyzing the interviews, two main trends seem to characterize the opportunistic strategy. The first one is characterized by several farmers who would like to increase the percentage of ALFSCs, but several constraints block them: especially regulatory constraints and market's constraints. For example farmer F17 stated that he would like to sell locally organic goat, but there are several regulatory constraints linked to the hygienic requirements of local slaughterhouses, and he also has problems in finding a local market for this product, while he has not such problems in selling the goat's chees. In this sense these farmers can be considered in a process of passage toward

ALFSCs. This will lead to reflections on the implications of political actions, able to free farmers from these constraints and in this way make more production available for the local food system. The second trend, consider farmers that choose to maintain a percentage of production in conventional food chains. This choice can be derived by the interest in preserving the relationships with the conventional food chain, in order to differentiate the enterprise's risk. For example F8 states that even the wholesale market is based on social relationships and trust between farmers and buyers, that guarantee a higher price or a faster sale; whenever the farmer decides to stop this conventional food chain, afterwards it will be more difficult for the farmer to reintegrate in such commercial relationships. In this case, reflections have to be made on the possible correlation between alternative and conventional food chains, local and global food system.

4. Discussion and Conclusion

We investigated three strategies depending on different food chain products and demonstrated the high degree of hybridization of solutions in farmers' marketing strategies. All this was possible through a "process of re-localization of economic activities and practices" (Sonnino and Marsden, 2006). Although the results are significant only for the periurban area of Pisa, our methodology, based on indicators that consider both conventional and AFCs, allowed us to overcome the "polarity" between them (Sonnino and Marsden, 2006). Further studies should analyze not only the trade-off between these two typologies of food chains but assess possible relations and interdependence between them. Our results suggest that some form of interdependence exists, especially observing opportunistic strategy. The opportunistic strategies especially highlight market constraints in selling products through alternative and local food chains. This is the case for certain products such as grain, fodder, and organically raised goats, which is confirmed by qualitative analyses of interviews. These products are outputs of the production cycle, but since farmers cannot find space in the local

market through AFCs, they have no recourse but to adopt conventional food chains, such as international traders, which results in a loss of local value for farmers and a potential loss of food sovereignty for the local food system. As for horticulture, wholesale markets ensure the sale of products not sold in AFCs; this reduces market risk, but with lower price, less transparent relationships and delayed payments. Moreover our results suggest that hybridization of strategies may be possible for all the farming systems. Thus, we can conclude that a diversified territorial farming system is in line with hybridization of farmers' marketing strategies. Further studies could assess what is the implication of hybridization in more specialized farming systems.

The second main result of this study is based on assessing the contribution of ALFSCs to the urban food supply and delineating and charactering the main strategies adopted by periurban farmers. We demonstrated large differences in their commercial strategies and in the external and internal factors that affect their decision-making. The indicators with significant differences among the three strategies are personal and professional bonds, diversification of ALFSCs, the number of products in ALFSCs and in OFSCs, commercial networks and the diversification of products sold in ALFSCs. Location, farm area, and farmers' characteristics have less influence in distinguishing the strategies. Results suggest that when farmers following active or opportunistic strategies participate in ALFSCs, they can choose between different competitive food chains and diversify profit between different and diversified products. Interestingly, opportunistic-strategy farmers differ from other farmers in the number of food chains, the number of products in OFSCs, and diversification and work on the products. They also seem more open to adapting to the new challenges of urbanization and to adopting innovations in their farming systems in the past 15 years. In this sense, opportunistic-strategy farmers show greater entrepreneurship and dynamism than in passive- and active-strategy farmers.

Further studies could improve this analysis by including other quantitative indicators, such as economic or agronomic indicators. We reached beyond simple qualitative analysis by combining indicators from several authors and extrapolating quantitative indicators from direct interviews with farmers. The importance of studies based on multicriteria indicators is justified by the ability to measure a system's condition with relative accuracy to inform policy-makers (Feenstra et al., 2005). Combined with a place-based or territorial approach, we investigated variability in farmers' strategies, which may advance the territorial development of periurban areas through new economic opportunities such as ALFSCs. Territorial development of periurban areas and its agriculture results from farmers' ambition and adaptation of efforts to maximize their profit and personal satisfaction, along with to maximize their productions and improve their networks. By understanding variability in farmers' strategies, we contribute to the debate surrounding Local Food Systems (Kneafsey et al., 2013) and demonstrate the benefit of considering in more detail factors in different regions that affect farmers' commercial strategies. This highlights the importance of investigating factors that promote the contribution of local food production to community food security (Anderson and Cook, 1999). Results from our case study could be used to strengthen links between professional networks of farmers and other food chain actors and political stakeholders, as well as to sustain the differentiation of products that farmers sell at the local level, which enhances local initiatives for new local markets. Our work could expand knowledge about the connections between the demand and supply of local products. It could also encourage the design of effective food policies that can sustain the development of such connections, which benefits urban food security.

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Annexes

Table 1 Drivers of marketing strategies in literature adaptable to the development of AFCs and local marketing strategies.

Farmer's perspective	Personal attitudes, attributes, and the resources the farmer encounters	Poole (2000)
	Importance of personal bonds, economic relations, access to key intermediaries, as a key to help famers build food chains	(Reynolds et al., 2009); Kirwan (2004); Eriksen and Sudbo (2015)
	Personal motivation: the relative importance each farmer gives to specific market elements	Kirwan (2004)
	Innovation as the capacity for adapting to new technology and external conditions	Lopez-Ridaura et al. (2005)
External conditions	External opportunities and constraints farmers are facing	Poole (2000)
	Innovation as the capacity for adapting to new technology and external conditions	Lopez-Ridaura et al. (2005)
Farm's internal characteristics	Internal conditions: land use and size of the farm, but also tools such as machinery	Pingali and Rosegrant (1995)
	Localization of the farm as a driver for SFSCs	Zasada (2011); Jarosz (2008)
	Link between multifunctional activities and ALFSCs	Zasada (2011);
Product characters	Different marketing strategies exist for different primary products	(Uematsu and Mishra, 2011).
	Product processing can distinguishes local food supply chains	Smith (2008)
	Investments on product process and diversification could be related to a change in the marketing strategy	(Pingali and Rosegrant, 1995b))
	Different typologies of food chains may require different kind of food production: especially commodities are more related to OFSCs.	Aubry and Chiffoleaus (2008)
	Possible difference in the amount of production's typologies, where AFCs are usually connected to higher degree of diversification	Petit et al (2010)
	Food characteristics	Eriksen and Sudbo (2015)

Table 2 – Indicators of farm structure describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains; UAA indicates Usable Agricultural Area; LSU indicates Livestock Units.

FARM STRUCTURE			
Topic	**Indicator (code)**	**Hypothesis / References**	**Unit**
FARM STRUCTURE AND MANAGEMENT	Farm size (UAA)	The size of the farm may affect the viability of ALFSCs: a minimum of production is necessary.(Renting et al 2003)	Ha
	Livestock Unit in the three groups of strategies (LSU)		LSU
	Livestock Unit calculated only for livestock farm (LSU lives)		LSU
	Presence / Absence of technical specifications (TECH SPEC)	Possible link between specific control on the production's quality though technical specification and the development of ALFSCs	0/1
FARM LABOUR	Percentage of family labour (FARM LAB)	A higher percentage of family labour lows manpower costs and it is a support for the farm pluriactivity	%
	Percentage of full time labour (FULL LAB)	A higher presence of part-time or seasonal workers increases the production costs	%
	Investment of specific know-how (SPEC KNH)	ALFSCs may require specific knowledge	0/1
MACHINERY AND BUILDINGS	Machinery adapt for the ALFSCs (MACH)	Involvement in ALFSCs requires proper buildings (e.g. food processing, food preservation). Their absence could affect the farm involvement in such ALFSCs. ((Pingali and Rosegrant, 1995b)	0/1
	Room adapt for the ALFSCS (ROOM)		0/1
FARM LOCATION IN THE PERIURBAN AREA	Distance from the closest urban centre (DIST CLOS)	Possible influence of the farm's location and urbanization respect to the potential local market and in terms of potential clients. (Zasada 2011 ; Jarosz 2008)	Km
	Distance from the largest urban centre (DIST BIG)		Km
	Opportunities (OPPORT)	The distance's perception from urban area influence positively the production and involvement in ALFSCs	0/1

	Constraints (CONSTR)	The distance's perception from urban area influence negatively the production and the involvement in ALFSCs	0/1
MULTIFONCTIONALITY	Number of activities (N.ACT)	Multifunctional activity could support the involvement in ALFSCSs	Value
	Sale of products in multifunctional activities (WITH SALE)		0/1

Table 3 – Indicators of the farmer characteristics describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains

FARMER CHARACTERISTICS			
Topic	**Indicator (code)**	**Hypothesis /References**	**Unit**
INNOVATION	Changes in the production strategies in the last 15 years (CHANGE <15y)	Modification of the farmer's action on the farm in the last 15 years(Lopez-Ridaura et al. 2005)	0/1
	Use of public funds for the activity (PUB FUNDS)	Ability of finding and attraction of public fund for the evolution of the activity (Lopez-Ridaura et al. 2005)	0/1
	Use of new technology (NEW TECHNO)	Tendency for investment and/or use of new technologies (email. website to sell. contact clients), and new technologies of production (Lopez-Ridaura et al. 2005)	0/1
PARTICIPATION	Participation in social networks (SOC NET)	Social/commercial interaction of farmers with other stakeholders may help the development of ALFSCs	Value
	Participation in commercial networks/promotion products (COMM NET)		Value
FACTORS AFFECTING FARMER INVOLVEMENT IN ALFSCs	The place where farmer works (PLACE)	Analysis of the personal farmers' motivations in the adoption of ALFSCs (Kirwan 2004; Reynolds et al. 2008)	0/1
	The products farmer sells (PROD)		0/1
	The network and stakeholders farmer participates in (NETWORK)		0/1
	The added value for the farmer (ADD VAL)		0/1

Table 4 – Indicators of products describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains.

Products			
Topic	**Indicator (code)**	**Hypothesis / References**	**Unit**
FOOD PROCESS AND OTHER PRODUCTS ACTIVITIES	Internal processing (INT PROC)	Investments on product process and diversification could be related to a change in the marketing strategy (Pingali and Rosegrant, 1995b)	0/1
	External processing (EXT PROC)		0/1
	Regulatory constraints (REG CONSTR)		0/1
	Diversification for the same primary produce (DIVERSIFIC)		0/1
	Use of external resource (EXT RESS)		0/1
	New technology (NEW TECHN)		0/1
N. PRODUCTS' DESTINATION	Number of products in ALFSCs (N. PROD in ALFSCs)	Possible difference in the amount of production's typologies, where AFCs are usually connected to higher degree of diversification (Petit et al 2010)	Value
	Number of products in OFSCs (N. PROD in OFSCs)		Value
QUALITY	Label on territory (TERRITORY)	Labels may positively affect the marketing strategy towards ALFSCs	0/1
	Label on product (LABELS)		0/1
	N. Labels (N. LABELS)	ALFSCs may or may not requires more labels on products	Value
PRODUCTS UNDER ALFSCs	Meat (MEAT)	Different typologies of food chains may require different kind of food production: especially commodities are more related to OFSCs. (Aubry and Chiffoleaus 2008)	0/1
	Vegetables and fruits (VEGFRUI)		0/1
	Olive oil (OLIVE OIL)		0/1
	Milk (MILK)		0/1
	Eggs (EGG)		0/1
	Cheese (CHEESE)		0/1
	Fodder (FODDER)		0/1
	Grain and Crops (GRAIN&CROPS)		0/1

	Bread (BREAD)		0/1
PRODUCTS UNDER TO OFSCs	Meat (MEAT)		0/1
	Vegetables and fruits (VEGFRUI)		0/1
	Olive oil (OLIVE OIL)		0/1
	Milk (MILK)		0/1
	Eggs (EGG)		0/1
	Cheese (CHEESE)		0/1
	Fodder (FODDER)		0/1
	Grain and Crops (GRAIN&CROPS)		0/1
	Bread (BREAD)		0/1

Table 5 – Indicators of commercial network describing the marketing strategies of periurban farms. ALFSCs indicates local and alternative food chains; OFSCs indicates Other Food Supply Chains.

Commercial Network			
Topic	**Indicator (code)**	**Hypothesis and references**	**Unit**
FOOD NETWORKS	Number of ALFSCs (N. ALFSCS)	The participation in different in ALFSCs and OFSCs may affect the number of food chains to sell the product: especially farmers that participate in OFSCs do not differentiate between different food chains	Value
	Number of OFSCs (N. OFSCS)		Value
	Presence of products in ALFSCS and OFSCs (ALFSCS in OFSCS)	Possible interdependence between the food chains	%
	Presence of ALFSCs (% of ALFSCS)	Farmers that participate in ALFSCs and OFSCs food chains combine food chains in different percentage.	%
BONDS	Personal bonds (PERSON)	Bonds may support the development of ALFSCs (Reynolds et al, 2008)	0/1
	Institutional bonds (INSTITUTION)		0/1
	Professional bonds (PROFESSION)		0/1
CLIENTS	Regularity in providing (PROV REG)	ALFSCs may have less stable commercial relationships	0/1
	Presence of intermediate actors (INTEMED)	ALFSCs may not need a support from intermediate actors.	0/1
PARTICIPATION	Activities for the promotion of products (ACT PROD)	The food chains is helped by the active participation of the producer to initiatives for the promotion of the product/territory	0/1
	Activities for the promotion of territory (ACT TERR)		0/1
	Exchange of products (EXC PROD)	Influence of the social relationships for commercial reasons with other farmers (direct or mediated)	0/1
CONSTRAINTS	Presence of constraints (N.CONSTR)	Constraints to be solved or already solved in the farm management may hinder the development of AFSCs.	0/1

Table 6 – Main Characteristics of the farm sample. UAA indicates the Usable Agricultural Area, LSU indicates Livestock Units, ALFSCs Alternative Local Food Supply Chains.

Farms	Farming system	UAA	LSU	Total % production to ALFSCs	Farm type
F01	Vegetables	14	-	100	Family farm
F02	Livestock	65	87	100	Family farm
F03	Olive Oil	3	-	100	Family farm
F04	Livestock	250	116	2	Family farm
F05	Olive Oil	2	-	100	Family farm
F06	Livestock	140	29	90	Family farm
F07	Livestock	280	213	70	Family farm
F08	Olive Oil	6.5	-	50	Family farm
F09	Cereal	145	-	60	Family farm
F10	Olive Oil	1.6	-	80	University experimental farm
F11	Olive Oil	10	-	60	Family farm
F12	Cereal	80	-	20	Family farm
F13	Vegetables	6	-	50	Family farm
F14	Olive Oil	11	-	65	Family farm
F15	Olive Oil	5	-	2	Family farm

F16	Vegetables	7	-	50	Family farm
F17	Livestock	126	52	80	Family farm
F18	Olive Oil	11	-	90	Family farm
F19	Livestock	284	63	95	Family farm
F20	Livestock	31	11	100	Family farm
F21	Livestock	29	275	80	Family farm
F22	Livestock	30	41	90	Family farm
F23	Livestock	110	150	20	Family farm
F24	Cereal	595	-	2	Co-operative
F25	Vegetables	11	-	50	Family farm
F26	Vegetables	22	-	5	Family farm

Table7 – Main Characteristics of the sampled farming systems, considering the numbers of farms, the corresponding percentage, the average of hectares, the percentage of production delivered to Alternative Local Food Supply Chains (ALFSCs); UAA indicates Usable Agricultural Area.

Farming system	Number of farms	% of the farm sample	Average UAA (ha) and (standard deviation)	% Of Produce Delivered To ALFSCs
Cereal	3	12	134 (103)	27
Livestock	10	38	6 (4)	73
Olive Oil	8	31	12 (6)	68
Vegetables	5	19	273 (280)	51

Table 8 Kruskall Wallis results for significant values for indicators: * OPP-PAS indicates significant difference only between the groups' opportunistic and passive strategies; * ACT/PAS-OP indicates significant difference between the groups active and passive by one side and opportunistic strategy by the other side; * ACT-PASS indicates significant difference between active and passive strategy; * ACT-OPP/PASS indicates significant difference between the groups active by one side and passive and opportunistic strategy by the other side. Results illustrate the average values of indicators and standard deviation

Topic	Indicator	ACTIVE STRATEGY	OPPORTUNIST STRATEGY	PASSIVE STRATEGY	
FOOD NETWORKS	N. ALFSCs	3.20 (1.10)	2.65 (1.93)	1.50 (0.58)	* ACT-PASS
	N. OFSCs	0.00 (0.00)	1.53 (1.01)	1.50 (0.58)	**
	ALFSCS in OFSCs	0.00 (0.00)	0.71 (0.47)	0.75 (0.50)	**
	% of ALFSCs	100.00 (0.00)	69.38 (14.59)	2.75 (1.50)	**
BONDS	PERSON	1.00 (0.00)	0.41 (0.51)	0.50 (0.58)	* ACT-OP/PAS
	PROFESSION	0.20 (0.45)	0.76 (0.44)	0.25 (0.50)	*
FOOD PROCESS AND OTHER PRODUCTS ACTIVITIES	DIVERSIFIC	0.20 (0.45)	0.53 (0.51)	0.00 (0.00)	*ACT/PAS-OPP
N. PRODUCT DESTINATION	N. PROD in ALFSCs	2.20 (0.84)	1.53 (0.80)	1.00 (0.00)	*
	N. PROD in OFSCs	0.00 (0.00)	1.53 (0.72)	1.50 (1.00)	**
PRODUCTS IN ALFSCs	GRAIN & CROPS	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	* ACT/PAS-OP
INNOVATION	CHANGE <15y	0.80 (0.45)	0.82(0.39)	0.25(0.50)	* OPP-PAS * ACT/OPP-PAS
FACTORS AFFECTING FARMER INVOLVEMENT IN ALFSCs	NETWORK	1.00 (0.00)	0.53 (0.51)	0.50 (0.58)	* OPP-PAS

7. Understanding networks in local food systems: which contribution from periurban farming system?

Paper in preparation, to be submitted to Applied Geography

Q.2.2

In the second result of the second research question the hybridisation of types of farmers' strategy and farmers' practices as previously assessed are linked to the types of proximity. Moreover the results stress that is not just farmers that have commercial relationships with a hybrid markets, but that also commercial actors have relationships with a hybridisation of practices and strategies' farmers.

Q.3.1

The constraints and drivers analysis shows that despite the hybridization of farming practices and strategies, most of farmers have the same perception of constraints and drivers. Their potential capacity of producing for the local food system is affected especially by regulations and commercial networks.

Understanding networks in local food system: which contribution from periurban farming system?

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1. Introduction

1.1. Networks in Food System

A network is commonly defined as a collection of point – the nodes – joint by lines – the edges. In social sciences, the nodes are the actors (or a collection of people), who are somehow related to one another (Wielinga et al, 2008). This simple definition opens to a wide field of study and debates.

The importance of network for rural development has been investigated by several authors. In his contribution Murdoch (2000) assesses the importance of networks for territorial development in rural areas. In the contribution he accurately shows how literature considers the network as a "third way" between endogenous and exogenous resources. Far to be considered as the unique solution for all rural areas, Murdoch shows the complex framework by which network is defined, and it is established in a rural area, claiming for studies which emphasize this networks' complexity, instead of providing a unique way of development. Singh and Bhowmick (2015), for example, recognize five types of network approaches in rural development studies: community network, entrepreneurial network, social network, innovation network, and technology networks. The differences rely on the implication of

actors in networks, which reflects their different purposes in participating in networks, which mobilize different set of tools.

Borgatti et al (2009) have listed several types of networks. Networks can be narrow or broad. In the first case actors consciously choose to participate in networks, while in the second case actors needs to be motivated by the networks' initiators. When actors are allowed to participate in a network because of their professional status, the networks are formal, while in informal networks actors represent others actors, and are thus based on personal affinity (Wielinga et al, 2008). Networks can be more or less centralized, processing from a simple "wheel" structure to a "circle" structure; they can be "close" or "open", if the points are all reciprocally joined together, or if there are some holes in the network (Borgatti et al, 2009). Studies on ties, seek to define the process of formation of the network, while other approaches try to understand the consequences of such ties. Nodes for example can be subject of a process of adaptation, through which they became more homogenous. In the case of open and close networks for example, studies have demonstrated that a proportion of holes in the networks enables such network to be more competitive and thus reliable. Authors have also defined a specific tie, the "chain" network, where actors are linked by a mechanism of "exclusion": the nodes are "allowed" to make connection only with the node they are directly connected to. In the network "a-b-c", the node "a" is allowed to be in contact only with node "b", but not with node "c", as well node "c" has not contact with "a", while node "b" is connected to both node "a" and "c". In this way node "b" has a power, that depends on the exclusion of the relationship between "a" and "c", and which result is that they don't have alternative "bargaining" actors (Borgatti et al, 2009). The food chain analysis is mainly based on this purpose: the chain is seen as vertical network, where the relationships are defined considering the reciprocal power between actors (Murdoch, 2000). According to Lockie and Kitto, (2000) in vertical food chain's analysis the "social life" of

food is not taken into account and the concatenation of the different actions, from production to consumption are treated as determinant; moreover there is no study of the social nature of the relationships.

According to Raynolds, (2004), commodity's network is more complex than just the result of a simple power relationship: keeping off the chain perspective helps in avoiding an extremely conceptualization of a linear sequence of actions from production, to distribution and consumption. In this way it may help in understanding how actors perform the relationships, without taking them without any already existing power, since in the agro-food networks a multiple set of social, economical, political influences may play a determinant role. According to the author, for example, this approach should be applied in studies about how local actors are able to maintain agro food networks. In fact in this study the emphasis should be "*on the practices of strategic and local actors in shaping these processes (…) we have to observe how different sets of people and agencies are trying to define the production and consumption of food"* (Lockie and Kitto, 2000, p. 9, cit. Arce and Marsden 1993).

Murdoch has opposed to the vertical networks analysis, an horizontal network analysis, which is based on territorial dimension, and in this way enables rural areas to put together different sectors, and different territorial levels. On the food system analysis, several approaches have tried to go beyond the linear dimension of food chains. In the SYAL approach, the territory is a symbolic construction of values done by actors, that through the food production, drives the development of rural areas (Fournier and Muchnik, 2010). The network in this approach simply enables actors to put together exogenous and endogenous resources, and Chiffoleau and Touzard (2014) claim for a deeper understanding on how these specific local agro-food networks are established and by which factors they are effectively moved.

Ilbery and Maye (2006) in order to show the complexity of food chains put in place by farmers, proposed to integrate the territorial dimension in the food chain analysis, operating a process of "*re-localisation*" of food chains. In this way they were able to show the complexity of elements which drive farmers' choice in participating in different networks. Nevertheless the network analysis is based on food chain linear approach, proceeding from production to consumption. Moreover the "territory" was a factor of selection in the methodological pathway, but it wasn't integrated in the model as a factor that may influence the organization of food chains.

To integrate territory in the food networks analysis means something more: it means to conceive it as both an opportunity and a constraint, it means to assign to territory the power of shaping the food chain (Abrantes et al, 2012; Morgado et al., 2012). This is especially true considering the spatial stakes that characterize periurban farming systems.

1.2. How to define Local: multiple boundaries assigned to territories

A Local Food System (LFS) has been defined by Kneafsey et al. (2013) as a system *"in which foods are produced, processed and retailed within a defined geographical area"* .

In literature LFS is connected to "alternative" food networks (Renting et al., 2003), where the shorter food chains' steps enables a power balance between farmers and consumers, especially for the benefit of profit's farmers. Moreover LFS are connected to the "quality turn" (Feagan, 2007) of both food production and consumption, where food production is re-connected to sustainable practices (Sundkvist et al., 2005).

Several authors have thus pointed out that the debate around the term local is very complex. First of all several authors have recognized the hybrid characters of such alternative food systems (Filippini et al, 2015); Ilbery and Maye (2006) demonstrated that the duality between local/alternative and

global/conventional is purely theoretical or methodological, because in empirical analysis farmers have not moved from one system to another, but they are part of both, creating a niche space of action. Secondly according to Eriksen (2013), the different literature's approaches on LFS relies on the different definitions given by scholar to the concept of proximity. Three domains of proximity are found: *Geographical proximity*, *Relational proximity*, and *Values of proximity*. The first one refers to explicit spatial reference, where food is produced, processed, retailed and so on. Relational proximity refers to the relationships between actors that go beyond the fact to be close to each one; for example, alternative food chains group actors for their specific relationships, more than their localization. Values of food chains refer to the different values that actors attribute to local food, for example, the origin or the freshness.

In debate on local agro-food networks, Torre (2000) has recognized two types of proximity (Torre, 2000b). The first on is the organizational proximity which is mainly based on networks among actors, based on common values and the participation in common projects; the second one is the geographical proximity based on the spatial vicinity of actors. These two proximities can be thus well combined in the case of IGP, where actors share agro-food values (organizational proximity), based to a certain specified territory (geographical proximity). Moreover, considering farming system, the geographical proximity enables to open the debate on the spatial dimension of the production (natural resource, land use, etc.), while the organizational proximity enables to assess their networking in managing natural resources, or their common commercial relationships. According to Torre and Rallet (2005), the process of *localization* is possible only if the two components are connected.

According to (Torre, 2000b) periurban farming system experiences both proximities, since they are characterized by a geographic proximity which can be turned in a organizational proximity both for the functional relationships

with urban system and the importance that space plays for the farming system in periurban area.

1.3. Aim of the study

In this analysis the overall purpose is to analyze the organization of local food chains between farmers, processors, and sellers of farmers' products, by taking the starting point of farmers' productions. The approach is based on a place-based and territorial approach, where territory is both a tool for the selection of farmers and one of the factors that may influence the organization of food chains.

By assuming the definition of Knfeseay et al (2013), we define a local food chain as a chain where the produce is produced and retailed in the same area, and which final destination is known by farmers. In this way we prefer the "network approach" of Reynolds (2004) than the linearity of "food chain approach". Considering the definition of local, defined as both geographical and organizational proximities, we have chosen to accept two level of locals, the first one related to the periurban area where produces are produced and retailed, and the second one, the area where the products are processed.

The hypothesis is that in order to control the final destination of product at local level (geographical proximity), farmers need to establish complex local networks (organizational proximity). Moreover this complexity is a way to adapt to the proximity with urban area and so to sustain agriculture in periurban areas. Finally due to its peculiar characteristic of "double proximity" periurban farming system can be a good case study to assess the importance of localized agro-food networks, for sustaining of farming practices in the territory.

2. Methodology

2.1. Case study

The case study is the periurban farming system of Pise (Italy), a medium sized city in Tuscany (Italy). (…) The case study is characterized by an heterogeneous farming system, mainly composed by horticultural (8%), winter cereal (26% on the total cereal oriented farms), livestock (16%) and olive oil (34%) productions (see Marraccini et al, 2012). Moreover it is characterized by a certain dynamic in the development of projects for the local food chains based on local food production (see Lardon et al, 2015; Di Iacovo, 2012; Marraccini et al, 2013). The analysis is based on semi – structured interviews done in the years 2013-2014, on 14 livestock productions.

2.2. Methodological pathway

The analysis of local food chains for the periurban farming system of Pisa is composed by several elements.

1) Local food chains typology

We build up a model that analyzes the different organizations of a food chain's network by taking into account its principal elements (nodes) linked together (edge) by the farmer, as specifically mentioned in the interviews. The nodes represent both the actions, the actors and the different places where the action is taken, following the approach of Benoit et al., (2006). This enable us to group together farmers beyond the food produced and to observe if there are differences or similarities in the food chains for the different productions.

The types developed are thus macro-categories. The arrows indicate the bonds between the nodes managed by the farmer, while the nodes indicate the different functions operated by the different actors for each state of the

product. The node F indicates both the farm and the place of production. P indicates the processor as well as the action of processing, when it occurs for example in the farm. S indicates both the out farm and the on farm direct sale of product, as well as the action of selling, including small groceries, restaurant. In the literature it is considered as “direct sale”; D indicates the distributions actors, especially supermarkets, that not only have the function of selling the products to the final consumers, but also managing the distribution of the product, and in this way the final allocation of the product. In this study we don’t analyze the consumers’ step of the food chain.

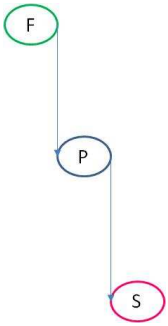


Figure 1 Example of a food chains' typology

With this model we also think to understand better the different management that farmers have in local food chains.

In this part of the analysis there is no spatial reference, so we don’t specify if the sale is on-farm, out-farm, in the periurban area or at regional or national or international level. In this model we also didn’t specify the presence of any intermediate actor. This is due to the fact that the intermediate actors of these relationships are considered as farmers’ facilitators in the local food chains, helping farmers in placing the food locally where the farmer wants to allocate it; it is not considered as another step of the food chains in term of

costs or negotiation for the farmer. In this way we can consider the food chains that have an intermediary actor as a sub-category of the existing types.

In this analysis we have fixed a spatial limit for F and S nodes that need to be located in the periurban area in order to be chosen, while the border of P and D can be in the regional level.

2) *Spatial local food chains*

We have thus spatialized those models, connecting the farmers' location with processors and sellers' location. In this way we can have the information about the localization of the different functions operated by the actors (nodes), and in this so to calculate and interpret the potential role of proximity.

3) *Network Tables*

We have thus analyzed the resulting model from 1) and 2) combining other components of the networks, organized in the "Network's Table". The Network Table sums the main information from the interviews regarding the commercial networks: how networks were established, and their rules, as the frequency of exchanges in terms of food provisions and payment, quantities, prices, the quality's assurances.

4) *Comparison of Network Tables*

Finally we have compared the analysis of farmers' networks with the Network's Table analysis of other stakeholders' networks, especially the processors and three types of sale of local farmers' products.

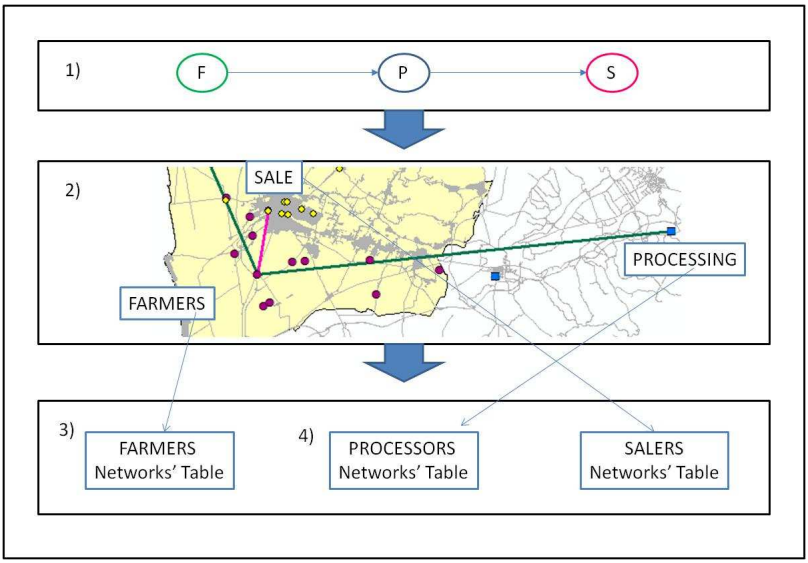


Figure 2 Methodological pathway of the network analysis

2.3. Selection of actors

Farmers

The farmers selected for the analysis are farmers with livestock productions as the main farming system. We have chosen this type of farmers, for several reasons. First of all considering the whole sample, they are more engaged in local food chains. Finally, studies on periurban farming system and local food chains/short food supply chains have been more focused on horticultural productions, but also meat and milk productions can be consider as fresh products locally commercialized.

The sample has a good representativeness, representing 80% of the total livestock production following the last national census (ISTAT 2011). The livestock productions in the area are mainly constituted by cattle and sheep breeding which represent 2% and 1% respectively of the total local farms

according the last agricultural census (ISTAT, 2011). Both livestock productions benefit from several quality's labels, IGP "Vitellone Bianco dell'Italia Centrale" (veal), the local label "Carne Bovina di Pisa" (beef) and "Pecorino del Parco" (sheep cheese) run by the local livestock producer association and the Province of Pisa (Filippini et al., 2014). These labels confirm the interest of local authorities and consumers in the production of local meat, and also for this it is interesting to assess the networks organized for such productions.

Most of the farmers have a traditional family-based farm (Table 1), while one farm is part of the university and another one is part of the regional natural park. 7 farms are principally cattle breeding (Chianina, Limousine, Mucco Pisano), while 3 farms produce milk from sheep Massese, 3 farms have a diary production (Friesian) and 1 farm have both dairy and cattle production.

Table 4 Principal information about livestock productions. LSU refers to livestock unit, UAA refers to Usable Agricultural Area

Farm	LSU	UAA	Main Products and breed	Typology of farm
J7_0	63	284	Meat: Limousine, Mucco Pisano	Family
J7_7	213	700	Milk: Friesian; Meat: Mucco Pisano	Experimental
J7_10	52	126	Milk and meat: Sheep Pecora Massese	Family
J7_11	315	220	Meat: Limousine, Mucco Pisano, Chianina	Regional
J7_12	29	140	Milk and meat: Sheep Pecora Massese	Family
J7_27	17	10	Meat: Chianina	Family
J7_30	116	150	Milk: Friesian	Family
J7_31	87	65	Meat: Limousine, Mucco Pisano	Family
J7_32	330	290	Milk and meat: Sheep Pecora Massese	Family
J7_34	150	100	Meat: Mucco Pisano	Family
J7_40	41	30	Meat: Chianina	Family
J7_49	275	29	Meat: Limousine	Family
J7_51	384	265	Milk: Friesian	Family
J7_54	11	31	Milk: Friesian; Meat: Pecora Massese	Family

The network analysis was thus organized considering these two main outputs: meat and milk (Table 2). They are coming from cattle productions for milk (Friesian) and meat (mainly Limousine and Mucco pisano), and milk and meat coming from sheep (Massese). The farmers network table helps to characterize the spatial network analysis. The main information refer to quantitative indicators, such as prices, quantities, importance of each local sale, etc., and qualitative indicators such as type of sale, name of other stakeholders involved, in order to understand if there are common stakeholders between the farmers, type of labels.

Table 5 Indicators of Network Table

Indicator		Code
PROD	Primary products	MEAT / MILK
TyLFS	Type of local sale	ONF = on-farm direct sale; FM = farmers market; GRO =groceries; SUP = supermarket; REST= restaurant; PRO = processor; OUF = other typologies of out farm; OUT = out of local area
NamSel	Name actors	*Names*
TerSal	Territorial level for sale	Area Pisana (local sale); Provincia di Pisa, Regione, OUT
% TyLFS	Percentage of food chains	% for each types of local sale
% PrLFS	Percentage LFC for the product	Cumulative of percentage of food chains
% TotLFS	Percentage LFC on tot production	Cumulative % of LFC on the total chains of the farm
€	Price of sale	€/kg; €/lt
QT	Quantity produced	Kg (for meat see Filippini et al, 2014)
PRC	Internal processing	0 = no need; 1=need but out farm; 2 =yes, inside
cost PRC	Cost processing	€
TerPRC	Territorial level for processing	Area Pisana (local sale); Provincia di Pisa, Regione, OUT
Name	Name processors	*Names*
N.Lab	N. Labels	Values
NamLab	Name Labels	*Names*
IntAc	Intermediary actors	0/1
NamInt	Name intermediary actor	*Names*
ParPro	Participation in projects	0/1
NamPro	Name projects	*Names*

The constraints have been hypothesized, considering both the literature on periurban farming systems' adaptation and local food networks' development (e.g. Darly and Torre, 2013; Eriksen and Sundbo, 2015; Pascucci, 2007; Tolron, 2001) and previous information collected on the territory. In the interview there were specific questions about the farms' constraints.

Table 6 Constraints

Constraint	Hypothesis
Regulatory Constraints (REG)	Periurban farmers experience constraints linked to the organization of local food chains (for example direct sale, processing of product), but also from the fact to work in periurban area and from general agriculture regulatory
Constraints link to urbanisation (URB)	The proximity to the urban centre is both an opportunity and a constraint, due to the inefficiencies of urban sprawl on territory
Commercial networks' constraints (COMM)	The possibility to establish local commercial networks is affected by external and internal conditions to the farm, such as the difficulty in negotiating, the price, the requests from buyers, etc
Socio-political constraints (SOPO)	The "periurbanity" imply new social conflicts, as well as conflicts link to the public policies.
Technical constraints (PROD)	The periurbanisation has specifically affected the farming practices, for which for example some products are not suitable.
Internal constraints (INT)	Internal characteristic of the farm, doesn't allow or facilitate farm in pursue a specific strategy.

Processors

The processors were selected considering the information provided by farmers in the interviews. Among the regional processors mentioned, we have selected 3 processors, on the basis of the final destination of the product on the periurban area, while for all the other processors the product is not mainly devolved to the consumers of the area selected. The processors are (Table 4):

- a slaughterhouse (P1) which also do the processing of meat
- a cheese factory more connected with local, regional and international markets. (P2)
- a cheese factory mainly focused in local markets (P3)

Table 7 Principal information about Processors

Processor	Description	Origin	Quantity processed	Localisation
P1	Slaughterhouse and Butchery	Public consortium of farmers, butcheries, and the abattoir	Abattoir: 5000 cows/year; Butchery: 50 cows/year	Province of Pisa
P2	Cheese factory	Family	400-500 qt milk/day	Province of Pisa
P3	Cheese factory	Family	50 qt milk/day	Area Pisana

A forth processor, a slaughterhouse connected with local market, was not included in the interviews because it has been closed in the time between the farmers' interviews and processors interviews' phase.

Table 8 Constraints perceived by processors

Constraints	Hypothesis	Specific constraints
AVAILABILITY/QUANTITY	Assessment of the real demand of food production from commercial actors	Seasonality
		Single product quantity
		Products diversification
		Available farms
PRICE	Assessment of negotiation capacity of farmers and processors	Poor added value
		Price too low
		Price too high
QUALITY	Assessment if there are any limits in the quality of periurban farming's products	Organic farming
		Processed products
		Local products
		High quality products
FOOD CHAIN	Analysis of the chain beyond the farmer and the processor negotiation: how is it organize the food chain? are there limits that don't depend on farmer and processors strategy?	Lack of a local food chain
		Lack of coordination in the FC
		Actors power issues
		Consumers demands
		Difficult agreements

Processors constraints have been hypothesized, considering the possible stakes firms can face in approaching local farms. Thus, they have been proposed in the interviews, with open question, in order to leave the possibility to add other elements.

Sellers

Three types of sale were considered for the analysis; they have been selected because they all have in common the purpose of supporting local food production, but they have put in place a different strategy to involve farmers and so to organize the local food chain. The sellers (Table 6) are:

- a grocery, individual enterprise, engaged in the promotion of local and/or organic production. (S1)
- a farmers market (FM), which project is managed by a farmers' union. (S2)
- a cooperative which project is a "mediated" direct sale. (S3)

Table 9 Main information about the sellers

Processor	Description	Origin	Farmers
S1	Grocery	Private Individual initiative	J7_10
S2	Union's FM	Union initiative, with farmers involvement	J7_40, J7_0
S3	Cooperative	Partnership between the cooperative and the municipality	J7_40

The constraints analysis applied to processors have been applied also to the sellers, with the same procedure.

3. Results

3.1. Types of Local Food Chains

The types of local food chains is in Fig.3. For each type we have indicated the corresponding farmers.

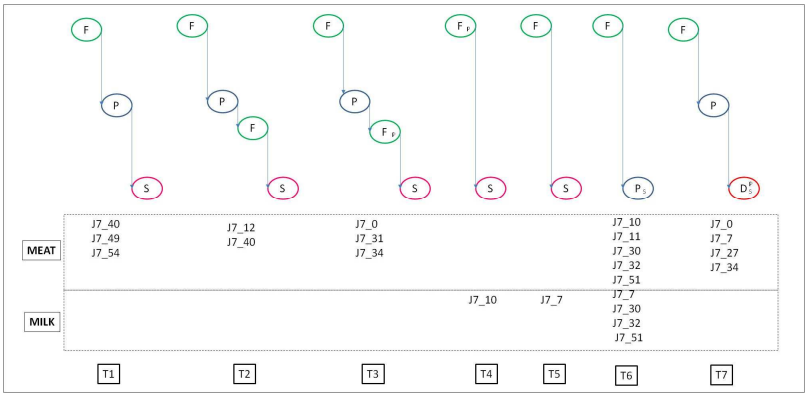


Figure 3 Types of Local Food Network

T1 farmers control directly the space of sale, but needs to do all the phases of processing outside the farm; thus the product goes directly from the processor to the seller. In T2 the product has a short passage in the farm before going in the space of sale. In T3, farms do the first phase of processing (eg. abattage) in the processor, while the second phase (eg. butchery) is done in the farm, before be sold. In T4, the processing is completely done in the farm, while in T5 there is no need for processing. In T6 farmers the product is sold since the beginning to processors, and finally T7 farmers have established an agreement with distributors, which includes also a part of the processing; in T7 the responsible of the sale is the distributor, as well as the final process phase.

As it is possible to notice, T6 is the unique network that is possible both for milk and meat production, while other networks are especially designated for one milk or meat production.

Several farms belong to several types of food chains. This is due to the different productions they manage. For example J7_10 process the milk in the farm, and sell directly the final product (T4), while the meat needs to be sale through regional food chains and it is processed at regional level (T6).

Sometimes this is also due to the fact that for the same production, farmers combine a direct sale (T3) with a sale through supermarkets (T7) (eg. J7_34). This result confirms the hybridization of farmers strategies (Filippini et al, 2015).

Intermediate actors participate in some of T6 and in T7 food chains' types. The intermediate actors are one cooperative for the sale of milk (J7_51, J7_30, J7_7) and the local Livestock producers' Association (J7_7, J7_0, J7_34, J7_34). In the first case the food chain is considered as a conventional food chains, where the product is sold to an agri-business, but the milk is sold through a high quality certification "Alta Qualità", well known by farmers. In the second case the meat is sold through local circuits to supermarkets that have invested in high quality certifications in agreement with the local livestock producers' association: they promote a local race of cow (Carne Bovina di Pisa). The first intermediate actor (GD in Table 7) has just the role to collect the milk, and help the price's negotiation between farmers and the firm; the second one operates the same function, negotiating the price decided by farmers, both with supermarket and the slaughterhouse abattoir.

J7_0 describes in this way the role of the second intermediate actor AG:

"J7_0: We have a relationship with AG that has contracts with several supermarkets, and the prices are still interesting for farmers.
Interviewer: So in AG the farmers decide prices and contracts?
J7_0: yes, prices are agred among farmers, then AG propose the price sto the clients and then there the negotiations.. in any case, the prices are good for us"

The fonctioner of AG describes in this way AG's action:
"Our technicians visit regularly the farms for technical assistance.. we verify the vales and we agree with farmer which animals are ready for the abattoir, then we prepare a schedule considering the request of supermarkets. We have convention with a unique slaughterhouse, P1, and from there the half carcass goes directly to the supermarkets. (…) The purpose of AG is not the profit, it is

by one side the preservation of farms activity on the territory, and meanwhile we preserve the pole gene of local races."

All the productions of meat result to have longer food chains, with a step of processing: this is due to the fact that the slaughter of the animal needs to be done in a proper slaughterhouse; similarly 50% of the farms manage the sale of all or a part of the meat produced. Here 30% of the farmers has an on-farm butchery and thus manage the processing of the meat, while most of the farmers have organized an out off farm selling.

The less complex networks are those of milk production. The milk production is mainly sold to processors, small cheese factories or the firm. Only one farmer milk's producer from local races' sheep (J7_10), do to internal processing and direct out-farm and on-farm sale. Only one farm (J7_7) sells directly fresh milk. Even if there is not a phase of processing, the sale of fresh milk includes the use of specific refrigerators and specific rules; because of these rules the farmer is obliged to sale the milk not sold freshly to conventional food chains.

This result seems to suggest that even if the networks are shorter, farmers still needs to participate in longer commercialization's networks.

3.2. Spatial local food chains and Network analysis of farmers

The spatial local food chains will be interpreted with the use of the Table Network (Table 6).

Processing

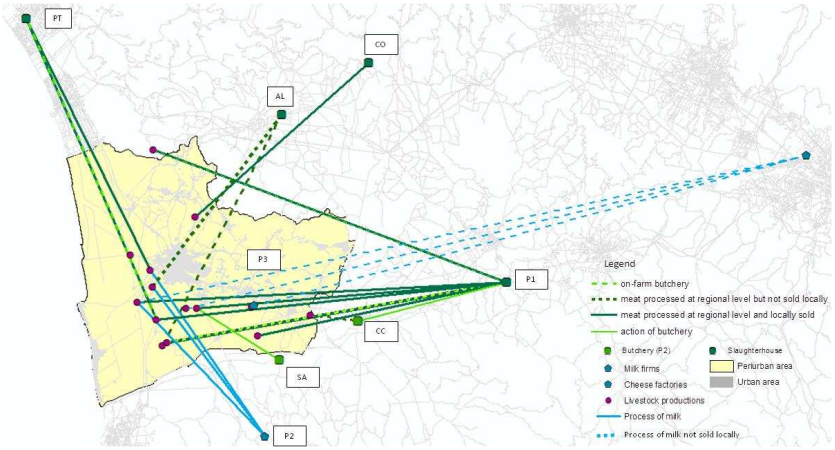


Figure 4 Total processing of livestock productions (milk and meat) coming from Pisa's periurban farming system

In Fig. 3 it is possible to see the total processing of the products for both milk and meat, while in fig. 4 and 5, it is possible to see the processing respectively of meat and milk.

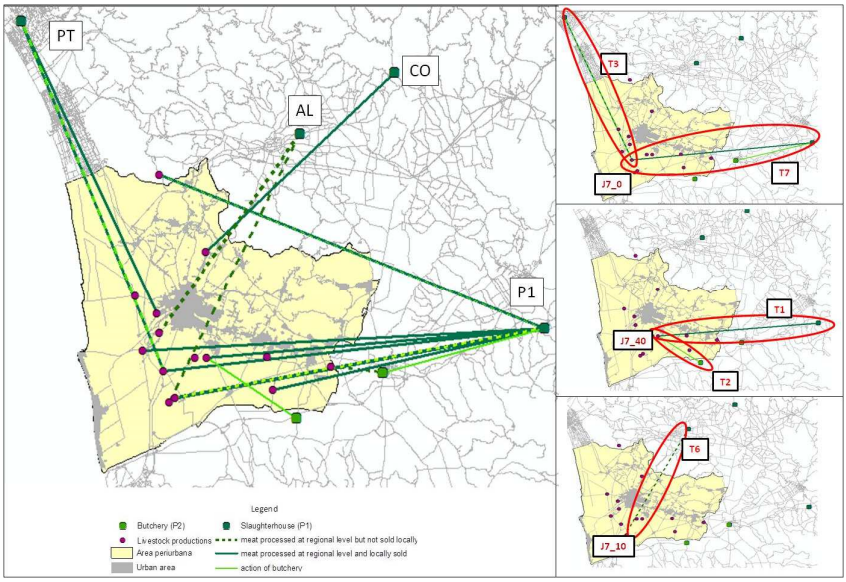


Figure5 Total processing of meat

The 7 types in Fig. 4 are spatialized in Fig. 5 for meat productions. As it is possible to see for meat production there are no example of T5 and T4.The processing of meat is done through 5 channels:

- in the first one (Fig. 5a), the processing is divided in two steps: the first is done in the slaugher, while the butchery is done in the farm, so the product comes back in the farm. (J7_0, T3);
- in the second one (Fig. 5a), the processing is done completely out of the farm; the killing of the animal in the slaugher, and the butchery is done in a specific place owned by the company who does also the distribution of the product (J7_0, T7);
- In the third one (Fig. 5b), the farmer does both the butchery and the slaugher in the slaughterhouse (J7_40, T1).

- in the forth one (Fig. (b), the same farmer devolves a very small part of the production to have ham and sausages and it is sent by the farmer in a specific butchery (J7_40, T2);
- in the fifth one (Fig. 5c), the meat is processed at regional level, but sold through national food chains (J7_10, T7).

We can observe that all the farmers need to process the livestock production outside the periurban area, because there is no slaughterhouse inside. As it is possible to see in Table 1 the distances are not so relevant (Table 7).

Tabella 10 Distance in networks of processors

Name	Total_Leng (km)
J7_0 – PT	37
PT –J7_0	42
J7_0 – P1	42
P1 - J7_0	32
J7_10 – AL	32
J7_12 – PT	7
J7_27 - CC	41
J7_31 – P1	41
P1 - J7_31	26
J7_32 - AL	50
P1 - J7_34	50
J7_34 – P1	36
J7_40 – P1	13
J7_40 - SAL	29
SAL -J7_40	30
J7_49 – P1	44
J7_54 - CO	37
J7_7 – P1	42

7 out of 14 farmers sell the meat outside the region, especially in North of Italy: nevertheless 3 of them processed the meat at the regional level (J7_27, J7_10, J7_32). The other farms send directly the animal outside the region. These last farms are dairy farms.

Moreover among the 14 farmers, 8 of them process the meat that will be locally consumed and distributed. Some of these farmers (3) participate in projects for the valorisation of local races through agreements with supermarkets. The butchery of this meat is usually taking into account by the supermarkets. Other farmers (4) do the slaughter and the butchery in the same slaughterhouse, and then organize networks for the local and regional sale. 3 farmers do the butchery in the farm and from here organized the direct sale of meat. Most of these livestock productions are from cattle breeding (Limousine, Chianina, Mucco Pisano), they all have a certification as typical product (IGP, or local private label), and only one of them has also organic production (J7_0). Only one farm has sheep, the local race Massese.

The processor P1 attracts more farms than others. These are farms that are in the T7, and there's an agreement between the actors of the food chains, but also other farmers, simply because there are existing relationships. Especially this processor is considered the most important in the area. Several farmers have decided to rely on other processors, because P1 is too much "industrial". For example J7_0 says that for the slaughter of special races as Mucco Pisano it is better P2, because the process is more accurate and traditional. So J7_0 is included in 2 types of food chains. J7_54 has organized with P3 a food chain, where the slaughterhouse does both the slaughter and the butchery, and then the farms' customers go directly to the processor to take the meat.

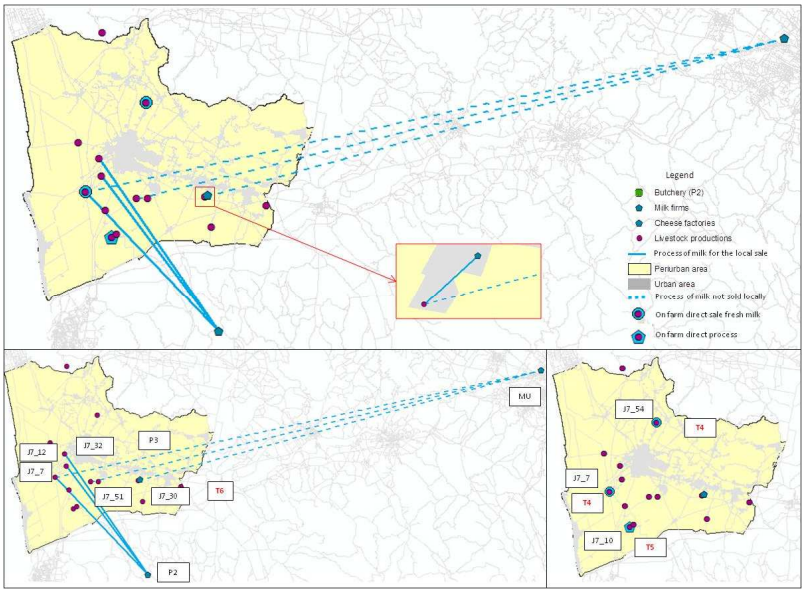


Figure 6 Milk processing's network

At the same time for milk production, there are no examples of T1, T2, T3 and T7.

As explained before there are two examples of on-farm direct sale of fresh milk (T4), one example of on-farm processing (T5), while the rest of the production is sold to enterprises of processing (T6). Here the difference is in the fact that one cheese factory is located in the periurban area (red box), while the other two firms are not, and the distances are bigger than in the meat productions. We can thus assume that one constraint for milk production is to have closer processors. At the same time we need to consider that dairy production is not typical in the area especially from cattle, while for sheep other areas are more relevant at regional level.

Our results suggest that there are differences in the processing network, considering the type of production.

Table 12, shows that the higher distance is for the processing of milk by the regional firm (Mu). Even if a cheese factory is located inside the periurban area (P3), most of the farm sell the milk to the other cheese factory located around 26 km away; the unic farm that sell the milk to P3 has a very irregular provision, since it's main food chain is with the regional firm, because it has dairy production and not sheep one.

Table 11 Distance in milk processing

Name	LENGTH (Km)
J7_30 - P3	0,17
J7_32 - P2	26,51
J7_51 - Mu	78,42
J7_30 - Mu	69,43
J7_7 - P2	27,37
J7_7 - Mu	84,02
J7_12 - P2	26

Sale

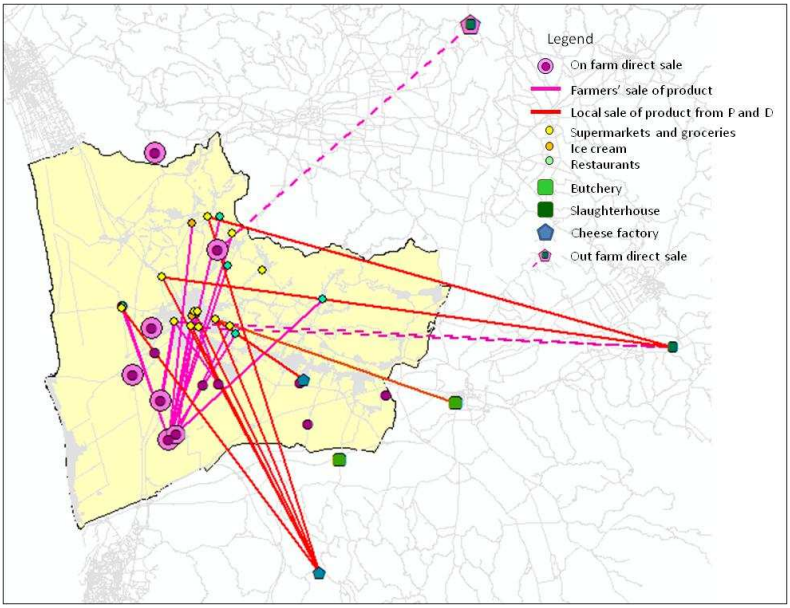


Figure 7 Networks of products' sale

The sale of product completes the description of the types of food chains. In the Figure 7 both the production sold by farmers and the production sold by distributors and cheese factories is shown. These last two networks are not part of types of networks: they are indirectly indicated in T6 and T7. By observing these networks we can notice that a part of the production is sold locally, even if the networks is not controlled by farmers.

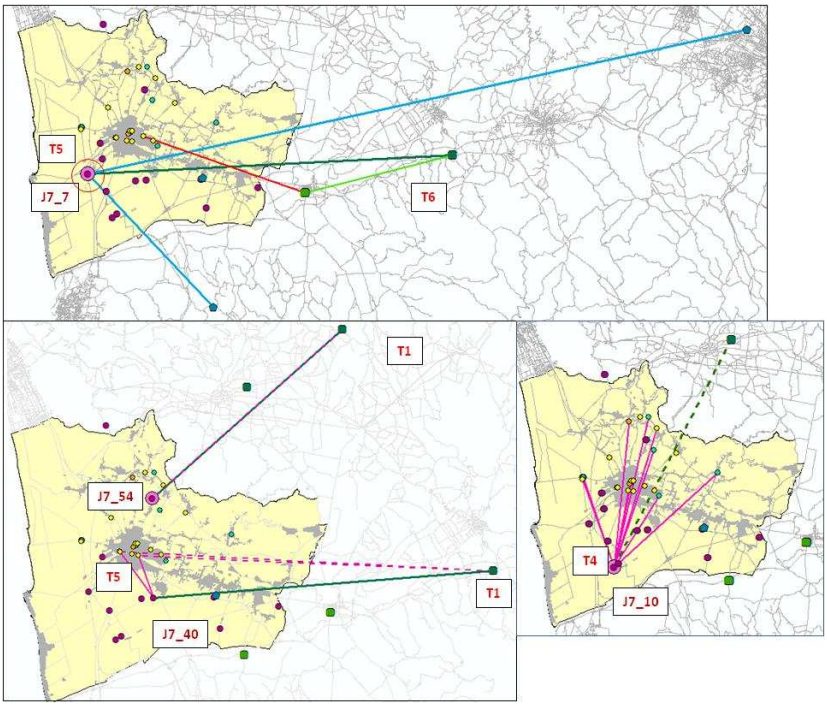


Figure 8 combination of sale and processing

The Fig. 8 shows that local direct sale of products can be organized in several ways, asking farmers different organizations of the food network.

Usually farmers who have invested in internal processing of product, do also on-farm direct sale (J7_0, J7_10, J7_31, J7_34) (T3 + T4) while farmers selling fresh milk they don't need to (J7_7, J7_54) (T5); farmers that have not invested in on-farm processing organize several ways to sale directly their products to consumers, farmers markets, small groceries and butcheries (J7_40, J7_54, J7_49) (T1). For example J7_54 has organised an out-farm sale directly in the slaughterhouse, where the clients, usually the neighbours go to buy the meat. J7_40 has organised the direct transport of the meat from the

slaughterhouse (P1) and the sellers (S1 and S2). Farmers show an interesting differentiating of networks among different production (milk and meat), but also for the same production. For example J7_0 has 3 different networks to sale the same production, a on-farm direct sale (T5), a sale to P2, and a sale to the regional milk processing firm. Especially according to the farmer this third one supports the on farm direct sale, since the milk not sold daily can be transported and processed in the firm, avoiding the loss of profit. Moreover J7_34 and J7_0 combine the on farm direct sale with the sale through supermarket supported by the intermediate actor.

Only J7_40 participates in a farmer market (FM) to sell the product (T1); 4 farmers sell to groceries, and 7 farmers have organized an on-farm direct sale; only one farmer (J7_49) sells to other small butcheries (Table 8).

Constraints

The analysis of constraints has confirmed the hypothesis of the classes, and especially have assessed the presence of several specific constraints among livestock producers (Table 9).

Table 9 Constraints perceived by periurban farmers

Constraint classes	Specific constraints
Regulatory Constraints	Regulatory constraints link to the processing of produces and the direct sale
	Environmental rules
	Rules for street circulation
	Rules link to the job and manpower management
Urbanisation process constraints	Fractioning of land
	Infrastructures influence
Commercial networks' constraints	Payment of the products by local actor
	Negotiation of price
	Constraints link to consumers' demand
Socio-political constraints	Bureaucracy
	Conflicts involving public institutions
	Conflicts with neighbours
	Attention to agricultural issues
Technical constraints	Scale constraints
	Land use system

	Territorial environmental aspects that affect the production
Internal farms constraints	Financing of project
	Structure of the farm

Most of the farmers have experienced regulatory constraints (Fig.9), especially for 50% of the sample's farmers, the constraints were related to regulations of processing of products (eg. butchers and cheese factories): the obstacle is related to the financial investment needed to adapt to the health regulations present, but also the difficulty in having the permission from the local authorities. Other rules are related to the presence of a Natural Park in the production area: even though it has protected agricultural land use, it also imposes strict environmental rules, thus affecting the development of farms' diversification, for example in open direct sale. This constraint is linked to a socio-political constraint, the conflicts between different public institutions: in fact there's a lack of dialogue with policy-makers, for example in establishing common rules for the on farm processing. In general the conflict with public institution is perceived by almost 50% of the farmer and it includes also difficulty in bureaucracy. Socio-political constraints are followed by commercial constraints, due to the difficulty of negotiating a local food chain with no support; farmers have highlighted the difficulty in be paid by local commercial actors, especially restaurants, and small groceries. Finally constraints link to urbanization causes fragmentation of land, influencing the rotations decision, due to high cost of transport; moreover the presence of infrastructure affects the possibility pasture. The technical constraints are thus a consequence of urbanization process.

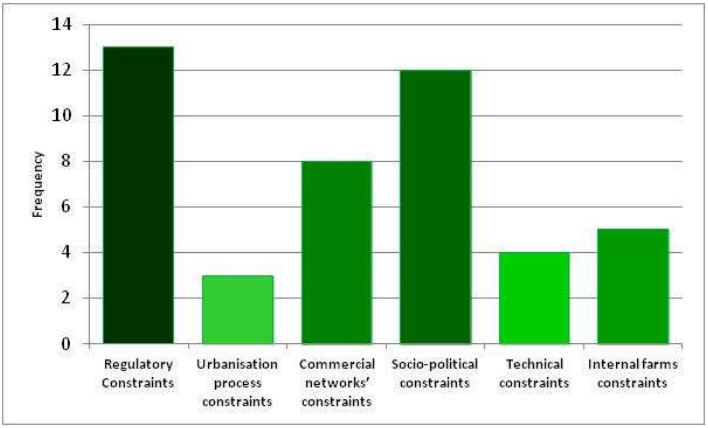


Figure 9 Frequency of farmers'constraints

Processors (Table 10)

P1 is a slaughterhouse located around 40 km from Pisa, for the slaughter and the butchery of cows, pigs and sheep. The clients are 100-150 from Tuscany region, especially from Valdera, while 10/15 are from Area Pisana. For 80% of them they do only slaughter that means the killing and the sectioning in half carcasses (for example, J7_0), producing around 40.000 kg of cow's meat, while for the rest they also do the butchery (for example J7_40). In case of these farmers they operate under contracts, but other clients can be also other butcheries (30%), wholesalers (50%), school canteen (10%) or other private clients (20%). The agreement with supermarkets located in the Area Pisana for the sale of meat with the aid of Agritoscana expects at least 3 animals to be sent to the supermarket each week. The quality certification envisages 2 steps: the first one is the veterinary control from local municipal hygienic authority, which especially assesses the animal welfare, regulated by European rules. The second one is an "internal" control from the quality's labels and in the case of butchery, which rules come from the private or public labels, as IGP, CBP, organic labels, and others.

P2 is a cheese factory which main objective is the processing and the sale of cheese from Massesse sheep's milk. The firm is located about 30 km out from Pisa. The milk comes from all the Tuscany since the firm is member of a regional Consortium for the label "Pecorino Toscano"[1]; farmers from Pisa's periurban area represents only 3-4% of the total, and in some period the firm needs to buy milk from France, due to the seasonality of the Italian sheep's milk production. There's a high diversification of products: from soft cheese (9 cheeses) to more matured products (about 35 cheeses), in combination also with vaccine milk and with different aromas. The firm specifies the territorial origin of the products. The quality of the processed cheese is certified through the regional label; at the farm level, farms are subject of two kinds of control, the first one is the hygienic control mandatory from the public authority, the controls is made in the internal laboratory in the firm's siege. The second one is a animal welfare's control, done through the compilation of a survey and the farm's inspection. The food chain is organized at different territorial levels: first of all there's a shop in the firm's where they sale not only their products but also other local products from different areas of Italy. The meaning of local here is thus "typicality" or even "certified typicality": in this way the shop is not only a space of sale, but also a space of promotion to the final consumers of "local product", or of a certain "artisanal production", a quality's production, because traceable and so well done. Moreover they have organized a distribution's network to groceries, supermarkets, especially located in the region, but they are also exploring the possibility to export abroad. They didn't rely upon traders or wholesalers, because they want to control the distribution of the product.

P3 is a cheese factory, smaller than P2 (see table 3), which main purpose is the processing and the sale of cheese. The firm is located inside the periurban area. The milk comes from Valdera, an area located in the south of the Province of Pisa and only 4 farmers' sale the milk to this firm. The milk

[1] http://www.pecorinotoscanodop.it/

processed is from 2 breeding: Massese and Sarda. The quality's control is done in a laboratory located outside the region (Bologna). The firm has invested in high diversification of the product: almost 23 types of cheese and ricotta. The food chain is mainly organized through contracts with the main supermarket chain, and the distribution is organized by the firm. The contract is done in Florence, renovated each year, and it rules just the possibility to sale in each supermarkets' grocery: the effective sale depends on the single availability of each supermarkets' groceries. The distribution-sale is done 2 times per week with 2 firm's pick-up in all the Nord-Tuscany.

Constraints for processors

The analysis has revealed several constraints linked to quantity, quality, price of products expected by processors on periurban farming system, as well as several constraints on the organization of food chain (Table 11).

Table11 Constraints perceived by processors

Constraints	Specific constraints	Acron.
AVAILABILITY/QUANTITY	Seasonality	Seas
	Single product quantity	QtP
	Products diversification	Div
	Available farms	QtF
PRICE	Poor added value	Adv
	Price too low	PrLo
	Price too high	PrHi
QUALITY	Organic farming	Org
	Processed products	Proc
	Local products	Loc
	High quality products	HQP
FOOD CHAIN	Lack of a local food chain	LFC
	Lack of coordination in the FC	LCf
	Actors power issues	Pow
	Consumers demands	Cond
	Difficult agreements	Agree

The analysis revealed that the constraints more recognized by processors are linked to Availability and Food chain, both for milk and meat processors

(Figure 10). Especially all the actors express the need of more farmers closely located, as well as the problem of seasonality but only for milk processor.

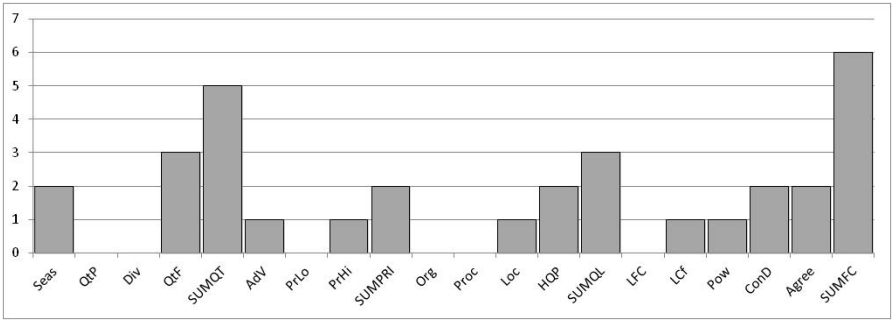


Figure 10 Frequency of constraints for processors. For acronimous see Table 11; SUMQT, indicates the sum of frequency for indicators on availability; SUMPRI, indicates the sum of frequency for for indicators on price; SUMQL, indicates the sum of frequency for for indicators on quality; SUMFC indicates the sum of frequency for for indicators on food chain.

In order to overcome the constraints of availability of farms, P2 has organized an international food chain in order to have sheep milk all over the year; moreover it has diversified the production in order to offer cheese made by cow, for example from J7_7. This last strategy has been adopted also from P3which is provided of milk by the neighbour J7_30.

The availability of local farms is the unique constraint expressed by all the processors. For sure, the processors have as reference different level of locals. For all, the problem is the decrease of farms at regional level, but also the fact that traditionally the farms are far from there, and more farm in periurban area will be a benefit in terms of transportation's cost. While the first fact express the general crisis on farming activity in all the supply basins, the other refers to the fact that to have much more close farms would reduce the cost of transports and negotiations. The milk processors have both a supply basin in the province of Pisa (P3) or at regional level and international level (P2), but they also processed different amount of product (see Table 3),

as well as they have different distribution's channels, local (P3) and regional/national/international (P2). Nevertheless they are both critic in the lack of "local" product, or in other words product from Pisa's farmers.

The slaughterhouse has observed a decrease of almost 70% of both private butchery and livestock producers in the last 15 years, which has lead to a change in the legal form, from a Consortium to a Limited Liability Company (LTD).

Food chain constraints are the more frequent constraints detected. Especially they linked to the consumers' expectations, especially from cheese processors which report an increasing preference of "soft" cheese, considered of less quality, and with a reduced price. Moreover actors claim for a more organized food chain. (P3) for example expresses difficulty in agreement with supermarkets in the provision, which change a lot, and several constraints linked to the label: they put the label of Pisa and it has been considered as a concurrence to the IGP, which is connected to power issues. Organization of food chains mean also projects of local institutions for the support of local products, this has been especially expressed by P1 and P2, which have also promoted several food chains' projects. The first one with local institutions has participated in a *Progetto Integrato di Filiera*[2] , which one of the action puts in place was the building of a shop exactly in the cheese's factory location, for the sale and thus the support of products from Tuscany with special focus on certified products and products from Pisa's Province; in the shop there is also the sale of various products, which have in common to be "local", in the meaning of "typical" of same place. The slaughterhouse has organized a project for the provision of local school

[2] http://www.pisa.coldiretti.it/filiera-toscana-piano-multifiliera-per-garantire-prodotti-tracciati-etrasparenti-due-mega-store-del-.aspx?KeyPub=GP_CD_PISA_HOME|CD_PISA_HOME&Cod_Oggetto=41434964&subskintype=Detail

canteen[3], but it detects difficulties in participating in public calls, that seems not designed for the specific support of local initiatives.

Sale

Network table shows principal information about networks of sellers (Table 12).

S1 is an individual enterprise, established by two partners, which main objective is the sale, and thus the support of organic production or local products. The interest of the sellers is not just on the label, but in the possible traceability of the products: they want to assess directly the quality of the product. Before purchasing the product the sellers visit the firm or the farm producer, in order to have direct contact of the "quality" of the production. They have also done specific courses to learn about the food processing, the primary produces, and so on. The relationship with the farmers both from periurban area (2) and out of the periurban area (3) is begun with personal knowledge or knowledge through clients. It is an evidence that one of the farmer of periurban area (J7_10), is the farmer that have more relationships in the area including other groceries and restaurants. The shop is located in the city centre. For J7_10, the provision is one time per week, with an estimated quantity of 2-3 kg per week; the price of sale from the farmer to the grocery is the same: farmer doesn't differentiate the price among different commercial actors and consumers. The grocery has a mark-up of almost the double of the farmer's price.

S2 is a farmers' market (FM) organized by a farmer union at national level. In Pisa the market includes 14 farmers (in 2014), 35% from the periurban area of Pisa. The aim is the meeting between consumers and producers in order to

[3] http://www.consorziomacelli.com/documenti/fattorie_tavola2009.pdf ; http://iltirreno.gelocal.it/pontedera/cronaca/2014/01/17/news/il-comune-dismette-la-parte-pubblica-del-servizio-1.8488264

cut the cost of intermediation of the traditional food chains. The market is open 2 times per week in the city centre and it is also organized in the other municipalities of periurban area, as well as in the Province. As in an usual FM, products are directly sold by farmers, but in this case they need to be member of the union. Moreover to join the FM they need to do a formal request to the local union's administration, that considering the products marketable, and the local request of such products, decide if the farmer can join the FM, and in which FM he can go, in Province of Pisa, in order to balance the offer and demand of product. For each FM they participate in, farmers need to pay 20 euro. This money is used for investment in the FM's structure, so it is not for the profit of the union. There's an agreement for the price: for example for horticultural production the price is decided considering the national price of primary produces from the Minister, minus 30%. An important difference between Pisa's FM, is that the production the farmer can sell, must be produced by the farmer itself. If one farmer doesn't have product to sell, he simply doesn't go to the FM, leaving the place for someone else. In this way the term "local" has several meanings: first of local is produced in the Province of Pisa, and especially it needs to be produced in a specific territory, the farm. In order to be sure, the union organizes controls in the farm, by which it provides also technical assistance if needed. The produces more offered are vegetables and fruits. Cheese, meat and bread are very requested. The central FM in Pisa have an estimation of 600-800 clients per week, with a pick of clients in summer, that specifically look for fresh vegetables and fruits.

S3 is a cooperative which main objective is the "mediate sale" of local products. This means that the cooperative has organized the shop and it has the responsibility of the sale, with a saleswoman paid by the cooperative but the price, the quantity and the times of provision are decided by the farmer. The project is result of a project between the cooperative and the municipality of Pisa, for the financing of initiatives for the direct sale of local

farmers' products through a fund coming from the regional Rural Development Program. The promoter of the project has specifically addressed the project to periurban farmers, with the idea of supporting the geographical proximity of periurban farmers. However the project includes 35 farmers not only from Province of Pisa, and only 8 of them from the periurban area. The products are both fresh and processed, especially olive oil, vegetables, meat (J7_40), bread, from the periurban farming system. It also includes products from ethical projects as Fair Trade's products or Libera. This suggests an assignment of a certain ethical meaning to the promotion of local farmers.

Constraints from sellers

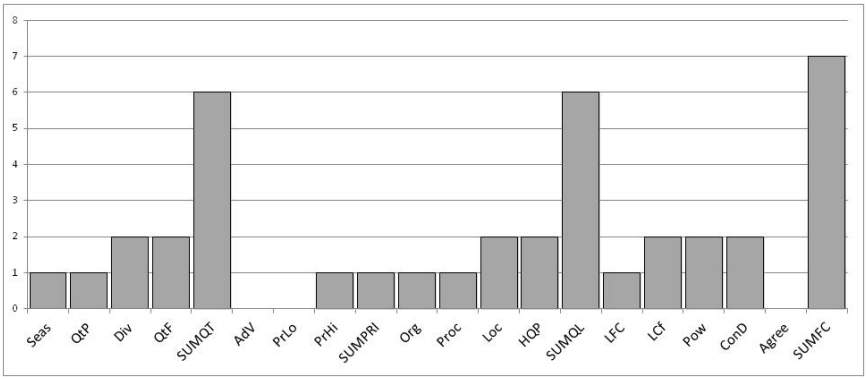


Figure 11 Frequency of constraints for sellers. For acronimous see Table 11; SUMQT, indicates the sum of frequency for indicators on availability; SUMPRI, indicates the sum of frequency for for indicators on price; SUMQL, indicates the sum of frequency for for indicators on quality; SUMFC indicates the sum of frequency for for indicators on food chain.

The constraints analysis (Fig. 11) reveals that one of the most perceived constraints is connected to availability of farms. A part S3, the other sellers denounce by one side a difficulty in finding farms available to sell products, by the other side there are difficulties in negotiating with farms the furniture of product. This reflects a general lack in the coordination of the local food

chains. As said by the actors, the strategy is to contact the farmers already involved in other food chains, and there is no way to know about the availability of new farmers. Farmers already involved in other local food chains, need to balance the different requests they have and so the furniture is irregular. New farmers have to adapt to a certain standard quality not always certified by a label, and especially S3 question the effective productive quality of local product without a certification. By the other side organic productions are difficult to find. Nevertheless the sellers highlight the increasing demand of local production from urban consumers. Especially, few consumers look specifically for organic or certified productions, and the unique request are for more productions, or with more frequency.

In general FM shows less constraint with farmers, since there's an increasing demand of joining the markets, as well as an increasing demand from municipality to organize such markets in their places, as well as an increasing consumers' flow. According to the actor interviewed there's a problem of diversification, since most of the producers sale horticulture.

4. Conclusions

Considering the variety of experiences puts in places by farmers in participating in local food chains, we have identified types of networks in order to better assess the characteristics of such networks and the constraints of farmers in having such food chains.

It's not the distance per se that influence the organization of local food chains, but the wider interpretation of "proximity". For several farmers (J7_0, J7_34, J7_ 7) we have found elements confirming the existence of an organizational proximity in the way farmers participate in a certain network because they share the participate in the same projects as slaughter, butchery, intermediate actors (Carne Bovina di Pisa); also the participation to the FM (S2) is more connected to the organizational proximity, due to the fact

that J7_40 was already member of the union. The same farmer participates in S3, and justify his participation to a possibility to attract citizens consumers, that later on will go in the FM or in his farm, when he will have build a proper space. In this sense it's probably the geographical proximity that plays a determinant role. Another example is from J7_30 that sells a percentage of the production to the local cheese factory; similarly or all the farmers that have experiences of direct on-farm sale stated that the location close to the urban area is a determinant driver.

Nevertheless this is not true for all farmers and all the productions. J7_7, stated that the direct sale of fresh is not regular in the year, even if the farm is close to the urban area and infrastructures; moreover the farmer states that the participation in a conventional food chain (Renting et al., 2003) is a drivers for the organization of local food chains: the milk not sold in the term imposed by the rules is sent to the regional firm for the processing.

Many farmers participate in multiple networks, activating different internal and external resources. This observation may suggest by one side an interesting dynamic and enthusiasm in the local food chains, by the other side it may suggest the need to develop policies to support local food network: most of the farmers seem to move more with an individual initiatives.

Beside this interesting individual farming dynamic, there's a lack in coordination of the food chain. Processors and sellers claim for common or public project that may ensure the coordination between farming initiatives and consumers' initiatives. Especially while the farmers already participating in agro-urban projects or direct sale, are already well known and included, there's a lack in the knowledge of new farmers, potentially includable in the initiatives. This constraint is especially expressed by S1 and S3, while S2 and the processors have a better knowledge of the possibilities of the local farming system. We can hypothesis that the difference between S1, S3 and S2 is that S2 has a territorial perspective, including all the farmers joined to the

union, beyond the food chain they participate in. The same perspective can be adopted also for the processors,

since they are focusing in less producers and they need to actively seek farmers on territorial ground. In our opinion for S1 and S3 there's also a general lack in the knowledge on how the farming system is composed and especially which territorial dynamic they face.

In the analysis we have also found a different approach in the interpretation of the term "local" between producers and consumers. While for producers the term refers to the production produced in their farm, in the periurban area (no farmers in the sample sale other farmers production), for processors and sellers, "local" refers to a certain quality production, labeled or not, but in some way traceable; especially for processor, the "local" is referred to the action of processing, more than the production. In our opinion the difference in these perspectives reflects a lack in the understanding of the territorial management components of the periurban farming system: the fact that a product is produced in periurban area has different implication than the production in rural areas.

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Annex

Table 8 Network Table. For indicators' code see Table 2. In order to protect the privacy the name of salers are indicated with a code (S1 nad S2) while for the others it is indicated the numbers of sellers; for processors and intermediate actors there's a code. In the table, in "QT" column: "oth.irreg." refers to the irregular provision to other actors, while the regular provisions are specified; "kg/y" and "kg/w" refer to kilograms per year and per week, "qt/d" refer to quintal per day, "lt/y" and "lt/w" refer to liters per year and per week; "Prov. Pisa", refers to Province of Pisa

FARM	PROD	TyLFS	NamSel	TerSal	% TyLFS	% PrLFS	% TotLFS	€	QT	PRC	cost PRC	TerPRC	Name	N.Lab	NamLab	Int Ac	Nam Int	ParPro	Nam Pro
J7_10	MILK	ONF			60	80	80	18 €/kg	150 kg/y	2	0	Pisa	0	1	bio	0	0	1	GAS
		GRO	S1	Pisa	40				2 kg/w	2	0	Pisa	0			0			
			n.3						20 kg + oth. irreg.										
		ICE-CR	n.3	Pisa, Pontasserchio Tirrenia				?	15 kg/w cad.	2	0	Pisa	0			0			
		REST	n.7	Pisa	15			18 €/kg	3 kg/w + oth. irreg.	2	0	Pisa	0			0			
		OUT	/	Lucca	?	0	0%	?	*ija*	0	?	Lucca	AL			1	?	0	0
J7_11	MEAT	OUT	/	Emilia								Emilia	0	0	bio	0	0	0	0
J7_40	MEAT	FM	S2	Pisa	93	100	90	16 €/kg	100 kg/w	1	400 €	Prov. Pisa	P1+SAL	1	IGP	0	0	0	0
		GRO	S3	Pisa	7					1						0		0	0
J7_0	MEAT	ONF			95	100	98	6,10 €/kg	34.345 kg/y mucco 56.576 kg/y limousine	1,5	?	Prov.Pisa	P1	2	bio +CBP	0	0	1	GAS Firenze, Livor
		GRO	n.2	Pisa												0	0		

		SUP	n.1	Pisa	5			5.10 €/kg					P1+CC			1	AG	0	no, Pisa, Massa
J7_7	MEAT	SUP	n.1	Pisa	100	100	75	5 €/kg	18.493 kg/y	0	0	Provincia di Pisa	P1+CC	1	CBP	1	AG	0	0
	MILK	ONF			10	100		1 €/lt	450.000 lt/y 7000 lt/w	0	0		0	0	0	0	0		
		PRO	P2	Prov. Pisa, Toscana	75			0,90 c/lt		0	0			1(m)	AlQ	1(m)	0		
			MU		14			0,38 c/lt									GD		
J7_12	MEAT	ONF		Pisa	100	100	90	3,5 €/kg	250 kg/y	0	0	0	0	0	0	0	0	0	0
	MILK	PRO	P2	Prov. Pisa	100	100		0,90 c/lt	?	0	0	0	0	0	0	0	0	0	0
J7_27	MEAT	SUP	n.1	Toscana	100	100	0	5,50 €/kg	1320 kg/y	0	?	0	0	2	IGP + COOP	0	0	0	0
J7_30	MILK	PRO	MU	Toscana	98+2	100	2	0,40 c/lt	80 qt/d	0	0	0	0	0	0	0	GD	0	0
			P3														0		
	MEAT	OUT		Emilia					*IJA*	?	?	Emilia	INA			1	?		
J7_31	MEAT	ONF			95 (75 % gas)	100	100	?	14.144 kg/y	1,5	120 000 € invstm.	Prov. Pisa	P1	1	CBP	0	0	1	Gas
		SCH	n.1	Pisa												0			
		REST	n.2	Pisa	5											0			
J7_32	MILK	PRO	P2	Prov. Pisa	100	100	0	?	?	0	0	0	0	0	0	0	0	0	0
	MEAT	OUT	/	Lucca					7500 kg/y			Lucca	AL						
/ _	MEAT	SUP	n.1	Pisa	95	100	20	?	14861 kg/y	1,5	?	?	?	1	CBP	1	AG	0	0

		ONF		Pisa	5			?				?	?			0	0		
J7_49	MEAT	PRO	18-19	Pisa, Livorno, Viareggio	?		50	5,30€ /kg	495040 kg/y	0	0	Prov.Pisa	P1	0	0	0	0	0	0
		GRO	n.1	Vicopisano							0								
		REST	?	?							0								
J7_51	MILK	PRO	MU	Toscana	100	100	0	0,41 c/lt	?	0	0	0	0	0	AlQ	0	GD	0	0
	MEAT	OUT	/	Emilia					294 kg/y			Emilia	INA						
J7_54	MILK	ONF		Pisa	100	100	100	?	?	0	0	0	0	0	0	0	0	0	0
	MEAT	OUF		Collodi				?	2160 kg/y	0	?	Collodi	COL	0	0	0	0	0	0

Table 10 Network Table for processors

PROC	TerLev of action	prodotto primario richiesto	Quantities processed	n. farmers from periurban area	% farmers from periurban area	€BUY	€CTZ	KNOW	Differentiation of products	ACTIONS	Commercial networks	SPACES	What is "local"?
P1	Prov. Pisa	MEAT bovina, suina, ovina	5000 cows, butcher: 2000 kg/y	10-15	10%	/	0,40c/kg butchery	Personal knowledge	0	PROCESSING SALE	50% wholesalers 30% buchery 20% privates 10% schools	Area pisana Prov.Pisa	Tuscany
P2	Prov. Pisa	MILK pecora massese, latte vaccino	400-500 qt/d	3	3-4%	0,90 c/lt	/	Personal knowledge	40	PROCESSING, SALE, DISTRIBUTION in groceries, supermarkets, markets	50% supermarkets 3-4%HO.RE.CA 45% groceries: 10% abroad, 90% Italy: 35% Toscana	Area pisana Prov.Pisa Toscana, Nord Italia, Europa, Internazionale	Tuscany
P3	Pisa	MILK pecora masses, latte pecora sarda, latte vaccino	50 qt/d (march-august)	4		0,85/0,90	/	No fix contract	23 cheese 1 ricotta	PROCESSING, SALE, DISTRIBUTION in groceries, supermarkets, markets	70% Supermarkets, 30% groceries + markets	Area pisana Prov. Pisa, Toscana Nord	Area Pisana, for the processing (see label of the product), Province of Pisa for the producers

Tabella 12 Network Table for Sellers

SELLER	N. Farmers	Farmers' products	What is Local?	Periurban area's farmers (interviewed)	Products from periurban area	Knowledge	Price for final consumers	Quantity	Quality	Contract
S1	5	Vegetables, sauces, bread, jams, salads, cheese	Toscana	1		Personal bonds, information from clients		not definable	1	formal
				J7_10	Cheese	Locally well known	+50%	2-3 kg la settimana	1	
S2	14	vegetables, sauces, bread, meat	Provincia di Pisa	5 (3)		members of the union	< 30% of the national price	not definable	0	After acceptance by the union farmers need to pay 20 € each time
				J7_40	Meat			100 kg	1	
				J7_0	Meat			saltuario	1	
				J7_39	Vegetables			?	0	
S3	35	Vegetables, fruits, milk, cheese, eggs, olive oil, wine, bread, honey, meat, ham, sauces and jams	area pisana + provincia di Pisa e Lucca	8 (6)		through unions, and other projects	Prices decided by the farmer	not definable	0	Farmers need to join to the association and they pay each month 20% of their total sale
				J7_40	Meat, eggs			7-8 kg la settimana	1	
				J7_5	Olive oli			Irregolar	1	
				J7_26	Potatoes			30 kg/w	1	
				J7_3	Olive oil			Irregolar	1	
				J7_20	Vegetables, fruits			Irregolar	1	
				J7_41	Vegetables, fruits			Irregolar	1	

				J7_40	Meat, eggs			7-8 kg la settimana	1	
				J7_5	Olive oli			Irregolar	1	
				J7_26	Potatoes			30 kg/w	1	
				J7_3	Olive oil			Irregolar	1	
				J7_20	Vegetables, fruits			Irregolar	1	
				J7_41	Vegetables, fruits			Irregolar	1	

8. Discussion and conclusion

7.1. Limits and Futures perspectives of the thesis

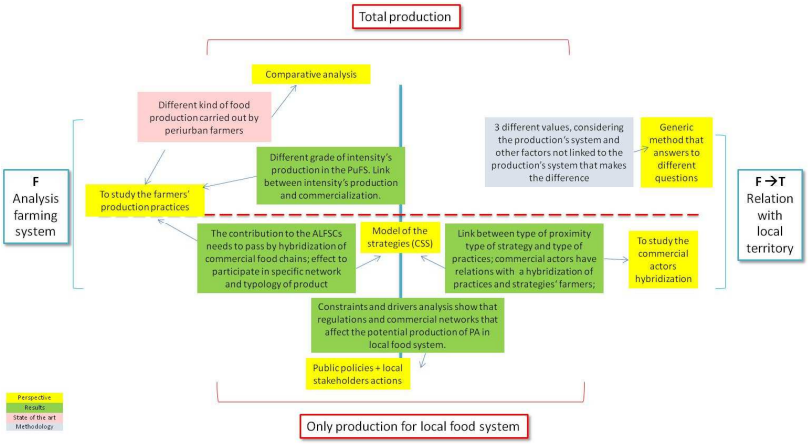


Figure 35 Results and future perspectives

Contributions from analysis

In Fig. 40, one or more future perspectives of analysis are associated to each result of each research question. This thesis provides several methodologies applicable in different case studies. In the case of Farms' Food Typologies (Cap.2) agronomic studies can go deeper in the subject, providing solutions in order to increase the quality, the quantity of food production at farm level. At the same time perspectives will be more focused on characterising the intensity of farming practices, in order to elaborate experimentations on the necessary adaptation of periurban farming systems and their cropping systems. The calculation of food production capacities is applicable also to other productions, as well as other case studies, or with other scale of analysis; this analysis can also be supported by parallel analysis on local food

demand. As well analysis on food strategies can include other indicators as well as can be spatialized through the use of socio-spatial configurations. The spatial network analysis could be applied to other food chains, at other territorial levels and it can highlight other elements, through the adaptation of the Network Table to other topics and targets, with the inclusions of other indicators. Finally future analysis can study the contribution of policies and local stakeholders' actions in order to improve the local supply LFS and so to affect the territorial development of periurban areas.

Contribution to the debates on periurban farming systems and LFS approaches

In general the study provides empirical evidences of several approaches and theories, as well as it demonstrates the need of more accurate territorial farm-based analysis, in order to assess the influence of territorial changes in the productive systems, as well as the farm's contribution to the local food chains and local food security.

Contribution on periurban agriculture's studies

Considering the debate on periurban farming systems, the study has provided several results on periurban farming systems in Mediterranean case studies; moreover it contributes in the debate of periurban agriculture in medium-sized cities (Arnal, 2012), and above all it deals with the periurban agriculture put in place in areas with recent urban sprawl (Pascucci, 2007). The analysis goes beyond the classical farming system's analysis concentrated in one food chain, or one production system, since it includes all the farming systems available on the territory, involved in multiple local food networks. In this sense it provides interesting elements of reflection about the territorial adaptation of different periurban farming systems. While being based on a territorial approach, the study is anyway capable to provide farm-based

analysis (Cap. 2 and 3), in order to properly assess the hybrid ways of adaptation of periurban farming system.

Nevertheless the methodologies used can be applied both on urban, periurban and rural areas where agriculture is performed, while only some indicators of the analysis are specific to frame periurban stakes and opportunities. Further studies could elaborate specialized frameworks of analysis and distinct methodologies in order to properly address and solve the specific stakes of periurban agriculture.

Contribution on LFS's studies

Considering the debate on LFSs, the analysis of this thesis has taken benefit from the different contributions explained in the introduction. The analysis have thus provided elements of discussion for all different approaches, based on empirical evidences about the effective participation and involvement of farmers in LFS, beyond the classical literature's references on short food supply chains, food miles, urban food supply basin. This was possible with the analysis of farmers' complex strategies (Cap 4) and the spatial networks they are effectively included in (Cap.5). In this contribution the *localization* of food system, is firstly based on the territorial level of farmers' production; this territorial level is peculiar, because it is periurban and it affects the spatial management and possibilities of productions, asking farmers to adapt farming practices and crop systems; hence the "geographic proximity" acquires a symbolic meaning, and the periurban area merits the status of *territory*. For example, while in the SYAL approach the territory – conceived as a system of values (Fournier and Muchnik, 2010) – is represented by a specific product, which label assess a peculiar system of production from a specific area (usually a place administratively delimitated), in this study the territory is not represented by a product, but by the specific conditions of production (Fig.41).

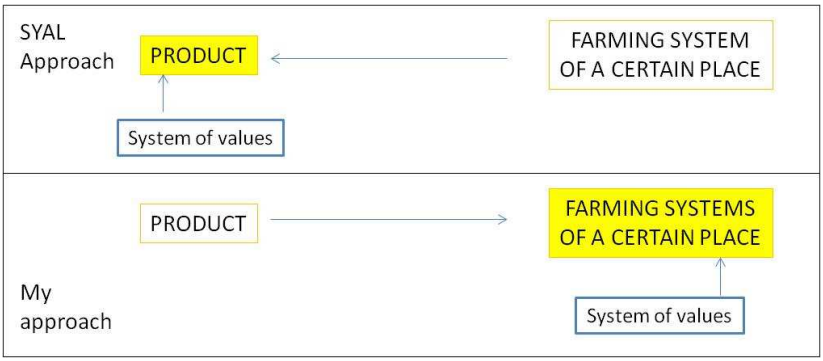


Figure 36 SYAL and my approach

Moreover the *localization* is defined by the effort of farmers to provide food to the close urban system, and in this way by the effort in becoming the supply basin, the food shed of urban system: the difference with food shed and urban food system approaches is that the focus is not in what final consumers need, but in what periurban farming system can provide (Fig. 42). This assessment has be done by the calculation of effective and real food capacity and also the strategies farmers organize to contribute to LFS.

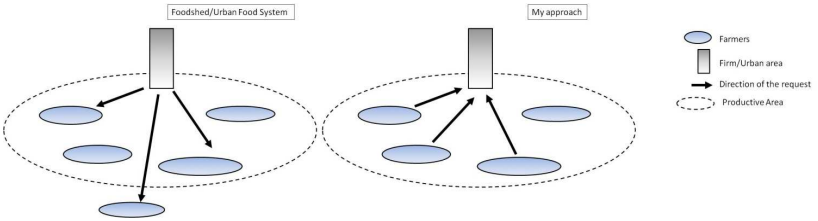


Figure 37 Demand driven approaches

Thus, the study has not considered the final consumers' demand, but only the first buyers' request. Further analysis could assess how to increase food production locally allotted, for example through process of local valorization, in order to satisfy local food demand; moreover more analysis should be

done on the entrepreneurial capacity and the profitability of LFS for periurban farmers with more economically oriented studies.

7.2. Medium-sized cities: the representativeness of Pisa's case study

The case study provides important elements about periurban agriculture's system of production in developed countries, especially in Mediterranean area, while most of literature's contribution on such topic has been done in developing countries. As claimed by Opitz et al. (2015), more studies are necessary about periurban agricultures in the Global North. For the overall purpose of the analysis proposed in the manuscript, the case study of Pisa meets the expectations, since its high degree of representativeness. The importance of studies on periurban agriculture in medium-sized cities has been already demonstrated, especially in Italy where most of the studies have been focused on metropolitan cities (Milan, Rome, Boulogne, etc...). Moreover the comparison with other Italian medium-sized cities we have performed (Filippini et al., 2016, in preparation), in the same region Tuscany (Lucca) and in the adjacent region Emilia Romagna (Reggio Emilia), has revealed that Pisa is more characterized by an heterogeneous territorial farming system, enabling research on different farms' production, and different food chains organized for different production. First of all, comparing the data from '80s we have detected a "regional" effect, probably due to the different development of agriculture and urbanization in Emilia Romagna and Tuscany. While in the first case the urbanization has been more homogenous, in the second case, Lucca and Pisa has lived an important phenomena of urban sprawl; here, the case of Pisa, represents more than Lucca the phenomena of "urban shrinkage", with a decrease of population from the main urban centre and a parallel increase in the neighbor municipalities. By comparing agriculture's data on periurban and not periurban munipalities for each case study, a "food chain effect" is possible to detect in the three case studies and among different regions: while in

Emilia Romagna agriculture activity is usually more specialized, in Tuscany there's a prevalence of a mixed territorial farming systems. In particular in Reggio Emilia several food chains around livestock productions are valorized at local, national and international level (e.g. Parminggiano Reggiano, Prosciutto di Parma, etc.). In Tuscany, Lucca is certainly traditionally more specialized in cereal productions, while in Pisa the crisis of traditional horticulture based on small farms had caused a fragmentation of territorial farming system on several different productions, as cereals, forages, industrial crops.

Nevertheless in all the three case studies it is possible to identify a periurban effect due to the recent urban sprawl that characterizes all the Italian medium-sized cities. Further studies can investigate the equilibrium among *periurban effect* and *food chain effect*, in the assessment of periurban agriculture's development.

7.3. Constraints

The effective participation of periurban farmers in LFS is affected by several constraints and drivers. The literature has been focused in analyzing social and land use conflicts farmers perceive (Darly and Torre, 2013; Henderson, 2005) or the productive adaptation of periurban agriculture (Heimlich, 2001; Pascucci, 2007), but more attention needs to be paid on the transformation from perceived conflict to constraints (Giacché et al., 2013).

In Filippini et al. (2013) a comparative analysis of constraints and drivers perceived by farmers has been proposed, applied to all the sample of farms (Fig.43). Constraints and drivers hypothesized are both related to the urbanization process, as well as the organization of LFS[4]. The analysis reveals

[4] For the definition and hypothesis behind them, see Cap. 6

that between drivers and constraints, the most important difference is the perception of regulatory constraints, while regulatory drivers seem not to be perceived by farmers both in commercializing in local food chains, and in the fact to be in periurban areas. This result may suggest a deeper study in the effective awareness of opportunities and constraints farmers face (e.g. Giacche et al, 2013). The fact to be located in periurban area is one of the less drivers' perceived, while the fact to produce a production directly marketable and the participation in projects are the most perceived drivers. Among the constraints, regulation and socio-political constraints are the more perceived ones: especially several constraints are linked to environmental rules connected to Natural Park regulations, constraints linked to the processing of products; moreover several farmers detecting a lack of dialogue with local institutions, as well as among institutions that formulate overlapping and sometimes opposite rules.

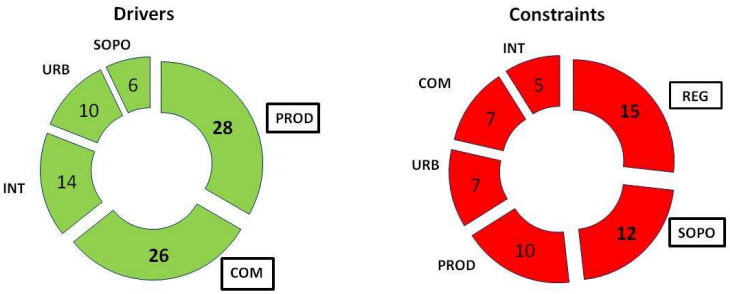


Figure 38 Frequencies of drivers and constraints in farmers perception (Filippini et al., 2013)

Further studies are necessary to better formalize farmers perceptions, and how drivers and constraints operate in farm's choices. However these first results may already suggest that the development of periurban farming system is more linked to farmers' individual initiatives or local organization of actors, than to a specific action of institutions, or territorial coordination among actors.

7.4. Territorial development: which contribution from periurban agricolture?

One of the hypotheses of this study was that agriculture activity and its productive valorization could be one of the tools for the sustainable development for periurban areas, especially resulted from recent urban sprawl. The participation in LFS has been hypothesized as one of the possible tools to maintain agriculture in periurban areas.

The analysis of both territorial periurban farming system and local food networks has shown the heterogeneity proper to these experiences. The effective participation of periurban farming system to LFS should not be taken for granted.

In order to better frame the results we need to revive the concept of "territory" proposed by several scholars on agriculture sustainable development and on those food system approaches that have the ambition to propose "ways of development". The territory is not only a space where local people meet together as well as it can't be defined only by the space where policies drops down. The territory is a third level where a coordination activity is put in place by actors from different levels, involving multisectorial stakeholders and activities (Governa and Salone, 2004).

My suggestion is to study in deep the farming system put in place by farmers at territorial level (Tolron, 2001; Pascucci, 2007; Soulard and Therau, 2011), as well as to study in dept how local food networks are developed both considering them in their vertical chain's organization (Murdoch, 2000) and in their territorial complex food networks (Lockie and Kitto, 2000; Raynolds, 2004). This needs to be done when research approaches the periurban farming system operating in local food chains.

A possible suggestion comes from territorial analysis provided by triptych "actors-activities-spaces", proposed by the geo-agronomy approach (Benoit et al., 2006). According to it in fact, agri-urban systems are particular systems where different actors (farmers, institutions, other stakeholders, as the "commercial actors" of this thesis), different actions (the multifunctional characters of periurban farming practices, or the different pattern of intensity, the hybridization of farmers' commercial strategies, the stakeholders' projects to develop LFSs), and different spaces (soil uses, different perceptions of land use, different constraints linked to urbanization of this thesis, different perceptions of *local*) integrate together. According to the authors the triptych formalizes the different dimensions of integration possible at territorial level, and in this way it supports a deeper analysis of the territorial dynamics, in order to address them in a territorial development perspective (Deffontaines et al. 2001). In this perspective the network capacity has a determinant role for the development of periurban territories. Networks provide the basis for the construction of the territory, where actors are not simply acting in one or different spaces, but they integrate together in a dynamic process of change, which output have not been always hypothesized at the beginning.

This means also to include such projects that even if they don't have as specific objective the meeting of urban and rural actors and the coordination of a common agri-urban project, somehow have had the capacity to valorize farming production in periurban areas through LFS. In Pisa several projects revoke such idea. One of them is the *Carne Bovina di Pisa*[5]. Promoted by local livestock producers' association, with the unique objective to preserve the gene pool of local cattle race, the project has coordinated farmers, local livestock producers' association and local supermarkets around a common label which distinguish livestock produced in the Province of Pisa. It is a fact that most of the livestock productions that participate in such project are

[5] http://web.tiscali.it/apapll/apapisa.htm

located in the periurban fringe of the Pisa's city. Here, alongside the commercialization through local supermarkets (which assure the sale of all the production), the farms, have organized experiences of direct sale principally addressed to Pisa's citizens. They have thus taken the opportunity of the geographical proximity. Similarly the sale of the meat in supermarkets and other groceries is done inside the periurban area, thus characterizing local food demand. Moreover in the farms' interviews the fact to be in the periurban area has affected also such production: for example, the presence of infrastructures and the traffic preclude the organization of pastures. In other words in such project the spatial proximity with urban areas is a determinant element, in a dynamic process of development which is the result of adaptation's strategies both from the farmers perspective and the perspective of the other stakeholders.

Multi-actor, multi-actions, multi-spaces networks can drive the *localization* of the territorial dynamics (Torre, 2000); the hybridization thus appears as a condition for the adaptation of periurban farming system, which needs to reply to new and different demands coming from the recently proximal urban area. If a new meeting should be put in place between periurban farming systems and LFS, this meeting should understand the multiple requirements coming from the urban area, as well as the hybrid possibilities and constraints that are faced by a previously unfamiliar agriculture system of production. The hybridization should consider different localization processes. The terms of this adaptation are different considering the periurban farming systems, the process of urbanization and the LFS projects. Further studies should study deeper how and if in different case studies adaptation and hybridization are organized at territorial level.

In other words the *adaptation*, condition of a system's *sustainability* (López-ridaura et al., 2005), needs to be put in place by farmers, but also by their buyers and consumers, in a process of *localistion* that is possible with reciprocal *networks*, base for an effective territorial development.

Nevertheless the observation of LFSs organized in the case study by different stakeholders, with different actions, has also moved a reflection on the stability and thus the reliability of such experiences. During the three years of this PhD's analysis, which has also been developed under the ANR-DAUME project, several projects and individual initiatives have been initiated, changed or they have even been stopped, both from farmers and other local stakeholders. This dynamic process is interesting, since it reflecs a general and creative dynamic in adapting to new opportunities; nevertheless it arises reflections about the conditions of sustainability of the agro-urban projects. As formulated by Lopez-Ridaura et al. (2005) the sustainability of a system relies not only on adaptation to the hybrid characters of supply and demands, but it depends also on stability, profitability, resilience. Only by composing these elements all together, a sustainable long-term territorial development process is facilitated. It means to understand in which ways these initiatives can be profitable for farmers and the other components of LFS; to which point LFS can stabilize and maintain agriculture in periurban areas; to which point periurban farming system is resilient to urban pressure.

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Annex 2

Potentiel de production alimentaire de l'agriculture périurbaine : contribution des exploitations périurbaines aux systèmes alimentaires locaux

Rosalia Filippini

Résumé étendu en langue française

Le système alimentaire mondial fait face à plusieurs défis dont celui de la croissance de la population urbaine. Ce phénomène est associé à la croissance des ressources alimentaires et à une dépendance de la population mondiale à la volatilité des prix agricoles. L'agriculture périurbaine est alors proposée par les politiques et le monde académique comme l'élément clé pour résoudre le problème de la sécurité alimentaire urbaine, ainsi que différent enjeux de développement territorial liés au phénomène d'étalement urbain. Le système alimentaire local apparait central dans la contribution de l'agriculture périurbaine à la sécurité alimentaire urbaine. Pourtant plusieurs travaux académiques ont souligné la nécessité d'étudier les motivations réelles, les stratégies et les conditions qui affectent la participation des agriculteurs dans les systèmes alimentaires locaux. (Tregear, 2011; Venn et al., 2006). Pour cette raison, il apparaît urgent de développer des recherches sur comment l'agriculture périurbaine s'articule avec les systèmes alimentaires locaux.

1. Introduction : Contexte, hypothèses et objectif de la recherche

1.1. Enjeux de développement territorial dans des zones traditionnellement agricoles

Le terme « urban sprawl » se réfère à une urbanisation rapide et déréglementée qui développe l'espace urbain hors du centre de la ville avec une très faible densité urbaine (Snyder and Bird, 1998). Dynamique mondiale, ce phénomène est surtout caractérisé par une croissance de l'espace urbain plus importante que la croissance de la population. L'étalement urbain est lié à la périurbanisation, un processus pour lequel le tissu rural se mélange au tissu urbain (EEA, 2006). En Italie ce phénomène est assez important pour que la littérature se réfère aux villes italiennes comme à des « shrinking cities » (Salvati et al., 2012) vu que le changement d'usage du sol pour l'urbanisation est beaucoup plus important que la valeur moyenne européenne (7.8% vs 4.6%) (EEA, 2006). Presque tout le territoire national est caractérisé par cette urbanisation « diffuse » (Fig. 1) (ISPRA, 2015).



Figure 39 Etalement urbain en Italie (couleur orange) (ISPRA, 2015)

Le phénomène de périurbanisation a de multiples conséquences, par exemple : la perte de terres agricoles, vu que très souvent l'urbanisation est encouragée sur des terres très fertiles pour l'agriculture ; la diminution de la biodiversité et l'augmentation de la pollution de l'air ; la perte des terres agricoles et naturelles augmentant le risque d'inondation et l'augmentation du coût public pour la gestion territoriale (EEA, 2006). En général, l'impact sur l'agriculture est si important que de nombreuses analyses ont parlé d'une urbanisation qui est essentiellement « contre l'agriculture » (Pascucci, 2007; Tolron, 2001). L'agriculture périurbaine est alors devenue un champ d'étude.

Dans la littérature, l'agriculture périurbaine est définie par deux approches qui reflètent deux visions différentes sur la relation entre agriculture et espace urbain. La première définition identifie un lien fonctionnel entre l'agriculture et l'espace urbain : l'agriculture est périurbaine quand elle est capable de fournir des services, par exemple des services environnementaux, sociaux, de nourriture (Nahmías and Le Caro, 2012). La deuxième approche identifie l'agriculture périurbaine selon un critère de distance et localisation : l'agriculture est périurbaine quand elle est pratiquée dans le voisinage de l'espace urbanisé (e.g. Pascucci, 2007). Ces deux approches sont intégrées dans la littérature, et surtout les deux fournissent des éléments de réflexion sur les avantages et inconvénients mutuels, contraintes et atouts qui existent entre agriculture et espace urbain. Par exemple, parmi les contraintes, il y a la compétition pour les ressources naturelles, les contraintes sociales et politiques, la marginalisation de l'activité agricole. Parmi les avantages de la périurbanisation, il y a l'amélioration du « métabolisme urbain », ou le fait que l'agriculture se trouve dans un espace potentiellement plus dynamique au niveau économique et social, qui contribue à sa durabilité et à sa capacité d'innovation. Il y a la possibilité d'utiliser la terre comme capital foncier, pour rénover l'activité agricole, ou l'opportunité de valoriser des caractères différents de l'agriculture. Ainsi, la proximité à la ville peut représenter une opportunité économique pour profiter de nouveaux marchés de vente

comme les circuits courts (Darly and Torre, 2013; Heimlich, 2001; Nahmías and Le Caro, 2012; Pascucci, 2007; Tolron, 2001).

Au delà de la définition, pour étudier l'agriculture périurbaine, la littérature a pu appliquer les approches agronomiques classiques (Marraccini et al, 2010) (Fig.2). La *cropping system approach* étudie la gestion des cultures sous l'influence de l'urbanisation (Mawois et al., 2011). La *farming system approach* intègre les études de la gestion des cultures à la gestion de l'exploitation par l'agriculteur et aux dynamiques autour de l'exploitation (e.g. Zasada, 2011) . La *land use system approach* se concentre sur les effets du changement d'usages du sol (e.g. Salvati et al., 2012). La *territorial approach* étudie comment les dynamiques urbaines sont capables de créer une diversité de systèmes agricoles, répondant aux différents enjeux de la zone urbaine (e.g. Soulard and Thareau, 2009).

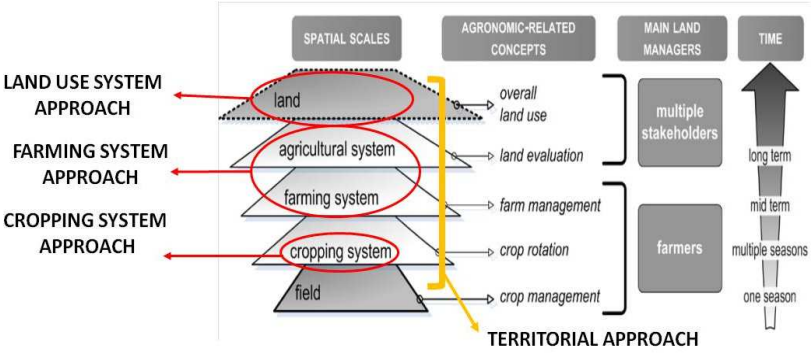


Figure 40 Approches agronomiques pour l'étude de l'agriculture périurbaine

Toutes ces approches s'interrogent sur la durabilité de l'agriculture périurbaine, en utilisant les mêmes attributs reconnus pour les systèmes durables (López-Ridaura et al., 2002; López-ridaura et al., 2005) : résilience, équité, productivité, stabilité, adaptabilité. C'est surtout sur ce dernier attribut que la recherche de cette thèse s'est orientée.

Dans le cas des systèmes de production périurbains, la littérature a considéré le développement des filières alimentaires locales comme un facteur d'adaptation des exploitations aux nouveaux enjeux posés par la périurbanisation (Lamine and Perrot, 2008) : la proximité géographique à la ville et la crise des systèmes productifs traditionnels basés sur une commercialisation conventionnelle sont des facteurs suffisants pour amener les exploitations à changer d'itinéraire productif, de pratiques et surtout de stratégie de commercialisation. Le système alimentaire local est considéré par la littérature comme une opportunité d'adaptation de l'agriculture qui se trouve dans un espace périurbain.

Le système alimentaire local est défini comme un système alimentaire où les différentes étapes de la chaine alimentaire sont réalisées dans le même espace géographique (Kneafsey et al., 2013). Pourtant, la définition de cet espace géographique, qui détermine le niveau « local » de la chaine alimentaire, est assez complexe dans la littérature.

En fait, on retrouve au moins quatre approches différentes qui visent à définir le système alimentaire local, en s'appuyant sur différents conceptualisations du « local » (Fig.3). La première approche est le SYAL (Système Agro-alimentaire Local) (Chiffoleau and Touzard, 2014; Fournier and Muchnik, 2010), qui donne au caractère local de l'espace une valeur symbolique liée à des pratiques agricoles spécifiques ou à un environnement particulier, dans lequel le produit agricole se reconnait et autour duquel une commercialisation est organisée et soutenue par une certification qui souligne et valorise ses valeurs. La deuxième approche ou l'approche « Foodshed » (Kloppenburg Jr et al., 1996; Peters et al., 2008; Le Gal et al., 2004) est liée à différentes conceptualisations du « bassin d'approvisionnement ». Les entreprises cherchent dans l'espace « local » la fourniture du produit dont elles ont besoin : c'est alors la demande d'une entreprise sur un bassin géographiquement proche. La troisième approche ou

approche « urban food system » (Touzard et al., 2013) se concentre sur les besoins de nourriture de la population, pour évaluer la capacité productive de l'agriculture périurbaine. Enfin, la quatrième approche liée au système alimentaire local fait référence aux « Alternative Food Networks » (Renting et al., 2003). Dans le cadre des systèmes productifs périurbains, les études se sont concentrées sur les circuits courts. Cette approche s'est plutôt focalisée sur la relation entre producteur et consommateur.

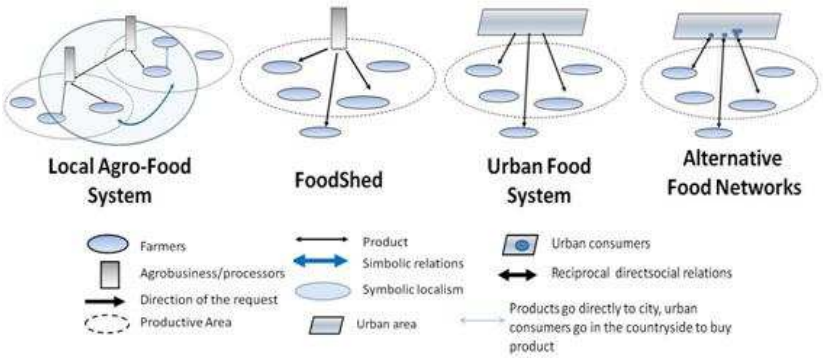


Figure 41 Différentes approches des systèmes alimentaires locaux

Toutes ces approches donnent des éléments pour réfléchir à la relation entre production agricole, localisation de cette production et marché de vente locale, ou plus simplement sur la relation entre offre alimentaire locale et demande alimentaire locale. Pourtant plusieurs éléments restent à clarifier sur comment concevoir la possible contribution de l'agriculture périurbaine à l'alimentation locale.

L'analyse de la bibliographie sur les systèmes alimentaires « locaux » nous invite à réfléchir sur le fait que « local » se réfère à différentes choses. Tout d'abord, à travers les approches sur les bassins d'approvisionnent, le local est conçu comme l'espace de production agricole, un périmètre spatial bien défini proche où l'entreprise et la ville ont la possibilité de repérer le

nécessaire parmi toutes les productions localement produites. Ensuite, à travers l'approche SYAL, le « local » obtient une valeur symbolique où l'espace est porteur de certaines valeurs de production agricole, sur lesquelles des valeurs sociales, historiques se basent, assignées par les acteurs et qui justifient l'utilisation d'une certification spécifique, ou la traçabilité de ce produit. Le fait qu'un produit vienne d'un certain « lieu » assure la « traçabilité » locale de ce produit et sa qualité. Paradoxalement, avec ce processus de certification, le local va lier des espaces différents, mais qui sont dans la même zone d'influence, normalement délimitée par des frontières administratives. Par contre, avec une approche purement spatiale, la production « locale » obtient de la valeur parce que c'est proche.

Sur ce raisonnement, on pose alors des nouveaux éléments de réflexion. L'agriculture périurbaine est en fait définie par une certaine proximité spatiale ou de relation avec l'espace urbain. La littérature reconnait plusieurs typologies de « proximité » (Eriksen, 2013) qui renvoient à différentes conceptions du « local ». La proximité géographique et la proximité organisationnelle peuvent être appliquées au cas de l'agriculture périurbaine pour expliquer la complexité de la production agricole périurbaine qui est proche géographiquement à la ville et qui s'organise par rapport à la ville (Torre and Rallet, 2005).

Par ailleurs, les approches « place based », à travers un processus de « relocalisation » de la commercialisation agricole (Ilbery and Maye, 2006) mettent en évidence qu'au niveau spatial, les exploitants adoptent des stratégies hybrides de commercialisation, soit alternatives, soit conventionnelles. Si on l'interprète avec le prisme de la proximité de l'agriculture périurbaine, cette hybridation commerciale est caractérisée soit par des conditions de proximité géographique, soit par des conditions de proximité organisationnelle. Mais en adoptant une approche « place based », on va s'interroger sur les conditions spécifiques que ces espaces imposent

aux exploitations agricoles. Ces conditions spécifiques donnent une valeur symbolique à la proximité spatiale, pas seulement pour le produit agricole, mais pour le fait de travailler un espace particulier. Elles lient les exploitations, même si celles-ci ont des productions différentes en terme de qualité et de chaine alimentaire.

Les exploitations se sentent parties-prenantes d'un réseau d'exploitations qui partagent les même conditions de production, auxquelles elles se sont diversement adaptées et les mêmes valeurs sur le produit ou sur la commercialisation. Ce réseau est à la fois géographique et organisationnel. Dans le cadre de l'agriculture périurbaine, c'est alors l'élément de « réseau » qui donne du sens au « local ». En ligne avec la littérature qui soutient la capacité des réseaux d'être la condition du développement territorial (Murdoch, 2000), pour le développement territorial de l'agriculture périurbaine avec les systèmes alimentaires locales, il est nécessaire de considérer tous ces éléments de discussion.

Si on combine la question de l'agriculture périurbaine et les approches agronomiques utilisées pour l'étudier avec la question du système alimentaire local, on peut considérer alors le système alimentaire local comme une organisation territoriale. Celle-ci intègre acteurs, activités, et espaces. L'agriculture périurbaine est une agriculture où les agriculteurs (acteurs) partagent un territoire hétérogène (espace) défini par les différentes questions de l'urbain, où la proximité entre les acteurs et les espaces est à la fois géographique et symbolique-organisationnelle, en considérant les conditions de production spécifiques, et sur lesquels différentes activités sont pratiquées (Fig.4).

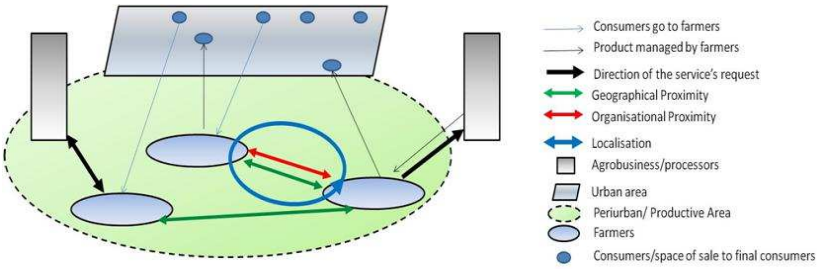


Figure 42 Relation entre système alimentaire local et agriculture périurbaine

1.2. Hypothèses

Pour développer cette analyse, trois hypothèses ont été posées (Fig. 5). La première hypothèse concerne la relation entre pratiques agricoles et développement territorial. Dans un système territorial en crise de planification territoriale comme le système périurbain, l'agriculture, peut redevenir un moteur de développement territorial, plus durable et plus en harmonie avec les nouvelles exigences qui viennent de la nouvelle relation avec la ville, produites par le processus de « périurbanisation ». Sur cette base, le maintien de l'agriculture dans le territoire périurbain est justifié. Là, le système alimentaire local peut être une opportunité économique qui permet aux exploitants de maintenir leur propre activité agricole sur le territoire périurbain.

La deuxième hypothèse concerne les études des systèmes alimentaires locaux. Pour comprendre et évaluer ses bénéfices territoriaux, ses bénéfices « locaux », le système alimentaire local doit être étudié à travers une perspective territoriale qui va au delà de la chaine alimentaire.

La troisième hypothèse est qu'il faut une approche territoriale pour comprendre la relation complexe qui existe entre système de production périurbain et système alimentaire local.

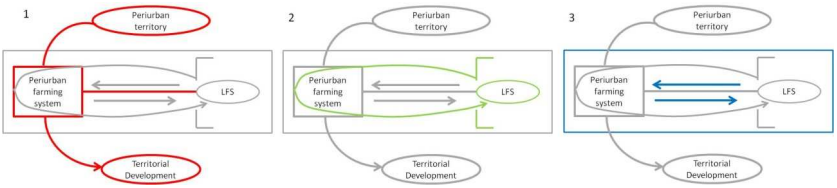


Figure 43 Hypothèses à la base de la thèse

1.3. Objectif général

L'objectif de la thèse est de développer une méthodologie pour l'évaluation du potentiel de production alimentaire pour le territoire local par l'agriculture périurbaine.

Pour les analyses de la thèse, on considère le système agricole périurbain comme le système proche et attiré par le système urbain principal. Sur cette base, dans les analyses, on considère les premières étapes de la chaine alimentaire locale, sans aller jusqu'à la consommation, ni toutes les problématiques logistiques liées à la distribution (Fig.6).

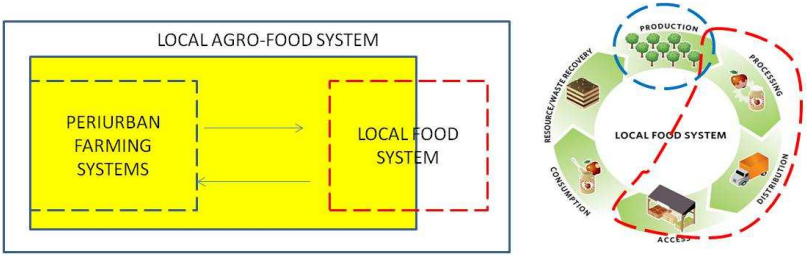


Figure 44 Objectif de la thèse

2. Méthodologie

2.1. Itinéraire méthodologique

L'analyse de la thèse est organisée autour de l'Itinéraire Méthodologique (Fig.7), où pour répondre à l'objectif de la thèse, trois questions méthodologiques ont été formulées et organisées comme les principales phases de la thèse. Les trois questions de recherche et les analyses mobilisées sont :

1. Quelle production alimentaire par l'agriculture périurbaine ?
   1.1. Diagnostic des systèmes de production périurbains
   1.2. Diagnostic de la capacité productive de l'agriculture
   1.3. Lien entre l'intensité de la production et la chaîne d'approvisionnement locale
2. Comment les agriculteurs maintiennent la production pour le territoire local ?
   2.1. Diagnostic des stratégies de commercialisation
   2.2. Diagnostic des réseaux alimentaires
3. Dans quelles conditions les agriculteurs peuvent maintenir la production locale ?
   3.1. Formalisation des contraintes et atouts

La première question considère toute la production agricole du territoire, tandis que la deuxième et la troisième question de recherche se focalisent sur la production alimentaire qui est déjà fournie au système alimentaire local. Parmi les analyses associées aux questions de recherche, une partie se focalise seulement sur le système productif (1.1, 1.2, 2.1), tandis que les autres se focalisent sur la relation entre le système productif et le territoire ou le système alimentaire local.

Itinéraire méthodologique

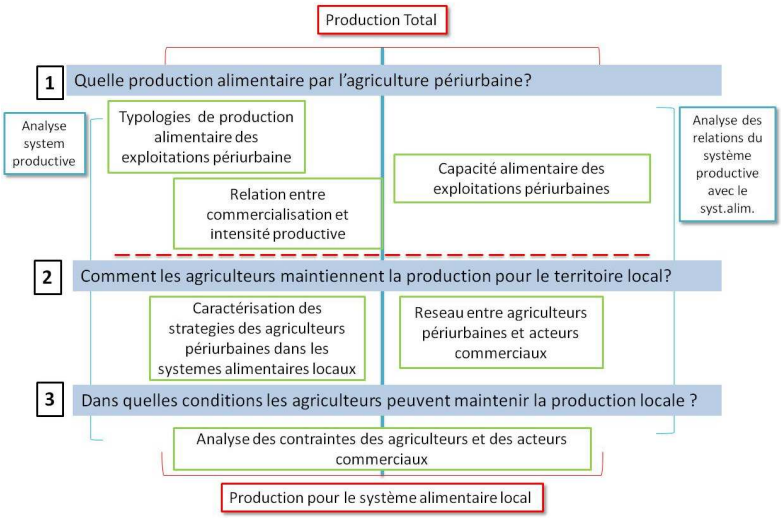


Figure 45 Itinéraire méthodologique et questions de recherche

2.2. Cas d'étude

Le cas d'étude est l'aire urbaine de Pise, en Italie. La zone est bien définie géographiquement en étant délimitée par la mer à l'ouest, la montagne du Monte Pisano, au nord-est et la frontière administrative du département de Livorno au sud. Cette région, deuxième aire métropolitaine de la Toscane, a une superficie de 500 km2 et une densité de population de 431 hab/km2. La zone comprend 6 municipalités (Pise, Vecchiano, San Giuliano Terme, Calci, Vicopisano, et Cascina) qui ont élaboré un projet d'intercommunalité « Unione dei Comuni dell'Area Pisana » pour le partage des principaux services publics comme l'éducation, la santé, mais aussi la planification et le management territorial. En plus, le département de Pise a élaboré dans les années passées un cadre de réflexion et d'analyse sur la planification alimentaire locale, le « Piano del Cibo della Provincia di Pisa », où l'une des

préoccupations était aussi la contribution de l'agriculture locale au système alimentaire local.

Le cas d'étude est représentatif des dynamiques d'urbanisation italiennes et européennes, en étant caractérisé par une diminution de la population résidente dans la zone urbaine principale la ville de Pise, et une croissance de la population dans les municipalités périphériques les plus proches.

Le cas d'étude est représentatif aussi des dynamiques agricoles dans les zones de plaine en Méditerranée, avec une intensification progressive des systèmes de production, au détriment de l'horticulture, tandis que l'oléiculture est restée quasiment stable. En plus l'agriculture n'est pas spécialisée, et plusieurs filières sont mises en place : ces élément permettent l'application des méthodologies sur plusieurs filière productives.

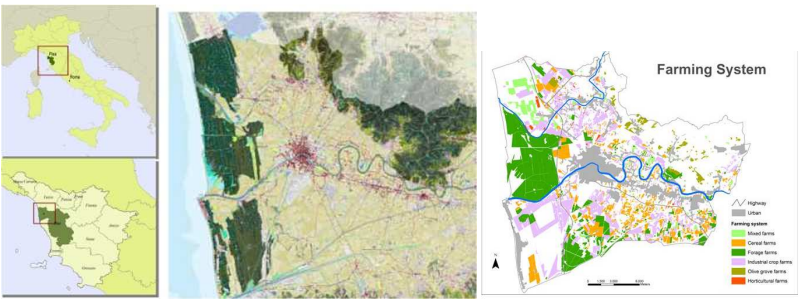


Figure 46 Cas d'étude : la région urbaine de Pise (Toscane, Italie) et le système productif de Pise

2.3. Principales méthodes

Les données utilisées pour les analyses sont de différentes origines. Elles sortent de base de donnés officielles statistiques (ISTAT, ARTEA, LPIS). Elles sont basées sur des enquêtes semi-structurées auprès de 58 agriculteurs sélectionnés sur la base de trois éléments. D'abord les exploitations étaient sélectionnées en considérant la production principale parmi 5 classes de productions : céréales, grandes cultures, cultures fourragères, horticulture et oléiculture. Ensuite les exploitations étaient choisies en considérant la taille

de la SAU. Enfin les exploitations étaient sélectionnées en considérant la distance à l'espace urbain principal, la ville de Pise. Ce processus de sélection a eu l'objectif de donner un cadre représentatif du secteur agricole du cas d'étude du dernier recensement national de l'agriculture de 2011. En plus pour développer les analyses, des enquêtes ont été menées auprès de 18 acteurs commerciaux : transformateurs, commerçants et acteurs intermédiaires. Ce type d'acteurs a été sélectionné en considérant les enquêtes des exploitations : ce sont les acteurs avec lesquels les exploitants ont de relations commerciales directes, tandis que dans le cas des acteurs intermédiaires, ce sont les acteurs avec lesquels les exploitants ont construit des projets de développement commercial.

Au final, des donnés spatiales, principalement de Corine Land Cover, mais aussi des données spatiale autoproduites ont été utilisées pour les analyses.

Pour chaque analyse, différentes méthodes qualitatives et quantitatives on été utilisées. Pour analyser les motivations de choix commercial des exploitants, les enquêtes ont été analysées qualitativement. Pour comprendre les facteurs les plus significatifs de ces choix et comprendre le lien entre commercialisation et intensité productive, des analyses Kruskal Wallis ont été menées. L'analyse multivariée a été utilisée pour créer des typologies d'exploitation. Au de-là de ces méthodes classiques d'analyse statistique, une méthode innovante a été construite pour calculer la capacité productive de l'agriculture périurbaine, sur la base de données statistiques et de données d'enquêtes.

3. Résultats

Le but de la première question de recherche est de caractériser la production agricole périurbaine. Cette caractérisation est proposée dans les chapitres 2, 3 et 4 de la thèse.

D'abord le chapitre 2 propose une **méthodologie pour comprendre la composition de la production alimentaire fournie par le système agricole périurbain à travers ses exploitations agricoles**. Cette méthodologie se base sur la création de typologies d'exploitations agricoles en considérant trois classes d'indicateurs : la qualité alimentaire, la quantité alimentaire, et l'intensité productive alimentaire de la production agricole de chaque exploitation. Cette analyse considère toute la production agricole de l'échantillon au-delà de la destination commerciale. À travers de la *Principal Component Analysis* et en suite la *Cluster Analysis*, 5 classes d'exploitations ont été produites. Les résultats de l'analyse révèlent une grande diversité du système productif périurbain en terme d'intensité productive, d'indicateurs de quantité et de qualité alimentaires.

Group	n	Quantité alimentaire (%SAU)			Intensité productive (%SAU)		Elevages (%)	Grandes culture (%)	Expl. Olivicol. (%)	Expl. Horticol. (%)	Expl. Cereal.(%)	% certif bio	% of outres certif. l
		UAA	PLocal	PCereal	Fodder	Manure							
G1	20	19	33	10	5%	15.7	5	10	48	24	19	40%	40%
G2	2	183	40	35	55.2	83.7	100	0	0	0	0	50%	0
G3	3	254	30	27	47.8	3.6	67	0	0	0	33	30%	30%
G4	15	264	4	41	12.8	3.7	13	47	0	0	40	10%	10%
G5	9	108	51	27	35.6	36.0	44	11	0	11	33	20%	30%

Figure 47 Résultats: caractéristiques de la production alimentaire des groupes d'exploitations

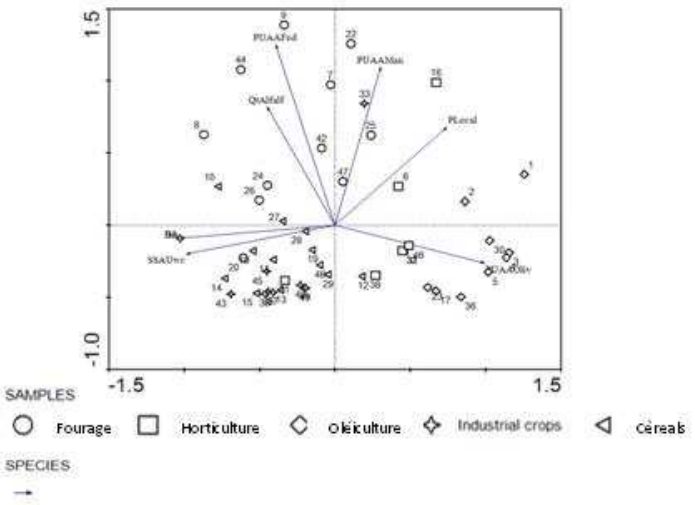


Figure 48 Résultats de la *Principal Component Analysis*

Les résultats suggèrent que la production commercialisée dans le système alimentaire local ne semble pas en corrélation avec la taille de l'exploitation, l'orientation productive principale de l'exploitation ou les certifications. En plus, les exploitations d'élevage ont différents types de production alimentaire en fonction de leur intensité. Les indicateurs d'intensité définissent les groupes, mais présentent des dynamiques différenciées entre les 5 classes d'exploitations. Ce résultat suggère la nécessité de mieux enquêter ces facteurs d'intensité productive.

Dans le chapitre 3, on va plus dans le détail de l'intensité productive et on se pose la question du **lien entre intensité productive et commercialisation des produits agricoles** (Fig.11). Dans cette analyse, l'intensité productive est considérée avec une définition plus extensive, qui considère outre l'intensité d'usage du sol, la structure de l'exploitation, les caractéristiques de l'agriculteur et la gestion de l'exploitation. Ces quatre classes d'indicateurs d'intensité productive sont appliquées à trois classes d'exploitations, définies

selon la commercialisation. La première groupe les agriculteurs qui participent exclusivement à des chaines alimentaires conventionnelles, le deuxième groupe est constitué par des agriculteurs qui participent exclusivement aux chaines alimentaires alternatives et locales, et le troisième groupe est composé par des exploitants qui participent soit aux chaines conventionnelles, soit aux chaines alternatives. Les résultats démontrent que les indicateurs d'intensité les plus significatifs pour différencier les trois classes d'exploitation sont liés surtout à l'intensité des pratiques agricoles et à l'intensité du sol. De plus, les dynamiques sont très complexes et plus différenciées.

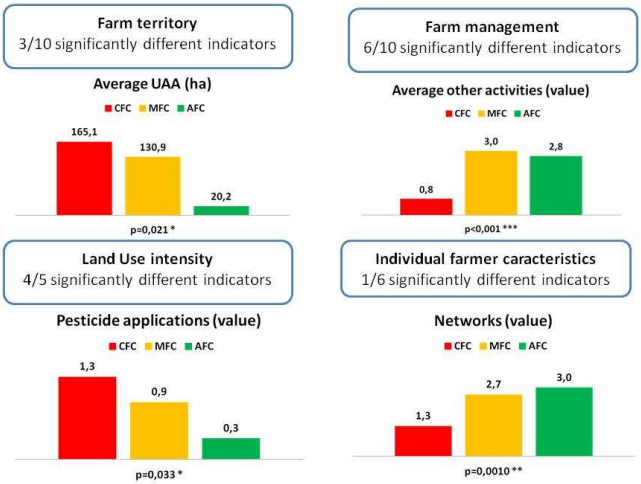


Figure 49 Résultats de l'analyse Kruskal Wallis sur le lien entre commercialisation et intensité productive

Le chapitre 4 propose une **méthodologie pour la mesure de la capacité productive alimentaire du système productive périurbain**. La méthodologie considère la construction de trois index de capacité productive : la capacité productive potentielle qui est basée sur les données statistiques ; la capacité productive effective, qui se base sur les données de production fournies par

les enquêtes de l'échantillon des exploitations ; la capacité productive actuelle qui se base sur la production agricole des exploitations agricoles qui est destinée au marché local (Fig. 12a). La méthodologie est appliquée à la production de viande bovine et ovine. Les résultats (Fig. 12b) montrent qu'il y a une différence importante entre valeur potentielle et les autres index. Elle suggère la nécessité de développer des analyses territoriales pour évaluer la capacité productive. En plus, il y a une différence entre capacité effective et actuelle et cette différence est plus importante pour la viande ovine que pour la viande bovine. Ce résultat suggère le fait qu'il existe des contraintes et atouts spécifiques relatifs aux possibilités de commercialisation locale. Ainsi par exemple des actions de valorisation de la production locale ont soutenu la participation au marché urbain des exploitants de viande bovine.

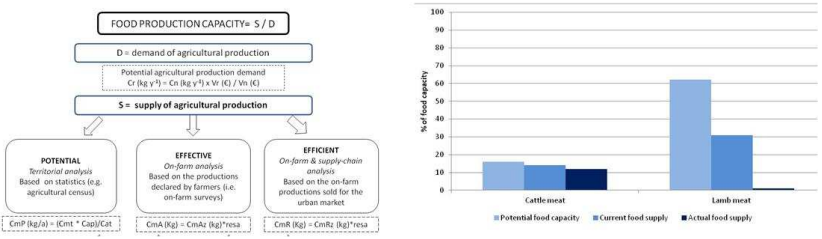


Figura 50 Méthodologie (a) et résultats (b) de l'analyse

La deuxième question de recherche est concentrée sur comprendre comment les agriculteurs maintiennent la production pour le territoire local et organisent les chaines alimentaire locales. Ici, seulement les exploitations qui ont un lien avec le marché local ont été considérées.

Dans le chapitre 5, le but de l'analyse est de **caractériser les stratégies commerciales des exploitations agricoles périurbaines qui vendent tout ou une partie de la production dans le système alimentaire local**. Les exploitations sont regroupées en trois classes en considérant le pourcentage de production dévolu au marché local : 100%, entre le 99% et 10%, et moins de 10%. Sur les trois groupes d'exploitations, les quatre classes d'indicateurs

appliquées se réfèrent à la structure de l'exploitation, aux caractéristiques de l'agriculteur, aux produits commercialisés et au réseau commercial. Le résultat le plus important est que la plupart des exploitations maintiennent une stratégie commerciale hybride entre filière locale et filière conventionnelle (Fig. 13). Parmi les indicateurs les plus significatifs, il y a la participation à des réseaux et les types de production.

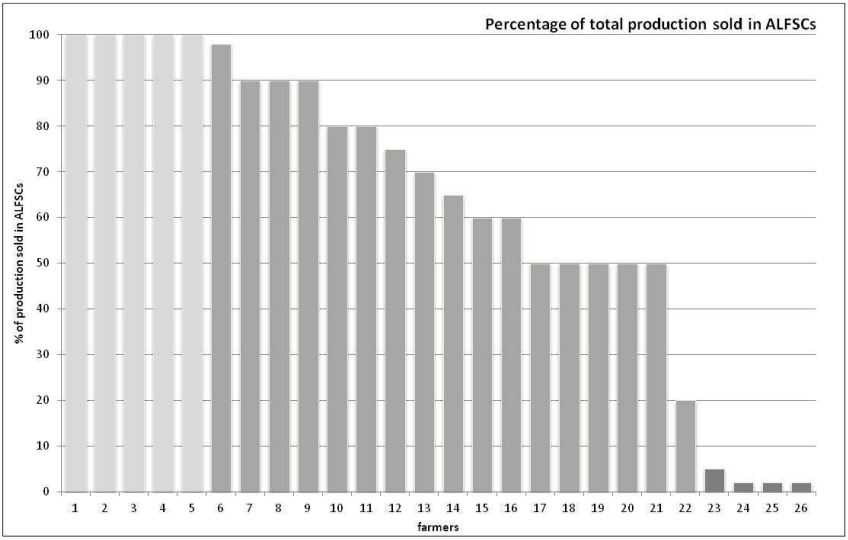


Figure 51 pourcentage de production vendu dans le système alimentaire local : rouge 100%, bleu entre 10% et 99%, vert moins de 10%

Le chapitre 6 analyse dans le détail **l'hybridation des stratégies des exploitants**. Cette hybridation est liée aux typologies de proximités reconnues par la littérature. La méthodologie est appliquée aux exploitants d'élevage. Tout d'abord, sept types de chaines alimentaires ont été repérés. Ils ont pour but de montrer comment les exploitants organisent les fonctions principales des chaines alimentaires locales : la production, la transformation, la distribution et la vente (Fig. 14).

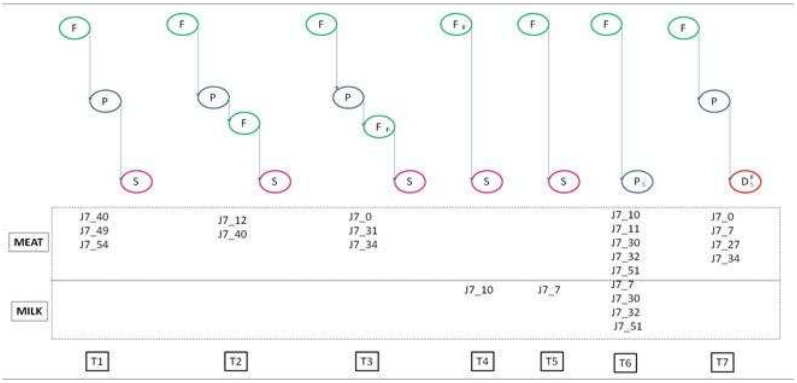


Figure 52 Types de réseau alimentaire local géré par les exploitants (J7_x) : *F* production, *P* transformation, *S* vente, *D* distribution de la production de viande ou lait

Ces typologies sont spatialisées à travers du système de géoréférence informatique, pour donner à voir la proximité géographique et la proximité organisationnelle.

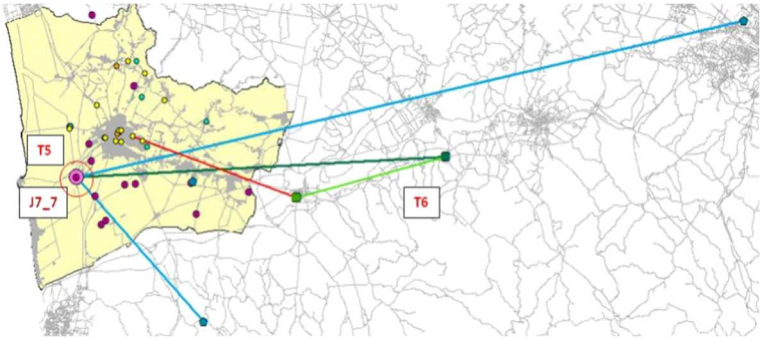


Figure 53 Spatialisation de types de réseaux commerciaux (T6 et T5) pour chaque exploitant (J7_7) et chaque production : la production de lait en vert ; la production de viande en bleu ; en rouge la distribution.

Au final les réseaux ont été analysés dans des tableaux croisant éléments qualitatifs et quantitatifs. Ces tableaux on été réalisés aussi sur les transformateurs et les acteurs commerciaux. Un premier résultat montre que ce ne sont pas seulement les exploitants qui doivent s'adresser à un marché

hybride pour vendre leurs produits, mais les transformateurs et les vendeurs aussi doivent se rapporter à un panorama très différencié et instable d'offre de produits agricoles, caractérisé par une haute fragmentation de l'offre agricole.

Ce résultat est confirmé par **l'analyse des contraintes**. Cette analyse répond à la troisième question de recherche de la thèse, pour évaluer quelles sont les conditions grâce auxquelles il est possible d'organiser des chaines alimentaires locales. Les résultats de cette analyse montrent que la capacité potentielle de production par les exploitants périurbains pour le système alimentaire local est particulièrement touchée par les règlements et l'organisation d'une chaine alimentaire locale (Fig. 16). Même dans les circuits locaux, les agriculteurs hybrident différents types de réseaux alimentaires locaux. L'analyse des contraintes des transformateurs et des commerçants montre qu'il y a des problèmes de disponibilité des produits et un manque de connaissance sur les exploitants périurbains disposés à vendre leurs produits localement.

En général, que ce soit les exploitants ou les transformateurs et les commerçants, les acteurs expriment la contrainte liée au manque de coordination des acteurs et des initiatives liées aux chaines alimentaires locales.

En conclusion les agriculteurs périurbains s'adaptent aux nouvelles possibilités de la proximité géographique avec les zones urbaines, mais un effort est nécessaire pour coordonner ces initiatives individuelles. Cette coordination doit intégrer la dimension territoriale qui affecte la production alimentaire périurbaine, afin de mieux répondre aux questions sur le développement territorial.

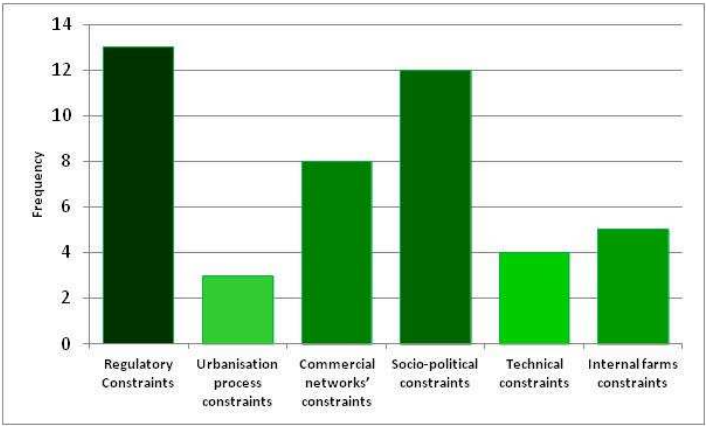


Figure 54 Fréquence des contraintes perçues par les exploitants

4. Conclusion

L'analyse des systèmes territoriaux d'exploitations agricoles périurbaines et des réseaux alimentaires locaux a montré l'hétérogénéité propre à ces expériences. La participation effective des systèmes agricoles périurbains aux systèmes alimentaires locaux ne devrait pas être tenue pour acquise.

Un des éléments clés qui sort des résultats des analyses, c'est la nécessité de coordination entre les acteurs et les initiatives locales. Le contexte montre un haut degré d'hétérogénéité : hétérogénéité des pratique agricoles et de l'intensité productive (chapitre 3), des stratégies commerciales (chapitre 5), des réseaux mis en place par les agriculteurs et les autres stakeholders pour développer la commercialisation locale des produits (chapitre 6). Cette hétérogénéité peut suggérer une capacité importante des agriculteurs de s'adapter à un territoire qui est devenu périurbain et qui pose des enjeux différents aux agriculteurs, et qui a permis la mise en contact des exploitants et des acteurs locaux. Cette hétérogénéité peut alors être considérée une condition de la durabilité du système périurbain.

Par contre les analyses montrent aussi qu'il y a une potentialité alimentaire par le système productif local, pas tout à fait bien exploité (chapitres 2 et 4), et que de nombreuses contraintes posent des limitations à la contribution effective des agriculteurs périurbains au système alimentaire local (chapitre 6). Ces contraintes viennent soit du système de production, soit du système commercial. L'action spécifique des acteurs intermédiaires semble soutenir le système alimentaire local, soit par le coté technique soit par le coté commercial (chapitres 4 et 6). Tout cela ouvre des réflexions sur les possibilités d'action pour des politiques alimentaires qui peuvent agir pour rendre cette adaptation, premier élément de durabilité du système, également résiliant, profitable, stable, pour pouvoir adopter tous les éléments de durabilité des systèmes.

Le développent territorial des zones périurbaines, à travers la participation des exploitations périurbaines dans le système alimentaire local, doit pouvoir comprendre des réseaux alimentaires qui disposent de tous les éléments de la durabilité. En plus, ces réseaux doivent pouvoir être configurés au niveau territorial, car ce niveau est capable de comprendre la complexité propre aux réseaux, surtout dans les systèmes productifs périurbains.

Le triptyque acteurs-activités-espaces (Lardon, 2012) est une approche méthodologique possible pour pouvoir étudier l'intégration entre système de production périurbaine et système alimentaire local.

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