UNIVERSITY
OF TRENTO - Italy
Department of Economics and Management

Scuola Superiore
Sant'Anna
di Studi Universitari e di Perfezionamento

MAIN – Master in Innovation Management

(Laurea Magistrale)

Master Thesis

ANALYSIS OF THE DIFFUSION OF INNOVATIONS MODEL IN ORGANIC AGRICULTURE: A QUALITATIVE RESEARCH OF APPLE PRODUCERS IN TRENTINO

Supervisor:
Prof. Francesco Testa

Student:
Danilo Ropele

ACADEMIC YEAR 2018/2019

TABLE OF CONTENTS

LIST OF TABLES AND GRAPHICS

CHAPTER 1) Introduction to sustainable and organic agriculture

1.1) Characteristics of sustainable agriculture

The whole concept of agriculture has been radically changed in the 20th century, moving from subsistence agriculture to a system capable of doubling its productive capacity of just 35 years after the sparking of the green revolution (Tilman, 1999). The green revolution is widely considered the era in which technological innovation impacted most agriculture. Starting from the studies of Norman Borlaug in the 1940's the approach to agriculture changed almost worldwide thanks to the combination of genetically improved crop varieties, new agronomic practices, like the use of chemical fertilizers and pesticides and an increased mechanization. Is interesting to notice how the doubling of the worldwide production is linearly correlated with all these factors, joint together with a 10% increase in arable land. This increase in food production, at a faster pace than the increase in population, has been able not only to feed the increasing world population but also to fight hunger in many developing countries and to increase standards of living. On the opposite side the increasing demand of food production associated to the estimation of the population reaching ten billion by 2050, raises many doubts about the sustainability of traditional production practices (Tilman et al., 2002). Furthermore, many studies found that intensive agricultural practices and in particular the negative externalities associated to the use of chemical inputs have a negative impact on all the 3 areas of sustainability: environmental, social and economic. On the environmental side, current agricultural practices severely harm the whole natural ecosystem, also outside of the agricultural land. Just to mention some examples, these practices have proved to reduce the biodiversity of flora and fauna, as well as exploiting and polluting the water reserves (Wilson and Tisdell, 2001). Moving on the social perspective, chemical inputs have proven to expose the farmers involved to the risks of acute toxicity and to the dangers associated with chronic toxicity, harming also those living in the surroundings. Another issue to be considered is the equity in the social conditions of all those involved in the food cycle. Regarding the economic side, it can be divided into two parts, the production and the actual economic risks of the farmers. Tilman (Tilman, 1999) proved that the increasing need for production due to the increasing population and the increasing demand for meat in developing countries is impossible to be met using current practices. Returning to the problems

associated with the use of chemical inputs, various proofs have been brought to prove (Moorman, 1989) the negative effect on soil productivity in the long run. Regarding the economic sustainability and the profitability for the farmers themselves, increasing attention is placed upon the competition of food imports and worldwide competition.

All these problems and drawbacks shape the "Food Challenge" for the years to come. That challenge involves directly two of the seventeen UN Sustainable Development Goals, "zero hunger" and "responsible consumption and production". The challenge considered moreover will have an impact to be considered in the goals on "climate action", "life below water" and "life on land".

If we are to tackle the impacts that agriculture has on all these 5 areas, the topic of sustainable agriculture needs to be considered and studied in-depth. Sustainable agriculture itself is a wide topic, involving several practices, studies, policies and underlying philosophies which have in common the principle of satisfying the present demand without compromising the possibility for future generations to satisfy their own. In this topic are included practices and sub-topics covering all the stakeholders involved in the food supply chain, namely producers, wholesalers, and retailers but also consumers, policymakers and researchers. The role played by the researchers is particularly interesting due to the cross-disciplinary of the topics of the studies carried on, which often involve a combination of biology, economics, engineering, management and social studies. To understand the variability of the sub-topics is useful to look at some examples of topics under analysis, which move from precision agriculture, soil management and genetically improved crops, to food labelling and certifications or even to organic farming and direct marketing. Due to the explained above overall complexity of the subject of sustainable agriculture, in my study I decided to focus only on Organic agriculture.

1.2) Characteristics of organic agriculture

Organic agriculture, sometimes called also biological agriculture, represents a shift in the paradigm toward overall ecosystem management from the exploitation of external inputs which characterized the green revolution. In particular, the specific aim of organic agriculture is to consider and avoid the social and environmental negative externalities associated with the use of synthetic inputs, from pesticides and fertilizers to genetically modified seeds and additives. To do that producers have to put in place a series of

practices relying on agronomic, mechanical and biological methods to have a correct and adapted agro-system management which can increase the health of the biodiversity, the biological cycles and the overall ecosystem. In this thesis I will not concentrate my efforts upon the biological and chemical effects of the organic agriculture, trying instead to highlight the economic and managerial features of this production and diffusion. To do so, I will start in the next pages by describing the history and the worldwide spread of organic agriculture, mixing information upon scientific advancement and market development. After that, I will use the knowledge acquired during my studies in both innovation and sustainability management, to gain some insights over the economical drivers that helped its diffusion and the drawbacks that limited it, both among producers and consumers.

1.3) History of organic development

Organic agriculture has some practices and approaches similar to the ancient subsistence agriculture. The modern acceptation of this term, however, began to develop in contrast to conventional agriculture, as a concept and as an ideal in the first years of the 20th century mainly in Europe and in the U.S. The first pioneers wanted to find a solution for the main problems of agriculture, namely reduced quality of food and soil as well as the cut in crop varieties related to the excessive exploitation of the fields. They believed that the cause of these issues could be solved by focusing on soil health and developed a first soil management strategy aiming at the preservation and regeneration of the soil called humus farming. To do so, the first humus farmers used a set of ancient techniques, like utilizing animal manures and crop residues, and in most cases avoided synthetic fertilizers because these were considered outside the traditional idea of the soil food web. From these concepts, the term organic gained popularity in the 1940s to describe this farming system, considered as a whole living entity. Two of the most important researchers in the first years were Rudolf Steiner and Albert Howard. Steiner was an Austrian philosopher who developed the theory of anthroposophy, based on the conception of a spiritual world accessible through scientific observation. From his study on agriculture developed the farming system called biodynamic agriculture which joins the use of natural compounds to the study of astral cycles. I considered the biodynamic movement also in the case study I carried on as a potential further improvement of the organic production. Howard, on the other hand, was the key researcher on the theories of

the use of ecological techniques and soil management. This first phase of pioneers which developed the principles and the vision of organic agriculture is referred to as “Organic 1.0”. (Rahmann et al., 2016)

The subsequent phase can be traced back to the 1960s-1970s and the countercultures. This second phase has been crucial in the marketing and the successful commercial development of organic agriculture. It is a false myth that from the countercultures originated the organic production system. During these years instead, organic food gained a “left-leaning” image and increased its popularity as an alternative to industrialized food. Is in these years that can be traced back the creation of the organic market and industry. The book “Silent Spring” from Rachel Carson, published in 1962 (Carson R, 1962), played a crucial role in generating awareness in the public over the risks and the damages generated by the use of pesticides. This phase shaped the consumers’ vision of organic agriculture which is described by the three pillars proposed by Michael Pollan in “The Omnivore’s Dilemma” (Pollan, 2006): Alternative and environmentally friendly productions, alternative distribution system aimed at reducing middlemen and lastly consumption of fresh and minimally processed foods. On the producers' side, this phase is associated with some farmers mainly ideologically driven which denied or ignored any agricultural practice ending up in low-quality foods.

It is in these years that the first movements and research institutions dedicated to organic agriculture were founded, mainly in western countries. The largest of these movements is the International Federation of Organic Agriculture Movement (IFOAM) was created in 1972 with the specific aim of giving a single and united voice to the different organic movements worldwide. Since then IFOAM has grown and now it is formed by almost 800 member organizations across 117 countries and, more than its advocacy and representative role, it is responsible for its own organic certification standard.

The first research institutions upon organic agriculture were born in the 1950s, in the U.S. the Rodale Institute and in Germany the biodynamic research institute, Forschungsring. In subsequent years other institutions were created in Austria, Switzerland and other countries of Northern Europe. These first institutions were privately founded, while research upon organic production was not receiving any attention in conventional institutions, being considered as un-scientific. A factor which strongly incentive the production of papers and research itself upon this topic was the foundation of

two journals, Biological Agriculture and Horticulture in 1982 and the American Journal of Alternative Agriculture, recently renamed Renewable Agriculture and Food Systems, in 1986. The turning point in the involvement over the topic of the European Union is the first regulation at European level in 1991 of organic farming and production. In the 1990s the European Union started funding research projects on the topic and in successive years research upon organic agriculture started to be funded in several nations and research institutions by both national and European programs. Some well-known efforts of this type are included in the European Action Plan for Organic Agriculture (ORGAP) and the CORE Organic (Coordination of European Transnational Research in Organic Food and Farming Systems). Nevertheless, in 2014 a bibliographic study (Siegmeier et al., 2014) found that in the period between 1977 and 2011 the share of research on organic farming or agriculture (2801 total publications) were only 2% of the overall research on agriculture. The authors, however, showed that the expected exponential patterns (Vickery, 1948) were present regarding publications, authors and other significant indicators of diffusion. Rahmann and Aksoy (Rahmann et al., 2016), showed that in 2012, Germany was the country with the highest rate of funding dedicated to organic research these represented only 2% the agricultural research funds. The global average rate of organic research funds is much lower, with 0,04% in the same year.

In the following years, governments started paying increasing attention to the topics of sustainable agriculture and creating policies to deal with the externalities of farming. The first to adopt Agri-Environmental Policies (AGP) were the United States and the European Union, relying both on subsidies to solve the market failures deriving from the externalities, but using different approaches, as highlighted by Baylis (Baylis et al., 2008). In the EU, AGP were first established in the 1980s as an option for member states and since 1992 AGP became mandatory for member states to be applied in rural development plans. These policies aim at preserving the positive externalities of traditional agriculture, as a way to contrast land abandonment and the beauty of certain landscapes. Another issue tackled by AGP is the intensification of farming and the excessive use of inputs by recommending and remunerating the use of technologies and inputs considered environmentally friendly. The standards to be applied and the compensation system are included in the pillars of the Common Agricultural Policy. Organic farming in this sense does not only provide compliance with all the standards but is also more remunerated for itself. In the US instead, where the rate of cultivated land per

inhabitant is more than three times higher than the EU, the policies dealt with the limitation of the negative externalities of extensive agriculture, offering subsidies to the farmers that decide to stop the production in some identifies areas. These apparently opposite approaches reflect the differences in structural factors and the opposite preferences, due also to different products and productions, for cultivated over wild landscapes (Hackl et al., 1997). Another explanation might be found in the interests of the stakeholders involved: while US policies benefit either the farmer or the environment, in contrast, EU policies aim at creating value for the consumer or the non-farmer taxpayers and might be seen as a response to the "greening" of demand from the taxpayers.

Moving closer to the present, the organic demand followed the overall trends of "green demand". Since the 1990s the spread of awareness over the sustainability issues outside of the boundaries of the counterculture expanded the demand for these products. In particular, the personas of the consumer evolved from being the lifestyle choice of a small number of consumers with specific and identifiable characteristics to the majority of the population which consume organic from occasionally to often. (Dimitri et al., 2002) To fulfil this new demand organic products started to appear also outside the alternative distribution systems traditionally used, being present also on the shelf of large retailers. The success of this new commercial channel has been proven by the US market, where since 2000 supermarkets provide more organic products than any other marketplace. (Dimitri et al., 2002; Stevens-Garmon et al.,2007). The expansion of organic sales outside its niche of well-informed consumers and the direct sales channels however stressed the downturns of the credence attribute of organic products. A credence good is a product for which its quality cannot be perceived by the consumer, resulting in difficulties during the assessment of its quality. Consumers are not able then to distinguish organic from conventional products because the absence of pesticides and other chemicals simply cannot be appreciated during the consumption. As I will highlight in the case study, this issue is getting increasingly critical because organic products in the past used to be of inferior visible quality, making it a characteristic and identifiable feature, while the new broader set of consumers, less devoted to environmental friendliness, is demanding organic products of comparable quality. Building consumers' trust is consequently of crucial importance, especially in the case where the credence attribute is subject of a price premium and suspects of falsification might arise. Direct sales and marketing used to solve this problem of trust through a direct contact with the producer, which had the

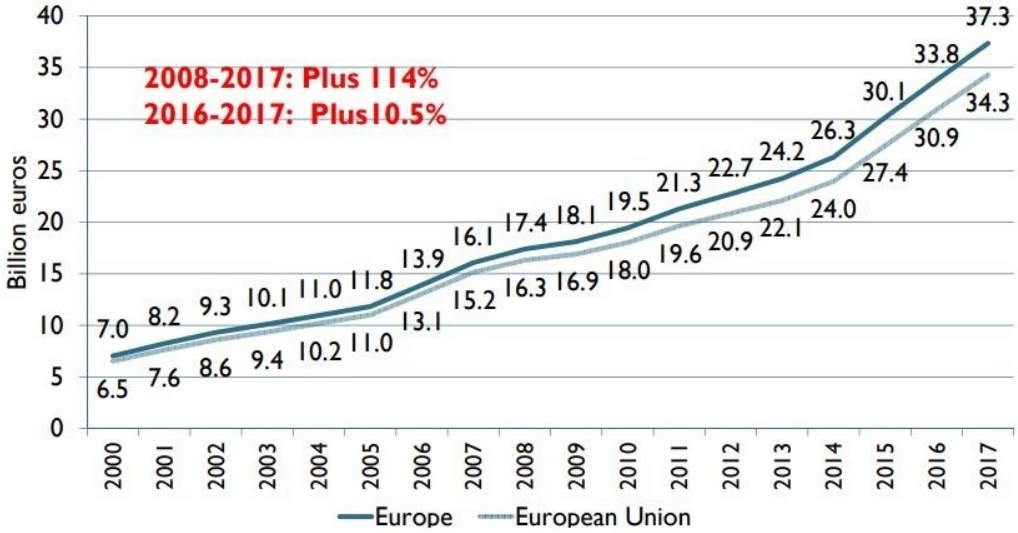
opportunity to directly explain its procedures and production and build the reliability needed for the purchase. The traditional retail channels instead do not have this opportunity. The organic movement as well as policymakers decided then to rely on third party product certifications and labelling of the supply-side to build consumers' trust. Organic labelling provides certainty for the buyer at the point of sale that the production standards entailed by the certifier institution are respected. Worldwide, a number of organic certifications and labels co-exist, which are created by national, regional or independent institutions. A European study (Janssen and Hamm, 2012) demonstrated that consumers' willingness-to-pay varies between different certifications and logos. The differences are to be searched in the trust consumers' place upon the certifier institution. The certification preference and trust vary across different countries and is directly connected to the visive available knowledge of the certification's label. The only exception is the Demeter certification which achieved higher results in willingness-to-pay and trust in Northern countries because it certifies the biodynamic products. This paper however was written before July 2010, the date since when EU regulation made mandatory to use the label with the European organic logo and follow the same standards for all the organic products sold in the EU. The logo, showing a leaf composed of stars, must be placed on all the pre-packaged organic products and must include the serial number of the control body and the geographical provenience of the agricultural raw materials included. This unified approach could greatly increase the knowledge and consequently the trust consumers place upon the certification itself, impacting positively their willingness-to-pay, and the overall market even though further research on its effectiveness is needed.

1.4) Organic market

The US is the largest market for organic products and followed in the years an exponential growth. Considering the rate of organic food sales over total food sales, these accounted for 0,8% in 1997, 1,9% in 2003, 2,5% in 2005, when the market was worth less than 15 billion dollars, to 5,5% in 2017 (Unites States Department of Agriculture Economic Research Service, 2019). In 2018 the organic food market of the US is worth 47,9 billion dollars, with an increase of 5,7% over the previous year. If we sum to this amount also the 4,6 billion dollars of non-food organic products, we can see that for the

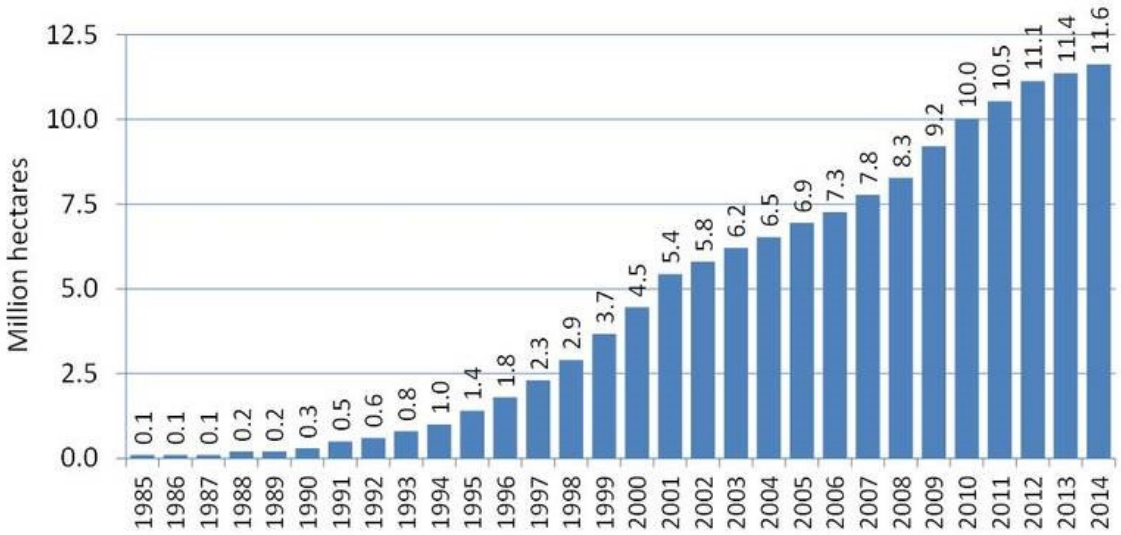
first time the organic market exceeded 50 billion dollars.

In Europe, that represents the second largest market worldwide, after the US, the development of the organic demand, as well as the production, started in Central Europe, with Germany, Austria and Switzerland leading the way. Once again, also in Europe, the breakthrough into mainstream consumption arrived in the late 1990s and 2000s, with the common regulation playing an important sustaining role. Considering all the European countries, the market evolved from 7 billion euros in 2000 to 17,4 billion in 2008 and 37,3 billion in 2017, as showed in Graph 1.1. In the period considered organic market achieved a growth of 432% (base year 2007) and is still rising steadily, obtaining in 2017 a growth of 10,4% over the previous period (base year 2016).



Graph 1.1 Organic retail sales in Europe and EU, 2000-2017. Source: FIBL-AMI Surveys 2006-2019, OrganicDataNetwork Surveys 2013-2015

Similarly, on the producers' side organic agriculture have seen an exponential growth, which can be observed by analysing the development of organic agricultural land (Helga and Lernoud, 2019), as can be observed also in graph 1.2. In 1985 the hectares devoted to organic agriculture were around 0,1 million, grew slowly to 0,5 million in 1991 and since then followed an almost linear pace of growth, reaching 14,6 million hectares in 2017, with an increase of 1 million hectares compared to 2016. This land is formed by almost 185.000 farms and involves around 306.500 operators, which can be divided into producers, processors and importers.



Graph 1.2 Development of Organic agricultural land, 1985-2014. Source: Lampkin, Nic, FIBL-AMI and OrganicDataNetwork, 2015.

Analysing the single countries, data over the level of consumes in 2017 reflect the centrality of countries situated in central Europe. The largest European market for organic food is Germany, with a total of 10 billion euros, followed by France with 7,9 billion euros and Italy, 3,1 billion euros. These data are however flawed by the large population of these 3 countries. If we look at the share of organic food in the overall food market, the highest shares are found in Denmark, followed by Sweden, Switzerland, Austria and Luxembourg. Denmark with a 13,3% share of organic food purchase over total food is the only country in the world with a share above 10%. The distribution of sales channels varies as well across countries, with the most purchases, with different rates, in general retailers everywhere, which is also the channel growing most rapidly, followed by specialized retailers, direct marketing and other sales channels. In Italy, 50,8% of organic purchases takes place through general retailers, which is a low amount compared to other European countries where this share is always higher and, in some cases, reaches more than 80%. This is due to the strong presence in Italy of specialised retailers, 27,6% of all organic sales, which however is growing in sales much more slowly than the sales in general retailers, suggesting Italian's sales channels are following the path of other Nordic countries, where organic market is older and more developed, of concentration in general retailers.

Moving the perspective over the producers' side, the situation shown is different from the consumption, with Spain having the largest agricultural land dedicated to organic

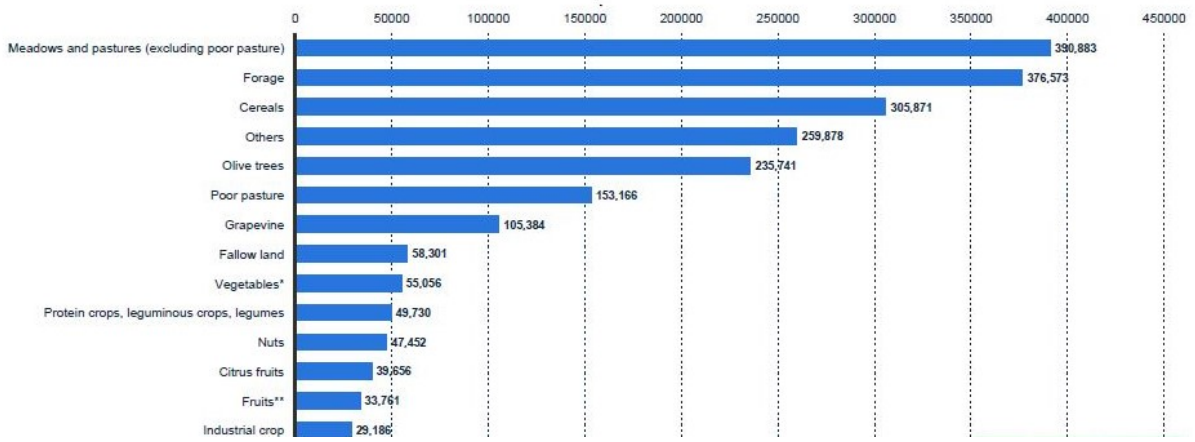
farming with 2,1 million hectares, followed by Italy, France and Germany. (Helga and Lernoud, 2019). These 4 countries together account for more than half of European organic farmland. Similarly to the situation presented above for the consumption, there are several discrepancies between absolute and relative data due to the smaller size of countries of central and northern Europe. Across the EU 7,2% of farmland is devoted to organic production, with Austria and Estonia having the highest share, being the only 2 countries with more than 20% of organic farmland, followed by Sweden and Italy. Italy with more than 15% of organic farmland is a crucial producer of organic products and is also a net exporter, with a total of 1.915 million euros worth of export (Bellini et al., 2013).

Worldwide the organic market is much less developed, with North America and Europe accounting for 90% of all the organic sales (Willer and Lernoud, 2019). Decomposing the consumption in continents, Asia despite its high population generates only 8,6% of total world organic sales, Oceania 1,2% and Latina America less than 1%. The amount of organic sales in Africa of certified organic products is insignificant but should be kept in mind that most of the subsistence production characterising this area might have similar characteristics with the organic system. The situation is drastically different on the producers' side. In Oceania can be found 47% of the total hectares used for organic production in the world, 12,3% in South America, 8,5% in Asia and 3,11% in Africa. Joining data about consumption and production can be easily understood that these countries are net exporters of organic products toward the most developed markets of North America and Europe.

1.4.1) Italian organic market

As my study is set in a specific province of Italy, Trentino, I place further attention on the Italian and regional organic production system. The analysis of the distribution of areas for organic farming is the best measure to allow comparisons between different regions because would be impossible to compare total yields due to huge output variance between crops. On the other hand, as can be seen in the Italian example, meadows and pastures for breeding occupy the largest share of organic land with 390.883 hectares in 2003, even though the economic value generated by these areas are well below other crops due to the lower productivity per hectare of meadows. After pastures the largest organic

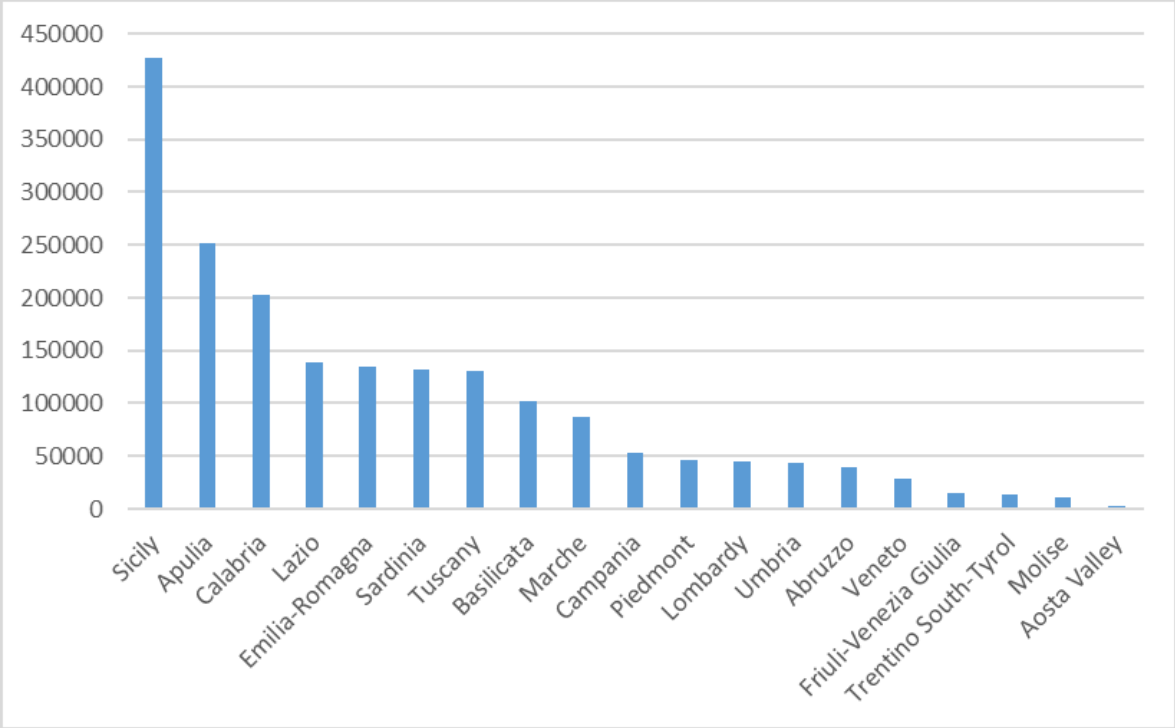
areas are devoted respectively to forage with 376.573 hectares in 2017, cereals (305.871 ha), olive trees (235.741 ha), poor pasture (153.166 ha), grapevine (105.384 ha), fallow land (58.301 ha), vegetables (55.056 ha), legumes (49.730 ha), nuts (47.452 ha), citrus fruits (39.656 ha), fruits (33.761 ha) and other productions.



Graph 1.3 Total land used for organic farming in Italy by cultivation type, in hectares, 2017. Source: SINAB, 2018.

The most represented areas are all grown grasses, which can be considered low-productivity crops, with olives and grapes being the most diffused plant-based productions. The fruit market, considered separately from citrus fruits, represents the 12th largest productive organic area. Of this already limited dimension, I decided to focus my thesis only on the apple market in which, by 2017, the production is limited to 6.201 hectares. This specific production is however much more relatively spread compared to other crops in Trentino, as I will highlight in the description of the case study. Shifting the analysis on the organic production of different regions, the largest devoted areas are all placed in the southern-central parts of Italy. Looking simultaneously at organic productions and crops in different regions can be clearly seen a correlation between these two dimensions (ISTAT, 2013). When comparing regions should be kept in mind that the data described are in absolute terms and do not account for the differences in total and agricultural land between regions. The largest organic producer is also the largest Italian region, Sicily, which with 427.294 hectares almost doubles the Apulia, being the second largest producer with 252.341 hectares, as can be seen in graph 1.4. The first region placed in the Northern part of Italy is Emilia-Romagna which has the 5th largest organic area in Italy with 134.509 hectares. The other large northern regions, Piedmont (46.850 ha),

Lombardy (45.176 ha) and Veneto (27.970 ha) have respectively the 11th, 12th and 15th largest organically farmed areas. In this landscape is no surprise finding out that Trentino South-Tyrol has only the third smallest organic area, with 14.078 hectares.



Graph 1.4 Distribution of areas used for organic farming in Italy by region, in hectares, 2017. Source: SINAB 2018.

1.5) Organic and sustainability

Having described the main traits and the most important events that led the market expansion of organic products, is appropriate to take a step back and see if and how organic agriculture is able to impact the food and environmental challenges for the years to come. I will show how organic agriculture can help to achieve better results than conventional agriculture in the three dimensions of sustainability, economic, environmental and social. As previously seen economic sustainability can be divided into two sides, the need of having an adequate amount of high-quality production and the financial feasibility over time. The amount of production is considered the main drawback of organic production and has often been stressed by the critics of organic production. To cite one, former US agricultural secretary in 1971 stated: ”Before we go back to organic

agriculture in this country, somebody must decide which 50 million Americans we are going to let starve or go hungry". Various studies proved this point, with organic production having a lower average yield varying from 6%-11% for most productive organic production, for example rice and corn, to 27%-28% for lowest-yielding organic productions, like fruits and wheat. (de Ponti, Rijk and van Ittersum, 2012). These differences, however, reflect only the discrepancies between productions in developed countries with a high input – high output production. In developing countries, characterised by a low input-low output production, the introduction of all or even just some organic agronomic practices might help to move the system toward a low input – medium output situation (Reganold and Wachter, 2016). Positive impacts of organic production on yield quantities over time can also be found when considering longer periods and the problems of soil degradation. Desertification and soil degradation impact the production potential for the years to come, estimated by (FAO, 2013) to account each year for 1,15 billion dollars in capital loss, which represents 170% of the value produced yearly by agriculture. The main drivers of this dramatic rise in depleted soils derive from conventional agriculture, which makes use of excessive external chemical inputs to maximize the quantity produced of a monoculture in the short period. (Gomiero, Pimentel and Paoletti, 2011). Organic terrains have a higher capacity of water absorption, resulting in increased production in conditions of drought. Feeding the world is nevertheless a complex challenge which might hold the future of the whole population and should be not left to agriculture alone. Nowadays the calories and proteins produced are sufficient to satisfy properly the needs of everybody but the uneven distribution, the preference for meat over vegetables which is spreading also in developing countries, and the enormous amount of food waste along the whole supply chain result in undernourishment for more than 800 million people, 11,3% of the whole population (FAO, 2014). To deal with this which is probably one of the main challenges for the present and the years to come a coordination of different stakeholders, professionals and policies is needed.

The other side of production is the actual quality of the product. This point is crucial because also consumers' purchase and are willing to pay a price premium because they expect not only a more environmentally friendly production but also some vague forms of enhanced health safety and better taste (Zanoli and Naspetti, 2002). If the better taste can be explained by the expected higher level of freshness of the products, perceived in association to organic food and especially alternative distribution systems, the topic of

health safety and nutritional values is currently subject of debate. Academics cannot find an agreement on the topic, with studies showing a significantly higher level of Vitamins but no differences in terms of protein (Worthington, 2001), other showing similar levels of vitamin but slightly higher levels of protein (Brandt and Mølgaard, 2001) and other finding no statistical differences at all, as highlighted by a complete systematic review on the topic (Dangour et al., 2009). The ambiguous results of nutritional values might disappoint the consumer but, on the side of food safety, studies are unanimous in their findings of lower values for dangerous substances, for example pesticides residues and antibiotic-resistant bacteria, in organic food (Smith-Spangler et al., 2012). Regarding the financial sustainability and efficiency of organic production, I showed previously the trends of organic consumption, describing a constantly growing market. A meta-analysis has been carried out to prove the financial competitiveness of organic production (Crowder and Reganold, 2015), highlighting that even with lower yields, when accounting of price premiums organic production proved to be more profitable with an increase in profits between 22% and 35%. The price premiums allowing this increased profitability were found to be 29-32% of the conventional price. However, even considering the higher labour cost of organic agriculture (between +7% and +13%) and the lower production yields (between -10% and -18%), the break-even premium needed to have the same profitability level of conventional agriculture was found to be between 5 and 7%. This large discrepancy between break-even premiums and actual price premiums can assure the financial competitiveness of organic production for years to come, even if the level of the price premium would eventually reduce.

Moving on the social perspective of sustainability, the crucial topic regards the health safety of farmers and those living in the surroundings of the farms. The alarm on the risk of the use of pesticides on human health has been raised many years ago. In 2000 the Pesticides Action Network highlighted that 3 million people are poisoned by chemical pesticides and 200.000 die each year due to pesticide poisoning (FAO, 2000). Considering specifically the farmers' health, a study demonstrated that their health is affected by the type of agriculture adopted. Analysing specific biomarkers, researchers found higher genetic damage for conventional farmers exposed to pesticides and other chemicals when compared to organic producers.

Similar to the social impact, environmental impact and its relative changes for different production methods is a wide topic which due to my economical background

could not grasp in its total complexity. The different environmental impacts, however, have luckily been already studied in depth by more expert researchers which found with almost unanimity the better performance of organic agriculture for many key indicators, although results may vary across different crops. I exposed previously that organic agriculture can increase the long-run yield because it proved to better conserve and enhance the fertility of the soil. As shown by Gomiero, Pimentel and Paoletti (Gomiero, Pimentel and Paoletti, 2011), organic agriculture performs better or much better on a set of key environmental issues. Regarding biodiversity, organic production proved to foster it on crop, floral and faunal level, also considering the external habitat of the surroundings of the farm. Also, the farm animal welfare itself highlighted better results in organic breeding when compared with traditional techniques. The better condition of the soil and its qualities is proven by the higher results of organic agriculture upon the benchmarks of soil biological and biophysical characteristics. Organic production showed to use fewer external inputs of nutrients, water and energy, resulting in a lower of Greenhouse emissions, including CO2, CH4, N2O and NH3. Regarding water dispersion, organic agriculture proved to leave lower levels of even less dangerous residues in the water, which is a crucial topic because it is strictly connected also with the lifestyle with those living in the surroundings.

To sum up the effectiveness of organic agriculture across the areas of sustainability, will be shown the results of an American study of the apple production systems, that will be the focus of my case study. The researchers compared organic, integrated and conventional agriculture on economic profitability, energy consumption, soil degradation and overall environmental impact. Regarding both the economic and environmental sustainability organic agriculture achieved the best results followed by integrated agriculture and lastly by conventional agriculture.

We have seen the positive impact organic agriculture can have over the challenge humanity is facing across the different sustainability fields. These years, however, represent a threshold for organic agriculture to affirm as a solid alternative to conventional and integrated agriculture worldwide as we are now entering the phase of Organic 3.0. In this phase, a solid research base will be needed to sustain the development and diffusion of organic farms, which was lacking or following agricultural practices in previous years. A successive challenge and improvement placed upon the organic movement in the years to come is to include other perspectives to the agricultural one in order to create a

complete agri-food system approach. This new approach will require the joint efforts of all the different stakeholders, including researchers, farmers, policymakers, distributors and other economic agents, consumers and activists.

CHAPTER 2) Diffusion of innovations model

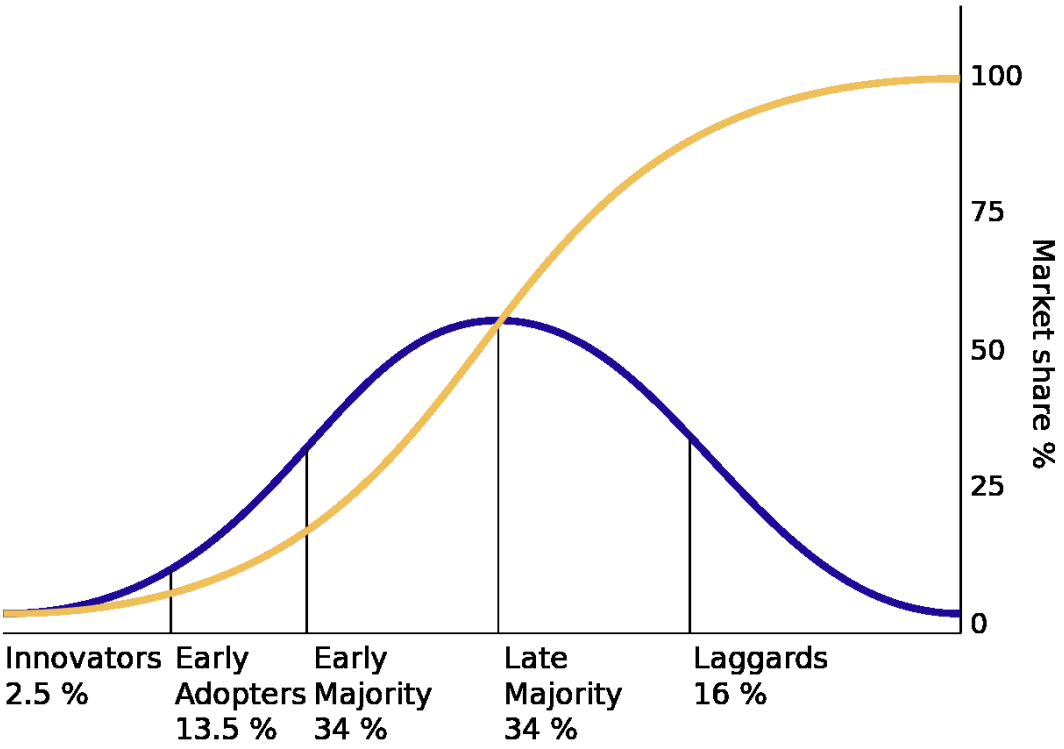
2.1) Description of the model

The multiple definitions of innovation can be summed up describing it as the application of a novel discovery or an invention in an economic or social system (Godin, 2014). All the innovations aim at solving an existing need, generating therefore a social advancement after their introduction. In recent years, the concept of innovation expanded from the standard division between product and process innovation to include other possibilities, as innovation in business model, organizational practices and marketing process. The innovation process is more complicated than a simple technological advancement because it includes also managerial and commercial steps to be developed, implemented and diffused. Of the overall innovation process, the most intriguing part is the diffusion process, which by considering many variables aims at explaining why, how, and at which pace individual adopt an innovation. The research I carry on with this thesis aims at evaluating the diffusion of innovations on the producers' side of organic agriculture, analysing the case of apple producers in Trentino.

The diffusion-adoption model I will test derives from the fundamental text on the topic "Diffusion of Innovations" by Everett Rogers, which was first published in 1962 and is still the cornerstone and most studied publication on the topic (Rogers, 1962). The study of this topic did not originate with the book of Rogers, as he highlights, and already existed across various fields. Rogers instead strongly popularised this field of study by proposing a model joining aspects deriving from different disciples. Being himself a professor of Communication sciences, he applied knowledge and features coming also from sociology, anthropology, marketing, and economics to create a model capable of describing the process of diffusion of an innovation. The cross-disciplinarity of this theory (Bailey, Rogers and Shoemaker, 1974) can be seen not only in the different approaches composing it but also on the impact the study from Rogers itself had these fields, but on the academic and professional side. To cite the fields which I am most familiar with, the study had a fundamental role in developing the whole field of Innovation Management and is used daily by marketing departments worldwide. Regarding a more sociological approach on the field, showing the potential uses of his model, for example in the diffusion of techniques to prevent addiction (Rogers, 2002). For a better comprehension of the model, this thesis includes information and assumptions from the first, the third and

the fourth edition of the book Diffusion of Innovations (Rogers, 1962; Rogers, 1983; Rogers, 2010). This descriptive chapter relies mainly on Rogers' book, I decided then not to specify for each assumption the theoretical reference. When the literature in this chapter is not specified, it refers to Rogers' Diffusion of Innovations. The theory of diffusion of innovations has been already applied in the past to agriculture, Rogers himself included various examples from the US primary sector which was at the time in the golden era of innovative applications due to the "Green Revolution". As I will highlight later, diffusion of organic practices presents many differences, from the diffused knowledge system to the role of sustainability, which would require further research.

The fundamental aspect of his theory is based on the first assumption that he made, which is that not all users decide to adopt an innovation at the same time, while the diffusion of an innovation is a process requiring different amounts of time. After this statement, he discovered that the distribution of adopters over time follows a normal distribution. Along this curve users with different characteristics can be found, with the very first in time to adopt being the Innovators, around 2,5% of total users, followed by Early Adopters, 13,5% of users, Early Majority and Late Majority, both with 34% of share of users and lastly the laggards, last 16% to adopt. (Graph 2.1)



Graph 2.1 Adopter categorization on the basis of innovativeness.

This division is particularly useful because Rogers understood that the diffusion process is influenced not only by the specific features of the innovation but also by the personal characteristics of the adopters. The division of adopters in the five categories is reflected also on the different characteristics for socioeconomic and personality variables as well as communication behaviour the users of these categories have. To sum up the different variables, a meta-study has been carried on, showing the result from studies of various innovations. Later I will show that literature found some discrepancies and variables to add for the specific innovation under analysis. Generally speaking, some generalizations can be made, for example on the socioeconomic side, education, higher social status, higher income, upward social mobility and a favourable attitude toward credit are all positively related to innovativeness and show higher levels for earlier adopters. On the personality side, earlier adopters statistically tend to have greater empathy, greater attitude toward change and risk, favourable attitudes toward science and education, higher intelligence and rationality, higher aspirations and tend to be more open-minded. About the third area of personal variables, the communication behaviour, those adopting earlier in time statistically have more contacts with the social system and change agents, are more cosmopolite, more exposed to channels of information and look more actively for information. Opinion leadership deserves special attention because it is positively connected with personal innovativeness but the higher levels for this variable are found in the category of Early Adopters and not for the Innovators. This happens because, due to the highest levels of all other variables, innovators are often considered as different and sometimes judged negatively in their decisions by the rest of the population. In my qualitative analysis, I will test with direct interviews to farmers some of these variables to check if the statements of the theory are reflected in the sector and the innovation under analysis.

To do so, I structured the interview following the stages proposed by Rogers for the process of Innovation-Decision. The proposed model structures the decision over the adoption of an innovation by potential users in 5 stages or phases: Knowledge stage, Persuasion stage, Decision stage, Implementation stage, Confirmation stage. This structured pattern of decision, or even rejection, is increasingly interesting in association with the 5 adopter categories because the different socioeconomic, personality and communication characteristics result in different behaviours of the agents across the 5 phases. During the Knowledge phase the individual, or the decision-making unit in the

case of adoption from complex institutions, becomes firstly aware of the existence of this innovation and gains some initial information of it. A debate exists on the role played during this phase by the individual perception of a need or dissatisfaction that the innovation is likely to fulfil. Contestants sustain that cannot be perceived the need and seek information for something not existing. Supporters, on the other hand, affirm that through selective exposure individuals are more likely to be exposed and capture information over something we are positively interested in, in this case, the innovation capable of solving a perceived problem. For what it is worth, the personal idea I developed after my interviews is that perception of a problem plays a crucial role in the capacity of receiving initial information. Earlier knowers share some personal characteristics with earlier adopters, having statistically higher education, higher social status, higher exposure to mass media and interpersonal channels and being more cosmopolite (White, 1968). From these characteristics is easily understood why earlier-knowers tend to receive information before others in the system, due to their increased contact with change agents and with those agents external to his social or economic system. Communication outside the existing system has proven also in my analysis to be the most important factor because novel ideas and information are most likely to come at first from the outside of the system where the individual lives and acts. After this first phase, the individual goes through the Persuasion stage, in which he looks for more information trying to form an attitude, positive or negative, over the innovation. During this stage agents actively look for information but also in this process agents look for different types of information, using different channels, putting different levels of effort and interpreting those in different ways. Individuals usually look for innovation-evaluation information to reduce the intrinsic uncertainty upon the actual capability of the innovation in achieving the desired outcome and its relative advantage compared to the existing situation. Considering this need for security is not surprising to see that individuals tend to search mainly for how-to knowledge, which includes the information needed to make use of the innovation. The other type of knowledge which forms a personal attitude is the principles knowledge which consists of the underlying and often theoretical functioning principles of the functioning of the innovation. The knowledge of underlining principles, however, is not needed to adopt an innovation but when this is lacking the innovation might be used not correctly, resulting in worse results and eventually discontinuance of use. All the information that potential users process is available across different channels and even if

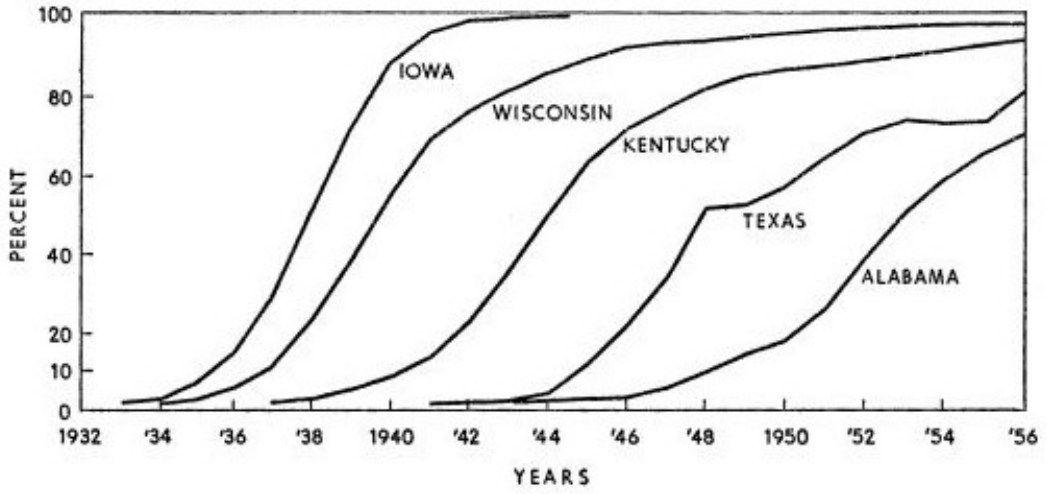
the needed knowledge is usually available in scientific publications or reports, most individuals are more convinced by the opinion previous innovators developed during use. This is particularly true for later adopters which have a lower level of education and worst attitude toward science while having a wide range of previous adopters to check for opinions. Earlier innovators instead have to rely on theoretical studies or to look for opinions outside their system, but this process is enabled because they are statistically more active in the search for information. At the end of this phase, individuals should have a positive or negative toward the innovation, but not necessarily have decided over the adoption. In many cases, a positive attitude is not sufficient to make a decision and a particular event, referred to as a cue-to-action is needed to enter the Decision stage, which will result in either adoption or rejection of the innovation.

Adoption refers to the full use of the innovation; before that decision, many individuals decide to try the innovation on a partial basis to reduce the uncertainty through personal experience. The opposite decision, which is the rejection, can happen in two different ways, Active or Passive rejection (Eveland, 1979). In the case of Active rejection, the individual considered the adoption, even carrying on some partial trials in some cases, ultimately deciding not to adopt it. We refer to the rejection as passive or also as non-adoption when the user never considered the use of the innovation. Is important to keep in mind that often the decision over adoption or rejection is not taken by a single individual but from a more complicated decision-making unit of an organization. Four different types of innovation-decisions exist: Optional is the case in which the choice is made independently by an individual; Consensus is the case in which the choice is taken by consensus among the members of a system; Authority is the case in which the choice is taken by a few individuals of the system possessing specific characteristics like power or expertise; Contingent is the case the choice over adoption is optional but can be taken only after a prior innovation-decision, usually Collective or Authority (Rogers, 1983). If and after the individual has taken a positive adoption decision starts the implementation stage. During this phase, the efforts move from a purely theoretical and mental approach by the innovator to a real and practical implementation. A certain degree of uncertainty of the expected outcome is usually still present at the beginning of this phase. The adopter, however, as the individual can now be referred to, will now search for a different type of information, mainly on how to practically deploy and use the innovation rather than on its effectiveness. The implementation phase can have different levels of complexity, related

mainly to the intrinsic complexity of the innovation itself, but also to the organizational complexity of the roles which will use it. The intrinsic complexity of the innovation derives from a combination of its technical complexity and the degree of re-invention needed. Just a few innovations can be implemented only by copying the use of other users, while in most cases it must be modified by the user during the process of adoption and implementation. Re-invention mainly happens because users adopt innovation with different needs and problems to solve which cannot always be solved with an identical solution but also because users have different available expertise and knowledge which might need ad adaptation of the innovation to use it. The degree of re-invention is expected to be greater for enabling technologies have a wide range of scopes which must be specifically adapted for every use. This will lead to different amounts of time needed for a correct and complete implementation in the standard practices. The implementation stage can be considered over when the innovation is not anymore a novel idea and has been implemented and institutionalized inside the standard and managerial practices of the individual or the organization. When this stage is finished, and the innovation has entered the organizational routine its real capacity and effectiveness can be observed during a final phase called the Confirmation stage. During this phase the adopter tried to match the knowledge of the innovation he gained during use with external information, trying to reduce its dissonance and remaining insecurities over the innovation. This phase ends when the user has lost any doubt and dissonance, resulting in either definitive confirmation or discontinuance. Discontinuance, which can be defined as the definitive decision of rejecting an innovation after a period of use, can be of two types, replacement or disenchantment. The term replacement is used to describe the situations in which the adopter stops using the innovation and starts using a better substitute, going therefore through a new adoption-decision process. When instead the user is not satisfied by the use of the innovation and decides to turn back to the previous situation, the rejection can be defined as disenchantment. This last phase has a strong linkage with the division in 5 categories of adopters as later adopters, and even more, laggards, tend to discontinue innovations more often than earlier adopters. Adopters with high rates of discontinuance show characteristics similar to laggard, for example, lower education, lower social status and lower change-agent contact, opposite to the characteristics of innovators.

A very interesting empirical evidence of the normally distribution of diffusion of innovation was found in the agricultural sector in 1957 (Griliches, 1957), before Rogers'

studies. The study, which results can be observed in the graph 2.2, highlights the phases of diffusion of an innovation, in this case the use of hybrid corn seeds, measured as the percentage of the total acreage. The resulting curves are very similar to the predicted curve by the model of the overall diffusion of an innovation. Particularly interesting is the differences, in starting point and rate of diffusion, that these curves have while keeping an overall similar shape. The article aims at explaining these differences, which are ascribed to differences in land characteristics and policies adoption. This study has served as a fundamental empirical basis for the successive theoretical studies of the diffusion of innovations.



Graph 2.2 Percentage of total corn acreage planted with hybrid seed, 1933-1956. Source: Griliches, 1957.

After having described the personal characteristics of the users which drive their adoption and the process of their decision, is useful to analyse the general characteristics of innovations influencing the diffusion. This analysis will be particularly useful in the next chapters to understand the specific features of organic agriculture which boosted or slowed its diffusion.

2.2) Drivers of diffusion rate

2.2.1) Characteristics of the innovation

Firstly, I will analyse the specific attributes of the innovation itself that influence the diffusion, moving later on the considerations over the complete innovation system. The factor which impacts mostly the rate of diffusion of an innovation is its perceived relative advantage over the previous situation or solution, with higher levels of relative advantage resulting in a faster diffusion process. The relative advantage might refer to several factors, with the most commonly considered being economic profitability and status enhancement depending on the reasons why innovation is considered and eventually adopted. The relative advantage is perceived because, even if individuals try to understand the output of the innovation during the persuasion phase, still measuring the impact and compared with the previous situation can be done with security only after the actual implementation. Considering only economic factors for an example, the increased productive capacity of a new machine might be easily measured while the willingness to pay a price premium for a new product or an incremental feature usually cannot be estimated with such precision.

Compatibility is another factor strongly impacting the rate of diffusion of an innovation. Rogers uses this term to refer mainly to the moral compatibility of values between the innovation and the values, beliefs, existing ideas and needs of the system under analysis. In this perspective is easily understood that an innovation-based upon moral or intellectual habits opposed to the social and economic system will slow and eventually block its diffusion. Compatibility has the biggest impact on the diffusion process when considering the technical features of the innovation. Technical compatibility became one of the most important topics in the literature of innovation management and refers to the capability of an innovation to function with existing technologies and with existing complementary goods. The technical complexities of matching technologies and innovation became increasingly crucial in the last decades, with innovation characterised by high intrinsic technical complexity, incompatible software, cross-fields innovations, joint development and open innovation. To tackle this issue and trying to guarantee the best experience for the consumers different types of standard bodies, both private and public, exist. Standard bodies impact the diffusion of an innovation because some of their external decision might completely stop the commercialization or require serious changes

in the technical features of the innovation. To generalize, compatibility of an innovation with the moral values and the technical specification existing in the system is likely to fasten the rate of diffusion of the innovation.

A specific factor that I already introduced in different parts of the description of the model is the complexity of the innovation. The complexity, recalling the two types of knowledge introduced during the description of the persuasion stage, might refer to the complexity of the underlying principles or complexity of use and of the how-to knowledge. Generally speaking, can be said that the perceived complexity is negatively correlated to the rate of adoption of the innovation. One of the first studies of the discipline of diffusion of innovations (Fliegel and Kivlin, 1962), analysed an interesting case of agricultural innovations and found that complexity of farm innovations is the second factor after relative advantage impacting, in this case negatively, the rate of diffusion.

All of the attributes impact the rate of adoption with their perceived values. Strictly connected to the innovation in action is also the Observability characteristics. Observability is the degree by which an innovation is easily observed and understood, making it easier to describe to other potential users in the system. To summarize this characteristic can be said that the observability of an innovation is positively correlated to its rate of adoption. To understand better the concept of observability and what is actually observable of an innovation, I will stress the 2 components of each innovation and technology: Hardware and Software. Hardware is the physical object and tools of the innovation; Software is the information needed to use the innovation. Can be clearly understood that while the hardware part is easily observable, the software component is not easily seen by an observation. From this derives that innovations which are mainly based upon software features are harder to be observed by an individual in the first phases of the decision process, leading to a slower diffusion.

The last feature of an innovation, as I introduced in the Decision stage, is the trialability of the innovation. Trialability allows, due to the technical characteristics of the innovation, to try at first the innovation on a limited basis. Clearly, the real or perceived possibility of trying the innovation on a smaller basis as a way to gain information and reduce potential risks is positively associated with a faster rate of adoption. Trialability has an intersection with the 5 adopter categories and how they see this possibility. Earlier adopters give higher importance than later ones to this possibility because they cannot see

the results of previous adopters in terms of practices development and reduction of the uncertainty associated with the innovation. Also, the duration of the trial is shorter for later adopters when compared with the initial trials of innovator and early adopters.

Up to now, I have described the main attributes of an innovation which impact its rate of adoption. Would be however naïve assuming that these 5 variables explain all the overall spreading speed. The attributes of innovation are just one of the 5 typologies of variables which contribute to set the speed of diffusion. I have already explained the second typology which is the type of Innovation-decision, Optional, Collective, and Authority, to which must be added the category of Contingent innovation. These different approaches to the innovation-decision can have different impacts on the adoption rate, either slowing or fastening it for every type of decision.

The other factors guiding the diffusion of an innovation are the Communication Channels involved, the Nature of the social system itself and the role of Change Agents. Before entering their analysis is important to remember that the rate of adoption is likely to vary over time. As time passes more information enter the social system and are at disposal for users to take a more rational and risky decision. Moreover, as time passes and more individuals decide to adopt, the more contact with information and in most cases positive opinion those who have not adopted yet can have. It is this mechanism that, after a long period, brings information and drives the decision of the laggards who tend to be more sceptical and have less contact with other members. The expansion of adopters can be seen as a snowball effect, typical of the normal distribution, spreading at increasing pace toward all the population but to achieve the necessary amount to be effective the diffusion has to "cross the chasm" (Moore, 1999), which means being able to move outside of the niche of early adopters and spread over wider ranges of individuals. To do so, often a different set of motivations or events from those which drove the decision of earlier adopters might be needed.

2.2.2) Communication channels

Deepening the analysis of the communication channels is important to first stress the concepts of Homophily and Heterophily. Homophily is the degree of similarity between two individuals interacting in terms of beliefs, social status, education, and other attributes. Most of the interactions we have every day are homophilous because

communication is more effective between individuals having similar characteristics. On the other hand, heterophilous communication is rarer because it generates problems which make it less effective in passing information. The adversity for heterophilous information is, however, great harm to the diffusion of innovation because new ideas are likely to come from outside of the social system and enter it initially through individuals characterised by higher social status and innovativeness. If knowledge of the innovation is to be passed on individuals with lower social status, heterophilous interactions are therefore needed. At this point must be kept in mind that the rate of preference and effectiveness of homophilous interaction over heterophilous one varies across social systems and between individuals, adding another variable to the complexity of estimating through independent variables the rate of diffusion of an innovation. The impact of homophily and heterophily over diffusion leads to some generalizations: most of the interpersonal diffusion networks are homophilous, and when in presence of heterophilous diffusion networks, followers tend to follow opinion leaders who are more educated, of higher social status, with mass media exposure, more cosmopolite, more innovative and with greater change agent contact. These generalizations highlight that later adopters place opinion leadership over earlier adopters as the characteristics of opinion leaders coincide with those of earlier adopters. This enhanced trust usually derives from the expected technical expertise of opinion leaders and early innovators. Heterophily helps explaining why the greatest trust and opinion leadership is placed upon early adopters instead of innovators; innovators usually have the highest technical expertise and could hold the most important information about an innovation but their rate of heterophily with the rest of the system is usually too much high to allow at effective communication. This is in line with the last generalization about opinion leadership, which states that when in the social system change is favoured opinion leaders are more innovative, instead of when change is judged negatively by the system opinion leaders are not particularly innovative. This describes our case because innovators tend to not place excessive consideration over the social system beliefs while early adopters place much more value in them, also to protect their best position inside the system. Keeping in mind that the drawing of diffusion and interpersonal network is a very complicated topic, I will highlight the main features of this theory which will prove to be very useful in the description of the case under analysis.

Every individual in the network has a number of linkages with other agents in the social system which can carry potential information. The ties composing the

communication network of each individual can be divided in strong ties, those characterized by high homophily and in most of the cases also physical proximity, and weak ties which are characterized by a higher heterophily and in some cases also physical distance. Statistically, most of the communication networks are formed by a higher number of strong and close ties when compared to weak ties. However weak ties have an extremely important role in the diffusion of new ideas and innovations because these are capable of bringing information from outside the system and also to connect the different social clusters inside the system itself. This concept is referred to as the "strength of weak ties" (Granovetter, 1973). Diffusion networks can take many different shapes but the most common one is composed by a series of strictly connected strong ties which are connected to other similar closely connected networks with a limited number of weak ties between individuals which are called bridge ties. This can be stated more formally by saying that the potential value of information exchanges is negatively correlated to communication proximity, which is a measure of the strength of ties and to homophily between individuals. The differences in social contact I stressed before in the description of the five adopter categories find in the network analysis a theoretical framework. Earlier adopters tend to have a greater interconnectedness, which is defined as the number of linkages with other individuals, and a higher rate of contact through weak ties than later adopters. These characteristics can be generalised by stating that interconnectedness is positively correlated to innovativeness degree of the individuals. The information networks are not composed only by the adopters and potential ones because, even if considering only the ties in the social system which have an impact on the diffusion of an innovation, various types of players compose these networks. The most important type of agent for the diffusion of ideas and innovations, which composes one of the five independent variables driving the diffusion rate and eventual success, is the change agent.

2.2.3) Role of change agents

Change agents have a linkage role between the change agency and the system of the clients. Change agency is the organization or the set of organizations promoting the diffusion of the innovation. Sponsoring the diffusion can be done by different types of private or public institutions with a wide range of possible reasons. These reasons can be economical only, as in the case of a company trying to spread its innovation on the

market, or more socially oriented as in the case of a government promoting new healthy habits for the citizens. A linkage between the change agency and the potential adopters is in most cases, but not all, needed because of the extremely high heterophily between them. Change agencies are composed mainly of highly skilled professionals, for example, engineers or social planners to recall the previous example, which are the most expert of the principles of the innovation. On the contrary potential users are usually characterised by lower education and social status and are interested primarily in the how-to knowledge of the innovation. Communication between these two typologies of agents would not be effective and therefore institutions involved as change agencies rely on change agents to spread the message. Change agents are in the halfway between the professionals working in the change agencies and the potential adopters in terms of education and social status. Specifically, change agents usually have a technical rather than theoretical background which allows them to understand both the principles and the how-to knowledge of an innovation. Not all the potential adopters, however, have the same number of contacts with change agents. Recalling the theory of networks, contact with change agents is to be considered in most cases as a weak tie, due to the heterophily level with potential adopters. From this assumption is easily derivable that earlier adopters tend to have more contacts with change agents, leading to the generalizations that change agent contact is positively correlated with higher social status, social participation, education and cosmopoliteness among clients. This focus, however, raises a discussion on whom change agents should focus their attention on to have the most efficient diffusion. Later adopters need the biggest recommendations and help in the adoption due to their lower education and higher scepticism but the heterophily with the change agent is likely to result in less effective communication than the communication between earlier adopters and change agents, which presents a lower level of heterophily. Change agents should, therefore, focus their attention on targeting opinion leaders which will then spread the innovation over later ones, being careful on effectively contacting the opinion leaders of the system and not the earliest innovators. In order to achieve a successful spread, change agents should also try to match the needs of potential users with the innovation considered, making use of empathy and keeping as much as possible a client-orientation rather than a strictly applying a change-agency orientation approach.

The eventual success of change agents is largely derived from the credibility these have in the eyes of adopters. Credibility can be divided into competence credibility,

described as how much an information channel is perceived as an expert of the topic, and safety credibility, how much an information channel is trustworthy. Theoretically speaking, weak ties and heterophilous contacts have perceived competence credibility while strong ties and homophilous contacts have perceived safety credibility. Change agents should look for the perfect match of the two credibilities, for example by having similar social status and different technical characteristics. When this is not possible, change agents rely on paraprofessional aides, which are not professional and lower-skilled individuals which contact individuals to affect their decision, as a way to bridge and avoid the heterophily gap and have a complete competence and safety credibility. The other factors driving the success or failure of the change agent is the effort they put in contacting clients, the homophily with clients and the capability of identifying and work through opinion leaders.

The role of change agents is, however, changing and becoming less important in recent years, because new models of innovation production are arising, spacing from joint development to lean methodology. These new strategies move away from the standard methodology of technology development and deployment, which consists of a company with an R&D department of huge dimensions which has the capability of generating and spreading the innovation alone. The initial standard diffusion-system is called centralised, as opposed to the new arising models of decentralised diffusion systems, where innovations are jointly developed by companies and users, where the innovation and the characteristics of this to be adopted are not decided ex-ante by a single organization but emerge through coordination and the market mechanism. These new mechanisms, therefore, reduce the power of change agencies, consequently diminishing the need for change agents. Decentralised diffusion systems have the best results in the case of low-technological intensity and are usually preferred by the users which feel control over the system but might lack coordination. I decided nevertheless to highlight the role of change agents because agricultural innovation systems are in most cases centralised systems and to better understand the twisted impact on the diffusion process in the particular diffusion systems of my analysis.

2.3) Final considerations on the model

The last branch of the five variables driving the adoption rate deals with the nature of the system itself. Analysing and understanding the whole complexity of a system and how this could influence entrepreneurship and innovativeness is a very troubling problem and I decided to focus only on the characteristics interesting for the case study I considered. The interconnectedness of a social system is a key variable in the spread of new ideas and innovation and can be observed with network analysis, keeping in mind the opportunities and the problems of weak and strong ties and different network shapes. Another topic I previously highlighted is the connection between the values of the innovation and the values of the overall system, which can seriously slow the diffusion if these are not compatible. Without entering the specific differences between of rural and urban social system, I will bring a crucial finding by Rogers for my case study, which found individuals in urban contexts statistically more innovative than individuals living in an urban context. In this chapter, I made a short description of the model proposed by Rogers for the diffusion of innovation. For the impossibility of describing with the same specificity all the topics involved in this model, I decided to place particular attention on the elements impacting most the diffusion of organic innovation in the system considered. Organic farming is not the most cutting-edge technological advancement but is still to be considered as an innovation on the producer's side due to its specific features. Most importantly, it applies a new fundamental idea, the avoidance of chemical inputs, to create value for the user and the overall system. Even if the idea of avoidance of pesticides might seem a regression to the era previous of the "Green Revolution", modern organic production can be described as an innovation because aims at maintaining comparable production levels with the existing agriculture, while generating value on the three areas of sustainability. Particularly interesting is the co-development of practices, biological inputs and theoretical studies which, jointly developed by a range of stakeholders as incremental innovations, helped raising dramatically the quality of organic's production in recent years.

In the next chapter, I will describe why I decided to analyse this innovation inside this system and the gap in the theory I encountered and tried to fulfil with my study. After this brief review of the existing theory I will deepen the description of the system and of the considered characteristics of organic information to have all the information needed to understand the main drivers of its diffusion.

CHAPTER 3) Theory gap and analysis of scope

3.1) Review of existing literature

In Trentino organic farming is a very discussed topic as this type of production can be observed on both the consumers' and the producers' side. As will be shown in the next chapter, Trentino is formed by valleys with a high agricultural extension and agriculture is consequently under the eyes of every citizen. At 2019 the diffusion of organic innovation in the apple industry covers 11,3% of the total apple fields (Trentino's Organic Productions Office, 2019), highlighting that it is in a high development phase and about to reach the highest diffusion speed, as assumed by the Gaussian distribution (Rogers, 1962). Differences in the level of development are however found in the province areas, with an area now entering the late majority adopter category and others area whom just entered early adopter category. Organic farming proved to be more profitable on both a local and global scale (Crowder and Reganold, 2015) and also the evaluation of the positive effects of this type of agriculture over health and environment were already widely available in the existing literature. Many studies were found confirming the better overall environmental impact of organic agriculture (Gomiero, Pimentel and Paoletti, 2011), with the most interesting being the research carried on apple-producing systems (Reganold et al., 2006). Moving on the health side of the problem I easily found that organic has less risk for the health of producers, citizens living near farms and even consumers (Smith-Spangler et al., 2012; Hoefkens et al., 2009). According to existing studies, organic farming can be considered as a Pareto superior agricultural productive system, presenting benefits in all the three sustainability areas. This assumption, together with the observation of the discrepancies in diffusion levels, suggested the need of a complete study of the diffusion system, capable of explaining the differences existing in the almost homogenous territories of the same province. The knowledge and the tools derived from the field of innovation management were used to find an answer to this macro-question question. The best approach appeared to be the application of Rogers' model for the diffusion of innovations. This model has been largely used over years to study the introduction and diffusion of innovations in the agricultural field, with Rogers himself bringing many examples in his book, and many other existing studies on the topic (Griliches, 1957; Diederen et al., 2003; Feder and Umali, 1993). Taking into consideration also the environmental benefits of the adoption of organic farming, different studies applying the

model of diffusion of innovations to green innovations were taken into consideration (Pampel et al., 1997; Noppers et al., 2015). After having gained some insights on the characteristics of the five adopter categories for green innovations, the existing literature of diffusion of agricultural green innovations and organic innovations was taken into consideration. Worldwide agriculture is a complicated matter and its production phase is approached differently in different countries, even in their innovation diffusion systems (Lybbert and Sumner, 2012; Picciotto and Anderson, 1997). Just to cite the major difference, European agriculture is characterised by relatively small acreage where the owner works alone or with few employees, in the U.S. and in the developing countries agriculture is made usually in huge acreages with many employees working for the owner and in under-developed countries still rely mainly on subsistence agriculture (Baylis et al., 2008). These and other differences of various agricultural productions eventually resulted in discrepancies among the drivers of the diffusion of organic production and in the characteristics of the adopters. Was therefore decided to still consider cases from different countries and continents (Sanders, 2006; Lanjouw and Mody, 1996; Bravo-Monroy, Potts and Tzanopoulos, 2016), but to place increased attention on the study of European cases of diffusion of organic production. Among the different studies analysing theoretically the diffusion of organic agriculture (Wilson and Tisdell, 2001;; Bravo-Monroy, Potts and Tzanopoulos, 2016; Diederen et al., 2003; Padel, 2001; Feder and Umali, 1993), were found of particular interest the studies of an Irish researcher, Doris Laepple, for the capacity of demonstrating statistically the differences in many considered variables between different adopter categories of organic agriculture in Ireland (Läpple and Rensburg, 2011; Läpple, Renwick and Thorne, 2015; Läpple et al., 2016). Considering the adjustments that the research made to the diffusion of innovations when focusing specifically on green technologies, agricultural innovations and most importantly organic production, the characteristics of the different adopter categories of organic agriculture in Trentino were hypothesized. The variables considered most important were included in the interview protocol, which was conducted with a set of 20 farmers carefully selected to be able to cover all the different adopter categories. This interview had the double objective of both checking the fitness of the assumptions of the model of diffusion of innovations and its adjustments to the Trentino case and gaining a better understanding of the phase of diffusion across different areas of Trentino. The analysis of the personal characteristics of adopters is however capable of explaining just partially the diffusion of

an innovation. This problem was faced also in this study, because huge diffusion differences across the areas of the region considered were found, which could not be explained only through the relatively small differences of its population. The main drawbacks of most of the studies applying diffusion theory is the decision to focus only on the quantitative analysis of a limited number of variables describing the personal characteristics of the adopters, placing lower attention on the overall system involved. As highlighted in previous studies, the adopter analysis alone does not provide sufficient information to understand the overall development of organic production (Padel, 2001). A more integrated systematic approach is used in several studies which consider and analyse the effects of policies and other macro-mechanisms driving the diffusion of organic agriculture (Sanders, 2006; Morone, Sisto and Taylor, 2006). The downturn of these studies is the complete or partial lack of consideration of the theory of diffusion of innovation. Another topic that I will try to cover with one of the research questions is the conventionalization hypothesis (Buck, Getz and Guthman, 1997). This concept has been already analysed through case studies (Best, 2007; Hall and Mogyorody, 2001), which are distant from the Trentino's scenario because is based upon agriculture on a larger scale. The risk of conventionalization is connected in existing studies with very large producers adopting organic, which might non be the case of Trentino where agriculture, especially for apple farming, is usually done on a small scale. The last research question considered covers the decentralised and decentralised form of the diffusion system. Research upon this topic exists but is mainly related to the centralised form of traditional agricultural systems (Rogers, 1983; Läpple et al., 2016) or to the decentralised systems in place for organic diffusion (Morgan and Murdoch, 2000; Padel, 2011; Pamuk, Bulte and Adekunle, 2014). In existing literature, a gap is present in the study of the intersection between the two systems for organic diffusion, which is the present situation for organic diffusion in Trentino. The aim of this study is therefore to join the analysis of the personal characteristics of the adopters with the analysis of the surrounding overall system driving the diffusion of organic production to gain a deeper understanding of the whole development. I believe this study will be extremely useful to highlight the best and worst practices used by the different actors of the system, including farmers, to foster the diffusion of the innovation. The specific features of organic products which can have an impact on its diffusion rate will be described in organic's description analysing organic features based upon Rogers' assumptions. The knowledge acquired during the analysis

helped me also to understand the overall role of farmers' sustainability concern in fostering the diffusion of organic production.

3.2) Research questions

I highlighted in previous chapter the problems existing studies encountered in analysing the complete diffusion system for organic diffusion on producers' side. With my analysis I tried to have a complete view of organic diffusion in the system considered. I aimed at obtaining a more complete view by addressing four main research questions

The first research question, which is strictly connected with the second, aims at understanding the boundaries of the innovation system to be considered and can be expressed as:

Q1) Which are the reference system for organic diffusion in the case study and what are the driver of different diffusion rates?

Specifically, this question tries to demonstrate that the diffusion systems in place are different between the various systems considered. To answer this question, I will compare the diffusion rate in different areas with the personal characteristics of the adopters. In particular, I will compare the estimated adopter category of the personal variables assumed by the theory with the actual results, considering the phase of development in the reference area. This comparison will be useful to understand the geographical dimension of the innovation system to be considered. The comparison between theory's assumption and the results obtained will be useful to understand the degree of compatibility of theory and the case study, which is the second research question.

Q2) What are the most important characteristics and adoption drivers in different adopter categories?

It is this research question, that could be most useful for policymakers, which aim at targeting specific classes for the future development of organic agriculture. The third research question aims at demonstrating the evolution from a decentralised innovation system toward a centralised innovation system. To test this assumption, I added questions over the decision-making process and their interactions with other farmers, change-agents and the main organizations.

Q3) Is the system considered exposed to the risks of conventionalization?

This question considered aims at evaluating the organic diffusion in Trentino considering the "conventionalization hypothesis". This last question aims at evaluating the changes in the conception of organic farming between earlier and later adopters to check if for the later ones it is considered as a slightly modified integrated agriculture. To check this question, I will compare the evolution of the motivations between adopter categories, the degree of attachment to organic principles and the specific personal characteristics of earlier and later adopters.

Q4) Which type of knowledge system exists in the case considered, how it changes over time and how it affects the decision-making process?

While traditional agricultural innovation diffuse are based upon a centralised innovation system, organic diffuse usually through a decentralised innovation system between farmers. These different approaches were respected in Trentino but in recent years a centralised diffusion system is trying to be set up also for organic diffusion. This question aims at evaluating the presence of this trend, analysing the role of main stakeholders and the decision-making process of the farmers. The main risks and effects of this new approach will also be exposed.

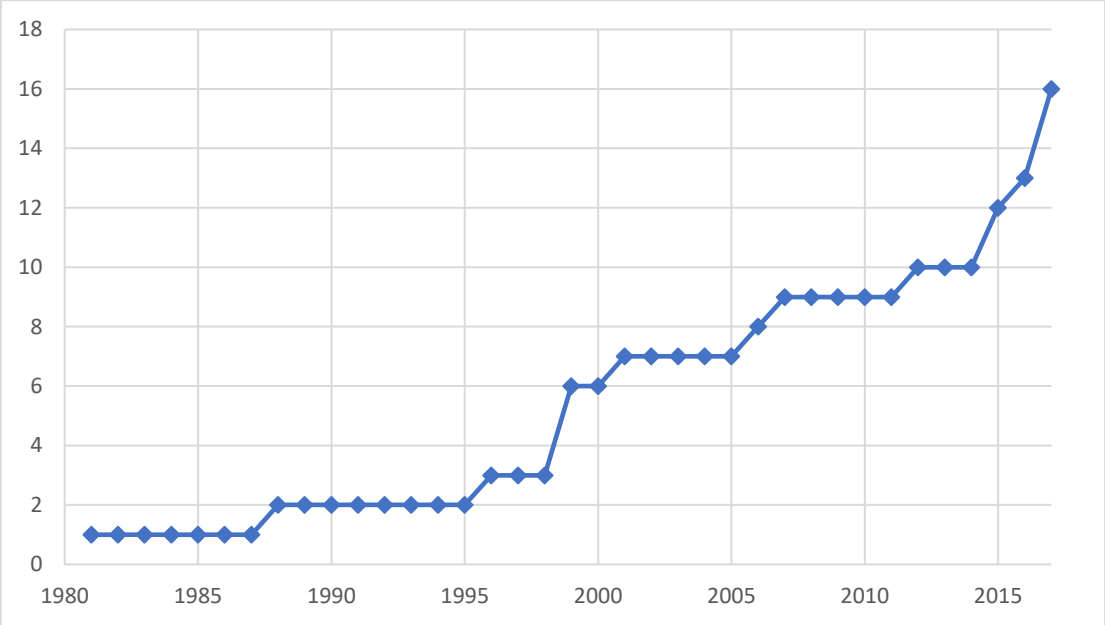
To check this question, I will compare the evolution of the motivations between adopter categories and the degree of attachment to organic principles.

Trying to answer these questions I developed a structured interview formed, by 23 questions, with associated sub-questions to highlight the specific variables of interest. I will describe in-depth the interview and sample development as well as the single questions in separated chapters. When comparing the actual results of my study with the theory's expected values, I will rely mainly on Rogers' predictions and his meta-analysis included in the book diffusion of innovations (Rogers, 1983) and with studies over adopter's categories for organic innovation (Wilson and Tisdell, 2001; Läpple and Rensburg, 2011; Bravo-Monroy, Potts and Tzanopoulos, 2016; Diederen et al., 2003; Padel, 2001; Läpple, Renwick and Thorne, 2015; Feder and Umali, 1993)

3.3) Methodological note

Trying to answer all four proposed research questions involves many different types of information, regarding personal characteristics and motivations as well as whole systems' characteristics. To cover all the topics considered, I decided to use the instrument of qualitative research. My analysis considered variables involved in the whole process of adoption decision, therefore the interview has been structured following the stages of adoption decision. The questionnaire obtained is formed by a total of 23 questions, divided into six sections, including a first background section and five stages of the adoption process, Knowledge, Persuasion, Decision, Implementation and Confirmation. I personally conducted all the interviews face to face with the farmer, or the farmers in the case of more than one individual jointly owning and working the farm. In total the 20 interviews were done with 23 farmers. The interview protocol and the actual interviews were in Italian to avoid language barriers. The interviews took all place in quiet places, at farmers' house or farm for 18 interviewed farmers. The farmers were directly contacted by phone before the interview to agree on a possible meeting. The first contacts were with farmers I previously personally knew. I asked to the first interviewed farmers if they personally knew and were willing to share the phone contact of farmers in the areas and categories of interest, which were previously selected. All the interviews have been recorded and, in a later phase, transcribed. Due to the length of the interview, a sample of twenty farmers was carefully selected. I decided to select the farmers' sample to include the different adopter categories, while a randomly picked sample of farmers would have produced an extremely high number of interviews to non-adopters, which were less useful for the purpose of the research. The interviewed farmers considered adopted in different periods, with a set of non-adopters to compare the results. The reference categories which farmers belong could not be decided ex ante, as these depend on the boundaries of the reference system, which is the aim of the first research question. Anticipating the results for this question, 2/3 interviewed farmers belong to the innovators category, 9/10 to the early-adopters category, 4 to the early-majority category and 4 non-adopters. I could not interview any adopter belonging to the categories of late-majority and laggards as the critical amount needed for these categories has not been reached yet for any reference system. The adoption over time of the interviewed farmers is highlighted in the graph 3.1. The first adopter interview was the first organic adopter of the whole Trentino's agriculture, converting in 1981. The latest adopters interviewed started their conversion

period in 2017. I decided to focus intensively on earlier adopters to understand their role and impact in the development of practices and incremental innovations which characterises the decentralised diffusion system considered.



Graph 3.1 Cumulative adoption over time of farmers interviewed.

The interviewed farmers belong in different areas of Trentino and, as I will highlight in the first research questions, to different diffusion systems. The geographical spread of interviewed farmers does not reflect the geographical diffusion of Trentino's apple farmers but is comparably close to the geographical diffusion of organic producers. My interviews focused on farmers in the most developed organic area on the producers' side, the South Trento area. This allowed to capture the answers of farmers belonging to the early-majority category, which is not yet present in the other systems. Basing on the spatial division in "Comunità di Valle", eleven farmers work in Val d'Adige, five in Val di Non, two in Rotaliana-Königsberg, one in Valle dei Laghi and one in South-Tyrol.

From the interviews I obtained a total of 615 minutes of recordings, with an average of 30 minutes and 45 seconds of interview for each interviewed farmer. Even though I prepared a set of sub-questions to obtain wider answers, aiming at capturing the core of the question, the duration of the interviews has been highly variable, from a minimum length of nine minutes to a maximum of more than one entire hour. On average the interviews to non-adopters have been much shorter compared with interviews to

organic adopters. This happened partly because not all the questions proposed were valid also for non-adopters but also because they were less willing to talk extensively about organic farming, even though that is a personal impression. During many interviews, and in particular during longest ones, farmers digressed from the questions asked. They were not stopped as the information received outside the proposed questions proved useful, especially to understand the relations, positive or negative, between agents in the system. In the following pages, I will go through the questions, for each describing the research question of interest, the expected result and the actual results. Is important to keep in mind that the statistical validity, over such a limited sample in which the number of interviewed farmers for each adopter category is even lower, is fragile. Therefore, this study aims at identifying the main variables of interest for all the four research questions rather than estimating precisely correlations between the variables considered. The results obtained should be analysed in depth through a specific quantitative research to obtain a higher level of statistical reliability.

Another issue which could harm the statistical reliability of the results is the necessary interpretation of the statements I had to apply because I decided to avoid multiple-choice and numeric scale questions. In some questions, for example the main motivations and the sustainability concern, this meant I had to assign weight based on my interpretation.

To have a more complete view of the diffusion systems considered, were included in the interviews also other stakeholders involved in the system. A two hours long unstructured interview with the first organic-change agent, whom crucial role has been confirmed by most of the organic adopters, was included in my research. Two of the interviewed farmers were contacted for their double role of farmers and president of one of the largest commercial cooperatives in one case, and member of an organic awareness committee in the other case. The information received from these additional stakeholders proved useful for understanding the whole complexity of the diffusion systems considered and the existing characteristics also from a different perspective.

CHAPTER 4) Description of the case study

4.1) Agriculture in Trentino

Trentino is a mountainous area, with agriculture taking place mainly in the valleys and breeding in the uplands. Trentino is a province with special status of Italy, which has legislative power delegated from the state over most of the topics, including agriculture. Together with South-Tyrol, Trentino forms the independent region of Trentino South-Tyrol. In this thesis I focused only on the agricultural system of Trentino's province, considering the role of South-Tyrol only for its influence over the diffusion process in Trentino. Trentino's agricultural sector is composed of 16.446 farms with a total Utilised Agricultural Area (UAA) of 137.219 hectares. Most of the UAA is however composed by meadows and pastures, almost 110.000 hectares, with only 22.000 hectares devoted to woody crops and 3.000 hectares of arable land. The distribution of farms is the opposite of the distribution of hectares, with only 15% of the farms (2.389) involved in breeding activities, which occupy 81,5% of the total UAA. If we consider also the forest areas and the unutilised agricultural areas, the total area owned by farms is much higher, with 408.871 hectares. These data and most of the others presented in this introduction on the sector are taken from a 2010 survey of Italian agricultural sector, which proved to be the most reliable source (ISTAT, 2013). Before deepening our analysis, must be highlighted that Trentino, due to its geographical morphology, is divided into 16 communitarian valleys with specific administrative powers. This division is crucial to be kept in mind because I will show the differences in the diffusion process between the various areas, considered as the territories of communitarian valleys. The distribution of farms between the valleys is uneven, with Val di Non having 3.844 units, 23% of the total, and Vallagarina 3.079 units, 19% of the total. All the other valleys have less than 10% of the total number of farms. Moving on the side of AUU, only Valli Giudicarie has consistently more than 10% of the total AUU, having 19% of the total AUU, with 30.117 hectares. Comparing the data from 2010 and the previous survey in 2000, some clear trends appear. First of all, there is a clear reduction (-53%) in the total number of farms. This collapse is however partially explained by the new regulation of the survey which excluded the farms smaller than a predetermined size in hectares. The total UAA saw a relatively smaller reduction between 2000 and 2010, with 7% less utilised hectares. An important distinction is to be made between professional farms, those in which at least one person works full time as a farmer,

and the so-called hobby farms, where the farm is worked only as a secondary job and as a parameter is considered a maximum number of 300 hours worked yearly. In Trentino, around 70% of the overall registered farms are worked professionally, with a total of 11.416 farms. This number saw a decline of -8% when compared to 2000, much lower however to the -53% reduction in the total number farms, which can be ascribed to the breakdown, real and due to the new parameters, of hobby farmers. Most professional farms take the juridical form of individual company, 10.819 out of 11.416. The rate of individual companies however slightly decreased between 2000 and 2010 due to the emerging form of the simple agricultural society, which increased in number from 128 to 316. To the different juridical forms are associated also different cultivated areas, with societies owning on average four times larger crops than individual companies. The professional farms, in their different forms, cultivate 97% of the total AUU, with an increase from 2000 where professional farmers cultivated 92% of the total AUU. The AUU of professional farms is higher than for hobby farmers and this discrepancy even increased between 2000 and 2010, as the AUU of professional farms increased on average. All these data suggest an increasing professionalization in the agricultural sector, with a lower number of producers having increasingly bigger farmland. This is particularly true for breeding, while woody crops saw a smaller increase, moving 3,20 average hectares in 2000 to 3,51 hectares in 2010. The average size for apple cultivation is much smaller than the overall average agricultural area but is comparable with the size of vineyards, with an average area of 3,26 hectares in 2010. A particular case is represented from Val di Non, which as I will show is the largest apple producer, wherein the period between 2000 and 2010, the average AUU of each farm even reduced, from 4,97 to 4,82 hectares. These data, of Val di Non and province level, highlight that the suggested increasing professionalization of Trentino's agriculture is happening at a much lower rate for apples' production.

Shifting the analysis over the distribution of the different productions, I will base the comparison over the data of gross marketable production provided by ISPAT, the statistics institute of the province of Trentino (ISPAT, 2015). Analysing the economic value of different productions allow for a more efficient comparison than the quantities produced due to the high difference in yields and values of the productions. As can be seen in the table 4.1, excluding first processing, the highest gross value is generated by fruit-growing with 206 million euros of value, followed by viticulture and zootechny, both with a value close to 130 million euros. After including the relatively lower economic

value generated by field crops and forestry, both close to 34 million euros, the total agricultural value produced in the province of Trento reaches 819 million euros.

Year	Agriculture					Forestry	Total
	Fruit-growing	Viticulture	Field crops	Zootechnic	First processing		
2000	164.165	119.496	23.738	100.004	152.986	27.497	***587.886***
2005	171.055	127.480	22.528	103.155	167.685	27.202	***619.105***
2009	200.413	104.634	31.967	111.598	258.320	34.427	***741.359***
2010	231.516	108.468	31.744	119.231	237.492	30.191	***758.642***
2011	244.158	114.097	30.427	125.284	283.614	34.233	***831.813***
2012	303.059	114.709	33.902	129.909	279.875	25.947	***887.401***
2013	**206.380**	**129.978**	**34.390**	**130.914**	**283.231**	**34.276**	***819.169***

Table 4.1 Value generated by Trentino's primary sector, by sub-sector, in thousand euros, 2000-2013. Source: ISPAT, 2015.

Comparing different years can be noticed that the total value follows an increasing but not strictly linear trend. This volatility happens because the value produced yearly by agriculture is highly variable between years, due to macro-differences in both quality and quantity derived mainly from weather conditions. Considering the apple market, which is the most consistent part of the fruit-growing category, the variance of the total value produced is particularly evident, with a value of production reduced by almost 50% from 2012 and 2013. The variance in the overall value derives from the variance in quantity and in prices, which is generated by the variance in quality and the productivity of other apple producers. The volatility of prices can be observed in table 4.2.

Year	Agriculture					Forestry	Total
	Fruit-growing	Viticulture	Field crops	Zootechnic	First processing		
2001/2000	33,7	14,2	16,9	1,5	8,2	0,1	***14,9***
2005/2004	-7,9	-0,5	-8,7	0,1	6,2	4,7	***0***
2009/2008	-8,1	-13,1	-0,1	1,6	21,9	-9,5	***1,1***
2010/2009	21,7	10,3	4,2	7,8	-7,4	7,8	***6,8***
2011/2010	-20,3	8,4	-9	5,9	13,3	5,2	***0,7***
2012/2011	34,7	8,4	13,8	0,9	6,6	-5,7	***13,9***
2013/201	**-18**	**-7,3**	**1,3**	**3,4**	**-7,5**	**19,4**	***-9,8***

Table 4.2 Variations in average prices of Trentino's agriculture, by sub-sector, in percentage, 2000-2013. Source: ISPAT 2015.

Specifically, the largest variability in prices can be observed once again in the fruit-growing market, which is responsible for most of the variance in the overall prices. The variability in quantity produced can be observed by looking at the value of the production using the fixed price of the base year 2000, as in table 4.3.

Year	Agriculture					Forestry	Total
	Fruit-growing	Viticulture	Field crops	Zootechnic	First processing		
2000	164.165	119.496	23.738	100.004	152.986	27.497	***587.886***
2005	137.331	119.980	22.580	96.738	147.065	28.118	***551.812***
2009	143.284	148.008	23.776	96.450	154.521	31.716	***597.755***
2010	135.986	139.140	22.669	95.608	153.384	25.809	***572.596***
2011	179.945	134.983	23.874	94.888	161.683	27.818	***623.191***
2012	165.803	125.238	23.365	97.529	149.628	22.357	***583.920***
2013	**137.689**	**153.126**	**23.400**	**95.090**	**163.752**	**24.738**	***597.795***

Table 4.3 Value generated by Trentino's primary sector, average fixed price year 2000, by sub-sector, in thousand euros, 2000-2013. Source: ISPAT, 2015.

The overall quantity did not change much when comparing 2000 and 2013 level of production, even though relatively high differences can be observed in some of the years in between. Once again, the greatest variance is shown in the fruit-growing subsector, which, even excluding the low level of 2013, did not follow the slightly increasing trend of the other productions. On the contrary, the subsector which grew the most is the first processing, due to an increase in both price and value. This set of operations, which is usually included in the industrial sector, is here considered as part of the agricultural one in the part which takes place inside the agricultural cooperatives. Therefore, in the Trentino case, it is formed by Consortiums of fruit producers which, with 162 million euros in 2013, account for the largest share with 58,3% of the total value of first processing, wine cooperatives with a value of 85 million and social diaries with value of 35 million in the same year. The value generated by agricultural cooperatives, net of their costs, will eventually be shared with farmers, not in the form of profits but as an increase in the price paid to the farmer member of the cooperative for its production. In the fruit-growing subsector, the cooperative or consortium sales channel is used by almost all the farmers, while in the two other subsectors requiring processing, wine, and milk, farmers rely on both cooperative and private sales channels, which are not accounted for in the primary sector. In the fruit subsector, which is the focus of this thesis, farmers tend not to sell their products directly to retailers or large distribution, rather they chose to join together in agricultural cooperatives to achieve the necessary economies of scale needed to be efficient in the processing phase and on the market. Doing so they can delegate the commercial effort to the cooperatives' sales professionals and focus on the production phase. The minority which, for a variety of reasons, decide to avoid the cooperative sales channel can either sell through a private retailer, delegating once again the commercial

phase, or sell themselves their products, usually through direct marketing. During my interviews I talked with farmers experienced in all the three possible sales channels, understanding that the cooperative one is holding stable as the most commonly used, the retailer sales channel is steadily decreasing in latest years, and the direct marketing played and is still having a crucial role in the development of organic agriculture. The role of the cooperatives in the diffusion process is one of the gaps that this thesis is trying to solve because, due to the existing differences between the agricultural systems and the reliance upon agricultural cooperatives in a limited number of regions, it is often ignored by researchers. A study over the role of cooperatives over the knowledge system of Trentino's agriculture (Fontanari; 2017) found their importance in the spread of information and innovations to farmers, both directly and as a facilitator of communication between farmers. I will start from this study to understand the role played by agricultural cooperatives in the specific innovation under analysis.

I will now sharpen the analysis of the fruit subsector to highlight the importance of apple production in Trentino's scenario. Worldwide in 2017 were produced more than 83 million tons of apples, with China being by far the largest producer with 41 million tons. In Europe, the major producer is Poland with a total of almost 2,4 million tons produced, followed by Italy with 1,9 million tons of apples. (FAOSTAT, 2019) Trentino South-Tyrol provides 73% of the overall Italian production, respectively 0,95 million tons for South-Tyrol province and 0,45 million tons for Trentino province. Trentino province alone has two times the production of the following region with the highest production, Veneto. Recalling the data upon the fruit-growing subsector previously shown, in table 4.4 can be observed that apples represent more than 80% of the total value produced.

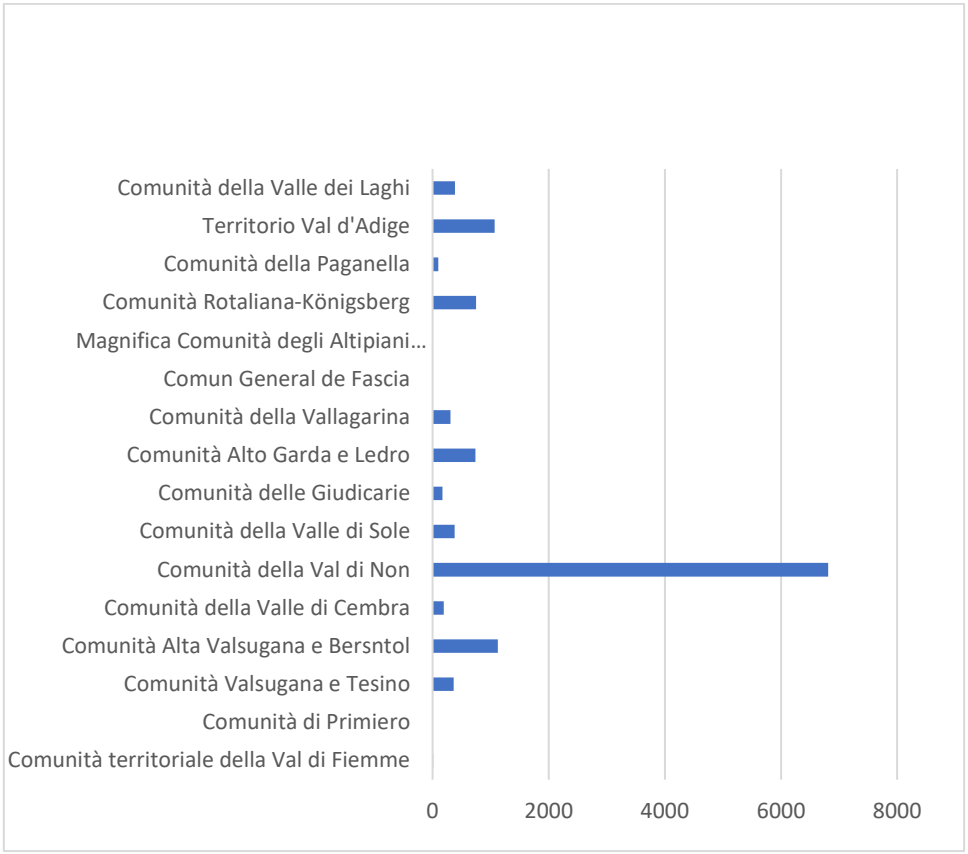
Category	2011	2012	2013
Apples	68,90%	75,80%	**83,70%**
Pears	0%	0%	**0%**
Drupaceous	2,40%	1,90%	**3,40%**
Other ligneous	0,50%	0,50%	**0,60%**
Berries	11,70%	7,60%	**9,20%**
Adversity Compensation	16,50%	14,10%	**3,20%**
Total	**100%**	**100%**	**100%**

Table 4.4 Composition of fruit-growing sub-sector, in percentage, 2011-2013. Source: ISPAT 2015.

The share of apples' value is to be considered above 80% also in the years 2011 and 2012,

because the value of "adversity compensation" is the amount paid by insurances for the failed production, due to weather conditions, of the whole fruit-growing subsector. This value should be therefore spread over the various productions based upon their relative weight, bringing the share of apple over 80% for all the 3 years considered. Due to the major importance of apples production in the fruit growing sub-sector, during this thesis will be considered, depending on the data available, the trends in fruit-growing sector as trends in the apples production. The distribution of apple's production is unevenly spread over the territory. To understand where geographically the production is more intensive is useful to look at the distribution of fruit-growing production areas in the different valleys, considering it representative of the apple production, in graph 4.1.

As I previously introduced, Val di Non is by far the largest producer, with more than 50% of both the number of fruit-growing farms and hectares cultivated. None of the other valleys reaches 10% in any of the two indicators of production considered. The valleys outside Val di Non with the largest fruit-growing areas are Alta Valsugana e Bernstol (9,07% of cultivated hectares), Val d'Adige (8,63%), Comunità Rotaliana-Königsberg (6,04%) and Comunità Alto Garda e Ledro (5,94%). Comparing the data for the number of farms and the total hectares can be seen that Val di Non has an average acreage for each farm of around 2 hectares, close to the average regional size. An average much higher acreage can be found in the central valleys of Trentino, Rotaliana, val d'Adige and Vallagarina, which are also the most anthropized areas of the province. The geographical distribution of the agricultural areas is reflected also in the membership to the major cooperatives. The by far largest cooperative commercializing fruits in Trentino is Melinda, which was born in 1989 as a consortium of 16 cooperatives of Val di Non and neighbouring territories. Melinda generates yearly around 80% of the total turnover of the sales of fruit produced in Trentino, relying on approximately 4.000 conferring members which cultivate roughly 6.500 hectares. Being the most known and largest Italian apples' producer, in 2003 received the only Italian recognition of Protected Designation of Origin (PDO) for three of their apple's varieties, Golden Delicious, Red Delicious, and Renetta Canada. Golden and Red delicious are the two varieties most produce across all Trentino, followed by Royal Gala, Fuji and Renetta Canada.



Graph 4.1 Total area of fruit-growing fields by "Comunità di Valle", in hectares, 2010. Source: ISPAT, 2014.

Latest years saw the emergence of a new business model in the apple varieties with the increasing development of the so-called club varieties, for which the seeds are owned and sold by a private company which controls the production by selecting the new implants and the commercialization, also through the variety's marketing. The organization owning and controlling a variety can be both an independent organization, as in the case of Pink Lady, the most cultivated club variety of Trentino, or owned by a producer, as in the case of Evelina, which is owned by Melinda itself. Despite its massive presence in the apple's market, Melinda is trying to expand to neighbouring markets by offering finished products, cherries, and wild berries. La Trentina is Melinda's main competitor, generating yearly between 10% and 20% of the annual turnover from fruit's production. It takes the juridical form of a consortium of 4 cooperatives, gathering the production mainly from Vallagarina and Valle dei Laghi but also Rotaliana and Val di Cembra. The production derives from approximately 1300 producers, cultivating around the same number of hectares. The most produced apple's varieties are similar to Melinda's

production; La Trentina generates 3% of its turnover from the production of other fruits, kiwis and plums. The last of the 3 largest players of the system considered, Società Frutticoltori Trento (S.F.T.), is the only one not taking the juridical form of a consortium of agricultural cooperatives but is a cooperative of farmers. Born by the merge of three existing cooperatives, S.F.T. has been part of La Trentina consortium until 2016. In the previous years, the cooperative went through juridical problems, due to suspected frauds, which ended with the removal of the existing president. The new president, which I could interview in the double role of organic farmer and head of S.F.T., decided to join, at first with a commercial agreement and later with direct membership, the consortium APOfruit from Cesena. The consortium, commercializing both organic and traditional apples, started to put an enhanced emphasis on the potential of organic production, also through its well-known organic brand Almaverde Bio. With less than 19 million of revenues in 2018, S.F.T. is the smallest of the three main players but is also the only one which increased its sales when compared to the previous year. After the split from La Trentina, S.F.T. saw a steady decrease in the number of members, which is formed by 267 farms by 2018, places mainly in Val d'Adige and Vallagarina. These three players commercialise the majority of the apple's production of the territory, but also other smaller cooperatives exist, for example, Cooperative Valentina placed in Rotaliana, and other sales channels are possible, either through direct sales or working with a retailer. The largest commercial destination of the apples produced is the Italian market, followed by the export toward Germany, Spain, and other European countries.

4.2) Trentino's agricultural diffusion system

Before moving on the description of the organic agriculture in Trentino and its innovative approach, some other characteristics of the existing system need to be highlighted. The most important thing to be kept in mind is that the agricultural system in Trentino is not conventional agriculture but follows the principles of integrated agriculture. Conventional agriculture, which was enabled by the green revolution, is characterised by extensive chemical inputs pre-scheduled on time lapses without considering the actual need and effectiveness treatment. All the treatments, whether it is conventional, integrated or organic agriculture, are applied over the fields by mixing the selected amount of inputs, chemical or biological, with water in an atomizer which has to be moved over all the cul-

tivated area to vaporize the solution over the trees. These solutions have a broad range of scopes, with the main ones being the limitation and contrast of harmful insects and fungi as well as weed management. Aiming the reduction of external inputs, Trentino's production moved toward an agricultural system of integrated production in the late seventies. Integrated agriculture can be considered, in terms of sustainable farming, as a halfway between conventional and organic agriculture. (Reganold et al., 2006). This type of agriculture tries to maximize the use of natural inputs and management practices, integrating with external chemical inputs only when needed. This basic concept is used in all the three main areas of concern for the farmer, fertilisation and management of the soil, weeds management, and plant defence. The underlining concept of maximization of natural inputs has been operationally applied through the principle of guided control, not applying the system of scheduled control which characterised conventional agriculture, that preselects yearly the time and type of treatments to be applied. Integrated agriculture instead relies on selected action thresholds to plan its interventions as a way to input chemicals only when those are needed. The action threshold is composed by benchmarks of different types, which vary according to the treatment needed and, for example, can be based upon the level of presence of harmful insects or the amount of recent precipitations. Integrated agriculture is trying to implement also in Trentino some practices derived from biological control and organic production, for example, the sexual confusion or the use of useful insects. Nevertheless, this type of production, according to farmers and technicians interviewed, evolved over time in Trentino and now is completely guided by the central institutions that I will describe later, being according to critics similar to conventional agriculture. Integrated agriculture does not have a national or European regulation, with different regions applying different production disciplinary, which contain limitations on the typologies and quantities of chemicals allowed for use. In Trentino, for the integrated production of fruits, the production disciplinary is created and updated over time by the Associazione Produttori Ortofrutticoli Trentini (APOT). APOT is a consortium of the three cooperatives previously described, Melinda, La Trentina and S.F.T., together with a cooperative of potatoes producers, CO.P.A.G., which is recognised as an Association of Organizations of Producers (A.O.P.), representing 90% of the Trentino's fruit growing sector. This association is also responsible for the brand Qualità Trentino, which is available for all the production respecting their standards. APOT disciplinary includes the requirements of the Global G.A.P. standard (Good agricultural practices), an international and well-known set

of farming standards; APOT, therefore, is a recognized certification body of the Global G.A.P., certifying all the production of the member cooperatives. More specifically the Global G.A.P. considered is the IFA version 5, Integrated Farm Assurance, which checks the productive system over the four areas of Environment, Food Safety, worker's protection, and traceability. Compliance is checked through the farm's journal, which must be kept by farmers, and through third party controls. For the control phase, APOT relies on Fondazione Edmund Mach (FEM), the last of the organizations involved in Trentino's agriculture system I will present.

Formerly an agricultural institute and centre for alpine ecology, FEM is the core of the knowledge, innovation, and diffusion of Trentino's agricultural system. The foundation's mission is the development of the rural system of the territory, in terms of both zootechnics and agronomic practices, keeping in mind the double role of Trentino's agriculture, both productive and of social, landscape and territorial maintenance. The foundation is divided in four main centres and is geographically placed in San Michele, a town in Rotaliana close to Val di Non. The four centres are: Centre for Research and Innovation, Centre for Technological Transfer, Centre for Education and Formation, Centre for Agriculture, Environment and Food. The Centre for Research and Innovation employs more than 200 researchers, working on theoretical scientific research with special attention to the plants and Trentino's agricultural system. The research is divided into four departments, covering different areas of the chemical and biological research: Sustainable ecosystems & bioresources, Genomics and biology of fruit crops, Biodiversity & molecular ecology, and Food quality and nutrition. The research covers the three pillars of sustainable agriculture, efficient production, respect for the environment and food safety. The analysis of the research centre is however too theoretical to find an immediate practical application in the surrounding agricultural system.

The gap between the theory and practical application is solved through the bridging function of the centre for Technological Transfer. The centre activities can be divided into two main branches, technical experimentation and technical consultancy, both covering different areas of agriculture, not only the fruit-growing subsector but also zoo technique, vineyards, forestry, and biomass. The technical experimentation is responsible for the trial and development of new practices and products to solve the existing problems of local agriculture, also based on the discoveries of the Research centre. The experimentation takes place on a farm of 120 hectares owned by the Foundation. The

other side of the centre, the technical consultancy relies on 70 technicians spread over 10 offices spread over the Trentino territory, with 5 of those set in Val di Non. The consultancy services are aimed at both the cooperatives and the single farmers, for various types of production. Focusing specifically on the fruit growing sub-sector, jointly with the technicians employed directly by the cooperatives, the technicians offer directly to the farmers technical advice on various aspects of the agronomic management of the orchard. The most important service of this department is in the territorial planning of the plant defence. By carrying different types of analysis of the territory, the technicians can identify the timings and chemical specificity of the intervention needed to solve the arising problems. This information is shared with the farmer, in most cases through a message on their phone, who just need to prepare the selected mixture, pour it into the atomizer and cover with it all the field's territory. This solution is, however, very controversial, with critics claiming the impossibility of grasping the existing differences among close territories, in terms of soil quality and exact scale of the problems, and the spoil of the role of the farmer to a mere executor, and those in favour supporting the simplification of the farmer's duty.

The centre for Education and Formation offers a range of fields of study to both high school students and professional training. The high school offers both professional and technical study courses. The three technical courses offered cover the areas of forestry management, processing of agricultural products and wine and fruits production. This last one, together with the professional school is the main source of formation for the farmers to come. The professional school is reserved to students belonging to a family owning at least a prefixed amount of cultivated land, is nicknamed as the "school for sons of farmers", and together with the classroom lessons provide many hours of in the field experience. The professional training offers various study courses, which cover the three areas of technical studies with deeper comprehension. Lastly, the centre for education and formation, jointly with the centre for agriculture, environment and food and the University of Trento, offers a university course in oenology and several doctorate scholarships for researchers to integrate into the other departments.

The foundation here described might be imagined as the perfect example of centralised diffusion system. The system, assuming its efficient functioning, has its core in a large organization, in this case a public enterprise, which carries on the initial research phase, through the centre for research and innovation, and the development phase in the

centre for technological diffusion. The impact on the overall system is even greater because the foundation is responsible also for the spreading on the territory of the innovations through its technician and also for the education of all those involved in the agricultural system, farmers, technicians, and researchers for the years to come. Analysing the education phase can be seen how the characteristics theorised for the change-agents are reflected in the technicians educated and eventually employed by FEM. Technicians have a longer period of study, minimum five years, than the professional study, composed by three years plus an optional one, and their education is on more theoretical and technical aspects of the agricultural production when compared with the practical knowledge acquired during professional studies. When compared with researchers can be seen instead that technicians have a lower and more technical degree of education, placing them in the halfway between theoretical researchers and farmers. According to the statements over change agents by Rogers, due to their level of education and other variables, technicians should have the right balance between homophily and heterophily to successfully transmit innovation toward the final users. The transfer of knowledge happens however not only through direct contact between the technician and a single farmer but also through workshops and meetings organized by the Foundation.

The foundation is not, however, the only organization involved in the knowledge system of Trentino's agriculture. As previously introduced, Euricse, a research organization born in Trentino analysing the role of cooperatives, published two studies over the importance of the cooperative in the agricultural system (Fontanari, 2017) The authors carried on a quantitative analysis, through a series of interview to both farmers and cooperatives' managers, highlighting the intermediate role of the cooperative in the knowledge transmission system. A particular role, which could not be done by FEM, is the bridging function between the whole supply chain and the farmers. Cooperatives have crucial importance in the reception and interpretation of information coming from the market in terms of new techniques, varieties, technologies and specific features of the product demanded from the market, which is cooperatives' duty to be transmitted to the farmers. Cooperatives have also in some cases an intermediate role in the transmission of the latest theoretical and technical results available, from FEM and other external institution. In the process of knowledge sharing must be kept in mind that cooperatives' themselves employ a set of technicians, in a number depending on the dimension of the cooperative, which has a connecting role. According to this study, which I can confirm

analysing most of the statements after the interviews I carried on, the cooperative as an impact on the diffusion of innovations by the creation of networks between farmers. These networks are created mainly through technical or informal meetings. Many farmers, more than one third according to the study, personally experiment new agricultural practices, input composition or varieties, sharing their results with both the cooperative and other farmers. In my study, as I will highlight later, the actual effectiveness of networks among farmers found partial rejection.

The knowledge system here described can be summarized as having two main sources of external novel information, coming from the market and scientific research. The information is passed on to the farmers through a series of intermediaries aimed at reducing the heterophily discrepancy between the source of innovation and the eventual adopter, in this case, the farmer. With my interviews, I tried to understand the optimal balance between competence and safety credibility, and the connected preference for heterophilous or homophilous information sources.

After the description of the other channels of information, the knowledge system can still be considered as mainly centralized because most of the innovations analysed are developed and brought to the farmers through existing organizations and only partial adaptations are done by farmers, which eventually share them through the organization itself. In the next section, however, I will highlight how the knowledge system radically changes when considering the diffusion of the knowledge associated with organic production. Due to specific features of the organic production and to the inadequacy of adaptation to organic from the centralized system, the organic knowledge system has the characteristics of a decentralized diffusion system. I believe that the study of such a particular knowledge system, which is now trying to move toward a centralization also for organic production, is a very interesting topic of my thesis which has not been analysed yet.

4.3) Organic innovative characteristics and practices

The reasons why organic farming can be considered as an innovation have been previously described, this chapter will highlight the main characteristics of organic production and the needed agronomic and managerial practices. The content of this chapter is needed to understand the drivers of diffusion rate to the specific production

considered.

At first, is important to clarify that organic production is a process innovation, and not a product innovation, even though the final product, in this case the apple, has a different market and even a different price. As previously seen, the new marketing channels might result in some cases also in an associated business model innovation. This type of production radically changes the whole production process of agriculture. To understand better this process innovation, must be described briefly the actual production process of organic production and how it differs from integrated agriculture. Consumers, and especially the most recent and less expert ones, tend to misconceive organic production as having a minimal human intervention and no external inputs. This is wrong because organic farmers need to use external inputs but are much limited in the available treatments, and are allowed to use only brass, sulphur, polysulfide, bicarbonate and some other vegetal products, as Neem's oil. These products are then mixed in the proper amount with water and applied on the trees using an atomizer. Integrated producers instead know that also organic production makes use of external inputs, but they believe that organic production is just a change of typology of inputs. This is wrong as well because organic production needs also new agricultural practices in order to be efficient. The most important practices in the annual production of apples regard the management and reduction of pests, fungi and weeds, the fertilization, extremely important for young trees, and the thinning of the production. The thinning is the practice of selection and reduction of fruits in an early phase to produce the proper yield. This can be done either manually or through agrochemicals. Agrochemicals have to be applied through an atomizer in the earliest phase directly on the flower and, according to farmers, eliminates yearly the proper amount of future fruits. These products, however, are not available for organic production which must manually thin the production, a process on average longer than 150 working hours for each hectare. The manual thinning increases the variability of quantity produced yearly, which is among the problems of organic production. This happens because the thinning is done directly on the fruits and, for its biological process, has already planned the production of the buds for the successive year. The biologically planned production will be lower for the excessive effort the plant believes will be needed to produce the year quantity, ignoring that part of this production will be removed. A new machinery for the mechanical thinning is slowly developing but its practical effectiveness is still unknown to most of the farmers.

Another issue requiring an increased number of working hours is weed management. Integrated agriculture can use a chemical herbicide, requiring maximum three or four treatments every year. Organic agriculture does not have any admitted herbicide and has to directly cut the weed to leave the soil nutrients to the trees. Nowadays various types of machinery for the mechanical mowing close to the trees are available but it still requires a longer time to cut the weed than using the chemical herbicide and a higher number of annual interventions. The weed management was a much more complicated issue for the innovators and the early adopters of the system which had to cut the grass by using hand-held trimmers, requiring a huge amount of time. However, as the number of organic producers increased worldwide, also the types of machinery available to solve their problems increased and also improved in quality, as the first machines would eventually harm the trees.

The fertilization is once again easier for integrated agriculture thanks to the available chemical fertilizers. Organic producers instead have at their disposal only organic and animal fertilisers. This might be a problem especially for young trees, where the farmer might need to integrate more often with fertilisers and rely on manual ploughing practices, requiring an overall higher number of working hours. The results are not however, according to producers, of lower quality fertilisation, with even in some cases better results due to the higher attention placed.

Regarding the pests, the main problems for Trentino's apple producers are associated with specific species of bugs and louses and, strongly increasing in the last years, wires. Simplifying as much as possible, pests spread because in the monoculture some species find a perfect habitat and no antagonists, as the biodiversity is harmed, and have therefore to be reduced using chemical products. In integrated agriculture, the control of pests was easily solved by vaporizing the product specific for harming each species over the crop. Organic agriculture has some products used to fight the spreading of pests, for example Neem's oil, but those have lower effectiveness. Therefore, trees' protection must be integrated with other practices and techniques, mainly sexual confusion, anti-insect nets and the use of useful insects, to find the proper biodiversity balance. The balance is a principle I introduced in the first chapter and here it can be seen how it applies to this specific agriculture. Organic agriculture aims at creating a perfect balance, of insects, trees, nutrients and inputs, to have the best possible production, as opposed to traditional agriculture which does not consider this basic principle and just erases any

problem with an external input as it arises. If action thresholds were used in integrated agriculture, these find increased importance in organic agriculture. The inputs used in organic production are less effective when compared with the same solution used in integrated agriculture and, in some cases as for brass, have to be used preventively rather than as a reply to a problem. This involves a radical change in the perspective of the farmer which now has to keep a complete view of the plant management to prevent the arising of problems, instead of keeping a reactionary approach to the problems. These issues will require many changes in the agricultural decision-making process that I will describe later. For the pest-control practices, the sexual confusion consists of the spreading in the air of the pheromone produced by the female of the target insect, making it impossible for the male to find the actual female and reproduce. The anti-insect nets are the evolution of the existing and already partially used anti-hail nets, which consists of a thin net covering the whole crops to prevent hail damages, which lower the market value of the product. Anti-insect nets completely close also the vertical sides of the crop, preventing the entrance of harmful insects. The last technique, currently under trial, is the insertion of useful insects, those who eat and reduce the population of insects harming the production. This practice finds its most common use in closed agricultural productions, as in greenhouses, while for open crops its effectiveness is still to be confirmed.

The last category of problems that apples' farmers must solve to have a proper production in terms of quality and quantity is the control of fungi. In integrated agriculture, farmers can rely on a chemical which is not washed away by the rain to block the spreading of fungi. Organic farmers, on the other hand, can rely only on brass and polysulfide. Brass must be applied just before the rain, but its effectiveness is severely reduced after a certain amount of rain. In this case, farmers have to apply immediately during the rain the polysulfide to block the development of fungi. This means that farmers have to be constantly aware of the weather conditions and be ready to intervene before and in some cases even during the rain, even if the intervention is needed during the night. The need to intervene while raining and even during the night might be a barrier for some farmers of val di Non, which is characterised also by steep fields, which could be dangerous to be treated in similar conditions. This problem could be solved by a solution currently under test by FEM and some farmers of al di Non which consists of using a technology similar to the irrigation system applying the mixture of polysulfide over the crop.

With this brief description of practices and inputs utilized by organic production, I wanted to highlight the increased complexity of this type of agriculture and the differences with integrated production. The biggest differences are in the intervention readiness and the decision-making process, rather than in the actual complexity of the new practices. I highlighted how the inputs for the control of fungi and pests have a lower resistance over time and weather conditions, needing more interventions and in a specific time-lapse. Deciding when to intervene, in which quantity and at which time is a crucial decision in agriculture. This problem was easily solved in the integrated agriculture productive system, as farmers would receive a message by the technicians of FEM or the cooperative with the needed treatment. Farmers can then decide to apply the treatment at any time of the selected period because their inputs are more resistant over time and weather conditions and do not require any readiness of intervention. FEM, together with the cooperatives, started to develop in 2015 a service of technical consultancy for organic farmers, which was not existing previously. I will highlight later in the thesis why FEM moved late to support organic production. Should be however pointed out that a technical consultancy is considered by most organic farmers as useless, as it cannot grasp the differences, between close fields or inside one single field, that must be considered to have proper plant management. This spatial difference in conditions, whether is the spread of fungi, insects or plant diseases, even if existing for all types of agriculture, is most important for organic farmers. Organic farmers, which can rely only on inputs of lower effectiveness, cannot wait for the problems to spread and must take a proactive rather than a reactive approach and consider the whole complexity of their crops to prevent the arising of problems. This means being always aware of the conditions in every part of the crop, as large differences might be present even in the same field. This has been proven in both the scientific side of research and from the interviews I made to farmers. As highlighted in the stylized models proposed by Morgan and Murdoch (Morgan and Murdoch, 2000), conventional farmers rely mainly on external and specialised sources of knowledge. Organic farmers, on the opposite, must learn a new set of practices which are specific for their ecosystem and consider the whole natural lifecycle. To give a more theoretical framework, conventional agriculture bases its practices on standardised knowledge generated by upstream players in the supply chain, with a limited role played by the tacit knowledge developed by local farmers. Organic farmers instead rely their decisions on a combination of tacit knowledge and standardised knowledge developed inside the local

systems. The authors theorize that thanks to organic production farmers can become again "knowing agents", which have control not only on their production but also on the interactions with other agents across the supply chain. If the control of the personal supply chain is true only in the case of farmers selling through direct marketing, I found something similar to this definition of knowing agents in my analysis. Organic farmers often cite the increased independence in the decisions and personal entrepreneurship as among the greatest satisfactions of organic agriculture and in some cases also among the reasons for the decision. On the contrary, integrated farmers are sometimes referred by organic ones as mere operators, stating:

"Those farmers whom do not take their decisions cannot be defined agricultural entrepreneurs, as they are only truck drivers."

4.4) Organic diffusion system

The role of knowledge is probably the most important factor to be considered in the analysis of organic diffusion rate. Recalling the division made by Rogers between the software and hardware parts of an innovation, with software being the knowledge and information needed to use the hardware, which is physical mean to utilize composing the innovation, can be stated that organic farming is mainly a software innovation. The hardware requirements for organic production are low, requiring in most cases only the weed management machinery, adjustments in the varieties produced. The different types of inputs can be considered as another part of the hardware of the innovation, but once again the most important factor is the different software knowledge needed to use those correctly. On the software side, the information needed is wide and start from the whole concept of plant management, the comprehension of the surrounding ecosystem, the new managerial and operational practices needed and lastly the inputs' effectiveness. All these pieces of knowledge, together with the information derived from the self-analysis of the field, are needed in the decision-making process of the farmer. This knowledge, however, is not available through the standardised external channels of information, usually deriving from upward in the supply chain or the knowledge system, which are FEM and the cooperatives in Trentino scenario. The knowledge needed for organic production must rely on the farmers' tacit knowledge, which can be self-generated or transmitted by neighbouring farmers. Most of this knowledge, for example over soil qualities, fertility and integrative

managerial practices, used to be known and used before the advent of the Green Revolution (Morgan and Murdoch, 2000). The green revolution developed innovative chemical solutions, which principles could not be understood by farmers, and changed the perspective from the previous plant management proactive approach to a reactive problem-solving approach. For these reasons, farmers started to rely exclusively on the external standardised knowledge sources rather than on their available tacit knowledge. These different approaches to knowledge can be observed also in the existing agricultural systems for the diffusion of innovations. The Green Revolution saw the rise of centralized agricultural extension to research, develop and diffuse innovations, as in the case I widely described of FEM for Trentino's scenario. This centralized model, however, was not used in most cases for organic production (Padel, 2001) for two main range of reasons. The first is that for its ecosystem's specific adaptation and reliance on tacit knowledge, a centrally developed model should need serious adaptation to the new system to be effective. The other causes are to be searched in the low consideration and attention placed upon organic agriculture by the national organizations, research centres and ministries that I introduced in the first chapter (Rahmann et al., 2016). To bring an example, English Ministry for Agriculture, Forestry and Fisheries considered organic agriculture, by citing a senior official, "weird" and did not consider it until recently (Byng, J., 1997). A similar approach can be found in Trentino's scenario where until very recent years politics, FEM and APOT, which are the players of the system with the largest regulatory power, did not consider organic agriculture at all. This can be observed in the involvement by FEM which, before 2015, employed only two agents, working both as researchers and technicians, for the development of organic practices for both fruit and grapes production. From the most technical side, they were not able to offer the technical assistance of integrated agriculture, because of the almost impossibility of this service for organic agriculture and their limited number, rather offering only experimental assistance. This type of assistance consists of jointly developing practices with farmers and is in line with the decentralized diffusion system expected for organic agriculture (Padel, 2001). All the innovators and early adopters I interviewed referred very negatively to FEM's role in their process of diffusion and implementation of organic agriculture, apart from the excellent assistance done, with their limited resources, by the first organic technicians. The negative approach and perception toward the innovation can be found in the whole culture of FEM and all its functions. Regarding the research and technological development centres, the interest placed upon organic agriculture

was low if we compare the two researchers with a much higher number of integrated ones. For the technical assistance, not only there was a limited commitment, but also integrated technicians were opposing, through the spread of negative and in some case even false information to the farmers. Being the technicians the change-agents of the system, they can be considered as negative-change agents, because they used their role to limit the spread of organic innovation. A similar opposition can be found also in the school of FEM. Two interviewed farmers, who recently graduated from the technical and professional courses, confirmed that very limited time was devoted to the study of organic agriculture, with some professors even mocking this type of production. I decided to describe extensively the role of FEM because, since 2015, it slowly started recognising the potential of organic production for Trentino's agriculture and tried to move toward a centralized diffusion system, with clearly FEM as the central role. The year of 2015 has been a turning point for Trentino's organic production of apples, as Melinda, the largest cooperative of producers, started for the first time recognising its potential. Following this decision, all the main regulatory actors, APOT, FEM and politics, started to publicly state support to organic production. After these change in the approach toward organic production, FEM expanded the technicians employed, while the same cannot be said for the researchers. Thanks to the expansion of the organic department, FEM started offering the same service of technical consultancy of integrated agriculture, with farmers receiving a message with the specific time and quantity of the treatment to be done. This service has been widely criticised by early adopters of organic and even the previously existing technicians, whom I could interview. The critics stress the radical change this service is bringing into the organic production, moving away for the whole ecosystem and plant management proactive approach toward the reactive problem-solving approach which characterises the conventional agriculture. These consultancies have also been criticised by most of the experienced organic farmers on an agronomic level, with the recommendations being wrong, excessive or late due to the low experience in the organic field of technicians and the impossibility of capturing the specific ecosystem features without the actual observation of the field. This said, the new approach toward organic of FEM removed the problem of negative change-agents and even, with the expansion in the number of organic technicians, greatly increased the number of positive change-agents. Recalling the concepts of standardised knowledge, FEM is trying to establish its knowledge, which is external from farmers, as

the standard of the system, reducing the reliance over the tacit knowledge developed between organic farmers during the years.

The new centralized role that FEM is trying to take, together with the reliance over the same reactive approach and decision-making process, is exposing Trentino's organic agriculture to the risk of the "Conventionalization" (Best, 2007; Hall and Mogyorody, 2001). The authors, relying on a previous case studies, theorise that as organic production spreads and farmers grow in number, organic farming risks of becoming increasingly similar to conventional agriculture, or, in the case of Trentino, integrated agriculture. This happens because organic agriculture becomes increasingly competitive or even economically superior compared to integrated agriculture, attracting even farmers who do not share the underlying principles of the organic farming system. I expect to find differences in terms of environmental concern, practices and farm characteristics, and motivations of the conversion between earlier and later adopters. I will highlight in the results of the interviews whether my analysis supports or rejects the conventionalisation hypothesis.

If the centralised diffusion system, included in the conventionalisation hypothesis, only recently started to develop and doubts arose about its effectiveness, I will now describe the decentralised diffusion system that drove the diffusion of the organic movement in Trentino. Firstly, is important to understand where this innovation initially came from. Trentino borders with South-Tyrol region, which shares many traits of its culture with the German world, with most of its inhabitants having German as the first language. Recalling the introduction, the organic movement started to develop in Germany and other middle-north European countries, and this is true also for the spread of organic apple production. It is no surprise then discovering that the organic movement started to develop many years before in South-Tyrol if compared with Trentino and the rest of Italy. This happened because South-Tyrol shares similar culture with Germany, which is strictly connected to the principles of organic farming, but also for the communication channels enabled by the geographical proximity and the common language. South-Tyrol and its farmers played an intermediary role in the spreading of organic knowledge from Germany to Trentino, where only a minority of farmers fluently speak German. The hypothesis of the descend of organic knowledge has been confirmed in my interviews, with all the earliest adopter, including the first organic farm of Trentino, which converted in 1981, receiving the first bits of organic information, the so-called knowledge phase, from

farmers or other stakeholders from South-Tyrol or Germany and Switzerland. These first connections, between farmers belonging to different cultures and regions, are the weak-ties I previously described, which are in most cases the ones carrying the knowledge of innovations. The intermediary role of South-Tyrol has however been crucial in the spreading of the organic movement because it gave the necessary amount of homophily to the information channel needed to be considered reliable by Trentino's farmers. This homophily does not refer to the technical capabilities of agents involved rather on cultural and communication aspects. Even the language barrier was almost entirely removed as almost all the farmers in South-Tyrol speak fluently both German and Italian. The importance of this connection has been confirmed also in the persuasion stage, with all the early-adopters stating the importance of personal visits to existing organic farms in South-Tyrol in the formation of their positive opinion toward organic production. The importance of personal visits to organic farms has been confirmed also by later-adopters, with almost all farmers stating the personal observation of the agronomic effectiveness of organic production as the leading driver of the formation of a positive attitude or even of the adoption decision. This connection with other farmers also suggests the preference of homophilous sources of information, as considered more reliable, than the heterophilous and more technically specialized sources of knowledge (Rogers, 1983). This seems to prove the existence of a decentralised network, where the innovation spread geographically between similar agents rather than being spread with a top-down approach from more technically skilled researchers or from the market through the intermediary role of the cooperative.

After the first transitions to organic, as a confirmation of the presence of a decentralised diffusion system, farmers started to create connections and networks between them to share best practices and experimentations. These connections were clearly at first on a wide area, connecting farmers from the whole province and even farmers from South-Tyrol, as the number of innovators were extremely low. As the movement started developing, moving into the phase of early adopters, these started creating networks closer in geographical terms. The organic technicians of FEM played in that phase an integrative part of the network characterizing diffused systems. They did not decide for the farmers on the tackling of specific problems, as in the centralised technical consultancy, rather working with them on the experimentation of new practices. FEM's organic technicians, after the innovators' phase, created some courses with the scope of

spreading to interested farmers the knowledge of basic principles of organic production and ecosystem management. These technicians stressed how their role should be of guiding over the functioning principles of the ecosystem, while the actual decisions should be taken by the farmers, which have the highest knowledge of the field. This idea, which is completely in line with the approach to knowledge of organic principles, brought the first researchers to publicly oppose the newly developed technical assistance of FEM. These courses had the additional value of creating a network between farmers and connecting those interested in organic production with the farmers already producing organically. In this effort for the creation of the network can be seen as the correct approach by FEM organic technicians to a diffused knowledge system. The first researchers proved to be aware of the preference for homophilous sources of information, inviting existing organic farmers to integrate their competence credibility with the safety credibility of the farmers, which had a role similar to a paraprofessional aid. During the courses also visits to existing organic farms were organized both inside and outside Trentino, to allow interested farmers to see themselves the actual results, which as previously highlighted proved to have crucial importance in the creation of positive opinion. To recall the double polarisation of knowledge in the traditional Trentino's agricultural knowledge system with FEM and the cooperatives, also these played a marginal role in the spreading of organic information. Varying much across cooperatives and over time, based on their level of commitment, the cooperatives organized some sporadic meetings to give to farmers' at least the basic concepts of organic principles. Regarding the technicians of the cooperative, in most cases until the most recent years, when not only Melinda but also the other cooperatives started placing increasing attention toward organic production and markets, they had the same negative change-agent role as FEM's technicians.

The presence of a decentralised innovation is highlighted not only by the absence of a centralised system but also by the increased strength of connections between farmers. All the organic farmers interviewed, independently of their adopter category, stated a drastically increased share of information with other farmers. This increased information flow takes place both before and after the innovation. The range of information shared is wide and includes evaluative information for farmers in the persuasion stage, support in the understanding and development of the practices of plant management for farmers in the implementation stage and even suggestions and discussion over the interventions

needed in a later phase. This is particularly interesting when compared with the existing networks of integrated agriculture. The farmers know almost each other and have some connections especially with neighbouring ones but all farmers interviewed clearly state that nobody shares useful information with others. Integrated farmers, even if in a system characterised by a central diffusion of knowledge, carry on some trials and take some decisions alone, but rarely share it with others. I do not however have the social and behavioural competences to understand why integrated farmers avoid sharing their knowledge and information. On the other side, organic farmers state that the increased share of information had positive effects not only on the agronomic management of the field but also on a personal side, with new positive relationships arising between them. The positive effects of the network between farmers are highlighted also in the development and share of innovative practices for the ecosystem management, as confirmed especially by the earliest adopters. All the farmers interviewed belonging to these classes clearly state that at first, they did not know how to solve specific problems and had to develop by themselves the practices to solve the specific issues, eventually sharing the positive or even negative experiences with other organic producers. An interesting example can be found in the development of the practice of sexual confusion, which is now commonly used among organic producers and also by some integrated farmers and the devices are sold by many companies. The initial trials, however, as stated by various farmers, were done by the first organic producer of Trentino which imported and manually installed over the crops a specific tree branch with the solution for the confusion. After this technique proved to be successful in reducing the number of harmful insects, he started sharing his experience and the tree branches personally imported with the other organic farmers.

4.5) Drivers of organic diffusion rate

After having briefly described the main practices of organic agriculture and the differences with the pre-existing integrated agricultural system, I will recall and apply to organic production the specific characteristics of an innovation that influence its diffusion rate. For the purpose of this analysis the organic agronomic and managerial practices will be examined considering the assumptions of the diffusion of innovation fundamental study (Rogers, 1962). This section is inserted in the case study chapter because it joins the

theory described in the second chapter with the case study specifications described in the previous section. Most of these specific drivers have not yet been analysed in the theory and a specific quantitative study should be therefore done to support these findings.

Of the factors driving diffusion rate, the first thing to be considered are the specific innovation characteristics.

The main driver is the relative advantage, which includes economic, environmental and health aspects. All these three aspects are brought as the leading motivations of farmers' adoption decision, even though the relative weight assigned changes drastically between individuals. On the economic side, organic production proved to have higher profitability than integrated agriculture as confirmed by data and the interviewed farmers. Farmers receive different payments based on the quality of the apples produced which can be of first or second choice or for industrial use in the case of serious damages. Each cooperative uses a machine capable of assigning a value to every single apple produced by each farmer. As introduced in the first chapter, organic crops have a lower production in terms of yields and overall quality, even though this discrepancy is reducing in recent years, especially on the quality side. Considering the lower quantity and quality of organic production, the higher profitability is lower than that expected by the simple comparison of the price received but remains positive. These factors severely reduce the observability and the evaluative capacity of the economic advantage, with most of the non-adopters raising doubts upon the actual economic advantage, which is however confirmed by data and organic producers' estimations. Even though the comparison cannot be limited to the simple observation of the average price per kilo received by the producer, it is useful to consider the existing differences in price. I obtained the most specific data of the price paid to farmers by S.F.T. In 2017 for integrated production the average price per kilo received by farmers was of 27,6 cents while the price received by organic producers was of 72,9 cents. Even adjusting for the needed considerations about the lower yields, which is difficult to calculate on such a wider scale, the comparison of the prices clearly highlights higher potential profits for organic production. These difficulties in measuring the real economic output however severely reduce the observability and the evaluative capacity of the economic advantage, with most of the non-adopters raising doubts upon the actual economic advantage, which is however confirmed by data of S.F.T. budgets and organic producers' estimations. Similar uncertainty is present also on the environmental side. Theoretical studies, comprehensive of all the factors involved, highlight the overall

lower environmental impact of organic production compared with integrated farming on the field and the surroundings (Reganold et al., 2006). All organic producers highlight the benefits of avoiding the use of pesticides, while integrated farmers stress the need for neutral studies evaluating the impact of organic practices on the environment. The main controversies of organic farming are in the residues of brass and other heavy metals in the soil and the higher fuel consumption needed for the higher number of treatments. Even if organic production has proven scientifically to be environmentally superior, must be kept in mind that it still has an impact on the crop and the external environment. The third area regards the negative impact over the health of the farmer itself and the consumers. The risks for the health of the use of pesticides are nowadays known by all farmers and even the majority of the consumers (Lichtenberg and Zimmerman, 1999). Once again, the positions of organic and integrated farmers differ. Organic farmers cite the concern for personal health among the motivation of the decision, even as the leading reason as for the case of the first organic producer. Some farmers even stated that this difference can be perceived personally during the practices requiring direct contact with the fruit, causing lower irritation over hands and eyes. On the other side, integrated farmers tend to minimize the risks for health, leveraging on the existing limitations over products to be used from the adherence to the GlobalGAP certification. I believe that even though organic production has back-draws on all the three aspects considered, showing reliable and neutral data, through a channel having the right balance of competence and safety credibility, could reduce this uncertainty, eventually benefiting the organic movement and its diffusion rate.

Strictly connected with the low capacity of evaluating the benefits of the innovation is the capacity of observing it, which is the observability characteristic. Observability, according to my interviews, has been for many years the main barrier to the diffusion of organic production. On the practices, only some practices can be observed as different from integrated ones, which happen to be the most tedious operations, fruit thinning and mechanical weed management. The largest problem is the observability of the output of organic production, which is a fruit characterised by lower dimension and quality. I understood after talking to farmers that having a product of high quality is important for them, besides the economic gain, as it gives personal satisfaction and as a form of pride with other farmers. This told, for farmers, especially in the first years of diffusion of organic production, was easy to spot an organic field due to the lower quality

of its apples and problems with the weed management. Can be therefore said that the observability of the negative characteristics of organic production severely harmed the diffusion of this production. Rogers states that the incapacity of observing an innovation severely slows its diffusion. In my case, the results show the contrary. In the system considered, everybody personally knows at least neighbouring farmers and gets to know their innovation-adoption even without seeing it in practice. Most of the organic farmers interviewed reported that their cue-to-action, the reason that convinces an individual with a positive attitude toward the innovation to adopt it, was seeing no difference between an organic and integrated field in terms of quality. In this specific case can be said that impossibility of observing the different output in terms of fruit and field overall quality might have increased the actual diffusion rate of organic production. As previously introduced, organic production has increased in its quality, in terms of product and by reflection overall field. Most of the farmers, both organic and integrated producers, confirmed that in recent years is almost impossible to tell the difference between the two typologies of fields. In order to be recognised, some organic farmers are modifying their field, using hedges and other non-productive plants, to give the capacity of distinguishing, this time positively, their field.

The next issue influencing the rate of innovation adoption is the trialability of the innovation. Trialability is used to reduce the uncertainty of the outputs of the innovation and could be extremely useful in the first phases of the diffusion when there is the highest uncertainty over innovation's practices and their output, economic and of product's quality. There are no barriers preventing farmers from initially carrying some trials on a portion of their field. The certification body, however, limits that possibility, because to be certified organic a farm has to be completely organic for the same type of production. Some farmers solved this issue by creating a new juridically separated farm owning only the organic fields. Only four out of the twenty interviewed farmers adopter this solution and, as predicted, are all among the early adopters in their reference system. If trying at first on a portion of the field can give users some initial experience on the ecosystem management, the new practices and the new inputs, some farmers criticise this decision for the impossibility of grasping ecosystem's complexity when not completely devoted to it.

To understand the effect that compatibility, the next factor to be considered, had on the diffusion of organic agriculture I need to stress how it is perceived. Organic agriculture has been considered, and by some individual still is, as a less professional form of

agriculture. This is a misconception; I have already explained the increased complexity in decision-making for organic agriculture but still has been harassed for the lower quality of the production. This misconception might be the residue of the first opinions, based on the observation of the first organic farmers. The innovators, as confirmed by my interviews, were mainly ideologically driven and, due to the lack of knowledge, were close to the so-called neglect organic farmers, which arose from the counter cultures. Therefore, their approach to agriculture was considered as a hobby of richer individuals rather than a profession. There are certainly many reasons why organic farming was, and in some cases still is, perceived negatively by the rural culture and system. The green revolution was judged positively by most of the older farmers as it helped to move away from an agricultural system based on landlordism toward a system characterised by many professional farmers. This distance between the values of the rural culture and the perception of organic agriculture resulted in negative judgements, from other farmers and even the overall population, toward organic adopters. This strong social pressure against the adoption had been confirmed by both innovators and early adopters. Rogers in his book stated that people living in an urban system tend to innovate more than those living in a rural system. This is particularly true for organic innovation, as the rural system is further from the values of organic innovations. To understand the effect that the social system had on the diffusion I need to highlight the existing differences between areas of Trentino territory. After the first phase of the innovators, which were spread over all the territory of Trentino, adopters started to concentrate in the area around the city of Trento, the so-called South Trento group. It is in this phase that the diffusion started showing differences among the areas and valleys of Trentino, highlighting the need to differ the diffusion systems of different areas. There are many reasons why diffusion happened at such a different rate, with areas nowadays producing more than 50% organically, as for the S.F.T. cooperative, and other where this rate is under 7%, as in Val di Non, but the different cultures played certainly a crucial role. I have highlighted the much higher diffusion of organic between S.F.T., which is confirmed by the data of all the plain areas of Trentino, where organic is cultivated, in 2018, on almost 25% of all the apple fields. In the other considered areas major producers of apples, Valle dei Laghi, Alto Garda e Ledro and Valsugana, 11,3% of apple fields are cultivated organically. The diffusion of organic farming in the different areas of Trentino can be observed in the table 4.5, which includes areas under conversion and the overall rate of organic for main apples producing

"Comunità di Valle".

Comunità	Organic	Conversion	Total Org + Conv	Total surface	% Organic surface
Valsugana e Tesino	26,25	11,10	37,35	244	15,31%
Alta Valsugana e Bersntol	29,23	10,34	39,57	768	5,15%
Valle di Cembra	15,88	1,59	17,47	120	14,56%
Val di Non	318,99	149,77	468,76	6738	6,96%
Valle di Sole	4,18	11,01	15,19	371	4,09%
Giudicarie	55,63	0,00	55,63	123	45,23%
Alto Garda e Ledro	28,24	8,93	37,17	219	16,97%
Vallagarina	37,37	9,95	47,32	194	24,39%
Rotaliana-Königsberg	122,37	16,67	139,04	691,00	20,12%
Paganella	28,22	0,00	28,22	92	30,67%
Territorio Val d'Adige	247,82	15,75	263,57	960	27,46%
Valle dei Laghi	61,19	8,01	69,33	277	25,03%
Total	**975,37**	**243,13**	**1.218,62**	**10797**	**11,29%**

Table 4.5 Organic, Conversion and Total apple fields area, by "Comunità di Valle", in hectares, 2018. Source: Trentino's Organic Productions Office, 2019.

For the explanatory capacity of the comparison between the most and the least diffused systems, I will focus mainly during my analysis on the South Trento area and Val di Non. Opposed to the almost urban area of South Trento Val di Non, the largest producer of apples in Trentino, can be assumed as the area with the most intrinsic rural and agricultural culture, with a total of 3.844 farms and a population of 39.000 inhabitants, almost one farm every 10 individuals. I expected a higher social pressure in Val di Non and other mainly rural valleys when compared with territories closer to the city of Trento. Regarding farmers' opinion, I could not find sensible differences, with earlier adopters of both systems being harassed for their decision and non-adopters expressing scepticism over organic production. The largest difference was found in the public opinion toward organic production. If in the past citizens of both systems were sceptical over organic production, even questioning adopters' decision, the two types of systems started differing in recent years. While in the valleys a cultural negative perception of organic production persists, in the areas closer to the city the social pressure, due to increasing environmental concern of inhabitants, changed in favour of organic agriculture. Later-adopters of this area clearly stated that they perceived and received pressure before the introduction against the use of chemical pesticides, especially in the areas close to the houses. The risks for the health of those living close to the farm started concerning also some inhabitants of Val di Non. This valley, due to the higher value of its production and the limited territory

available, has fields also close to the houses and in steep areas. After seeing that Val di Non, together with Rotaliana, is the area with the highest rate of diffusion of tumours (TrentoToday, 2018), some individuals joined together to form the "Comitato per il diritto alla salute in Val di Non". They financed a study (Rizzi R., 2016) which highlighted the damages of pesticides over the DNA of those living in the surrounding. The committee, which already submitted a petition asking the intervention of the province's politicians (Girardi A., 2009). started promoting the results, both through information evenings and the sponsorship of two documentaries (Pesticidi siamo alla frutta, 2018; Veleni in paradiso, 2015). A farmer personally involved in the committee was interviewed and confirmed that their approach caused much cultural clash in the valley and, in his opinion, positively affected the opinion of the inhabitants toward organic production, with however lower impact on the opinion of integrated farmers. Regarding the other compatibility issues, compatibility with previously existing ideas is strictly connected with the misconception of low professionalization of this new type of farming previously discussed, rather than the actual changes of the actual production. The compatibility with needs is however high because it benefits the three main areas of needs which are the economic benefit, the environmental concern, and the personal health desire. As previously introduced in the observability part, the main problem is that the effects of benefits upon desired needs are sometimes difficult to be perceived and are a source of uncertainty for farmers. The operational compatibility with existing practices presents a serious problem under the specific circumstance of part-time farmers. Part-time farmers are individual with a different full-time job owning a small field that they cultivate in their free time. Even if in the introduction to Trentino's agriculture I described the trend of professionalization and the reduction of part-time workers over the years, they are still widely present. This category of farmers is, for many reasons, particularly diffused in Val di Non. Even if organic production is mainly compatible with the practices of integrated production, it is not compatible with part-time farming. Organic farming requires a higher presence and observation of the field to have a correct decision-making process, which could be mistakenly solved by an excessive reliance over the new organic technical consultancy service. The main incompatibility issue lies in the much higher reactivity needed for the organic interventions, which is not compatible with a different full-time job. In integrated agriculture, due to the higher persistence of the interventions, farmers could manage the time of intervention based on their other commitments but this time-

interval for intervention is not available in organic production. Part-time farmers have a huge barrier for adoption, which up to now can be solved only by relying on a professional farmer for the interventions requiring the highest reactivity. The interviewed part-time farmer confirmed this blocking barrier of organic adoption. He also suggests that part-time farmers are less committed to farming and are therefore less willing to invest, in terms of economic investment, personal work and knowledge acquisition. This can be summarised that the presence of part-time workers limits the diffusion rate of the innovation, eventually limiting the complete adoption by all the system.

The last characteristics influencing the diffusion rate to be considered is the perceived underlying complexity of organic production. This innovation implies high difficulties, as previously described, in the decision-making process rather than in everyday practices. The need for considering the whole ecosystem and keeping proactive behaviour are the main components of this increased complexity. The increased complexity is higher in the case of an excessive reliance on external knowledge, as in the case of FEM message for treatments in integrated agriculture. Not surprisingly, I found a high share of organic producers reporting that they did not follow blindly external suggestions even previously with integrated agriculture. I found, however, that the perceived complexity is in some cases lower than the actual complexity as the farmers start considering the new approaches only after the initial implementation. The perceived complexity, in the opinion I developed during the interviews, changed along the diffusion process. In the initial diffusion phase, the complexity perceived was high and strictly connected with the uncertainty underlying the practices and the solution of the problems, like insect and weed management. In recent years, the perceived complexity reduced, as the practices and the needed machinery refined, and the uncertainty reduced. The implementation of the technical assistance from FEM, sending messages with the recommended organic interventions, reduces also the complexity for new adopters in the decision-making process. Excessive reliance on this consultancy in the decision process might harm organic production due to the incapacity of considering the complexity of each ecosystem. The risk, as predicted by the conventionalization hypothesis (Best, 2007; Buck, Getz and Guthman, 1997; Hall and Mogyorody, 2001), is that the new adopters could end up in a product of a lower quality or presenting excessive residues, eventually harming the perceived reliability of organic's certification and all the organic movement.

The description of the characteristics of organic agriculture driving its rate of

diffusion highlighted how these vary geographically between the areas of Trentino and over time, resulting in a faster diffusion as time passes. I have already described four of the five variables which drive the rate of diffusion: innovation's attributes, the nature of the social system, the communication channels and the role of change agents. The remaining variable is the type of innovation-decision. It might seem obvious to think that adoption of organic is an optional innovation-decision, as it solely depends on the farmer. If we consider also the cooperatives' role, can be easily understood how the innovation is more similar to a contingent innovation-decision. This means that a farmer producing for a cooperative can decide to adopt organic innovation only after the cooperative has made a prior innovation-decision, in this case to create an organic market channel and to implement the practices needed for becoming a certified organic transformer. If this is true for the majority of the farmers, some farmers nevertheless approached the innovation as an optional innovation-decision, deciding to market their products outside the cooperatives' system. As previously introduced, this can happen through a private retailer or direct marketing. The latter is supposed to be the preferred marketing channel for organic farmers, as included in the principles described in the first chapter. The method of direct marketing has been therefore used especially by innovators, partly due to their higher belief in the organic principles and partly due to the complete absence of a structured marketing system at the time of their adoption. Therefore, the innovation can be considered as optional for everybody but is strongly simplified, by the possibility of relying on the previous marketing system, by the decision to support and market organic production by the cooperative. The decision to support organic agriculture by the overall agricultural system, including FEM, APOT and politicians might be a facilitator of the innovation. I decided to describe this type of innovation-decision as semi-contingent due to the absence of finding a comparable example in the existing literature. The innovation-decision by the cooperative can be considered as closer to an authority rather than a collective decision. Even if cooperatives take their most important decisions through a democratic vote of members, and the demand for an organic channel is likely to start from a subset of members, the creation of a new separated channel does not require the support of the majority of members but rather just a managerial decision. The creation of a new market channel is more complicated than a simple yes or no decision and requires a high effort from the cooperatives' commercial department. For example, Melinda had for many years an existing organic channel, but the price paid to producers was in some cases even

lower than the price paid to integrated ones. In 2015 Melinda did not create a completely new market channel, rather deciding to support organic farming with new policies and increased effort in the marketization of organic products, resulting in much higher prices paid to producers. Contingent innovation limits the rate of diffusion as long as the first decision happens after a set of individuals would have already decided to adopt. The theory states that authority innovation-decisions are in most cases faster to spread then collective ones. In this case the speed of the first decision is expected to be slightly lower than a traditional authority innovation-decision as it is in the halfway between authority and collective type of innovation-decision, due to the cooperatives' juridical form. The relationship between support of organic from a cooperative and the actual rate of diffusion between its members is however a double-sided relationship, because the cooperatives can incentivize the diffusion with high prices and support but also an increasing number of organic members is likely to increase the effort and support over organic by the cooperative itself. This said, I assumed that the semi-contingent innovation-decision affects negatively the rate of diffusion rather than an optional innovation-decision. The first support of this effect can be found in the different rate of diffusion in the different cooperatives. This is a simplistic claim because a set of factors drove the different rates of adoption in different cooperatives, with the actual role of the cooperative being only one factor. The cooperatives coincide geographically with different areas which, as previously introduced, have also different cultural values. The important role of the cooperative supports the division of the diffusion system of organic agriculture into different areas, which coincide with the main agricultural valleys, and therefore the cooperatives of Trentino. In my interviews, I tried to highlight whether not only the number of organic producers but also the characteristics of adopters confirm the different stages of development of organic innovation in different areas.

Before moving in the description of the phases of development of organic innovation and the interview I will briefly describe the role of the organic certification, as perceived by farmers. All the organic producers I interviewed are certified organic. The organic certification is based upon European Level regulation and grants that this is respected in the production process. To strengthen the certification, it is based upon one Italian accreditation body, Accredia, and twelve independent certification and control bodies operating in Trentino. The innovators are the only farmers that started producing organically before the creation of the certification. Interviewed farmers are aware of the

important role that the certification has in building consumers' trust over credence goods as organic fruits. The need for certification is increasingly important when commercialising through traditional market channels if compared with direct marketing, in which the farmer can build consumers' trust also in other ways. The conventionalization hypothesis is perceived as a risk for the certification's strength by some earlier-adopters because if some of the products of later-adopters would not be in line with the certification's rules, this could eventually end up in a scandal harming the organic's certification credibility. The certification also grants the traceability along all the supply chain. The compliance can be found in any step of the supply chain through a series of analysis over randomly picked samples by Agecontrol S.p.a., the public agency for agriculture's products quality. A case of non-compliance with the certification rules can be then traced back to every single agent involved in its production, including the cooperative and the specific farmer. The process of certification is based on the filing of the demand and needed practices, an initial control and random controls after the certification is granted. This process is considered annoying by some farmers, especially for the time loss of successive randomly picked controls. The filing phase was described as long and complicated by only one farmer, with others stating that with the support of earlier-adopters and the cooperative the certification's demand can be easily filed. Regarding the financial costs to be sustained in order to obtain the certification, these are refunded up to 90%, as included in the most recent RDP (Rural Development Programme). The Rural Development Programme is defined at the province level and, applying its principles, distributes the funds received by the Common Agricultural Policy. Trentino's RDP tries to support and spread a more sustainable agriculture, therefore increasingly supporting organic producers. Through RDP farmers receive funds also for the purchase of new machinery. The funds received and the rate of funds over the purchase value is based on a ranking, which calculation includes the type of machinery, with those needed for organic production having higher value, the age of the farmer, with higher funds devoted to younger farmers, and the organic certification of the farmer granting a higher rate of funds.

The biggest requirement of the certification, which needs to be separately discussed for its impact on the diffusion of organic production, is the three years needed for the conversion. During this period, the farmer must file the organic certification demand and produce following all organic requirements, but its products cannot be sold as

organic. The three years are usually started just before the period of gathering, as the certification requires specifically three gatherings before the certification grant, making it possible to have three conversion gatherings with only two years of organic treatments. The high demand of organic products, together with the insufficient offer in the past years, brought to the creation of a market for products under conversion, with a relative price in the halfway between integrated and organic price. This was particularly true for the market of low-quality products for industrial use, which had the highest demand for organic products, with a connected high demand for products under conversion. The higher relative value paid to apples for industrial use is highlighted in S.F.T. budget, with a price per kilo of 5 cents for integrated products of low-quality and 45 cents for organic fruits of this category. In the last years however due to the increasing organic offer, of both high and low-quality, the market for products under conversion thinned and eventually disappeared, resulting in conversion fruits sold as integrated ones. The years of conversion are the biggest investment needed for the conversion, even though indirect due to not realized revenues. These years represent an economic loss even when compared with integrated production because the price received is the same but products under conversion present the lower levels of quantity and quality characterising organic production. In the years of conversion, the farmer has to sustain the direct investments for the new machinery and the adjustments in the varieties produced, has the highest amount of working hours and faces the highest uncertainties in the decision-making due to the personal knowledge still developing. The period of conversion has been described as hard by many organic producers because it requires the highest effort and grants lower revenues than the previous agriculture. One farmer's description of the conversion period helps understanding the difficulties encountered:

"It is like getting punched in the face for three years, it is hard in terms of working hours, it is hard financially and it is even hard psychologically"

The three years needed for the conversion slow the rate of diffusion of organic production because, if accounted for this indirect cost, the investment needed is higher. Selling through the conversion market, resulting in higher profits due to the higher price than the integrated market, reduces the adoption's indirect costs, lowering the barrier posed by the period of conversion.

The main cooperatives are adopting policies to reduce the economic loss of the conversion period and connectedly the barrier to the adoption. Specifically, S.F.T. is

paying a relatively higher price of ten cents per kilo than integrated products only for the products under conversion with the highest quality, while Melinda is paying a higher price for all the products under conversion. Melinda to support the development of organic agriculture, which is much less spread between its members than across the members of S.F.T., is paying to the farmers 10.000€ for each hectare they convert to organic farming.

Another issue posed by the organic regulation regards the drift of integrated intervention. If the neighbouring field is cultivated using integrated agriculture, the trees and products on the boundaries are likely to have some residuals of their chemical inputs due to the vaporization in the air of the inputs through the atomizer. As a rule, products grown on trees placed on the boundary with an integrated producer are not allowed to be sold as organic. The regulation implies to sell as integrated the products of the trees distant less than 10 metres from an integrated producer, or of the whole first row in the case of a parallel neighbour integrated producer. Selling organic products with the price of integrated ones reduces the revenues generated. Is important to remind that these products are likely to give lower profits than if those were produced using integrated farming. The impact that the sale of the boundaries' products has on the overall revenues changes in rate depending on the field's characteristics. Generally speaking, the wider in hectares the organic field, the lower the rate of reduction in revenues due to the boundaries' problem. The boundaries, therefore, represent a big issue where the fields are highly fragmented between many producers, resulting in fields on average smaller. This problem is particularly crucial in Val di Non, where the high fragmentation of the fields resulted in each farmer owning differently dislocated fields, in many cases smaller than one single hectare. This means that organic producers have to sell as integrated a relatively high percentage of their product, severely reducing the revenues obtained. This problem has been described among the most limiting barriers by both the integrated producers of Val di Non. In other areas, as the South Trento zone, boundaries have a lower impact on overall revenues due to the much higher average acreage of each field. To sum up can be said that the issue of boundaries, by reducing the revenues of organic production, reduces the relative economic advantage of organic farming, consequently slowing its diffusion rate. The effect on the diffusion rate is likely to vary across different systems depending on the average acreage of the fields. The problem of boundaries is reduced as organic farming spreads and neighbouring farmers adopt organic innovation. This leads to an interesting communication mechanism between farmers because existing organic producers are

incentivised to communicate with neighbouring integrated farmers information over organic production, as their eventual adoption would increase also the existing organic producer's revenues. This mechanism has been confirmed by some early adopters, even though they underlined that the spread of information always takes place without any pression for others' adoption.

CHAPTER 5) Description of the interview

The interview started with an introductory part to briefly introduce myself and the purpose of the interview. I then described the interview process and the estimated duration, asked permission to register the conversation and use the results keeping the anonymity.

5.1) Background information

This brief introduction to the interview was followed by the first part, called Background, which analyses some personal variables of the farmers. At first, I looked for six types of useful personal information: level of education, age, professional or part-time farmer, farmer's descendants, size of the fields cultivated and geographical zone of residence and work. Level of education is the variable most commonly associated with innovability by both generic and agricultural innovation studies, with higher levels of education positively associated with innovation tendency. Most farmers followed an agricultural field of study, for a total of 12 of the 20 interviewed farmers. Ranking the education level as professional high school, technical high school and university degree, a higher average level of education can be found associated with earlier adopters. This is especially true if we consider also the field in association with the years of education, as the results highlight a much higher rate of farmers with agricultural related education among the innovator and early adopter categories. The only two farmers holding a degree in agriculture can be found in the early adopter category. In the later adopters and non-adopter categories can be found a higher rate of farmers holding a lower than superior qualification or holding a qualification in an unrelated field. No significant difference can be found between farmers holding a professional and technical agricultural qualification. The expected results for the education variable and the values across the categories are respected, with earlier adopters showing on average higher education. The degree of compatibility between expected and actual results is even higher when considering only education in the agricultural field. The results can be observed in the table (5.1)

Level of education for adopters-categories	Innovators	Early-adopters	Early-majority	Non-adopters
Agronomic degree	0	2	0	0
Non-agronomic degree	0	1	0	1
Technical highschool diploma	2	3	1	1
Non-agronomic highschool diploma	0	2	1	1
Professional agronomic diploma	0	1	0	1
Lower level of education	0	0	2	0

Table 5.1 Level of education for adopters-categories of the interviewed sample.

Age, the next variable considered is controversial because it is considered non-associated with innovability by the majority of the theory, including Rogers' meta-study, but is negatively associated with innovation propension by some studies of organic adoption (Läpple and Rensburg, 2011). I decided to consider for adopters the age at the time of conversion rather than the present age, which would inevitably associate an older age to innovators. The age variable might have a higher relevance due to the three years needed for the conversion phase, which delays the economic benefits, therefore extending the time needed to cover the direct and indirect investment. I expected to find an average younger age for earlier adopters. The age variable needs to be considered also in association with the eventual desire of the farmer of leaving the field, with a profitable crop, to his sons. In this case, an old farmer could not be limited in his decision by the long period needed to obtain profits from organic adoption. I decided to consider the average age of father and sons actively working. The sample considered highlighted a positive correlation between earlier adoption and younger age at the time of conversion. I compared the average age of adoption with the average age of all the Italian farmers rather than with the selected sample, which is characterised by an extremely average young age for non-adopters. The champion considered highlights an average age at the adoption of 35 for innovators and early adopters and of 40 for the whole organic farmers considered, which is much lower than the 50 overall average farmers' age (Bellini et al., 2013). The comparison between the sample considered and the overall Italian agricultural system suggests a positive correlation between younger age and adoption of organic innovation.

The next variable under analysis is the professional or part-time approach to farming. As I previously introduced, I expected not to find organic part-time farmers. Although having no statistical value, I interviewed only one farmer working part-time who does not take into consideration at all organic farming due to its semi-professional agricultural role. An interesting case is represented by two other interviewed farmers, father and son, which integrate their first agricultural work with another job as

entrepreneurs. They show characteristics similar to earlier adopters, especially for age and motivations of the decision, but started organic production only in 2015, among Early-majority category. This suggests that their secondary job has been a barrier to the adoption decision, which they confirmed in the question regarding the perceived risks and problems of adoption.

The agricultural descendants, the next variable under focus, is not a characteristic I derived from the analysis of existing literature. I received this suggestion instead from the first organic technician of FEM and decided therefore to test it. The underlining assumption is that sons of integrated farmers, as the sons of organic farmers are few and started to work just recently, are more related to the values and the practices of the existing agricultural system. As previously introduced, this could generate problems of compatibility with the organic innovation. A farmer without a descendance in integrated agriculture might therefore be less bounded to these values and practices, lowering the compatibility barriers and enhancing the diffusion rate. The farmer's job is highly familiar, with only two farmers being the first generation of farmers. These are to be placed one in the innovators' category and one in the early adopters, suggesting an actual correlation between having no agricultural descendants and rate of adoption. Their case is interesting because, they both started with integrated agriculture and adopter organic farming three years later, even if 28 years passed between each other's adoption.

The size of the cultivated field is another controversial characteristic. Assuming comparable outputs of the same production systems, field size can be considered as a raw measure for farmer's revenues. A higher acreage should be therefore connected to higher revenues and socio-economic status, which are variables empirically found to positively influence the innovability of individuals, also in the diffusion of agricultural innovations (Läpple, Renwick and Thorne, 2015; Diederen et al., 2003). On the contrary, studies specific for organic adoption found either no empirical evidence (Läpple and Rensburg, 2011) or even a negative relationship between farm size and earlier adoption (Padel, 2001), with the average size of organic fields increasing as organic farming diffuses. This negative relationship would be in line with the conventionalization hypothesis, which expects to find a number of very large producers in the later adopter category (Best, 2007; Hall and Mogyorody, 2001). The results do not highlight large differences in the farm's size between adopter categories. Must be noted that higher variability in the field's size is present among later adopters, with some very large and some particularly smaller farms.

This could be in line with the conventionalization hypothesis, even though comparable large sizes can be found also in both innovators and early adopter categories. Differences can be found when comparing the average size of organic's field, of almost 10 hectares, which the much lower average size of integrated fields, with an overall average size of fruit-growing fields of less than two and a half hectares in Trentino (ISPAT 2014). The much higher average size can be partly explained by the absence of organic part-time producers, who reduce the average overall field's size. Another possible explanation is that most of the organic producers interviewed own fields outside Val di Non, which has the highest revenues generated and acquisition price per hectare, resulting in smaller fields, of 1,9 average hectares (ISPAT 2014). The results for the firm's size highlight a higher average size for organic producers, confirming the expected results from innovation's theory but not the other studies for organic innovation. Would be interesting to compare the trend for the firm's size of organic innovation with other agricultural innovations diffusion.

The last of the first set of characteristics considered is the geographical place of residence and work. This question was useful to highlight the innovation system of reference. Of the sample considered, eleven farmers live and work in the South Trento area, five in Val di Non, two in Rotaliana, one in Valle dei Laghi and one in South-Tyrol. Two farmers own and cultivate fields in different areas, one in South Trento, Valsugana and Val di Non and the other in Rotaliana and Valsugana. The geographical distribution was useful also to consider the existing cultural differences between areas. I included the area of residence to check the existence of a higher social and environmental commitment when owning a field closer to the residency area. This assumption was suggested by some farmers stating a higher social and environmental commitment when cultivating areas closer to houses. The question did not produce any results because all the farmers considered own fields in the same municipality where they live.

The second question of the background section analyses the types of production cultivated. The organic principles include the commitment to increase the biodiversity also inside every field. I expected to find a higher diversity in productions among earlier adopters of organic. The results show that the majority of farmers interviewed, and even of organic ones, produce apples only. Ten of the interviewed farmers produce only apples, eight if considering organic farmers only. Seven farmers have two types of production, five if considering only organic producers, which can be divided into apples and grapes

producers, four farmers, and apples and cherries producers, one farmer. The three remaining organic farmers sell a wider range of products, producing respectively four, seven and eight different cultivations. In Trentino, the cultivation of only two comparable fruits is common among both organic and integrated farmers. Therefore, I consider as in line with organic principles only the three farmers with a wider range of products, which include more particular productions, like nuts, peaches and kiwis. Partially confirming the conventionalization hypothesis, all these three farmers belong to the innovators and the early adopter category. The results of this question are strengthened by the next one, which considers sales channels and the production of semi-finished products. Of all the sample considered, the three farmers producing a wider range of products, are the only not selling their apples through the cooperatives' sales channel. Seventeen producers sell the cultivated apples through cooperatives, together with sales through private or cooperative wineries for the grape producers. Ten of the farmers considered are members of S.F.T. cooperative, four are members of cooperatives belonging to Melinda, two/3 are members of Valentina cooperative and one is member of both S.F.T. and a cooperative belonging to Melinda. For these seventeen farmers is not possible to produce semi-finished products because farmers must confer to the cooperative the whole production and are not allowed to keep a fraction of it for direct sale or processing. Of the other three farmers, two belong to the innovators' category and the other to the early adopter. The innovators, which are the only innovators of the sample, started the conversion of organic farming in 1981 and 1988, before the development of the European regulation and much before any of Trentino's cooperatives created an organic sales channel. To be able to sell the organic products they had to rely exclusively on direct marketing. Direct marketing could have been the only available sale channel at that time because, due to the absence of an organic certified regulation, the contact with the farmer was the main way to generate consumers' trust. To better exploit this channel, they developed a wide range of semi-finished products, including juices, jams, dry fruits and energetic snacks. Production of semi-finished products was useful to utilise some of the products with lower quality and could not otherwise be sold, which characterised the organic production of this first period. Both farmers own also a portion of forest almost of the same size of the fields, and one of the two fields is also a certified oasis of biodiversity by WWF. The other early adopter having four types of agricultural productions owns a private winery. Before the introduction, he used to sell only the wine through private retailers and the apples through the cooperative

LaTrentina. After the adoption of organic farming, due to the perceived low commitment of the cooperative in the organic market, he decided to rely on private retailers also for the apples. They process their production mainly for wine production, producing juice only in the years of average low-quality apples. This first section of the interview was useful to test some main variables defining the characteristics of adopter's categories. The main difference that here is highlighted between adopters and non-adopters regarding the personal characteristics and between innovators and other adopter's categories regarding the production types and the marketing channels. This last difference in the market structure is in line with the conventionalization hypothesis that I will test in the next sections.

5.2) Knowledge stage

The following section of questions covers the first part of the adoption decision process, the knowledge phase. The first question aims at understanding when and from whom the interviewed farmers received the very first information about organic farming. The time of reception of the first information varies greatly between farmers, more than I expected. Even though most of the farmers could not recall the exact year of the reception of the first information over organic agriculture, most of the farmers place this phase in the last years of the nineties. The farmers interviewed reporting the furthest in time reception of information place it in the late seventies, which is compatible with the history of development in Europe introduced in the first chapter. On the contrary, a farmer declared to have received the first information over organic farming after 2010. As expected, earlier adopters received the first information on average before later adopters and non-adopters. This is in line with the similar characteristics of earlier knowers and earlier adopters. I asked this question also to be able to understand the time passed between the first information reception and actual adoption. The time passed is much shorter, between one and three years for the innovators and the early adopters of the South Trento system. The time passed between first reception and adoption is on average much longer, even more than 20 years for other adopters. I tried to highlight the drivers of this longer time with successive questions. Moving on the who side of the question over the first information received, there were mainly four types of agents passing this first knowledge to Trentino's farmers: farmers from South-Tyrol, other agricultural

stakeholders in Northern Europe, neighbouring farmers and the first organic technician of FEM. The type of agent passing this information changes over time as organic diffuses. The very first contact was with researchers from northern Europe which exposed to the first organic producer of all Trentino not the characteristics of organic production but the risks of the use of pesticides, as the concept of organic at the time still had to be completely developed. The other interviewed innovator exposed a similar type of information, of the possibility of farming without pesticides, from South-Tyrolean farmers. The other farmers who adopted before 2000 first heard of organic farming either from the first FEM's technician or farmers in South-Tyrol. Later adopters received the initial information from the technician of FEM or from neighbouring farmers. As previously cited and confirmed by the farmers, the first information came from Northern Europe, either directly or through the intermediary role of South-Tyrolean farmers and FEM's technician. The difference between first and later adopters in the geographical origin of the information reflects the evolution toward a channel with a lower degree of heterophily. The first information coming from the FEM's organic technician were passed to farmers through direct contact or by organised courses and information evenings. I tried to highlight also the type of information received in this first contact. Even though some farmers did not mention or could recall the typology of information, for most of the others these were basic principles about the possibility of having a comparable production avoiding the use of chemical inputs.

In the next question, I asked to farmers if they were already aware of the potential problems of integrated farming toward the environment, health and future profitability. The aim of the question was to find an answer to the question if comes first the perception of the need or the awareness of the innovation. I expected to find earlier knowers on average more aware of potential problems at the time of the first knowledge and therefore more actively looking for a possible innovative solution. I found that the earlier knowers, which in most cases are also earlier adopters, were already aware of the potential problems of integrated agriculture, confirming the assumption. The type of problems alarming the farmers vary greatly between adopter categories. Innovators and roughly half of the early adopters were aware of the potential personal health and environmental issues. The other half of early adopters, later adopter and non-adopters considered only potential the future economic issues, arising in the last decades, of the integrated production. These different types of perceived problems, if associated with similar answers for the question of the

leading motivation, might support the conventionalization hypothesis. Only one non-adopter interviewed, which received the first information only five years ago, did not state awareness of any kind problems of integrated agriculture. This question confirmed, for the system considered, the preceding role of the need than the awareness of the innovation available. This section of the interview confirmed differences between earlier and later knowers to be similar to the differences between earlier and later adopters and helped to understand the initial phase of the evolution and diffusion of organic farming in Trentino.

5.3) Persuasion stage

The next section, following the adoption decision process, covers the persuasion stage. During this phase, individual look for further information over the innovation considered in order to develop a positive or negative opinion toward the innovation under analysis. In one question, for which I expected and received the longest answers, I asked farmers which type of information they searched, through which channel and which category of agent they contacted. The communication channels used were similar to those previously described for first information. Only four farmers cited in this phase as the most important source of information the FEM's technician. A higher number of farmers previously highlighted instead of the importance of this first contact in the knowledge phase. This is in line with the correct approach of a decentralised diffusion system initially adopted by FEM's technician. Specifically, she kept organic courses with the double aim of giving first information on the basic principles and create a network between existing organic farmers and those interested in the adoption. The importance of meeting other farmers in the search for information has been confirmed by my interviews. The majority of the interviewed farmers looked for more information by direct contact with other farmers. The geographical distribution of the farmers contacted is similar to the first information received, with earlier adopters looking for information among South-Tyrolean farmers and later adopters contacting organic farmers in the Trentino's province and, if available, neighbouring organic producers. Just one of the interviewed farmers looked for information mainly through the internet and other media channels. The internet, as stated by farmers, started to develop as a reliable source of information for organic farming only in recent years. Is interesting the case of the first organic producer, which tried unsuccessfully to look for further information as in the early eighties there was only few

information available. Nevertheless, he started avoiding the use of chemical inputs, trying new practices as problems arose. In this question, also other farmers confirmed a similar approach toward the development of new practices, which is comparable to a decentralised diffusion system. The other innovator and the early adopters interviewed, especially those in the South Trento area, actively looked for information, but could not find complete and secure answers over organic agriculture and the practices involved. They had to develop these themselves by making personally trials and experimentations, passing on the results to other organic producers and future adopters interested. In this phase, farmers looked mainly for others' experiences confirming the possibility of producing organically rather than the actual things to be done, as these were still to be mainly developed. Later adopters could find a wider set of information, also about all the agronomic practices needed, among farmers closer geographically and through the cooperatives. In some cases, I tried to obtain wider answers by asking which type of information they looked for, whether mainly related to the principles of organic, to the concepts of plant and soil management or to the inputs and machineries needed. The results obtained were different among categories, with earlier adopters stressing the research for information over the principles, both of organic and plant management, and later adopters focusing mainly on the inputs used. This is in line with Rogers' theory, which highlights the focus during this phase on the principles of the innovation for earlier adopters and on the know-how for later adopters.

In the next question of this section, I asked farmers if there was an event that made them understand it was the proper time to start the production. This event is referred to as cue-to-action and turns farmers' positive opinion toward organic production into a positive adoption decision. Thirteen of the sixteen organic farmers interviewed cited a specific cue-to-action as the driver of their adoption decision. The cue-to-action are mainly of two types, economical and agronomical. The economic events that evolved farmers' positive opinion into an adoption decision are related to the increased commitment of the reference cooperative and the emerging of a market crisis of integrated fruits. The agronomic event that lead the adoption decision of farmers was the personal observation of the actual comparability of organic production. For six interviewed farmers, personally seeing organic producers having products of similar quality to integrated ones, and with only slightly higher amount of time required, drove the decision of adoption. Earlier adopters stated in most cases the role of an agronomical cue-to-action, while later adopters cited in

the majority of cases the importance of an economical cue-to-action. None of the interviewed integrated producers declared any rejective cue-to-action, as in all the cases their decision is a passive rejection, also called non-adoption. This section of the interview highlighted the preference for homophilous channels of information, as farmers look for information through the channels having the highest safety credibility, which characterises the communication with other similar farmers. This is especially true for earlier adopters, where the level of information and knowledge available in the system was low and farmers were not looking for complete agronomic information, which could have been found through highly specialised researchers with a high level of technical credibility, preferring the less technical but more comparable experiences of similar farmers, having the highest level of safety credibility.

5.4) Decision stage

The next section covers the fundamental step of the decision of innovation's adoption. At first, I asked the year of adoption, to be able to identify the belonging category for each farmer by comparing it with the statistics of organic diffusion in every system. The year of adoption considered is the starting point of the conversion period, not when the sale of certified started, after the three years of conversion. The cumulative distribution of the organic adoptions over time in the sample considered can be observed in the graph 3.1 previously presented. As can be seen from the graphic, two main periods of adoption can be found among the sample, which are the late nineties and the years after 2015, which as I previously introduced has been a turning point for organic farming in Trentino. I successively asked if the initial adoption was partial or over the whole farm. Only five of the sixteen organic farmers interviewed tried at first on a portion of the field. Of these, four converted entirely to organic farming after a period ranging from one to five years, while one started the partial trial in 2017 and is still cultivating organically only on a section of the farm. All the farmers whom tried organic farming on a partial basis belong to the early adopter category in their reference system. They took this decision to reduce the uncertainty over the adoption of organic and the practices needed. As previously introduced, I expected to find a higher rate of farmers trying at first among the earlier adopters, due to the higher level of uncertainty in the system during earlier phases of the diffusion. The assumption has been confirmed by the sample considered.

The next question is of crucial importance for the purpose of this thesis and covers the motivations driving the farmers' adoption decision. Mainly four types of possible reasons for the adoption have been stated and these are: financial reasons, personal health concern, environmental concern and health concern toward neighbours and consumers. The financial reasons are mainly of two types, the pursuit of higher present economic revenues and the research of a better future financial sustainability of the production. The motivation about personal health regards the risks of health and genetic damage derived by the use of pesticides, as the farmer is the most exposed individual during the phase of preparation and application through the atomizer of the chemical inputs. In some cases, farmer's decision happened to be driven by the desire to reduce the health's risks of the exposure also to individuals living in the surroundings of the field and to the consumer, which eventually eat the chemical residues on the fruit. This is a more social-oriented decision. The last motivation highlighted regards the preservation of the environment's quality. This can refer to the management and preservation of soil's fertility, therefore being connected also with long term financial sustainability, and to the preservation of environmental quality of the surrounding areas. The decision in most cases cannot be explained by only one of the previous reasons, rather by a mixture of some of these, therefore I asked farmers in some cases to rank them by perceived personal importance. These sets of reasons have different levels of complexity involved in their assessment by the farmers, with financial reasons being much easier to evaluate than the non-financial motivations. For financial motivations the only complexity lies in evaluating the higher price, considering the lower output in terms of quality and quantity of organic production. Financial relative advantage can be therefore evaluated specifically after the adoption, but even before the farmer can have a sufficient understanding of the economic factors to support his decision. The non-financial reasons are associated with more complex scientific problems, which are in most cases impossible to be understood completely by farmers, even when data are provided in an information evening. Most of the farmers, even those driven by non-financial motivations, for example, do not know the specific scientific risks generated by the use of chemicals, stating nevertheless a concern on any of the three areas of impact considered. Non-financial reasons can be barely analysed previously of the adoption and high importance is therefore placed on the individual passing the information of the non-financial risks. After the adoption, even though the scientific risks and principles are still difficult to be understood by most, some farmers

stated the observability of these benefits, as higher fertility of the soil or the reduction of irritating substances during the work in the field. I expected the relative importance of the decision's motivations to change over time. Starting from Rogers' theory, which states that early adopters tend to value more the principles and the non-economic reasons of the innovation, I started the hypothesis that earlier adopters tend to place more value on non-financial reasons while later adopters consider more the financial aspects of the innovation. These differences between adopters' motivations have been confirmed also by the specific studies over the diffusion of organic innovation in other European countries. The increasing importance of financial reasons is in line with the risks exposed by the conventionalization hypothesis, which sees as a potential problem the latest adopters driven only by the economic benefits of organic farming. I expected to find earliest adopters placing more importance on the non-financial aspects and latest adopters, especially in the area with the highest development of organic production of South Trento, to emphasize the economic aspects in the leading motivations. My interviews confirmed the expected result of changes in motivations, even though the majority of organic farmers, including later adopters, expressed the importance of non-financial motivations, alone or combined with financial motivations. Fourteen out of the sixteen organic producers interviewed included non-financial motivations, with only two farmers stating only economic reasons as drivers of the adoption decision. Of the fourteen farmers driven by non-financial aspects, seven included financial motivations as drivers of their decision, while the other seven did not emphasize at all the role of economic aspects in their decision. The farmers emphasizing only non-financial aspects are all among the innovators, with both of the interviewed farmers stating only non-financial motivations, or early adopter category for their reference system. It's in the early adopter category, following the diffusion process, that farmers started including jointly financial and non-financial aspects. Early adopters emphasized the importance of financial aspects of green innovation to be sustainable by farmers adopting it and to successfully diffuse, while also considering the non-economic benefits. The economic reasons started gaining relatively more importance over the other reasons as the diffusion process continued, up to the point of two interviewed later adopters describing their decision as driven only by financial aspects. Looking specifically at the economic aspects, early adopters tend to focus on the long-term sustainability of revenues, while later adopters are more interested in having higher present revenues, even if considering the lower revenues expected for the three

years of conversion. The differences in economic perspective are in line with the development of the organic market and the crisis of integrated production that I will describe in the next question. Focusing specifically on the different non-financial aspects, earlier adopters tend to place more importance on a personal health concern, stating it as the only motivation in three cases. Personal health concern was cited only once in association with economic aspects. Following again the diffusion process and moving toward early and later adopters, increasing attention was placed upon the environmental concern and the social aspects, mainly related to the health of consumers and neighbours. These reasons were cited in most cases together with economic aspects; only one farmer stated the environmental concern as a unique driver and two farmers included environmental concern together with health concern as drivers of the decision. A shift can be therefore observed also when considering the different non-economic aspects. Before my interviews I were expecting, as presented in the bibliography of green innovations (Jansson, Marell and Nordlund, 2011), to find a higher concern for health and social aspects in earlier adopters, with later adopters placing more importance on a rather egoistic reason as the health concern. An analysis of the bibliography of the organic diffusion could not explain why this happens, as most studies did focus only on generic non-financial aspects and concern, without focusing specifically on personal health and other non-financial motivations (Läpple and Rensburg, 2011). Only one study proposed similar results, with the higher level of environmental concern found among the early adopter category (Padel, 2001). One possible explanation can be seen in the advancement of scientific research, which provides information over more complicated topics as the impact of chemical inputs on the environment and on health with lower levels of exposure, while the impact on the health associated with a high level of exposure was discovered previously. Nevertheless, the importance placed upon different non-financial information should be studied more in-depth, especially to spark the diffusion of organic farming in the areas of the developing world where this production is still completely absent. The major assumption of relatively higher importance placed of non-financial aspects by earlier adopters has been however confirmed by the sample of farmers considered. I decided to focus on the perceived drawbacks limiting the decision adoption in a following question, where I analyse the perceived problems at the time of adoption for adopters.

In the subsequent question, I tried to analyse in-depth the financial drivers of the adoption, and specifically the pursuit of a higher remuneration in the immediate future. To

understand if this was the leading economic benefit, I asked farmers if they were satisfied with the revenues generated by integrated production in the years before their conversion. Twelve of the twenty interviewed farmers stated that they were not satisfied, or still are not in the case of integrated farmers, with the price received for their production. Six of the interviewed farmers stated that the price was, and in one case still is satisfying, while the other two remaining farmers described the revenues of integrated production as neither satisfying neither not satisfying. Among current integrated producers, the revenues generated are mainly considered unsatisfying, with only one integrated farmer of the sample considered stating the contrary. Five out of the six farmers who stated satisfaction with the revenues of integrated agriculture nevertheless adopted organic production. All these farmers belong to the innovators and early adopters' category. There is a match between the satisfying level of revenues generated by integrated agriculture and the preference of non-financial motivations of the adoption, as four out of the five organic farmers previously considered did not state any financial reason among the drivers of their decision. Later adopters instead state almost all a clear unsatisfaction with the revenues generated by organic agriculture, especially regarding those whom adopted after 2010. This reflects the crisis that integrated apples' production has been going through in the last years, as can be observed in the average price paid by the cooperatives for each kilogram of apples conferred. When looking at this data, must be kept in mind that Melinda always paid a much average price to its conferring farmers when compared with the other large cooperatives. This is due to the highest cost of production in Val di Non, which has a semi-mountainous morphology, resulting in almost 20-30% higher production costs than lowland farming, as confirmed by both farmers and technicians. Nevertheless, Melinda has been able over the years of paying a higher price thanks to the quality of the apples produced in Val di Non and to the market strength of its brand, which is one the most famous in the Italian market. I could not find studies showing the average costs of production per kilo produced, even because it is complicated to compute due to the high variability in yields. A technician suggested, relying on a personally carried study, that the average production price for a kilo of integrated apples could vary between 25 and 35 cents, which includes a satisfying wage for the farmer. I was not able to obtain long time series of price received by farmers, even directly contacting the cooperatives. Even comparing one single year, in this case 2016, the different price paid to farmers is evident, with Melinda paying on average 43 cents per kilo to farmers and S.F.T. having a lower

price paid of 27 cents per kilo to integrated producers. Even if the data on long time series, all the stakeholders involved confirmed a clear decreasing trend for integrated production revenues across all the areas of Trentino. Looking at the price paid to farmers, the present situation is particularly critical for farmers in Val d'Adige, with a price only slightly higher than the production costs. The most common variety in the area, Golden Delicious, is paid to farmers less than 20 cents per kilo, less the production costs. A farmer interviewed declared that he cultivates and gather that field only for his pride, as he would have a lower loss by abandoning the crop. The situation in South Trento area suggests that the economic crisis which makes unsustainable production over a long time period might be the critical factor allowing the crossing the chasm (Moore, 1999) between early adopters and the early majority.

In the following question I tried to investigate the main drawbacks and problems associated with the adoption of organic agriculture that were, and in some cases still are, limiting the adoption decision. The most important limitation is associated with perceived agronomic problems and uncertainty over the use of new practices and products as well as their eventual efficacy. Other reasons for uncertainty eventually limiting the decision are the market channel of the products, especially in the case of the earliest adopters which had to create their market channels, being the only stating this perceived issue. Another issue which limited and is still limiting the decision of non-adopters is the uncertainty over the relative advantage of organic production. This uncertainty was mainly on the quality and the yield, which are the drivers of the economic output, for earlier adopters stating this perceived problem. Non-adopters stated instead both doubts over the potential economic revenues and uncertainty over the different impacts of organic and integrated agriculture over the health and the environment. As previously mentioned, a serious comparison of the two productions, avoiding the discredit of integrated and covering the points most criticised of organic agriculture, could reduce the uncertainty of the farmers over the non-financial impacts, therefore removing one limit in the diffusion of organic agriculture. Even if most of the organic producers stated some agronomic problems as the main perceived drawback of the adoption, the categories of problems perceived vary greatly across the diffusion process. Earlier adopters perceived uncertainty over most of the agronomic practices and the inputs to be used, as there was a high degree of uncertainty across all the organic knowledge system. The decision has been described by some of these adopters as a "jump into the void", as they were tackling specific problems by trying

new practices as the problems arose, as described by a farmer:

"I did not focus on the problems, I just changed otherwise you would never do it, it felt like a jump into the void at that time"

The uncertainty of the innovators was on three areas of the production: the problems that will arise, the practices and products to tackle them and the actual productive capacity of organic agriculture. After the first phase of the innovators, early adopters knew the potential problems arising but still presented a high level of uncertainty on the other two areas. As organic agriculture diffused, a lot of knowledge has been developed inside the Trentino's decentralised diffusion system, as farmers, organic technicians and other external stakeholders developed new practices and associated inputs to be used. Later adopters stated much more specific agronomic issues, suggesting that most of the other previously existing problems had been solved. In three cases farmers stated as the only problem perceived before the adoption the higher number of working hours needed, demonstrating that the major uncertainties had been solved. Two farmers, among the latest entrants interviewed in the South Trento area, stated that they had some lack of knowledge to be fulfilled but knew that the major problems and reason of uncertainty had been solved by previous adopters, relying upon their trust in them. This proves that the reduced level of uncertainty and the increased knowledge of the system reduced the barriers for new entrants, that see as potential downturns only partial and specific problems. In some cases, I also asked to farmers if they perceived some forms of social pressure, before or after the adoption decision. Almost all the innovators and early adopters answering this sub-question stated that they received explicitly critics from a wide range of stakeholders in the agricultural system, including technicians and other farmers. Later I will deepen with a specific question the role of technicians. Earliest organic adopters stated to have received discredit and jokes by many of their neighbouring farmers and in some cases also other inhabitants. The discredit in most cases took place by referring to organic producers as less serious farmers and by blaming organic farmers of spreading fungi and insects over close fields. The spreading of problems has absolutely not been confirmed by organic producers and even technicians, even though it was based on a single previous record cited by the first organic producer. The misperception of organic producers as bringers of fungi and insects helped to develop a strong negative attitude toward organic production in many integrated farmers, leading together with other reasons to a social pressure over organic farmers. As the organic production diffused, and

the number of potential interactions between integrated and organic farmers increased, the problem of social pressure tended to decrease. In the South Trento area, recent adopters did not state any form of social pressure from other farmers. One recent adopter of this area stated that he was increasing perceiving a form of social pressure from inhabitants for its integrated production before the organic adoption. This is an interesting newly arising potential driver of the diffusion of organic production and is in line with the trend of environmental and health awareness that is spreading around the agricultural world. On the contrary, recent adopters in Val di Non, where organic is much less diffused, still perceive a high level of social pressure from neighbouring farmers and even inhabitants for their adoption decision, confirming the different levels of development of the two systems.

I then tried to analyse the social pressure from the cooperative and FEM, also to understand better their role in the knowledge system of Trentino. Starting from the cooperatives, these must be considered singularly. The largest cooperative, Melinda, as previously introduced, drastically changed its approach toward organic in 2015. Before that time, some of its technicians were opposing and discrediting organic farming and organic farmers would receive a price per kilo even lower than integrated producers. After 2015, however, Melinda tried to find more profitable organic markets, resulting in average higher price paid to producers, developed policies to sustain financially new organic adopters and established jointly with FEM a new technical consultancy service. The two organic farmers conferring to Melinda I interviewed adopted after 2015 and stated that they are receiving useful support, both financial and of knowledge, from Melinda. An interviewed innovator, working and living in of Val di Non, had a very negative opinion of Melinda, which tried to discredit his organic production also by spreading false information. He was also a member of the "Comitato per il diritto alla salute in Val di Non", which has been strongly opposed by Melinda, even threating to file a lawsuit against their association. Many earlier organic adopters stated scepticism about the transition in 2015 of Melinda and about the excessive reliance over technical consultancy it is supporting, even though the real impact of Melinda organic support is still to be seen. Most of the interviewed farmers belonged to the S.F.T. cooperative, working in the South Trento area. The approach of this cooperative to organic production changed as well over time. Early adopters of the area stated that only some technicians of the cooperative tried to discredit the organic production, with the cooperative keeping a neutral approach.

Regarding the price per kilo received, in the first years organic producers were mainly satisfied, apart for some specific years of low prices received. Even this cooperative changed its approach toward organic in 2014-2015, moving from a neutral perspective toward a supportive approach. After S.F.T. joined the consortium APOfruit, first as a commercial agreement and later as member cooperative, it started to increasingly support organic farming, through policies, higher commitment toward the organic market and spreading initial information. This cooperative did not initiate any policy to force farmers' conversion, but the adoption decision is still freely taken by farmers. The new and increased commitment toward organic did not pass unnoticed by farmers, which stated the new approach as an important driver of their decision. This is in line with the high interest in the financial drivers of the decision of later adopters. Nevertheless, this cooperative as by far the highest share of organic producers, with a total of 52% of the productive hectares cultivated using organic method. Roughly half of this area, 26% of the total members' fields, is certified organic, while the other half is currently under conversion. I did not interview any farmer currently member of the other largest cooperative, LaTrentina. A former member of LaTrentina decided to quit and sell through direct marketing after his adoption in 2006 as the cooperative did not have an organic sales channel. However, he stated that as the interest developed in the area and organic farming started diffusing, also this cooperative slowly changed its approach, supporting an organic market channel and supporting the decision trying to find proper areas and farmers interested in adoption. Another smaller cooperative, Valentina, placed in Rotaliana, is following the trend of larger players, searching for better markets for organic and recommending, but not forcing, the adoption of organic cultivation.

The role of FEM followed a similar evolution, increasing its commitment in the support of organic agriculture since 2015, even though earlier adopters expressed scepticism. All the interviewed organic farmers who adopted before 2015 expressed a very negative opinion of FEM. The foundation before the new approach had a very limited number of technicians working on organic agriculture, offering mainly support in the development of new practices, the so-called experimental consultancy. All the earlier adopters commended these technicians, although knowing that further help was needed from an organisation trying to place as the centre of the agricultural knowledge system. The most controversial point is the action of discredit undertaken by some of FEM's technicians, who directly criticised organic producers and had a role in spreading false

information, as highlighted by most of the earlier adopters. Some of the early adopters, looking for the support for organic production that FEM was not offering, started interacting with Laimburg, which is a similar research and experimentation public organisation operating in South-Tyrol. This organisation has been historically researching more actively in the field of organic farming, offering also a better support service to the local South-Tyrolean organic producers and to the interested Trentino's farmers. Farmers received from Laimburg knowledge, information and even agronomic consultancies that FEM did not provide to Trentino's organic producers. Since 2015 FEM increased the number of technicians employed to support organic farming, offering also a technical consultancy service, describing the specific needed interventions and inputs to be used, similarly as for integrated agriculture. This service has been strongly criticised by earlier adopters, who now do not rely on it, and even by the first technician of FEM, because it is not capable of considering the whole proactive ecosystem approach needed for efficient organic production. Nevertheless, all the most recent adopters converting after 2015 do not have such a negative opinion of the role of FEM. As I will highlight later, later adopters tend to rely completely or as a support on the recommendations of FEM new technical consultancy service. Even if not all the most recent adopters rely entirely on this service, they have a less negative opinion probably because they did not have to bear the discredit by some of the technicians against previous adopters in the years before. After having analysed why farmers decided to adopt organic production, proceeding with the adoption decision process I asked questions about the phase of the implementation of the innovation in the following section.

5.5) Implementation stage

In the implementation section of my interview, I tried to analyse the difficulties encountered by the farmers in the first years of conversion, the information needed, and the communication agents involved. At first, I asked to the farmers from who and which type of information they looked for the practical development of the organic practices and intervention needed. As previously introduced in the knowledge and persuasion section, the organic technicians played a role in spreading the principles of organic production but the communication channels most used shifted toward more homophilous channels as the information needed become more practical. Therefore, I expected to find reliance mainly

on information coming from other farmers for the most practical information needed during the actual implementation. This assumption has been confirmed from my interviews, with all the farmers relying on information, knowledge and experience of other farmers to develop the organic practices. The communication channels between farmers however changed during the diffusion process, strictly connected with the development of the practices. During the phase of innovators and the first early adopters, there was low knowledge across the whole system regarding the practices to be developed, which were tested by the farmers themselves, with the support of the FEM experimental consultancy. All the farmers interviewed belonging to this subset declared that they actively shared experiences with all the other organic producers, receiving back the feedback of others' experiences. The development of the needed practices, as stated by the earlier adopters, is in line with a decentralised innovation system. This communication channel, relying mainly on the tacit knowledge developed and transmitted by farmers, was at first on a regional level, including even some South Tyrolean farmers. At present time the practices needed to solve most of the arising problems are well established and can be spread also through the communication channels using codified knowledge, including manual and technical assistance, even though new problems are arising which need to be tackled by new practices still being currently developed by farmers themselves. Some of the latest adopters confirmed to look for information over the practices also through more codified knowledge sources compared to the direct contact with other farmers, including the internet, which was very scarce of information in previous years. The direct contact with other organic farmers is nevertheless the most important source of information and knowledge for the development of the needed practices. This channel changed over time because moved from a channel between similar farmers sharing multilaterally information toward an almost unilateral communication channel from most experienced and previous adopters toward new entrants. This almost unilateral channel has been confirmed by recent adopters, which however highlighted the presence of a multilateral communication channel for the joint development of the practices needed for the new problems arising. The diffusion of the practices should not be considered as similar to a technical consultancy recommending how and when to intervene, rather as a help in understanding the needed intervention and their functioning, that the farmer will have to decide whether to use based on the consideration of the whole ecosystem situation of his field.

The second question tried to highlight the problems and the difficulties

encountered during the implementation phase. As expected, the types of difficulties changed during the diffusion of organic farming. The biggest problem presented by most of the farmers across all the diffusion process is the increased number of working hours needed for each hectare cultivated for organic farming when compared with integrated agriculture. As previously introduced, this higher amount of labour is mostly devoted to simple manual tasks as thinning and weed management. Another difficulty cited by some farmers equally spread over different adoption periods, is the drastically reduced time lapse available for intervention and the higher number of specific interventions needed. These problems are due to the reduced strength and lasting power of the biological inputs when compared with their chemical counterparts used in integrated agriculture. The result is a reduction in the planning possibility of the interventions, which have to react faster, even outside the traditional working hours and in adverse weather conditions. This caused more problems to farmers working fields in steep areas, as some field of Val di Non, and required an adjustment in the managing of the intervention for all the organic producers. Another problem which has been highlighted by farmers belonging to all the adopter categories is the acquisition of the knowledge needed to fully understand the ecosystem and the functioning of the new inputs and practices. Neighbouring farmers helped in developing the initial comprehension of the practices needed and the functioning of the ecosystem, but each farmer has to acquire through his personal experience a deeper understanding of his field and the solution needed for his specific problems. A problem arising in the implementation phase which has been highlighted only by earlier adopters is related to the new needed machinery. Organic farming, as previously introduced, needs new machinery types, as the tools for mechanical weed cutting. In the first years of diffusion, this and the other machinery were described as inefficient or even not existing by earliest adopters, being later refined as the number of worldwide organic producers increased and so did the demand for these machineries. Earlier adopters confirmed that now the quality of the machineries utilised in organic production is higher, while none of the latest adopters expressed any problems with the machineries. In this question, all earlier adopters stated as the main difficulty the absence of proven practices and knowledge for many problems, which had to be developed by farmers' themselves. The problems with the new practices have been stated by latest adopters but only for the issues of understanding and implementing those, not citing the uncertainty that earlier adopters had to face, as most of the practices and inputs are now well known and tested by the

system. I tried to move the focus also on the difficulties associated with the certification filings and controls. Only a minority of farmers described the filing phase as a complicated issue, even because they receive support from other farmers and the cooperative in the bureaucracy. Three farmers complained of the random controls of the certification due to the associated loss of time.

In the last question of the implementation phase, I focused specifically on one specific problem that farmers have to face during and after the implementation phase, which is the changes in the decision-making process. Organic farming requires a more complicated decision-making process because it is associated with a different approach toward agriculture. Integrated production could rely on more efficient chemical inputs, allowing for a reactive approach which applies the needed input to solve the specific problem as the issue arise. In Trentino, for the technical advancement of inputs and the excessive reliance on the technical consultancy, the integrated agriculture moved close to conventional farming, which is reflected in the description above. In organic farming, due to the lower efficacy of inputs and a different conception of agriculture, must be kept a proactive approach, trying to prevent problems before these arise. To prevent the emergence of problems, farmers must apply the biological inputs before the problem arises and, if not sufficient also during and after the occurrence of the issues. In organic farming is therefore important to predict the emergence of problems, whether it is fungi, insect infestation or other plant diseases. The prediction is based on extensive observation of the field and the knowledge of the specific characteristics of each soil and tree, as the exposure to the sun, the average humidity, the likelihood to suffer infestations and many other characteristics that only the farmer can know. The interpretation of all the variables composes the analysis of the ecosystem, which based on the specific intervention threshold drives the decision of intervention. From this simplistic description can be observed how the number of factors to be considered is higher in organic farming. Some farmers use a software tool to support their decision, RimPro, which after the first period of use and trial by organic farmers has started being used and supported also by FEM. The system is based on a meteorological sensor, capable of measuring a wide set of information as the wind, rain and sun intensity. RimPro is considered an application of the concept of precision farming, which aims at using IT-enabled solutions to support farmers' decisions and work, with the final purpose of minimizing the use of inputs. This software is supported by a sensor which can estimate the likelihood of the major risks for

apple production based on the measured weather conditions, supported by a huge number of observations and tests during the years, suggesting also the intervention thresholds for the needed treatment for each potential agronomic problem. This software, as confirmed by farmers, is a useful support tool in the decision-making process but should not be used as the only source of information. Even the technical consultancy can be used as a support in the decision-making, incorporating it with the analysis of the field. The decisions over intervention and other main practices are therefore more complicated for organic farming, as these must include personal observation, weather measurements, technical consultancies and other farmers' suggestions, joint together using farmers' personal experience. I did expect to find differences in the decision-making process across adopter categories, with a deeper and more complicated analysis for earlier adopters and just partial considerations for more recent adopters. This is partially due to the higher experience in organic farmers for earlier adopters, which allows for better analysis. The largest driver of the different decision-making process is to be searched for in the misconception of organic production as a slightly modified version of integrated production predicted by the conventionalization hypothesis, as defined by the first FEM's organic technician:

"It is much more than a mere change of inputs, you have to change completely how your work, your perception and your mind".

This misconception would change the decision-making process of organic farming, making it more similar to the integrated production process, basing the decision mainly or exclusively on the technical consultancy. In the sample considered I expected to find a more complete decision-making process for the interventions among earlier adopters, with latest ones considering a limited set of information and relying more on the service of technical consultancy. All the interviewed farmers declared to consider more than one set of information and to rely on different sources to make their decisions, with none exclusively basing the decisions only on the technical consultancy. This proved to be different from the decision-making process characterising integrated production, in which the majority of current or former integrated farmers stated to rely exclusively on the technical consultancy service. In integrated farming, however, not all producers rely on technical consultancy, as confirmed by six of the farmers interviewed, of which five eventually adopted organic farming. They stated that for them the implementation of organic farming did not require large adjustments in the decision-making process. This

suggests that a reduced reliance over external consultancies could reduce the barriers of adoption of organic farming due to the higher compatibility between the decision-making in the two agricultural systems. This assumption needs however further studies and quantitative analysis to be confirmed. The above assumption is controversial because the new organic technical consultancy service could have the same effect of increasing the compatibility in the decision-making process, increasing however the downturns of the conventionalization hypothesis. Deepening the analysis of the use of technical consultancy in organic farming, seven organic producers stated to consider it as a support in the decisions, while the other nine interviewed organic farmers stated not to consider at all this service. There is a clear correlation between earlier adoption and avoidance of the use of technical consultancy, with eight out of the nine earliest adopters not using this service, and only one of the farmers in the early majority category not considering it. Six of the seven latest adopters instead consider the consultancy as a support in their decisions. The different levels of reliance over the consultancy among different adoption categories however does not prove necessarily the conventionalization hypothesis, as it could be due to the experiences gap of latest adopters or the availability of this service at their time of first adoptions, which was not the case for those whom adopted before 2015. I will analyse not the reliance over another component of the information needed for the decision, the use of the software for precision farming RimPro. Even if not to all the interviewed farmers were asked if they use this tool, can be immediately observed the difference between organic and integrated farmers, with none of the latter using RimPro and the majority of the first considering it in their decisions. Even if the statistical validity of the results is reduced by not having asked the question to all the farmers, a higher rate of users is found among earlier adopters compared with later ones. All the farmers which adopted before 2000 stated to make use of RimPro, while only two out of the four farmers adopting after 2012 which I asked this question confirmed to use this software as a support in their decision-making process. I could not measure the level of reliance on personal observations of the field, but all the organic farmers interviewed stated to consider the analysis of the field in their decisions. The other sources of information considered in the decisions are communication and comparison with other organic farmers. All the interviewed organic producers stated to communicate and compare with other organic producers, especially for extraordinary decisions. This communication flows through the channels previously described for the sharing of new practices', starting on province level

and evolving in subsystems of neighbouring farmers as organic farming diffused. The results of the interview highlighted the importance of the communication between the farmers in the phases of knowledge, persuasion, decision and implementation of the organic innovation. The communication between farmers has been crucial to support organic farmers belonging to all the adopter categories from the first innovators to the very last adopters. The communication between farmers is an important aspect of organic farming distinguishing it from integrated farming. Many organic farmers, belonging to different adopter categories, stated that this precious communication channel was not existing in integrated production. Integrated farmers know each other, especially neighbouring ones, but do not share useful information with others, whether it is information upon an intervention or regarding an innovation. Three interviewed organic farmers sustained that this might be due to a form of envy existing between integrated producers. All the integrated farmers interviewed did not include communication with other farmers as a source of knowledge considered in their decision-making process. This last question highlighted the consideration of more and different sources of information in the decision-making process for intervention and practices to use for organic farmers than integrated producers. The results show also differences in the decision process between earlier adopters, completely avoiding the technical assistance, and later adopters, considering the technical assistance together with the other sources of information typical of organic production. The results are in line with the conventionalization hypothesis, even if the decision-making process is closer to the one characterising organic production, relying in most cases on multiple sources of information, than to the decision process of integrated production.

5.6) Confirmation stage

The last section of the interview covers also the last phase of the decision adoption process, the confirmation stage. The confirmation stage is in some cases considered controversial because, for some innovations, is always possible to return to the condition before the innovation, therefore the confirmation stage might never end. I tried to understand not only the personal satisfaction of organic innovation but also the consideration over a possible return to integrated production. I included in this section also questions over the opinion toward further innovations. Lastly, I inserted some questions,

considering sustainability concern and the profitability per hectare, that I placed in this last section to avoid the bias, for example pro-environmental, that these questions might generate.

In the first question, I asked farmers if they were overall satisfied with their decision of adoption of organic farming. All the interviewed organic farmers replied positively. Some farmers explained that their satisfaction did not derive only from the positive economic results, but also for example from the re-appropriation of their role of entrepreneur and decision-maker, which was lost in integrated agriculture, according to them. Other sources of satisfaction are related to the experience, the knowledge of the field and the overall ecosystem obtained, as well as seeing the positive results received from the field in response to the use of simple biological inputs. Two farmers, both over 55 years old, stated that having to do with an innovation requiring such an active role as well as a change in their mindset was such a positive experience that motivated them to work in the fields for a longer time. The most recent adopters, which are still in the conversion phase, described the adoption of organic farming as a positive experience, even if explicitly stating that they cannot evaluate the eventual positive economic results of this innovation and if it will be worth the economic indirect loss of the conversion phase.

In the next question, I asked organic farmers if they ever considered returning to integrated agriculture. The answer received was unanimous for all the sixteen organic producers, which replied to have never considered going back to the integrated production system. Two answers have been particularly interesting in understanding how secure farmers are now of their adoption decision and their determination in never going back. One interviewed organic producer declared that even if the organic sales channel would eventually disappear, he would still produce using the organic method even if selling the apples as integrated. Another farmer stated that, if for some reasons he would have to switch back to integrated farming, he would quit agriculture and get a different job. The only farmer interviewed which is currently testing organic farming on a partial basis declared that he will not convert this portion back to integrated, rather trying to expand the field cultivated organically. In this question, I asked current integrated producers if they were satisfied at the moment with their production. The answers received were all negative, even in the unsatisfaction was entirely related to the reduced profitability of recent years.

The subsequent question tried to analyse the propension toward a possible following innovation which is biodynamic farming. Biodynamic is a holistic approach to agriculture, combining some practices characteristics of organic farming with homeopathic principles. The concept of biodynamic derives from the anthroposophical studies of Rudolf Steiner and it considers as a living body the soil and all the biodiversity it generates. The main agronomic difference with organic production is in the inputs used, composed in most cases by medicinal plants cultivated on the field, which must be prepared by the farmer himself. Biodynamic also requires a set of unscientific and esoteric practices, as the infamous "cow horn", which imposes to place a cow's horn filled with manure under the composting pile. This example, together with other practices drove a negative judgement by some farmers over biodynamic because it is considered too mystical. Nevertheless, some other farmers recognised the agronomic potential of having production's quality reducing the use of heavy metals like brass as inputs, relying more on medicinal plants and animal manure. Due to its pseudoscientific nature, biodynamic research is still scarce in the existing bibliography (Turinek et al., 2009; Carpenter-Boggs, Kennedy and Reganold, 2000). Biodynamic agriculture is regulated by a standard set by Demeter which is a private association of biodynamic producers. Demeter, through its national association, is responsible also for the accreditation and the control of the certification, raising doubts on the objectivity of the certification, as confirmed by four farmers. The main markets for biodynamic products are in Germany and Austria, while in Italy this agricultural system is still mostly unknown. The market premium for biodynamic agriculture over organic one is however low, particularly when compared with the higher difference between integrated and organic and has been confirmed by a biodynamic producer. One of the interviewed farmers is currently a certified biodynamic producer; for my study I considered him as an organic producer. Biodynamic farming can be considered as a successive innovation because to be certified biodynamic the farmer has to be already certified organic and because it increases the focus on the whole ecosystem approach and the research of sustainability, even if further studies should be carried on to measure the different impacts. Another interviewed farmer produces following the principles and practices of biodynamic production but decided not to be certified biodynamic due to the high costs and the low market advantage of the certification, relying instead on the organic certification. Both the organic farmers belonging to the innovator's category are utilizing some biodynamic practices but with different purposes. While one is using some of the

practices of biodynamic incorporated in its organic system without any adoption intention, the other is currently trying some of the biodynamic practices before adopting it and can be considered in a transition phase. Biodynamic proved to have a high level of interest in the Trentino's system considered, with ten out of the twelve remaining organic farmers declaring to be currently considering biodynamic farming as a further innovation. The farmers interested can be found in both early adopter category and among the latest adopters. These farmers are interested in biodynamic for potential economic benefits or for a further innovation capable of raising, even more, the quality of their production. In most cases, the farmers considering this further innovation are not interested in the anthroposophical and esoteric aspects of biodynamic, expressing scepticism over these less scientific areas in most cases. This mainly financial driven decision suggests the risk of conventionalization hypothesis also for biodynamic production, although the only interviewed certified biodynamic producer suggested that many adopters started considering increasing positively the underlining principles after implementing biodynamic innovation. Eight of the ten organic farmers currently considering biodynamic innovation are members of S.F.T. cooperative. S.F.T., as stated by its president, is interested in biodynamic because APOfruit, the consortium which includes S.F.T., is trying to develop a new certification body for biodynamic different from Demeter, which is judged negatively due to its presumed low objectivity in the certification process by the president of S.F.T. himself. Further analysis will be interesting in the future studying the diffusion of biodynamic, which is now very limited in Trentino, to understand the diffusion potential for this type of agriculture.

The last questions that I will describe here are more related to general aspects rather than the confirmation stage. I inserted these in the last part of the interview to avoid the emergence of any bias, eventually influencing the results obtained. I asked farmers if for them sustainability is an important personal value, both in their work and their personal life. The purpose of this question was to check if differences, in terms of sustainability concern, exist between adopters and non-adopters and between the different adopter categories. Both the theory for the diffusion of innovations and the conventionalization hypothesis expect to find a higher sustainability concern and commitment among earlier adopters compared to later ones. This question did not prove this assumption because all the farmers interviewed, both organic and integrated producers, declared to have a concern about sustainability issues. Most of the answers received are even difficult to be further

evaluated because farmers simply stated yes, I have a strong concern, without explaining more in-depth. Earlier adopters gave on average longer answers, which might suggest that their opinion over sustainability matters is more elaborated and developed, but this cannot be considered as a proof of higher commitment. Both the innovators sustained their environmental and social concern also with the green solutions adopted in their everyday life, which can be found also among some of the early adopters. The rest of the early adopters gave an unexpected answer, declaring their environmental and social commitment, stressing however the needed economic results for supporting the development of sustainable practices. They gave the highest importance to the economic results of organic production, considering nevertheless the other positive impacts in the other sustainability's areas. It is my personal opinion that their answer was driven by the need to differentiate from the innovators, which are in some cases negatively judged as ideologically driven and less professional. One very interesting answer I received from a farmer belonging to the later adopter category declaring that adopting organic farming stimulated his interest over sustainability matters, eventually increasing his commitment in his personal life. This question did not highlight the desired results, maybe due to the presence of positive environmental biases among interviewed farmers. A further quantitative study should be carried out using a more elaborated analytical study of the sustainability concern, using, for example, the Marlow-Crowne test (Strahan and Gerbasi, 1972).

Following the interview, I asked after if the very first opinion toward organic farming and farmers was positive or if it changed over time. This question aims on one side at highlighting the evolution of the organic perception, especially for later adopters which have a greater time discrepancy between the knowledge and decision stage. On the other side, I wanted to check the existence of a negative judgement expressed toward organic innovators, being considered less professional in their farmers' role. Regarding the first side of the results considered, the assumptions were confirmed, demonstrating that almost all of the later adopters had an initial negative conception of organic farming, mainly due to the agronomic problems and the few solutions available, being therefore judged as a less serious productive system. Their opinion changed over time, eventually leading to the adoption of organic farming, as their understanding of organic production increased and the overall knowledge of practices and inputs of organic production available in the system expanded. This evolution in the perception of organic farming did not happen for the earlier adopters, which declared a positive attitude since the first knowledge reception, re-

sulting in a much lower discrepancy between the knowledge and decision phases. For the other side of the question, analysing the opinion toward the organic innovators, the expected results were confirmed. Almost all the farmers interviewed, who stated to have an opinion toward the innovators, declared that this was negative, due mainly to an adoption decision considered too much ideological and the low perceived professionality. This negative judgement has been expressed both by farmers belonging to the early adopters and early/late majority phase. The opinion toward farmers belonging to the early adopter category expressed by later adopters is instead positive in all cases, as confirmed by analysing the answers received in the South Trento area where all interviewed farmers highlighted in previous questions the importance of previous adopters. This difference in the opinion between the two first adopter categories confirms the opinion leadership role of the early adopter category, contrary to the role of innovators which are, in the theory and the sample considered, perceived as too different from other farmers and external to the system.

Aiming at the measurement of the financial performance of the different productions, I asked farmers to declare the average gross revenues per hectare. Only 13 of the interviewed farmers were able and willing to produce the economic value asked. At first, I wanted to ask the average profitability per hectare but, due to the higher complexity of the calculations involved, I decided to evaluate the gross revenues of farmers. The profitability would have allowed a better evaluation of the different productive areas, as Val di Non which has on average higher gross profits than plain cultivations in other areas, but also higher production costs. The higher level of gross revenues in Val di Non area has been highlighted by my interviews, with an average revenue for integrated agriculture of 29.000€. The only organic farmer in this area is an innovator, selling through direct marketing and declaring a slightly higher level of average revenues of 30.000€. The economic results of organic farmers selling through Melinda will be highlighted in the next years. In the past, Melinda used to pay unsatisfactory revenues to organic producers, even lower than for integrated production but started placing higher commitment over the organic monetization after 2015. The other interviewed farmers sell through direct marketing or the cooperatives S.F.T. or Valentina. The integrated producer and the most recent adopters selling through these channels highlighted the average gross profit per hectare obtained as being much lower than in the Val di Non area, around 18000€. For organic producers, this amount is higher, around 25000€ per hectare. This highlights higher gross revenues in organic farming compared to integrated production which, even considering the slightly

higher costs of organic farming, is likely to generate higher profits. Two farmers interviewed declared to have observed an increase in profits between 20% and 30% after the adoption. Even if the data declared by farmers are to be considered carefully because it is based on approximation by the farmers rather than on specific data, the results presented confirm the assumptions. Organic production has on average higher revenues and profits than integrated production in similar areas. As assumed, farmers in Val di Non have much higher revenues than plain areas, even if higher costs per hectare are present lowering the expected profits. The low revenues generated by integrated agriculture in plain areas might suggest that the high number of transitions in this area in recent years has been driven by a crisis in the integrated products market. The average production cost previously introduced of around 25 cents per kilo is incompatible with an average price received of 25 cents per kilo, and in some cases even lower, as stated by farmers themselves. Even if the economic benefits of organic production have been known for many years, what have might be driven the decision of a large portion of farmers toward adoption might have been the emergence of a crisis, making integrated production almost impossible to be sustained economically. In this sense, a market crisis for integrated production might be considered as the factor that allowed the "crossing of the chasm" (Moore, 1999) spreading the adoption outside the niche of innovators and early-adopters toward the categories of early-majority and eventually later-majority and laggards.

In the last question of the interview, I asked farmers if they had sustained many investments in the last years. This question had the double aim of analysing in-depth the investment needed to start organic production and to evaluate the relation between early adoption and innovativeness also on other possible investments. On the first side of the question, farmers confirmed that the investment directly needed to start producing organically are relatively low, with the necessary investment in machineries being around 10.000€. Much higher investment is however done by some farmers to change the varieties produced and plant new trees. As previously introduced, the same varieties might generate different financial outputs in organic and integrated production. For example, the most cultivated apple variety in Trentino, Golden Delicious, does not produce satisfactory financial results in organic farming as it is too much likely to suffer from potential agronomic problems and due to the low demanded level in the organic market. The same can be said also for other common varieties like Red Delicious and Grannysmith. Farmers switching to organic might be willing therefore to change their produced varieties,

switching from these less financially rewarding toward new varieties. In the organic sector, at the moment the higher economic results are related to varieties resistant to fungi infection, which would otherwise severely harm organic production, like Royal Gala or club varieties like Pink Lady. Planting a new variety requires both a direct investment, for the purchase of the plants and the other materials needed, and an indirect investment because plants require some years, with a minimum of four, to reach the optimal production capacity. Not all farmers decided to sustain this cost when necessary. I found earlier adopters being more likely to try and use new varieties, not only to support the initial organic adoption but also in later years. Another investment sustained by many organic producers is the installation of anti-hail nets, which is not mandatory but avoids many potential problems and the insurance price to be paid yearly. The two innovators sustained further higher costs, compared to all other adopters, because they had to purchase the machineries needed for the processing and the stocking of their products due to their decision to sell through direct sales channel. This question helped me understand that the investment needed to adopt organic farming is relatively low but can become much higher if considering also the indirect costs of the conversion years and the complementary, but not necessary, investments. The propension toward investment and innovativeness in machineries is partially confirmed, even if further studies should be done analysing more specifically the rate of re-invested revenues between the various adopter categories and non-adopter.

In this chapter I described in-depth the research I carried on with my interview and the results obtained for each specific question. For each of the questions considered I already explained the reference research question, the expected results, the results obtained and the degree of compatibility between these. In the next chapter I will discuss more generally the confirmation or rejection of the research questions based on the answers received.

CHAPTER 6) Results discussion

After the description of Trentino's agricultural system, the specific features of organic farming and the results obtained from the interview, I can answer the four research questions considered. The purpose of this thesis was to consider the whole diffusion process and all the features of the innovation and of the system involved. The results obtained are useful not only to answer the questions under analysis but also to have a complete comprehension of the diffusion mechanism. This broad comprehension helped me understand some variables which were not considered in existing studies on organic diffusion.

6.1) Boundaries of the reference system

The first research question aims at understanding the boundaries of the diffusion reference systems. Observing the data of the organic diffusion, which up to 2018 covers 11.3% of the total fields size of the province, a clear unevenly distribution emerges, with some specific areas, as the South Trento zone, having a much higher diffusion, covering 50% of the cultivated area of S.F.T., the reference cooperative of the area. With this first research question, I wanted to understand if the different areas of the region presenting different diffusion levels are to be considered as separated subsystems, each having a separate diffusion or as jointly forming the diffusion rate of the province system. To demonstrate the presence of different sub-systems the analysis was focused on two main areas: on the one side was considered the existence of characteristics explaining the differences in diffusion rates, with a focus on the knowledge system in place; on one other side were analysed the personal characteristics of the farmers, to see if the assumed characteristics for the different adopter categories are respected and comparing simultaneous adopters in the different proposed sub-systems. The knowledge system is among the main drivers to be considered and I decided to focus on it in a separated question. For the purpose of this first question must be underlined that the traditional centralised up-down approach to agricultural innovation diffusion was not present for organic diffusion, relying rather on a decentralised diffusion system. As underlined by the farmers, the decentralisation was based on all province in the first years, dividing into sub-systems closer geographically as the innovation diffused. Another difference between the

diffusion between systems is in the approach of the reference cooperative. The "semi-contingent" nature of the adoption decision was described, demonstrating the centrality of the cooperatives' role in the decision and the adoption rate. In this sense is not a surprise to find the highest diffusion among the only cooperative which kept at first a neutral approach, and later a positive one, toward organic farming. The role of the cooperative is however only one of the drivers of the different diffusion rates. The semi-contingent nature of the adoption decision slows the diffusion rate because farmers willing to adopt before the decision of the cooperative must wait until the previous innovation-decision of the cooperative. Considering only the role of the cooperative, would be expected to find that the rate of organic farmers of Melinda after 2015 would soon reach the same rate of S.F.T. Even though a high number of farmers members of Melinda converted in 2015, their number is still not comparable to the development of the South Trento area. Based upon interviews' results were found also other factors demonstrating the different diffusion rates and their drivers. Comparing the two exemplary areas of Val di Non and South Trento, differences in fields' characteristics can be observed explaining the different diffusion rates. Val di Non has fields on average smaller, which reduces the relative advantage due to the drift problem, and in some cases also in steep areas, which could result in problems for some organic interventions. Other differences can be found in the culture of the two areas, closer to agricultural values in Val di Non, reducing the compatibility with organic and increasing the social pressure received by the farmers. The different pressure perceived by the most recent adopters also demonstrates the different development of the values in the surrounding systems, supporting the presence of different diffusion systems. The other side considered to support the presence of different sub-systems is the analysis of adopters' characteristics. I expected to find the recent adopters of Val di Non, assumed to be among the early adopters of the considered sub-systems due to the limited diffusion in the area, as having characteristics more similar to early adopters in the South Trento area, whom adopted almost twenty years before, rather than to their contemporary adopters in the South Trento area. This assumption was respected for all the most important variables considered, which are the decision's leading motivations, the information channels used, the initial opinion of organic farming, age and the education level. The sustainability concern, even if based on my interpretation of the answers received, confirms the compatibility between the early adopters of the two systems considered. The latest adopters of the South Trento area, on the other hand, present clear

differences for these characteristics and show higher compatibility with the characteristics assumed by the theory for later adopters, and specifically the early-majority category. Their belonging to this category proves the presence of separated sub-systems, because considering the whole Trentino's system the 16% of diffusion considered as initial threshold of early-majority category is far to be reached. To measure the diffusion level, I assumed the size of the field as representative of the market share. Considering S.F.T., organic was diffused in 2014 on 14% of the members' fields, therefore I decided to consider the interviewed farmers in the area adopting after 2015 as belonging to the categories of Early majority. After 2014, which saw the crossing of the chasm between early adopters and early majority categories in the area, the number of organic producers saw a steep increase. This is demonstrated by the 2017 data, where the number of organic producers under conversion, 17% of the total fields, is higher than the value of organic producers, with 14% of the total fields. Even if the characteristics of adopters and of the system demonstrated the different stages of diffusion between the two systems, it would be wrong to imagine that Val di Non and other areas will follow the same diffusion trend delayed in time. The differences between the systems are likely to result in different diffusions also in the future, because the external conditions of the market and scientific advancement will be different as well as the available knowledge. A difference that will inevitably affect the future diffusion in the systems is the availability of the organic technical assistance which, as confirmed by my interviews, is used also by the early adopters of the less developed sub-systems. Another difference can be found in the development of practices and knowledge involved, which has been created by farmers themselves in the South Trento area. Some of this knowledge is tacit and easier to be transmitted to neighbouring later adopters, rather than toward innovators in further systems. Regarding the main practices these are now well known and can be diffused through channels based upon codified knowledge. Early adopters in the Val di Non system will not need to develop all these practices but only to implement those. It will be interesting to observe in the years to come the development of the new practices needed to overcome the structural issues of fields of the Val di Non area, which are currently being tested by farmers together with FEM's technicians. I decided to focus my interviews and this discussion on the areas of South Trento and Val di Non because the first is the area with the highest organic diffusion and the latter is the largest Trentino's apples producer. A similar comparison could be done between South Trento and other areas, even if the

agricultural products considered should be expanded to grapes to capture better the productive system of the other "Comunità di Valle". Drawing a roadmap of diffusion's history regarding organic apple producers in Trentino, it started spreading geographically from Northern Europe and South-Tyrol in the early eighties. In this phase of innovators, organic farming spread slowly, through farmers following accurately organic principles, as can be observed in the different crops produced, the leading motivations and the direct marketing channel. In the late nineties a high number of producers started converting to organic production in the areas around Trento, with a particular concentration in the South Trento area. These farmers were different from the innovators because they followed less strictly organic principles, cultivating only one or two crops, selling through the cooperative channel and stating as leading motivations a combination of financial and non-financial reasons. They were also judged less negatively by other farmers, confirming their role of opinion leadership, even though they still perceived social pressure. The symbolic threshold of 2,5% diffusion level, considering the size of areas of cultivated organically, was passed in 2001 considering the whole Trentino, and few years before considering only the areas around Trento. It is during this period that differences between the sub-systems started emerging, even because the central agricultural institution of Trentino, FEM, played a marginal role in the support of organic producers which relied almost exclusively upon communication with other organic farmers. The diffusion of organic slowed and even reduced in the successive years, starting to grow again at an enhanced rate after 2010, mainly due to conversions in the areas around Trento, as a possible solution against the emerging market crisis for integrated apples. In the other apples producing areas, mainly Val di Non but also Alto Garda e Ledro, Valsugana and Rotaliana diffusion did not develop outside of the innovators phase toward the early-adopters category in these years. This barrier between the phases must be searched in the almost complete absence of an organic market channel in the reference cooperatives, Melinda, LaTrentina and Valentina, in the different agronomic and social characteristics between the rural subsystems in the valleys and the more urban subsystem in the plain of Val d'Adige. The year 2015 was crucial in the diffusion of organic, as the main stakeholders of apple production in Trentino, FEM, APOT and the main cooperatives changed their approach toward organic farming, starting to support it with services and even policies. This year saw the crossing of the chasm (Moore, 1999) between early-adopters and early-majority in the South Trento area and in the other sub-systems the

diffusion reached the threshold of innovators and entered the early-adopters category. In the South-Trento area organic diffused after this date at the highest speed, reaching in 2019 52% of the cultivated area of S.F.T. cooperative, including fields under conversion, effectively entering the stage of late-majority. In the other three systems considered and the associated cooperatives, Val di Non with Melinda, Alto Garda e Ledro, Valle dei Laghi and Valsugana with LaTrentina and Rotaliana with Valentina, organic farming spread much faster than previous periods but at different paces between the areas. I could not access the data for each cooperative so I will compare apple production of organic and overall surfaces of the reference areas. Before 2015 Val di Non had the lowest diffusion, with only 1,5% of organic surfaces and in 2018 this value is approximately 7%. Regarding the three reference areas for LaTrentina, organic surfaces increased from 5,2% to 11,3% of total apple fields' size. Regarding the smaller cooperative Valentina, Rotaliana moved from a share of organic surfaces of 8,3% to 20,1%, although this data must be considered carefully, as some of the organic farmers might be members of S.F.T. cooperative which is active in the neighbouring area of Val d'Adige. Considering the whole Trentino, 11,3% of total apple's field size is currently cultivated organically, either certified and during the conversion period. Would be a mistake considering these three cooperatives as a unique diffusion system with a central role played by FEM, which tried to impose as centre of organic diffusion since 2015. In the knowledge systems of organic, the most important role is played by information coming from neighbouring farmers, as assumed by decentralised diffusion systems theory (Rogers, 1962) and confirmed by the interviews. The different policies of the cooperatives, the social and cultural contexts of the areas, and the geographical characteristics' result in differences between these three systems which will result in different diffusion rates also for the coming years. The organic diffusion system can be therefore divided into four main subsystems, associated with the four main cooperatives and different areas, considered as "Comunità di Valle" for a rough separation, as confirmed by data provided and interviews. One of these, the South Trento area, has a much higher rate of diffusion of organic agriculture. The remaining three have lower levels of diffusion, presenting however different levels and rates of diffusion, and cannot be considered as a united diffusion system due to the existing differences in the main barriers and facilitator to the diffusion, as in policies, agricultural culture, social context and morphology. The separation of the diffusion systems is highlighted also in the knowledge flow between farmers. Farmers communicate with individuals in different

systems, especially with more experienced farmers, but this is in most cases a weak-communication channel, carrying important but limited information about organic principles and practices. The largest part of knowledge is then developed by communication with neighbouring organic farmers as will be highlighted in the discussion of the last research question, which deepens the analysis of the existing organic diffusion system.

6.2) Adopter categories characteristics

In this second research question, will be summed up the main differences between earlier and later adopters highlighted in the interview's results. This research question has two main aims: to evaluate the compatibility of the categories' characteristics assumed by the theory and observed on one side, and to identify the most important variables for identifying potential earlier adopters on the other. Starting with farmers' personal characteristics, the first to be considered is the level of education. This variable is associated with innovability by most theoretical studies and is associated with earlier adoption in the sample considered, especially when considering the studies in the agricultural field in association with the level of education. Age is another variable associated with earlier adoption in the sample considered, with a negative correlation. This finding does not respect general innovation theories (Rogers, 1983) but is in line with organic diffusion studies (Läpple and Rensburg, 2011). Acreage cultivated can be considered for the purpose of the study as a rough measure of revenues generated and therefore correlated with higher social status. Comparing the average field's size of interviewed organic farmers, this is much higher than the average Trentino's apple field, confirming the importance of this variable and the compatibility with theories assumption. No differences were highlighted in the sample considered between earlier and later adopters. A variable that is not found in the theory, and should be therefore studied more, is the agricultural descendance with the only two first-generation farmers being among earlier adopters. Considering the communication channels, both innovation diffusion studies (Rogers, 1962) and organic diffusion studies (Läpple and Rensburg, 2011) sustain the preference for earlier adopters of more heterophilous communication channels, especially in the phases of knowledge and persuasion. This assumption is confirmed by my analysis, where earlier adopters had to communicate at first with different

stakeholders, placed in distant geographical areas. Even if differences emerge between earlier and later adopters, all the farmers interviewed place the highest importance upon communication with other organic farmers, which have the highest safety credibility, rather than communication with technicians and researchers who have higher competence credibility. The communications channels considered by adopter categories change across the different adoption stages. During the implementation and confirmation stages, later adopters place higher consideration than earlier adopters on the technical consultancy service, which is a heterophilous communication channel, while earlier adopters consider almost only communication with other farmers, the most homophilous communication channel. This evidence is opposed to the assumptions of the previous studies, both specific for organic and generic for innovation, which are respected only in the first phases of the decision-adoption process. Moving the analysis upon the leading motivations of the adoption decision, existing theories, from Rogers to organic studies (Läpple and Rensburg, 201; Läpple, Renwick and Thorne, 2015; Padel, 2001) found higher importance placed upon non-financial driving motivations for earlier adopters. The correlation of non-financial motivations and earlier adoption is respected in my sample, with innovators declaring only non-financial motivations, early-adopters a combination of financial and non-financial drivers and early-majority emphasizing the financial motivations of the decision. The importance placed on non-financial drivers is confirmed by the sustainability commitment of farmers. In the specific question of the interview, all the farmers declared commitment toward sustainability but merging the answers received in other questions and the digressions from the interviews, a clear higher commitment is found among earlier adopters. Five farmers, among innovators and early adopters, declared they would have never adopted only for financial reasons. One farmer explained well this concept:

"If it was only for the money, I would have never adopted organic farming, I adopted trying to do my part in making this world a better place".

The changes in motivation and sustainability commitment are in line with the conventionalization hypothesis, that I will analyse separately in the subsequent paragraph.

6.3) The conventionalization hypothesis

The term "conventionalization" has first been used to describe the emerging trends characterising organic farming in 1997 (Buck, Getz and Guthman, 1997). The term was used to describe the increasing industrialization in organic agriculture. At the time of that first paper, these were described as individual cases but, as later studies highlight (Best, 2007; Hall and Mogyorody, 2001), these cases expanded almost becoming the norm. These studies found that, as organic farming spreads and the number of organic producers increases, their production is likely to detach from organic principles. Recalling the organic principles introduced in the first chapter, these introduced covered the concepts of whole ecosystem approach, avoid excessive industrialization of the production, commercialise fresh products through direct marketing and equal conditions for all those involved in the production. As organic diffuses, farmers are likely to be less driven by the non-financial aspects of organic production and more attracted by the financial gains of organic farming, placing consequently lower importance on the correct consideration of the whole organic principles. The risk is that these former conventional farmers consider organic farmers as "a slightly modified version of conventional agriculture" (Best, 2007), not considering the different underlining approach of organic agriculture. The risks are related to two main areas of organic farming, the commercialisation, with an increasing reliance on traditional market channels instead of direct marketing, and the increasing farms' mechanization. This last trend is highlighted by an increase in average organic size, reliance on mechanical and chemical inputs as much as allowed by the certification and the reduction in crop biodiversity (Darnhofer et al., 2010). In the Trentino's case considered the risk is that latest adopters produce through a slightly modified version of the previous farming system, in this case integrated agriculture, as declared by many earlier adopters:

> *"They try to adopt organic farming only as a change of inputs without adopting the proper mindset, but it will be a disaster for their production".*

Combining the existing studies over the conventionalization hypothesis with Trentino's apple agriculture, I expected to find differences in the production process among adopter categories mainly in the products' commercialization, crop diversity and decision-making process. As noticed by the first study on this topic (Buck, Getz and Guthman, 1997), the possibilities of excessive mechanization of organic farming are limited by the regulation and, in the case of Trentino's apples, by the average high-quality

standard of the production. The increasing importance of financial drivers of the decision often cited as related to the conventionalization hypothesis is a useful signal of the conventionalization in the farmers' perception rather than in the actual organic adoption. Another possible signal of the conventionalization in farmers' perception is their former attitude toward organic (Best, 2007). Farmers initial negative attitude toward organic is in most cases due to the underlining principles of this production, perceived as distant by some farmers, which are expected to be among the later adopters. The exposure to the conventionalization hypothesis is confirmed by all the aspects considered in the sample under analysis. The adherence to organic principles, in terms of enhanced biodiversity and direct marketing, was found only for innovators and one early adopter, with all other farmers producing only one or two crops and selling through the cooperatives, which can be considered as a traditional market channel, as it exports and sells its products mainly through retail. Regarding the last considered effect of the conventionalization, upon the decision-making process, I expected to find a higher reliance on organic technical consultancy, as for integrated production, by later adopters. This aspect has been confirmed by my sample, as almost all adopters after 2015 use this service as a support in their decision-making, while only one of the previous adopters declared to consider this service. This might anyway be due to the absence of this service at the time of their adoption. An important aspect considered by studies as the main proof of the conventionalization is the increasing fields' size of adopters. I did not find in the sample any correlation between adopter categories and fields' size, rejecting consequently this aspect. I will now switch the focus from the practical results of the conventionalization of the production to the personal attitudes that might be seen as signals of exposure to conventionalization's risk. Starting from the motivations, I found an increasing emphasis of financial reasons for the adoption across the diffusion, as highlighted in the last paragraph. Regarding the initial opinion of organic production, four current organic farmers, all belonging to the early-majority category, declared an initial negative attitude toward this type of agriculture. The conventionalization hypothesis is in line with Rogers' assumptions (Rogers, 1962) over the diffusion of innovation. He stated that earlier adopters are more likely to focus intensively on the information principles of the innovation, while later adopters instead would tend to consider mainly the needed know-how information of the innovation.

The process of conventionalization can be divided, for the case considered, in three phases, roughly corresponding with the first three adopter categories. During the first phase of innovators, they followed all the principles of organic farming, from agricultural aspects to marketing and biodiversity ones. Farmers belonging to the early adopter category saw more professionally organic farming (Padel, 2001), placing less emphasis on the field's biodiversity and the unconventional marketing channels, selling instead through the existing cooperatives' channel. These farmers had nevertheless a high level of knowledge of the agronomic principles of organic farming. The early adopter phase can be considered as the second stage of conventionalization of Trentino's organic farming, with farmers adoption being driven by a combination of financial and non-financial drivers and emphasizing only the agronomic principles of the innovation. The starting point of third phase of the conventionalization can be considered the "crossing of the chasm" (Moore, 1999) between early adopters and early majority categories. During this period adopters share with early adopter category the low consideration of marketing and biodiversity principles but started placing less importance also upon the agronomic principles of the innovation and emphasizing the financial drivers of the adoption decision. In particular, during the search for information, farmers tend to focus more on the technical know-how of the innovation rather than on the underlining principles of ecosystem management.

The gap of agronomic principles is partially fulfilled by the reliance on the technical consultancy, as the knowledge of agronomic principles are needed mainly during the decision-making process. It will be interesting to observe the evolution of organic conventionalization in future years and later categories, as the effects described for the third category are currently emerging but not completely developed yet. This division in three phases is based upon a simplification to highlight the evolution over time of organic farming and its movement toward the conventionalization. Further studies are needed, both in Trentino and other agricultural systems, to support the division in steps of the organic evolution toward conventionalization.

The presence of a process of conventionalization emerges clearly in the sample considered, as previously demonstrated, and exposes Trentino's organic to two main categories of problems (Best, 2007), as suggested by both theory and earlier adopters. The exposure to these risks is increased by the market's pressure, which requires an increasing organic products' quality, that could end up in unsatisfying financial results, especially in the case of later adopters placing less importance on the principles of the innovation. The

most crucial of the two risks considered regards the possibility of later adopters not following the certification's limits, either using non-allowed chemical inputs or using excessive amounts of allowed inputs. The risk is that these incompatibilities are discovered, resulting in scandals potentially harming the certification's credibility and as a consequence the overall organic movement. The other risk for organic diffusion is associated with the increasing importance placed upon financial drivers of the decision by later adopters. As described by farmers and S.F.T. president, organic price premium has been reducing in the last years, even if it is still high and resulting in enhanced profitability. The risk is that, if organic profitability decreases, all the later adopters interested only in the financial drivers would switch back to integrated agriculture, reducing the diffusion of organic agriculture and enhancing the inputs' drifts issues which previously decreased as organic diffused. Knowing the risks of the conventionalization hypothesis is important to understand its potential impact and start acting to increase farmers' awareness of organic principles, and sustainability impacts of different productions, to have a future deeper organic comprehension, that will result in higher products' quality, and more importance placed over non-financial drivers.

6.4) Evolution of the diffusion system

The diffusion systems characterising organic farming and the other agricultural innovations proved to be different in most cases analysed (Padel, 2001; Pamuk, Bulte and Adekunle, 2014; Morgan and Murdoch, 2000) and even in the Trentino's apple production case considered. To briefly sum up the two systems previously described for Trentino's scenario, the organic diffusion system is mainly decentralised, with innovation communication taking place mainly between similar farmers, in a geographical range reducing as organic diffuses. The first FEM's researcher had an important role in this system, not as the centre standardising the knowledge, rather creating a network between farmers and generating together with farmers the underlining tacit knowledge. On the contrary, the traditional innovation diffusion system utilised in agricultural systems is in most cases centralised (Bordenave, 1976; Rogers, 1983). In the Trentino's traditional agricultural system there are two main central actors, FEM and the reference cooperative, transferring the codified knowledge coming respectively from scientific advancement and the market. As confirmed by the interviews, the communication between farmers upon

innovation and complicated decisions is almost absent in this system. Studies found that the traditional centralised diffusion system did not demonstrate effective to spread soil fertility managerial practices (Pamuk, Bulte and Adekunle, 2014) and organic farming in general (Morgan and Murdoch, 2000). This suggests that organic diffusion issues might arise as FEM and cooperatives started placing increased commitment toward organic farming, trying to impose as the centre of the organic system. The new attitude of cooperatives and FEM proved successful in increasing organic diffusion rate but risks of passing just partial information to the farmers, mainly the necessary know-how knowledge as confirmed by interviewed farmers, unsuccessfully spreading the underlining organic and agricultural principles.

The principles of organic farming are useful not only during the persuasion and decision phases of the adoption process but also during the implementation, confirmation and further use of this process innovation. The knowledge of the underlining principles needed for organic adoption (Morgan and Murdoch, 2000) is developed locally by farmers and shared through direct communication with neighbouring ones. The knowledge and complete understanding of the ecosystem is almost impossible to standardize, as stated by FEM's technician, because it is highly dependent on the specific fields' characteristics and is developed through experience and communication with local farmers. Therefore, the evolution in the diffusion system that is taking place in Trentino organic apple production, from a decentralised toward a centralised diffusion system, risks increasing the loss of principles' knowledge which characterises later adopters (Rogers, 1962). The loss of the principles will eventually result in insufficient evaluation potential during the decision-making, with farmers relying increasingly on the external codified source of knowledge, the technical assistance, which is not however capable of capturing the whole ecosystem approach needed for a correct organic production.

The evolution from a decentralised toward a centralised system is however still in a developing phase, with recent adopters stating reliance on both tacit information coming from previous adopters and codified organic knowledge coming from the central players of Trentino's agricultural system, FEM and cooperatives. Some of the recent adopters, who rely on tacit and codified knowledge, are however among the early adopters in their reference sub-systems. The loss of part of the tacit knowledge of the principles among early adopters might result in a loss of knowledge of the whole system in the coming years, reducing the tacit knowledge communicated to later adopters. The effects of the

centralisation of the knowledge system will be seen in the next years, and uncertainty persists among the possibility of centralisation to impose as the only diffusion system for organic or to maintain the present hybrid situation with the two diffusion systems co-existing. Another issue of the centralised system will be in the development of new solutions and practices for organic production. These were developed by farmers and later shared between them in the past years, in line with a decentralised diffusion system. FEM, according to farmers and even organic technicians, proved unable to develop internally the solutions for organic issues in the past. It is still not known if it will show able to solve these after the new organic approach started in 2015, even if early adopters expressed doubts about the foundation's present capacity. A centralised innovation system should develop internally the incremental features of the innovation and spread those to users (Rogers, 1962). New solutions and practices still are to be developed for Trentino's organic apple farming to tackle new problems arising, as the "asian bug" and cultivation in steep areas, and to develop better solutions for existing problems. In the coming years will be seen which diffusion system, centralised or decentralised, will prove successful in solving these problems. It must be however admitted that the increased commitment toward organic of FEM and especially cooperatives' commercial departments strongly increased the diffusion of organic farming in all the sub-systems considered, as the first simplifies adoption and the latter results in higher profitability. It can be therefore suggested that the two systems are co-existing, creating a hybrid diffusion system capable of increasing the diffusion rate without resulting in an excessive loss of knowledge and efficacy in practices development. Due to the lack of research on hybrid diffusion systems in organic agriculture, will be interesting to consider with a specific study the situation in Trentino in the years to come, to check if the hybrid system proved successful or if the centralised system took over the decentralised part of the diffusion system

CHAPTER 7) Conclusions

Trying to describe the adopters, their decision and the whole diffusion system of an innovation is a wide issue, which includes a high number of variables and stakeholders involved. This thesis aimed at drafting a model for the complete analysis of organic diffusion, which was later checked on the specific organic apple production system considered. The core of this case study is a qualitative study of the characteristics and the role of farmers, based upon a series of structured face to face interviews. Some of the results obtained are very specific for the system considered, for example the connected agronomic problems of the area, while the majority of the findings, after providing statistical strength with a quantitative study, can be used in the analysis of the organic diffusion in other systems.

Matching the Diffusion of Innovations theory with the characteristics and practices of organic farming allowed to understand the main drivers of the organic diffusion rate. Among the drivers analysed, some interesting topics are the negative observability of organic relative advantage, in both financial and non-financial terms, and the intersection of organic principles and rural environment that generates issues due to the low compatibility with values and the existing centralised agricultural system. Specific to the system considered is the commercial role of cooperatives, resulting as a possible barrier to organic diffusion, which adoption-decision has been defined as “semi-contingent”.

The high uneven rate of organic diffusion in different areas of Trentino suggests the presence of separated diffusion systems to be considered inside the province. This assumption has been confirmed by the interviews with farmers, which highlight high similarities between adopters in the same category across different areas. The personal characteristics of farmers, as age and education, together with their decision drivers accentuated the separation between adopter categories. These differences between earlier and later adopters are in line with the theoretical assumptions, obtained matching the Diffusion of Innovations theory with existing agricultural and organic diffusion studies. The previous analysis of diffusion drivers allowed to understand the main characteristics of different sub-systems, resulting in distinct diffusion rates. These differences between areas are mainly due to fields’ characteristics, social system’s pressure and cooperatives’ approach.

Focusing specifically on the nature of the diffusion system, the organic apple production case considered highlighted a peculiar evolution. The existing agricultural diffusion system is based upon a centralised model diffusing the innovations coming from the market through cooperatives, and innovations from scientific advancement through FEM. Organic instead diffused based on a decentralised system between farmers, spreading from Northern European's farmers through the mediator role of South Tyrolean adopters. In recent years the two systems co-existed for organic diffusion, which can now be defined as a hybrid diffusion system.

Lastly, the risk of "conventionalization" of organic adoption was considered. This term describes the trend of later adopters to adopt organic as an only partially modified integrated agriculture, without considering the whole organic principles. The system considered proved to be exposed both in the effects, partial adoption of organic practices, and in the drivers, financial driven adoption-decision, to the conventionalization hypothesis.

This thesis, by drawing a roadmap and a detailed description of diffusion in Trentino's organic apple production, will be useful to policy makers and other major stakeholders involved in the diffusion of organic farming in the province. Regarding the theoretical side of this thesis, it confirmed many assumptions deriving from the existing theories and suggested a number of variables of interest for personal characteristics and system features of interest. This study developed a theoretical model for the complete analysis of the diffusion of organic which can be applied, with the needed adjustments, by other agricultural systems and other organic productions. The model could find a series of application for stakeholders interested in the development of organic farming, as the identification of potential earlier adopters, the understanding of social and agronomic issues slowing its diffusion and the development of efficient communication channels. Nevertheless, due to the limited sample of farmers considered, further analysis is needed to confirm the different aspects of the organic diffusion system. The best approach to confirm all the variables involved will be to develop a series of quantitative researches in different organic agricultural systems, capable of providing the statistical strength needed for the confirmation and the future utilisation of the organic diffusion model.

REFERENCES

- Bailey, F., Rogers, E. and Shoemaker, F. (1974). Communication of Innovations: A Cross-Cultural Approach. *Man*, 9(2), p.331.
- Baylis, K., Peplow, S., Rausser, G. and Simon, L. (2008). Agri-environmental policies in the EU and United States: A comparison. *Ecological Economics*, 65(4), pp.753-764.
- Bellini, G., Lipizzi, F., Consentino, F. and Giordano, P. (2013). *6° Censimento Generale dell'Agricoltura*. Atlante dell'agricoltura italiana. ISTAT – Accessible at: https://www.istat.it/it/files//2014/03/Atlante-dellagricoltura-italiana.-6%C2%B0-Censimento-generale-dellagricoltura.pdf [Accessed on 30 September 2019].
- Best, H. (2007). Organic agriculture and the conventionalization hypothesis: A case study from West Germany. *Agriculture and Human Values*, 25(1), pp.95-106.
- Bordenave, J. (1976). Communication of Agricultural Innovations in Latin America. *Communication Research*, 3(2), pp.135-154.
- Brandt, K. and Mølgaard, J. (2001). Organic agriculture: does it enhance or reduce the nutritional value of plant foods?. *Journal of the Science of Food and Agriculture*, 81(9), pp.924-931.
- Bravo-Monroy, L., Potts, S. and Tzanopoulos, J. (2016). Drivers influencing farmer decisions for adopting organic or conventional coffee management practices. *Food Policy*, 58, pp.49-61.
- Buck, D., Getz, C. and Guthman, J. (1997). From Farm to Table: The Organic Vegetable Commodity Chain of Northern California. *Sociologia Ruralis*, 37(1), pp.3-20.
- Carpenter-Boggs, L., Kennedy, A. and Reganold, J. (2000). Organic and Biodynamic Management. *Soil Science Society of America Journal*, 64(5), p.1651.
- Carson, Rachel (1962). *Silent Spring*. Houghton Mifflin Company.
- Crowder, D. and Reganold, J. (2015). Financial competitiveness of organic agriculture on a global scale. *Proceedings of the National Academy of Sciences*, 112(24), pp.7611-7616.
- Dangour, A., Dodhia, S., Hayter, A., Allen, E., Lock, K. and Uauy, R. (2009). Nutritional quality of organic foods: a systematic review. *The American Journal of Clinical Nutrition*, 90(3), pp.680-685.

- Darnhofer, I., Lindenthal, T., Bartel-Kratochvil, R. and Zollitsch, W. (2010). Conventionalisation of organic farming practices: from structural criteria towards an assessment based on organic principles. A review. *Agronomy for Sustainable Development*, 30(1), pp.67-81.
- de Ponti, T., Rijk, B. and van Ittersum, M. (2012). The crop yield gap between organic and conventional agriculture. *Agricultural Systems*, 108, pp.1-9.
- Dimitri C., Greene C., (2002). Recent Growth Patterns in the U.S. Organic Foods Market / AIB-777 Economic Research Service/USDA
- Eveland, J. (1979). Issues in using the concept of "adoption of innovations". *The Journal of Technology Transfer*, 4(1), pp.1-13.
- FAO (2000). HEAL: Health in Ecological Agricultural Learning – Accessible at: http://www.fao.org/nars/partners/2nrm/ proposal/9–2–6.doc [Accessed on 30 September 2019].
- FAO (2013). Land degradation assessment in drylands – Accessible at: http://www.fao.org/3/i3240e/i3240e.pdf [Accessed on 30 September 2019].
- FAO (2014). The State of Food Insecurity in the World 2014 – Accessible at: http://www.fao.org/3/a-i4030e.pdf [Accessed on 30 September 2019].
- FAOSTAT (2019). Worldwide apples production, 2017 – Accessible at: http://www.fao.org/faostat/en/#data/QC/ [Accessed on 30 September 2019].
- Feder, G. and Umali, D. (1993). The adoption of agricultural innovations. *Technological Forecasting and Social Change*, 43(3-4), pp.215-239.
- Fliegel, F. and Kivlin, J. (1962). Farm Practice Attributes and Adoption Rates. *Social Forces*, 40(4), pp.364-370.
- Fontanari, E. (2017), The Modern Agricultural Cooperative: A Cognitive-Knowledge-Based Approach, Euricse Working Papers, 91|17.
- Girardi, A. (2009). Audizione in quarta commissione del comitato per la difesa della salute. Agricoltura intensiva in Val di Non e controlli ambientali. *Consiglio della Provincia Autonoma di Trento.* – Accessible at: https://www.consiglio.provincia.tn.it/news/giornale-online/Pages/articolo.aspx?uid=172654 [Accessed on 30 September 2019].

- Godin, B. (2014). Invention, diffusion and linear models of innovation: the contribution of anthropology to a conceptual framework. *Journal of Innovation Economics*, 15(3), p.11.
- Gomiero, T., Pimentel, D. and Paoletti, M. (2011). Environmental Impact of Different Agricultural Management Practices: Conventional vs. Organic Agriculture. *Critical Reviews in Plant Sciences*, 30(1-2), pp.95-124.
- Granovetter, M. (1973). The Strength of Weak Ties. *American Journal of Sociology*, 78(6), pp.1360-1380.
- Greene, C. (2019). *Organic Market Overview*. United States Department of Agriculture Economic Research Service.
- Griliches, Z. (1957). Hybrid Corn: An Exploration in the Economics of Technological Change. *Econometrica*, 25(4), p.501.
- Hackl, F. & Pruckner, G.J. Environmental and Resource Economics (1997) 10: 189. https://doi.org/10.1023/A:1026480123406
- Hall, A. and Mogyorody, V. (2001). Organic Farmers in Ontario: An Examination of the Conventionalization Argument. *Sociologia Ruralis*, 41(4), pp.399-322.
- Helga, W. and Lernoud, J. (2019). *The Organic Market in Europe 2017: Current Statistics*. [online] Research Institute of Organic Agriculture FiBL. Accessible at: http://www.organic-world.net [Accessed on 24 September 2019].
- Hoefkens, C., Verbeke, W., Aertsens, J., Mondelaers, K. and Van Camp, J. (2009). The nutritional and toxicological value of organic vegetables. *British Food Journal*, 111(10), pp.1062-1077.
- ISPAT (2013). 6° censimento generale dell'agricoltura 2010 – Accessible at: http://www.statweb.provincia.tn.it/PubblicazioniHTML/Settori%20economici/Agricoltura,%20silvicoltura%20e%20pesca/Censimento%20dell'agricoltura%202010/index.htm [Accessed on 30 September 2019].
- ISPAT (2014). Dati censuari e agricoltura professionale in Trentino 2000-2010 – Accessible at: http://www.statweb.provincia.tn.it/PubblicazioniHTML/Settori%20economici/Agricoltura,%20silvicoltura%20e%20pesca/Dati%20censuari%20e%20agricoltura%20professionale%20in%20trentino%202010/indice.htm [Accessed on 30 September 2019].

- ISPAT (2015). La produzione lorda vendibile dell'agricoltura e della silvicoltura in provincia di Trento 2013 – Accessible at: http://www.statweb.provincia.tn.it/PubblicazioniHTML/Settori%20economici/Agricoltura,%20silvicoltura%20e%20pesca/La%20produzione%20lorda%20vendibile%202013/index.html [Accessed on 30 September 2019].
- Janssen, M. and Hamm, U. (2012). Product labelling in the market for organic food: Consumer preferences and willingness-to-pay for different organic certification logos. *Food Quality and Preference*, 25(1), pp.9-22.
- Jansson, J., Marell, A. and Nordlund, A. (2011). Exploring consumer adoption of a high involvement eco-innovation using value-belief-norm theory. *Journal of Consumer Behaviour*, 10(1), pp.51-60.
- John, Stevens-Garmon,, Huang, Chung L. and Lin, Biing-Hwan, (2007), Organic Demand: A Profile of Consumers in the Fresh Produce Market, *Choices: The Magazine of Food, Farm, and Resource Issues*, 22, issue 2, number 94487.
- Lanjouw, J. and Mody, A. (1996). Innovation and the international diffusion of environmentally responsive technology. *Research Policy*, 25(4), pp.549-571.
- Läpple, D. and Rensburg, T. (2011). Adoption of organic farming: Are there differences between early and late adoption?. *Ecological Economics*, 70(7), pp.1406-1414.
- Läpple, D., Renwick, A. and Thorne, F. (2015). Measuring and understanding the drivers of agricultural innovation: Evidence from Ireland. *Food Policy*, 51, pp.1-8.
- Läpple, D., Renwick, A., Cullinan, J. and Thorne, F. (2016). What drives innovation in the agricultural sector? A spatial analysis of knowledge spillovers. *Land Use Policy*, 56, pp.238-250.
- Lichtenberg, E. and Zimmerman, R. (1999). Information and farmers' attitudes about pesticides, water quality, and related environmental effects. *Agriculture, Ecosystems & Environment*, 73(3), pp.227-236.
- Lybbert, T. and Sumner, D. (2012). Agricultural technologies for climate change in developing countries: Policy options for innovation and technology diffusion. *Food Policy*, 37(1), pp.114-123.
- Moore, G. (1999). *Crossing the chasm*.
- Moorman, T. (1989). A Review of Pesticide Effects on Microorganisms and Microbial Processes Related to Soil Fertility. *jpa*, 2(1), p.14.

- Morgan, K. and Murdoch, J. (2000). Organic vs. conventional agriculture: knowledge, power and innovation in the food chain. *Geoforum*, 31(2), pp.159-173.
- Morone, P., Sisto, R. and Taylor, R. (2006). Knowledge Diffusion and Networking in the Organic Production Sector: A Case Study. *EuroChoices*, 5(3), pp.40-46.
- Noppers, E., Keizer, K., Bockarjova, M. and Steg, L. (2015). The adoption of sustainable innovations: The role of instrumental, environmental, and symbolic attributes for earlier and later adopters. *Journal of Environmental Psychology*, 44, pp.74-84.
- Padel, S. (2001). Conversion to Organic Farming: A Typical Example of the Diffusion of an Innovation?. *Sociologia Ruralis*, 41(1), pp.40-61.
- Pampel, F., van Es, J.C., 1977. Environmental quality and issues of adoption research. Rural Sociology 42 (1),57–71.
- Pamuk, H., Bulte, E. and Adekunle, A. (2014). Do decentralized innovation systems promote agricultural technology adoption? Experimental evidence from Africa. *Food Policy*, 44, pp.227-236.
- Paul Diederen, Hans Van Meijl, Arjan Wolters, Katarzyna Bijak. Innovation adoption in agriculture: innovators, early adopters and laggards. Cahiers d'Economie et de Sociologie Rurales, INRA Editions, 2003, 67, pp.29-50.
- *Pesticidi siamo alla frutta*. (2018). [film] Directed by A. Tomasi and L. Fabbri.
- Pollan, M. (2006). *The omnivore's dilemma*.
- Rahmann, G., Reza Ardakani, M., Bàrberi, P., Boehm, H., Canali, S., Chander, M., David, W., Dengel, L., Erisman, J., Galvis-Martinez, A., Hamm, U., Kahl, J., Köpke, U., Kühne, S., Lee, S., Løes, A., Moos, J., Neuhof, D., Nuutila, J., Olowe, V., Oppermann, R., Rembiałkowska, E., Riddle, J., Rasmussen, I., Shade, J., Sohn, S., Tadesse, M., Tashi, S., Thatcher, A., Uddin, N., von Fragstein und Niemsdorff, P., Wibe, A., Wivstad, M., Wenliang, W. and Zanoli, R. (2016). Organic Agriculture 3.0 is innovation with research. *Organic Agriculture*, 7(3), pp.169-197.
- Reganold, J. and Wachter, J. (2016). Organic agriculture in the twenty-first century. *Nature Plants*, 2(2).
- Reganold, J., Glover, J., Andrews, P. and Hinman, H. (2006). Sustainability of three apple production systems. *Nature*, 443(7112), pp.717-717.

- Rizzi, R. (20 March 2016). Pesticidi in Val di Non. La ricerca lancia l'allarme. *L'Adige* – Accessible at: http://www.ladige.it/popular/salute/2016/03/20/pesticidi-studio-residenti-val-non-agiscono-dna-passano-mamma-feto [Accessed on 30 September 2019].
- Rogers, E. (2002). Diffusion of preventive innovations. *Addictive Behaviors*, 27(6), pp.989-993.
- Rogers, E. (1962). Diffusion of Innovations, 1st Edition. *The Free Press.*
- Rogers, E. (1982). Diffusion of Innovations, 3rd Edition. *The Free Press*.
- Rogers, E. (2010). Diffusion of Innovations, 4th Edition. *The Free Press*.
- Sanders, R. (2006). A Market Road to Sustainable Agriculture? Ecological Agriculture, Green Food and Organic Agriculture in China. *Development and Change*, 37(1), pp.201-226.
- Siegmeier, T.; Blumenstein, B.; Mühlrath, D. and Möller, D. (2014) Structure and development of scientific journl publications on organic agriculture: a scientometric review. In: Rahmann, G. and Aksoy, U. (Eds.) *Building Organic Bridges*, Johann Heinrich von Thünen-Institut, Braunschweig, Germany, 2, Thuenen Report, no. 20, pp. 327-330.
- Smith-Spangler, C., Brandeau, M., Hunter, G., Bavinger, J., Pearson, M., Eschbach, P., Sundaram, V., Liu, H., Schirmer, P., Stave, C., Olkin, I. and Bravata, D. (2012). Are Organic Foods Safer or Healthier Than Conventional Alternatives?. *Annals of Internal Medicine*, 157(5), p.348.
- Tilman, D. (1999). Global environmental impacts of agricultural expansion: The need for sustainable and efficient practices. *Proceedings of the National Academy of Sciences*, 96(11), pp.5995-6000.
- Tilman, D., Cassman, K., Matson, P., Naylor, R. and Polasky, S. (2002). Agricultural sustainability and intensive production practices. *Nature*, 418(6898), pp.671-677.
- TrentoToday (22 February 2018). Rotaliana e Val di Non le zone con la maggiore incidenza – Accessible at: http://www.trentotoday.it/cronaca/ail-trentino-leucemie-val-non-rotaliana.html [Accessed on 30 September 2019].
- Turinek, M., Grobelnik-Mlakar, S., Bavec, M. and Bavec, F. (2009). Biodynamic agriculture research progress and priorities. *Renewable Agriculture and Food Systems*, 24(2), pp.146-154.

- UN, General Assembly (2015). Transforming our world: The 2030 agenda for sustainable development. A/RES/70/1, 21 October. Available at: https://sustainabledevelopment.un.org/sdg12 [Accessed on 30 September 2019].
- *Veleni in paradiso*. (2015). [film] Directed by A. Tomasi and J. Valenti.
- VICKERY, B. (1948). Bradford's law of scattering. *Journal of Documentation*, 4(3), pp.198-203.
- White, W. (1968). The Adoption of Modern Dairy Practices. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 16(1), pp.29-39.
- Willer, H. and Lernoud, J. (2019). *The World of Organic Agriculture Statistics and Emerging Trends 2018*. FiBL & IFOAM – Organics International.
- Wilson, C. and Tisdell, C. (2001). Why farmers continue to use pesticides despite environmental, health and sustainability costs. *Ecological Economics*, 39(3), pp.449-462.
- Worthington, V. (2001). Nutritional Quality of Organic Versus Conventional Fruits, Vegetables, and Grains. *The Journal of Alternative and Complementary Medicine*, 7(2), pp.161-173.
- Zanoli, R. and Naspetti, S. (2002). Consumer motivations in the purchase of organic food. *British Food Journal*, 104(8), pp.643-653.

INTERVIEW PROTOCOL

Number	Question	Minutes
A	**INTRODUCTION**	**2**
	I explain interview objectives	1
	I explain how the interview will take place	1
B	**BACKGROUND**	**5**
1	General information (Age, education, part-time or full-time farmer, agricultural descendants, fields' size owned in hectares, place of work and live)	3
2	Which productions do you have? Apples only?	1
3	Do you sell through the cooperative? Do you produce semi-finished products?	1
C	**KNOWLEDGE**	**4**
4	When and from who did you receive the first organic information?	3
5	Were you already aware of potential issues of pesticides and integrated farming? Were you looking actively for an alternative?	1
D	**PERSUASION**	**5**
6	After the first information did you actively looked for more? From who and which type of information.	4
7	What was your cue-to-action	1
E	**DECISION**	**8**
8	When did you start organic farming?	
9	Did you initially try on a portion of the field?	1
10	What were the main drivers of your adoption decision?	3
11	Were you satisfied by the revenues generated by integrated agriculture?	1
12	Which problems did you perceive connected with adoption?	2
13	FEM and your cooperative tried to influence your decision?	1
F	**IMPLEMENTATION**	**6**
14	Which information and from whom did you look for the development of organic practices?	3
15	Which difficulties did you encounter during the implementation phase?	2
16	Did you change your decision-making process with organic agriculture?	1
G	**CONFIRMATION**	**8**
17	Are you overall satisfied with organic agriculture?	2
18	Have you ever considered switching-back to integrated agriculture?	1
19	Have you ever considered biodynamic farming?	1
20	Is sustainability important for you?	2
21	What was your initial opinion for organic farming? And for organic farmers and technicians? Has it changed?	1
22	Can you provide an average estimation of the revenues generated per hectare?	
	Did you sustain further investment after the adoption?	1