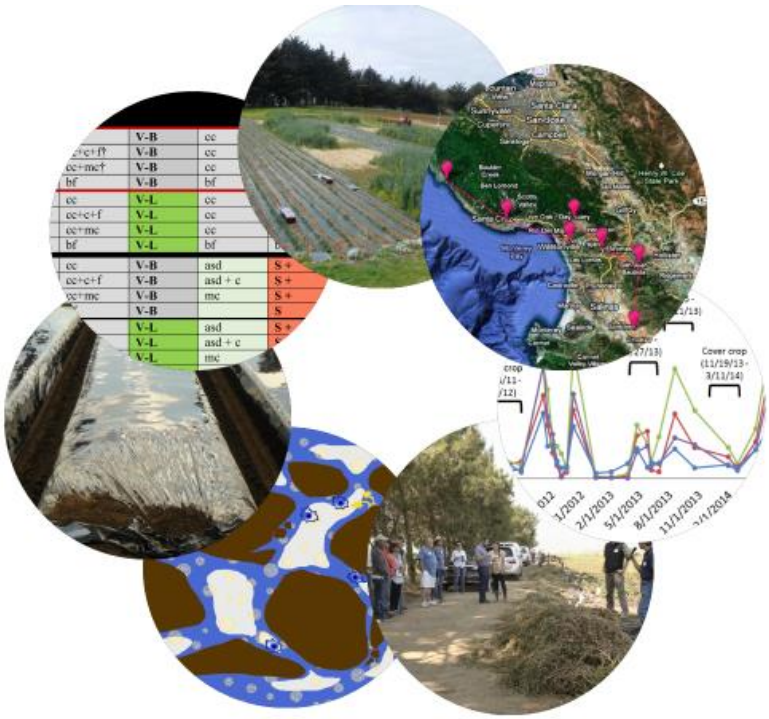
Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Faculty of Landscape Architecture, Horticulture
and Crop Production Science

Bridging the gap between researchers, growers, extension and industry in organic strawberry production

A case study on the agricultural knowledge network of central coastal California

Konstantinos Kalaitzoglou



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Foreword

A casual discussion about a plant disease problem I have experienced with my family's olive orchard was the beginning of my thesis idea. My problem was about the devastating soil borne disease *Verticillium dahliae* and how it affected our olive trees and my father's mood who struggled to raise them. My supervisor Marco Tasin informed me about Santa Cruz and their work on Verticillium wilt in strawberry production. I didn't know at that point, but that was the beginning of a long journey.

By getting into the Agroecology program I was not exactly sure what Agroecology was about. At the end of the first course I realized the importance of having a wholistic approach towards agriculture and its interaction to society. By getting into the Ecology of Production Systems I had the opportunity to expand this view and understand the different aspects of sustainability. Environmental Economics and Management came to enrich this perception by making the realistic connection to the economy and market. Every one of those courses contributed to my initial idea of doing a research on *Verticillium dahliae* and its impact to agricultural systems.

The course of Project Management and Process facilitation was the most important contribution to my thesis idea because it helped me understand the concept of a project and more importantly, how we can evaluate one. As I entered the course of Scientific Methods and Thesis Writing I already knew what I wanted to search for in my thesis, only this time it was not the *Verticillium dahliae* but how a large scale project about soil borne diseases impacts the organic production in a specific area. By the end of the course I had my research question ready and my thesis proposal accepted by the University of California, Santa Cruz. As a preparation for my thesis, I choose to conduct a plant pathology experiment on strawberry for my Project Based Research Training course.

Through the MSc program of Agroecology, I was able to expand my views and perceptions, on science, understand the interdisciplinary nature of agriculture and the crucial role of society as the other end of a complicated system. This thesis is the result of all this accumulated knowledge and an effort to cross over to social sciences and gain an in breadth understanding of the agro-food systems and their impact on the environment and society. I am sure that I will carry this expanded perception with me where ever I end up working.

Abstract

The aim of this research was to investigate how and why the development of a knowledge network between researchers, growers, extension agents and industry impacts the knowledge creation and dissemination in organic agricultural networks. Theoretically, we drew upon the concept of Embeddedness in agro-food networks. Empirically, we relied on a case study research by utilizing multiple sources of data.

For many decades strawberry growers in California have relied on methyl bromide. Despite the heavy dependence on this soil fumigant, a phase out was scheduled by the Montreal protocol. In order to meet the emerging sustainability demands of organic strawberry production and strengthen the communication between researchers, extension, growers and industry, an organic research network was initiated in central coastal California in 2004.

In this research, the case was bounded by space (central coastal California), activity (network activities) and time (progress of the network). The complete set of data includes both primary data (semi- structured and open-ended interviews) and secondary data (research papers, digital material and documentation).

The empirical findings showcased the gradual building of trust between the actors of the network throughout the years. The common research activities and the previous good relationship between growers, extension agents and researchers was the baseline of this network. Additionally, the successful commercialization of the new organic techniques produced by the research activities, played a major role on the organic strawberry production of the area.

Three different types of Embeddedness played an important role in explaining the 'knowledge processes' in this network. More specifically, Relational Embeddedness -based on casual interaction and trust- constitutes the most plausible explanation of the network's performance. Structural Embeddedness along with the Proximity aspect has complimentary function.

Overall, the network is consisted of knowledge creators (those who conduct the research), knowledge funnels (those who channel the knowledge) and knowledge receivers (those who receive the knowledge). The initiation of the research network, the participatory nature of the research, the unique role of extension agency and the connection to private sector re-enforced the network linkages by bringing all the different actors together.

Key words: Alternative Food Networks, Embeddedness, Knowledge creation, Knowledge dissemination, Organic Strawberry production, Participatory research

Contents

Abbreviations

ANT	Actor Network Theory
ALBA	Agriculture and Land-based Association
ARS	Agriculture Research Service
AFN	Alternative Food Network
ASD	Anaerobic Soil Disinfestation
CAFF	California Association of Family Farmers
CCOF	California Certified Organic Farmers
CalCORE	California Collaborative Research and Extension
Cal State MB	California State University, Monterey Bay
CSC	California Strawberry Commission
CASFS	Center of Agroecology and Sustainable Food Systems
CSA	Community Support Agriculture
CT	Convention Theory
SFSC	Short Food Supply Chains
USDA	United States Department of Agriculture
UCCE	University of California, Cooperative Extension
UCSC	University of California, Santa Cruz

1. INTRODUCTION

Universities are considered the traditional high-level knowledge creators for developed societies. However, literature suggests that the type of knowledge that the universities create is not necessarily disseminated properly within the society. In many cases, researchers tend to be isolated in their own research activities and loose the contact with society's actual problems. (Gera, 2012). At the same time, it is very difficult for the practitioners of various disciplines to keep up with the high-level knowledge produced by universities (Kelemen and Bansal, 2002).

The higher level of knowledge coming straight from the institutions (explicit knowledge) tends to totally replace the implicit (local) knowledge coming from the growers. However, implicit knowledge -deriving from the growers- has the potential to embrace values and beliefs that are aligned with the principles of sustainable farming (Curry and Kirwan, 2014). Explicit, is the articulated knowledge that is codified, verbalized and it is transferable. It is the visible part of the iceberg. Implicit or local knowledge is the experience based knowledge which is tested through trial and error over time. It is applied locally and it changes constantly depending on the situation. It is the invisible part of the iceberg (Figure 1) (Bolisani and Bratianu, 2018).

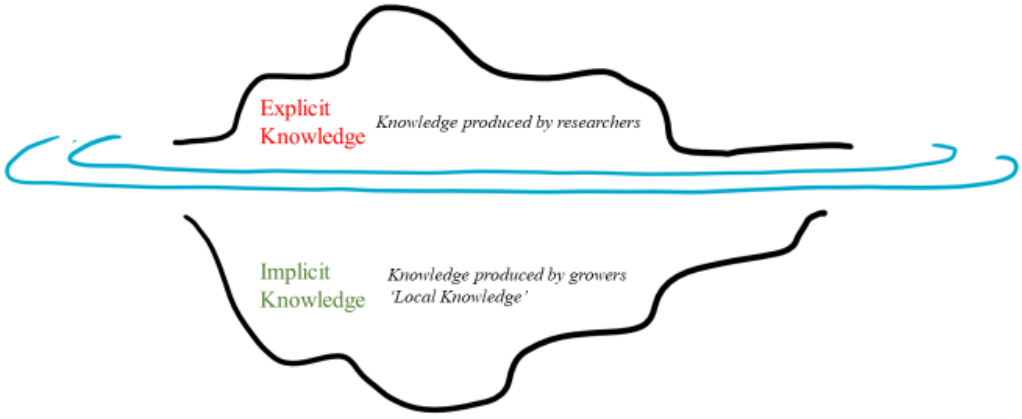

Figure 1 The Iceberg Knowledge Metaphor. Explicit is the easily transferable knowledge and the visible part of the iceberg. Implicit or local knowledge is the knowledge produced by the grower and it is based on experience (Bolisani and Bratianu, 2018).

A lot of work has been made by agro-scholars in order to explain the dynamic relationship between explicit and implicit type of knowledge in regards with the development of agro-food networks. Agro-food networks -apart from the financial flows and physical distribution- contain a system of actors, control and information (Larsson, Ekelund and Carlsson, 2009). These networks are made up by people and institutions that are linked by professional, social or commercial relationships. The basic structure of these networks remains the same despite differences that might exist depending the context. Additionally, these networks are comprised by growers, researchers and extension agents with common goals regarding production, environmental protection and distribution (Kaine *et al.*, 1999).

The progress of these networks is a result of universities' scientific accomplishments, innovation and the emerging problems of the agricultural production. In the last 25 years, the traditional knowledge flow of information -within these networks- has shifted towards a more problem-based approach, due to the emerging production and environmental issues (Larsson, Ekelund and Carlsson, 2009). The effectiveness of the knowledge flow within these networks depends on the existence of incentives for the involved actors, to communicate with each other, and thus create and disseminate knowledge appropriately (Kaine *et al.*, 1999).

The performance of an agro-food knowledge network depends on the efficient communication between of the involved actors such as growers, researchers, institutions and extension. If the participation of the growers in these networks is not well-represented, the research tends to follow an independent course based on individual research interests. Additionally, if there is no link (extension) between the two ends of the information line (researchers and growers) the 'translation' of the explicit research knowledge is going to be limited (Kaine *et al.*, 1999; Larsson, Ekelund and Carlsson, 2009).

Crucial to the formation of these agricultural knowledge networks, are the incentives for the involved actors. The common goals and the commitment constitute the essential characteristics of these networks. In comparison with the private sector, these networks are not necessarily having a distinct structure and the willingness of the actors to engage on common activities or action varies. On the other hand, the private sector is driven by financial incentives and represents a more distinct knowledge network due to its structure and the availability of resources (Kaine *et al.*, 1999).

Taking into consideration all the emerging issues of agriculture, the need for coordination and collaboration in agricultural networks is more relevant than ever. The communication of knowledge between researchers and growers is not confined only to developing resilient agro-food systems in a local level, but it is a global issue. With more complicated problems and limited access to innovative academic knowledge, alternative agricultural networks are more 'susceptible' this this lack of communication (Goodman, Dupuis and Goodman, 2012).

This research investigates the knowledge creation and dissemination issues of organic agro-food networks and their performance. Accordingly, the purpose of this thesis is to increase the understanding on these networks by addressing the following research question: *How and why the development of a knowledge network between researchers, growers, extension and industry impacts the knowledge creation and dissemination in organic agricultural networks?* Theoretically, we draw upon the concept of Embeddedness in agro-food networks. Empirically, we rely on a case study research by utilizing multiple sources of data.

2. THEORETICAL FRAMEWORK

2.1. ALTERNATIVE FOOD NETWORKS

For the last 20 years, there is an increasing interest by agro-food scholars regarding 'alternative' food networks. This interest is a result of the emerging public awareness about the agro-food networks and their impact on the environment (Goodman, Dupuis and Goodman, 2012). Alternative Food Networks (AFN) are defined as channels of consumption, distribution and production of food with the objective of bridging the production with the consumption. These networks allow the re-allocation of value in order to benefit the producers and develop new types of governance and relationship between the involved actors (Sanchez Hernandez, 2009).

The specialized literature concerning AFNs flourished the last years as a result of the above-mentioned interest. The large amount of produced papers resulted to a categorization of AFNs which is based on the variety of developed trends. Some examples of these trends are:

1. Farmers' markets: The farmers sell their products directly to the costumers. Usually these markets held once a week.
2. Community-supported Agriculture (CSA): The costumers subscribe to a certain local farm.
3. Farm shops: The costumer purchases the products from the farm.
4. Box Schemes: Similar to CSA. The costumers usually subscribe to a certain farm. A box of seasonal products are delivered to the costumers in close proximity.
5. Organic Food: The food is produced without the addition of chemical inputs. This type of production is certified and regulated.

The level of establishment, autonomy or radicality of an AFN, depends on its different attributes and characteristics (Sanchez Hernandez, 2009; Maye and Kirwan, 2010).

For many years, the AFNs products were distributed only through alternative supply chains and not through conventional retailers. However, the rising interest of consumers about agricultural products of high quality, created a demand that the conventional market tried to fulfil. This expansion in market terms, created a wave of skepticism towards any 'loose' interpretation of AFNs. Many agro-food scholars, academics and activists, are opposed to these 'extended' definitions of AFNs (Maye and Kirwan, 2010). In seeking to address the sense of complexity and diversity of AFNs, scholars created a general distinction between 'stronger' and 'weaker' alternative networks. More specifically, the pragmatists advocate for a mix and match approach, by acting both within and outside the existing distribution and market system ('weak' AFNs). On the other hand, the purist approach regards a deeper socio-political and structural critique towards the distribution system, dependence on external inputs and modern market ('strong' AFNs) (Watts, 2014).

Despite the crucial role of consumer demands regarding AFNs, most of the empirical and theoretical research remained attached to the production aspect of these networks (Maye and Kirwan, 2010). Additionally, the majority of the theoretical research made for AFNs concerns the understanding of the material and social constructions of these networks (Harvey, McMeekin and Warde, 2004). The higher level of theoretical developments have been neglected while empirically grounded approaches were favored. The theoretical work on AFNs remains in some ways

underdeveloped despite the work that has been made on convention theory (CT), cultural economy and actor-network theory (ANT) (Goodman, 2003). Three of the main theoretical concepts regarding AFNs are convention theory (CT), short food supply chains (SFSC) and social embeddedness (Maye and Kirwan, 2010).

For the last 20 years CT influenced the work on alternative agro-food networks by providing both analytical and theoretical understandings regarding the governance and the coordination of these networks (Maye and Kirwan, 2010; Ponte, 2016). In the CT, "conventions are defined as a broad group of mutual expectations that include -but are not limited to- institutions. While institutions are collective and intentional objects that are set up for the purpose of implementing an intention, conventions may also arise from a shared set of regularities that are unintentional" (Ponte, 2016, p.13). For the CT, rules are not necessarily decided prior to any arrangement, but emerge naturally through the process (Wilkinson, 1997). CT has been a useful concept in analyzing transitions from local to locality food (Goodman, Dupuis and Goodman, 2012).

SFSC are a result of the growing awareness by the consumers regarding both the production and the distribution end of the AFNs (Murdoch, Marsden and Banks, 2000). SFSC are defined as chains "involving a limited number of economic operators, committed to cooperation and to local economic development, and close geographical and social relations between producers, processors and consumers" (Augère-Granier, 2016, p.3). Moreover, SFSC enable the medium or small-scale enterprises to absorb a bigger proportion of the added value of their products by having direct connections with their customers such as FMs, Box Schemes or CSA (Renting, Marsden and Banks, 2003). There are two types of SFSC, the spatially proximate and the extended. The first, refers to a direct distribution within vicinity and the second to local distribution via local retailers (Maye and Kirwan, 2010).

The concept of social embeddedness suggests "that economic action is embedded in structures of social relation" (Granovetter, 1985, p.481). The research on social embeddedness emphasizes on the importance of social relations -such as friendship, trust, attention or respect- in AFNs (Sage, 2003). AFNs were benefited by the work on social embeddedness, especially in regard to the interaction between economic and social dimension of these networks. Many publications have appeared since Mark Granovetter re-introduced the concept of embeddedness in socioeconomics in 1985 (Boekema and Rutten, 2004). However, Granovetter has been critiqued for the misinterpretation of the term by emphasizing mainly the 'social' rather than the 'economic' dimension (Krippner, 2016). Apart from the social and economic aspects, the concept of embeddedness applies in a wide range of topics such as proximity, knowledge creation and networks (Håkansson and Snehota, 1995). Despite the big number of publications, there is not yet achieved a conceptual clarity concerning the matter (Boekema and Rutten, 2004).

2.2. EMBEDDEDNESS CONCEPT

There is a certain level of 'compatibility' between the previously mentioned theoretical concepts and the different types of AFNs. Despite the fact that SFSC can be applied to a wide array of alternative networks, there is an emphasis on 'stronger' AFNs with close-proximity characteristics (Augère-Granier, 2016). Additionally, CT seems to fall short regarding the interpretation of phenomena within complicated 'weaker' AFNs with multi-actor structural and non-structural

interrelations (Ponte, 2016). On the contrary, the work regarding the concept of embeddedness -especially in the field of knowledge creation networks- can be a useful tool in interpreting cases of big-scale organic food networks that function within the conventional system ('weak' AFNs). However, based on the little attention given to these "weaker" and more pragmatic agro-food networks, it seems like there is plenty of room for research on the topic.

As previously mentioned, embeddedness became a useful concept for understanding networking, knowledge creation and proximity. Embeddedness can be considered as an explanation of a network's performance and the behavior of its actors. However, it still remains uncertain how embeddedness impacts knowledge creation in these networks. The reason for that, is the broad performance of embeddedness (Boekema and Rutten, 2004). There are many types of embeddedness such as cognitive, political and structural embeddedness (Dequech, 2003), regional embeddedness or relational embeddedness (Granovetter, 1985).

Despite all the previous work on the subject, the conceptualization of embeddedness remains incomplete (Boekema and Rutten, 2004). Some of the studies with theoretical contributions to the concept of Embeddedness and its broad performance are:

A study by Schamp, Rentmeister and Lo (2004) in which the authors investigate the impact of regional embeddedness. In this theoretical contribution the researchers came to the conclusion that the knowledge creation is a result of various forms of embeddedness.

A study by Rutten (2003) regarding a manufacturing industry network. In this network, the element of strong trust existed between the actors, despite the fact that there was an absence of previous structural embeddedness. This result may be explained by the relational embeddedness perspective.

A study by Gössling (2004) concerning the spatial proximity and the trust. In this case the author argues that trust and proximity are not necessarily beneficial because of unpredicted and possibly immoral behavior of the actors.

A study by Cooke (2002) concerning the performance of firms that are strongly embedded in regional networks and show a better performance in comparison with firms in other regions. Regional networks refer to research institutes and small or large companies.

A study by Lambooy (2004) is a theoretical contribution based on a Dutch example and concerns the important role of the universities in the creation of knowledge by companies or other institutions in the same region.

A study about the broad performance of Embeddedness made by Boekema and Rutten (2004) is an important overview regarding the different types of embeddedness in regards to trust and personal relations (Relational Embeddedness), structure (Structural Embeddedness) and spatial proximity. More specifically, the author argues that embeddedness is an important factor in explaining 'knowledge processes' in networks but not all the types of Embeddedness have equal importance.

This thesis draws upon the different types of Embeddedness in order address the research question.

3. METHODOLOGY

3.1. CASE STUDY APPROACH

Based on the research question posed, this research uses a Case Study approach (Yin, 2018). Moreover, in order to analyze a bounded phenomenon like the development of a knowledge network, one suitable approach is to search for viewpoints from the actors who are involved with such networks at an institutional or individual level (Merriam, 2004; Yin, 2018). Additionally, with respect to the concept of embeddedness in knowledge networks, a case study is an appropriate methodological approach to test these theoretical considerations (Thomas, 2016).

A case study is mainly a methodological choice of what to be studied rather than a simple method itself. The case itself is the focal point of the study and the chosen sources of data (methods) are the different angles from where it is going to be studied (Thomas, 2016). The different sources of data can be utilized in combination (triangulation) in order to either corroborate or contradict any research inference, regardless of the number of available cases. An in-depth research on a single sample (case) can reveal hidden processes, relationships and other valuable insights (Creswell and Creswell, 2018; Yin, 2018).

The chosen case for this research, not only fulfils the criteria for answering the research question, but also represents an outlier example (Thomas, 2016) of a 'weak' AFN that functions within the framework of modern agriculture. For many decades strawberry growers in California have relied on methyl bromide, a fumigant known for its efficiency against the devastating impact of soil borne diseases (Goodhue, Fennimore and Ajwa, 2005). Despite the heavy dependence on methyl bromide, a phase out was scheduled by the Montreal protocol -starting in 2005- because of its impact on the ozone layer (US Environmental Protection Agency, 2006). In order to meet the emerging sustainability demands of organic strawberry production and strengthen the communication between researchers, extension, growers and industry, an organic research network was initiated in central coastal California. The network was initiated in 2004 and since then has changed throughout the years as a result of available resources (funding) and emerging needs of organic strawberry production (Muramoto *et al.*, 2013; Shennan *et al.*, 2016).

3.2. BOUNDING THE CASE

To determine our case (research network), we need to define its boundaries in order to clarify what exactly is going to be studied (Baxter and Jack, 2008). In this research, the case is bounded by geography (central coastal California), activity (network activities) and time (progress of the network). More specifically, the research network concerns the counties of Santa Cruz, Monterey, Saint Luis Obispo, Santa Barbara, Ventura and San Benito in central coastal California. The activities of the network include the research, communication and collaboration between the different actors of the network. The goal of the network is to deal with the rising demands of organic strawberry production and bridge the knowledge gap between the different actors of the network such us researchers, organic growers, extension agents, industry professionals and NGOs (Shennan and Muramoto, no date; Muramoto *et al.*, 2013).

Concerning the element of time, the manifestation of this contemporary phenomenon like our network, is a result of sequential events that started back in 2004 and are still in progress

(Muramoto *et al.*, 2013; Shennan *et al.*, 2016). The main facilitator of this research network is the University of California, Santa Cruz (UCSC). The research network has gone through three distinct phases until today depending on the available funding and the emerging issues of organic strawberry production. More specifically:

- First phase (2004-2011): The Organic Research Network (Muramoto *et al.*, 2013).
- Second phase (2011-2016): California Collaborative Research and Extension (CalCORE) Network (Shennan *et al.*, 2016).
- Third phase (2016-today): SCRI - integrated approaches to soil borne disease management in strawberries (expanded outside of California), Anaerobic Soil Disinfestation (ASD), N-Immobilization (Shennan, 2018).

For Robert Yin (2018), one of the main preconditions in choosing a case study approach, is whether the events to be studied are contemporary. This approach is being considered the most orthodox, due to the fact that Yin is the most cited author regarding case study research (Yin, 2018). However, in order to make a holistic analysis of the network and answer the research question properly, we need to include its temporal progress (all the phases). Contrary to Yin's strict approach, there are other methodological pathways that address the element of time in such cases (Byrne and Ragin, 2009; Thomas, 2016). Gary Thomas (2016), addresses the element of time by dividing the studies into *snapshot* (contemporary) and *retrospective* (past).

3.3. RESEARCH DESIGN

The pragmatic approach is considered to be ideal for holistic inquiries by allowing the researcher to use pluralistic strategies in order to overcome methodological deadlocks and emphasize the research objective (MacQuarrie, 2010; Creswell and Creswell, 2018). Pragmatism is not limited to a particular philosophy, approach or method. The inquirer has the freedom to utilize every possible strategy, method or tool in order to tackle the research problem (Creswell and Creswell, 2018).

In our case, the main methodological issue was how to include the two past phases of our research network within the research design, with respect to scientific validity. Gary Thomas (2016), defines the case as a wrapper that the researcher uses in order to focus on the study need. Based on this pragmatic approach, Gary Thomas (2016) -by drawing upon Yin's (2018) case study designs- suggests that a single case (like this) can include multiple nested sub-units of analysis depending on the situation. This design suggestion allowed us to incorporate the three different phases in our analysis, for the sake of a holistic approach. More specifically, our case (the organic research network), includes the three phases as sub-units of analysis. The first and the second phase are the *retrospective* (past) sub-units of analysis and the third is the *snapshot* (contemporary) unit of analysis (Figure 2). This design showcases the temporal progress of the network and allows an in-breadth analysis of the phenomenon.

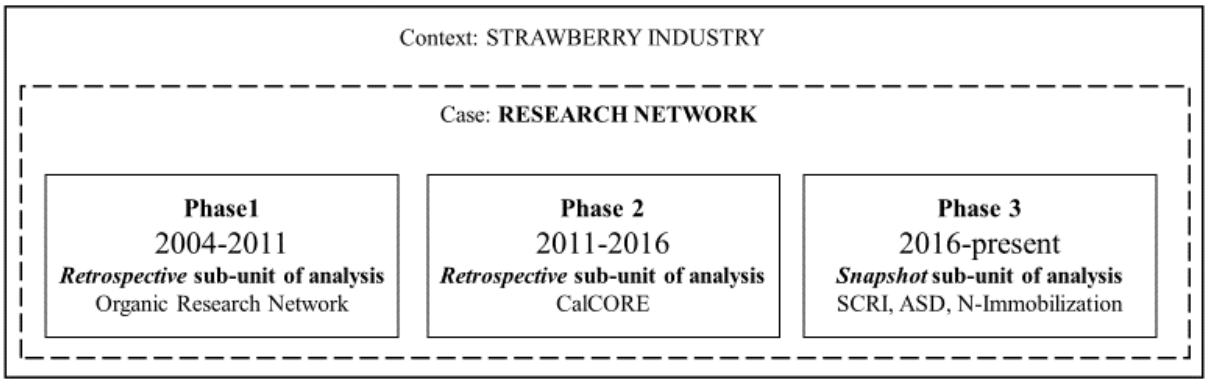

Figure 2 The research design of the case (organic research network) based on Gary Thomas' (2016) approach. The case includes three nested sub-units of analysis -two retrospective (past) and one snapshot (contemporary)- in order to allow a holistic analysis of the temporal progress of the network.

3.4. SOURCES OF DATA

Triangulation of data is the main rationale for following a case study approach. Using multiple sources of data allows the inquirer to examine a case from different viewpoints (Thomas, 2016). In this research, the complete set of data includes both primary data (semi- structured and open-ended interviews) and secondary data (research papers, digital material and documentation). All the sub-units of analysis draw from the same sources of data depending upon availability. More specifically:

First phase (2004-2011): (i) Semi-structured and open-ended interviews with involved actors, (ii) Research papers produced in this phase.

Second phase (2011-2016): (i) Semi-structured and open-ended interviews with involved actors, (ii) Research papers produced in this phase, (iii) digital material (websites and videos).

Third phase (2016-present): (i) Semi-structured and open-ended interviews with involved actors, (ii) Documentation.

In this research, the interviews constitute the common source of data for all the three sub-units of analysis. More specifically, some actors of the research network are involved in all the phases and some others only in one or two. The list of interviewees -used in the research- is common for all the three sub-units. Regarding the secondary sources, there is a clear distinction of which source of data is being utilized for each phase. This pragmatic approach allowed us to overcome some practical difficulties such us the time limitations, proximity and willingness of the actors to volunteer. Moreover, this approach gave the opportunity to create a balance between the depth and the breadth of the analysis. Figure 3 depicts the research design of our case with every source of data that is utilized in every sub-unit of analysis.

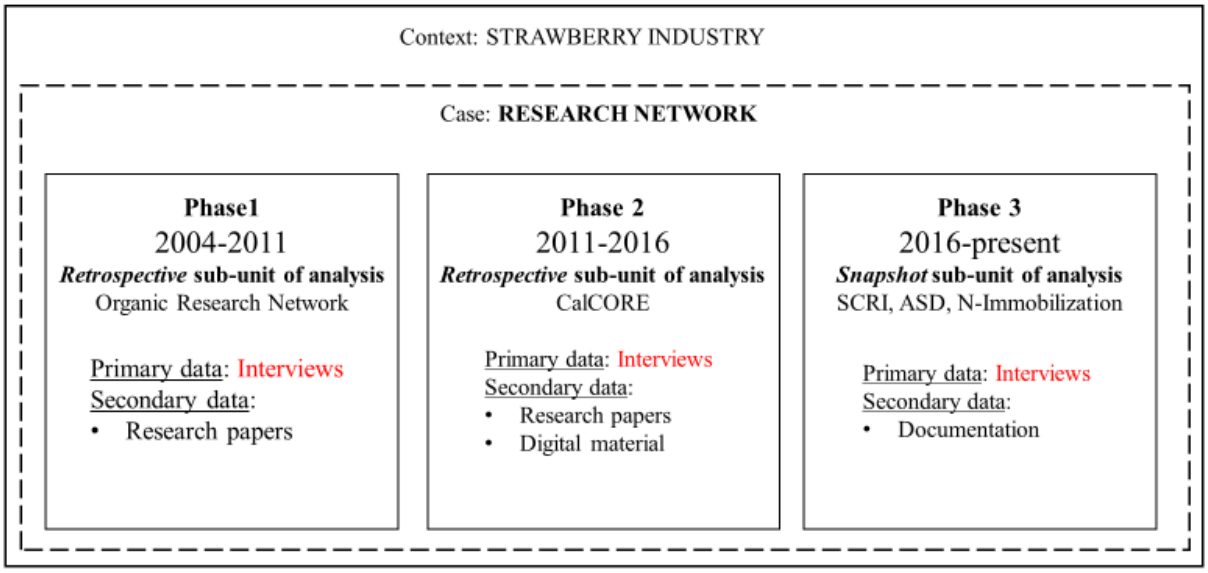

Figure 3 The research design of the case (organic research network) along with the sources of data utilized in each case. The case includes three nested sub-units of analysis -two retrospective (past) and one snapshot (contemporary). Interviews (primary data) are the common source of data for all the three cases. For the first phase (retrospective) research papers are used as a secondary source of data. The same is happening with the second phase (retrospective) with the addition of digital material. For the third phase (snapshot) documentation is used as secondary data.

3.4.1. PRIMARY DATA

For this research, semi-structured and open-ended interviews were conducted in order to collect the primary data. As mentioned in the previous sub-chapter, the interviews are common for all the three sub-units (Figure 3). This happened for reasons of limited resources, proximity and the overall availability of the involved actors.

The interview list includes 17 network actors in total. The involvement and the role of the actors in the network varies accordingly. More specifically:

- 5 scientists from the UCSC.
- 3 extension agents from University of California Cooperative Extension (UCCE).
- 1 employee from the Agriculture and Land-based Association (ALBA).
- 1 scientist for the University of California, Monterey Bay.
- 1 employee from the Organic Agriculture Community (eOrganic).
- 3 organic growers from central coastal California.
- 3 employees from the agricultural private sector.

All the interviews were carried out on a volunteer basis. The interviews were recorded after verbal and written consent (Appendix A) by the participants. The identities of the participants are kept confidential. Table 1 illustrates the details regarding the professions of the interviewees, the Phases that they participated in, along with the type and the number of interviews for every one of them.

Table 1 The interview list with the profession of each interviewee, the institution or company they are affiliated with, the Phases they participated in, along with the number and the type of interviews.

Interviewees	Institution/Company	Participation (Phases)	Number of Interviews	Type of Interviews
1. Associate Researcher	UCSC	1, 2, 3	2	Open-ended & semi-structured
2. Junior Specialist	UCSC	2, 3	1	Semi-structured
3. Professor	UCSC	1, 2, 3	1	Semi-structured
4. Extension Agent 1	UCCE	1, 2, 3	1	Semi-structured
5. Employee	ALBA	1, 2	2	Open-ended & Semi-structured
6. Director	Private sector (Ex. UCCE)	1, 2	1	Semi-structured
7. Extension Agent 2	UCCE	1, 2, 3	1	Semi-structured
8. Field and Laboratory Technician	Cal State MB	2, 3	1	Semi-structured
9. Employee	eOrganic	2	1	Open-ended
10. Organic and Conventional Strawberry Grower	-	1, 3	1	Open-ended
11. Organic Berry Grower	-	1, 2	1	Open-ended
12. Entomologist	Private sector (Ex. UCSC)	1, 2	1	Semi-structured
13. Social Scientist	UCSC	2	1	Open-ended
14. Extension Agent 3	UCCE	1, 2, 3	1	Open-ended
15. Diversified Organic Grower	-	1, 2, 3	1	Semi-structured
16. Employee	FarmFuel	2, 3	1	Open-ended
17. Emeritus Professor	UCSC	1	1	Open-ended

A general protocol was followed for the semi-structured interviews that intended to cover all the aspects of the network's function (Appendix B). For the growers (Appendix C) and for the private sector employees (Appendix D) a different protocol was followed because of their different role in the network. Additionally, instant adjustments had to be made for the more talkative interviewees, by adopting open-ended strategies in a more casual manner. Each interview was conducted only once, except with two participants with whom additional interviews were conducted in order to clarify certain information.

3.4.2. SECONDARY DATA

In order to enrich the analysis of the case with different viewpoints, we drew upon data from secondary sources such as research papers, digital material and reports. Each of the above mentioned secondary sources represent a different viewpoint point for the analysis (Thomas, 2016; Creswell and Creswell, 2018). More specifically:

i. **Research papers:** All the research published by the researchers of the network. This material concerns the two retrospective sun-units of analysis because the present research is not published yet.
ii. **Digital material:** Websites, uploaded videos. This type of material was available only for the two retrospective sub-units of analysis.
iii. **Documentation:** Internal documents regarding the present research activity and state of the network. This material concerns the snapshot sub-unit of analysis.

3.5. DATA ANALYSIS PROCEDURE

A major methodological issue for the analysis of the data derives from the complexity of the research design. There are many ways and tools (software) of analysis based on different approaches (Miles, Huberman and Saldana, 2014). In this research, the data analysis procedure was based on Creswell's (2018) approach for analyzing qualitative data. More specifically:

- Step 1: Preparation and organization of the gathered data.
- Step 2: Reading and looking the gathered data.
- Step 3: Coding of the data.
- Step 4: Generating a description and themes (by using the coding).
- Step 5: Representing the description (create the narrative). Explain the case based on the analysis.

After gathering all the data (step 1), an edited transcription was conducted for the 2nd step. In order to create a reasonable narrative with a chronological sequence, the coding procedure (step 3) was divided into two parts. The first part concerned the separation of the data according to the three phases of the network. For the second part, each phase was coded, and a description was generated based on the coding of each phase.

The overall analysis was divided into two chapters. The Empirical Findings and the Discussion chapter. The Empirical Findings chapter includes the description of the case, which presents the network's narrative along with the research activities of each phase and the additional findings about the different actors, characteristics and outcomes of the network (Figure 4). In order to have a better understanding of the case, an additional chapter with the region's characteristics was introduced before the Empirical Findings chapter.

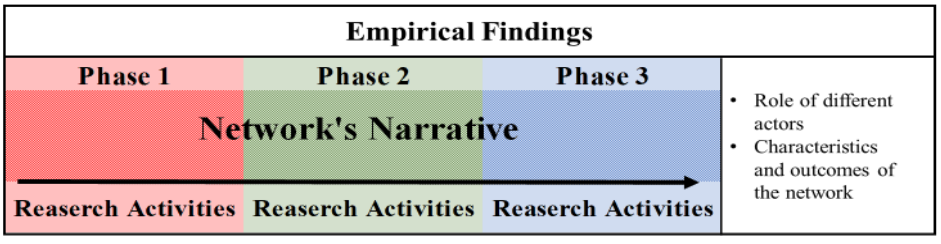

Figure 4 The Empirical Findings chapter includes the network's narrative along with the research activities of each phase and additional information about the different actors and the characteristics and outcomes of the network.

4. CASE STUDY REGION

4.1. AGRICULTURAL PRODUCTION OF CALIFORNIA

California's agricultural production includes more than 400 agricultural products. More specifically, California produces two thirds of the country's nuts and fruits and over one third of its vegetables. For 2017 the top producing commodities of California were:

1. Milk and dairy products: $6.56 billion
2. Grapes: $5.79 billion
3. Almonds: $5.60
4. **Strawberries: $3.10 billion**
5. Cattle and Calves: $2.53 billion
6. **Lettuce: $2.41 billion**
7. Walnuts: $1.59 billion
8. Tomatoes: $1.05 billion
9. Pistachios: 1.01 billion
10. Broilers: $939 million

Over 76.700 farms operated in California in 2016. The average size of a farm was 331 acres in 2016, below the 442 acres, which is the national average. Over 27% of farms in California generated sales over $100.000, which is greater than the national average. The exports of Californian products for 2016 reached $20.04 billion. Some of the export commodities were wine, almonds, walnuts, pistachios and dairy products (California Department of Food and Agriculture, 2018).

4.2. STRAWBERRY PRODUCTION OF CALIFORNIA

California grows about 88% of the country's and 20-30% of the world's strawberry production on approximately 35,000 acres along the California coast. California strawberries are exported over 30 countries (California Strawberry Commission, 2018).

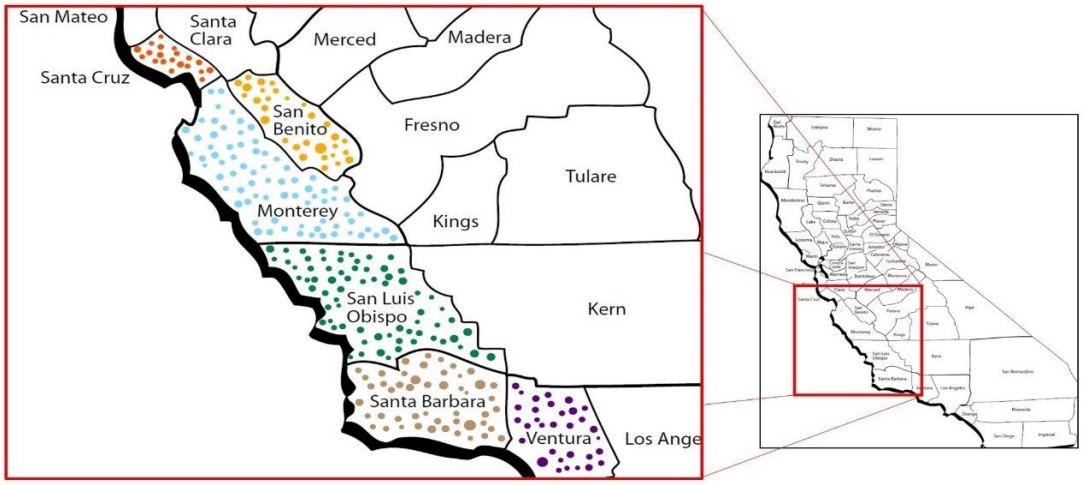

Figure 5 Santa Cruz, Monterey, Saint Luis Obispo, Santa Barbara, Ventura and San Benito of the central coast are the six main strawberry production counties of California (California State Association of Counties, 2018).

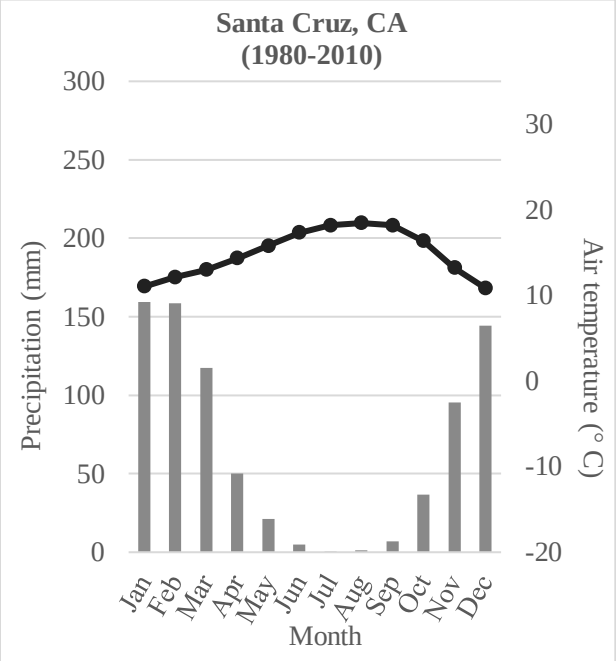

Figure 6 Santa Cruz area precipitation and air temperature data from 1980 to 2010 (U.S. Climate Data, 2018).

The main strawberry production counties are Santa Cruz, Monterey, Saint Luis Obispo, Santa Barbara, Ventura and San Benito of the central coast of California (Figure 5). The Mediterranean climate along with the soil type favors strawberry production in the area of central coast (California Strawberry Commission, 2018). The mild moist winters along with the moderate summers (Figure 6) allows an extended cultivation period for strawberries. Strawberry harvest last almost 9 months usually by starting late March until -sometimes- November (California Department of Food and Agriculture, 2018).

Organic strawberry production and acreage increased the last 15 years (Figure 7). At this point the organic strawberry acreage represents 11.8% of the total acreage.

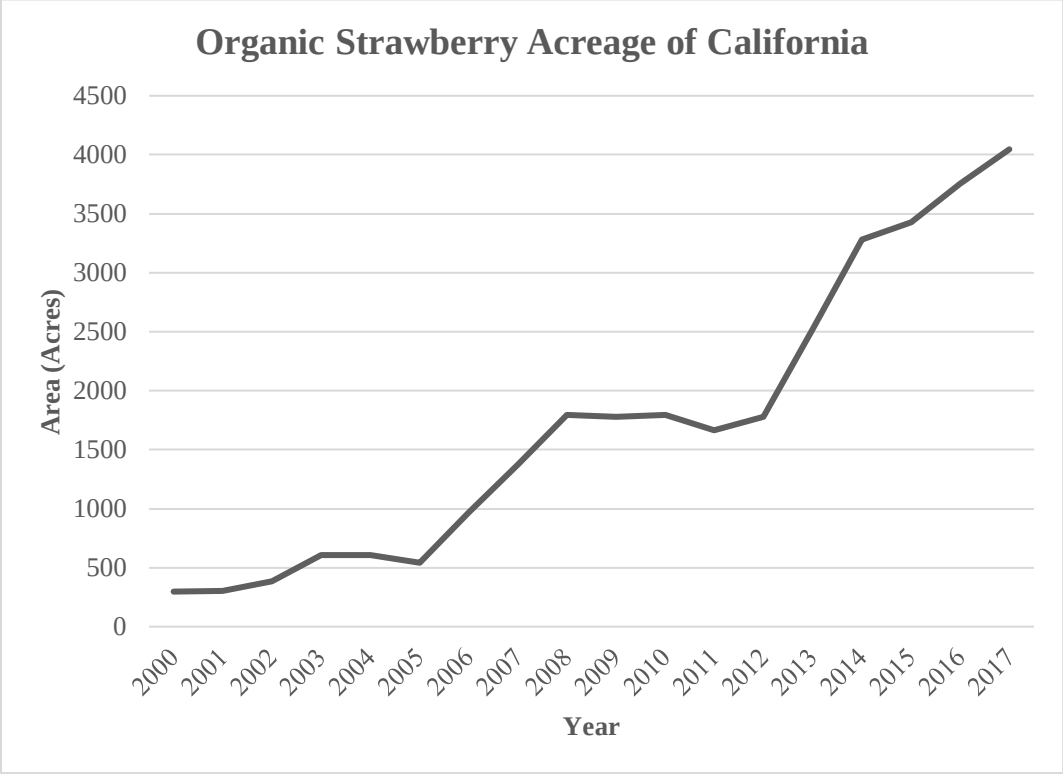

Figure 7 The organic strawberry acreage of California from 2000 until 2017 (California Strawberry Commission, 2018).

4.3. STRAWBERRY PRODUCTION ISSUES

4.3.1. SOIL BORNE DISEASES

For the strawberry production of California, soil borne diseases are reported as the most constraining (Lloyd, 2011). The harvest period and thus the productivity can be decreased dramatically due to soil borne diseases. There are three major soil borne diseases for strawberry:

Verticillium dahliae: Verticillium wilts occurs globally but mainly in temperate regions. Verticillium attacks more than 200 species of plants like strawberries, vegetables, field crops and forest trees. Some of the infection symptoms are gradual wilting, defoliation or sudden collapse and death of the whole plant (Figure 8). Its initial appearance in a field is mild and local. In the coming years, the inoculum increases, and the attacks become more widespread and severe (Agrios, 2005).

Figure 8 Verticillium dahliae symptoms in strawberry plants in California (Bolda and Steven Koike, 2013b).

Fusarium oxysporum: Fusarium wilts affect and cause severe losses on flowers, most field crops, vegetables and plantation crops such as banana, sugar cane and coffee. Its symptoms are almost the same to *V. dahliae* (Figure 9). The pathogen is most severe under high soil temperatures and greenhouses. *F. oxysporum* is capable of causing significant damage to strawberry plants as long as major economic losses in the strawberry cultivation (Agrios, 2005).

Figure 9 *Fusarium oxysporum symptoms in strawberry plants in California* (Bolda and Steve Koike, 2013).

Macrophomina phaseolina: The charcoal rot, is one of the current issues of the strawberry production in California. The pathogen attack also nuts, cabbage, vegetables and other field crops. This fungus causes wilting, stunting, drying and death of foliage (Figure 10). The symptoms increase if the plant is under stressful conditions (Bolda and Steven Koike, 2013a; Santos, Chamorro and Medina-mínguez, 2016).

Figure 10 Macrophomina phaseolina symptoms in strawberry plants in California (Bolda and Steven Koike, 2013a).

4.3.2. METHYL BROMIDE BAN

Bromomethane (CH_3Br) is a colorless and odorless soil pest control fumigant known as methyl bromide. Its applications include a wide variety of pests such as fungi, nematodes, weeds and nematodes. The chemical is injected about 60 cm deep into the soil in order to sterilize it before the strawberry planting. Despite the plastic mulch coverage, 50-90% of the methyl bromide is released in the atmosphere. Bromomethane is a toxic substance, which causes damage to respiratory and nervous system of mammals, especially at the fumigation site. Moreover, as defined by the Montreal Protocol in 1991, methyl bromide is a Class I ozone depleting substance (US Environmental Protection Agency, 2006).

Anaerobic Soil Disinfestation (ASD)
Definition: ASD is a technique that creates anaerobic soil conditions by incorporating decomposable soil amendments (grass hay, rice bran, molasses etc.) covered by polyethylene mulch and irrigated to saturation.
How it works: The available carbon from the amendments works as a food source for soil microbes. As a result, the soil oxygen is reduced with water filling the soil pores and the polyethylene prevent the gas exchange with the atmosphere. This process creates anaerobic conditions (almost two weeks) while there is a significant accumulation of toxic byproducts and other volatile compounds. The result of this process is the decrease of soil-borne pests.
Other effects: ASD treatment enhances populations of beneficial biocontrol microbes in soils, which also likely play a role in the effectiveness of treatment.

Box 1 Anaerobic Soil Disinfestation definition and characteristics (Shennan et al., 2014).

California strawberry growers have relied on methyl bromide since 1961. Over 90% of methyl bromide use in California is for pre-plant soil fumigation mainly in strawberries, nursery crops, nut and fruit trees and grapes. Despite the heavy dependence on methyl bromide, a phase out was scheduled for California -starting in 2005- because of its above mentioned environmental impact. Methyl bromide was available to Californian strawberry farmers until 2016 (Guthman, 2017; UC Davis, 2018).

Because of the Montreal Protocol, both non-chemical and chemical alternatives were developed throughout the phase out years. Among chemical alternatives, Chloropicrin is the main fumigation substance in strawberry production. For the non-chemical, cultural practice such as rotations (Gliessman *et al.*, 1996) and Anaerobic Soil Disinfestation (Box 1) are used mainly by the diversified smallholder and the specialized organic strawberry producers (Shennan *et al.*, 2013).

4.3.3. NITROGEN LEACHING

The last 20 years, high nitrate concentration in aquifers has been reported globally. This phenomenon is mainly a result of agricultural practices (Guimerà *et al.*, 1995). The federal water drinking standard threshold exceeded in the coastal valleys of California. 254,000 people in Tulare Lake Basin and Salinas Valley face health risks. As a result, the regulation of strawberry production became stricter in order to deal with the nitrogen leaching issue. (Bottoms *et al.*, 2013; Tomich *et al.*, 2015).

Strawberry production in California is using sprinkler irrigation during transplants' establishment and drip irrigation afterwards. The management of Nitrogen usage in organic strawberry production is a challenge because of the long growing period and the fact the transplant is followed by rainy season. Additionally, the unpredictability of N mineralization makes the management effort more difficult (Muramoto *et al.*, 2003).

4.4. HISTORICAL FARMING CONTEXT OF THE REGION

The central coast of California is considered a hot spot for organic farming and research due to a variety of different reasons. Top-down and bottom-up driving forces impacted both the conventional and organic farming in California. In order to have a better understanding of the farming context of California and more specifically of the central coast, a timeline of some of the important events regarding the organic farming research, movement, market or practice is presented below:

1938: United Stated Department of Agriculture (USDA) publishes a manual on organic agriculture.

1965: *New Age Natural Foods* store in San Francisco.

1967: Alan Chadwick is hired to create a Student Garden Project in Santa Cruz. Later becomes the Apprenticeship Training in the techniques of organic farming, gardening and agroecology.

1971: Chez Panisse Restaurant is opened in Berkeley, California. Creates a market for organic products in Bay Area. Chez Panisse is credited with inventing the California Cuisine.

1974: California Certified Organic Farmers if founded (CCOF).

1974: Veritable Vegetable, now the oldest distributor of certified organic produce, opens in San Francisco.

1978: Governor Jerry Brown signs the Direct Marketing Act.

1980: USDA publishes the Report and Recommendations on Organic Farming to increase communication between organic farmers and the U.S. Department of Agriculture.

1981: Stephen R. Gliessman in hired by the UC Santa Cruz Environmental Studies. **Gliessman founds the Agroecology Program.**

1981: The first Ecological Farming Conference is held in California. Forty-five people attend.

1983: California Association of Family Farmers is founded (CAFF).

1987: Swanton Berry Farm becomes the first certified program in California.

1990: UC Santa Cruz Agroecology Program researcher Sean Swezey, Steve Gliessman and others publish the first organic strawberry conversion study. The study is conducted on Jim Cochran's Swanton Berry Farm.

1997: Steve Gliessman publishes Agroecology: Ecological Processes in Sustainable Agriculture.

1998: Swanton Berry Farm becomes the first organic farm to sign a contract with the United Farm Workers.

All the above historical events -one way of another- played a role in the development of the present framework of organic farming in the region (Farmer, 2012).

5. EMPIRICAL FINDINGS

This is the Empirical Findings chapter, in which the three phases of the case are described based on the interviewees and the secondary data. Each phase of the network is described along with details about the initiation of the network, the involved actors, the goals, the research activities and achievements of the network for each phase.

5.1. PHASE 1

The organic research network pre-existed in an unofficial form in the area of central coast. At the beginning a group of researchers tried to organize a more distinct form of network. The whole effort became more solid when they decided to apply for funding. *"There was no, short of cohesion to it. It was just short of ad hoc collaborations on particular projects. We would meet intermittently but it didn't go very far until we really started to raise money, because everybody is busy and so finding time for another meeting -without there being some direct tangible benefit from it- was difficult." (Professor, UCSC).*

The network officially started in 2004 by UCSC (Table 2). The first grant award -which represents the 1st phase of the network- came to link the organic research with UCCE and also bring growers to the process. The initial goal of the network was to create more organic systems by bringing different aspects of organic production together and establish a knowledge network between different actors of organic strawberry production. More specifically to build an organic community, increase collaboration between different actors, improves linkages and knowledge exchange.

As mentioned previously, the main limitations of strawberry production in the area was (and still is) soil borne diseases and nitrogen management. In order to cope with these issues, growers were looking for land without strawberries or were applying long rotations between strawberry crops. With the methyl bromide phase out the situation became even more difficult. *"In the process of looking for organic management strategies, we developed an interest in other alternatives to fumigants, since the strawberry industry was so reliant on them." (Professor, UCSC).*

One of the fumigant alternatives that UCSC researcher tried to investigate was ASD. Phase 1 included research activities on ASD, crop rotations and other emerging issues of organic strawberry production. More specifically, over 10 studies on soil borne disease (ASD, Crop rotations and mustard cover crops), nitrogen (N management, Ni fixation) arthropod management (Alfalfa traps, European parasitoids and hedgerows) and financial evaluation were conducted during the 1st phase of the network (Table 2). UCSC was the main facilitator of the network with the collaboration of UCCE, Center of Agroecology and Sustainable Food Systems (CASFS), USDA-Agriculture Research Service (ARS), one researcher for the UC Davis and the University of New Hampshire. In addition, the general network included central coast growers and strawberry industry representatives as showcased in Table 2. At this phase they had 3 or 4 farmers as collaborators, they established a trial at CASFS and also to a conventional farm because *"The fund required us to compare ASD against fumigated plot, so we had to work with conventional growers with that" (Associate researcher, UCSC).*

The use of ASD included many technical implications and financial difficulties and like any new technique it was difficult to convince growers for its effectiveness. *"We can't adopt new principles unless they are easy. They have to work. They have to be effective, affordable and available. So, that's what we are doing." (Employee, FarmFuel).* Till 2007 there were no growers from the wider network working with ASD until they started to communicate the information with presentations and meetings. 2010-11 was the year that made difference regarding the application of ASD. UCSC, Monterey Bay Academy (MBA) in Watsonville and California Strawberry Commission (CSC) conducted a trial on ASD. With that trial they demonstrated the potential of ASD against Verticillium wilt and a large private berry company trusted the data and started gradually to apply the technique.

The research network of Phase 1 was part of the wider strawberry network of the central coast which could not be easily defined due to its complexity. *"Network is kind of an ambiguous think because there is no membership or something similar, but it is very important. In some sense it's kind of social capital and for me it's the most precious thing that I am working hard to maintain. It's like friendship!" (Associate Researcher, UCSC).* Regarding the design and the implementation of the research the network there were meetings at least once or twice a year with the direct collaborators. For the knowledge dissemination in the wider networks there were various meetings, workshops, presentations and field days facilitated mainly by UCCE. Apart from the above ways of communicating, the majority of the interviewees agreed that the casual communication with each other was the most important way of exchanging knowledge.

Table 2 Overview of the Phase 1 of the Organic research Network. The table includes the period of the 1st phase, the area of the network's activities, the general goals of the network, the specific research activities, the participants of the direct and the general network and the other outcomes of the network.

<table>
<tr><th colspan="5">Phase 1
Retrospective sub-unit of analysis
Organic Research Network</th></tr>
<tr><th>Period</th><th>Area</th><th>Goals</th><th>Research Activities</th><th>Participation</th></tr>
<tr><td>2004-2011</td><td>Central coastal California
- Santa Cruz
- San Benito
- Monterey
- San Luis Obispo
- Santa Barbara
- Ventura</td><td>- Community building
- Increase Collaboration
- Improve linkages
- Knowledge exchange</td><td rowspan="3">Soil Borne Disease Management
- Crop rotation
- ASD
- Mustard cover crops
Nitrogen Management
- N management (Strawberries and Broccoli)
- N fixation (Legume Cover Crops)
Arthropod Pest Management
- Alfalfa traps and European parasitoids (Lygus bug)
- Hedgerows (Beneficial Insects)
Financial evaluation of the proposed applications</td><td rowspan="3">Direct network
- UCSC (Main facilitator)
- UCCE
- 3 core growers
- CASFS
- USDA-ARS
- University of New Hampshire
- UC Davis
General network
- Central coast growers
- Private sector</td></tr>
<tr><td colspan="3">Other Outcomes</td></tr>
<tr><td colspan="3">- Organic Strawberry Production Manual
- A review to more sustainable practices since 1980s</td></tr>
</table>

5.2. PHASE 2

By the end of the 1st phase, the network members identified the most important research needs concerning the organic strawberry production. Some of the identified research objectives were soil borne disease management, N management, irrigation, soil fertility, fruit quality and crop rotation and pest management. In order to put all the different research objectives together and expand the network, a fully integrated rotation study was developed for the 2nd phase.

The study for the 2nd phase was called CalCORE and it was funded by USDA and the program Organic Agriculture Research and Extension Initiative (OREI). The program required to have growers involved within the research and do extension beyond state. Similar to the 1st phase, UCSC was the main facilitator of the network with the collaboration of UCCE, 6 core growers, FarmFuel, ALBA, USDA-ARS, UC Davis, San Jose State University (SU), CalState Monterey Bay, DNDC-ART, eOrganic and CSC. In addition, the general network included central coast growers and strawberry industry representatives as showcased in Table 3.

The CalCORE phase was the natural extension of what was happening in the 1st phase along with the enhanced participatory character. *"What it happened during the 1st organic grant was that we've done a lot of farm work looking at fertility management, looking at insect management, looking at disease management. What the group wanted to do after that grant, is to put all these pieces together. That's what led to the idea of mother trial where we have this complex design of rotations of different lengths with different rotation crops plus different fertility disease management strategies." (Professor, UCSC).*

They used the Mother/Baby design to see whether the results in Mother field were reflected on the growers' fields and at the same to tame to have growers involved with the research procedure. In a replicated field trial (Mother), they compared 2 versus 4 year rotations with different crop combinations. Superimposed on the rotations were the cover crop and the fertility treatments. Six core growers (part of the direct network) had the opportunity to choose a sub-set of these treatments to test on their farms (Baby trials) and compare to their own management practices. Both the scientific and the community element were really important.

From the scientific point of view, a participatory Mother/Baby design does not fall into the traditional way of conducting an experiment. *"Participatory research was considered as messy and time consuming. That it wasn't really science." (Professor, UCSC).* However, this design provided a wider perspective of what really can be applied in different situations with different microclimate and soil conditions. "*It allowed us to do kind of more detailed work on the mother site and then you can extend that out, in more realistic circumstances, for the baby sites. With the babe site you could do similar work but in a different context. I think it has a lot of merit." (Entomologist, Private sector. Ex. UCSC).*

In addition to the scientific importance of the Mother/Baby design, the social element of the grower's participation was appreciated from all sides. *"Some relationships were new in CalCORE and some were old, and it was interesting to see this dynamic. It gave us the opportunity to see what is happening in the field and the relationship between scientists and farmers." (Junior Specialist, UCSC).* Not only the exchange of practical knowledge, but the benefits that were

coming out of the casual interaction. *"It was certainly helpful (the collaboration) because we've learned a lot of lessons through trial and error and I think, the main benefit to me is just being of an informal information loop. Just standing on the margin of the field and talk (with the researcher) or hear how other farmers deal with problems." (Diversified Organic Farmer).*

Like the 1st phase, knowledge dissemination within the wider network was really important for CalCORE. *"We were trying to disseminate any outcomes by increasing the audience." (Associate Researcher, UCSC).* Meetings, workshops, presentations and field days facilitated mainly by UCCE. The workshops were well attended (30 to 50 participants) and concerned matters like fertility, pest, soil borne disease management and ASD practice. In addition, 4 webinars about technical issues were organized and 3 YouTube videos were created by eOrganic. *"We were a collaborator in their proposal (for funding) with the idea that we would help bring their outreach material to a wider audience." (Employee, eOrganic)*

Regarding the wider farming community of the central coast, CalCORE tried to include the Spanish speaking farming community, hence the participation of ALBA. *"We've made special effort to try and involve the Spanish speaking farming community by working with the organization ALBA." (Professor, UCSC).* ALBA participated both in the general network by organizing field days and also one of ALBA's growers hosted one of the six baby trials in his field. *"ALBA was the voice of Latino farmers within network, because they are really important demographic in California. This kind of relationships are really important for these farmers (Latinos), because they are very important demographic, fast growing group of farmers in California, yet they have more difficult time accessing typical resources than other farmers." (Employee, ALBA).*

Table 3 Overview of the Phase 2 of the Organic research Network. The table includes the period of the 2nd phase, the area of the network's activities, the general goals of the network, the specific research activities, the participants of the direct and the general network.

Phase 2 ***Retrospective* sub-unit of analysis** CalCORE				
Period	**Area**	**Goals**	**Research Activities**	**Participation**
2011-2016	**Central coastal California** - Santa Cruz - San Benito - Monterey - San Luis Obispo - Santa Barbara - Ventura	**- Build upon the Phase 1 results** **- Coordination of Phase 1 research activities** **- Expand and strengthen the network** **- Increase knowledge exchange and grower participation** (Spanish speaking farming community) **- Knowledge dissemination on national level**	**Mother-Baby Design** - Participatory research design with one Mother trial and 6 baby trials **Compare 2 and 4-year rotations for:** - Yield - Soil borne disease and pest management - C sequestration and Greenhouse emissions **Compare ASD, Mustard Seed Meal (MSM) and crop rotation** - Soil borne diseases **Financial evaluation of the proposed applications**	**Direct network** - UCSC (Main facilitator) - UCCE - 6 core growers - FarmFuel - ALBA - USDA-ARS - UC Davis - San Jose SU - CSU Monterey Bay - DNDC-ART - eOrganic - CSC **General network** - Central coast growers - Private Sector

5.3. PHASE 3

Phase 3 is the ongoing stage of the network but without the Mother/Baby design due to limited financial resources (lack of funding). However, the major focus is still integrated approaches to soil borne diseases, ASD and N immobilizations. Regarding the ASD, the network is expanded in the states of Washington, Florida, North Carolina and Tennessee. The direct network includes UCSC as the main facilitator, UCCE, CASFS and USDA-ARS WA (Table 4).

The majority of the participants stated that they would prefer to continue with the Mother-Baby design if they had the funding and try to do different types of rotations with the farmers. Although they are not doing the same things, the good relationship still exists. *"Direct collaboration is not there anymore but it feels like that we did established a network also with extension and industry groups" (Junior Specialist, UCSC).*

Table 4 Overview of the Phase 3 of the Organic research Network. The table includes the period of the 3rd phase, the area of the network's activities, the general goals of the network, the specific research activities, the participants of the direct and the general network.

Phase 3 ***Snapshot* sub-unit of analysis** SCRI, ASD, N-Immobilization				
Period	**Area**	**Goals**	**Research Activities**	**Participation**
2016-Present	**Central coastal California** - Santa Cruz - San Benito - Monterey - San Luis Obispo - Santa Barbara - Ventura **Four other states** - Washington - Florida - North Carolina - Tennessee	**- Build upon the Phase 2 results** **- Expand and strengthen the network** **- Expand research activities to other states**	**SCRI** - Integrated approaches to soil borne disease management in Strawberries. **ASD** - Refining anaerobic soil disinfestation for disease management in strawberry and apple production. **N immobilization** - Immobilizing mineralized nitrogen from cole crop residues using organic amendments.	**Direct network** - UCSC (Main facilitator) - UCCE - CASFS - USDA-ARS WA **General Network** - Central coast growers - Private Sector

5.4. THE SIGNIFICANCE OF THE REGION AND UCSC

Agricultural research in UCSC is part of the Department of Environmental Studies and it is not considered land-grand Agricultural School; hence they do not have their own farm for experimentation like other Agricultural Schools. As a result, they need to collaborate with growers in order to conduct some of their experiments at growers' fields. *"We don't have our research farm, so we have to work with local growers and this is strength and weakness at the same time. (Associate Researcher)*. That alone was a good baseline for collaboration between the different actors and it came into fruition in the 1st phase of the organic research network. *All that were possible because this campus wasn't a traditional agricultural school" (Associate Researcher)*.

Additionally, the historical context of the area regarding the organic research and the hippie culture of the area seem to have affected the research of UCSC. *"It's kind of unusual place to do research." (Associate Researcher, UCSC).* As mentioned in sub-chapter 4.4, UCSC was the first

university in the US of including an Agroecology program in its curriculum. *"There's a lot of change in the last several years and decades maybe, but you have to keep in mind that Santa Cruz is kind of special place for organic, because that's were a lot of people who understand, practice and enjoy organic, live. There's a lot of interaction and learning. Santa Cruz has been an outlier with regards to the rest of the country" (Extension Agent 1, UCCE).*

Moreover, there is an accumulation of wealth in the area and consumers tend to have higher degrees of education. On top of that, the close proximity to the Silicon Valley played an important regarding the market opportunities and the available resources. *"There are market forces at play that want more sustainable food production and Santa Cruz is certainly a hub of those forces for sure." (Entomologist, Private sector. Ex. UCSC).*

5.5. THE ROLE OF UCCE

UC Cooperative Extension belongs to the land-grant universities (owners of federal land) and plays an important role in creating and communicating knowledge. They are the ones who are going to communicate with the regulatory authorities regarding matters of the agricultural sector in California. The UCCE is a collaborator with multiple roles, both in the direct and the general network. Regarding the general role of UCCE is to communicate knowledge to the growers by organizing big group meetings, meetings with specialized themes (plant pathology), small group meetings, one-on-one individual outreach, media (articles, webinars and blogs).

The other states are not similar to California. In addition to the typical role of extension, UCCE conducts research with the collaboration and of the growers. *"All of our research is working with growers one way or another." (Extension Agent 3, UCCE).* To the rest of the US, the Extension plays the role of communicating the knowledge from the Universities to the growers. The diversified agricultural context of California created gradually a different and more demanding type of extension; hence UCCE has this enhanced role of conducting research. *"When people come from other states expect us to be doing grant work, while we generate research. That's the way it works here. It works like that because of the wide diversity of crops that we have. No one is going to know to how to manage all these in a university level. It needs to be done at local level by people who are capacitated to do so." (Extension Agent 2, UCCE)*

The connection with UCSC is well appreciated by both sides. In many cases UCCE and UCSC conduct research together. Concerning the direct network, UCCE gave to the project the outreach opportunities by co-organizing workshops, hosting meetings and field days in order communicate information to the general network. This collaboration existed in an unofficial form before 2004. *"We connected the network with the growers but also, to some extent keep real because we have all the background with the growers and kind of what they need and what they are looking for. Of course, the grower is going to know, but just kind of in a broader sense. Because we communicate with so many growers, we can give less specific and more general and probably more applicable from a research side view" (Extension Agent 2, UCCE)*

In terms of knowledge dissemination by UCCE, it seems that there is a gap regarding the smallholder -usually organic- growers of California. ALBA is one of the organizations that one way or another fills this gap. By putting all these different actors together in a more coordinated

way, the research network gave the opportunity to a wider spectrum of growers to catch up with the new organic farming techniques. *That's how I see this (network) benefiting them (smallholders), help put some of these techniques in their radar." (Employee, ALBA).*

Overall UCCE represents a realistic perspective of the situation of strawberry production and the organic market in California. The UCCE agents seem to have a good grasp of the growers' actual needs and they are really aware regarding the process of communicating and implementing new environmentally friendly techniques. *"I call this adoption process, the rule of three Es. It has to be economical, effective and environmental. Once you hit all three it's easier (for the farmer) to adopt. Because if you have an issue with one of those three, it means extra work" (Extension Agent 1, UCCE).* This understanding is well appreciated by both the growers and the UCSC researchers.

5.6. THE ROLE OF PRIVATE SECTOR

As previously mentioned, the close proximity to Silicon Valley and the fact that the central coast is a hot spot of organic research and production plays an important role. Not only the impacts of the market and the willingness of the consumers to buy quality agricultural products play a crucial role but the close relation to new technological achievements and innovations is also important. Almost all the interviewees referred to this connection one way or another. The farming industry in the area is diverse and there are many companies who are related to the organic strawberry production. As the consumers interest on organic products increased the last decades, the private sector tried to fil this market gap.

Like any new technique, growers were really skeptical regarding ASD for practical and mainly financial reasons. *"I feel that if there is no profitability they (farmers) will never going to make any change" (Junior Specialist, UCSC).* Private berry companies on the other hand represent a lot of acreage and they are capable of applying new techniques because of the availability of resources. In the case of central coast, a private berry company was the first who implemented ASD in commercial scale and included the technique as a part of good management practice. In this way the private sector -in some sense- legitimized the ASD method and convinced the growers of its efficiency.

The wider network includes different types of companies such as private research companies which collaborate with the university for different reasons. A strong part of the direct network was and still is FarmFuel which is the company who played crucial role in commercializing ASD. *"FarmFuel short off is the people who do the thing (ASD). We would go out and do the application. We short off commercialized ASD, mustard seed meal and things like that." (Employee, FarmFuel).* FarmFuel collaborates with UCSC from the beginning of the 2nd phase of the network. *"We work short off hand-in-hand on projects" (Employee, FarmFuel).* The general collaboration includes sharing of data, taking part in meeting and exchange insights. The growers who want to apply ASD hire FarmFuel. Depending the situation and the difficulties the company pulls different consultants to assist them. More specifically, they are bringing together all the necessary experts together to help the grower with the application of ASD.

5.7. BENEFITS FROM THE NETWORK

All the interviewees agreed that the network benefited them one way or another (Table 5). For the growers, being closer to researchers who understand their problems, is really important. The fact that they are able to access new information directly helps them to overcome issues regarding the production and the market. *"(Without the network) It would be harder for growers to get the information directly from the university." (Organic and Conventional Strawberry Grower)*. More specifically, the application of ASD lowered the risk of organic production and gave flexibility to the organic growers (shorter rotations).

Table 5 The benefits of the network for the growers, the researchers, the private sector and the knowledge creation and dissemination.

	BENEFITS
Growers	- Access to new information - Decrease production risk by applying effective organic techniques (Rotations, ASD) - Production flexibility (shorter rotations) - Knowledge exchange and interaction with growers, researchers and other involved actors
Researchers	- Realistic perspective - Implicit knowledge regarding the farming systems - Knowledge exchange and interaction with growers and other involved actors
Private sector	- Applicable organic farming techniques - Opportunity to apply environmentally friendly practices
Knowledge creation and dissemination	- Reinforcement of the relationship between the different actors - Outreach to different types of growers and inclusion of Spanish speaking community

In addition, the fact that all the research activities are large scale field experiments -with the participation of the growers- added the pragmatism that growers tend to appreciate, and researchers seem to understand that. *"I really like the field-scale approach. Not just working with pot experiments in the lab but being out in the field and see. It is so useful to see what the problems are in big scale. It is just fantastic to know how the farmers use the system. We learn from them so much, because they are the ones who deal with the problems." (Junior Specialist, UCSC).*

For the private sector, the benefits were also obvious. By implementing efficient organic techniques, strengthened the perception of organic production and lowered the risk. More specifically, the fact that ASD became a legit fumigant alternative gave a boost to organic production and market. One the other hand, the impact of private sector adopting organic technique created a positive status quo at least regarding the environmental aspect of the production.

Regarding the knowledge creation and dissemination, the network gradually brought together the different actors of organic strawberry production. By creating channels of communication, different grower groups were able to come in touch with new information, exchange ideas with

researchers and mainly exchange ideas with each other. *"At the beginning they (farmers) were reluctant to say how they managed things, there was the fear of competition. I think by the end there was a genuine interest in how each other were doing stuff." (Professor, UCSC).* Table 5 showcases all the different benefits for the different actor groups of the networks.

6. DISCUSSION

This is the Discussion chapter, in which an interpretation of the empirical findings is made based on the concept of Embeddedness. As mentioned in the sub-chapter 2.2, there are different types of Embeddedness in regard to knowledge creation and dissemination of knowledge. Literature suggests that the different types of Embeddedness enhance networks' performance but not in all the cases (Moran, 2005). There are cases within which the different types of Embeddedness could play a negative role on knowledge creation and dissemination (Dankbaar, 2004).

6.1. RELATIONAL EMBEDDEDNES

In the effort of interpreting the empirical findings, it was easily noticeable that there is a strong sense of trust between the actors of the direct network. This trust is a result of various reasons but mainly it has to do with the research set up of UCSC, at least at the beginning. As mentioned before, UCSC is not considered an Agricultural School, thus they do not own a large experimental site to conduct their research. For this reason, they collaborate with the growers by conducting field experiments in their sites. That alone created a trust between the different actors before the official initiation of the network. The different actors knew each other through everyday interaction and this played an important role in the network's function.

Except the special type of the research relationship, we have to consider the attitudes of the involved actors. Both the researchers of the UCSC and the UCCE are highly conscious about the real problems of the farmers and their efforts to survive. *"That was the reason that forced me to respect and appreciate what farmers doing and forced me to make an effort understand the system better." (Associate Researcher, UCSC). "I really believe it's important for people (farmers) to understand your motives, if they are going to trust you." (Professor, UCSC).* The same attitude also shared by the UCCE agents. *"Being close to them (farmers and industry), understanding them, knowing what their problems are, what they need, what they want, that's the key of any extension program" (Director, Private Sector. Ex. UCCE).*

At the same time the growers of the network seem to understand this mentality and appreciate it. *"It was nice to have them (researchers) around." (Organic Berry Grower)*. This appreciation and trust was not only towards the researchers and the UCCE agents, but for the other growers also. This type of trust among farmers was not there from the beginning but it came as a result of the long term interaction with each other. This long term interaction that was built throughout the different phases, improved the relationships between farmers, who at the beginning were skeptical in sharing information. *"It's super important to have a network of people who are not super secretive, and they are willing to share knowledge. You know, you share a little bit, and somebody gives you a little bit." (Organic Berry Grower).*

The fact that the network created the trust and its research provided applicable results after the 1st phase gave the confidence to the researchers to continue working with that and at the same time the growers were convinced to do something different. *"Trust and good relationship was established during the first stage of the project and the growers liked it, so we decided to expand the network." (Associate Researcher, UCSC).* Different reasons played role on building a social capital, with time being the major one. *"If you just start, by doing alternative work you will be crashed (by the established situation). You need to take time on it, to figure it out. You need to*

know the lay of the land and understand who is where and at the same time to establish your reputation in order to weather negative reactions. So, it is an investment. You are building a social capital." (Extension Agent 2, UCCE). In addition, the participatory set up of the 2nd phase of the network re-enforced the already existed trust.

6.2. STRUCTURAL EMBEDDENESS

Although Relational Embeddedness seems to explain the performance of the network at the same time the structure created by the different research projects (Phases) could possibly explain some other aspects of the network's performance. The distinct roles of each actor within the network seems to create a steadier structure for the knowledge dissemination. Moreover, the knowledge dissemination outside of the direct network and the structural role of UCCE and ALBA suggests the same. More specifically, the Phases reinforced the already structural role of UCCE and added ALBA in order to disseminate the outcomes to the wider audience. Based on this structural role, the actors of the network -mainly on institutional level- are embedded in the network.

The distinct phases of the direct network gave a structure and specific goals that enhanced the performance of the network. The fact that there are many collaborators working on same projects one way or another creates many knowledge channels towards different knowledge receivers. UCCE plays a major role on that, by communicating the knowledge to the large audience. At the same time ALBA, communicates the created knowledge to different type of growers. Both UCCE and ALBA, function as knowledge funnels that channel high level of institutional knowledge (Explicit) to wider audience. *"What that network did, it connected some really high level university research with the farmers. That doesn't always happen" (Extension Agent 2, UCCE).* The same is happening with the involvement of the private sector.

Except the structural role of UCCE, there is no official type of structure of the general network. However, progress of research activities of the direct network created an unofficial structure of actors who -one way or another- served a common purpose. *"Regardless the differences in research projects, we shared common interest of making organic farming more sustainable and that alone kept us going." (Associate Researcher, UCSC).* It seems that in some level Structural Embeddedness is complimentary to Relational Embeddedness.

6.3. THE ROLE OF GEOGRAPHICAL PROXIMITY

Except the Relational and Structural Embeddedness there are other types of Embeddedness that could explain the performance of our network. Previous work on Embeddedness suggests that the universities play an important role on knowledge creation by companies in the same region (Lambooy, 2004). In our case, our empirical findings showcase the important role of the private sector in knowledge creation and dissemination. The overall function of the strawberry industry and the fact that there is a connection between UCSC, UCCE and the private sector explains the function of knowledge dissemination. That refers to the role of companies like FarmFuel, and their role in the successful implementation of ASD. *"FarmFuel played a big role in helping make ASD available for the farmers. Which is an important result for both CalCORE and the farmers" (Junior Specialist, UCSC).*

Proximity also seems to play an important role. More specifically, all the involved actors of the network are in the same region. *"If you are close to a university campus as a grower you will connect with more research than if you are far away" (Extension Agent 2, UCCE).* All the events, common field experiments, meetings, field days made easy by the close proximity. That alone could be an explanation of the performance of the network. Additionally, the close proximity to the Silicon Valley was mentioned by almost all the interviewees as positive influence regarding the success of the network. Not only in the market sense, but also for the resources and the technological achievements that derive from the area. *"I've seen farmers welcoming and adopting technology associated with their practices. I've seen that really increased in the last decade." (Field and Laboratory Technician, CalState MB).* The matter of proximity overlaps also with the above mentioned value of the companies being in the same region with universities.

6.4. KNOWLEDGE CREATION AND DISSEMINATION

As Dankbaar (2004) suggests, different types of Embeddedness play an important role in explaining the 'knowledge processes' in networks. All these different types are not of equal importance. The same is happening in our case with Relational Embeddedness -based on casual interaction and trust- to be the most plausible explanation. Additionally, Structural Embeddedness along with the Proximity aspect are complimentary to the Relational Embeddedness as an explanation. Figure 11 is graphical representation of the different forms of Embeddedness that explain the performance of the network.

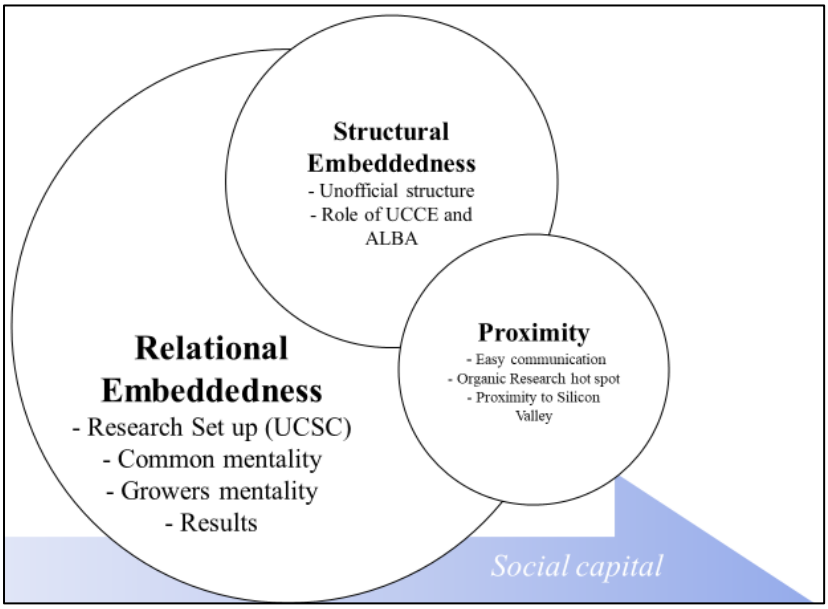

Figure 11 The Different types of Embeddedness that explain the performance of the network. Relational Embeddedness based on trust is related with the research set up of UCSC, the common mentality of the actors and the growers' mentality. Structural Embeddedness is unofficial in the case but is closely related with the role of UCCE and organizations like ALBA. Easy communication, organic research hot spot and closeness to Silicon Valley showcase the role of Proximity in the network's performance.

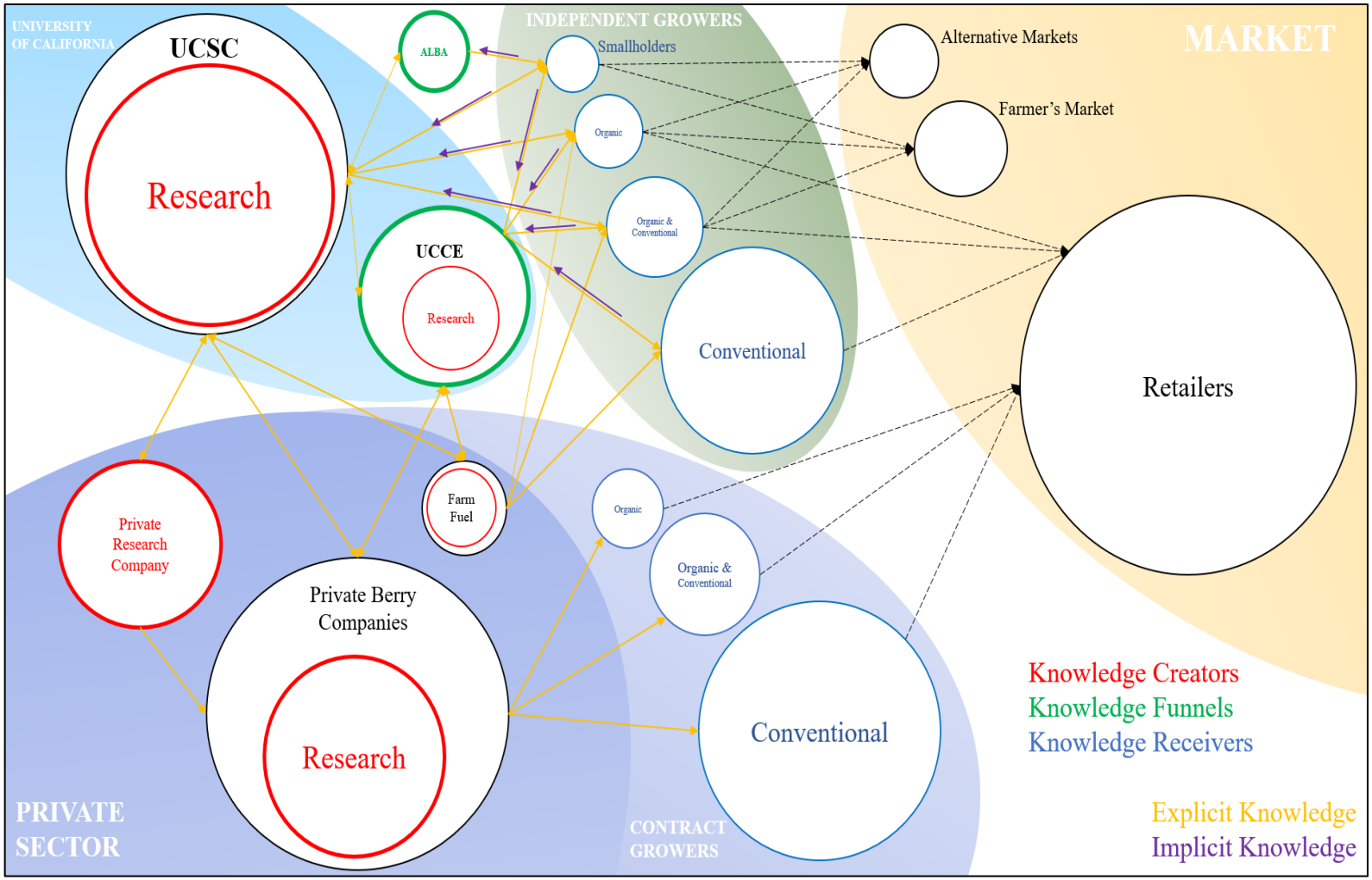

Figure 12 Knowledge flow map of the general network. The figure showcases the knowledge creation and dissemination of the network and includes the majority of the actors along with the different type of connections they have with each other. There are three different categories of actors. The knowledge creators such as, UCSC, UCCE, private research companies and private berry companies. The knowledge funnels such as, UCCE and ALBA. The knowledge receivers which are the different types of growers (both under contract of independent). The light blue color includes the UCSC and the UCCE. The light yellow includes all the different types of markets. The light purple color includes the private companies. The yellow arrows showcase the explicit knowledge that derives from the knowledge creators and the purple knowledge showcase the implicit knowledge the derives from the growers

Figure 12 showcases the knowledge flow between the different actors of the network. More specifically, the network consists of knowledge creators with red color (those who conduct the research), knowledge funnels with green color (those who channel the knowledge) and knowledge receivers with blue color (those who receive the knowledge). In our case, UCSC, UCCE and Private companies are creating knowledge by conducting research. UCCE has a double role by being both knowledge creator and funnel. Complementary role to UCCE is ALBA by communicating the knowledge to different audience (smallholders). Knowledge receivers are the growers of the wider network (smallholder, organic, organic/conventional and conventional). The growers are separated into the independent and contract growers.

The yellow arrows in Figure 12 represent the explicit knowledge created by the knowledge creators (red) of the network. The double-sided arrows showcase the bidirectional flow of the knowledge. The typical example for that is the connection between UCCE and UCSC and their reciprocal relationship by conducting common experiments and other activities. Most of the yellow arrows though are unidirectional, especially in the connection with the knowledge receivers (blue). The purple arrows on the other hand, showcase the effect of the network's activities in the direction of knowledge. More specifically, the participatory nature of the research activities creates this bidirectional flow of knowledge.

What the research network actually did, was to connect all the different actors together by enhancing the knowledge dissemination. The connections became steadier as the time passed and the participatory nature of the research activities re-enforced the communication. The researchers had the opportunity to take insights from the growers (implicit knowledge) and give high level information (explicit knowledge) (Figure 12). Crucial role to this exchange played the knowledge funnels by turning the high level knowledge to a more 'digestible' form for the growers. Additionally, the network gave the opportunity to smaller growers to have access to innovative knowledge. This contribution was very important especially for the smaller independent growers. For the contract growers, access to knowledge is easier because they are embedded to the firm structure of private companies.

In our case the development of the knowledge network reinforced the existed communication between the different actors by creating a distinct structure of knowledge channels. These channels are the infrastructure for the knowledge to be disseminated. Additionally, the common goals and the mutual trust facilitated the process. The wide range of the Embeddedness concept explains the network's performance in regard to trust (Relational Embeddedness), specific roles (Structural Embeddedness) and geographical proximity.

6.5. THE VALUE OF KNOWLEDGE NETWORKS

An agricultural knowledge network build upon trust and sincere relationships is an important asset for tackling emerging farming and environmental issues. Taking into consideration all the emerging issues like resources depletion (Rockström *et al.*, 2009), researchers and growers will not always have the luxury of alternatives, like fumigant alternatives in our case. The ongoing debate on the matter of alternative food networks between purists and pragmatists (Watts, 2014) creates an unnecessary buzz. Either 'weak' or 'strong' the AFN, the problems remain, and the development of functional knowledge networks could benefit both.

These knowledge networks become even more important when it comes to small independent growers. Especially, for the small independent growers, being embedded to a network is of crucial importance and this is the value of our case network, to spread the knowledge to the ones who do not have access. Knowledge availability is very important even for a 'weak' high-input/high-yield food network in the heart of California. A strong network build upon trust, is the unified voice of the growers. The necessity of such networks becomes more crucial because they function within the conventional distribution system and they produce high volumes of agricultural products.

Figure 12 clearly showcases the two aspects of knowledge dissemination between the contract and the independent growers. Some of the actors expressed a concern about the rising private sector in berry production although everybody agreed that it is good in environmental terms. On the other hand, the small diversified growers seem to understand that it is not a matter of competition with large corporations but a connection to the community, and thus a different market (Figure 12). *"On whole I would have to agree that the large scale producers getting into it is more of a positive as far as the environmental effect, but at the same time what they are doing is very different of what we are doing. That's the critical aspect of what we do (communication with the community) is distinguishing ourselves from the large wholesale operations and make the connection with our customers and our community." (Diversified Organic Grower).* A knowledge network can be expanded to the community because this connection is very important for the smaller growers and all the opportunities that derive from the alternative markets such as farmer's market, box schemes and CSA.

6.6. RESEARCH LIMITATIONS

In many case studies the boundaries between the case and the context are not so distinct (Stake, 1995). That was one of the main methodological problems of this research. The fact that there was no distinct network structure, created an uncertainty about the limits of the network. By using the direct research network as the main point of reference unlocked most of the methodological issues. In addition, it gave the opportunity to create the distinct phases of the network in order to address the element of time. The direct network is the core of the wider network and the starting point of the knowledge creation. Figure 12 is the graphical representation of this wider network.

It was almost impossible to include all the involved actors and all the details of the research activities and common experiments between the different collaborators. For this reason, the most crucial methodological choice was to adopt a pragmatic and wholistic approach in order to make an in breadth analysis of the network. The case is stretched through time but on the other hand it would have been impossible to analyze the present situation without explaining how it came to be. Time, resources, practical difficulties and the participants willingness to collaborate played a crucial role to this decision.

7. CONCLUSION

By examining the knowledge network of central coast of California we were able to understand how its development occurred and upon what base. The empirical findings indicate the important role of the different actors of the network. More, specifically, the scientific research set up at UCSC and the absence of large experimental site established a relationship with the growers of the central coast. The special role of UCCE with the enhanced responsibilities of both conducting and communicating research to the wider audience was also crucial. The connection with the private sector also and the characteristics of the area as an organic production hot spot played a major role.

The network consists of knowledge creators, knowledge funnels and knowledge receivers. UCSC, UCCE and Private companies are creating knowledge by conducting research. UCCE has a double role by being both knowledge creator and funnel. Complementary role to UCCE is ALBA by communicating the knowledge to different audience (smallholders). Knowledge receivers are the growers of the wider network. The participatory research set up enhanced the knowledge exchange between the researchers and the growers and at the same time provided useful scientific results on organic strawberry production.

The actors of the network -both individuals and institutions- were embedded in un-official structure that came to take shape as the years passed by and trust was developed. Relational Embeddedness is the major explanation of what happened all these years and it has to do mainly with the actors knowing and trusting each other. The performance of the network is built upon social capital and common goals. Structural Embeddedness and proximity were complementary to Relational Embeddedness.

Concerning the research on AFNs, context plays an important role and maybe the connection with alternative markets can be a subject for future research. The broad performance of the concept of Embeddedness (Boekema and Rutten, 2004) could be utilized in order to explain such relationships. The need for such work becomes even more important if we consider that the majority of the work on AFNs focuses on the production aspect of the agro-food systems and not the consumer end (Maye and Kirwan, 2010). Additionally, there is a need of theoretical contribution especially when it comes to the function and performance of AFNs. Such work could play an important role for shaping future policies on agricultural matters.

The role of Extension is very important on such cases. The uniqueness of UCCE in comparison with the role of Extension in EU could be an interesting comparative research. Additionally, participatory research is mainly considered as a useful research set up when it comes to ‘strong’ AFNs mainly in developing countries (Chambers, 1994). However, our case is unique representation of the value of participatory research in ‘weak’ AFNs, not only in scientific sense but as a communication tool that creates bonds between the growers and the researchers. The ‘dialog’ between growers and researchers is a crucial one especially in modern agricultural systems and participatory research could play an important role in scaling up agroecological practices by providing pragmatic solutions. Additionally, Participatory Research may be a key tool to invest the co-development of new feasible and acceptable agroecological production methods in cooperation with involved actors.

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9. APPENDIXES

Appendix A.

INTERVIEW CONSENT

Please consider this information carefully before deciding whether to participate in this research.

Purpose of the research: To understand how and why the development of a knowledge network between researchers, growers, extension and industry impacts the knowledge creation and dissemination in organic agricultural networks?

What you will do in this research: If you decide to volunteer, you will be asked to participate in one interview. You will be asked several questions. Some of them will be about your general background occupation. Others will be about your role and perception within the above mentioned collaboration. With your permission, I will tape record the interviews, so I don't have to make so many notes. You will not be asked to state your name on the recording.

Time required: The interview will take approximately _____

Risks: No risks are anticipated.

Benefits: This is a chance for you to tell your story, experiences and ideas concerning the above-mentioned collaboration.

Confidentiality: Your responses to interview questions will be kept confidential. At no time will your actual identity be revealed. You will be assigned a random numerical code. Anyone who helps me transcribe responses will only know you by this code. The recording and transcript, without your name, will be safely kept until the research is complete. You can have access to this material whenever you wish to. The data you give me will be used for a thesis research I am currently writing and may be used as the basis for articles or presentations in the future. I won't use your name or information that would identify you in any publications or presentations.

Participation and withdrawal: Your participation in this study is completely voluntary, and you may refuse to participate or withdraw from the study without penalty or loss of benefits to which you may otherwise be entitled. You may withdraw by informing the researcher that you no longer wish to participate (no questions will be asked). You may skip any question during the interview but continue to participate in the rest of the study.

To Contact the Researcher: If you have questions or concerns about this research, please contact: Konstantinos Kalaitzoglou, *(Contact details)*. You may also contact the faculty member supervising this work: Carol Shennan, Professor, *(Contact Details)*.

Agreement: The nature and purpose of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

Signature: _____ **Date**: _____

Name: _____

Appendix B.

GENERAL INTERVIEW PROTOCOL

Education, previous working experience, current position.

How and why the research network was initiated?

Since when are you participating in the network? (Phases of the Network)

How the ASD came up and why? What was happening before ASD?

What where the differences in the network at the beginning and now?

Why you decided to move to the 2nd Phase and what were the differences from the previous Phase?

How the Mother/Baby trial came up and why?

Did the Mother/Baby trial affect the collaboration and in what way?

What exactly was the role of growers in the Mother/Baby trial?

What was the most important output of the Mother/Baby trial except its scientific value?

In what ways the historical context of the area affected the building of the network?

Why UCSC has different experimental set up? (Differences with other universities)

How important was the role of UC Extension in building the network?

What was the exact role of the UC Extension in the network?

Does the UC Extension reach out to all the different types of growers?

What was the role of ALBA in the network?

Over the years how the network changed its research goals and why?

Is there a need for better coordination in the network and how can this happen?

What was the role of private companies in network? How important were they?

What was the exact role of FarmFuel?

What was the role of California Strawberry Commission?

What was the main output of the network?

Do you consider the network successful and why?

What was the main reason of how the networks have progressed?

How the network can be expanded?

What would you do differently?

Appendix C.

INTERVIEW PROTOCOL FOR THE GROWERS

Background, Current position.

How many years you are farming?

What was the biggest difficulty of being a grower?

Why and when you decided to grow organic?

How the general context of the area affects organic?

What are the differences of growing organic then and now? (Access to information)

In what ways have you participated in the network? (Phases)

How the network impacted your activities?

How researcher were benefited by the network?

What would be the difference if there was no network?

What were the practical benefits of the network?

What do you think about the Mother/Baby trial?

What has changed from the beginning until now?

Would you recommend new farmers to engage?

What the scientists could do differently?

What the growers could do differently?

What UC Extension could do differently?

How do you feel about private companies adopting organic techniques?

What would you like to happen in order for the situation to be better?

Appendix D.

INTERVIEW PROTOCOL FOR PRIVATE SECTOR EMPLOYEES

Education, previous working experience, current position.

Details about the company. (Goal/History)

What types of growers you are working with? (Organic/Conventional)

Differences with organic in the area. (Past and present)

What is your connection with UCSC?

What is your connection with UC Extension?

Since when and in what ways have you participated in the network? (Phases)

What was your exact role in the network?

How all these connections affected the performance of the company?

How the growers are affected by the network?

How the researchers are affected by the network?

What is the main obstacle for grower to go organic?

What would you do differently?