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Small Italian Farms' Willingness to Adopt a Food Traceability System: a case study based on the UTAUT Model

TESI DI LAUREA MAGISTRALE IN
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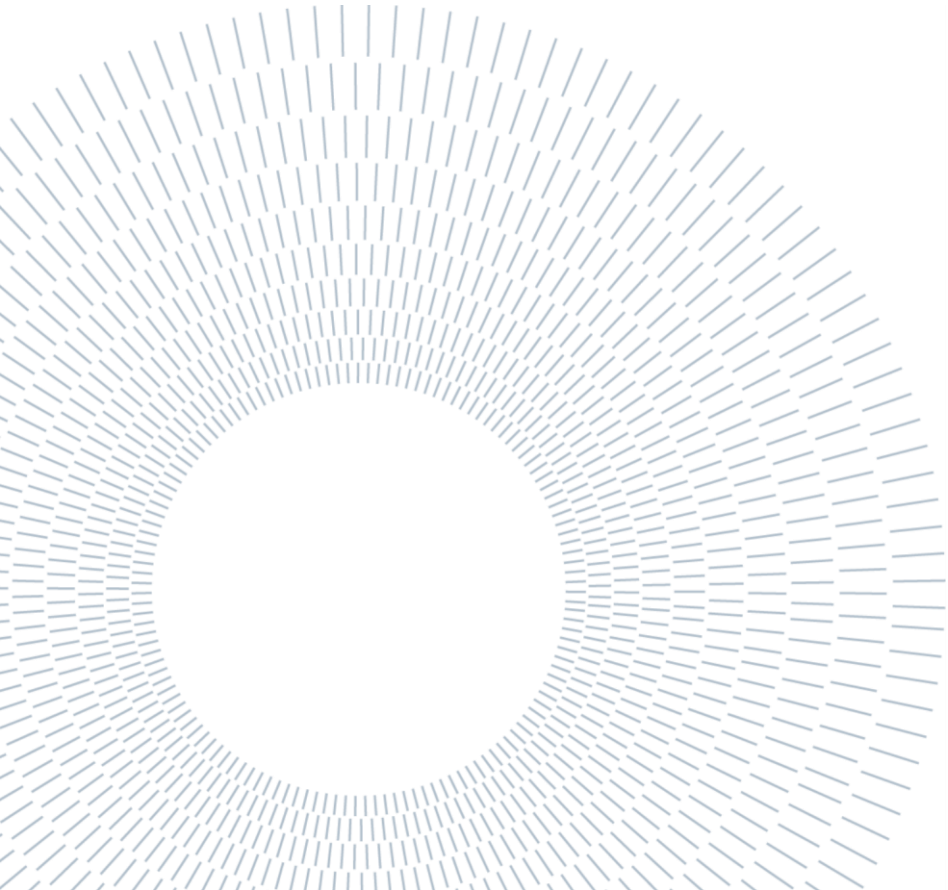


Abstract

The purpose of the following research is to identify the willingness of small bio-farms to implement traceability in their productions. First, a general description of the current European agriculture status is performed, with particular attention to sustainability. Traceability definition will be analyzed considering its benefits under various aspects such as economic, environmental or food safety, as well as the costs and potential barriers. By using the UTAUT Model (Unified Theory of Acceptance and Use of Technology), will be discussed the determining variables involved in the decisional process of implementing traceability for small farms, according to literature review. This case study is based on semi-structured interviews and cross-case analysis, to perform a comparation between theoretical UTAUT determinants and empirical ones collected with interviews to small farmers of Northern Italy. The results highlighted that effort expectancy and facilitating conditions, two UTAUT determinants, do not seem to play a substantial role into this decisional process. The willingness is overall determined by social influence and in particular Regulations, that force farmers to implement traceability if they want to expand their market-share and sell to retailers and supermarkets. Overall, traceability use was mainly dependent on the size and type of farm: small farms, selling non processed vegetables directly to customer are not interested in it, whereas farms selling processed vegetables or selling to large distributors are forced to use traceability and provide information on product's label.

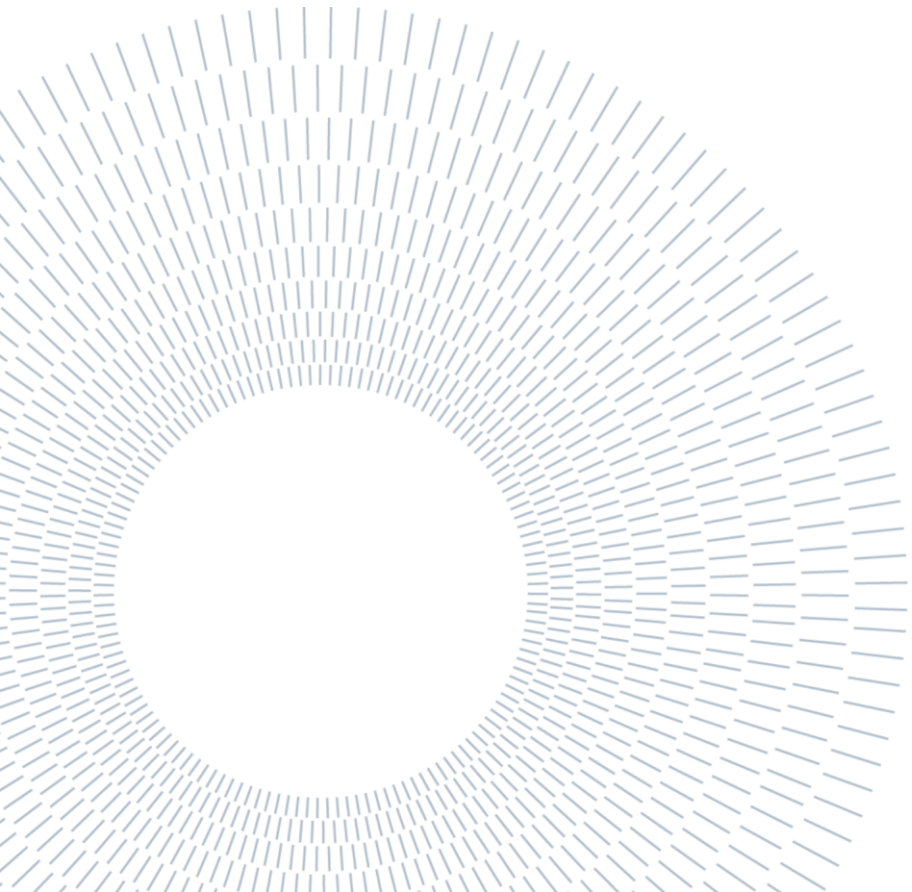
Key-words: traceability, sustainability, UTAUT Model, farm

Abstract in lingua italiana

Lo scopo della seguente ricerca è quello di capire se uno strumento come la tracciabilità, che vuole essere una prova di sostenibilità da parte dei venditori alimentari, non rischi di tagliare fuori le piccole imprese agricole che sono per definizione la realtà più sostenibile e meno impattante nell'industria alimentare.

A questo proposito verrà indagata la volontà delle piccole aziende agricole biologiche di implementare la tracciabilità nelle loro produzioni. Partendo dal concetto di sostenibilità, verranno discussi la definizione di tracciabilità e i suoi benefici sotto vari aspetti, come quello economico, ambientale o della sicurezza alimentare, nonché i costi e le potenziali barriere di questa tecnologia. Questo case-study si basa su interviste semi-strutturate e sull'analisi cross-case per effettuare un confronto tra i determinanti teorici dell'UTAUT, secondo la letteratura scientifica, e le determinanti empiriche raccolte con interviste a piccoli agricoltori del Nord Italia. I risultati hanno evidenziato che l'aspettativa di sforzo economico e tecnologico e le eventuali condizioni facilitanti, due determinanti dell'UTAUT, non svolgono un ruolo sostanziale in questo processo decisionale. L'utilizzo è determinato soprattutto dall'influenza sociale e in particolare dalle leggi, per le quali la tracciabilità è obbligatoria nel caso di vendita ai supermercati. In generale, l'uso della tracciabilità dipende principalmente dalle dimensioni e dal tipo di azienda agricola: le piccole aziende agricole, che vendono ortaggi non processati direttamente ai clienti, non sono interessate alla tracciabilità.

Parole chiave: sostenibilità, tracciabilità, agricoltura, fattoria, UTAUT Model



Contents

Introduction

Traceability on labels is intended to prove sustainability of food products to consumers. The question arises: is it too complex to be implemented by a small farm, which is the greenest and less impacting food producing reality? Are small farmers cut out of this system because of its costs? This case study's intent is to explore this topic, by asking farmers themselves.

To do so, the Unified Theory of Acceptance and Use of Technology (UTAUT) will be considered. This tool proposes four key determinants to a decisional process: performance expectancy of that technology, effort expectancy in implementing it, social influence to invest in it, and facilitating conditions that would be helpful if necessary. These determinants will be related to the intention of implementing traceability of small farmers, according to literature review expectations. Then, with semi-structured interviews to farmers, will be collected empirical data that will be compared to expectations of previous scientific publications, underlying both differences and similarities.

This case study' beginning relies upon sustainability, which is an important concept behind traceability: in fact, traceability is a tool which certifies that a certain food product has an exact origin, controls the legality of added pesticides and guarantees that the harvest was realized without human exploitation.

Sustainability in agricultural sector will be analyzed with environmental and socio-economic perspectives and will be proposed Regulations currently into force in Italy and Europe upon this topic.

After that, the typical structure of a food supply chain will be presented: farms are only the first step of a structure where supermarkets often retain the decisional power, stating raw materials' price, new seeds plantation and cultivation. To limit the power of retailers, farms are usually organized in cooperatives, whose goal is to merge the efforts of small realities, both in economic and products senses.

Fourth chapter will be discussing traceability, with its definition, and its advantages according to literature review under many points of view (economic, food safety, environmental etc.) and will be presented barriers and limits of this technology.

Later on will be introduced the UTAUT model, and analyzed the expectations of literature review upon performance expectancy and the other determinants.

As anticipated, the methodology, that will be clarified in Chapter 6, relies upon case study guidelines, and will be performed semi-structured interviews to farmers, that will be analyzed with a cross-case selection.

Chapters seven and eight will be based on interviews' results and discussion and will highlight that there have been observed differences between literature review expectations and actual famers' perceptions of this topic. In fact, will be proposed new determinants to the model, to try to clarify this decisional process.

This study is affected by many limitations, such as the number of interviews, twelve, their duration, the restricted geographic area of farms. Statistical conclusions can be more accurately drawn if the sample population is high, so this study's proposal is not willing to have a universal validity but can be useful for farmers to understand their colleagues' opinions on this theme and might represent the starting point for future researchers to furtherly investigate this topic.

1. Sustainability in agri-food sector

Before analyzing traceability in the food industry it is best to provide context in which this important tool is spreading. In particular, the European trend in the agri-food sector is moving towards sustainability. In the following chapter, the concept of sustainability will be analyzed including environmental, social and economic aspects, to underline its role in this case study.

Agricultural sustainability is defined as 'meeting the needs of the present without compromising the ability of future generations to meet their own ones'. (Reganold et al., 1990) Therefore, long term management of natural and human resources must be considered with the same weight of the short-term economic profit.

This path towards sustainability, which was born back in the '90s, is nowadays a mission that is mandatory for every firm operating in Western countries. Sustainability is a wide concept that can be discussed through three main aspects: environmental, social and economic.

1.1 Environmental sustainability

As anticipated in the introduction paragraph, sustainable agriculture aims to meet the food needs of the growing world population while ensuring minimal impact on the environment and humans, as well as productivity. Achieving complete sustainability towards the environment is a big challenge for the sector, which must face different issues such as use of pesticides, soil conditions (erosion, loss of organic carbon, deforestation) and emissions of GHGs.

In fact, the intensification of cereals, root vegetables and horticultural production has led to dramatic changes in soil cultivation over the last 100 years, due to the growing demand for food resources required by an increasing global population and product consumption (Reganold et al., 1990).

First, pesticides seem to represent an obstacle to sustainability because of the correlated adverse effects on human health and environment. The stringent regulatory requirements led to an increase of costs and research of pesticides and improved products. (Lykogianni et al., 2021). Pesticide malpractice is more severe in developing countries rather than in developed ones, due to ignorance or unavailability of safe material. This also leads to pesticide exposure of farmers causing nausea, skin irritation, headaches and long-term effects like kidney problems, reproductive system ones, cancer or even death.

The Agricultural system welfare is also strictly connected to soil conditions. Soil has been defined as a vital, non-renewable resource, which requires sustainable measures to guarantee food production (Reganold et al., 1990). In particular, the problem in Western Europe's agriculture soil is erosion, which leads to the loss of fertile topsoil. The actual soil erosion rates for tilled, arable land in Europe are on average 3-40 times greater than the upper limit of tolerable soil erosion. This has various negative effects, such as thinning by removal of topsoil, textural coarsening, decline of soil organic matter and loss of nutrients. Research also showed that there are several practices to reduce soil erosion: low risk and cover crops, tillage timing and intensity, buffer strips (Rosenzweig et al., 2020).

A more sustainable approach to agriculture would also significantly reduce the impact on climate change, since 18-29% of emissions are caused by agriculture and land-use changes for food production. (Rosenzweig et al., 2020).

In the environmental sustainability scenario, we can therefore underline three main issues: the use of pesticides, soil conditions and Green House Gases emissions.

1.2 Socio-economic sustainability

In this paragraph will be analyzed sustainability under social and economic point of view. As previously explained, the agricultural sector in Europe is currently struggling, especially due to bad conditions in its cultivable soil. This problem is a consequence of another important issue: overpopulation. In fact, the current need for food is constantly increasing and the market has all the interest in satisfying this exponential demand. This process leads to overcultivation, without taking into

consideration Conservation Agriculture and other good agricultural practices, because they would slow down the productivity of the sector (Singh et al., 2019).

Soil erosion caused by overpopulation also negatively affects agricultural labour productivity: for each ton per hectare increase in the annual soil erosion rate the productivity decreased by 28% in the selected European studies (Giannakis & Bruggeman, 2018).

While discussing labour and social conditions of European farmers, it is best to underline that, especially after the Covid-19 Pandemic, in countries like Italy or Spain the industrial fruit and vegetable production excessively depends on foreign labour of migrant workers, who are living in astonishing social and employment contexts (Molinero- Gerbeau, 2021).

During 20th century, productive units were mostly family-owned, composed of peasants and were connected only with local markets. Currently, given free trade agreements and wide economic market-shares like EU, the whole system faced a change into a more industrial and exporting type of production (Molinero-Gerbeau, 2021).

From a social perspective, large part of EU's fresh fruit and vegetable production is competitive because employers in southern Europe provide low wages to peasants, even below legal thresholds. This issue is related to housing conditions of immigrants, which represent most of the workforce in this sector. Their living context is very poor and might include slums, abandoned factories with lack of drinking water or electricity and when accommodation is provided by farms, they are often overcrowded. A shift towards sustainability would also mean to redesign this model, with proper wages, accommodations and living conditions for workers, without financing the illegal immigration in order to get cheap workforce for farms. (Molinero-Gerbeau, 2021).

In general, sustainability on a social and economic point of view affects working and living conditions of laborers, needs of rural communities, consumer health and safety in the present and in the future. In the following chapter will be presented the main legislations currently in force in Europe and Italy, to understand which are the information that food manufacturers have to provide into products' labels.

2. Sustainability regulations

2.1 Environmental sustainability regulations

The transition towards sustainability is not a short path and governments often emit guidelines and legislations to push countries into this direction. With these constraints, firms are not only pushed by the previously discussed advantages of sustainability practices but are also forced by laws. The Italian Regulation in the sustainability sector is a direct consequence of European Union Directives, which are then applied within the Italian context by our government, according to our country's special context and needs.

To fight the soil related issues the EU published the SFD (Soil Framework Directive), whose goal is to protect, preserve and prevent future degradation of soil. To do so, this directive highlighted many threats to soil quality: erosion, decline of soil organic carbon, compaction, contamination, sealing, salinization, landslides and desertification.

Strictly connected to SFD, another publication made by the EU is called the Water Framework Directive (COM 2000/60/EC,2000), which required a reduction in soil erosion, and the Nitrates Directive (COM 91/676/EEC) which put limitations on emissions of pollutants to soil. (Creamer et al., 2010). However, more recently, the introduction of the Good Agricultural Environmental Conditions (GAEC) guidelines under Cross Compliance (EC 1259/99, 1999) and the growing adoption of soil

conservation management techniques have aimed to reduce land degradation processes from arable agriculture.

Environmental sustainability and socio-economic one are connected by one important topic, which is food safety. The safe access to food is a fundamental right for world population, no matter their economic or social status (FAO, 2009). The agricultural sector will probably undergo lots of new challenges in this decade to safeguard food production and exponentially increasing productivity due to the world population growth, which is forecast to be 9.7 billion people in 2050 (United Nations, 2019). This growth is connected to several practices like increase of pesticide application or agriculture intensification, which lead to climate change, pollution, dramatic reduction of insects' population, habitat losses due to deforestation and water soil contamination.

This issue was faced by worldwide organizations: FAO (Food and Agriculture Organization) and WHO (World Health Organization) with the publication of the International Code of Conduct on Pesticide Management (2014) which is adopted and strictly followed in Europe. Another legislation, the Maximum Residue Levels (MRLs) focuses on the pesticide residues in food. The European Union is currently supporting the Common Agricultural Policy (CAP) in order to trade in a sustainable way all over the world.

Connected to CAP, in the EU, the Integrated Pest Management (IPM) and the organic farming offer a good sustainable path to follow for the protection of environment and human health. In particular, it involves cycling of organic resources to get an environmental balance and preservation of biodiversity, while IPM is a smart way to study the use of pesticides, in order to minimize their life cycle impact to the environment.

The European Commission, with the European Green Deal, highlights that food systems that are not sustainable cannot stand against important periods of crises like the Covid-19 Pandemic. Moreover, with the Farm to Fork strategy, the EU is willing to have no impact on the environment, help to mitigate climate change, reverse the loss of biodiversity - on Nature related side.

2.2 Social sustainability regulations

When it comes to social sustainability, the goal of legislations is to ensure food security, nutrition and public health, preserving affordability and in the meantime generating fair returns for the whole agri-food supply chain, starting from farmers (EU official website, Farm to Fork strategy). These regulations affect farmers' power in the supply chain, transparency of companies in sharing information, and ensure that small farms in Europe are overcoming difficulties related to the increase of costs due to Russian-Ukrainian conflict.

First, the Farm to Fork regulation would bring the farmers back a lot of power, improving their position in the supply chain, creating new business opportunities due to plant-based trend, decreasing production costs thank to the advance in innovation and technology (e.g., computer vision technology) and finally expanding the markets thanks to sustainable reputation and the consumers' support. (EU Green Deal – Benefits for Farmers.)

Second, on 5 January 2023 the Corporate Sustainability Reporting Directive (CSRD) entered into force. This new EU directive modernizes and strengthens the rules concerning social and environmental information that companies must report. A broader number of companies will provide access to information like impact of companies on people or climate to their stakeholders. Companies subject to CSRD must comply to the ESRS- European Sustainability Reporting Standards.

Third, after the breakout of the Russian-Ukrainian conflict, EU also published Measures to safeguard food security and support EU farmers. This directive includes the distribution of €500 million euro in national allocations to support farmers most affected by higher input costs and the closure of export markets and the introduction of market safety measures to support the pig meat sector which is currently struggling. Finally, to help EU farmers, measures to ensure availability and affordability of fertilizers have been introduced.

As anticipated in this paragraph, the correct division of power within different players in an agri-food supply chain is an important indicator of welfare for farmers. In the following chapter, the focus will be on the structure of the supply chain itself, and on an important and common organization, which are cooperatives.

3. Agri-food supply chain and cooperatives

3.1 Agri-food supply chain structure

Agri-Food Supply Chain structure is the key starting point to understand the decisional process while implementing traceability. In fact, the raw material harvesters, farmers, are only the first player in the whole chain and the decisional power is usually not in their hands. In this sub-chapter, will be presented the most common supply chain structure in the agri-food sector, with a focus on the player that usually pulls the entire process: the retailing firm (Clapp, 2021).

After the harvesting process, there are food manufacturers and processers which confer added value to the raw materials and get them ready for being sold. After the distributor the last player is the retailer, who sells the product to the consumer. Food flow is going downwards in this chain, while money flow upwards (Harvard University).

The Agricultural supply chain is, in most of the cases, controlled by the retailing company which pulls the entire economic process and interests. In fact, after the stages of farming, raw materials are sold at very low cost to food processors by intermediaries and then to the manufacturing company, then retailing the products in supermarkets at higher prices. If farmers are paying more, they are likely to absorb these costs in the form of lower retribution for their work. This is due to the structure of the agri-food supply chain: farmers are not selling the product to consumer (which could let them increase the price) but to a concentrated intermediary firm, which retains the power to decide the price (Clapp, 2021).

This controversy is also supported by corporate concentration and power in the global seed and agrochemical industry (Clapp, 2021). In fact, the worldwide trend consists of a small number of large firms dominating markets in the global food system, and this can lead to severe consequences for farmers: exerting power in food systems broadly leads to shaping markets and technologies, innovation, policies and governance frameworks. Large companies can control which types of seeds and crops are planted and grown by farmers, and in which type, or brand of facilities. They also influence the working conditions for system workers, and most importantly the selection and the price of the food coming to retailers' shelves directly to the final users. For this reason, most regulatory attention is given to the impact on consumer prices. In 2018, only four top firms controlled 70% of global pesticides market and around 60% of global seed market (Clapp, 2021).

Concentrated power can also control markets limiting the choice upon certain types of products, making the useful or more remunerating ones more available. An example is the difficulty in finding non transgenic varieties of seeds in the US market.

Regarding the influence on Politics of concentrated large firms, Bayer and BASF spent more than €3 million euros lobbying the European Union in 2019 to expire glyphosate's registration in 2022. There is also a continuity in employment of large agribusiness firms and governments, meaning that the people controlling the government decisions are most of the time related to very big firms and vice versa (Clapp, 2021).

Fortunately, this issue can be fought with competition policies on prices and monitoring of equitable livelihoods for farmers. Governments can also support small and medium sized firms, promoting diversity, sustainability and innovation all along food supply chains.

Overall, the supply chain structure in the agri-food sector is composed by farmers, manufacturers, food processors, retailers, but in most of the cases all the decisions regarding investments or types of seeds and plants to grow are taken by the retailing firm, which is also the one usually pushing the supply chain towards traceability.

3.2 Cooperatives in agri-food sector

The present research aims to analyze the willingness to implement traceability in the Italian small farms context. Therefore, to better understand the Italian agri-food background, it is useful to mention the role of Cooperatives, that is very prominent in this country.

Cooperatives in Agriculture -or farmers' co-op- are autonomous associations of people united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly owned and democratically controlled enterprise (Kumar et al., 2015).

Agricultural cooperatives are generally considered as an instrument to strengthen the position of producers throughout the whole supply chain, constituting an economy of scale in processing and marketing activities. This is made to take back some economic power from their buyers, which in most of the cases are the ones that drive the price and the type of products that the supply chain is producing and retailing (Clapp, 2021).

European Union is supporting the role of cooperatives since 2001, with the introduction of Producer Organizations (POs), and limiting the unbalances in food supply chain power with a regulation against Unfair Trading Practices published in 2019 (Lee & Van Cayseele, 2022).

The reasons for farmers to enter a cooperative are several: greater revenues, better management of economic risks due to price volatility, increased variety in the products that are overall sold, larger market share (Lee & Van Cayseele, 2022).

In particular, the social role of cooperatives is recognized by the Italian Constitution in Article 45, as evidence of the long history of support to cooperatives in this country. In fact, in Italy one- fifth of the largest Italian agri-food enterprises are cooperatives (Fonte & Cucco, 2017) and most of them are related to marketing and food processing. About 40% of agricultural cooperative activities is covered by fruit, vegetable and dairy sectors.

Members of most of Italian cooperatives usually deliver all their output to cooperatives, which leads to problems related to traceability of the food origin into the following supply chain stages. In fact, for the retailer is difficult to trace back the exact origin of a certain vegetable or fruit, if it is collected from several farms that take part in the same cooperative. (Saltini et al., 2013)

An example of cooperative in Italy is Altromercato, which has a prominent role in international Fair Trade in Italy by handling relationships with more than 140 organizations of producers in 40 countries which are then sold in Italy with more than 200 retailing points.

Overall, the important role of cooperatives in Italian agri-food sector was discussed, as well as the limitation in products' traceability that it relates to. Therefore, in this scenario, spreading this new technology would definitely provide benefits to the whole Italian agricultural sector. The following chapter will be discussing traceability in its definitions, its main advantages and disadvantages.

4. Traceability in agri-food sector

The fourth chapter will be considering traceability, which is the main topic of the present article and the subsequent interviews and methodology. To clearly understand the decisional process for a small farm to adopt a Food Traceability System (FTS), it is first useful to define what traceability is and its advantages and disadvantages to a company.

4.1 Traceability definition

Among many definitions of traceability, the most comprehensive states: "It is the ability to trace the history of a product through the supply chain to or from the place and time of production, including the identification of the inputs used and production operations undertaken". (Manos and Manikas, 2010) or again "The ability to trace the history, application or location of an entity by means of recorded identifications" (International Standard Organization, ISO 8402).

Further definitions distinguish between logistics traceability, which follow the physical path of the product and qualitative traceability, assessing products' quality and safety (Folinas, Makinas & Manos, 2006).

Traceability refers to the ability to track and trace the movement of a product or item through a supply chain, from its origin to its destination. This can include tracking the movement of raw materials, components and finished products as well as recording information about the various stages of production, processing and distribution.

FTSs often use unique identifiers to track the movement of products through the supply chain such as barcodes, RFID tags or serial numbers. This information is typically recorded in a database or other information management system, this allows companies to quickly retrieve information about the origin, location and status of a product at any point in the supply chain.

This practice is important for a variety of reasons including ensuring the safety and quality of products, maintaining compliance with regulatory standards and enabling companies to make data-driven decisions about their supply chain operations. Traceability can also contribute to building trust and transparency with customers, stakeholders and other partners in the supply chain. The following chapter will analyze the most important regulations and directives upon traceability currently in force in Europe, with a focus on Italy.

4.2 Traceability regulations

Legislations are considered an important driving force to implement traceability in order to be able to stay in the market for many food companies (Zhang et al., 2017). Therefore, to investigate the context in which small Italian farms are deciding whether to adopt it or not, it is also useful to discuss the regulations that are currently into force in Europe and Italy.

European Union established that traceability is mandatory with the General Food Law (GFL) contained in the CE Regulation 178/2002, which has been active since January 1st, 2005 in Italy. This regulation introduced a list of mandatory information that companies must provide: lot number, product ID, product description, supplier ID, quantity, unit of measure, buyer ID. Optional data include supplier's name, contact information, receipt date, country of origin, date of pack and others.

The CE 178/2002 also set up the EFSA – European Food Safety Authority, responsible for scientific advice and support, which is particularly active for what concerns chemical and biological hazards, animal health and welfare, additives and GMOs.

Finally, this Regulation also established the RASFF- Rapid Alert System for Food and Feed, whose goal is to provide a quick reaction with food safety authorities of all member states in cases of food emergency or threats. It enables a quick flux of

information between the states in order to let them take immediate actions in case of risk.

In November 2007 became law the Legislation 193/2007 in Italy, which followed the European 2004/41/CE about control on food security.

Another important regulation was published in Italy on the Official Gazette in 2011: the Regulation 1169/2011 which integrated two European Directives: CE/13/2000 on labelling of food products and CE/496/90 on nutritional labelling.

In 2019, after many years the European Union published another regulation: the EU 2019/1381, which entered into force in Italy from March 27th, 2021. This new regulation modified the previous one in many aspects: it guaranteed higher transparency, meaning that all the traceability information would be public and free access, a better management of scientific studies regarding independence and impartiality. Other sectors in which it uploaded the old one are enforced scientific cooperation and governance, as well as better risk communication on a global point of view.

The EU 2019/1381 also set new standards upon: GMOs emissions to the environment, additives to animal feed, aromas to smoke food, materials to get in contact with food and new food establishment.

An important certificate of traceability are Standards: ISO 9000 provides a definition of traceability and ISO 9001 defines a Quality Management System as "part of a management system intended to lead and manage an organization regarding quality". ISO 9001 also divides into Measurement traceability and Identification traceability, meaning that firms should select suitable identification methods of the outputs in the whole supply chain such as finished products or information flow, as well as recording and storing the information properly.

Moreover, UNI EN ISO 22005:2008 "Traceability in the feed and food chain – General principles and basic requirements for system design and implementation" represents the actual conformity of a firm towards new traceability system, providing customers an important message of sustainability, quality and safety, as well as an important tool for internal product and supply chain management for the firm.

Last, it is important to mention the European Green Deal. There is a clear connection between it and food traceability. The European Green Deal is the European Union's roadmap for making the EU's economy sustainable and achieving carbon neutrality by 2050 (European Commission, 2019).

Food traceability is an important tool for achieving this goal as it helps to promote more sustainable and environmentally friendly practices in the food supply chain, such as carbon emissions reduction.

In conclusion, many regulations have been analyzed in this chapter. In short, the current regulation concerning traceability into force in Italy is the EU 2019/1381 which is based on EU 178/2002, supported by many ISO Standards and the European Green Deal.

4.3 Traceability for safety concern

With this chapter will start a discussion on the advantages of traceability that are provided by the literature review. The purpose of it is to set the background for the following methodology of interviews, which will investigate whether small Italian farms realities are aware of these important benefits or not. The first one that will be described is the positive impact of traceability to food safety.

Traceability is particularly important for safety in the agri-food sector, where there are a range of potential risks to human health and the environment. By implementing effective traceability systems, companies can track the movement of food products throughout the supply chain, from farm to fork. This can help to identify the source of contamination in the event of a foodborne illness outbreak, and to quickly remove affected products from the market. Examples of food-related illnesses are foot-and-mouth disease, the melamine contamination of milk, bovine spongiform encephalopathy (BSE), the dioxin crisis, the avian flu that in the last decades affected the world-wide population. (Bosona and Gebresenbet, 2013)

In addition, traceability systems can help to ensure that food products are labeled correctly, and that consumers have access to accurate information about allergens and nutritional content. This can help to prevent allergic reactions and ensure that consumers are making informed choices about the food they consume.

Finally, traceability systems can help to build trust and confidence in the agri-food sector. By providing transparency and accountability throughout the supply chain (Rupprecht et al., 2020), companies can demonstrate their commitment to safety and sustainability, and build long-term relationships with customers and stakeholders.

Food safety issues cause severe losses in economic and marketing relationships with customers, so companies try to avoid them at all costs. For example, EU banned import of aquatic products from China due to veterinary medicines, pesticides and heavy metals contained in them.

Overall, traceability is a critical tool for ensuring the safety of food products in the agri-food sector. By implementing effective traceability systems, companies can reduce the risk of harm to consumers and the environment and build trust and confidence in their products.

4.4 Traceability for quality concern

Traceability can have a positive impact on the quality of products in the agri-food sector in a number of ways. (Hobbs et al., 2002)

Firstly, by implementing effective traceability systems, companies can ensure that raw materials and ingredients are sourced from reputable suppliers and produced using sustainable practices. This can help to ensure the quality and safety of the raw materials, which in turn can improve the quality of the final product. (Saltini et al., 2013)

Secondly, traceability systems can help to ensure that food products are stored, transported, and processed under the correct conditions. For example, by tracking the temperature and humidity of storage and transportation facilities, companies can ensure that food products are not subject to spoilage or degradation. This can help to maintain the quality of the products and extend their shelf life. In fact, also on the Hazard Analysis Critical Control Points logic, it is fundamental to track all the steps of the manufacturing process and all the additives and hygienic conditions of the production.

Thirdly, traceability systems can help to ensure that food products are processed and packaged according to industry standards and regulations. By tracking the movement of products throughout the supply chain, companies can identify and eliminate potential sources of contamination or other quality issues.

Finally, traceability systems can help to ensure that food products are labeled accurately and in compliance with regulations. This can help to build consumer trust and confidence in the product, and improve the overall quality of the product.

Research has shown that traceability systems can improve the quality and safety of food products, reduce waste, and increase efficiency in the agri-food sector. Overall, effective traceability systems can help to improve the quality of products in the agri-

food sector, which can lead to increased customer satisfaction, repeat business, and improved brand reputation. (Zhou et al., 2022)

In conclusion, quality is increased with traceability during the farming stage, during the storing and transportation stages, and the processing and packaging stages. During all these steps traceability helps to keep records of products' information.

4.5 Traceability for transparency towards customers

The third benefit of traceability for a company is the ability to build trust with customers being more transparent about product information. Consumer base opinion is a very important driving force when it comes to invest in traceability for a company. (Choe et al., 2009)

In fact, people are getting more and more interested in the different attributes of a product such as country of origin, animal welfare, genetic engineering issues, so it becomes a matter of marketing to promote their own brand for food firms.

Customers are more willing to buy a product that has a national or close as possible origin, rather than a product that made a trip of thousands of kilometers to get to the retailer. Moreover, a brand that provides many information about its food is likely to increase its reputation among consumer base also for food safety and health reasons. (Choe et al., 2009)

For these reasons, transparency is really an important added value and can be obtained with traceability by:

1) Identification of the products origin and correct labeling: with a proper FTS the companies are able to assess the actual origin of their raw materials and thereby provide correct labels for it, including allergens and certifications.
2) Documentation and record- keeping: traceability necessarily leads to a digital supply chain management, which takes the place of paperwork which often leads to errors

3) Blockchain technology, which is a new tool for traceability, is a cryptographic system that provides data in real time and that cannot be modified by companies
4) Collaboration between supply chain players: digital management is very helpful to collect and share information in a fast and optimized manner to other stages of the supply chain.

4.6 Economic advantages of traceability

The following sub-chapter will be discussing traceability under economic point of view which is definitely an important concern for firms that are willing to adopt traceability.

First, investing in traceability is not cheap (Bosona and Gebresenbet, 2013) for a food firm, but after a first investment, it would definitely provide large returns, as well as meaningfully respecting the regulations of food tracing in most countries. Traceability ensures better market access, better prices, potential funding by governments. In fact, research showed that maintaining market power and political pressure are the two major drivers for large retailers to invest in traceability. (Bosona and Gebresenbet, 2013).

Traceability can improve a firm's efficiency: it allows to track and monitor inventory levels more accurately and in real-time. This can lead to improved efficiency in inventory management and operation performance reducing the risk of overstocking or stock-outs, lead times. Moreover, improving order accuracy (Alfaro & Rabade, 2009) will provide important cost savings for companies, having lower inventory holding costs and optimizing purchasing and production processes. (Narsimhalu et al., 2015). The perishable supply chain with short-term used by date needs high inventory management to reduce waste at many stages of the supply chain from supplier to distributor to retailer. By implementing traceability, the information can be on time and accurate, helping to reduce waste.

It also provides wider market access and competitive advantage: In some industries, traceability is becoming a requirement to access certain markets. For example, the food and beverage sector often requires traceability to comply with food safety

regulations. By implementing traceability systems, businesses can meet these market demands and expand their reach. Moreover, businesses that can demonstrate robust traceability systems have a competitive edge over those that cannot, as they are perceived as more reliable and trustworthy by both customers and business partners.

Another advantage is an improved quality control and risk mitigation: Traceability allows businesses to identify and address quality issues in their supply chains promptly. By tracking the origin, handling, and processing of products, companies can detect and solve problems such as contamination, counterfeiting, or non-compliance with regulations. This helps to reduce the risk of product recalls, legal disputes, and reputational damage, thereby saving costs associated with potential liabilities.

In conclusion, after a first, important, investment, traceability would definitely provide a number of economic benefits to companies: better market access, better prices, improve firm efficiency, quality control and risk mitigation.

4.7 Environmental benefits of traceability

Traceability also retains an important role in reducing the environmental footprint caused by food industry.

The aspects are various and are an important driver to the decisional process of adopting a FTS; they include:

1. Reducing Environmental Footprint: Traceability allows companies to monitor and optimize their supply chain operations, which can help reduce their environmental footprint. By tracking the source of raw materials, monitoring transportation routes and emissions, and reducing waste throughout the supply chain, companies can reduce their environmental impact and improve sustainability. (Cousins, Lawson, 2014.)
2. Promoting Sustainable Practices: Traceability can help promote sustainable practices by enabling companies to identify areas where they can make

improvements. For example, by tracking the origin of raw materials and working with suppliers to ensure sustainable practices are being used, companies can reduce the negative impact of their operations on the environment. (Cousins, Lawson, 2014.)

3. Preventing Deforestation: Traceability can help prevent deforestation by enabling companies to track the source of their wood and paper products. By ensuring that they are not using wood from illegal or unsustainable sources, companies can help preserve forests and protect the biodiversity they support. In the last decades the global production of soy – both for direct human consumption and animal feed purpose – has more than doubled, leading to further deforestation. This issue was faced with the introduction of many sustainable certificates for companies' traceability which ensure deforestation free supply chains. Adopting those practices companies in many sectors can reduce the environmental footprint of human food supply chains. (Hinkes and Peter, 2020)
4. Reducing Carbon Footprint: Traceability can also help reduce carbon footprint by enabling companies to identify areas where they can reduce greenhouse gas emissions. By tracking transportation routes and emissions, companies can find ways to optimize their operations and reduce their carbon footprint.
5. Improving Waste Management: "Traceability can also help improve waste management by enabling companies to track the flow of materials and identify opportunities for waste reduction, reuse, and recycling." (Gnoni et al., 2013).

In conclusion, the environment would benefit from traceability with environmental footprint reduction, sustainable practices promotion, deforestation prevention, carbon footprint reduction, and better waste management.

4.8 Traceability impact on labour conditions

Strictrly connected to sustainability, traceability is a good enhancer of better working conditions for farmers and migrants. In fact, it was underlined that almost one third (Molinero-Gerbeau, 2021) of the Southern Europe – including Italy – of the total peasants are illegal migrants that are constantly exploited in terms of wages and living conditions: their wages are far below the minimum required by law, and they often live in overcrowded accommodations, with scarcity of electricity and drinking water. By tracing the product throughout the whole supply chain, firms and customers are able to reconduct what they are buying to the place where it is harvested and produced, and hopefully not to choose companies that adopt these types of malpractices. Many new firms adopt slogans like Equity and Sustainability and make them their milestones to construct an identity to promote their firm towards customers. These products may cost a bit more than the others but are certificated in the working conditions of their raw materials harvesters and on environmental footprint, besides the raw materials origin.

This point of view is constituting a slow but progressive shift from quantity of food to quality/safety and sustainability of it, thanks to the awareness in customers' consciousness on these themes.

Overall, traceability can help labour conditions by enabling communication of information about peasants' wages and working conditions and sustainable practices.

4.9 Technological concern of traceability

One of the main reasons for companies in the agri-food sector to not adopt traceability has always been the complexity and the high price of devices and systems that provide an effective FT system. In fact, farms are usually not able to pursue investments of this weight, and in the worse cases are not even able to have internet access.

However, recently the technology reached prices that are cheap enough to motivate companies to develop FTSs, also thanks to nanotechnology-based traceability.

The traditional food traceability systems are based on Internet of Things (IoT), used to monitor and store specific information in all production stages with Radio Frequency Identification, Wireless Sensor Network, or NFC. (Feng et. al., 2020). This data can be integrated with traceability systems to provide a complete picture of the crop production process, from seed to harvest. By using integrated technologies, farmers can improve their environmental performance by reducing the use of pesticides, optimizing water use, and minimizing soil degradation. They can also improve their productivity and efficiency by using data analytics to optimize crop yields and reduce waste.

The drawback of this tech is that it is based on centralized server-client paradigm, a single point to store, transmit and share information. This leads to difficulties for consumers in acquiring all the information about the products. (Feng et. al., 2020). A promising technology to try to solve this issue is blockchain, that provides transparency and security, since the information cannot be altered in its structure of set of time-stamped blocks, linked with a cryptographic hash. In fact, it represents a distributed and decentralized technology that can help the whole traceability system. This can help to build trust and accountability and ensure that all parties in the supply chain are following sustainable and ethical practices.

Overall, the main technology implemented in a FTS remains IoT, and its price is more and more affordable also for small players. A groundbreaking technology is blockchain and will increase its spread in the food traceability systems, with the important benefit of complete transparency of information.

Table 1- Benefits of traceability to food supply chain

In order to clarify the main advantages provided by the adoption of a Food Traceability system, it can be useful to summarize them into a table:

Quality of the final product	Products are stored, transported and processed in the correct humidity, Temperature, light-exposure, Pressure conditions
Safety of the final product	Raw materials origin and potential contamination, correct labelling of the final product (allergens declaration)
Technology development	Blockchain: decentralized, cryptographed and effective
Cost saving	Wider market access, higher prices, inventory management efficiency, operation performance, reduction in recall cost
Environmentally friendly	Prevent deforestation and carbon footprint, improve waste management, promotion of sustainable practices
Consumers positive opinion	Positive impact to customers for tracing raw materials, assessing sustainable practices and means to the final product
Positive impact on labour conditions of workers	Shift towards proper wages and living conditions for farmers and peasants
Traceability to adapt to new regulations to stay into the market	EU-2019/1381 – ISO9000/9001 European Directive and International Standards Organization guidelines.

4.10 Technological concern of traceability

As anticipated in the technology section, to implement traceability can be expensive and complicated, and benefits allocations are an extra cost for the supply chain. (Bosona and Gebresenbet, 2013)

This is why in some cases there are players making resistance to the adoption of this system, that requires much administration and paperwork, besides the investment.

Another problem related to FTSs is uncertainty related to information about geographical origin and time origin. (Saltini et al., 2013). Traceability is required at every stage of the production, processing, storage and distribution (EC 178/2002) but does not require any internal traceability data, that would provide faster and more precise tracing of products. Packaging and labelling are important instruments to assess traceability to customer, that on the other hand is more willing to buy light or unpacked food, so it becomes a trade-off for the company to satisfy customers preferences about little packaging of products and green labels reporting traceability.

The focus of next chapter will be on small-medium farms in the Italian agri-food sector so will be discussed main issues for this type of farms. Implementing traceability can be challenging for small players due to a number of reasons:

1. Cost: Implementing traceability systems can be expensive, particularly for small players with limited resources. This can include the cost of technology, training, and personnel (Regan et al., 2012).
2. Technical Complexity: Traceability systems can be complex and require specialized technical expertise to implement and maintain. Small players may lack the necessary technical expertise or may not have the budget to hire specialized staff (Regan et al., 2012).
3. Limited Market Access: Some small players may face barriers in accessing markets that require traceability systems. This can limit their ability to compete and grow their business (De Souza Monteiro et al., 2009).

4. Resistance to Change: Small players may be hesitant to adopt new technologies or change existing processes, particularly if they have been successful using traditional methods. (Bosona and Gebresenbet, 2013)

To overcome these barriers, small players may need to collaborate with other stakeholders, such as industry associations, governments, and larger firms, to share resources, knowledge, and expertise, with the negative drawback of conferring too much decisional power to large firms. They may also need to focus on implementing traceability systems in a phased manner, starting with critical points in their supply chain and building up over time.

In conclusion, the discussed barriers in implementing traceability both for small and medium companies regard costs of both IT equipment and employees training, lack of proper technologies, limited knowledge of its benefits and resistance to change.

5.Willingness of small-farms owners to implement traceability, a UTAUT model approach

5.0 Introduction

The goal of the present research is to determine the willingness of small Italian farmers to adopt a traceability system, based on their real perception of the advantages and the barriers of this technology. Therefore, in this chapter the research will investigate the main factors affecting the decisional process of a farmer regarding this investment, according to literature publications. The following dissertation will be based on UTAUT (Unified Theory of Acceptance and Use of Technology), which states that there are four core determinants in every decision-making process: performance expectancy, effort expectancy, social influence and facilitating conditions that are the main factors affecting it, supported by moderating variables that are gender, age, voluntariness of use (Venkatesh, 2003).

In this chapter will be presented the literature review background of all these determinants in small farms and companies' reality. This will be the starting point for the following interviews to farmers, which will investigate whether or not their perception is consistent with the scientific based one.

5.1 UTAUT model definition

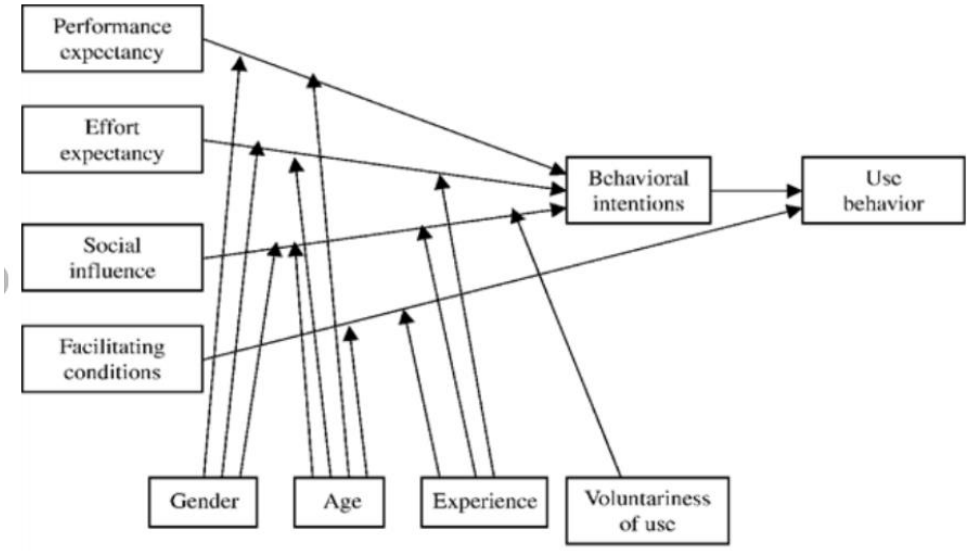


Image 1 – UTAUT Model graphic representation (Venkatesh et al., 2003)

As anticipated in the introduction paragraph, The Unified Theory of Acceptance and Use of Technology (UTAUT) is a research model published by Venkatesh et al. in 2003, created to analyze the willingness of individuals to have a certain behavior or to take a certain decision. The decisional process of an individual, according to this model, is based on four core and direct determinants, which constitute the column on the left of the image. (Venkatesh, 2003)

First, performance expectancy represents the degree to which an individual believes that using the system will help him or her to attain gains in job performance. Second, effort expectancy is the degree of ease associated with the use of the system. The social influence, on the other hand, is based on the perception of an individual of the importance of other people beliefs and social trends of behavior. Finally, facilitating conditions refer to consumers' perceptions of the resources and support available to perform a behavior. (Venkatesh, 2003.)

There are also moderating variables that can influence direct variables like gender, age, experience, voluntariness of use, level of education.

Therefore, in this chapter will be analyzed the willingness of Italian small farmers to adopt traceability by analyzing the above categories in this context.

Overall, the UTAUT model's importance lies in its comprehensive framework, wide applicability, predictive power, flexibility for customization, and practical implications. It has become a valuable tool for researchers and practitioners in understanding and facilitating user acceptance and adoption of technology. (Venkatesh, 2003).

5.2 Performance expectancy of traceability in small farms context

The expected performance is with no doubt one of the most important drivers for a small farm to implement a Food Traceability System, according to studies. As discussed in previous chapters, traceability provides several advantages for a firm if adopted, under various aspects. These advantages can be considered for a small reality like a small Italian farm and will be discussed in this sub-chapter. The most relevant ones are: economic, safety, quality, labour conditions, environment, larger market share and transparency towards customers.

First, an economic advantage on inventory management, operation performance and waste management by reducing the use of manual paperwork, leading to improved operational efficiency for a small farm, that is usually managed through it. This efficiency also reduces the risk of stock-out and recall costs as the raw materials are traced with respect to batch production (Narsimhalu et al., 2015). Overall, the supply chain performance is enriched with a higher information sharing and visibility, which can happen automatically and in real time with a FTS (Zelbst et al., 2010).

Second, traceability helps to ensure safety of the products because it identifies the product origin and the pesticides used in its cultivation, safeguard food in transit (Qian et al., 2020) and this aspect is often promoted by governments, like the EU or China, to ensure products' safety and regain people's trust upon food distribution.

Third, it also positively affects quality conditions of the products, since it would be easier to determine different geographical origin of the products and therefore their common organoleptic properties. In fact, a study on chocolate production (Saltini et al., 2013) showed that most of cocoa beans produced worldwide are taken from small-size farms, and then combined in large batches to be shipped to manufacturers. These batches are made because the origin of different small producers' cocoa is not precisely defined so, to obtain a constant taste, the manufacturer organizes the products this way. Adopting traceability would help agri-food supply chain in clearly understanding the origin of the raw materials, giving small farms added value for their unique products characteristics, which could be closely analyzed in the early processing stages which are the most important ones to get proper quality and taste of the product.

Moreover, it would provide positive impact on farmers labour conditions (Molinero-Gerbeau, 2021). Tracing the origin of raw materials and keeping records of the practice is also a mean to clearly show the workforce employed in the process by farmers, which in most cases is constituted by illegal immigrants that are exploited with low wages and terrible living conditions. A traceability system would help in recording and thereby identifying the eventual malpractices by farmers.

Traceability is also environmentally friendly: by tracking the source of raw materials, monitoring transportation routes and emissions and reducing waste throughout the supply chain, companies can reduce their environmental impact and improve sustainability. Traceability for small farms would ensure that during the harvesting no malpractices such as high GHGs emitting pesticides are used. This aspect, together with the capability of tracing raw materials and to provide this information to the consumers, lead to build trust between them and the distributor, that leads to satisfaction of the customer and revenues for the food supply chain (Cousins, Lawson, 2019).

Small farmers are also expecting, when adopting a FTS, to get the possibility to be included in a cooperative system, where their revenues would be much higher than in a stand-alone business by expanding their market share. Larger market share is another important driver to implement traceability. A study on Portuguese pear farms underlined that, in this sector, an important advantage to adopt a certain type of traceability is the possibility to sell to United Kingdom (UK) market. In fact, with this Food Traceability System, farmers can be linked to reliable producer organizations, farm productivity and their products would present a protected designation of origin (PDO) and farmer's age. (De Souza Monteiro, Caswell, 2009).

Having public access to products' information is also very important to add value to the final product and to get higher prices for the products that are sold to lower

stages of the supply chain. Traceability leads to higher revenues thanks to transparency towards customers, differentiating themselves from other firms. (Choe et al., 2009)

In conclusion, performances expected by small farmers from traceability systems are several, including economic ones, safety, quality, environmental impact reduction, inclusion in a cooperatives system, larger market share, transparency towards customers.

This is one of the main drivers for small farmers to decide to invest in traceability, alongside with social influence and regulations. (Li, Paudel, 2021.) (Zhou et al., 2022)

5.3 Effort expectancy of traceability in small farms

In the context of small farms, the effort expectancy of traceability refers to the perceived level of effort or difficulty associated with implementing and maintaining traceability systems within these agricultural operations.

The efforts to adopt a FTS for a small farms are many and represent the most influencing reason to stick with old farming practices and inventory management. In fact, as anticipated, a food traceability system is not a cheap investment because it requires the adoption of new technologies and software, alongside with a higher attention at every step of the harvesting process and this can represent a problem for a small farm. Moreover, to actually benefit for a FTS is an extra cost for small farms. (Bosona and Gebresenbet, 2013)

Another factor of resistance to the adoption of traceability is that many farmers usually don't fully understand the characteristics of traceability systems, so the expected performance is not that clear in their mind and this can be a resistance to adopt this behavior. (Li, Paudel, 2021)

Main efforts include size of the farm, the complexity of its operations, available resources, technological capabilities, and specific traceability requirements imposed by regulatory bodies or market demands and can be summarized as:

1) Farm Size: Small farms typically have fewer resources and staff compared to larger agricultural operations. Implementing traceability systems may require additional time and effort from farm personnel who might already be occupied with various tasks. The size of the farm can influence the perception of effort required to establish and maintain traceability.
2) Implement technological infrastructures: the availability of suitable technological infrastructure can impact the effort expectancy of traceability. Small farms with limited access to advanced information systems or digital tools may face additional challenges in implementing traceability compared to farms with more advanced technology in place.
3) Recordkeeping and Documentation: Traceability systems rely on accurate and comprehensive recordkeeping and documentation practices. Small farms may need to invest time and effort in establishing or improving their recordkeeping processes to ensure they capture all relevant information required for traceability purposes.
4) Training and Education: The level of knowledge and familiarity with traceability practices among farm staff can affect the perceived effort expectancy. Providing training and education to farmers and workers on the importance of traceability and how to effectively implement and manage traceability systems can help reduce perceived effort and increase overall acceptance.
5) Integration with other technologies (e.g., drones, computer vision)
6) Regulatory Requirements and Market Demands: Small farms may face regulatory requirements related to traceability, such as labeling or reporting obligations. Additionally, market demands for traceability, driven by consumer preferences for transparency and food safety, can influence the perceived effort expectancy. Compliance with these requirements may require additional effort and resources from small farms.

Overall, while implementing traceability systems in small farms requires some initial effort and investment, it can provide significant benefits to food safety, supply chain management and to meet regulatory and market demands. Small farms can leverage available resources, technology and training to streamline the implementation process and minimize the perceived effort associated with traceability.

In conclusion, main efforts in implementing traceability are budget barriers, farm size, lack of technological infrastructures, efficient record keeping, integration with other technologies and compliance to regulations.

5.4 Social influence for small farms in adopting traceability

Social influence is one of the key aspects in adopting a Food Traceability System for producers, for a number of reasons: the most important stakeholders of the supply chain are customers and their satisfaction upon traceability is another driver to adopt a Food Traceability System. In fact, traceability is often well accepted by customers, especially for its role in ensuring food safety. This aspect is promoted by European governments with legislations (e.g. 178/2002) and the establishment of agencies like EFSA (European Food Safety Authority) and RASFF (European Union's Rapid Alert System for Food and Feed). Legislation is an important driver for small farms to stay in the market and do not lose profit. (Qian et al., 2020)

Another example of governmental-driven traceability can be found in countries like Taiwan (Hsien- Tang Tsai et al., 2017). After many food-borne illness caused by agriculture food sector, the government decided to put more emphasis on traceability to regain consumers' trust and confidence. Adopting traceability would also mean complying with regulations like 'Corporate sustainability due diligence' (2022) in order to get better performance and social perception of the corporates, along with the possibility to be included in a corporate system. This important aspect leads to a wider market share and ultimately to higher revenues for small farms.

Usually, the main actor pushing supply chain towards traceability is the retailer that sells the product, that is likely to implement it through all the stages of its food supply chain to get higher revenues. (Clapp, 2021)

Increasing social concern about sustainability and environmental footprint is another driver to implement traceability, in fact this system can trace the potential use of illegal pesticides or malpractices that lead to excessive pollution. Besides that, traceability also enables products recycle, by keeping a constant track of raw materials extraction.

A FTS can help in investing in working labour conditions of peasants, because in this aspect as well, malpractices would be evident and punished. The result is a better

living asset for farmers, leading to higher productivity for the firm. Another study (Auger et al., 2008) revealed that ethical products features increase the likelihood of purchasing the product, but without sacrificing product quality in favor of ethical features.

In particularly rural areas, participation in a food traceability system is mainly influenced by the attitude and perception of family members, colleagues, friends, neighbors, or competitors. (Li, Paudel, 2021.)

Overall, the social influence pushing a firm towards traceability is vast and mainly promoted by: customer appreciation for food safety, transparency and environmental benefits, regulations compliance, and last the behaviour of colleagues and friends.

5.5 Facilitating conditions of traceability for small farms

This determinant refers to consumers' perception of the resources and support available to adopt a FTS and can be generally referred to three different requirements: technical, economic and human (Narsimhalu et al., 2015).

First, regarding the human aspect, the effective communication across the supply chain is the key to implement traceability through buyer-supplier common commitment towards this technology. This collaboration leads to integration of different technologies, information and resources share among different stages of the supply chain. Moreover, different partners' perception on traceability can provide awareness of the limitations in the company, helping human resources in setting the constraints to actually implement it (Narsimhalu et al., 2015). Commitment and information share through supply chain partners is considered a fundamental aspect to implement traceability (Bosona and Gebresenbet, 2013).

Alongside the proper communication, another important characteristic of the employees is their level of knowledge and skills, and also their perceived usefulness of this aspect (Narsimhalu et al., 2015). In fact, as will be discussed in the moderating variables subchapter, gender, age, level of education of farmers and employees play a crucial role in the commitment to implement traceability in a firm, according to literature. The importance of trained employees in using technologies is prominent and is a clear necessary condition to establish a FTS.

Financial and Technological conditions are strictly related since company funds enable technical investments that are necessary to implement a FTS. In fact, in many cases, small rural realities lack of technical equipment like internet connection, hardware and software. Eventually, the presence of these technologies in a firm would be a fundamental facilitating condition for it.

Regarding financial facilitating conditions, since traceability systems are not cheap and easy to implement for a small farm is important to get collaboration from other players in the same situation or even bigger companies that have interests in investing in their traceability. Small actors may need to collaborate with other stakeholders, such as industry associations, governments, and larger firms to share resources, knowledge, and expertise, with the negative drawback of conferring too much decisional power to large firms (Clapp, 2021). They may also need to focus on implementing traceability systems in a phased manner, starting with critical points in their supply chain and building up over time.

Research found that it is difficult for small farmers to participate in vegetable traceability systems without assistance. (Li, Paudel, 2021). In this sense, an important tool for a small player would be cooperatives (Li, Paudel, 2021) which share between members the financial burden, the technologies and the knowledge, helping the whole traceability process adoption.

Overall, adequate facilitating conditions are the most important aspect in order to pursue the intention of adopting a FTS, alongside performance expectancy. The most relevant ones are human resources training level, technologies availability and budget resources.

5.6 Influence of moderating variables of UTAUT Model

Moderating variables play a secondary but non-negligible role in the UTAU Model. In fact, these determinants directly affect the four core ones and therefore play a crucial role in traceability implementation commitment.

These variables include gender, age, level of education, geographic area of work (i.e. proximity to cities or rural context), experience with technology or (voluntariness of use.)

First, research showed that variables like gender and age have a significant role in the decision-making process when it comes to adopt traceability in a small farm: it is estimated around 10% of the decision (Li, Paudel 2021). In this Chinese study, 68.8% of farmers are reportedly low-level educated, of junior high school or below, and 92.8% are over 30 years old it was found that males are more willing to adopt a FTS than females, because it is reported that in this country they are often open to new ideas and have a higher educational level thanks to better opportunities. As expected, the commitment to traceability decreases with age, since older farmers are more conservative and linked to traditional techniques, and overall resistant to change. (Li, Paudel 2021). Stringent levels of traceability are more likely to be implemented by young farmers, like in the Portuguese pears agri-food sector. (De Souza Monteiro, Caswell, 2009).

In most of the cases the problem with them is a misconception of what traceability actually is, leading to reluctance on its advantages. On the other hand, young people are informed and aware of sustainability issues of food supply chains so are more willing to adopt it.

Second, farmers living nearby cities are more willing to participate in vegetable traceability systems, since they have geographical advantages like proximity to markets, larger market share, convenient transportation and are more open minded than rural farmers living in the countryside. (Li, Paudel 2021).

In Italy, from 2017 the number of farms owned and operated by young people has been growing and this is followed by increased interest in sustainability and traceability practices (Nuovo Censimento dell'Agricoltura, ISTAT, 2021).

As anticipated, experience with technology and software is also an important decisional factor in implementing traceability, since the FTS will be perceived as easier if the know-how starting point is quite high. (Narsimhalu et al., 2015).

Connected to experience, also personal innovation plays a role in accepting new things. If this technology increases, in his perception, a farmer's personal innovation he will be more willing to take initiative to learn and understand emerging technologies. When a technology is easier for a farmer to master, he tends to be more willing to take the initiative to learn about it. (Sun et al., 2021).

Overall, the moderating variables that play the most relevant role are age, experience with technology, proximity to cities when it comes to influence the four core determinants that are previously discussed. In the following chapter will be introduced the research methodology and the data collection method and analysis. This case study's research questions are based on farmers' perception of traceability: are their opinions similar to the literature review's findings? Is traceability cutting out small sustainable farms for its complexity? Is it considered too stringent or too costly by farmers? Which are the UTAUT determinants that are more influencing farmers in this decisional process? Is there any new determinant that is not considered by the UTAUT model but is useful to describe this research's scenario?

6. Research methodology

6.0 Introduction to case study research

The present chapter aim is to present research methodology, that is based on a case study approach, defined as a 'research strategy which focuses on understanding the dynamics present within single settings' (Eisenhardt, 1989). The objective of this method in this research context is to obtain qualitative and quantitative evidence from interviews to farmers, that are the first tool used to perform a case study.

Case studies based on interviews are useful to explore more the topic with new information and to learn more details, with a broader overlook than the literature review-based research. Moreover, it is based on an inductive logic, oriented on the research, which enables to formulate new theories starting from empirical reality. (Eisenhardt, 1989)

When performing a case study, it is useful to first define the research questions with specific research focus, (Eisenhardt, 1989), but without any preordained theoretical perspective, which could bias the interviewee and limit the findings. Therefore, when

formulating the questions, it is mandatory to separate the research focus and variables from the theory. This connection between theory and empirical findings will be the topic of 8th chapter, the discussion of the results.

After this contact with farmers, information will be collected and analyzed to determine whether the perception of the advantages of traceability in farmers is consistent with the literature based one, that was discussed in the past chapters. In fact, the research up to this point has been based mainly on scientific literature publications. With this chapter the analysis will shift towards an empirical approach, based only on farmers and employees' perception and knowledge.

6.1 Data collection

As anticipated in the introduction paragraph, data collection of this case study will be based on direct and semi-structured interviews to Italian small vegetable farmers.

Semi-structured interviews consist of a list of topics to be asked whereas leaving space to discussion and to new points provided by the interviewee. The importance of this method consists in its ease of use and quickness. In fact, it is the most common to collect primary data. Semi-Structured interviews also are the best to not bias the farmers with the interviewer's point of view. The interesting point of this method is that the interviewee can come up with completely new points of discussion that are not provided by the interviewer - like the UTAUT Model four core determinants in this case- and are not in data yet.

The questionnaire can be proposed both in oral and written forms. In particular, the oral version can be performed in presence, at the farm, by phone call, or online using platforms like Zoom or Teams. These options provide different benefits to the research: the first one can be a productive experience for the interviewer, which can get in touch with the farm reality and meet in person the farmers, enabling human contact during the interview. On the other hand, remote interviews with videocalls or calls are very effective in saving time for both interviewer and interviewee, eliminating also transport costs for the interviewer.

Moreover, with interviews either done in presence or online the interviewee is more willing to participate rather than with a self-report form method, for example with written online forms that would be sent by email to them thanks to the direct contact.

Farmers selection process was performed with two techniques: in-place interviews with farmers at marketplace, and farmers selection from online databases. In both cases the selected farmers were vegetable growers from Northern Italy, and with different proximity to big cities, in order to expand the statistics and make comparations between different locations.

Other variables to consider were the UTAUT moderating ones like age, gender and educational level, that might have an influence on farmers' decision.

The considered productions only regarded vegetables, as anticipated, since most of Northern Italy small farms usually grow many different vegetables and not just one, mainly for profit reasons.

The total number of interviews was function of theoretical saturation, (Eisenhardt, 1989), meaning that the interviews must grow in number until provided information are not new and do not add any further insight to the research.

In order to collect the information to build the theory it was then necessary, as anticipated, to formulate interview questions, that in this scenario were:

- Name
- Gender
- Age
- Educational Level
- Farm geographical position
- Have you ever heard of traceability? From whom? Do you have colleagues or friends who suggest/ do not suggest to implement it?
- If you already use traceability, what are the benefits that you are getting from it?
- If you haven't implemented it yet, what are the advantages that, in your opinion, are provided by its use?
- What are traceability drawbacks in your opinion? (costs, technologies needed ...) It would be easy for you to implement it? Would you need any financial help?
- Do you think that the Regulations on this topic provided by the Government are too strict? Or they are pretty loose?
- Do you have any other comment about traceability in general?

It must be underlined that these questions have been uncoupled with UTAUT four core literature determinants to not bias farmers. In fact, none of the expected performances provided by traceability were mentioned during the interviews, and no perceived effort as well: the goal was to hear these points from farmers.

The answers from two on-site interviews have been recorded and transcribed, with farmers authorization, and coupled with field written notes. On the other hand, during call interviews, answers have been registered with written notes only. Unexpectedly, farmers contacted by phone call were not willing to answer to the questions in most of the cases, since only 10 out of 90 have been interviewed. Nevertheless, online written questionnaires sent by email would have been even less useful than phone calls to collect data.

6.2 Data analysis

After data collection the second most important phase of a case study is data analysis, which is considered a key aspect in building theory from case studies (Eisenhardt, 1989).

Since the purpose of this case study is to analyze the reasons for adopting or not traceability in small farms, data collected from interviews is then coupled with UTAUT model questions like performance expectancy of traceability, effort expectancy, understanding why farmers took the decision to use traceability or not.

Data analysis method that has been used is called 'Cross-Case' (Eisenhardt, 1989), which consists in looking at farmers' different answers and comparing their similarities and differences, according also to UTAUT moderating variables like age, gender or educational level. (E.g. farmer 1, aged 40, had this performance expectancy of traceability, whereas farmer 2, aged 27, had this different expectation.)

Overall, it is important to underline that in this phase every interview has been referred to UTAUT core determinants and moderating variables, in order to enable a cross-cases comparation. For example, concerning the first UTAUT core determinant, performance expectancy, it was possible to compare every different farmer perception about this topic, since information has been analyzed trying to answer the question 'why performance expectations played (or not) a role in implementing traceability?'. Therefore, every interview has been coupled with UTAUT questions and compared to understand similarities or differences between farming realities. The best way to do this process was to use tables, which are the most direct and effective way to present comparisons.

6.3 Reliability of the work

When it comes to discuss reliability of a case study, it is hard to not mention the fact that past theories and literature publications are crucial in providing bias to the researcher and interviewer. In fact, all the advantages or disadvantages of

traceability provided by literature review were expected to be found also in the farmers' opinions, but this in most of the cases didn't happen. This can be overcome by asking questions in a not biasing way to the interviewee, letting he/she free to talk about his/her opinion, but of course a first limitation can be found in the fact that all the questions and interviews have been performed by one single researcher, with his background and biases, therefore they are personal and not universally valid.

Building theories from case studies is probably going to generate new ones (Eisenhardt, 1989), but it can occur that excessive use of empirical data leads to complex theories. (Eisenhardt, 1989) These theories might be rich in details but lacking in clarity and effectiveness, and not providing general information. Therefore, a good theory, is defined as 'parsimonious, testable, and logically coherent' (Eisenhardt, 1989). The aim of this study is to build a 'good theory', but this methodology itself is coupled with empirical data leading to complex theories as anticipated, so the first step is to keep the results analysis and discussion effective and narrow to write a reliable case study.

Reliability of the present study is affected by many limitations; first, number of interviews, 12 farmers working in Northern Italy, which does not represent an universal and general scenario in agricultural sector, since results are strictly connected to the number of interviews itself. This can be an important statistical tool to understand a broad sample's behavior but is always difficult and expensive to increase the number of the population in every statistical study. Therefore, this study's aim is not to draw rigid conclusions to the research question, which would never be the case, but to present a small reality circumscribed by its many limitations.

Moreover, due to the shortness of interviews - about five minutes each - it is possible that the information collected are not representative of farmers' opinions in their entirety, which could maybe have been collected by longer and more in-depth interviews. This was not possible since farmers were not willing to spend too much time on a free interview.

Another limitation is connected to technology in general in farming context: in fact, this study only addressed traceability and is not valid for other types of technologies that farmers might be willing to implement (e.g., drones).

Since the aim was to conduct an exploratory study its the results are partial, and the addressed focus is opened to other future studies, which might investigate the same question but reducing this research's limitations (e.g., number of interviews, restricted time of interviews, restricted geographical are of farms)

Overall, the conducted research is not willing to provide a scientific value since it represents an explorative case study.

7. Results

The purpose of the present chapter is to present interviews' results in an objective way, and to provide a first analysis based only on empirical data. As anticipated, data will be collected in a table, in order to make the communication to the reader quicker and more effective. In fact, tables are often used in case studies for this reason. (Eisenhardt, 1989)

The aim of this table is to present on-field notes and information of each interview in a schematic way, including farmers' name, age, educational level, geographical position of the farm and notes of each interview. As will be observed, in most cases farmers' age is below 40 and most common educational level is high school.

Interview Number	*Farmer's Name*	*Age*	*Geographical Location*	*Educational Level*	*Interview Notes:*
1	*Stefano*	*32*	*Trucazzano (MI)*	*IT High School*	*Small family-owned farm, vegetable products are directly sold to customers so traceability is not needed since product's origin is perfectly known and the food is not processed.*
2	*Leonardo*	*33*	*Merlino (LO)*	*High School*	*Traceability is implemented in this medium size farm and it is structured in batches, using barcodes with PCs*

					and notebooks. This farm distributes to large retailers so traceability is mandatory. It represents an extra cost but it can be easily overcome with profits. Traceability regulations are not too strict and are suitable for our food sector in farmer's opinion.
3	*Marco*	*32*	*Lodi*	*Agricultural High School*	*Traceability is not necessary because they are selling directly to public and products do not need to be traced. Exact origin is known because products are originated from a single field. No sale to large retailers because the quantities required are too high and a small farm usually can't get along with those shipments.*
4	*Elisa*	*37*	*Lodi*	*High School*	*As in other interviews, the reported comments upon traceability are that since products are sold directly to customers, there is no real need to implement it, and it would provide an un-necessary cost to the farm.*
5	*Ilaria*	*34*	*Pizzo (MI)*	*High School*	*As seen before, medium-sized companies need traceability to be able to sell to supermarkets, so it is compulsory. The respondent argues that for*

					very perishable products such as salads and vegetables it does not make sense to be so meticulous and in addition labels cause pollution and represent a cost. So, the opinion is that traceability is too stringent and unjustifiably so for supermarkets.
6	*Luca*	*45*	*San Bovio (MI)*	*High School*	*No traceability needed since products are directly sold to customers.*
7	*Ambrogio and Alessandro*	*40*	*Rodano (MI)*	*High School*	*No traceability needed since products are directly sold to customers.*
8	*Elisa*	*48*	*Impoggio (PV)*	*High School*	*The farm produces both vegetables and honey. The interviewee says that some of their products are processed in-house, so they need traceability in each of their working steps (honey extraction, maceration, etc.) mandatory HACCP even if they do not sell to the general public as supermarkets. So for them it is mandatory*
9	*Erik*	*30*	*Bussero (MI)*	*High School*	*No need of traceability because products are directly sold to the public. No selling to supermarkets because,*

					according to farmer's opinion, it is very complex: IT equipment needs dedicated human resources, plus the fact that supermarkets only pay you for the products they sell, the remaining are thrown and the profit is too low.
10	*Roberta*	*40*	*Castegnato (BS)*	*High School*	*Traceability for many production processes is mandatory to let the customer know products' origin and helps to learn how to properly read the label. Traceability with labels and barcodes is not expensive and not particularly rigid, it is the right way to describe the unitary processes that the product is subject to.*
11	*Ezio Giovanni*	*74*	*Busca, CN*	*High School*	*Organic and biologic fruit and vegetables are sold directly to consumers or to a small intermediary; therefore, traceability is not required, only the country of origin. There is no will to implement it.*
12	*Carlo*	*70*	*La Spezia*	*Middle School*	*The sale of the products is direct to the consumer, therefore, there is no need for traceability and there is also no interest in it.*

Table 2- Interviews' Results

7.1 Division into three groups of farms

First, according to the information in Table 1, it is possible to group farms into three typologies: small farm, family owned, selling non processed vegetables directly to customers; small farm, family owned, selling processed products to customers; small-medium size farm, selling non processed or processed vegetables to Organized Great Distribution (ODG). As will be discussed later, this distinction is fundamental to understand the results of this case study. Second, will be proposed an analysis of the characteristics of each group, with no connection with the others.

Starting with small farms selling non-processed vegetables directly to customers, the first thing that has to be underlined is that this group represents the most common scenario in Northern Italy's small farms sector. In fact, 8 out of 12 interviewed farmers belong to this category. Farms of this type are family-owned, composed of three or four employees, and directly sell vegetables to the public via their site, or in open-air markets nearby the farm. Farmers belonging to this category are reportedly having a very clear perception upon traceability: since products are directly sold to customer and there is no intermediary like retailers or manufacturers, implementing traceability is not mandatory for them, therefore they have no interest in investing in it. In other words, it would be an unnecessary cost. In fact, according to Regulation CE 178/2002, it is obligatory to trace the products, the unitary processes to which they are subjected to and the additives that they might have, from their harvest to their consumers, but in this case however, products are not processed and are clearly originated in farm's field, meaning that farmers already know country of origin and location of the vegetables' growth. Moreover, their products are not merged with others, like in cooperatives, because there is no need for them to reach high quantities to be sold. Of course, in this scenario farm's costs are lower, but revenues will be lower too. As noted in interview number three, farmer Marco reportedly believes that since he doesn't sell products to supermarkets, traceability is not needed, and he isn't willing to implement it. Selling to the OGD is very complex for a small farm and

this concept is reinforced by interview number 9, which clearly underlined that selling to supermarkets is not easy because there are high volumes of products that must be delivered in fixed periods and only sold ones will be paid to farmers (with low profit) and the unsold products will be brought back to farms, who will have no choice but to throw them away. For this reason, farmers belonging to first group gave the impression that given that traceability is strictly connected to large distribution, they have no interest in implementing it considering their current commercial reality, and do not seem to have any interest in increasing their profits in future by opening their commerce to this possibility.

The second group of farms that was highlighted consists of small farms, mainly family owned, which sell processed vegetables and other products like honey directly to customers. Their products undergo unitary processes into the farm, so their label must indicate them. Interviewee number 8 and 10 belong to this category, and reportedly affirm that in their business traceability is mandatory, because their food is processed, in order to sell it. Moreover, the Hazard Analysis of Critical Control Points (HACCP) is also important and must be traced. In this sense, farmer Roberta of interview number 10 affirmed that traceability is a good mean to communicate with customers to let them understand how to correctly read labels and be aware of food processing. For this reason, she believes that traceability is not too strict and neither too expensive since it can be easily repaid by her revenues. Overall, this second group farmers has the duty to implement traceability in their production, and what might change is perception of its usefulness and its related costs. In conclusion, these workers consider traceability as quite convenient and its implementation does not impact them economically.

Third group is represented by small to medium farms, with a number of employees of 10 to 20, that sell non-processed vegetables to the great distribution, i.e., to retailers and supermarkets. According to Regulation CE 178/2002, for this group it is mandatory to provide lot number, product ID, product description, supplier ID, quantity, unit of measure, buyer ID. In fact, when it comes to great distribution, high amounts of products that are originated in many different farms and cooperatives are put together. For this reason, it is important that every producer describes products' features. As anticipated, commerce with OGD (Organized Great Distribution) is not easy for a small farm, since high amounts of food are requested periodically, and is paid at low price only what is sold by the retailer. The unsold food is returned to farms and thrown away most of the times. For this reason, only small to medium sized farms can keep on with this formula with economic advantages. Farmers of interviews number two and five take part of this group and have different opinions upon traceability: Leonardo, 32 years old, thinks that it is not too strict and neither too expensive, whereas Ilaria, 34, argues that traceability can be

excessively rigid and costly, especially for very perishable products like salad. She thinks that printing plastic labels for a product that has a shelf life of only two to three days creates unnecessary pollution to the environment and is basically a waste of money for her farm.

7.2 Connection between interviews and UTAUT model determinants

The purpose of the present sub-chapter is to analyze the interviews' results with UTAUT model point of view. As extensively seen before, UTAUT model is a way to explain which are the determinants that take part into a decisional process to perform a certain behavior. In this case study, the behavior is represented by the willingness to implement traceability, and the UTAUT determinants are, as usual, performance expectancy, effort expectancy, social influence and facilitating conditions. Moreover, moderating variables like age, gender, educational level and experience can also play a role. In this paragraph, interviews will be analyzed under the determinants' point of view, coupling each farmer's perception with the right determinant. To do so, will be kept the distinction into three groups of the first sub-chapter, to group similarities.

For the first group, as anticipated, there is no willingness in implementing traceability. Therefore, in this case, performance expectancy does not play a predominant role in this decisional process, and social influence neither. On the other hand, effort expectancy and facilitating conditions affect the decision of not investing in traceability, since the expected effort in terms of costs, IT equipment and HR expertise is high, and also the difficulty of supplying high amounts of vegetables to supermarkets. Therefore, potential facilitating conditions like government funds would help them to expand their market. In fact, with an investment in the productivity of small farms, it would be possible for them to provide much more products to the commerce and to start having business with OGD. Another determinant in the UTAUT model are moderating variables, but as can be observed in Table 1, age and others information seem to not play a crucial role in this decision. In fact, as will be discussed, the notes highlighted that traceability is mainly determined by the type of farm that is considered. By summarizing in a table the results of UTAUT model for the first group can be obtained:

Farm group	*Performance expectancy*	*Effort expectancy*	*Social Influence*	*Facilitating conditions*	*Moderating variables*
1, small farms selling unprocessed vegetables directly to consumers	*None*	*Costs, IT equipment, HR expertise, supplying great amounts of vegetables*	*None*	*Potential funds from Regional government or private investors*	*None*

Table 3 – Group one according to UTAUT Model

Second group, small farms selling processed vegetables directly to customers, have the duty to report all the steps that the product undergoes into its label. According to their answers, we can state that the expected performance of FTs consists in creating a bond between customer and farmer, building trust and therefore expecting higher revenues in the future. Moreover, traceability is also necessary for them to sell to the public. The effort expected is once again distributed on costs of IT equipment and training of employees but is considered sustainable for them. There are no facilitating conditions expected since their economic effort is easily overcome by their profits. Finally, social influence can play a role if Regulations are considered part of the social context. In fact, according to current ones like EU 178/2002, traceability is mandatory. Moreover, social influence is also similar to performance expectancy's idea, in the sense of building trust with the customer, that nowadays is expecting a certain type of description about sustainability on the products that he is willing to buy. Also in this scenario, moderating variables do not seem to play a key role.

Again, by summarizing in a table can be obtained:

Farm group	*Performance expectancy*	*Effort expectancy*	*Social Influence*	*Facilitating conditions*	*Moderating variables*
2, small farms selling processed products directly to customers	*Tool to build relation and trust with customers, possibility to sell processed products*	*Costs of IT equipment and training of employees*	*Regulations and consumers' expectations*	*None*	*None*

Table 4 - Group two according to UTAUT Model

For third group, small to medium farms selling to retailers and Organized Great Distribution, traceability is mandatory (Regulation CE 178/2002), but farmers' opinion can be quite different upon this theme. In fact, there are both farmers arguing that traceability is a correct instrument and is necessary to properly communicate with consumers, and farmers arguing that traceability can be too strict and costly without any particular reason, especially for perishable products. For this reason, the expected performance of traceability relies mainly on the possibility to sell to supermarkets, because it is a necessary condition to that. Once again, the effort expected by farmers can be considered appropriate but also quite high in some cases; it is usually not an unsustainable cost for farmers. Social influence is less felt by farmers belonging to this category, apart from the Regulations, that are the most important driver of this investing process. Facilitating conditions are not reported by farmers since, as anticipated, the costs can be easily overcome with profits. Moderating variables like position of the farm, farmers' age or educational level are neither playing a role.

Farm group	*Performance expectancy*	*Effort expectancy*	*Social Influence*	*Facilitating conditions*	*Moderating variables*
3, small to medium farms selling to retailers and supermarkets	*Possibility to sell to the Great Distribution*	*Costs, IT equipment and employee training*	*Regulations*	*None*	*None*

Table 5 – Group three according to UTAUT Model

8. Discussion

As introduced in chapter 6, interviews' data will be analyzed according to literature publications in this section. The methodology of this process consists in analyzing cross-case patterns, looking for similarities and differences between different farmers' opinion. (Eisenhardt, 1989.) Discussion will be coupled with UTAUT model by Venkatesh, and in particular, its four core determinants: performance expectancy related to traceability, effort expectancy, social influence and facilitating conditions. Moreover, moderating variables of the UTAUT model, that are age, educational level, gender, expertise will be analyzed. Each determinant will be compared in its literature review findings and in empirical ones.

Finally, will be proposed a new determinant for this model, that can provide a new insight to UTAUT model determinants to describe results of the interviews.

8.1 Comparation between empirical UTAUT determinants and literature review ones

The objective of this chapter is to verify if determinants of UTAUT model perceived with interviews are consistent with expected determinants given by the literature review of chapter 5. In particular, for every determinant (performance expectancy, effort expectancy, social influence, facilitating conditions and moderating variables) will be proposed a comparation between what was expected in the literature review, and the actual empirical evidence. Lastly, will be proposed a new determinant for the Model, that can add new material to describe the results of the research and to draw conclusions to the study.

Starting with performance expectancy, according to literature review this was one of the most important drivers when it comes to decide whether to implement traceability or not for farmers, but in reality its perceived advantages are way less. Those included in literature concern economic, safety, quality, labour conditions,

environment, larger market share and transparency towards customers, whereas the empirical ones only regarded the possibility to sell to the public and transparency towards customers. No farmer talked about food safety, economic inventory management, or environmental benefits. Of course, this limited importance given to performance expectancy is restricted to the limitations of the present case study and is not possible to draw univocal conclusions about it.

Discussing effort expectancy, it must be underlined that small, family-owned farms are expecting several efforts related to traceability. In fact, the first one is connected with selling to supermarkets, which can be a very complex business for a small farm because of the high amounts of food requested and the low profits. This is one of the main barriers that are perceived by small farmers and since they are not willing to sell to the Great Distribution, they are not forced to invest in traceability. On the other hand, farmers that must trace the processes that their food products undergo, or small-medium farms that sell to supermarkets, are forced to invest in traceability so they perceive actual efforts like costs of IT equipment, cost of employee training and resources allocation for paperwork and computer work. Nevertheless, farmers affirm that these costs are quite easy to overcome for their companies, since revenues are way higher.

Another point where literature expectations are different from empirical reality is social influence: in this context, farmers are not conscious of the advantages of traceability to customer appreciation for related food safety, transparency and environmental benefits, and are not apparently influenced by colleagues and friends' behaviour. The most important driver in this determinant consists of Regulations promulgated by the Government, like Regulation CE 178/2002, that made traceability mandatory in order to sell to retailers. For a restricted number of farmers, traceability is also a good tool to build trust with consumers, and to help them learn to properly understand labels and products' origin importance.

Facilitating conditions were not expected by farmers, since the ones that provide traceability of their products can easily face costs with their revenues. Moreover, potential funds by Government or private investors were not considered by farmers.

The role of moderating variables was once again different from the expected one: farmers' age, gender and experience did not play a key role in influencing them upon traceability investments in this study's findings, with the limitations of validity that have been described. Experience with software wasn't considered a strong barrier, since employees can be trained for this task, with investments that can be sustained by the farm itself.

The comparation between empirical UTAUT determinants observations and literature review ones has been summarized into this table in order to make it more effective:

	Performance expectancy	***Effort expectancy***	***Social Influence***	***Facilitating conditions***	***Moderating variables***
Empirical	• *Possibility to sell to retailers* • *Create trust with customers*	• *Costs of IT equipment* • *Costs of employee training* • *Human resource allocation* • *Difficulties in supermarkets' supply chain*	• *Regulations*	• *Relatively low importance*	• *Relatively low importance*
Literature	• *Economic advantages* • *Increased food quality and safety* • *Environmental Benefits* • *Better Labour Conditions*	• *Farm Size* • *Implement technological infrastructures* • *Recordkeeping and Documentation* • *Training and Education* • *Integration with other technologies* • *Regulatory Requirements and Market Demands*	• *Influence of colleagues* • *Food safety and quality increase* • *Transparency towards customers* • *Environmental Benefits*	• *Proactive communication through food supply chain* • *Private or Public Funds* • *Presence of IT equipment* • *Presence of trained employees*	• *Age and educational level influence* • *Proximity to cities influence* • *Employees experience influence*

Table 6 – Connection between empirical UTAUT determinants and literature review ones

With this comparation can be observed many differences between the two situations: in particular, facilitating conditions and moderating variables are not importantly determining the decisional process of farmers to implement traceability, and social influence appears to consist only of Regulations that make traceability mandatory. Moreover, performance expectancy doesn't seem to be the most important driver to implement traceability, and the cost efforts that farmers using it are perceiving are easily overcome with profits.

For these reasons, it should be noted that, besides these four core determinants of the UTAUT, there is another variable that plays a key role in the decisional process, which is farm size.

Farm size and its market-share is fundamental to understand if farmers are forced or not to implement traceability. In fact, as discussed, small farms selling non-processed vegetables directly to their customers don't need a Food Traceability System, because the exact origin of the products is known, and as long as they don't want to expand their market share by selling to supermarkets, they won't need traceability. On the other hand, farms that process their products in-site and then sell them, are forced to print this information on product labels, as well as farms that distribute their vegetables to supermarkets and retailers.

In conclusion, alongside Regulations and building a relation of trust with consumers, farm size and market-share seem to best describe the model of traceability implementation for small Italian farms. Therefore, according this study's findings, is possible to readapt, with all limitations, UTAUT model to the present scenario of analysis, by substituting those determinants that are less important to farmers' decisional process with factors that are more influencing it, such as farm size:

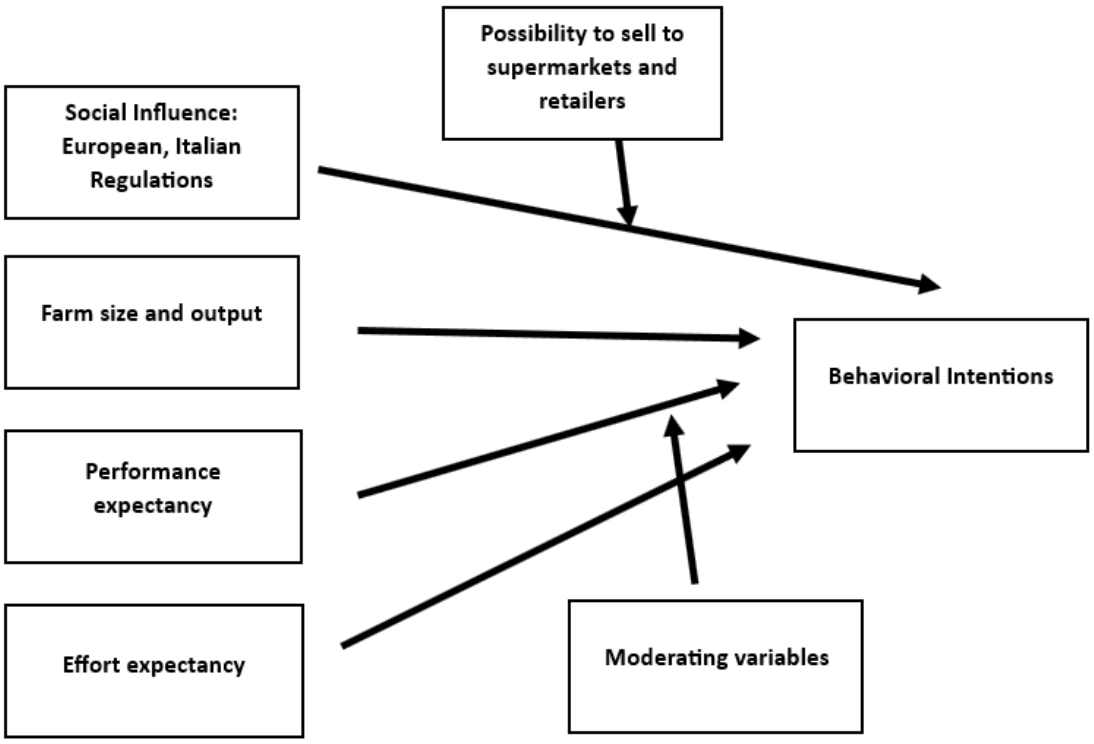


Image 2: UTAUT model representation according to this case study's findings

9. Conclusions

The purpose of the present case study was to identify main drivers of UTAUT model that play a role into the decisional process of implementing traceability in small Italian farms.

First was analyzed sustainability, since there is an important connection between traceability and sustainability. Sustainability was discussed under environmental, social and economic point of view, as well as the current Laws that regulate these aspects, mainly in Europe and Italy. Then, it was described the typical structure of a

food supply chain, which starts right with farmers, that are the focus of the research. This was done to understand the role of supermarkets into a supply chain that usually push to invest in sustainability and traceability all the other players. Third, the role of Cooperatives was underlined, since many farms currently work together in order to maximize market share and profits. Fourth chapter explored traceability, with its definition and its benefits on economic management, food quality and safety, environment and consumers' perception, as well as common barriers that can be an obstacle when investing in a FTS (Food Traceability System). Later, UTAUT Model was described and were investigated its four core determinants for a small farm, according to literature, that were the expected performance of traceability, the expected efforts, social influence, facilitating conditions to implement it, and the role of moderating variables such as age, gender, expertise or proximity to cities.

Case study methodology was described to justify the use of case study based on semi-structured interviews, as well as to propose the data collection method in detail and to introduce data analysis and discussion of the following chapters. Results of the interviews were reported into chapter 7, and were discussed into chapter 8, with an overall distinction into three groups, a relation with UTAUT determinants, and finally a comparation between empirical UTAUT results and the literature review ones, that highlighted many differences into farmers' real perception on this theme. Finally, it was proposed another variable to understand farmers' decisional process of investing in traceability, which is farm size and market share, that can add new material to explain the results from the interviews.

Limitations of the present case study were highlighted, that rely on the limited number of interviews, the restricted geographical area of Northern Italy, interviews' duration, bias in the interviewers and interviewee. These biases cannot be completely erased since there are certain beliefs that every human being is not able to identify and correct by himself.

Consistency with other technologies has not been investigated, since the only considered was traceability, so the present study is not willing to represent a model for each technology implementation in farms, but only regards Food Traceability Systems themselves.

As discussed, limitations on this case study are several and provide an important impact to the validity of the work, which is not universal, and can be useful as a guideline for farmers and future researchers.

First, farmers could take this study as a reference to understand their colleagues' perception upon this theme, to know whether their technologies and beliefs are common or not in this sector.

Second, future research could explore more this topic by reducing the present case study's limitations, e.g., expanding the sample of interviewed farmers. This could help to provide a more accurate statistical analysis; in fact it is statistically easier to draw conclusions from a variable if more samples are known.

This study's findings highlight how important is Government Regulation when it comes to implement a certain habit into every day's life. For common people, environmental issues are yet to become a real issue, and sustainability connected to traceability is forced by Governments for the moment because, otherwise, it would be of very little interest for farmers to keep trace of the product's features and processes to reduce their environmental impact.

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