



*The role of actors and institutions of
European farming systems: an analysis
of the dynamics over time.*

MASTER THESIS

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Title: The role of actors and institutions of European farming systems: an analysis of the dynamics over time.

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Executive summary

Farmers, actors and institutions of European agricultural sector are embedded in Social Ecological Systems that changed profoundly over time and are expected to change even more in the future. This study aims to analyse the dynamics of actors and institutions of European farming systems over the last decades and to identify the challenges that characterised the farming system evolution. This has been done by reviewing the variety of actors and institutions of the European agricultural sector and by analysing the historical evolution of an Italian farming system specialized in hazelnut cultivation. The case study used for this research has been studied by identifying those actors and institutions that are strictly connected with the farmers over different time trajectories, investigating their role in coping with major changes occurred on economic, environmental, institutional and social levels. The analysis shows that over time farmers and rural communities transformed while remaining in the farming system and economic actors assumed a relevant role, contributing to shape its evolution. Informal networks and trust among actors were found important for collaboration, but only between farmers and cooperatives. The results can be considered valuable for the farming system analysed but more research is needed to identify strategies that will allow cooperation between farmers, economic and social actors that over time lost connection with farmers.

Key words: Farming system, Institutions, Actors, European agriculture, Resilience

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LIST OF ABBREVIATIONS

AAS	Agricultural Advisory Services
CAP	Common Agricultural Policy
CEE	European Economic Community
COGECA	General Committee for Agricultural Cooperation in the European Union
COPA	Committee of Professional Agricultural Organisations
EC	European Commission
EU	European Union
HA	Hectares
LAG	Local Action Group
NGO	Non-governmental organization
SES	Social Ecological System
UAA	Utilised Agricultural Area

1 INTRODUCTION

1.1 BACKGROUND

Since the European Common Agricultural Policy (CAP) has been established in 1962, major changes that affected the European agriculture have occurred on a global, regional and local level (Daugbjerg, 2009). As any other sector, agriculture has experienced these changes and evolved accordingly over time. However, evolution of agricultural sectors has not followed a straightforward line, the solutions which answered some of the challenges over time caused the arisen of other issues. These problems are called wicked problems, which characteristic is a lack of univocal solutions for their complexity and multidimensions (Kuhmonen, 2018). For instance, rural development and farm optimization may lead to different outcomes (Van der Ploeg et al., 2000), leading areas with high technological optimization to work for different objectives. Indeed, with regards to long term objectives, farm optimization can stimulate persistency strategies, which prevents the system to adapt its economy to new changes and trends (Ashkenazy, et al., 2017), omitting the role of rural community in this process. Moreover, while the optimization of production systems led to assure food security to millions of people, it also provoked severe environmental impacts. Indeed, the sector is responsible for more than 10% of the total European greenhouse gas emissions (EEA, 2018).

Another environmental impact is represented by the loss of rural population over years, the separation between agricultural production and local food consumption is projected to increase even further in the future: in 2050 66% of the world population will live in urban areas (United Nations, 2014). These processes disconnect farmers and inhabitants of farming systems. For instance, when the food produced in the area is not meant to satisfy the consumption of the inhabitants or the consumption exceeds the production (Cumming et al., 2014). Regarding the environment, apart from the above mentioned pollution impact, climate changes pose a serious threat to agricultural systems. For instance, in an Italian region, climate changes, increase of temperatures and water scarcity could provoke in 100 years the loss 80% of the current wine area production while European northern countries could increase their wine production area (Hannah et al., 2013). Climate changes are not the only challenges posed to farming systems, for instance disconnections between farmers and other actors of the system is also identified as another issue by Cumming et al. (2014).

For instance, these disconnections between farmers and local consumers emerge when agricultural production is meant for industrial purposes, as in Viterbo (Italy) hazelnut farming system. In this farming system, case study of this research, global markets highly influence the dynamics of agricultural production and commercialization and hazelnuts are mainly sold to the confectionery industry for transformation (Rugini

and Cristofori, 2011). In this context of global challenges and dynamics, local actors and institutions are supposed to be relevant for the past and future evolution of the system (Streeck, 1991).

1.2 PROBLEM STATEMENT

Although research has shown that institutions can make a difference for the resilience of these systems (Berman et al., 2012), most of the researches have been focused on the role of institutions and actors of a system for economic regional development (De Blasio and Nunzio (2010). The current structure and mechanism of these systems, needed to plan future developments, can be fully comprehended by looking at what happened during the development path (Daudbjerg, 2009) and by considering multiple actors and institutions. Regarding the evolution of the Viterbo farming systems, studies are focused on the evolution of agricultural production (Rugini and Cristofori, 2011) without analysing the relationship between farmers actors and institutions. The role assumed by actors and institutions, if there was one in this phase, has not been explained yet. Therefore, a better understanding of the institutions dynamics over time is needed to develop an approach to facilitate the resilience and sustainable development of these systems.

1.3 RESEARCH OBJECTIVE

The objective of this research is to analyse the dynamics of farming systems institutions and actors over time.

The sub-objectives of this thesis are:

1. Review the diversity of actors and institutions related to European farming systems.
2. Identify the actors and institutions of the Viterbo hazelnut farming system over multiple time trajectories.
3. Identify how actors and institutions of Viterbo hazelnut farming system reacted to challenges over multiple time trajectories

1.4 THESIS OUTLINE

Beside the introduction chapter this thesis consists of five other chapters. The second chapter presents a literature review of institutions and actors of European farming system and the main concepts of this research. In Chapter 3 the conceptual model, the methodology and the data analysis are discussed. In Chapter 4 the results of the interview are presented together with the findings of the retrieved documentation. In Chapter 5 the discussion of the results and the limitations of the study are presented. Lastly, the conclusion of this study is presented in Chapter 6.

2 LITERATURE REVIEW

2.1 RESILIENCE OF FARMING SYSTEMS

Farming systems are complex systems in which farmers, food supply chain actors, households and institutions interact with each other. Therefore, these types of systems can be defined as social-ecological systems (SESs) (Ge. et al., 2016), a term that includes both the social and ecological elements, necessary to frame all the dynamics occurring in the systems. Interactions take place in a natural context, being agricultural production strictly linked to ecological systems. The evolution and development of these systems has been linked with resilience thinking in the last years. The concept of resilience has been firstly introduced by Holling (1973) as the capacity of these systems to recover and return to the original status. Following the logic of this definition one may think that all the systems can recover and return to their original status. However, due to the interactions between society and nature and the intrinsic dynamics of both elements, it is possible that SESs do not return to the status quo.

These critics have been expressed by different authors, for instance, Scheffer et al. (2009) pointed out that also the nature of the systems can change when there are so defined critical transitions which make the systems shifting from one stability status to a new one. These critics to the original definition of resilience led authors to review the concept and to include other concepts to explain the dynamics of these SES. Among all of them, it is important for the current study to define two other main concepts: adaptability and transformability. These concepts have been well defined in the context of resilience (Walker et al., 2004). The authors defined resilience as *“the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks”* (Walker et al., 2004). Adaptability has been defined as *“the capacity of actors in a system to influence resilience”* (Walker et al., 2004). Transformability is defined as *“the capacity to transform the stability landscape itself in order to become a different kind of system, to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable”* (Walker et al., 2004). Moreover, another concept, robustness, deserves to be mentioned because over the years it has been assumed to be important in the resilience thinking context, being defined as the *“ability to maintain desired levels of outputs despite the occurrence of perturbations”* (Urruty et al., 2016). An overview of the concepts is given in Table 1.

Table 1 Definition of the main concepts of resilience thinking.

Reference	Concept	Definition
Walker et al. (2004)	Resilience	<i>“The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks”</i>
Walker et al. (2004)	Adaptability	<i>“The capacity of actors in a system to influence resilience”</i>
Walker et al. (2004)	Transformability	<i>“The capacity to transform the stability landscape itself in order to become a different kind of system, to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable”</i>
Urruty et al., (2016)	Robustness	<i>“Ability to maintain desired levels of outputs despite the occurrence of perturbations”</i>

2.2 INSTITUTIONS IN AGRICULTURE

Institutions are identified as organisms that help to provide private and public goods (Streeck, 1991) and are believed to be relevant for the long-term perspective of society *“the humanly devised constraints that structure political, economic and social interactions”* (North, 1991). Although many definitions exist, institutions are generally sub-divided in formal and informal. Formal institutions are defined as *“universal and transferable rules and generally include constitutions, laws, charters, bylaws and regulations”* (North, 1991). In the agricultural system, formal rules have a determinant role, for instance, they define property rights on land and natural resources. Moreover, they provide the regulative framework for the production, trade and distribution of the goods. Instead, informal institutions are defined as *“norms, traditions and social conventions, interpersonal contacts, relationships, and informal networks”* (Rodríguez-Pose, 2006). Other authors have identified informal arrangements as social capital: *“features of social organization, such as networks, norms and trust that facilitate co-ordination and cooperation for mutual benefit”* (Putnam, 1993). Therefore, also the informal constraints matter in the agricultural sector, for instance networks and trust have been identified as a prerequisite for economic development.

Although the relationships between formal and informal constraints is not fully clear yet, they coexist in the same systems and one tends to dominate the other. For instance, Durlaf and Fafchamps (2005) found that informal institutions become more important when the formal ones are missing or not adequately present in the system. On this topic it has been shown that also when formal rules are present, informal constraints, *“meant as social capital”*, are relevant for the application and implementation of them. Therefore, a system

is believed to function better when both types of institutions are present and integrated. An overview of the concepts is given in Table 2.

Table 2 Definitions of institutions

Reference	Concept	Definition
North (1991)	Formal institutions	<i>“Universal and transferable rules and generally include constitutions, laws, charters, bylaws and regulations”</i>
Rodriguez-Pose (2006)	Informal institutions	<i>“Norms, traditions and social conventions, interpersonal contacts, relationships, and informal networks”</i>
Putnam (1993)	Social capital	<i>“Features of social organization, such as networks, norms and trust that facilitate co-ordination and cooperation for mutual benefit”</i>

2.3 FORMAL AND INFORMAL INSTITUTIONS

Formal Institutions

Mainstream economics has steered the system towards centrality, promoting centralized legislations and regulatory frameworks. As a result of this process, in the last decades, mainstream economics had to deal with local systems by applying uniform regulations, neglecting the importance of local elements, applying what is defined as an isomorphic approach (Chien, 2008). On a European level, politics have focused on unification processes in the past decades. In the European agricultural context, formal rules are spread over regional, national and EU level, providing the common strategy and regulations. Centralized in the Common Agricultural Policy (CAP), which was first established in 1962 and then modified over the last decades (European Commission, 2018c). The CAP is the centralized policy valid for all the member countries of the EU and its implemented on national and regional level to reach specific objectives. In these local contexts, informal rules belong to the local social characteristics of the local systems and may differ for each country and inter-country areas. Therefore, current farming systems rely on centralized formal institutions, where informal local institutions are important to ensure connections between the bottom and the top of the system. However, it has been argued by many authors, that the idea of self-balanced social ecological systems, where centralization is the key factor for development, needs to be reviewed because local institutions may play a determinant role, Local institutions arrangements have been identified as compulsory for regional sustainable development (Streeck, 1991) and necessary elements for adaptation and changing

capabilities of territories, as learning capacity, were attributed to local institutions (Morgan, 1997). Adaptation mechanisms, as the definition specifies, are linked with the concept of flexibility, redundancy and learning capacity of institutions. Flexibility is defined as the capacity of the system to react quickly to changes and change internal dynamics, promoting economic growth (Davis, 2010). It is believed that a large variety of institutions is beneficial to the system because it helps to increase its coping capacity and adapt (Sandström, & Carlsson, 2008). Redundancy and overlapping of institutions can help to absorb disturbances and prevent the system from failing. Additionally, these institutions may provide more effective solutions to collective action problems than the centralized institutions because they foster local knowledge, inclusion of participants, better adapted rules, they support shared decisions (Pahl-Wostl, 2009), and lower enforcement costs (Ostrom, 1990). On the other hand, variety and overlapping of institutions can lead to higher transaction costs (Low et al., 2013). For instance, if one considers a farming system where farmers, farmers associations and local institutions coexist, transaction costs can arise when more actors aim for the same results. Learning is another key factor of adaptive systems, through this mechanism feedback among the actors and the functions of the systems are more likely to exist and it is necessary to always maintain a system where the basis is questioned (Pahl-Wostl, 2009; Gupta et al., 2010). The attribute adaptive has been defined as “recover[ing] or adjust[ing] to change through learning and flexibility, so as to maintain or improve to a desirable state” (Engle & Lemos, 2010). Adaptive systems are defined by Folke et al. (2005) as systems which “are able to reconfigure themselves when subject to change without significant declines in crucial functions of the socio-ecological system.”

Informal Institutions

The mainstream view associates the importance of informal institutions to the presence of the formal ones. Regarding agricultural trade, it has been discovered that formal institutions are not sufficient because if trust is missing in the local system and a high level of corruption is present, trade will be affected (Álvarez, et al., 2018). This is an important element for understanding how interconnected and complex these systems are. When a lack of formal institutions occurs, the informal ones assume a predominant role in the system. Thus, the quality and the characteristics of institutional arrangements influence the adaptive capabilities of farming systems. On this topic, De Blasio and Nunzio (2010) referred to Putnam (1993) definition of social capital meant as “trust, norms and networks that can improve the efficiency of society” to carry their analysis about institutions in Italy. Their result confirmed that, given the same formal institutions, informal constraints matter, because it is possible to see differences in local development between areas with the same formal rules.

Social capital is a popular topic in contemporary rural studies and several other disciplines (such as regional development, economics, political science, sociology). Social capital has received increasing attention from 1980 onwards, because, as other types of capital (financial and natural), it is believed that its presence has a productive function in the economy and can lead to results that would not be reached without it (Coleman, 1990). Moreover, studying this topic can be very interesting in interdisciplinary studies because its effect is not limited only to the economic but also to the social and public performances (Paraskevopoulos, 2010). Although most of the authors have identified networks and trust as building elements of this concept, there is not a general agreement on which of these two is more important. Some authors believe that networks are the essence of social capital (Coleman, 1990) because through the networks collective actions can be stimulated, leading actors to collaborate for common objectives, which foster local development. However, some argue that the presence of a network is not a proxy for social capital itself because, while is a necessary condition for it, networks do not always represent social capital (Finsveen & Oorschot, 2008). Other authors (Putnam, 1993; Fukuyama, 1995), while recognizing the importance of networks for social capital, consider trust as the basis of this concept, arguing that without trust between individuals and institutions, social capital loses its strategic importance. These authors believe that networks without trust are not able to develop collective actions and consequently local development. These two dimensions of social capital are generally mentioned as structure dimension and cognitive dimension, where the first one refers to the presence of networks, for instance groups, associations or cooperatives and the second one refers to trust of individuals of these networks toward other individuals, institutions and local actors. Groups of citizens that decide to not participate in rural development programs can anyway promote and be representative of other forms of civic engagement or considered as social capital because the reasons why they do not participate might be due to cultural or ideological factors (Shortall, 2008). Institutions are also important in relations to the type of farms of a farming system, while larger farms are may able to access the market in more favourable conditions by themselves, small farms need institutions to be included in the same markets (La Porta et al., 1999). A summary of the findings of informal institutions can be found in Table 3.

Table 3 Overview of informal institutions role in European farming systems

Reference	Countries	Institutions	Role of institutions
De Basio e Nunzio (2010)	Italy	Social capital	Social capital is essential for regional development
Álvarez et al. (2018)	Spain	Informal institutions	For regional trade formal institutions are not sufficient, trust is a crucial element to enable trade
Durlaf and Fachamps (2015)		Informal Institutions	Informal institutions are needed to sustain formal institutions in regional development
Shortall (2008)	Northern Ireland	Social capital	Groups that are not considered in rural development programs can anyway show civic engagements
Finsveen and Oorshot (2008)	Greece	Social capital	Networks do not always represent a proxy for social capital

2.4 ACTORS OF EUROPEAN FARMING SYSTEMS

Food processors and distributors

Beside farmers, European agriculture is characterized by a variety of actors that goes from agricultural supply to food distribution. The main actors of the supply chain are food processors and distributors because European agricultural system have changed over time and from community suppliers, agricultural outputs are now embedded in complex markets dynamics where large distributors as supermarkets have gained power (Hollingsworth, 2004). Already in 1996, the power of distributors was attributed to the overproduction and conflict interests of farmer of north and south Europe (Wilson, 1996). Moreover, food processors tend to seek integration strategies with the actors of the supply chain upstream and not farmers (Hencion and McIntyre, 2005). The power of processors and middle man agents becomes of particular importance because it influence farmers and their activities in different ways: for instance, the price is contracted over the quality of the products and in this context supermarkets and distributors have the power to refuse all the products that do not satisfy the quality criteria of the consumers, affecting the ability of farmers to cultivate in the way they retain more appropriate. For instance, in order to obtain better quality farmers, use pesticides and there becomes the conflicts with local population or food industry that does not want to lose consumer trust (Bonny, 2006; Cavicchi et al., 2015). However, international industries were also found beneficial to farmers, providing them support to adapt marketing strategies (Graziano et al., 2018).

Cooperatives and Producer Organizations

Before the introduction of the CAP in 1962, farmers were already organized in associations designed to represent their interests with national, and later, with European authorities. For instance, the Committee of Professional Agricultural Organizations (COPA) was established in 1958 to represent the general and specific interests of farmers in the European Union (COPA-COGECA, 2018). Cooperatives have assumed an important role in European Agriculture and they are still key actors of the farming systems, both on the local level and as junction between farmers and the rest of the supply chain as they allow small farmers to compete in markets with bigger agricultural production entities and increase the power toward the food industry (Valentinov, 2007). Moreover, association of cooperatives help farmers to interact with institutions, for instance, COPA has the following objectives: examining materials for the development of the Common Agricultural Policy and maintaining and developing relations with the Community authorities and with other organizations that are established at European level (COPA-COGECA, 2018). Cooperatives have been important also for adaptation and social learning additionally to traditional functions as marketing of products and agglomeration of offer (Lebel, 2010). Moreover, cooperatives can help when markets do not function properly by contrasting power of corporations (Kyriakopoulos, Meulenber, and Nilsson, 2004). However, contrast between farmers associated and the cooperatives can arise when the interests are not aligned (Emery, 2014).

Together with the establishment of CMO (Common Market Organization) in 1972 also Producer Organizations appeared in Europe. Due to the tight link with CMO they changed accordingly when it was reformed in 1996, 2003, 2007 (European Commission, 2018a). While in the past they were only responsible for withdrawals with reform of 1996 they also assumed marketing role, especially for international trade (Camanzi et al., 2011). Producer organizations have the following functions which they perform on behalf of their members: concentrating supply, improving the marketing of products, optimizing production costs and carrying out research (European Commission, 2018a). Collaboration between organizations makes it possible for producers to accomplish economics of scales and synergies to process and market their member's products (European Commission, 2018b). Producer organizations can affect the farm performance in different ways. Firstly, they can improve the farm's productivity and profitability by strengthening the bargaining position in the supply chain, by responding to consumer preferences or by reducing the transaction costs of input and output market access (Cook and Plunkett, 2006). Lastly, producer organizations can reduce market risks with a greater capacity to diversify products and integrate activities (Camanzi et al., 2011).

Agricultural Advisory Services

Conventionally, the main function attributed to Agricultural Advisory Services (AAS) is to provide farmers with knowledge to improve agricultural productivity. However, these organizations are supposed to provide additional services as well, for instance connecting small farmers to high-value and export markets, and diffuse environmentally sustainable production methods (World bank, 2009). Within the European context, AAS are generally divided in four main categories: public, private, farmer-based, NGO (Hoffman et al., 2010, Knierim et al, 2017). With respect to the organizational type, it has been found that the dominant are public and farmer-based providers, each respectively in one third of European countries (Knierim et al, 2017). Public types of extension services can lead to inertia if not stimulated by alliances of farmers and politicians (Hoffman et al., 2000). From the beginning of 1900, the number of advisors available for farmers increased both in France and in the Netherlands, with a ratio similar to the decrease of farmers (Labarthe, 2009). Moreover, pluralism of AAS was found beneficial to increase service options for clients and staff organizations (Knierim et al, 2017) and to allow the system to evolve in respond to changing elements (Hoffman et al., 2000).

Other actors

Additionally, other actors were found connected to the European agricultural sector, such as NGOs and in between organizations. The role of NGOs in the European agricultural sector mainly concerns the protection of the environment. Runhaar and Polman (2018) found that a partnership between NGO and farmers in the Netherlands was beneficial to inform citizens, policy-makers and companies of the food sector and relatively beneficial to increase knowledge and contribution of farmers to birds' conservation. Another study has shown that these types of partnership were found interesting from an ecological perspective but with a low impact on farming systems dynamics (Runhaar et al., 2017). Local actors sustained by the LEADER programme of CAP are important in the local context because they promote progress and facilitate financial access to farmers and rural communities (Cristovao et al., 2005). Moreover, need to interact with public administrations that are not ready to cope with problems with a system approach (Cristovao et al., 2005). Table 4 provides an overview of the main actors of European farming systems discussed in the above section.

Table 4 - Actors of European Farming Systems

Reference	NGOs	Cooperatives	Producer organizations	AAS	Food industry	Food Distributors
Runhaar and Polman (2018)	x					
Runhaar et al. (2017)	x					
Hencion and McIntyre (2005)					x	
Hollingsworth, (2004)					x	x
Valentino (2007)		x				
Cook and Plunket (2006)			x			
Hoffman et al. (2000)				x		
Knierim et al. (2017)				x		
Graziano et al. (2018)					x	
Lebel (2010)		x				
Emery (2014)		x				

2.5 EVOLUTION AND CHALLENGES OF EUROPEAN FARMING SYSTEMS

2.5.1 The introduction of Common Agricultural Policy

After the second world war, Europe started a unification process of its policies, of which the first formal act is the institution in 1958 of the European Economic Community (EEC) among six countries: Belgium, France, Germany, Luxembourg, the Netherlands and Italy (Glockner and Rittberger, 2012). During the treaty of Rome, when the EEC was established, these countries also stated the objectives that should have been achieved with the CAP: a) stable provision of food, b) affordable food prices for consumers, c) increase income of rural communities d) stabilization of markets and e) increase productivity by the modernization of the agricultural

sector (Tangermann and Cramon-Taubadel 2013; Khumonen, 2018). As can be evinced from these objectives, the function of European agriculture was quite different from the current one, agricultural production needed to sustain rural communities and before the modernization, labour was the major input of agricultural systems (Schouten et al., 2012). Therefore, work force was an important actor of the agricultural systems. For instance, in Italy, in 1961 employed of agricultural systems represented 30% of the total national employees and the farmers associations counted already five million of members in 1950 (Mottura, 1993). The first CAP can be seen as the first redistributive policy of the EU (Bache et al., 2001). In this phase the European agricultural sectors were subject to a profound transformation. From a system that was needed to assure food security to the European population before the introduction of the CAP, it grew so fast that in 1985 European authorities needed to intervene to compensate over production through the instauration of quotas. For instance, in the Netherlands, milk production has tripled since the beginning of 1900 while the population has only doubled. As already mentioned, another important novelty in this phase was the introduction of Common Market Organization (CMO) in 1972 in Europe, that is also linked with the establishment of the Producer Organizations (PO) that assume important roles on behalf of their members (European Commission, 2018a). Those are mandatory for certain productions: fruits and vegetables, olive oil and table olives, silkworm, hops, milk and derivatives (European Commission, 2018a). Already in this phase Companies which are not strictly related to farming activities but a represent in the farming system can also have an impact on farming system dynamics, agricultural practices may affect their business and push them to interact with farmers. For instance, already in the 70's a water company in France, which was employing many people in the farming system, developed in collaboration with researchers, a new framework for agricultural practices that would have reduced the nitrogen content of water bodies in the ground (Gafsi and Brossier, 2002). Table 5 provides an overview of the challenges between 1962 and 1992.

Table 5 - Challenges of European Farming Systems between 1962 and 1992

Reference	Less favored areas	Structural market imbalance	Inequalities between members	Agriculture environmental impact	Increase productivity
Khumonen (2018)	x	x	x	x	
Daugbjerg, (2009)		x			
Gafsi and Brossier (2002).				x	
Tangermann and Cramon-Taubadel (2013)					x

2.5.2 From price support to income support

Policy instruments have changed accordingly to challenges occurred over time and the focus of CAP measures has incorporated from the single farm the health of humans and animals, natural environment conservation as well as the social and economic development of rural areas (Greer, 2005). This new view of farming can be defined as multifunctional agriculture (Greer, 2005), that included themes strictly or scarcely connect with the food production as part of agriculture. Rural development measures have been implemented after the Mc sherry reform of 1992 was the first structural reform to the CAP and substituted price support measure with direct payment to farmers (European Commission, 2018c). As mentioned before, in this period was also initiated the leader programme by the EU, designed to promote rural development, including municipalities, other institutional bodies and local representation of industry and agricultural sector, however bureaucracy of formal local institutions have been found as limitation factor for this initiative (Crisotvao et al., 2005). Europe Fisher's reform acceptance of farmers associations reflected the different interests of the EU countries. COPA directors strongly criticised the reform among all the countries while France, Italy, Ireland and Germany opposed to the reform, this was considered favourable for the Netherlands, Greece, Finland (Daugbjerg, 2009). As environmental impact of agriculture even increased as issue for European agriculture (Khumonen, 2018) in 2003 the CAP was again reformed, cutting definitively the subsidies for production and introducing income support to those farmers who operate respecting the environment and maintain high standards animal and food safety (European Commission, 2018c). After inclusion of new countries in 2004, keeping a balance between the interests of the "new" and "old countries" became more complicated, and policies became two folds and different: while the new received a more favourable the old ones experienced a less favourable context (Greer, 2005). Structural characteristics of the new countries implies also different actors involved in the farming systems. For instance, rural unemployment can vary across different countries and in areas where small holder farmers are prevalent is questioned that increase rural employment can be solved by farmers activities (Chaplin, 2004). In the meat sector, food industry and distributors, due to consumers concerns on effect that OGM and chemical inputs may have on their health are pushing farmers to change agricultural inputs in order to preserve their reputation (Schwägele, 2005). Moreover, consumer trust in food is also dependent on the country of origin of consumers, increasing differences between countries within the European boundaries (Cavicchi et al., 2005). Lastly, globalization has also facilitated the diffusion of insects that were not present in the natural environment before, creating new challenges for farmers that have been forced to cope with new species, dangerous for their crops (Wyss et al., 2005). The challenges of European Farming Systems after 1992 is shown in Table 6.

Table 6 – Challenges of European Farming Systems after 1992

Reference	Agriculture Environmental impact	Country differences	Pressure on farmers	Consumer trust	New insect impact	Rural unemployment	Burocracy
Khumonen (2018)	x	x					
Daugbjerg, (2009)		x					
Schwägele (2005)	x		x	x			
(Cavicchi et al. (2005)		x		x			
Greer (2005)		x					
Wiss et al. (2005)					x		
Chaplin (2004)						x	
Cristovao et al. (2005)							x

3 MATERIAL AND METHODS

3.1 CONCEPTUAL FRAMEWORK

The conceptual framework, as shown in Figure 1, is developed to analyse the evolution of a farming system by identifying the actors and institutions present in the system over a period of time and to identifying how the components of this system answered to challenges over time.

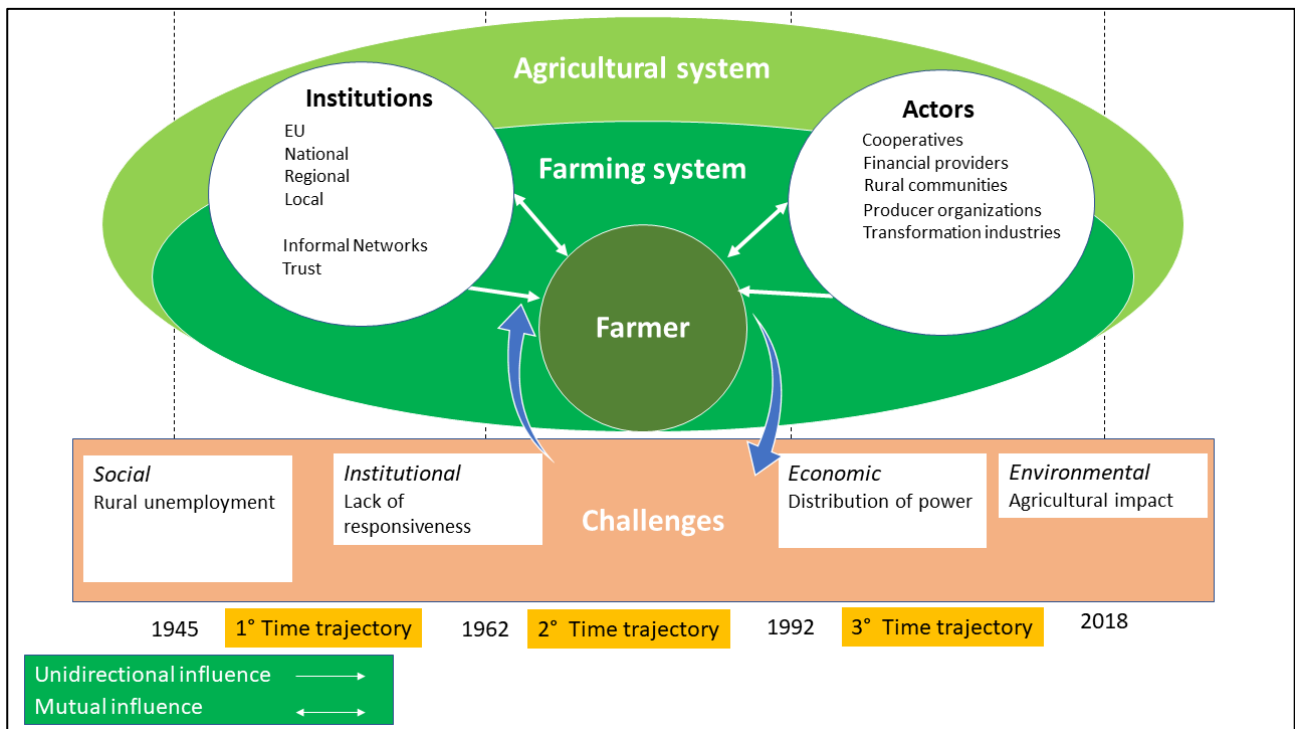


Figure 1 Conceptual model

Definition of time trajectories

In order to link this research and the unit of analysis to the European agricultural context, the time trajectories are identified by considering major changes occurred at the European level, specifically changes in policy strategy. Therefore, the model is built on three time trajectories, each one reflecting a different phase of European agricultural sector. The first time trajectory is identified as the period which goes from 1945 to 1961, years of the first CAP (EU, 2018c). The second time trajectory is identified as the period which goes from 1962 to 1991, years of the first main reform of the CAP (EU, 2018c). Lastly, the third time trajectory is identified as the period which goes from 1992 to 2018, years in which the research has been conducted.

Actors and institutions dynamics

To analyse the different dimensions of the farming system, the system is divided in *macro*, *meso* and *micro* (Ge et al., 2016). Following this approach, the farm in the current study is identified as *micro* level, the farming

system as *meso* level and the remaining part of the agricultural system as the *macro* level. Those institutions and actors “who influence the farmers and are influenced by the farmers themselves” (Meuwissen et al., 2018) are considered to be part of the farming system. This framework provides the possibility of both dynamics of institutions and actors over time within and outside the farming system.

In this study, beside farmers, actors are identified as local actors of the farming system, such as rural communities, producer organizations, financial providers and food industries that are related to the investigated agricultural system. Furthermore, as formal institutions are defined as “*laws, constitutions and regulations*” (North, 1991), they are considered as the European, National or Local government agencies or regulatory bodies in this study. Finally, regarding informal institutions, they can be considered as “*norms, social conventions, networks*” (Rodriguez-Pose, 2006) or “*trust and informal network*” under the sub definition of social capital (Putnam, 1993). In this study, informal institutions are considered as social capital, identified as informal networks and trust among the participants of the system that facilitate cooperation and coordination.

Challenges over time

Finally, to understand how institutions and actors of the farming system reacted to challenges over time, the challenges are first divided between shocks and long term disturbances and separated in four categories: a) economic, b) environmental, c) institutional d) social (Meuwissen et al., 2018). Secondly, within each time trajectory it is analysed how actors and institutions of the farming system reacted to the identified challenges and if the same patterns can be observed in multiple time trajectories. The challenges that will be taken into account are rural unemployment as social challenge; lack of responsiveness of institutions; asymmetric distribution of power in the supply chain as economic challenges; extreme weather conditions and environmental impact of agricultural activities.

3.2 RESEARCH METHODOLOGY: CASE STUDY

Due to exploratory nature of this research, a qualitative case study has been identified as the most appropriate research method to understand and investigate the dynamics of the theoretical construct described in the literature review (Vaus, 2011). As the objective of this study is to capture the dynamics of actors and institutions occurred over time, a retrospective approach has been chosen, as already done by Ruiu et al. (2017) to investigate the role of adaptive institutions in an Italian region. The selected case study for this research is intensive hazelnut farming system in the Viterbo area (Italy). The case study has been chosen among a total of fifteen case studies from the project SURE-Farm. SURE-Farm is a European project coordinated by Wageningen University in collaboration with eleven universities and four research institutes

(SURE-Farm, 2018). There are two main reasons why this case study has been chosen to answer the second and third sub-objectives of this thesis:

- 1) Since this is a qualitative study in which the analysis is conducted in an Italian case study, the researcher has been able to collect and analyze the qualitative data independently.
- 2) As hazelnut trees are a perennial crop that can last for plenty of years (Kaya-Altop et al., 2016), it is expected that studying a farming system with a perennial crop will provide more insights about the changes occurred over time.

With 12% of total world production (FAO, 2018), Italy is the second hazelnut producer in the world after Turkey, which is accountable for 65% of global hazelnut production (FAO, 2018). In Italy, this crop is cultivated in four main regions: Campania, Piemonte and Sicily and Lazio. However, hazelnut cultivation is recently expanding to other Italian regions also due to specific programs developed by confectionery industries such as Ferrero, to increase the national production (Ferrero, 2018). The case study area is located in the Lazio region (Figure 2) and accounts for 90% of the total regional hazelnut production and is concentrated in the Province of Viterbo (Istat, 2016). On a national level this province is the most important for hazelnut cultivation (Cristofori, 2017) representing 30% of the production.

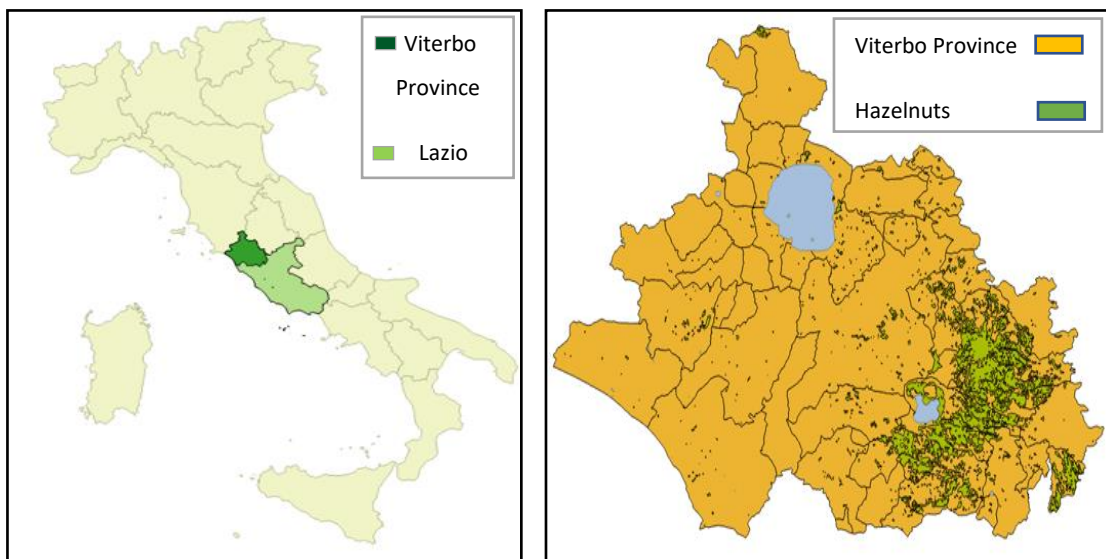


Figure 2 Case study area. In the left side figure is shown the Province of Viterbo (Dark green) and in the right side Figure is shown the area of the case study, coloured in green, inside Viterbo Province.

3.3 DATA SOURCES

3.3.1 Secondary Sources

Three secondary sources on the hazelnut farming system structural and economic characteristics over time have been retrieved through Università della Tuscia (Tuscia University) bibliographical archives and Viterbo Chamber of Commerce website. Secondary sources have been analysed to compare the qualitative results

of the interviews with quantitative data and provide insights on the study validity in term of its capacity to capture the effective evolution of the farming system over time. Specifically, they have been used to provide an overview of the evolution of the system in terms of relative importance of hazelnut cultivation in the case study area and to provide insights on the effect of EU policies, through producer organizations on farm economics of the case study area.

3.3.2 Farmers interviews

Three hazelnut farmers have been interviewed during the field research in the case study area. The farmers that were interviewed have been selected with the support of the network of Tuscia University and the interviews have been conducted in collaboration with researchers of the SURE-Farm project. Figure 3 shows the location of farmers who all have the farms in the municipalities object of the case study area.

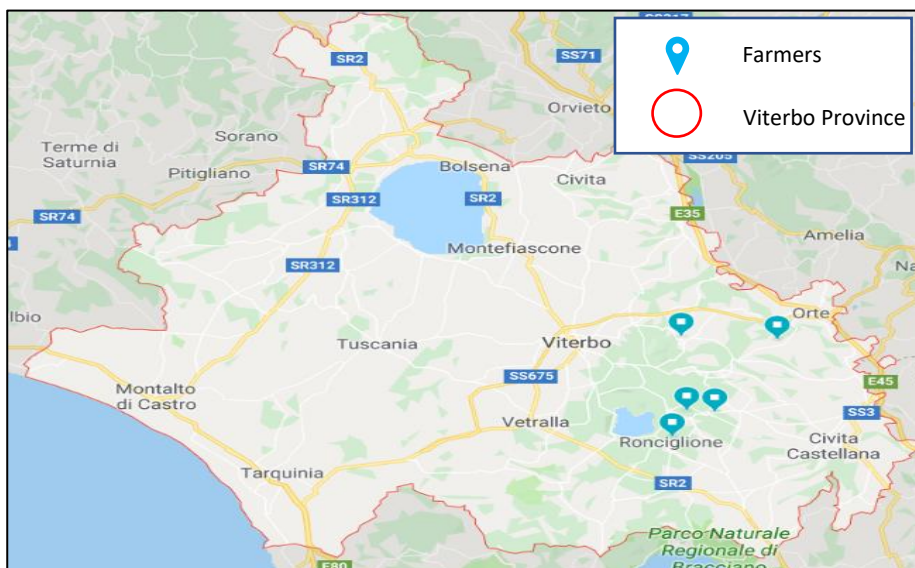


Figure 3 – Locations of farmers' land.

The interviews with the farmers have been conducted using a specific interviewing method, defined as narratives interviews (Hatch and Wisniewski, 1995). This methodology has been chosen to reconstruct the historical perspective of the specific context studied and it is built on a specific protocol which involves six steps: (Jovchelovitch and Bauer, 2000): a) Start audio recording, introduce the study and purposes of the interview; b) Main narration of the informant: interactions between the informant and the researchers were very limited; c) Questioning phase: researchers can ask clarifications, specific questions and data of the informant; d) Concluding talk: the audio recording was interrupted and the researchers proceeded with a short conversation with the informant; e) Comment: after each interview the researchers had a brief discussion on the topic covered by the informant; f) Memory protocol: for each interview a memory protocol of the interview has been elaborated. In Table 7 can be found an overview interviews conducted with farmers and the detailed interview protocols can be found in the Appendix (Table 17,18,19,20,21).

Table 7 Overview interviews with farmers

Informant	Age	Duration	Date	Location	Interview
Farmer 1	65	1 hour 13 minutes	07/05/2018	Viterbo University (Viterbo)	Self-conducted
Farmer 2	51	1 hour 9 minutes	15/05/2018	Viterbo University (Viterbo)	Self-conducted
Farmer 3	88	1 hour 8 minutes	16/05/2018	Farmer's house (Viterbo)	Self-conducted
Farmer 4	69	-	21/06/2018	Viterbo University	Obtained from La Tuscia University
Farmer 5	70	-	23/10/2018	Farmer's house	Obtained from La Tuscia University

3.3.3 Experts semi-structured interviews

After preliminary discussion with farmers and Professors of Università della Tuscia a list of possible experts to contact during the field research has been compiled and four of them have been interviewed. These four experts have been interviewed because of their knowledge on the case study characteristics and problematics. The experts are:

Expert 1: President of the *Local Action Group (LAG) Etrusco Cimino* (Local Action Group sustained by the leader project in the case study area). The LAG is a mixed public-private organization operating as intermediary between Lazio region and farmers to develop investments of agricultural or processing purposes.

Expert 2: President of *Università Agraria di Vasanello*. The expert is the administrator of this institution which owns around 1500 ha of land in the municipality of Vasanello (in the case study area). The land is owned by the institution but can be rented to residents of the municipality by paying a rent to the institutions and parcels of the land can even be bought by renters.

Expert 3: Employee of *Viterbo Province Water Office*. This office is responsible for allowing access to water sources to farmers, conduct studies on the hydrogeological status of the Province area and implement measures to optimize water consumption for agriculture.

Expert 4: Agronomist of one of the *Producer Associations* located in the case study area. The Producer association is operating both as intermediary between hazelnut farmers and confectionery industries and to implement CAP measures for hazelnut farmers.

This semi-structured interview methodology has been chosen because it provides the possibility to use a pre-defined set of topics or questions during the interview but also to tailor the interviews on the specific characteristics of the interviewees (De Vaus, 2001). Furthermore, this methodology allows the researcher to ask additional questions related to the elements mentioned by the informant. Table 8 shows the list of experts that were interviewed, for two interviews it was not possible to record the conversation, therefore answers to the questions and additional notes have been written down during the interviews. In the Appendix can be found the structure of questions used for these interviews (Table 16).

Table 8 Overview interviews institutions

Experts	Years of activity	Duration of the interview	Date	Location	Audio Recording
Expert 1	>10	1 hour	08/05/2018	Viterbo	No
Expert 2	>20	1 hour	14/05/2018	Vasanello (ITA)	Yes
Expert 3	>20	30 min	16/05/2018	Viterbo (ITA)	Yes
Expert 4	>30	1 hour	16/05/2018	Viterbo (ITA)	No

3.4 DATA ANALYSIS

3.4.1 Secondary sources

The secondary sources have been used to identify hazelnuts farmers evolution through the time trajectories and the role of producer organizations in the last time trajectory as shown in Table 9. Specifically, they have been used to understand hazelnut farmers profitability compared to other farmers in Viterbo farming system, evolution of specialization in terms agricultural land cultivated with hazelnuts and how producer organizations contributed to this evolution in the third time trajectory.

Table 9- Secondary sources used for each time trajectory

Source	Dono G., (2000).	Angeli L., and Senni S. (1995)	Gasbarra et al. (2002)
1945-1962		Farmers	
1962-1992		Farmers	
1992-2018	Farmers		Farmers

3.4.2 Interviews

The interviews were systematically analysed through a thematic analysis, a method used in qualitative study (Nowell et al., 2017). For this study, an inductive methodology is used and a coding scheme that served the purpose of the study was developed. The interviews have been coded and analysed using Nvivo software and the overall analysis process included a four step approach:

- 1) *Compiling*: the recorded interviews have been transcribed while the answers and the notes of the other interviews have been organized in structured texts.
- 2) *Coding*: The coding scheme has been elaborated by the researcher while performing the analysis with an inductive method. Each transcription or organized text has been read several times and a first list of codes has been done. This first list has been further elaborated into quantifiable codes.
- 3) *Defining themes*: The group of codes have been organized in themes that have been further reviewed to assess their consistency and usefulness to reach the research objectives. Only themes that represented a consistent pattern that emerged from the interviews have been considered. The codes have been grouped in four themes and are shown in Table 10:
 - i) *Farmers*: in this theme all the codes relatives to characteristics of farmers, such as their expansion strategy or production methods have been grouped.
 - ii) *Farming system*: in this theme all the codes relatives to the farming system, its characteristics and evolutions as well as the codes relatives to the informal institutions present in the system have been used to organize.
 - iii) *Actors*: in this theme the actors mentioned during the interviews, their characteristics and the functions that they have in the system have been included.
 - iv) *Institutions*: in this theme all the formal and informal institutions mentioned in the interviews were comprehended.
 - v) *Challenges*: In this theme all the codes describing challenges for farmers or other actors and institutions of the farming system were considered.

Table 10 – Coding scheme

Themes	Codes	Codes description
Farming system	Agricultural evolution	Mentions of changes occurred to agricultural activities in the farming system
	Technological evolution	Descriptions of how technology changed hazelnut cultivation over time.
	Market evolution	Descriptions of how the hazelnut market evolved over time
Farmers	Farm expansion strategy	Mentions of expansion strategies applied by farmers
	Innovation	Mentions of innovations adopted by farmers
	Information channels	Information channels used by farmers to acquire knowledge on agricultural practices.
Actors	Middle men	Mentions of hazelnut buyers and processors acting as middle men between farmers and food industry
	Industry	Mentions of confectionery industry characteristics and presence in the farming system
	Technology providers	Mentions of technology providers that affected farmers activities
	Cooperatives	Mentions of cooperative functions in the farming system
	Producer organizations	Descriptions of characteristics and functions of the producer organizations
	Local Action Group	Characteristics of the Local Action Group
	Other actors	Mentions of other actors' presence in the farming system
	Rural community	Mentions of interactions between rural community and actors of the farming system
Institutions	Centralized institutions	Mentions of interactions between the national and European institutions and the farming system actors and institutions
	Local institutions	Mentions of interactions between local institutions and the farming system actors and institutions
	Land civic use	Descriptions of how the civic use of land evolved over time and the interactions with farming system actors
Challenges	Market power	Description of power in the hazelnut food sector
	Price instability	Mentions of repercussion of price Instability for farmers
	Hazelnut cultivation expansion	Mentions of risks perceived due to expansion of hazelnut cultivation areas outside the farming system
	Environmental impact	Descriptions of environmental impact caused by intensive hazelnut production

Temperature shock	Mentions of extreme high or low temperature that threatened hazelnut cultivation
Climate changes	Mentions of how climate changes affected the farming systems
Pest risk	Mentions of pests and disease that represent a challenge for agricultural production in the farming system
Institutional impasse	Mentions of how institutional bureaucracy and slowness affect the farming system

Table 11 shows the interviews used to identify actors, institutions and challenges over the different time trajectories. The validity of the results in terms of number of references will be discussed in the discussion and conclusion chapters.

Table 11 - Interviews used to identify actors, institutions and challenges of each time trajectory

	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Expert 1	Expert 2	Expert 3	Expert 4
1945-1960									
Actors	x	x	x	x	x		x		
Institutions		x	x				x		
Challenges			x						
1960-1992									
Actors	x	x	x	x	x		x		
Institutions	x	x	x	x	x		x		
Challenges	x		x		x				
1992-2018									
Actors	x	x	x	x	x	x	x	x	x
Institutions	x	x	x	x	x	x	x	x	x
Challenges	x	x	x	x	x	x	x	x	x

x = interview used for analysing actors, institution and challenges in the specific time trajectory

4 RESULTS

4.1 FARMING SYSTEM EVOLUTION: SECONDARY SOURCES

Over the last decades the relative weight of hazelnut cultivation in the Viterbo farming system increased substantially. In 2001, beside arable crops as wheat, hazelnuts orchards covered 30% of agricultural land of the province and over the years it has increased substantially, from 1960 to 2002 it has tripled (Angeli and Senni, 1995; Gasbarra et al., 2002). Regarding farm profitability, already in 1990 hazelnut cultivation represented the most profitable agricultural activity in Viterbo Province, being the 22,83% total provincial agricultural revenue (Angeli and Senni, 1995) and in the municipalities of the case study area in 1990 52,1 % of the farmers were cultivating perennial crops (of which hazelnuts represented the largest portion), while in the Viterbo Province only 14,3 % (Angeli and Senni, 1995). Results of Producer organizations and Technology innovations that resulted in farm modernizations contributed to increase the hazelnut over the years, from 0,9 ton/ha in around 1960 to 1,1 ton/ha in 1988 (Angeli and Senni, 1995). Although this increase cannot be explained completely by the presence of technology providers within the farming system, this is one of the factors that contributed to this evolution.

Mc Scharry's CAP reform has been beneficial for the hazelnut farming system due to the strengthen of the role of producer organizations through operational plans that contributed to increase the quality and facilitate investments for hazelnut cultivation (Dono, 2000). Regarding the financial implication of European regulations of farmers profitability, both the measure "double harvest"¹ and the measure 2078/92 gave farmers the possibility to join agri-environmental schemes. The measure "double harvest" that helped to increase the yield of the hazelnut yield and the quality of the product had also beneficial effect on farmer's income, which increased 4 % in the year 1997 through this measure (Dono, 2000)². The effect on farmer profitability is even greater for those farmers who also benefit from the measure 2078/92³ with an increased profit of 6% in 1997 (Dono, 2000)⁵. In 2001, while the production value of hazelnuts cultivation in Viterbo Province was 31%, in other Italian hazelnut farming systems this number was lower, 11% in Cuneo Province and 21% in Avellino province (Gasbarra et al., 2002).

¹ The measure "double harvest" is applied by producer organizations to collect part of the hazelnuts shortly after the harvest has started in order to ensure better quality of the products.

² This number represents the profit increase of a company with 21 ha of hazelnut cultivation.

³ Regulation of the CAP introduced for the conservation and restoring of natural habitat in 1992.

4.2 FARMING SYSTEM EVOLUTION: INTERVIEWS RESULTS

4.2.1 Time trajectory 1: 1945-1961

Actors

In this time trajectory all interviewed hazelnut farmers had families involved in the agricultural sector, while hazelnut cultivation was still undeveloped and started to increase around 1955-1960 (Farmer 1, Farmer 3, Farmer 4, Farmer 5) the families were involved in other agricultural activities such as viticulture, arable farming and animal farming. It was mentioned by Farmer 3 that hazelnuts were planted to replace old and unproductive vines in this phase and before 1960 they were not considered as a profitable activity. Figure 4 shows that in this time trajectory farmers were either independent or dependent on a land owner, for whom they were cultivating land in return of an accommodation. Farmer 3 can be considered as a land owner at that time, and Farmer 2, whose father was a sharecropper, dependent on the local land owner.

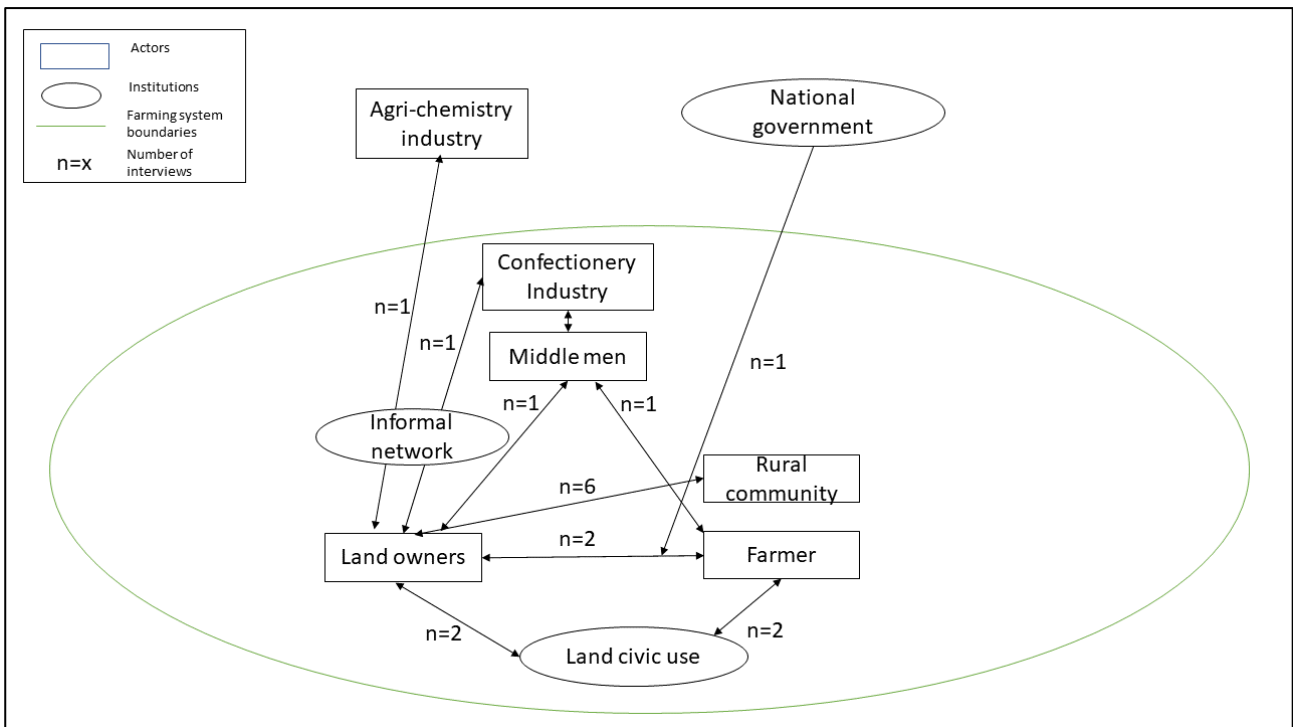


Figure 4 - Overview of actors and institutions of the farming system (1945-1961).

Farmer 3 mentioned the presence of a confectionery industry strictly connected to the case study area, because this was the only area where this industry could purchase hazelnuts, due to regulatory limitations of another important Italian region for hazelnut production. The informant explained that he tried to sell his hazelnuts to a company in 1958 without success because the company was already buying enough hazelnuts from other producers of the area. Two of the interviewed farmers mentioned that local inhabitants were used to manually harvest the hazelnuts directly from the trees: *“my mother was helping to harvest the men*

in extremely productive years”⁴ “there were group of inhabitants who were going to harvest from the end of August”⁵. Therefore, rural communities in this time trajectory were influencing farmers work and they were influenced as well, as showed in Figure 4.

Institutions

As already mentioned, property rights defined by the National government were still drawing a difference between land owners and farmers. This type of relationship was mentioned in three interviews, while two of them are sons of sharecropper, one of them was one of the land owner of the case study area. In this time trajectory, they initiated the process of land redistribution from land owners to farmers: *“My father received four ha from the land owner as compensation to leave his land”⁶*. This phenomenon provoked fragmentation of the agricultural land, that was divided in small parcels, in fact while the portion of land was quite small, the family property of the only land owner interviewed was around 1000 Ha. Land owners, the Land civic use in this phase, received the agricultural land from the local land owners of the municipality of Vasanello⁷, for a total of 1500 ha that was redistributed among the families of the municipality who became entitled to cultivate the land. Informal networks were the only informal institution mentioned by Farmer 3. He explained that he tried to sell his hazelnuts because of its personal network, he knew someone of the family of the confectionery industry. Moreover, as shown in Figure 4, he also used the personal network to experiment new fertilizers for hazelnuts trees through a family friend who was working in the agri-chemistry industry. One of the farmers interviewed mentioned that through family knowledge he had the possibility to contact this confectionery company. As well as facilitating business relationship, informal networks sustained also innovation of hazelnut cultivation, providing, in one case, the contacts to collaborate with university professors and research institutes and experimenting fertilizers and new hazelnut orchards set up. However, in this time trajectory, the impact of the informal network was found limited to the land owners levels that could use their position in the society to foster innovation and open new market possibilities.

Challenges

As shown in Table 12, in this time trajectory only two challenges related to farming activities were found with the interviews. Extreme temperature drops during spring, that destroyed the production of Farmer 3 in 1958, the only environmental challenge mentioned. Moreover, as already mentioned, he was not able to sell to the confectionery industry because there was already enough hazelnut supply from other municipalities from the case study area, the confectionery industry in this time trajectory had already enough power to control the market.

⁴ Direct quotation from the interview with Farmer 5.

⁵ Direct quotation from the interview with Farmer 3.

⁶ Direct quotation from the interview with Farmer 2.

⁷ Vasanello is one of the Municipality of the case study area.

Table 12 – Actors, institutions and challenges of the farming system (1945-1961)

	References	Influence farmers	Influenced by Farmers	Included in FS	Actors/Institutions involved in coping mechanisms
<i>Actors</i>					
Farmers	6				
Land owners	4	Yes	Yes	Yes	
Rural community	6	Yes	Yes	Yes	
Confectionery Industry	1	Yes	Yes	Yes	
Middle men	1	Yes	Yes	Yes	
Agri-chemistry industry	1	Yes	No	No	
<i>Institutions</i>					
Land civic use	2	Yes	Yes	Yes	
Informal Network	1	Yes	Yes	Yes	
National government	1	Yes	No	No	
<i>Challenges</i>					
Extreme weather events	1	Yes	No		Farmers
Market access for farmers	1	Yes	No		Farmers Middle men Industry

4.2.2 Time trajectory 2: 1962-1991

Actors

In this time trajectory hazelnut cultivation started to become more relevant within the farming system and the actors and of the system increased compared to the past as can be seen in Figure 5. The farmers sustained that in this time trajectory hazelnut cultivation grew rapidly and became the main source of revenue, apart from Farmer 4, whose father in this phase was still practicing only viticulture. The confectionery industry in this phase maintained its presence in the farming system. In 1964, the confectionery company, mentioned in the previous time trajectory, started to source for larger quantities of hazelnuts through local middle men to speed up the production and Farmer 3 was able to start the first hazelnut cooperative of the farming system. Moreover, the industry was also facilitating the production, giving access to financial resources to immediately repay the farmers and offering the use of a processing plant without paying the rent. Farmer 3

mentioned also that the cooperative, when offered by the industry, did not proceed with the purchase of the processing plant because of the presence of the rural inhabitants “*the building was too close to the village and was disturbing the inhabitants*”⁸, therefore rural communities have been considered part of the farming system also in this time trajectory. In this time trajectory a new actor entered in the system, technology providers, which are defined as producer and retailers of agricultural machineries for agricultural practices and processing. Four farmers (Farmer 1, Farmer 2, Farmer 3, Farmer 5) discussed in detail the mechanization and the relationship with technology providers, because they found it very important in the evolution of the farming system. The first agricultural machines were produced by a technology provider of another Italian region that were adapted from a machine used to harvest olives (Farmer 3, Farmer 5).

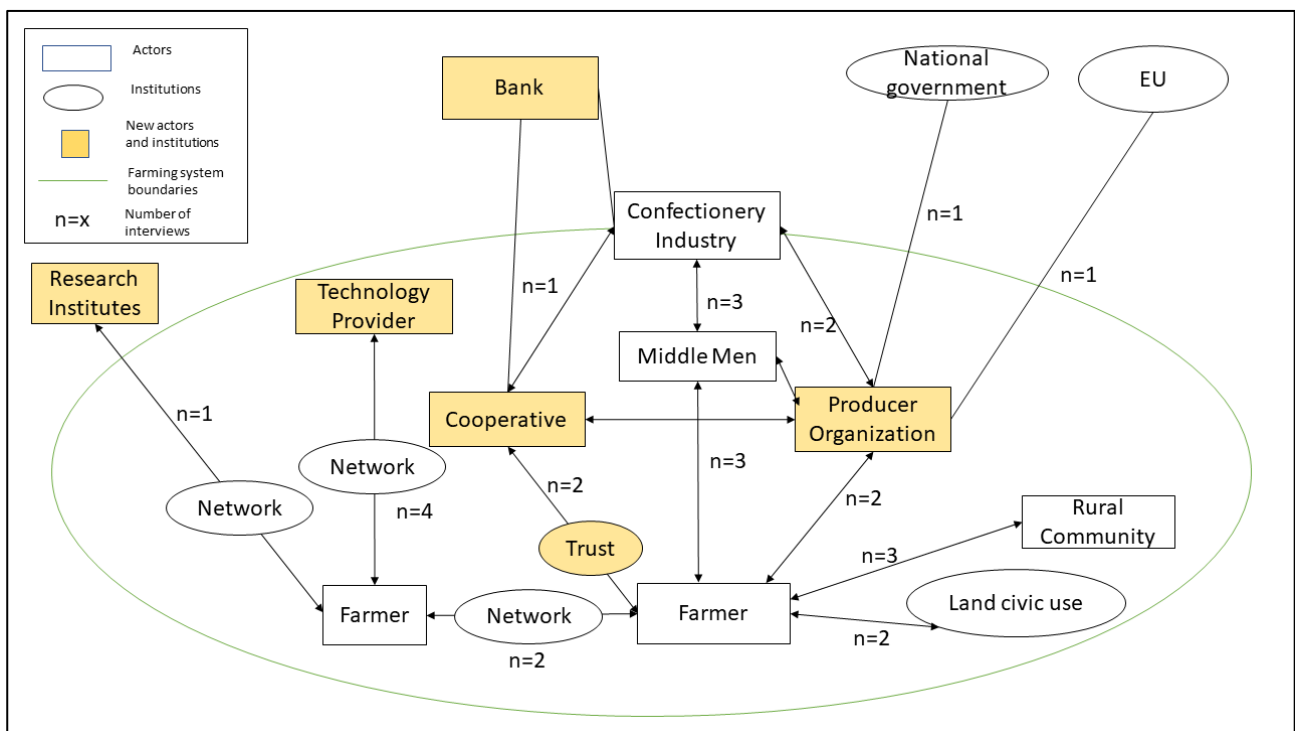


Figure 5 – Overview of actors and institutions of the farming system (1962-1992).

However, around 1972 another company based in the farming system area started its activities and sustained the modernization of the whole area. In two cases, the interviewed farmers mentioned this technology provider as “*the one who changed everything and led hazelnut cultivation to another level*”. According to the four farmers, agricultural machineries increased substantially the efficiency of hazelnuts harvest. Moreover, they described that they were used to buy new models of the machineries to constantly improve. On the other hand, the mechanization led to use less human labour, as the needed assistance for the machineries was continuously reducing. Therefore, it is assumed that technological providers based in the area were also influenced by farmers of this farming system, as they were the main buyers of their products.

⁸ Direct quotation from the interview with Farmer 3.

Moreover, regarding the commercialization phase, price instability and power of the industry led to the formation of cooperatives, association of cooperatives and producer organizations. These actors functioned both as aggregator of hazelnut supply and intermediary between farmers and institutions. Both Farmer 3 and Farmer 5 mentioned that they formed a cooperative in order to fight the market power of middle men and industry. Moreover, the same farmers mentioned that towards the end of this time trajectory they tried and in one case they succeed to establish a Producer Organization for hazelnuts. This new actor, as shown in Figure 5, was functioning as a collector of hazelnuts produced by cooperatives and farmers. Moreover, through cooperation with national and EU institutions, producer organizations have also been responsible of quality improvement of the hazelnut production.

Institutions

Informal institutions in this phase are identified as informal networks and trust that facilitate the evolution of the sector. Informal networks in this phase facilitated the innovation, through direct contacts between farmers and technology providers: *“At that time I was insisting with the technology provider for improving the machineries”*⁹. Three out of five farmers (Farmer 1, Farmer 3, Farmer 5) referred to one of the technology providers that arise in this time trajectory using the surname of the owners of the company instead of the company’s name. Moreover, Farmer 3 stated that he solved the problem of having persistent rain precipitations during harvest time through an adaptation of a silos used for wheat storage, adapted by a local blacksmith to store and dry hazelnuts, that were previously dried on the ground. Furthermore, with informal network he established relationship with University Professors that helped him to improve hazelnut cultivation. The geographical proximity of farmers and technology providers helped to create an informal network. As well as informal networks, in this time trajectory also trust within the informal institutions has been identified. In this case, trust emerged between farmers and cooperatives when the first ones saw that through cooperation, they could deliver the hazelnuts to the industry and receive the payment in advance as described by Farmer 3: *“when the farmers saw that the cooperative was paying in advance started to deliver the product”*⁴. Although neither experts nor farmers mentioned it, the civic use of agricultural land in the municipality of Vasanello continued also in this time trajectory.

Challenges

Regarding the challenges of this time trajectory, the main problems suffered by the farmers were the price volatility and power of confectionery industry as shown in Table 13. As already mentioned, to solve these issues the farmers joined forces through cooperation association strategies and eventually producer organizations at the end of the time trajectory. Lastly, as mentioned before, also informal networks helped

⁹ Direct quotation from the interview with Farmer 5.

farmers to cope with environmental challenges such as persistent rain precipitations. As Farmer 3 described, the idea of adapting the silos used for wheat came from a conversation in an informal context.

Table 13 - Actors, institutions and challenges of the farming system (1962-1991)

	References	Influence farmers	Influenced by Farmers	Included in FS	Actors/Institutions involved in coping mechanisms
<i>Actors</i>					
Farmers	6	-	-	Yes	
Rural community	3	Yes	Yes	Yes	
Middle man	3	Yes	Yes	Yes	
Confectionery Industry	2	Yes	Yes	-	
Technology providers	2	Yes	No	No	
Local Technology providers	4	Yes	Yes	Yes	
Cooperatives	2	Yes	Yes	Yes	
Producer organizations	2	Yes	Yes	Yes	
Banks	1	Yes	No	No	
<i>Institutions</i>					
National government	1	Yes	No		
European Union	1	Yes	No		
Informal Network	2	Yes	-	Yes	
<i>Challenges</i>					
Extreme weather events	2	Yes	No		Farmers Technological providers
Price instability	3	Yes	No		Farmers cooperatives
Industry market power	3	Yes	No		Farmers Cooperatives Producer Organizations

4.2.3 Time trajectory 3: 1992-2018

Actors

Figure 6 shows the farming system characteristics in the third time trajectory. As can be seen new actors emerged both outside and inside the system and all the actors found in the previous time trajectory maintained their role in the farming system. In this time trajectory also Farmer 4 switched from viticulture to hazelnut cultivation and as happened in the past time trajectory, Farmer 2 and Farmer 1 joined a cooperative. Apart from Farmer 4, all the other farmers in this phase sought expansion strategies through acquisitions of small parcels of land, that have been planted with hazelnuts. Only Farmer 5 diversified the investment and established also a olive oil production plant. Producer organizations increased their strength in this time trajectory and increased in number. At least three producer organizations from farmers and experts were mentioned. The competition between these producer organizations is considered both as beneficial because it encourages each of them to increase the quality of their operations and as negative because the lack of shared objectives leads industry and middle men to maintain their power towards the farmers (Expert 1, Farmer 3). However, produce organizations were also mentioned as the actors that helped to increase productivity and yield through increase of quality and facilitated investments. Along with middle men, in also the presence of processors were mentioned in this phase (Expert 1, Farmer 1, Farmer 3).

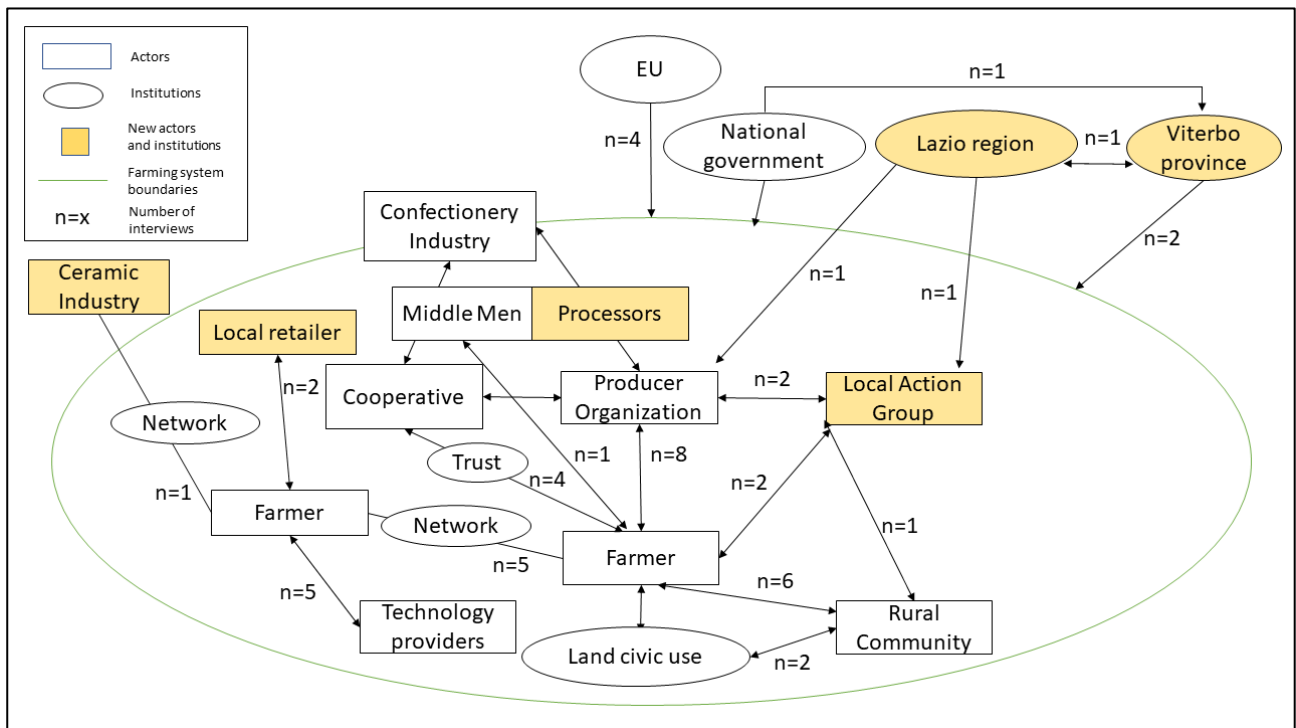


Figure 6 – Overview of actors and institutions of the farming system (1992-2018).

Processors are meant as the actors that play a role between supply and industry and perform the first transformations (drying, cracking), they have been attributed with strong power because of their capacity to influence the prices. Moreover, it emerged that some of the farmers and experts interviewed believe that one of the main processors has been bought by one of the confectionery industry leaders, contributing to concentrate the power among a handful of organizations. Technology providers maintained their role in the farming system and are considered crucial by farmers, the local proximity allows also technology providers to design commercialization schemes that involve replacement of agricultural machineries during harvest in case of failures (Farmer 2). Regarding new actors, the local retailer of agricultural supplies (e.g. fertilizers, pesticides) was mentioned by Farmer 3 and Expert 2 as source of information on best practices and new products for farmers. Another new actor, the Local Action Group, which has been established through the European Leader project, has cooperated with nine municipalities to distribute funds to farmers and municipalities for investments on technological modernizations and farm development. These actors are managed as a private company *“our profitability relies on farmers ability to pay back”*¹⁰, but contains other actors of the Viterbo province such as cooperatives, Viterbo Chamber of Commerce and the Association of Industries. One farmer mentioned also the arrival of foreign workforce to replace the lack of local agricultural workers, a problem that has been mentioned by other two farmers and has been solved by another farmer using cooperative workers to work on its land.

Institutions

European and National institutions were mentioned by the farmers only for what concerns funds for organic production and funds for improvement of agricultural production and farm expansion (Farmer 2, Farmer 5). While the Province of Viterbo was mentioned by Farmer 2 as the institution designed to give the access to natural water resources to farmers. The Lazio Region was mentioned in interviews with experts (Expert 1, Expert 3, Expert 5) as the institution that sustained the hazelnut cultivation expansion in the last time trajectory and has regulatory power on canalizing EU funds of the CAP and it is responsible for regulatory measures on water resources. In this time trajectory, informal networks are still important for exchange of information and discussion on farming: *“in some villages in the streets they speak only about hazelnuts”* or *“when a farmer sees another farmer starting to use pest controls it starts automatically afterwards”*. The local population of the farming system, in case of one municipality, reacted to challenges by voting to keep the civic use of land in the municipality of Vasanello¹¹, while the former representatives of the institution and the municipality wanted it to terminate. Additionally, the institution is trying to impose limitations on use of

¹⁰ Direct quotation from interview with Expert 1.

¹¹ Vasanello is one of the municipalities included in the case study area, where the civic use of land still exists.

chemicals for hazelnut cultivation both through educational initiatives and formal acts, as the joined local bio-district¹² community. Rural community vitality in this case has kept the public use of agricultural land.

Challenges

As can be seen in the list of challenges in Table 14, more challenges were found in this time trajectory compared to the previous time trajectories. For the farmers, one of the main challenges is the expansion of hazelnut cultivation area sustained by the industry, as they fear that the price could be lowered down by increased production. Another risk perceived by farmers is the invasion of new insects currently not present in the farming system. This fear is also sustained by the invasion of an insect dangerous for chesnuts, another important perennial production of the farming system which in the last decade seriously damaged this agricultural production and lowered the value of the land. Lastly, farmers fear the extreme weather events as freezing temperatures during winter and excessive heat during summer. However, while cooperatives and producer organizations have recently started to promote insurances for these risks, all the farmers interviewed did not made use of these instruments yet. Moreover, additionally through challenges described by farmers in this time trajectory it was possible to identify problematics mentioned also by the experts. Regarding these challenges, the environmental impact of intensive hazelnut cultivation was mentioned by two experts as their main concern for the present and future of the system (Expert 3, Expert 4). Furthermore, three farmers expressed concerns about this topic pointing out the bad impact of fertilizers and pesticides, sustaining either that EU should apply severer regulations of use of chemicals in agriculture and one of the farmers stated that he wishes his sons will not work in the future in hazelnut cultivation due to implications for human health. The expert working in Viterbo province, in addition to the bad impact that hazelnut cultivation has on water quality of natural water course, mentioned the hydrogeological impact and water scarcity as two challenges that are already affecting the farming system and will increase in the future. Regarding institutional challenges, the contacted expert from Viterbo Province mentioned that the relationship with the Lazio Region is complicated due to long decision-making procedures and unclarity of objectives. Specifically, it has been mentioned that the Lazio Region sustained the expansion of hazelnut cultivation over the years in the case study area and in the rest of the province without considering water exploitation of this agricultural activity. Although the Lazio region has blocked the possibility to obtain regional funds to build irrigation systems for several years, as confirmed by two experts (Expert 1, Expert 4), this measure was not considered sufficient by him. Rural communities are organizing themselves to pose limitations on use of chemicals, asking support from municipalities and research institutes. The relationship with the Lazio region was mentioned as problematic also by Expert 1 and Expert 4. The Local Action Group activities were stopped for two years because the regional administration did not yet approve the next phase

¹² Bio- district, it has been mentioned during an interview that the Università Agraria joined the local bio district as way of showing interest for the environment.

of the project, affecting farmers and municipalities ability to access to European funds. Similarly, the interviewed expert of the PO mentioned the relationship with the Lazio Region as very complicated “*I advise farmers to do not count on regional payments for organic production*”, because he mentioned that the region was not paying organic compensation to farmers associated with the producer organization for three years in a row.

Table 14- Actors, institutions and challenges of the farming system (1992-2018)

	References	Influence farmers	Influenced by Farmers	Included in FS	Actors/Institutions involved in coping mechanisms
<i>Actors</i>					
Farmers	9	-	-	Yes	
Middle men	4	Yes	Yes	Yes	
Rural Community	4	Yes	Yes	Yes	
Confectionery Industry	9	Yes	-	-	
Local Technology providers	5	Yes	Yes	Yes	
Cooperatives	4	Yes	Yes	Yes	
Producer organizations	8	Yes	Yes	Yes	
Local Action Group	2	Yes	Yes	Yes	
Local retailer	2	Yes	Yes	Yes	
<i>Institutions</i>					
Land civic use	2	Yes	Yes	-	
Informal Network	6	Yes	-	Yes	
Trust	4	Yes	-	Yes	
National government	1	Yes	No	No	
European Union	4	Yes	No	No	
Lazio Region	3	Yes	No	No	
Viterbo Province	2	Yes	No	No	
Municipalities	2	Yes	Yes	Yes	
<i>Challenges</i>					
Extreme weather events	3	Yes	No		Farmers Producer Organizations

				Cooperatives
Price instability	8	Yes	No	Farmers
				Cooperatives
Industry market power	8	Yes	No	Farmers
				Cooperatives
Agriculture	5	Yes	Yes	Municipality
Environmental impact				Rural community
Lack of cooperation between institutions	3	Yes	No	Viterbo Province
Expansion of cultivated area	8	Yes	No	Farmers
				Industry
Pest risks	3	Yes	No	Farmers

4.3 DYNAMICS OVER TIME

The dynamics of actors, institutions and challenges over the three time trajectories are shown in Table 15. Over the three time trajectories, farmers, rural community, middle men and industry remained in the farming system. All the farmers interviewed mentioned that their family was already in agriculture in the first time trajectory, either working a sharecropper for a land owner or as independent farmer. While in the first time trajectory, rural communities were involved in the agricultural production either as workers or as consumers, over time, also due to mechanization rural communities were not massively involved in agricultural production anymore. Although their role changed over time, they are still part of the farming system, acting as constraints for farmers activities already from the second time trajectories. Moreover, technology providers maintained their role in the farming system over the second and third time trajectories, as key contributors of the growth of the hazelnut cultivation and processing stages. In the last time trajectories cooperatives and producer organizations have also assumed an informative role (insurances and agricultural practices) and facilitator of investment for farmers. In the last time trajectory also the local action group, the local retailer of products for agricultural production became part of the farming system as vehicle for CAP funds for rural development that was mentioned for its efficiency in distributing funds to farmers and municipalities. Moreover, over time has been the only financial provider, apart from Produce Organizations found connected to the farmers, as the farmers have never mentioned banks as an important actor of the system.

Regarding institutions, only informal network and the civil use of land in one of the municipalities of the case study area were found present in all time trajectories. Informal networks have played an important role from

the beginning as source of information for farmers and facilitator of exchange between farmers and other actors. Moreover, the civic use of land survived all the time trajectories, inhabitants of the municipality of Vasanello have kept their rights to use the land given by land owners from the beginning of 1900 to the first time trajectory. In the second time trajectory, also trust between farmers and cooperatives became part of the farming system. Lastly, in the third time trajectories, some of the municipalities became part of the farming system, either as part of the Local Action Group or representants of environmental concerns of rural communities, while regional and institutional institutions remained outside the farming system. These local formal institutions maintain an important power on the farming system, as they define CAP investments funds and directions for the farming system and regulate access to the most important natural resources for farmers, water. Apart from the experts, they were mentioned only by one farmer, indicating that over time they never established trustfully and important relationship with farmers.

About challenges, temperature shocks and industry market power have been mentioned as issues occurred in all the time trajectories, although in different forms. Freezing temperatures that destroyed the production were reported for the first time in 1958 and they still represent a challenge for farmers. Market power of industry has evolved over time, while in the first time trajectory it was mentioned as a factor that blocked the possibility to sell hazelnuts to the industry. In the second and third time trajectory industry was mentioned both by farmers and experts as a powerful actor with the ability to lower the prices. In the last time trajectory, it was possible to identify challenges that affect not only farmers but also other actors of the farming system such as the environmental impact of hazelnut cultivation and institutional impasse of the Lazio region which affects not only farmers but also the local action group, the producer organization and Viterbo province. Expansion of the hazelnut cultivated area is a risk perceived both by farmers and other actors of the farming systems. However, while farmers are worried about a possible expansion of the cultivated area for economic reasons, the Province and the rural community are worried as they feel that the intensive production methods could even increase the bad environmental and health impact of hazelnut cultivation. In the third time trajectory, the invasion of pests as Murmured Asian bug is one of the biggest concerns for farmers as they fear that this insect could significantly impact their profitability in the future and increase the need for chemicals treatments.

Table 15 - Dynamics of actors, institutions and challenges over the tree time trajectories.

	Actors	Institutions	Challenges
Stable over time	Farmers	Informal networks	Extreme temperature shocks
	Rural community	Land civic use	Market power
	Middle men		
	Industry		
1945-1962	Land owners		
1962-1992	(-) Land owners	(+) Trust	(+) Price volatility
	(+) Cooperatives		
	(+) Producer organizations		
	(+) Technological providers		
1992-2018	(+) Processors	(+) Municipalities	(+) Environmental impact
	(+) Local Action Group		(+) Pest risks
	(+) Local retailer		(+) Expansion hazelnut cultivation area (+) Institutional impasse

(+) indicates new actors, institutions and challenges in the time trajectory, (-) indicates actors, institutions and challenges that exit the farming system in the time trajectory

5 DISCUSSION AND CONCLUSIONS

5.1 DISCUSSION

The results of the interviews have showed limitations in terms of consistency of results over time. While for the first time trajectory the interviews were used to identify actors, institutions and challenges was limited to farmers and only one of them provided a clear overview of farming system dynamics, for the other two time trajectories the results were built on more interviews. However, with regard to challenges, only in the third time trajectory it was possible to identify issues felt also by other actors and institutions of the system, while in the previous ones only farmers related issues were identified. Collecting and analysing more data through more interviews both with farmers, experts and other actors such as rural inhabitants or industry could have increased the study validity over the three different time trajectories. For instance, the confectionery industry, that was included in the farming system from the first time trajectory due to the strong connections with cooperatives, middle men and producer organizations, may became less influenced by farmers in the last time trajectory due to global markets and possibility to source hazelnuts in other locations. Also local banks, that have been mentioned only in relation with industry in the second time trajectory, may have played a role over time and conducting more interviews would have provided the possibility to understand these dynamics. However, the secondary sources analyzed showed that Viterbo hazelnut farming system has grown substantially over the three time trajectories, confirming the results obtained with the interviews. The confirmation that the UUA actually increased, together with the yield gave more value to the interviews, from which these information emerged as well. To obtain even a better picture it would have been valuable to compare the evolution of the profitability of hazelnut farmers to non-hazelnut farmers to investigate to what degree the higher profitability of hazelnut cultivation mentioned by farmers is true. Moreover, the secondary sources confirmed that the farming system has grown more than other Italian hazelnut farming systems and the yield has increased over time. Although it was not the objective of the study, investigating the role that local technology providers played in this context would give more insights on how relevant it is to be closer to technology providers for farmers.

The model used to conduct the analysis has been found valuable to define the boundaries of the farming system over time and allocate actors and institutions inside or outside the system and identify horizontal and vertical connections between farmers and actors over time, as achieved in other studies (Mikkola and Seppanen, 2005). However, compared to the ones defined in the model, more challenges and actors were found with the interviews and that these have developed over time. The analysis of the dynamics over time has showed that farmers and actors of the system have both transformed. For instance, farmers have switched from other forms of agricultural production to hazelnut farming and the role of rural communities

has changed over time, while in the first time trajectory were involved in the farming system as agricultural workers, their role has changed over time. Modernization of agricultural practices have contributed to make hazelnut cultivation less dependent on human labour, although this was not mentioned. The high rate of unemployment of rural population was mentioned due to the fact that local workers have been replaced by foreign workers for agricultural operations (Chaplin, 2014). Moreover, since hazelnuts are mainly used by confectionery industries, the connection between hazelnut farmers and inhabitants of the farming system, who do not see hazelnut farmers as food supplier, has been lost over time. If not restored, these disconnections can have a negative impact on the long-term development of these social ecological systems (Cumming et al., 2014). Furthermore, local formal institutions have been always identified as outsiders of the farming system and their capacity of coping with challenges have been questioned by the experts interviewed. Burocracy and non-responsive coping mechanisms of local formal institutions have been mentioned as a limitation for cooperation between actors and institutions by the experts, confirming what was mentioned in literature (Valentinov, 2007).

Informal institutions, in form of informal networks and trust have been found relevant to assure cooperation between individuals that resulted in the formation of established organizations, cooperatives and producer organizations. Trust has been found determinant for the effective functioning of cooperatives. However, the majority of the farmers interviewed fear the power of the confectionery industry, towards no trust has been developed, affecting the capacity of the system to develop diffused social capital (Fukuyama, 1995) . Similarly, middle men, who have increased their power by expanding their activities also to first hazelnut processing stage, are believed by farmers to be closer to industry interests instead of farmers. This reflects the tendency of food processors of seeking partnership and relationship with upstream actors of the farming systems instead of farmers (Hencion and McIntyre, 2005). Producer organizations have been relevant for increase quality and aggregate the product but the contrasts between them has reduced their capacity of contrasting industry power, one of the functions that are alleged to cover (Cook and Plunket, 2006). Moreover, middle men and the industry focus on received quantity instead of sustainability, pushing farmers to increase productivity through fertilizers and pesticides while rural communities are trying to lower the environmental impact of agriculture, creating wicked problems (Kuhmonen, 2018) that arise from different interest between actors of a system. Diffusion of new dangerous insects for hazelnut trees could even increase the impact of agricultural activities in terms of use of pesticides. When the main actors are not operating to solve a challenge, such as environmental impact of agricultural activities, local actors and institutions start to coordinate to cope with this challenge (Bonny, 2006).

5.2 CONCLUSION

The aim of this study was to provide an overview of the institutions and actors of the European farming systems and identify key actors, institutions and challenges in the Viterbo farming system over time. Specifically, the study has answered the following sub objectives:

Sub objective 1 - Review the diversity of institutions and actors related to European farming systems.

Beside farmers, actors and institutions of European farming system changed over time and European areas. While farmers remained the central part of these systems, new economic actors of the supply chain assumed a relevant role such as cooperatives, food industry and food distributors. While on the bottom line, farmers and associations remained diversified, industries and distributors were found scarcely diversified, creating an hourglass structure between farmers and consumers. Formal institutions have been subject to centralization and unification processes. Lastly, informal institutions as local networks and trust are found important to promote adaptation and collective learning of social ecological systems.

Sub objective 2 - Identify the institutions and actors of Viterbo hazelnut farming system in multiple time trajectories.

Farmers, middle men, confectionery industry and rural community were found stable actors over the three time trajectories as well as informal networks and the civic use of land that are identified as the institutions over time. Over time, the importance of economic actors in the farming system, such as cooperatives and producer association increased. On the contrary, the study showed that local formal institutions remained outside the farming system, although they played an important role in its evolution and still maintain strong regulatory power. Lastly, farmers trust towards other organizations has been developed through cooperatives in the second and third time trajectory but trust toward the industry has not developed over time, as well as trust of other actors toward local formal institutions.

Sub objective 3 - Identify how institutions and actors of Viterbo hazelnut farming system reacted to challenges over time in the farming system.

This research allowed to identify key challenges that affect farmers over time, mainly market power of the industry and middle men and extreme weather events. The economic challenges have been partially solved by cooperation and associations strategies. However, low prices and industry power are still feared by farmers. New environmental challenges such as diffusion on new insect species are felt as a challenge and could lead to increase use of pesticides that negatively affect the environment. Negative environmental

impact of agricultural practices, issue shared also by some farmers, is the main challenge felt by the rural community that through collective actions is trying to set constraints on agricultural production, cooperating with local municipalities.

5.3 FURTHER RESEARCH

As already mentioned, this study could be further improved by collecting and analysing more data, either increasing the number of interviews or using a questionnaire to consider more farmers and experts of the farming system. Data retrieved from other actors such as technology providers, industry, non-hazelnut farmers and rural inhabitants not connected with agriculture could provide more information on their relationship with farmers over time. To further research the role of actors and institutions, a comparison with other case studies could help to identify differences and similarities, pointing out different dynamics. Firstly, it would be valuable to compare this farming system with other farming systems specialized in hazelnut production, investigating if different settings of formal institutions and presence of different actors imply different outcomes in terms of growth over time. Secondly, a comparison with farming systems specialized in different agricultural sectors would may provide insights on how different agricultural productions evolved over time and which actors have been included in the farming system. Lastly, this study showed that farmers profitability can be in contrast with interests of other actors of the farming system, however more research is needed to identify how institutions and actors of the farming system can cooperate to ensure resilience of farmers while combining interests of other non-agricultural actors of the system, investigating the role of informal institutions and collective actions deeper.

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APPENDIX

Table 16 - Protocol used as basis for experts' interviews

Expert Interviews	
Objective	Expert and organization characteristics
To assess the relevance of the data obtained from the interview	<ul style="list-style-type: none"> • What are the activities of your organization? • What is your role in the organization? • Since are you working in the organization/ hazelnut sector? • What is the operating area of the organization? • When was the organization established?
Objective	Farming system
To understand the evolution of the actors and institutions	<ul style="list-style-type: none"> • Which are the moments/ elements which shape the evolution of the sector? (technological advancements, environmental changes, economic factors...) • Which actors are you collaborating with? (farmers, local/regional institutions, research institutes, producer organizations) • Were there some actors in the past that are no longer part of the system? If yes, which ones? • As organization, do you depend on the choices of other actors? Do you think that this was also the case in the past?
To understand the challenges of the farming system	<ul style="list-style-type: none"> • Which risks/challenges did the systems face in the past? (environmental, economic, social) How were they managed? (collaboration between farmers and actors, individualism ...) • Which risks/challenges is the system facing now? (How are they managed?)
Focus on specific points that were mentioned during the interview	<ul style="list-style-type: none"> • Can you please elaborate more on ...?

Table 17 - Characteristics farmer 1

Farmer 1	Farmer
Career stage (early, mid or late)	Mid (He believes to continue working in 10 years)
Location	La Tuscia University
Date of Interview	8/05/2018
Researchers conducting interviews	Elia Rocco Ferrara (Student, Wageningen University) Saverio Senni (Professor, La Tuscia University)
Interviewers notes	The interviews lasted around one hour. The informant was with the daughter, the interviews run smoothly and the informant provided information without need of asking often clarification.
Informant Context	The informant is 62 years old, is working since he was a teenager in the agricultural sector. There are three other family members working in the farm and other three workers (non family)
Informant Timeline	<ul style="list-style-type: none"> • Family activities switched from animal farming to hazelnut cultivation • Technology impact in cultivation • Creation of cooperative
Summary of key events	<ul style="list-style-type: none"> • The informant family was in agriculture, the father was a Shepard. They started to cultivate hazelnut because it was a more remunerative activity • Technology has transformed hazelnut cultivation (harvest, drying) • The informant and other farmers joined a cooperative in a period of low prices for hazelnuts • Over the years he has expanded the family farm • When he will retire the daughter will take his place

Table 18 - Characteristics farmer 2

Farmer 3	Farmer
Career stage (early, mid or late)	Mid (He believes to continue working in 10 years)
Location	La Tuscia University
Date of Interview	17/05/2018
Researchers conducting interviews	Elia Rocco Ferrara (Student, Wageningen University) Saverio Senni (Professor, La Tuscia University)
Interviewers notes	The interviews lasted around 40minutes, The researcher needed to ask for clarification or to add some information several times
Informant Context	The informant is 52 years old, is working since he was a teenager in the agricultural sector, he has joined on definitive way the family activities in 2006. Is working with the brother and they hire workforce for harvest or other agricultural practices.
Informant Timeline	<ul style="list-style-type: none"> • Non agricultural job • Technology impact in cultivation • Land purchasing • Joining of cooperative
Summary of key events	<ul style="list-style-type: none"> • The informant family was in agriculture, the father was cultivating arable crops. They started to cultivate hazelnut because it was a more remunerative activity • In 2007 he left his all job and joined the brother in the family business • Technology has transformed hazelnut cultivation • The informant joined a cooperative in 2007 • They expanded the farms over the years by buying and renting other land, they are trying to convert everything in hazelnut cultivation • The son of the farmer will probably join the father activity after he will finish with Univeristy

Table 19 - Characteristics farmer 3

Farmer 2	Farmer
Career stage (early, mid or late)	Late (He is retiring this year)
Location	Informant's house
Date of Interview	18/05/2018
Researchers conducting interviews	Elia Rocco Ferrara (Student, Wageningen University) Saverio Senni (Professor, La Tuscia University)
Interviewers notes	The interviews lasted around one hour, the informant is one of the maximum expert of hazelnut cultivation in Viterbo area. He was willing to talk and mentioned a lot of details of the farming system.
Informant Context	The informant is 88 years old, is working with hazelnuts since we a teenager. No one of the family is working with in the farm, external cooperatives perform agricultural workers.
Informant Timeline	<ul style="list-style-type: none"> • He switched from wine production and animal farming to hazelnuts • He believes technology had huge impact on cultivation • He was Creation of cooperative and PA
Summary of key events	<ul style="list-style-type: none"> • The informant family was in agriculture, they were land owners. They started to cultivate hazelnut because it was a more remunerative activity and as substitute for vines. • Technology has transformed hazelnut cultivation (harvest, drying) • The informant and other farmers made a cooperative to satisfy industry requirements and fight low prices. • He was the president of the first Producer organization of the case study area • The sons will probably abandoned the farms after he will retire

Table 20 - Characteristics of Farmer 4

Farmer 4	
Career stage (early, mid or late)	Mid (He believes to continue working in 10 years)
Location	La Tuscia University
Date of Interview	21/06/2018
Researchers conducting interviews	Saverio Senni (Professor, La Tuscia University)
Informant Context	The informant is 51 years old and is working as employee of the municipality of Vasanello. The informant's father was involved in agriculture since the informant was a child and he also worked in agriculture for long time as secondary job.
Informant Timeline	<ul style="list-style-type: none"> • The father obtained access to the land through the civic use of land of the municipality of Vasanello • The father continued the traditional viticulture of the location • In 2011 the family switched from viticulture to hazelnut farming
Summary of key events	<ul style="list-style-type: none"> • The informant family was in agriculture, the father was cultivating vines. They started to cultivate hazelnut in 2001 because it was a more remunerative activity and they received subsidies to terminate the viticulture activity. • Since 2015 he started to rent modern agricultural machineries from friends to carry out the harvest. • He hopes that in the future his sons will not continue the agricultural activity because he perceives it as not healthy.

Table 21 - Characteristics of Farmer 5

Farmer 5	
Career stage	Mid (He believes to continue working in 10 years)
Interview Location	Informant's house
Date of Interview	23/10/2018
Researchers conducting interviews	Saverio Senni (Professor, La Tuscia University)
Informant Context	The informant family was already in agriculture when the informant was a child. The whole family was helping during the busiest periods of the years. Over the years he expanded its activity and he differentiated investments, establishing also an olive oil production plant.
Informant Timeline	<ul style="list-style-type: none"> • Family switched from other agricultural activities to hazelnut cultivation • Investments in oil production plant • Investments in another Italian region to increase UUA • His going to retire in 10 years but his sons will continue the activity
Summary of key events	<ul style="list-style-type: none"> • The informant family was in agriculture, the father was cultivating arable crops. They started to cultivate hazelnut because it was a more remunerative activity. • He believes technology has transformed hazelnut cultivation and he had personal contact with technology providers. • Over the years he invested in new UUA in the case study area and in another Italian region, he also invested in oil production plant • The sons of the farmer left their job and they joined the father in the agricultural activities • The informant joined a cooperative which is responsible for selling the product