University of Zurich[UZH]

Towards Sustainable and Local Food Systems: Examining the Challenges and Opportunities in Soybean Production in Switzerland

GEO 511 Master's Thesis

Author
Andrea Martac
14-209-753

Supervised by
Prof. Dr. Christian Berndt

Faculty representative
Prof. Dr. Christian Berndt

30.04.2024
Department of Geography, University of Zurich

Towards Sustainable and Local Food Systems: Examining the Challenges and Opportunities in Soybean Production in Switzerland

University of Zurich
Department of Geography

Author
Andrea Martac, 14-209-753

Supervisor
Prof. Dr. Christian Berndt

Date of submission
30.04.2024

Syllabus

Figures

Tables

Acknowledgments

I would like to express my sincere gratitude to all those who contributed to the completion of this thesis. I am really grateful to all the participants who shared their time and insights for this study. Their participation was essential to the realization of this thesis.

I would also like to thank my thesis supervisor, Christian Berndt, for his guidance and encouragement throughout this research journey.

Last but not least, I would like to thank my family for their encouragement and understanding during this demanding and intense period of study. A special shoutout goes to my grandparents, for the awesome summers on their farm, where my love and interest for agriculture started.

Abstract

Following the outbreak of the COVID-19 pandemic and the steady growth of the world's population, it has become evident that there is a need for a quick change in the current global food chain and for the development of sustainable local food systems (Enthoven & Van den Broeck, 2021; Murphy et al., 2021). Soybean is the plant that has the highest protein content, and for that reason, it has become one of the world's most important protein sources (Messina, 2022; Liu et al., 2021; Jennings et al., 2020; Voora et al., 2020). However, its production is highly localized and involves various environmental and social issues (WWF, 2014). This thesis aims to examine the challenges and opportunities related to local soybean production in Switzerland, with a focus on the economic, social and environmental dimensions of a sustainable food system, while also analyzing the current offerings in promoting the sustainability of the country's food system. Interviews were conducted with the soybean farmers and different representatives of the agrarian/soybean industry in Switzerland to understand what opportunities and challenges are currently encountered. The interviews revealed that farmers' production decisions are influenced by market prices, farmers' economic status, personal beliefs, and market demand. The main opportunities offered by the soybean crop are related to the fact that it is a plant that can fix nitrogen, which makes it perfect for crop rotation and to keep the soil healthy. Moreover, the soybean is currently in high demand on the market, especially the organic one, and therefore farmers are offered prices that are considered very attractive, and the federal and cantonal contributions encourage soybean cultivation in Switzerland by giving direct payments for specific agricultural practices and crops. The main challenges of local soybean production relate to the limited number of local processing and harvesting facilities, limited useful agricultural area availability, weed management strategies, and agricultural benefit-cost disparities in the food chain. Swiss farmers also refer to the difficulty of finding workforce for manual weed control, highlighting labor-related challenges in organic farming. For Switzerland to have a sustainable and thriving industry, it is important to have more collaboration and communication between stakeholders and to invest in more collection, harvest, and procession infrastructures. As a result of increasing market demand, government support, and the crop's inherent environmental benefits, the prospects for soybean cultivation in Switzerland remain promising despite the current challenges.

1. Introduction

The global population is predicted to reach 8.6 billion in 2030, and it will continue to rise in the following years (United Nations, 2018). The rapidly growing population will increase global food consumption and demand, which will put food security at risk due to the consequences of climate change and poor land use practices (WWF, 2014; Branca et al., 2013).

As a complete protein vegetable-based food with nine essential amino acids, soybeans are the most important food crops after rice and maize (Sohidul Islam et al., 2022; Whaley, 2021). Soybeans have become an important source of protein for both people and animals. Most of the production (around 85% of the total) is used to feed animals, and the rest is used for human consumption (Voora et al., 2020; Thrane et al. 2017). However, soybeans are not only found in animal forages and human foods such as tofu or vegan food, but it can also be found in various edible and non-edible products, such as cooking oil, milk, and biodiesel, as well as in aquaculture (Thrane et al., 2017; Masuda & Goldsmith, 2009).

Demand for soybeans is expected to grow not only because the population is constantly growing, but also because consumer demands and habits are evolving. Nowdays fast-food companies, supermarkets, and retailers across Europe, and other developed countries, are more and more selling plant-based meat substitutes products due to a growing request from the population, and this has led to an increase also in human consumption of soybeans (Szenderák et al., 2022; Van Loo et al., 2020; Voora et al., 2020).

Even though soybean production is considerably profitable for both producers and traders, it has significant environmental consequences (WWF, 2022). Among the commodities imported into Europe between 2005 and 2017, soybeans, palm oil, and beef meat were the ones most related to tropical deforestation, followed by wood products, cocoa, and coffee (WWF, 2022).

Developed countries are increasingly adopting modern agricultural technologies and techniques to ensure food security for their populations, as well as to generate more income in order to be more independent of imports from other countries (Sohidul Islam et al., 2022; Shea et al., 2020).

In Switzerland, soybean cultivation is still a relatively small part of its agricultural production, however, there is a growing interest in developing sustainable soybean production practices (Brugger, n.d.; Schmid, 2019). This has been possible through some initiatives, which include, for example, working with farmers to adopt sustainable farming practices, promoting research and development of sustainable soybean varieties, and increasing market demand for sustainably produced soybeans (Jaunin, 2021; Klaiss et al., 2020).

Switzerland is also a member of the Roundtable on Responsible Soy Association (RTRS), an international organization promoting sustainable soybean production practices. Through this membership, Switzerland can help support and promote sustainable soybean production practices not only in other European countries but also globally by creating a demand for sustainable agricultural practices. This can influence market dynamics by encouraging stakeholders, such as companies and consumers, to prioritize sustainably sourced soybean products. It is important to promote these practices because soybean is a crop that is mainly grown in regions outside Europe, where sustainable practices are often lacking, which has led to high rates of deforestation, biodiversity loss, and the exploitation of farm workers (USDA, 2023; WWF, 2022; Jennings et al., 2020; Jia et al., 2020; Voora et al., 2020; He et al., 2019; Pendrill et al., 2019). This research aims to examine the challenges and opportunities related to local soybean production in Switzerland, with a focus on the economic, social and environmental dimensions of a sustainable food system, while also analyzing current offerings in promoting the sustainability of the country's food system. This can help to understand better how to protect the environment and the farmers while also promoting more sustainable agricultural land use and farming. To do this, a review of the existing literature, newspapers, reports, etc., related to organic and sustainable soybean production worldwide and in Switzerland will be made first. The second part is dedicated to researching and interviewing people who have connections with the Swiss agricultural world, particularly in soybean production, namely soybean farmers and experts/representatives of the soybean industry in Switzerland. By doing so, the aim is to collect their direct experiences and thoughts, filling the knowledge gap identified throughout the literature review.

2. Theoretical Framework

In the last few years, a transformation has taken place in the way goods and services are produced as a result of technological advancements and reductions in transportation and communication costs (Giovannetti & Marvasi, 2016). Due to rapid urbanization, agricultural land has been enclosed more intensively, and fertilizers have been used more frequently to increase output to meet the needs of expanding and increasingly concentrated populations (Marsden & Sonnino, 2012). Several factors are contributing to the complexity of the global agricultural markets, including changes in consumer demand, the development of food standards, advances in technology, and changes in the structure of the value chain across the industry (Cucagna & Goldsmith, 2018; Humphrey & Memedovic, 2006).

2.1 Globalization of Agriculture

Globalization is characterized by a diverse set of processes that are driven by international trade and investment, which have been facilitated by the development of innovative technologies and have led to changes in three main sectors: the economic, social, and political levels (Robinson, 2018: p.135; Kaplinsky, 2013):

(a) The economic, where globalization is a measure of trade barriers and trading partners (fewer barriers and more partners);

(b) The social, where globalization is a measure of how easily information, people, and ideas pass around the world;

(c) The political, where globalization is a measure of the level of cooperation between countries on political matters.

With the development of globalized industries, different corporations were able to move more easily across borders, establishing numerous subsidiaries, which enabled them to trade capital, goods, and services all around the globe (Sklair, 2001). But even if globalization refers to a vast geographical area of commerce and trade, some regions have managed to gain more power, making trade and capital investment concentrated there (Piketty 2017). Currently, North America, Western Europe, and China/Southeast Asia are the regions where this power is the most concentrated (Piketty 2017).

The globalization of agriculture was made possible by the improved developments in transportation and communication systems, which have enabled people to move to different regions of the world and created easier access to a cheap workforce (Robinson, 2018). Depending on the agricultural products involved, globalized agriculture can have different characteristics. In some cases, global processing corporations or retailers are involved, while in others, regional or local producers are involved (Robinson, 2018).

The European agricultural sector underwent an important transformation in the 20th century, which resulted in an increasing reliance on imported agricultural commodities (Polackova, 2020). European regions used to produce various agricultural products locally before 1870, ensuring food self-sufficiency among them. However, following that period, the population started to grow substantially, and a sizeable percentage of the workforce moved into the industrial sector (Polackova, 2020). This transformation resulted in a rise in the food trade as a number of countries became more reliant on agriculture and food imports (Polackova, 2020).

The agricultural sector began to develop, prioritizing quantity production over product quality (Adamisin et al., 2017). The rise of productivist agriculture has been attributed to globalization; it describes an increase in large, well-capitalized corporate farms rather than in small-scale family farms (Robinson, 2018). These larger corporate farms are often located in fertile lowlands with good drainage, increasing the separation between them and smaller farms run by families (Robinson, 2018). The globalization of agriculture has resulted in fewer but larger farming units, as well as greater sales of farm products to food processing companies, and contract farming has gained in popularity, in which agricultural production is contracted between farmers and buyers (wholesalers, processors, and retailers) (Otsuka et al. 2016). As a result, farmers have been integrated into a system in which agricultural activities are often distant from the end user, and which rewards large-scale production of standard products which can be easily processed and shipped to local and global markets (de Roest et al. 2017). Agricultural commodities are now being consumed at a far greater distance from the place of their production, where many of their environmental impacts are felt (Virah-Sawmy et al., 2019). Thus, the spatial distance between where agricultural commodities are consumed and where they are produced has increased with the globalization of food systems (Oosterveer & Sonnenfeld, 2012). A common example of this gap is soybean and palm oil cultivation: both crops are mainly cultivated in the tropics but supplied to northern markets, such as Europe (Virah-Sawmy et al., 2019).

The impacts of globalization on agriculture and food security can be examined from various perspectives. When we consider international trade, the transportation of goods results in the emission of pollutants into the atmosphere, leading to disruptions in ecosystems and contributing to climate change worldwide (Polackova, 2020). Middle-income countries have raised several concerns regarding globalized agriculture, mainly because of the damage it causes to the environment due to the use of pesticides, herbicides, and fertilizers, as well as the inhumane treatment of animals (Thompson et al. 2017; Hirst et al. 2015). Several studies have also suggested that monocultures as well as fast food expansion around the world might threaten food security, causing an increase in consumption of processed foods with poor nutritional value as well as a weakening of local food traditions and cultures (Lawrence & McMichael 2014; McIntosh 2013).

In order to ensure food security, sustainability, and competitiveness in the economy, society must take a responsible approach to agriculture without destroying the world's biomes (Polackova, 2020; Robinson, 2018). As a response to the drawbacks of productivism, a counter-current known as post-productivism emerged, which emphasizes environmental values and entails agrarian policy initiatives that promote small-scale, environmentally friendly, and sustainable farming. This approach prioritizes meeting local and regional needs (Tilzey & Potter, 2008). For example, unnecessarily transporting products halfway across the globe that a country can produce locally using domestic resources should be avoided. An agrarian policy should meet the population's demand for adequate access to high-quality food while considering regional disparities and promoting socially responsible practices in areas such as human rights, labor standards, and environmental protection (Polackova, 2020). It was mostly the European Union and North America that implemented these initiatives, which generally consisted of payments to farmers for environmental services (Raymond et al. 2016, Robinson 2006).

2.2 Sustainable Food System

Global population growth, urbanization, globalization, and climate change are factors that are increasingly putting pressure on food systems in various parts of the world, both in developing and developed countries (Nyström et al., 2019; Nguyen, 2018). For almost 30 years, solutions have been sought to cope with the rapid changes in food systems, which have not always led to positive results but to potentially negative consequences for food security and adequate nutrition in different countries around the world (Enthoven & Van den Broeck, 2021; Nguyen, 2018). For example, nowadays, the food retail sector offers more and more products imported from distant regions that are highly processed with a high caloric content but a low nutritional value (Nguyen, 2018).

In 1996, farmers' organizations from around the world encountered and discussed the challenges of safeguarding socially and environmentally sustainable food production (Timmermann et al., 2018; Via Campesina, 1996). What resulted from this meeting was the development of the Declaration on Food Sovereignty (Timmermann et al., 2018; Via Campesina, 1996). Food sovereignty is defined as the "right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Wittman, 2023: p. 474).

As food sovereignty is understood to be a concept that evolves over time, the Declaration on Food Sovereignty was developed with the intention of being updated and adjusted in response to changing social and environmental conditions, as well as for technological capabilities changes (Timmermann et al., 2018). In the latest revisions, principles related to consumer sovereignty have been included because of the gradual shift in food production from supply-driven to demand-driven (Korthals, 2001). According to certain studies, the food value chain is typically buyer-driven and relatively long in both production and retail chains (de Backer and Miroudot, 2014; Fally, 2012).

To deliver food to consumers, the food supply chain relies on the collaboration of three main sectors: agriculture, food processing, and distribution, as well as various stakeholders such as farmers, processors, traders, and retailers (Augère-Granier, 2016). It is a common problem in the food supply chain to have an imbalance in negotiating power due to the fact that small farmers and food processors, who have no access to the market except through large buyers, have to sell at extremely low prices to gain access (Augère-Granier, 2016). This puts pressure on the pricing and margins of agri-food products (Augère-Granier, 2016). The development of a sustainable food system involves the addition of positive value along the economic, social, and environmental dimensions (see Figure 1) (Nguyen, 2018: p. 4):

- Economically, a food system is considered sustainable if all stakeholders in it can economically or fiscally sustain its activities, including wages for workers, taxes, profits for companies, and improvements to the consumer food supply.

- Food systems are considered sustainable on a social scale when the economic value added is distributed evenly among all groups, including vulnerable ones, and also, for example, when the entire population has access to a healthy and nutritious food diet and when the labor conditions are equally good for everyone.

- In terms of the environment, sustainability is reached by ensuring that food system activities do not negatively affect the natural environment (biodiversity, water, animals, etc.).

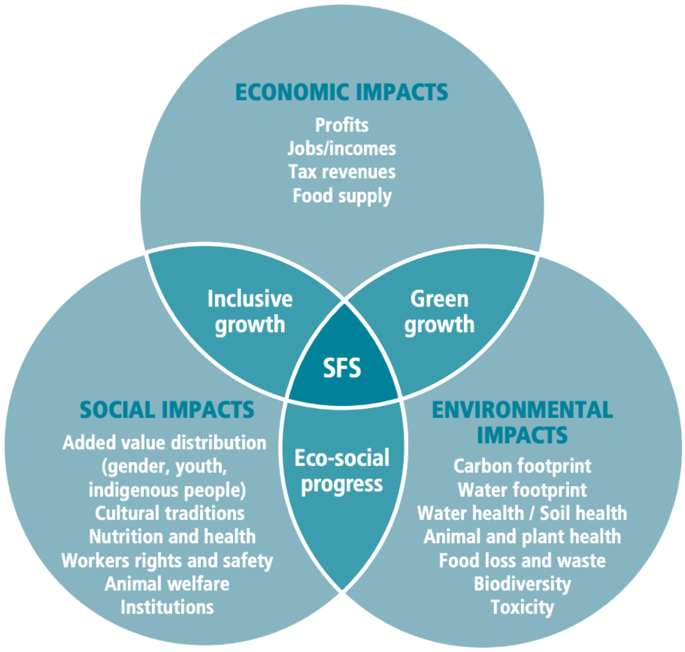

Figure 1: Elements in the sustainable food system. Source: Nguyen (2018).

SAPEA (Jackson et al., 2020: p.68) defines that a food system is sustainable if it "*provides and promotes safe, nutritious and healthy foods of low environmental impact for all current and future EU citizens in a manner that itself also protects and restores the natural environment and its ecosystem services, is robust and resilient, economically dynamic, just and fair, and socially acceptable and inclusive. It does so without compromising the availability of nutritious and healthy food for people living in or outside the EU, nor impairing their natural environment*". A transition toward a more sustainable food system depends heavily on the available resources, the goodwill of consumers and producers, and the level of education of those consumers and producers (Timmermann et al., 2018).

The development of local food systems is seen as having excellent potential for the development of sustainable food systems. This is because, for example, local economies can keep money in their regions instead of investing in other distant places (Enthoven & Van den Broeck, 2021; De Schutter, 2017; Kneafsey et al., 2013). However, if diets become more regionally focused and the food self-sufficiency of a country increases, food supply chains can be shortened, allowing the food system to become more resilient and sustainable (Vicente-Vicente et al., 2021). Short food supply chains are supported by extensive good practice evidence (Millard et al., 2022). They may be more sustainable than long supply chains due to the proximity of resources and processing, which makes their environmental impact small (Thomé et al., 2021; Kessari et al., 2020; Vittersø et al., 2019; Grando et al., 2017). They connect food producers with consumers, constructing a transparent supply chain where power is fairly distributed among the actors, and by doing so, social sustainability can be achieved (Thomé et al., 2021; Kessari et al., 2020; Vittersø et al., 2019; Grando et al., 2017).

Local food supply chains are fundamental to supplement the global market and maintain normal supplies of agricultural products during emergencies (Murphy et al., 2021). It is important to improve food policies and production pathways at the local level. This will benefit present and future generations, nature, and people both locally and in other parts of the world (Grey & Patel, 2015; Godfray et al., 2010). Over the past 30 years, several researchers have reported on the importance of developing local food systems to create a more resilient food system, but in addition to not making much progress in implementing this strategy, there has also not been sufficient research that confirms or refutes the benefits of its implementation (Enthoven & Van den Broeck, 2021). This began to change following the COVID-19 pandemic outbreak, which exposed the problems of current food systems to the general population as well (Enthoven & Van den Broeck, 2021; Stephens et al., 2020).

In the European Union (EU), a short supply chain is defined as a "supply chain involving a limited number of economic operators, committed to cooperation, local economic development, and close geographical and social relations between producers, processors and consumers" (Augère-Granier, 2016: p. 3). In 2020, the European Commission set up the "Farm to Fork Strategy," intending to shorten the food supply chain by strengthening the resilience of food systems at the regional and local levels, and reducing dependence on products that are produced far away, which imply long transportation to get to European markets (Enthoven & Van den Broeck, 2021; European Commission, 2020).

A local food system does not have a common definition, mainly because the "local" scale is interpreted differently around the world but is usually interpreted in terms of distance from the point of production to the point of sale (Enthoven & Van den Broeck, 2021; Augère-Granier, 2016). For example, according to the US Food, Conservation, and Energy Act (2008), a local food system is defined as one that has its products produced, sold, and processed within an area that is less than 644 km from the production site (Enthoven & Van den Broeck, 2021). While according to the EU regulation, a food system is defined as local when the foods are produced, processed and sold within a radius of approximately 20 to 100 km (Kneafsey et al., 2013). Globally, data on local food sales volume and value, as well as types of commodities, are largely missing (Enthoven & Van den Broeck, 2021).

The transition to a sustainable food system and the impact of specific initiatives, such as local food initiatives driven by different communities, have been assessed by several of European countries in recent years (Kugelberg et al., 2021; Galli et al., 2020; Guzman & Reynolds, 2019; Prost, 2019). The City Region Food System (CRFS) approach was developed by FAO and RUAF (with the collaboration of the CGIAR program and the Wilfrid Laurier University Centre for Sustainable Food Systems) (Blay-Palmer et al., 2021: p. 2) to:

(1) Understand urban-rural food systems and their vulnerabilities and strengths;

(2) enhance communication and cooperation across the rural-urban continuum through multistakeholder, multiscale collaboration, and system-centered planning;

(3) coordinate action to ensure the protection of livelihoods and food and nutrition security.

Socio-economically, the CRFS consists of all the actors, processes, and relationships that engage in food production, processing, distribution, and consumption in a determinated region (FAO, 2016).

Some research reports on the recent development and increase of short food supply chains in several European nations, with more and more farmers selling their products directly to consumers or collaborating with a minimum number of intermediaries (1-2 at most) (Augère-Granier, 2016). With the local food systems and short food chains, even small-scale farmers can gain greater bargaining power (they can retain a greater share of the product's market value), and consumers can easily trace the origin of the products they consume, which is not possible with the long supply chains or is very difficult to do (Augère-Granier, 2016).

In the longer food supply chains, large retailers, such as supermarkets, are the actors who make the most profit from the sale of food products, and consumers hardly have the opportunity to receive information about the production method or the compensation that the farmer received (Augère-Granier, 2016).

Consumer research has detected a change in eating habits and food preferences in the populations of developed countries, noting that an increasing number of consumers are now becoming attentive of the environmental and social problems related to the food that they consume, and consequently search for and buy more local products or products with sustainability certifications (Szenderák et al., 2022; Codron, 2005). So, the growing concern from the public and different stakeholders in the agribusiness sector has led several supermarkets to adopt greener strategies in managing their products; for example, the sale of local products in some supermarkets (e.g., Aldi, Carrefour, and Lidl) is increasing (Zwart & Wertheim-Heck, 2021; Augère-Granier, 2016). These supermarkets have engaged in local sourcing, generally for fruits and vegetables, by making contracts with local producers (Enthoven & Van den Broeck, 2021).

The implementation of local food systems and short food supply chains, although in high demand at the moment, is not easy to actualize (Enthoven & Van den Broeck, 2021). This is because even if there are farmers who want to start producing and selling their products directly to the consumer, they often do not have access to agricultural land, as prices (even just for lease) are constantly rising (Augère-Granier, 2016). In addition, farmers must have access to appropriate facilities for the harvesting and transformation of the products, and if these centers are not available, they have to invest and build them, which turns out to be very difficult, especially for small farmers, for whom the costs are even greater (Augère-Granier, 2016). Furthermore, farmers must obtain special permits, comply with regulations, and pass inspections in order to sell food products straight from the farm. These requirements further increase operating costs and make it particularly challenging to develop direct trade with consumers, especially for small farmers (Augère-Granier, 2016).

It is still unclear which policy interventions can effectively address the different food system challenges (Deconinck et al., 2022; Cattaneo et al., 2021). For example, some researchers have identified gaps in knowledge about the extent, characteristics, and drivers of policy issues, as well as a lack of knowledge about the effectiveness of different policy instruments or how different types of initiatives would affect the different stakeholders involved in the food system (Deconinck et al., 2022; Cattaneo et al., 2021; Reynolds, et al., 2019).

2.3 The Supermarket Revolution

Industrialization and globalization have led to an agricultural revolution and modernization, changing how agricultural products are supplied and consumed around the world (Bonanno & Busch, 2015). Latest studies have shown a shift in power from upstream firms to downstream ones in both production and distribution processes, where large-scale retail distributors are increasingly present and gaining power (Giovannetti & Marvasi; 2016; Lee et al., 2012). Recent years have seen a significant increase and consolidation of the global supermarket sector in both developed and developing countries, known as the supermarket revolution (Brown & Sander, 2007; Reardon et al., 2005). This revolution is characterized by large retailers gaining greater power and control over their suppliers because of international consolidations and aggressive pricing strategies (Brown & Sander, 2007). As a result, smallholder farmers are often excluded from the market due to a lack of economies of scale, a lack of knowledge of the markets, and limited investments in inputs and infrastructure. Food sales are now dominated by supermarkets at the expense of local small shops in developed countries (Brown & Sander, 2007).

The supermarket ideology is to buy massive quantities of food at very low prices in order to steadily increase profits and, in this way, it begins to restructure the agri-food supply chains (Bonanno & Busch, 2015). Today, supermarkets select only one broker and/or source products themselves, whereas in the beginning they worked with many of them, concentrating buying power on a few buyers but many sellers (Fuchs et al., 2009; Konefal et al., 2007; Bonanno & Busch, 2015). This concentration of power and the pursuit of lower purchase prices by retailers have led to a gap between what farmers are paid and the price of food in the supermarket, as well as the marginalization or closure of small farms and retailers (Carolan 2013; Young 2012; McMichael & Friedmann 2007). However, supermarkets began to grow in popularity among the global population as they offered large quantities of products at lower prices than smaller retailers, and consequently they quickly expanded in developed countries (Helander et al., 2024; Lawrence and Burch, 2007).

The supermarket revolution represents a major step toward the enhancement of livelihood and food security in some countries, but it also poses a serious threat to local agriculture (D'Haese & Van Huylenbroeck, 2005). Supermarkets have begun to import agri-food products from very distant regions, thanks to the globalization of agriculture and food chains, and the justification for this practice is the ever-increasing demand from consumers to have agricultural products (especially vegetables and fruits) throughout the year and not only in the seasons when such products grow locally (Bonanno & Busch, 2015). However, this practice has begun to raise concern among NGOs, some consumers, and scientific researchers with regard to the large consumption of fossil fuels and the consequent greenhouse gas emissions that are creating various environmental problems (Helander et al., 2024; Lang et al., 2009). Moreover, even though supermarkets today are more concerned with the environmental consequences of their business practices, the production methods of the companies that supply these supermarkets are still unsustainable (Bonanno & Busch, 2015). This is because methods that prioritize quantity over quality of product and production, like monocultures and highly concentrated animal feeding operations, are still employed to produce the large quantities required by supermarkets (Weis, 2013). These methods have resulted in several environmental problems, including biodiversity loss and water pollution, to name a few (Weis, 2013).

In addition to environmental issues, there have been other criticisms regarding how supermarkets handle agricultural products (D'Adamo et al., 2023; Bonanno & Busch, 2015). One of the major problems found is food waste: in 2023, 30% of food produced was discarded. Specifically, 13% was thrown away between the collection and resale stages, while 17% was thrown away in households, food service, and retail services. Supermarkets in developed countries generate a significant amount of food waste because they consider some of the products unsuitable for resale if they do not meet consumer and retailer aesthetic standards. This highlights the inefficiencies present in the current food system (USP, 2018; USP, n.d.b.; USP, 2018; WWF, n.d.b.; Bonanno & Busch, 2015).

The presence of supermarkets is growing globally, which allows them to gain more control over the food market and obstructs the development of sustainable food systems (Breed, 1998). This is because their policies on the distribution and sourcing of agricultural products put a strain on the development of sustainable economies and undermine the development of local economies (D'Haese & Van Huylenbroeck, 2005; Breed, 1998). Supermarkets aim to have a diverse range of food throughout the year, with several types of fruit and vegetables available to customers at all times. The problem is that most of these products come from regions outside Europe, are produced in environmentally and socially unsustainable ways, and are sold to retailers at rock-bottom prices (D'Haese & Van Huylenbroeck, 2005; Breed, 1998). This leads to the destruction of local food industries, which impacts developing (producing) countries disproportionally, creates various environmental, economic, and social problems, and further delays the establishment of a sustainable food system (D'Haese & Van Huylenbroeck, 2005; Breed, 1998).

2.4 Food Self-Sufficiency and Food Security

The concept of food self-sufficiency refers to a country's ability to produce enough food to meet its population needs, and food security is defined as the "*access by all people at all times to enough food for an active, healthy life, and at a minimum includes the: 1) ready availability of nutritionally adequate and safe foods and 2) assured ability to acquire personally acceptable foods in a socially acceptable way*" (Campbell, 1991: p. 1), are topics that draw increased attention, particularly during times of crisis (Clapp, 2017; Campbell, 1991). During the COVID-19 pandemic, the weaknesses and dependencies of the current food system were exposed, demonstrating the need to develop sustainable and stable food system (Vittuari et al., 2021; Farrell et al., 2020; Garnett et al., 2020; Orden, 2020). Following the COVID-19 occurrence, several regulations were imposed in an attempt to decrease the spread of the virus, but these interventions created imbalances in all the market sectors worldwide, disrupting the economy at the global level (Sridhar et al., 2023; Kakaei rt al, 2022). One of the sectors that was most affected by these imbalances was the agricultural and food sector (Sridhar et al., 2023). Travel restrictions, lockdowns, and social distancing, among the many measures put in place, led to a decrease in the number of people active in agribusiness production, directly impacting both producers and consumers (Sridhar et al., 2023; Kakaei et al., 2022; Stephens et al., 2020; UN, 2020). Lockdowns in particular have caused the closure of different companies and industries or their limited operation, further impacting the global supply chain (Sridhar et al., 2023; Kakaei rt al, 2022; FAO 2020b). Even if a farm could proceed with activities, it could still be forced to stop production because it lacked inputs (fertilizers, seeds, pesticides, etc.) which were made by companies that had to close down or drastically reduce production, leading to low food production and food insecurity (Sridhar et al., 2023; Kakaei rt al, 2022; FAO 2020b). In some regions of the world, on the other hand (e.g., the U.S. and India), excessive production combined with rules that restricted trade and travel led to several farmers being forced to throw away their harvest (Poudel & Subedi 2020; WFO, 2020a). Therefore, COVID-19 decreased trade and agriculture, resulting in a sustained rise in food prices (Kakaei rt al, 2022). Regarding Switzerland's agricultural production during the pandemic, it can be seen that conventional production decreased, while organic production remained stable (2023e.; 2023f.). This may also be because organic production does not require as many inputs, so they were able to continue producing even in the face of a supply shortage. This fact brings up an important factor for farmers and their earnings. During the pandemic in Switzerland, farmers experienced a decrease in total agricultural production and earnings, but those of large retailers increased (FSO, 2023e.; FSO, 2023f.; FSO, 2023g.).

There have been numerous factors that contributed to food insecurity over the last decade, including climate change, population growth and food price increases (Sridhar et al., 2023). The reduction in different sectors of the food supply chain, including production, distribution, and income losses, has led to more people in the world suffering from hunger (Kakaei et al., 2022). Many factors inhibit the supply and demand of food, such as job losses, limited transportation systems, purchasing power, and income (Kakaei et al., 2022). There was a rapid spread of the virus, which affected the world economies and caused inadequacies in both the agriculture and industrial sectors, leading to a rise in food insecurity worldwide (Jámbor et al., 2020).

A more equitable and resilient food system can be built through local approaches to food governance that also consider the socioeconomic factors determining food behavior, as highlighted by the COVID-19 crisis (Blay-Palmer et al., 2021; Morley & Morgan, 2021; Zollet et al., 2021). The objective is to achieve stable food security so that also households with lower incomes can have more access to food (Sridhar et al., 2023).

2.5 Soybean

Soybean is a plant that originated in China and is considered as having a high-potential as it is a protein-based plant composed of nine essential amino acids that can be used in different industrial sectors of the market (Sohidul Islam et al., 2022; Boerema et al., 2016). Until the 18th century, this plant was imported from Asian countries to both the American and European continents; then, this trend started to change, and this plant has become one of the most extensively cultivated plants in numerous parts of the world (Sohidul Islam et al., 2022; Boerema et al., 2016). Soybean has attracted so much interest around the world because of its great flexibility, both in terms of growing regions, as it can be grown in different types of environments (thanks to various management practices available today), and in terms of application and use of the plant, as it can be used in different areas, such as in food (human or animal), medicine (using extracts), and industry (biodiesel, textiles, bioplastics, etc.) (Singh & Krishnaswamy, 2022; Sohidul Islam et al., 2022; Voora et al., 2020; Jennings et al., 2020; Shea et al., 2020).

Currently, there are over 1 million km2 of soybean cultivated worldwide, however, there are only three major producers that supply most nations nowadays, making soybean production concentrated on one continent (USDA, 2023; Jennings et al., 2020; WWF, 2014). These three producing nations are Brazil, the USA, and Argentina, with respectively 42%, 31%, and 7% of the world production (USDA, 2023; Jennings et al., 2020; WWF, 2014). Not only is this crop concentrated in only one region of the world, but it is also mainly managed by a few large-scale farmers, which account for 80% of total production, while the remaining 20% of soybean production is carried out by small-scale farmers (Voora et al., 2020). Its cultivation methods, long transportation chain, and production limited to only a few regions, have ultimately led to various environmental and social problems (Jia et al., 2020; Voora et al., 2020; He et al., 2019; Pendrill et al., 2019). Studies have highlighted the importance of finding solutions to soybean management issues, as it is a crop in high demand all over the world, and can have a good potential to ensure food security in different countries because it can be grown in different environments for different purposes (Siamabele, 2021; Anghinoni et al., 2021; Yao et al., 2020; Jia et al., 2020; Voora et al., 2020; He et al., 2019; Pendrill et al., 2019).

To meet the growing demand for soybeans in the various sectors in which this plant is applied, large land masses have been converted for cultivation (Voora et al., 2020). The main environmental problem is related to deforestation, as soybean appears to be a crop directly responsible for increasing global deforestation, especially in the tropical forests of South America, its highest-producing region (49% of global production) (USDA, 2023; WWF, 2020; Song et al., 2018; Curtis et al., 2018; Pimm et al., 2014). This deforestation has subsequently led to other environmental issues, namely increasing greenhouse gas emissions, important losses of terrestrial biodiversity, and degradation of ecosystem services (Song et al., 2018; Curtis et al., 2018; Pimm et al., 2014). WWF reports that it is not only forests that are being affected by the growing cultivation of this crop, but also that millions of hectares of grassland and savannah have been reconverted into agricultural environments for soybean cultivation (WWF, 2014).

Various researchers have also identified the occurrence of different negative social impacts concerning soybean cultivation (Liu et al., 2021; Jennings et al., 2020; Voora et al., 2020). This is because the cultivation is carried out mostly by large companies in large agricultural areas, where the employees are often exploited and forced to work and live in poor conditions with low wages, increasing their food insecurity (Voora et al., 2020). In addition, there have been various reports of people who not only worked but also lived near these cultivations, revealing serious cases of poisoning and other medical problems due to the excessive use of agrochemicals in the soy cultivations (Liu et al., 2021; Jennings et al., 2020). There is a lack of scholarly work focusing on sustainability issues and mechanisms for better governance in the soybean supply chain; moreover, the relationship between the mechanisms used to control the soybean supply chain remains unclear (Jia et al., 2020).

With the development of new technologies and the evolution of old ones, various methods, and management strategies to cultivate soybeans are available today, which can be more or less sustainable (Shea et al., 2020). However, the final decision on how to cultivate it depends on several factors, such as cost, the personal preference of each farmer or industry, or even the ongoing preferences of consumers (a very important aspect since it is then the consumer who buys the products) (Shea et al., 2020).
Soybean is a resilient plant without too many requirements but is sensitive to weed competition and drought, so in several countries, there are breeding projects underway for the development of weed-suppressive and drought-tolerant soybean varieties (which is the case in Switzerland) (Klaiss et al., 2020; Shea et al., 2020; Martin et al., 2019). Additionally, methods that promote environmental health, such as cultural rotation of different species (and families) of plants and intercropping, are increasingly being promoted, while also raising more and more awareness about the importance of developing an agriculture that is both ecologically and socially sustainable (Klaiss et al., 2020; Shea et al., 2020; Martin et al., 2019). Some practices considered environmentally sustainable for soybean cultivation are, for example, organic fertilization, little or no soil surface disturbance, intercropping practices, and agroforestry. These practices are considered sustainable because they can reduce greenhouse gas emissions, increase carbon storage in soils, promote biodiversity, and lower water losses (Song et al., 2018; Curtis et al., 2018; Pimm et al., 2014). The benefits of these practices are not limited to environmental aspects; they also directly affect farmers, who experience improved fertility in their soils and lower chemical residues in their products, as well as having less exposure to factors and products that are dangerous for the farmers' and workers' health (Liu et al., 2021; Jennings et al., 2020).
The current food chain needs to be reshaped by all participants, from producers to consumers, to facilitate a transition toward a more sustainable food chain (Willett et al., 2019). As a result of growing awareness on the part of private companies linked to the agri-food market, they are implementing more environmentally friendly practices to reduce the environmental and social impact of soybean products (WWF, 2014). This awareness is mainly the consequence of an increasing number of shareholders, customers, and NGOs who are raising concerns about the practices used in the agricultural sector and

their potential impact (WWF, 2014). A rise in certified commodities in each market, as well as a rise in certified production areas, has been observed (United Nations, 2023; Kusumaningtyas & van Gelder, 2019). Most of these certifications require the seller to prove that the soybean that they are selling has been cultivated in accordance with sustainable agricultural practices. The requirements for obtaining a soy certification are often quite extensive, but meeting these certification criteria can result in reduced harm to the environment and a reduction in social conflicts (Schilling-Vacaflor et al., 2021). In this way, consumers can be assured that the product they buy has been produced according to established rules and that compliance is monitored (WWF, 2014).

After World War II, international agreements were made between various nations regarding different sectors of the economy, including agriculture. As far as agriculture is concerned, one of the more well-known agreements is the Blair House Accords, which states that Europe would concentrate on grain production, while America would be responsible for protein plant cultivation (A.G., 2023). At one point, there was even a kind of temporary ban on Europe to prevent it from becoming too independent in the production of proteins. This situation led to a shortage of local proteins in Europe, forcing its different nations to import most of them (A.G., 2023). Currently, the European Union has implemented some initiatives to reduce the dependence on U.S. protein imports and increase local production, but although there has been much discussion over the years about a European strategy to promote protein crops, so far there has been little progress in their development (Official Journal of the European Union, 2023; Debaeke et al., 2022¸Wedeaux & Schulmeister-Oldenhove, 2021). Still, in 2022, most of the soybeans on the European market are produced outside Europe (75% of imports), mainly from the USA, Brazil, and Argentina (Official Journal of the European Union, 2023). However, while Europe is still very dependent on soybean imports, local cultivation is steadily increasing, with a production that nearly doubled in 10 years reaching a total of 2.69 million tonnes (Kuepper & Stravens, 2022). Five countries in particular are the largest producers, namely Italy, France, Romania, Croatia, and Austria, and together they have produced around 80% of the European soybean (Kuepper & Stravens, 2022: p.11).
In Europe, soybean is currently the commodity with the highest embedded deforestation rate, amounting to 89.047 ha/y, making it the second largest contributor to tropical deforestation and related emissions (Wedeaux & Schulmeister-Oldenhove, 2021). These rising concerns have led to the creation and implementation of an increasing number of soybean certifications, which concern environmental and social issues (UN, 2023; Kusumaningtyas & van Gelder, 2019). The Donau Soja organization foundation is an example of the European desire and commitment to decrease American imports and augment local protein production (A.G., 2023). Donau Soja is a multi-stakeholder, not-for-profit European organization supporting sustainable soybean production in Europe without the use of genetically modified organisms (GMOs) (Krön & Bittner, 2015). This organization gives certifications to various elements and steps in the soy food chain, from the seeds to the final products such as milk or tofu, promoting, among other things, cultivation methods considered sustainable from an environmental and social point of view (Donau Soja, 2024). Despite Switzerland's relatively small scale in global

soybean production and trade, Swiss protagonists had a major influence on the development of responsible soybean production standards, both with regard to imported products and production on their territory (Soy Network Switzerland, 2023). WWF reported that Swiss producers, retailers, and manufacturers, as members of several associations for sustainable soybean production (Danube Soja, RTRS, etc.), can make verifiable claims about the sustainability of their products by obtaining certification from these associations (WWF, 2014). These certifications are becoming increasingly popular in Switzerland because they can assure customers that the products they buy are sustainably sourced (WWF, 2014). Recent consumer survey found that Europeans are changing their eating habits and their food preferences, with more people becoming sensitive to the sustainability of their decisions and activities and which are increasingly choosing to consume a plant-based diet, utilizing vegetable protein products as meat substitutes in their diets (Szenderák et al., 2022; Smart Protein Project, 2021). The retail industry can help facilitate this shift in food habits by encouraging consumers to choose plant-based substitutes. Already today, fast-food outlets, supermarkets, and retailers are selling more plant-based meat alternatives in Europe and other developed countries. (Szenderák et al., 2022; Jung et al., 2022; Coucke et al., 2022).

As previously mentioned, the soybean supply chain still lacks scholarly work addressing sustainability issues and mechanisms for an improved governance, and also the relationships between the mechanisms used to manage it remain unclear (Jia et al., 2020). In Switzerland, currently there is no published data or information related to the number and location of soybean farmers, consequently the data cited in this thesis were received following a direct request to the Federal Statistics Office.

2.6 Aim of the Thesis & Research Questions

In recent years, how goods and services are produced has changed as a result of technological advances and reductions in transport and communication costs (Giovannetti & Marvasi; 2016). This work aims to examine the dynamics of soybean production in Switzerland within the context of promoting sustainable and resilient local food systems. The development of a local sustainable food system involves the addition of positive value along the economic, social, and environmental dimensions (Nguyen, 2018). Because of its high protein content, soybean is a significant agricultural crop with a presence in a lot of products and high global demand (Singh & Krishnaswamy, 2022; Sohidul Islam et al., 2022; Voora, et al., 2020; Jennings et al., 2020; Shea et al., 2020). As the world's population grows and food demand consequently increases, it is important to look for sustainable alternatives to animal food derivatives.
Switzerland and Europe have implemented various projects to reduce dependence on imported commodities, but both still heavily rely on soybean imports increasing the economic and environmental risk associated with this dependency (Gebhardt et al., 2022). By examining the challenges and opportunities associated with local soybean cultivation, particularly focusing on the economic, social, and environmental dimensions, this research also seeks to understand the complexities of promoting

sustainable and local production practices in Switzerland. It is important to improve food policies and production pathways at the local level because this can benefit present and future generations, nature, and people both locally and in other parts of the world (Grey & Patel, 2015; Godfray et al., 2010). To ensure a stable food supply also during emergencies, local food supply chains are fundamental (Murphy et al., 2021). The COVID-19 pandemic exposed the weaknesses and dependencies of the current food system, demonstrating the need to develop durable and stable food systems (Vittuari et al., 2021; Farrell et al., 2020; Garnett et al., 2020; Orden, 2020).

This research also aims to identify the key considerations for implementing local sustainable/organic farming practices to see if and how this practice can enhance environmental sustainability, strengthen food security, and support local agriculture. This thesis research can contribute to the understanding of how to promote more local resilient food systems and sustainable agricultural practices in Switzerland. Switzerland's commitment to sustainable soybean production can help to promote responsible practices throughout the soybean value chain, from production to consumption. Actually, without adequate information and practices, this crop can be very harmful to the environment and the local producing populations. In addition, changing consumption trends are leading to more vegetarian diets, so care must be taken about where and how these plant products are sourced. Industrialization and globalization have led to an agricultural revolution and modernization, changing the way agricultural products are supplied and consumed around the world (Bonanno & Busch, 2015). Recent studies have shown that there has been a shift in power from upstream to downstream firms in both production and distribution processes, where large retailers (supermarkets) are increasingly present and gaining power (Giovannetti & Marvasi, 2016; Lee et al., 2012). This has created challenges for developing sustainable food systems because they are becoming more and more dominant (Breed, 1998). As a member of various associations such as RTRS and Donau Soja, Switzerland can share its findings, practices, and information on sustainable soybean production with other countries as well. Encouraging stakeholders, such as companies and consumers, to prioritize sustainably sourced soybean products by creating a demand for sustainable agricultural practices can influence market dynamics, and consequently help reduce the environmental and social impact of soybean production.

For all these reasons, this thesis will try to answer to the following questions:

What are the challenges and opportunities for local soybean production in Switzerland, considering the economic, social, and environmental dimensions of a sustainable food system?

- Which regions in Switzerland contribute to soybean production, what is the production volume, and what are the primary purposes for which soybeans are grown?
- What are the factors that Swiss farmers need to consider when shifting towards more sustainable methods of soybean production, specifically within organic farming practices?
- What strategies can be implemented to encourage the transition to a local and sustainable food system in Switzerland?

3. Methods

For this research, an interpretive methodological approach is applied within qualitative social research, because it takes into consideration the context and the different subjectivity of the interviewer and interviewee in the process of knowledge production (Reuber & Gebhardt, 2011; Flick, 2009). Researchers conduct qualitative research to understand the experiences, feelings, perspectives, and evaluations of participants in relation to the surrounding society, while also explaining how things work in some particular contexts (Vanclay, 2015; Flick, 2007; Mason, 2002), in this specific case, in a Swiss context. Rather than testing what is already known and developing new theories, this research aims to examine the challenges and opportunities related to local soybean production in Switzerland, with a focus on the economic, social and environmental dimensions of a sustainable food system, while also analyzing current offerings in promoting the sustainability of the country's food system. This is done because there is no such research available at the moment. The direct experience of the stakeholders is particularly important for understanding the current dynamics of Swiss soy farming and for gaining a broad understanding of the federal government's, farmers', and retailers' past, present, and future commitments regarding sustainable soybean production (Richter, 2019).

During the writing of this work, online resources were also used to translate and correct the grammar of the text. The online translation software DeepL (free version) was used for the translation of parts of the text, as it is considered a reliable tool by the Swiss Federal Administration (Federal Council, 2023). However, the free version only allows a certain number of translations, so when it was not possible to use DeepL, it was decided to use an AI system, more specifically the ChatGPT to do the translations. To improve the grammatical correctness of the text, the software Grammarly was used, which is an instrument also approved by the IT Centre of the University of Zurich, and also in this case, the ChatGPT system has been used to improve the grammar of the text (UZH, 2024).

The starting point of this research consisted of a literature review on soybean cultivation in Switzerland as well as a more general investigation of soybean production and chain. During the first step of this qualitative research, information was drawn from existing literature to gain context knowledge about the research topics, and to understand and see which statements and observations were made until today (Flick, 2009). For the literature review, academic databases of peer-reviewed literature were used; among them are Web of Science, Scopus, PubMed, and JSTOR. Newspaper articles were also evaluated to gain additional information on the current events in the agricultural sector in Switzerland. The literature review also serves as a background for the following empirical fieldwork that is conducted with experts and farmers from the Swiss agricultural sector, as it provides the initial information for creating the interview guidelines for the data collection (Templier & Paré 2015). The second step consists of the empirical fieldwork preparation by looking for people who can provide relevant data and thus contribute positively to research. The third step involves the empirical fieldwork research, which is applied to gain direct information from the persons involved in the agricultural sector, and develop conclusions from their knowledge and practices (Flick, 2009). The empirical fieldwork research is further divided into two more steps: the first consists of the data collection with the help of qualitative interviews, while the second is the inductive qualitative content analysis, which is done by applying the Grounded Theory methodology (Kuckartz, 2014; Flick, 2009).

3.1 Data Collection: Fieldwork Overview

Before starting with the empirical fieldwork, it was necessary to decide the type of qualitative interviews to be prepared and conducted. This thesis aims to understand the current opportunities and challenges related to soybean cultivation in Switzerland and the implementation of sustainable local food systems, so it was decided to carry out several interviews with representatives from institutions surrounding the Swiss soybean commodity and food chain, with a particular interest for those involved in the local soybean food chain. It has been decided to implement data collection based on two types of qualitative interviews:

1) The problem-centered interview (PCI) following Witzel (2000) with Swiss soy producers
2) The expert interview with representatives from institutions surrounding the Swiss soybean commodity chain.

Once the type of interviews to be conducted had been decided, the next step was to search online for potential interviewees. It was chosen to start with the expert interviews to gather general information about soybeans (quantity produced, places of production, etc.) and with the hope of obtaining information related to which farmers grow soybeans to interview them, as it turned out difficult to find such information online. Data collection using expert interviews is a popular method in qualitative social science because it provides researchers with the opportunity to collect direct knowledge about a specific field and gain initial insights for the next step (Flick, 2009). The use of expert interviews can be a great way to explore or outline a topic, develop a thematic structure, and generate hypotheses around it (Flick, 2009). They can be used to collect contextual information that complements other methods' insights (Bogner & Menz, 2002). This makes it possible to fill knowledge gaps in existing literature and, thus, develop theories about a particular issue. (Flick, 2009).

There are various definitions available and different ongoing debates about what criteria should be considered when defining someone as an expert (Döringer, 2021; Gläser & Laudel, 2010). In this thesis, an interviewee is defined as an "expert" because they are considered to have specific knowledge in a particular field or topic of the Swiss agricultural sector (Döringer, 2021; Kaiser, 2014; Meuser & Nagel, 2009). Various representatives of offices and organizations relevant to the Swiss agricultural sector whose functions, experiences, and knowledge match the objectives of this master's thesis were selected for the interviews. This is done because the availability of people with specific knowledge about soybean cultivation in Switzerland is limited, without considering who cultivates it. This methodological approach aims to compensate for the limited presence of practical experts on soybean cultivation in

Switzerland while still offering an empirical database through in-depth interviews with representatives of various market sectors. After sending out interview request emails and receiving confirmation from the contacted persons, interview guidelines were prepared, so that questions could be ready in case the interviewees did not cover the established topics during their interview. The interview guideline for the expert interviews has a stronger directive function because of the time pressure and the narrow scope of its application (Flick, 2009). The prior knowledge acquired through the literature review was used to create and structure the interview guidelines, and the questions were phrased to stimulate information that had not emerged during the literature review.

The final number of experts interviewed was influenced by the willingness of the representatives contacted to be interviewed (see Table 1 for the final overview of the interviews that were conducted with the experts). Interviews with experts were conducted during the period between July and September 2023. This period was selected because, during the summer, many offices closed and many people went on vacation, so there was a need to lengthen the period devoted to interviews with experts.

Institution	**Role in the agricultural sector**	**Reference in text**
Agroscope	Research	A.G.
Federal Office of Agriculture	Legislation	C.D.
Swissgranum	Disclosure/data collection	E.F.
Fédération Suisse Des Producteurs Des Céréales	Farmers and processors organization	G.H.
Moulin Rytz	Collection and distribution	I.L.
Ti Gusto	Processing	TiGusto
Union Suisse Des Paysans	Farmer organisation	M.N.
FiBL	Research in organic	O.P.

Table 1: Expert interviews conducted in 2023.

The PCI is based on the idea that subjective viewpoints are important (Flick, 2009). Research is conducted based on a process model, seeking to develop theories, such as Strauss and Corbin's Grounded Theory (1990). The PCI with farmers made it possible to collect data from their direct experience of growing soybeans so that it could be understood what obstacles they encountered during their cultivation, what positive opportunities were offered to them, and what could be improved.

The research and contact with farmers were done in two stages. Initially, an online search was conducted to identify potential soybean producers (through search engines, blogs, social networks, etc.). Considering the limited availability of online information on who grows and where soybeans are grown, the experts were asked during the interviews if they could provide any farmer contacts or places where they are aware of farmers growing soybeans. Unfortunately, every expert interviewed stated that they could not share such information for privacy reasons, so alternatives had to be sought to obtain it. Subsequently, during each interview conducted with a farmer, they were asked if they would and could provide additional contacts of farmers who grow soybeans; some interviewees provided such information, while others did not, but only because they said they did not personally know any other farmers growing this crop. After several emails and phone calls, a total of 10 soy farmers throughout different language regions of Switzerland were selected for the interviews (from the French-, German-, and Italian-speaking communities in Switzerland). This choice aims at the involvement of interviewees from different regions to contribute to a diverse representation of the experiences and perspectives of Swiss farmers. Table 2 provides details on the farms interviewed.

The interviews conducted with farmers extended from October to the end of November 2023; this period was selected due to the farmers' busy schedules. The decision to focus on this period was influenced by the initial feedback received during the first contact with farmers, which took place in late August. At that time, the farmers indicated that the most suitable time frame for their participation in the interviews would be after the harvest work was completed, i.e., starting in October. The choice of this time window made it possible to meet the needs of the interviewees, ensuring maximum participation.

Farm reference in text	**Region**	**Type of soy**	**SAU**	**Administration**	**Farm Label**
F.V.	Schaffausen	Human food	?	Family	BioSuisse
B.H.	Ticino	Fodder	40 ha	Family	Suisse garantie / IP Suisse
A.B.	Ticino	Human food	140 ha	Family	BioSuisse
E.V.	Vaud	Fodder	50 ha	Family	Suisse garantie / IP Suisse
M.M.	Ticino	Human food	90 ha	Family	BioSuisse
F.C.	Vaud	Human food	20 ha	Family	BioSuisse
F.J.	Vaud	Human food	30 ha	Family	BioSuisse
F.M.	Vaud	Fodder	38 ha	Family	Suisse garantie / IP Suisse
L.C.	Ticino	Human food	50 ha	Family	BioSuisse / Demeter
C.C.	Ticino	Collector and seeder	4.67 ha	Family	Suisse Garantie

Table 2: Farmers' interviews conducted in 2023.

Four tools can be used to implement a problem-centered interview: guidelines, questionnaires, a tape recording of the interview, and a postscript (Witzel, 2000). For this research, only interview guidelines and tape recordings were used. Once the farmers had agreed to participate, the guidelines for the interviews were drawn up based on the farmer's method of production (conventional or organic). The interview guideline was created to support the narrative developed by the interviewee, and as mentioned by Flick (2009), in the case of a stagnant conversation or unproductive discussion, it would give the interview a fresh direction. The prior knowledge acquired through the literature review was used to create and structure the interview guideline, while tape recordings were made to not miss any information given by the interviewee. The interviews were conducted in three different languages: Italian, French, and German, and the language of the interview depended on the interviewee's preferences.
Before each interview, permission was asked and obtained from the interviewees to record the conversation, and everyone has been informed that the recordings will not be distributed to third parties.

All interviewees agreed to the recording of the interview. However, one of the experts who agreed to be recorded for the interview specifically asked that no direct quotes be used, so his wish was respected, and his direct quotes were excluded from this work. Direct quotes have been translated into English, while also trying to keep the translation as close as possible to the literal meaning of the original language, so that readers can understand what the interviewees were saying. In addition, it was decided to anonymize the interviewees to protect their identities and, at the same time, allow them to share information without having to worry about consequences from third partites. In the text, each interviewee is cited with an abbreviation and the year in which the interview was conducted (see Tables 1 & 2 for the abbreviations).
The main challenge, and at the same time the major limitation of the empirical fieldwork, relates to the fact that when searching for farmers who grow soybeans in Switzerland, little data is available, as very few farms have websites or actively share information online. Since it was not possible to obtain such information through institutional channels either, alternative strategies had to be used. Specifically, the search for farmers willing to participate in interviews relied on personal contacts provided directly by other farmers. This methodology proved to be quite effective, allowing for a direct link with the farming community and overcoming at least some of the challenges associated with the limited availability of online information. However, it must be taken into consideration that the number of respondents is not sufficient to be able to draw precise conclusions on the research topic, as there could be many more opinions and points of view among the different actors in the soybean food chain, as well as more variation between advantages and disadvantages in different Swiss regions. In the future, more extensive research should be done in the area, including interviews with retailers such as Migros or Coop, to better understand certain preferences or trends in the market.

3.2 Data Analysis: Qualitative Content Analysis

This master's thesis applies the Grounded Theory methodology to the inductive Qualitative Content Analysis (QCA) to analyze the empirical data derived from the interviews (Kuckartz, 2014).

The decision to combine these two types of data analysis is because both Grounded Theory and QCA follow coding processes, but the goal of QCA is to extract categories from data rather than finding relationships between categories or building theories, while Grounded Theory analyzes concepts by labeling them, categorizing them, identifying their categories, finding relationships among them, and eventually if needed, it can generate theories based on them (Cho & Lee, 2014; Strauss & Corbin, 1994).

The interviews aim to provide an overview of the difficulties farmers face and the actual opportunities present for them in the agricultural production in Switzerland, with particular interest for soybean production. In other words, its aim is descriptive and not about the development of hypotheses or a theory. The recordings of the interviews were transcribed manually or by using the transcribe function available in Microsoft Office, and then corrections were made manually when relistening to the recordings. The resulting transcriptions were treated for the qualitative content data analysis by using a coding procedure analysis and the MAXQDA software to create different categories based on the analysis of the interview transcriptions (Flick, 2009). Typically, according to Kuckartz (2019), the inductive QCA consists of six steps:

Step 1:	Preparing the data, initiating text work, research question.
Step 2:	Forming main categories corresponding to the questions asked in the interview.
Step 3:	Coding data with the main categories.
Step 4:	Compiling text passages of the main categories and forming subcategories inductively on the material; assigning text passages to subcategories.
Step 5:	Category-based analyses and presenting results.
Step 6:	Reporting and documentation.

An inductive approach is chosen for the data analysis because prior knowledge regarding Swiss soybean production is limited or fragmented, and the Grounded Theory is appropriate when no or little theory exists before the analysis (Suddaby, 2006; Martin & Turner, 1986). When combining the QCA with an inductive Grounded Theory methodology, the first step (Step 1) is switched to open coding (see Figure 1) (Flick, 2009). Open coding involves the analysis of the interview data, which is done by breaking down interview transcripts analytically and conceptualizing them. Then, based on what is discovered during the transcript reading, codes are assigned in relation to the phenomena and facts discovered (Kuckartz & Rädiker; 2019; Flick, 2009). Coding can have varying levels of accuracy, which can be done with lines, sentences, paragraphs, or entire texts from interviews (Flick, 2009).

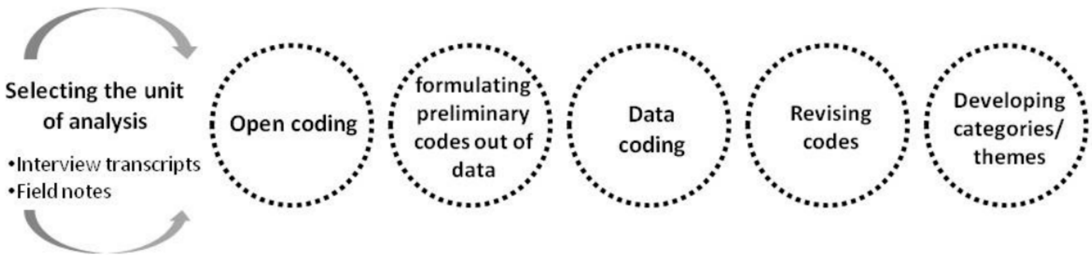

Figure 2 Procedure used in an inductive approach to qualitative content analysis. Source: Cho & Lee (2014).

After the transcriptions were imported in MAXQDA, the various categories were formed considering the information and phenomena reported during the interviews and also the elements of the interview guidelines, as in several cases they already covered certain topics and areas of interest. The coding analysis and formation follow an inductive data-driven approach and are a rather subjective step of analysis, as the creation of the categories can vary from person to person depending on their experiences and knowledge (Kuckartz & Rädiker, 2019). Furthermore, coding turned out to be a multistep process; in the first round of coding, the interview texts were analyzed and coded line by line. Then, over time and through deeper text analysis, new categories and subcategories emerged, and others were reorganized or changed. Also, Kuckartz & Rädiker (2019) state that there are many steps involved in the process of creating categories and subcategories. For this analysis, the MAXQDA software turned out to be particularly useful; with the use of the 'Creative Coding' module, it was possible to visualize the codes obtained through open coding and subsequently reorganize them (Kuckartz & Rädiker, 2019).

4. Agriculture in Switzerland

The globalization and industrialization of the agricultural sector permitted the development of new techniques and technologies, which consequently led to an increase in food production, but these implementations did not come without side effects (Nicolopoulou-Stamati et al., 2016; Pimentel & Peshin, 2014; WHO, 1990). This development also caused different environmental problems in different parts of the word, such as soil degradation and biodiversity loss due to the intensive agricultural work (Nicolopoulou-Stamati et al., 2016; Pimentel & Peshin, 2014; WHO, 1990). For example, various researchers have identified the increasing presence of pesticide residues in various foods (both for humans and animals) and in the drinking water of different countries (Nicolopoulou-Stamati et al., 2016; Chourasiya et al., 2015; Lorenzin, 2007). Researchers state that if this degradation of soils and environmental health continues at this rate, there could be major problems for the agricultural sector in the future, because without healthy and fertile soils, it will no longer be possible to effectively cultivate the land, and therefore food production will decrease (Gilgen et al., 2023; FAO, 2017). This means that to cope with the growing population and the increasing need for food, there is a need to improve agricultural production and implement sustainable production methods (Gilgen et al., 2023; Calicioglu et al., 2019; FAO, 2017; FAO, 2017; Nicolopoulou-Stamati et al., 2016).

In order to practice agriculture, a person in Switzerland must follow certain laws determined by the Federal Constitution (Articles 104 and 104a) and the Federal Law on Agriculture, which have the goal of enabling Swiss producers to engage in agriculture that contributes significantly to a safe and regular food supply while also taking into account the health of the environment (Gilgen et al., 2023). There are instruments of the State that serve to influence the sustainable development of national agriculture; these instruments are for example the direct payments paid by the State to a farmer in compensation for certain services that the farmers have implemented (Landis & Landolt, 2018). According to Gilgen et al. (2023), however, the environmental goals of the Federal Constitution and of the Federal Law on Agriculture are very ambitious and difficult to reach for Swiss agriculture, as the local population is continuously growing (in about 100 years, the Swiss population has almost tripled to 8.9 million in 2023), and thus it will be increasingly difficult to comply at the same time with the environmental and food security objectives (FSO, 2023d.). Gilgen et al. (2023) also points out that although the Federation talks about the need and desire to implement more sustainable agriculture and has proposed several environmental goals over the years, none of these goals has been fully achieved to date (Gilgen et al., 2023; FOEN & FOAG, 2016).

At the moment, Swiss agriculture contributes to nearly half of the national food security, with a gross National Self-supply Rate (NSR)[1] of 52%, while the net NSR amounts to 45% (FOAG, 2023a.). The higher levels are reached for dairy products (107%) and meat (78%), while for cereals, the coverage of national needs amounts to 39% (49% in the case of feed grains), and for legumes it stood at 39% (FOAG, 2023a.). As can be seen, plant crops play a significant role in Swiss agricultural production, and they supply not only food for humans, but also for animals (FOAG, 2023a.). Farmers cultivate many different species to meet the various market requests, for example, bread cereals (wheat, spelt, rye, etc.), feed

[1] FOAG (2023a.) defines the National Self-supply Rate (NSR) as the share of domestic production in total food consumption in Switzerland, and the total consumption is calculated by adding the import values to the local production values and then subtracting the exports and stock variations values (production + imports - exports & stock variations). There is a distinction between gross rates and net rates: when calculating net self-sufficiency, the proportion of domestic animal production that was produced with imported feed is deducted from the domestic animal production (FOAG, 2023a.). During 2021, the NSR decreased sharply to 52% (gross) and 45% (net) (FOAG, 2023a.).

cereals (wheat, maize, oats, etc.), oilseeds (rapeseed, sunflower, soya, etc.), and protein crops (peas, fava beans, lupins, etc.) (E.F., 2023; M.N., 2023; C.D., 2023; FSPC, 2023c.).

Scientists and stakeholders are constantly exploring the different barriers that are limiting the implementation of more sustainable agriculture and food systems (Muhie, 2022). Sustainable agricultural approaches and practices "have to provide solutions for producing food as well as other agricultural products at a low environmental cost that does not threaten food accessibility and availability, as well as future generations' general well-being" (Muhie, 2022: p. 1). In order to increase agricultural sustainability, it is important to identify and analyze the existing strategies that are designed to develop more sustainable agriculture, and which have clear environmental, economic, and social goals (Muhie, 2022; Clémençon, 2021; Armstrong & Kamieniecki, 2019). However, most of the current sustainable agricultural strategies focus on ecosystem sustainability (Muhie, 2022).
In this chapter of the thesis, an exploration of the system of Direct Payment and the Required Ecological Performances (PER) is conducted to show what the current agricultural policy in Switzerland is, in relation also to the promotion of sustainable agriculture and what role it has in Swiss agriculture. Then, the cultivation methods adopted in Swiss agriculture will be introduced and analysed to offer an overview of the main methods and their characteristics in the Swiss context. This is followed by details about the area currently under cultivation and the evolution of the farms to provide an overview of the current situation in the country and the role of farmers in national food security. Identifying and analyzing the progress of the agricultural practices and policies in Switzerland can contribute to the research on the potential benefits and challenges of implementing sustainable and/or organic practices in soybean production (Muhie, 2022; Clémençon, 2021; Armstrong & Kamieniecki, 2019). At the end of the chapter, an analysis and introduction to oilseed production in Switzerland will be made as a lead-in to the following chapter, which focuses on soybean cultivation in Switzerland.

4.1 Direct Payments and Required Ecological Performance (REP)

Direct payments are a key element of Swiss agricultural policy and, as will be explained later in the text, can influence production methods in agriculture due to the economic considerations of farmers.
The system of direct payments is defined by the Federal Law of Agriculture (LAgr., art. 11 to 25) and by the Ordinance on Direct Payments in Agriculture (OPD, 2013). Direct payments are subsidies paid by the Swiss state to farmers based on the services they provide, which the farmers have to demonstrate that they implemented, but there are also some basic rules that a farmer must follow to be eligible for these payments (OPD, 2013):
i) The farmer must be a physical person and be resident in Switzerland;
ii) The farmer must be less than 65 years old;
iii) The farmer must have an agricultural education;

iv) The farm requires a minimum workload of 0.20 UMOS (standard labor unit);
v) At least 50% of the work is carried out by the farmer who owns the agricultural holding;
vi) The ecological performance requirements (PER)[2] *are met throughout the entire agricultural holding.*

The goal of these rules, and therefore of direct payments, is to ensure that Swiss farmers produce in accordance with basic principles of environmental sustainability while also meeting market requirements and being able to contribute efficiently to the national food supply (Landis & Landolt, 2018; Federal Council, 2012). According to a study commissioned by BirdLife Switzerland, Greenpeace, Pro Natura, and WWF Switzerland, these contributions have a positive impact on the development of sustainable Swiss agriculture (Landis & Landolt, 2018).

Up until 2014, direct payments were classified into general and ecological payments. However, from the beginning of 2014, seven types of contributions have been distinguished: cultivated landscape, food security, biodiversity, landscape quality, production system, resource efficiency, and transition contributions (Landis & Landolt, 2018; OPD, 2013). This change resulted from a federal decision to give these payments to farmers who provide performances of public interest, but whose are not highly profitable in the market system, in order to support local production and simultaneously promote more sustainable agricultural practices (Landis & Landolt, 2018). For example, farmers who cultivate in areas that are unfavorable for agriculture or who introduce practices that improve animal welfare on the farm, can receive direct payments (Landis & Landolt, 2018; OPD, 2013).

The agricultural laws established by the Federal Council serve to develop an agricultural strategy that meets various objectives, including environmental, social, and economic ones. However, these goals, on some occasions, may conflict with each other (Landis & Landolt, 2018). The interpretation and implementation of Swiss agricultural policy instruments (such as direct payments) in specific sectors can affect other areas as well (Landis & Landolt, 2018). In a study, the authors presented examples of measures that were designed to guarantee food security for the Swiss population (art. 104, al. 1, let. A, Cst.) but which can sometimes be interpreted or implemented in a way that damages the natural resources (Landis & Landolt, 2018: p.18). Likewise, measures designed to promote biodiversity (such as Art. 70a & 73 LAgr) could result in a decrease in agricultural production, which then negatively affects the goal of securing food supply for the population (Landis & Landolt, 2018: p.18).

Similar concerns were raised in the interviews conducted for this thesis. These concerns have started to rise because of a Federal Council decision regarding agricultural production and environmental

[2] The PER requirements define the rules for the sustainable development of agricultural holdings by imposing the application of good agricultural principles (if someone wants to obtain financial support from the State) (A.G., 2023). These needs cover various fields of agriculture; for example, it's required that farmers carry out fertilizer and manure balances, that they respect regulatory distances between crops with plant protection products and the nearby watercourses, that they have a minimum rotation of four different plant crops (with maximum surface limits for each crop), that they have a determined surface dedicated to biodiversity promotion, and that they use only a limited quantity of phytosanitary products (G.H., 2023; M.N., 2023 ; A.G., 2023; OPD, 2013).

protection, which states that from January 2024 all Swiss agricultural holdings will be required to dedicate at least 3.5% of their open land to the promotion of biodiversity (OPD, art. 14a). Although this new agricultural law has very good objectives and motivations for environmental protection, it raises concerns among some farmers regarding the requirement to set aside a portion of their land for the promotion of biodiversity. They believe that this could result in some farmers practicing less environmentally sustainable agriculture to compensate for the loss of land, which can lead to a lower yield and consequently a lower income, and therefore would ultimately conflict with the environmental principles it seeks to promote (F.C., 2023; F.J., 2023). According to the soybean producer F.C. (2023): *"People are going to be more intensive and therefore less respectful of the environment on the pretext that, bah voilà, they have earned 3.5% more for ecology. So, if you are against this ecology, you are going to do even more chemistry, even more intensively".* F.C. (2023) talks about certain farmers in Switzerland who have at their disposal a land that is more suitable for biodiversity promotion and who then trade or sell their biodiversity quotas to other farmers, circumnavigating the rules and laws. The farmer points out that the current agricultural policy sometimes generates unexpected results, with some farmers dedicating the entire agricultural surface to biodiversity promotion, while other farmers engage in buying biodiversity quotas to avoid the loss of useful agricultural land. The OPD only states that land areas are suitable to be considered as areas for the promotion of biodiversity if they are located on the farm area and within a maximum travel distance of 15 kilometres from the farm centre or production unit (OPD, Art.14, pt.2a.), and the area dedicated to the biodiversity promotion must be owned or leased by the farmer (OPD, Art.14, pt.2b.).

This new law also raises concerns about food security, as farmers think that this decision could decrease the useful agricultural land and, consequently, the yield of Swiss agriculture, which ultimately would lead to the need to import more agricultural products instead of having produced them locally: *"Personally, I don't think that the initiative to deduct a further 3.5% from open land, from cultivated land, is a good solution. If we take the Swiss total, it is still... it is a huge area, 3.5%. And if we have to compare that with tons of soybean or tons of protein or tons of wheat, that is to say all that, we will have to import even more from abroad"* (F.J., 2023). According to the FiBL expert, it makes no sense to feed animals with products that came from outside Switzerland (O.P., 2023).

A.B. (2023) reports a phenomenon connected with direct payments that he considers on the rise in the Ticino region. He refers to the growing presence of (especially) large horticultural farms that lease their land to obtain direct payments, taking advantage of the work of other farmers. In this way, a landowner, who is often also the direct payment receiver, can rent out their land to other farmers to receive government contributions without actually cultivating the land. This seemingly mutually beneficial exchange raises ethical issues, according to some of the farmers interviewed, as it seems that those agricultural facilities focus solely on bureaucratic management without participating in farming activities but get the state payments from them (A.B., 2023; F.C., 2023). According to A.B. (2023), this behavior is fueled by the difficulty of monitoring those benefiting from direct payments. In addition, A.B. (2023) reports that in many cases, large farms are buying land at bargain prices, thus contributing to the concentration of land in a few hands, as also reported by Public Eye (n.d.). Switzerland has indeed experienced a decline in the number of small farms, while the number of large farms (with 30 ha or more) has increased (FSO, 2023c.; FSPC, 2023b.).

4.2 Agricultural Cultivation Methods in Switzerland

Today, the agriculture and food industries are facing several sustainability challenges, both in terms of environmental and human health (Sumberg & Giller, 2022). The world population is constantly growing, and therefore there is an increasing demand for farmers to produce growing amounts of various agricultural products (Boschiero et al., 2023). To meet the current food demands, a conversion of a lot of natural areas (tropical forests, savannah, etc.) into agricultural ones has taken place (Boschiero et al., 2023; Voora et al., 2020). This way of producinig food, has contributed to the degradation of natural resources, with also consequences for the future plant cultivation capacities, as the progressive loss of healthy and fertile soils can compromise future possibilities to produce food in different parts of the world (Boschiero et al., 2023; Poore and Nemecek, 2018; Godfray et al., 2010).
Two types of farming methods are generally used in agriculture, namely conventional and organic. Conventional agricultural production usually has a high production rate as well as high yields due to the use of phytosanitary products that enhance the plant growth and protect it from harmful organisms (Boschiero et al., 2023; Sumberg & Giller, 2022; Lori et al., 2017; Azarbad, 2022). These characteristics are thought to offer a good opportunity for feeding the growing Word population, however this practice has been demonstrated to have negative environmental and health impacts (Boschiero et al., 2023; Sumberg & Giller, 2022; Lori et al., 2017; Azarbad, 2022). Besides the conventional production method, there is also organic agricultural production, which has been shown to have the advantage of being more environmentally sustainable since no phytosanitary products are used (Boschiero et al., 2023; Azarbad, 2022; Wittwer et al., 2021). However, this practice also comes with an aspect that can be defined as a negative point, which is a production with lower yields (Boschiero et al., 2023; Azarbad, 2022; Wittwer et al., 2021).

Within this subchapter, the main cultivation approaches adopted in the Swiss agricultural context are introduced and analyzed. Organic and conventional cultivation are discussed to provide an understanding of the principal farming practices in Switzerland and what they imply. The first part of the subchapter presents the development and evolution of organic and conventional farming in Switzerland, to understand the factors that first led farmers to adopt organic or conventional production methods, what those production methods entail, and to get a perspective on the considerations that initially influenced farmers' production choices. Then, the labels that emerged during the interviews are presented for both production methods; more specifically, the certifications of BioSuisse and Demeter are introduced for organic cultivation methods, while for conventional methods, the labels of Suisse

Garantie and IP-Suisse are introduced. This is done to give an overview of the certifications associated with each cultivation method in the Swiss agricultural context. Finally, the main reasons why the farmer's interviewees chose organic rather than conventional production and vice versa are explored.

4.2.1 Organic Agriculture development in Switzerland

In Switzerland, in the early 1930s, the first farmers (Rosa and Konrad Oswald) started to implement an agricultural organic method that differs from the more common conventional one that had been principally used until then, and this new method is known as biodynamic agriculture (bioactualité, 2020). The principles of biodynamic cultivation hold that "soil, plants, animals, and people are all part of a great cycle of life in which all depend on each other and provide each other with reciprocal assistance" (bioactualité, 2020). Thereafter, other farmers began to try this new method, and in the late 1930s, the (first) Association for Biodynamic Production in Switzerland was founded. However, it was not until 1954 that the first label for Swiss biodynamic products was registered under the name "Demeter" (Alföldi & Nowack, 2017).

Following these pioneering biodynamic farmers, other farmers were inspired to look for alternative methods of growing agricultural products without the use of pesticides and fertilizers. Then, around the 1940s, another pair of farmers (Maria and Hans Müller) proposed an alternative to the conventional methods, which is also less restrictive than the biodynamic method, namely the organic (biological) method (Alföldi & Nowack, 2017). After defining this new cultivation method, Maria and Hans Müller founded the Organic Vegetable Production and Development Cooperative in Galmiz (AVG Galmiz) in 1946, which was the first organic cooperative in Switzerland (Alföldi & Nowack, 2017). However, other farmers also contributed to the development of organic agriculture in Switzerland. In the historical reports, a particular reference is made to Mina Hofstetter, who, in addition to contributing to the development of the methodology, founded in 1947 the Swiss Association of Organic Agriculture, known today as Bioterra (Alföldi & Nowack, 2017). Following these events and the further development of organic-biological methods, more and more Swiss farmers began to implement them on their farms, and in 1972, nine organ-biological farmers teamed up to create their commercial organization, known today as the Biofarm cooperative. (Alföldi & Nowack, 2017). All these organo-biological associations shared some fundamental elements/themes, such as the crucial importance of soil fertility, soil health, and a respectful approach to soil work (Alföldi & Nowack, 2017).

In 1973, the Research Institute for Swiss Organic Agriculture (FiBL) was founded to further research and develop organic agriculture and its products in Switzerland (FiBL, n.d.; Alföldi & Nowack, 2017). Finally, in 1976, five associations (Demeter, Biofarm, Bioterra, Progana, and FiBL) started a collaboration to create the basis for organic farming in Switzerland and developed a common set of basic specifications (BioSuisse, 2023a.; Alföldi & Nowack, 2017). In 1981, the first "Guidelines for the Production, Processing, and Trade of Organic Products" were created and accepted by the different associations (BioSuisse, 2023a.; Alföldi & Nowack, 2017). In the same year, as a follow-up to this

collaboration, the Association of Swiss Organic Producer Groups was born, which is known nowadays as BioSuisse (FSO, 2019).
The transition to organic farming practices can be complex, especially in certain production sectors (G.H., 2023; O.P., 2023). For example, G.H. (2023) states that growing rapeseed and potatoes organically without using insecticides or fungicides can be extremely difficult, with a high risk of crop loss. In organic farming, the use of chemical fertilizers is prohibited, so farmers without livestock must find alternatives to maintain soil fertility, and they have also to accept and keep in mind that their crop yields will be lower than with conventional farming methods (G.H., 2023; Kirchmann, 2019). Understanding the factors that have led farmers to adopt biodynamic and organic methods is important to gain insight into the considerations that influence agricultural practices in relation to environmental sustainability and ecosystem resilience and to be able to understand how to improve the development of a sustainable food system (Muhie, 2022; Clémençon, 2021; Armstrong & Kamieniecki, 2019).

Financial support and formal recognition for organic farming only began in 1989 at the cantonal level (and not in all cantons). Then, in 1992, organic farming was evaluated as valuable and entitled to be protected at the Federal level in the Agricultural Law (Alföldi & Nowack, 2017). However, the first organic farming regulation became effective at the beginning of January 1998 with the implementation of the "Organic Farming Ordinance", and from then on, the term "organic farming" was legally protected in Switzerland, and the legal basis and requirements for organic production were established (FSO, 2019; Organic Farming Ordinance, 1998). Since 1998, farmers who want to produce organically must observe the Swiss Organic Farming Ordinance, and to be considered an organic farmer, the following rules must be respected (2023, Art.3, Art.6):
- *Respect for natural cycles and processes;*
- *The non-use of synthetic chemicals;*
- *The non-use of GMOs and their derivatives;*
- *The non-use of ionizing radiation treatments;*
- *The adjustment of the number of animals in the agricultural area to optimize the use of natural fertilizers;*
- *The keeping and feeding of animals according to the standards of the ordinance;*
- *The compliance with the laws on the protection of animals, water, environment, and nature, and landscape applicable to agricultural production;*
- *The management of the whole agricultural holding according to the rules of organic production.*

Organic producers don't use chemical products like farmers in conventional agriculture, instead, they use alternative techniques (grow specific crops that improve soil fertility, implement diversified crop rotations) or products such as organic fertilizers (as manure or compost), and in some cases, they are also allowed to use fertilizer supplements such as biological phytosanitary products (which must appear on the list of permitted inputs established by FiBL) (Alföldi & Nowack, 2017). In agriculture, the main difficulty with the organic method lies in weed management, which turns out to be one of the biggest problems that farmers still face today, but over the years, innovative technologies and techniques have been developed to try to reduce the effects of this problem (Alföldi & Nowack, 2017). More specifically, weeds are controlled mainly through cultural rotations and mechanical practices (e.g. hoeing, thermal weeding, and appropriate tillage practices) (Alföldi & Nowack, 2017).

Swiss Organic labels:

Within the organic farming producers in Switzerland, the BioSuisse association occupies a leading position in the production and certification of organic agricultural products (FSO, 2019; BioSuisse, 2019). In 2022, Switzerland had 7,819 farms adopting organic methods; of these, 7,341 were certified with the BioSuisse Bourgeon label, representing approximately 94% of organic farms in the country, while the remaining 6% of farms followed only the PER (BioSuisse, 2022).

BioSuisse has developed its guidelines (BioSuisse Guideline) where the producers have to comply with very strict specifications to be certified as a BioSuisse farmer, which cover, for example, the use of certified organic products, crop rotation, the promotion of biodiversity, and specific standards for each crop (O.P., 2023.; M.N., 2023; FSO, 2019). In terms of traceability, the BioSuisse label certification also guarantees rigorous monitoring throughout the production chain, from the producer to the end buyer (C.D., 2023). Moreover, agricultural holdings under this label have annual controls and regular unannounced inspections every 4 or 5 years (O.P., 2023).

From 2022, BioSuisse introduced a new strict feed guideline for the ruminants: on BioSuisse agricultural holdings, it is mandatory to feed the ruminants with at least 95% roughage (grass, hay, etc.), while the remaining 5% at most can consist of concentrated fodder (soybeans, corn, etc.), and all of them must be sourced 100% from Swiss organic farms (BioSuisse, 2023; O.P., 2023; C.D., 2023). This change has tightened the BioSuisse rules even more; by comparison, the Swiss Organic Ordinance (Art. 16b) allows a minimum of 60% of roughage and, consequently, a maximum of 40% of concentrated fodder (BioSuisse, n.d.). These new requirements, according to some interviewees, contribute to supporting national protein production, stimulating the demand for local proteins, particularly high-protein crops such as soybeans, and consequently promoting local and sustainable products (O.P., 2023; C.D., 2023). The FiBL interviewee (O.P., 2023) views the reasons behind this choice as basic ethical motivations, in the sense that if you want to promote more local production in Switzerland, "*It makes no sense to feed animals things that are produced… In France ... far away*" (O.P., 2023). However, there is also an interviewee who views this decision by BioSuisse with some skepticism, raising questions about the motivations behind these decisions. G.H. (2023) argues that the choice of a 5% limitation in the use of concentrated feedstuffs for ruminants, all with 100% Swiss origin, has more to do with label marketing strategies than with actual sustainability concerns. He argues that Switzerland can also import sustainable produced products such as soybeans for animal feed, which comes from certified and

sustainable agricultural holdings outside Switzerland. Therefore, he says that he does not know whether to consider this abandonment of imports as "*an additional, unnecessary complication for producers*" (G.H., 2023) from an agronomic point of view.
According to most of the farmers interviewed for this thesis, this decision by BioSuisse had virtually no impact on their farm, and therefore they had no opinions to express. However, two farmers expressed disappointment about this decision: M.M. (2023) and A.B. (2023) have reported that following the BioSuisse decision on ruminants' nutrition, there is now a greater absence of plant protein in the feed of ruminant animals, which has led to lower meat quality. This is because the major sources of protein for animals, such as soybeans, have limited production in Switzerland, the available quantities are mainly given to poultry and pigs, which have a greater need for it than ruminants (M.M., 2023; BioSuisse, n. d.). Furthermore, the farmers complained that the elimination of the previously mixable 5% of conventional fodder in BioSuisse animal feed has increased their costs, causing an additional negative impact (M.M., 2023). BioSuisse's decision also extended the restriction on animal feeding to pigs and chickens; from January 2023, these animals must be fed with 100% organic products, which however can also be imported (the foreign companies must still follow the strict standards outlined in BioSuisse's guidelines) (FiBL, 2023; BioSuisse, n.d; BioSuisse, 2023a.).
A.B. (2023) shared his experience trying to use soybeans grown on his property to feed the ruminants, but in Ticino, with a lack of local facilities to process the fodder, there were a lot of added costs, such as renting a truck and transporting it to collection centres, which subsequently clean and process the product, and finally the re-entry transportation costs. The overall costs proved to be too high, and as a result, he decided to eliminate the main source of protein from his ruminants' diet, opting to purchase feed with significantly reduced protein content from another organic source (A.B., 2023).
These two farmers reported that these changes negatively affected the quality of the meat, and they are currently looking for solutions to replace the now-missing ingredients while ensuring a balanced diet (A.B. 2023; M.M., 2023).

Another certification for organic products that was mentioned in the interviews is that of Demeter, which is today an association part of BioSuisse that brings together all the actors involved in the production, processing, and trade of agricultural products, counting altogether about 413 farms (E.F., 2023; Demeter, 2022). Demeter-certified farms adhere to the BioSuisse guidelines, but Demeter also imposes additional requirements and restrictions, such as the use of biodynamic preparations, biodynamic plant breeding, and a higher limitation of allowed additives in processing (L.C., 2023; BioSuisse, 2019). In fact, the level of requirements demanded by Demeter regulations is the highest at both national and European levels (Alföldi & Nowack, 2017).
Swiss Organic labels impose strict conditions, including no use of unauthorized phytosanitary products, promotion of biodiversity, and high animal welfare standards (O.P., 2023; A.G., 2023; G.H., 2023; E.F., 2023). WWF and its partners have evaluated the major food labels on the Swiss market in terms of

environmental sustainability, animal welfare, social compatibility, and credibility (WWF, n.d.). Both BioSuisse and Demeter received excellent ratings, meeting the highest standards. Almost all Swiss organic food brands received an excellent or highly recommended rating, highlighting a significant contribution to the country's sustainable development (WWF, n.d.).

Until 1960, organic products in Switzerland were mainly sold by the farmers who produced them or by small local stores specializing in organic products (Alföldi & Nowack, 2017). But starting from that period, some big retailers also began selling organic vegetables in their stores; Migros and Coop were the first to sell them (Alföldi & Nowack, 2017). Today, Coop and Migros have the highest turnover for the products grown under BioSuisse guidelines (BioSuisse, 2022). Coop accounts for about 41.1% of BioSuisse's total income, while Migros accounts for about 32.5% of the total, so together they account for about 73% of the total bio income of local organic production, which in 2022 amounted to 3,873 billion francs (BioSuisse, 2022). Direct sales on the farm accounted for 207 billion, representing about 5.3% of the total BioSuisse sales (for more details, see Annex G) (BioSuisse, 2022).

4.2.2 Conventional Agriculture Evolution

When it comes to conventional agriculture, there are different opinions about what "conventional" means. The most widely used interpretation is that it is a method of agriculture that adopts a high number of synthetic products (fertilizers, herbicides, insecticides, etc.) (Tuomisto et al., 2012). However, this interpretation lacks a more specific interpretation because not all conventional agricultural methodologies use the same agricultural practices or synthetic products (Tuomisto et al., 2012).

For several years, conventional farming was the only method of cultivation in Switzerland. This is because, as a method that produces higher quantities, it was of greater interest to farmers (Alföldi & Nowack, 2017). But from the 1930s onwards, and especially after WW2, this trend started to change, and several farmers wanted to reduce the dependence on the input[3] industry that is associated with conventional agriculture without reducing their ability to have honest earnings and produce enough for the Swiss population (Alföldi & Nowack, 2017). However, despite this initial desire to reduce the use of inputs produced abroad, the 1960s saw an increase in their use in Switzerland, and it was not until the early 1990s that this tendency toward intensive use of inputs began to change (Alföldi & Nowack, 2017). This has been made possible by the pioneers of organic cultivation, who developed a new method of cultivation without the use of synthetic inputs, and by the introduction of the organic method into the Swiss Agricultural Law with the following rules, thus initiating the search and application of new methods that are not necessarily organic but that reduce the use of these inputs (Alföldi & Nowack, 2017). From the 1990s onward, Swiss agriculture has undergone a significant greening, marked by approaches focused on environmental protection, moving away from the classic definition of

[3] Inputs are defined as "*resources used in the growing and production of vegetables, including fertilizers, pesticides, seeds, and plant crops, as well as breeding and zoogenetic resources, veterinary medicine, machinery, and other technical means*" (Public Eye, s.d.: p.2).

conventional agriculture (G.H., 2023; C.D., 2023). In 1993, laws were introduced which are designed to improve the environmental sustainability of Swiss agriculture, and these laws offer, to those who comply with them, financial contributions based on the ecological performances that a farmer brings: ecological compensation areas, integrated production, organic farming, and controlled free-range livestock farming (FOAG, 2023f.). In Switzerland, integrated farming is increasingly gaining popularity and is currently the main nonorganic (i.e., conventional) farming practice adopted by Swiss farmers (USP, 2018). This method of cultivation differs from the classic definition of conventional production in that the farmers try to keep weeds, diseases, and pests under control with appropriate choices using as few inputs as possible, for example, through crop rotation, variety selection, tillage, or fertilization (USP, 2018). The integrated production follows the PERs guidelines by including in its practices a balanced manure balance, an adequate share of ecological compensation areas, regular crop rotation, appropriate soil protection, and the selective use of phytosanitary products (FOAG, 2023f.).

In the Swiss Federal Constitution, Article 104 (and 104.a) was introduced in 1999 to change the goal of agriculture, which until then was focused only on competition, to an approach that embraces and encourages forms of agricultural management that are respectful of the environment and animals, i.e., to an approach that wants to optimize production instead of maximizing it (Felley, 2018; Alföldi & Nowack, 2017). Today, thanks to the changes in Agricultural Law and the introduction of direct payments, almost all "conventional" Swiss farms cultivate according to integrated specifications or by following the PER, reaching 95% of the total agricultural holdings (FOAG, 2023f; WWF, 2019; Service de l'environnement Etat de Fribourg, 2017). For these reasons, the definition of conventional production in the Swiss context has evolved in such way that the term "conventional" generates mixed reactions in the population, as it is believed that Swiss methods, due in part to changes in the Agriculture Law and the introduction of direct payments, can no longer be compared to those used in other countries that practice conventional agriculture (G.H., 2023; C.D., 2023).

The use of inputs in the agricultural sector has been debated a lot in recent years, especially when it comes to sustainable agriculture, because several scientific studies have shown that these synthetic products have detrimental effects on both the environment and people's health, but others have reported the positive side of ensuring a nation's food security without necessarily expanding agricultural areas (Graczyk et al., 2018; Public Eye, n.d.; Clark & Tilman, 2017). Public Eye (n.d) reports that each year, 5 million people are severely poisoned by the pesticides used in agriculture.

However, despite the changes in farming habits and the reduction in the use of inputs, according to WWF and its partners, Switzerland is still far from reaching its goals to reduce the ecological sustainability gap (WWF, 2021; WWF, 2019). In 2021, the Federal Council made changes to the "Chemical Products Law, the Federal Water Protection Law, and the Agriculture Law" by approving the Action Plan "Risk Reduction and Sustainable Use of Phytosanitary Products" with the aim to decrease by 50% the use of phytosanitary products in agriculture by 2027. However, WWF, ProNatura, and

Greenpeace posit that despite these changes to the federal law, there are still significant gaps in the approval process for pesticides (WWF, 2021; WWF, 2019). They point out that, for example, pesticide manufacturers only pay a tiny amount for the costs for homologation of pesticides, which has the additional problem of not being carried out by independent organizations and lacking transparency because not everyone has access to this information (not even official cantonal authorities) (WWF, 2021; WWF, 2019).

In general, the sale of input products is still growing despite the introduction of these changes in the federal laws. In 2022, about 2,200 tons of phytosanitary products with active substances were sold (around half of them are active ingredients that are approved even in organic farming[4]); fungicides, herbicides, and insecticides are the main sold products, and each account for about 47%, 23%, and 22% of the total sales, respectively (FOAG, 2023g.). From 2008 until 2022, there has been a significant increase in the amounts of fungicides sold in agriculture, while at the same time, the sales of herbicides have decreased (the lowest levels were recorded between 2018 and 2020). On the other hand, insecticides experienced strong growth, increasing from 278.5 tons in 2008 to 488 tons in 2022 (FOAG, 2023g.). In the period between 2008 and 2022, there was also a significant increase in approved active ingredients in organic farming: quantities increased from 599.7 tons to 1097.8 tons, while at the same time, there was a considerable decrease in active ingredients with particular risk potential (also used in organic farming): in 2008, quantities were 462.5 tons, but in 2022, they decreased to 237.1 tons (FOAG, 2023g.). Between 2018 and 2019, there was a decrease in the total inputs sold. This may be related to the COVID-19 pandemic that affected agricultural practices during this period, while after 2019, there was again an increase in total quantities, returning to almost the same quantities as before the pandemic (FOAG, 2023g.).

The Swiss Farmers Union (USP) argues that the abandonment of synthetic input products is not feasible because it increases a lot the risk of decreased yields, and as a result, it would not be possible to continuously guarantee the supply of food products (Flückiger & Porcellana, 2023). Other Swiss producer organizations (such as Prométerre, the UMS, and Agora) had also come out publicly against the proposition of eliminating the use of phytosanitary products, as they considered it to be detached from the current realities of the agricultural-food market (Ziehli, 2023). Two interviewees report that to have sustainable agriculture in Switzerland, it is not only necessary to think about the environmental aspects (such as the total elimination of pesticides), but that it is also important to take into account the balance between the three main aspects of the sustainable production, namely the ecological, the economic, and the social aspects. According to them, one cannot have agriculture that is ecologically

[4] "*Natural, i.e., biological, plant protection products are distinguished from synthetic chemical plant protection products by the origin and manufacture of the active substances. Biological plant protection products are of natural origin, while synthetic chemical plant protection products are, as their name indicates, created from a chemical compound. Whether natural or synthetic, the origin of an active substance does not determine its toxicity. Thus, for example, copper hydroxide (non-degradable) and pyrethrin products used in organic farming are not without consequences for the environment*". (USP, 2018: p.8).

sustainable but is economically disadvantageous for a farmer (E.F., 2023; G.H., 2023). Current research has also reported on the importance of this balance in agriculture, confirming that these three elements are necessary for sustainable agriculture. It has also been reported, however, that there is still insufficient research that evaluates these three aspects together when examining the sustainability of agriculture (Bathaei & Štreimikienė, 2023; Ait Sidhoum et al., 2022).

Both pro-environmental associations and the Swiss Farmers' Union, have found that this reduction of inputs is currently not feasible in Switzerland, not only because there are farmers who do not want to reduce their use and thus have lower yields, but also because today's consumers are very demanding about the appearance of agricultural products (USP, 2018; WWF, n.d.b.). If consumers demand aesthetically perfect products, retailers who buy agricultural products to resell them also demand aesthetically perfect products, and currently, the only way to have these conditions is to use plant protection products that protect the crops. Therefore, they consider that it is also up to the Swiss population to change their preferences, accepting products that are not aesthetically perfect but are cultivated and transformed with more environmentally sustainable methods (USP, 2018; WWF, n.d.b).

Swiss Conventional labels:

As mentioned above, in Swiss agricultural production, even in the context of conventional farming, some regulations and principles have been created to promote sustainable practices. Farmers in Switzerland produce under a label and therefore must also comply with strict traceability standards to maintain the distinction between conventional and organic products (E.F., 2023; M.N., 2023). The decision on which principles to apply to the farm, such as PER and various labels, is left to the discretion of farmers, who consider their resources and consequently decide to produce under a specific label or requirement. This allows Swiss farmers to adopt approaches that best suit their needs and the specific conditions of their operation.

The implementation of PERs and certifications is regularly monitored by state and private inspectors, with specific controls, notably on genetically modified organisms (GMOs), also enabling label traceability in conventional production, an aspect that guarantees product quality and provenance throughout the value chain (G.H., 2023; M.N., 2023). The traceability of products grown in Switzerland extends beyond the farm, from the collection centers to the processors. A sample of each harvest is kept in the collection centers, enabling products to be traced in the case of quality problems, even for 2-3 years, thus ensuring precise and effective long-term traceability (G.H., 2023; E.F., 2023). These procedures, controls, and standards help to maintain high-quality standards even in conventional production in Switzerland (G.H., 2023).

Suisse Garantie is the label of Agro-Marketing Suisse for agricultural products that are produced and processed in Switzerland, and a total of 640 farms are certified with this label (G.H., 2023). The Suisse

Garantie production, according to the FSPC interviewee, is a reliable basis for sustainable production in Switzerland because the EPRs are the basis of the label, and the certification is also completed with other requirements such as the mandatory use of Swiss-certified seeds (G.H., 2023; A.G., 2023). Under the Suisse Garantie certification system, it is possible to certify only certain specific crops without the necessity of certifying the whole farm, and this principle contrasts with that of organic farming, which requires that the complete farm be certified (G.H., 2023). Suisse Garantie, combined with the attribution system and regular controls, can make verifiable claims about the product's traceability throughout the supply chain. Farm producers are subject to controls to ensure compliance with the Suisse Garantie principles and with the rules laid down by the PER (G.H., 2023).

In Switzerland, for conventional production, there is also the IP-Suisse label, which is a certification for integrated production. In integrated production, the use of phytosanitary products is limited or banned for certain crops, such as cereals (BioSuisse, 2019). With IP-Suisse, about 18,500 farms are certified and produce food for human consumption, representing around 46% of conventional farms (IP-Suisse, n.d; Annex E). IP-Suisse-certified farms must fully adhere to EPR requirements, with the addition of general label requirements (basic requirements for the entire farm) and label requirements specific to open-field crops, cider fruit, and meat (IP-Suisse, 2019). This certification also promotes measures to protect biodiversity on all farmland, and regular annual inspections are conducted by independent bodies (BioSuisse, 2019; IP-Suisse, 2019).

According to evaluations made by WWF and its partners about the sustainability of Swiss food labels, the Suisse Garantie's certification receives only a partial recommendation, which means that according to their evaluation, it currently meets the requirements of environmentally friendly, socially equitable, and animal welfare-conscious production only in a limited way (WWF, n.d). On the other hand, the IP-Suisse certification is strongly recommended, as according to these associations, it meets high standards and completely fulfills most of the sustainability criteria, making a relevant contribution to sustainable development in Switzerland. IP-Suisse's commitment to agricultural practices that meet strict environmental, social, and animal welfare standards is seen as a significant contribution to promoting a sustainable development model in the country (WWF, n.d).

4.2.3 Organic Vs Conventional, The Reasons Behind Swiss Farmers Production Method Choice

During interviews conducted for this thesis, farmers were asked why they would choose an organic method over a conventional one (and vice versa) for their farm production method. Conversion to organic farming requires a complete adaptation of the farming system to the requirements of organic farming, which poses more management challenges for farmers than for those who opt for conventional production (O.P., 2023; E.F., 2023).

The various restrictions imposed by the organic production requirements seem to be a significant discouragement for conventional farmers; the main restriction that deters the conventional farmers interviewed from converting to organic production is the requirement to convert the entire farm to organic since it involves a complex and costly process of at least two years (and during these two years, products are not allowed to be sold under the organic label) (F.M., 2023; E.V., 2023; B.H., 2023).

> "*My choice to join the IP Suisse label instead of BioSuisse is motivated by the need to ensure the survival of my crops and the ability to contribute to feeding the population. Facing the loss of 5 ha due to beetles or weeds is unacceptable to me. The requirements and restrictions imposed are such that I would be forced to spend hours and hours on manual weeding work, also generating a negative impact on the carbon footprint due to the intensive use of tractors. In addition, managing different crops would require a specific weeding device for each, making the whole process impractical.*"
> (E.V., 2023).

F.M. (2023) expresses disappointment with the management of organic products, as she believes that high requirements for "perfection" often downgrade organic food production to organic fodder, causing a major economic loss. According to her, there is a need to inform consumers about the diversity of approaches within the agricultural sector that are not necessarily organic methods, like the IP Suisse-type production standards, which present an intermediate alternative between organic and conventional. In her opinion, this nuance is not always understood by the public, representing an additional challenge in promoting more sustainable agricultural practices (F.M., 2023). F.M. (2023) makes an intriguing example, saying that if a person is sick and needs medicine to get better, they get it, so she does not see why you cannot do the same for plants and give them their 'medicines' (fertilizers, herbicides, etc.) when needed and in the right amounts. However, the TiGusto director (2023) makes an equally interesting comparison for organic production, saying that one cannot continue to use pesticides and fertilizers and thus drug the soils because it would be like drugging an athlete who may run fast at first but will not be able to do it for long under those conditions.

Organic agricultural methods have a more positive impact on the environment and land health; however, they are not an easier way to produce plant and animal products (Song et al., 2018; Curtis et al., 2018; Pimm et al., 2014; G.H., 2023; O.P., 2023). The approach also involves strategic and economic decisions to determine whether the farm is equipped (or can be equipped) for organic production, both in terms of tools and available time. This is because organic production requires greater attention to crop and soil management, and there is also a risk of taking on too much debt to keep up with the requirements of organic production (E.F., 2023; O.P., 2023; M.M., 2023). Since there are basic laws in Switzerland that require a rotation of a minimum of four crops, the farmer has to consider whether all four crops he has are feasible to manage in organic production, because even if one has only one complicated crop in organic, such as potatoes and rapeseed, the farmer does not want to risk losing significant amounts of crop yields, and so they prefer not to switch to organic production (G.H., 2023.; E.V., 2023).

In the interviews conducted with organic farmers, three main reasons were identified that influenced the farmer's decision to start cultivating according to organic practices:

1) For Environmental and Soil Health Benefits (M.M., 2023; C.C., 2023; F.C., 2023; F.J., 2023; L.C., 2023; F.V., 2023): The reason of these farmers, that stood behind the decision to have an organic agricultural holding, was the will to improve the health of the land, microorganisms, and soil. Also, they did not want to have residuals in the soil or in their food products.

2) For Ethical Values (M.M., 2023; F.V., 2023; F.C., 2023; F.J., 2023): For some farmers, the choice to grow organic is driven by ethical values and a deep belief in organic farming as a correct and sustainable form of farming to maintain a balance with the environment.

3) For economic feasibility and profitability (M.M., 2023; A.B., 2023): A tangible advantage that leads to the choice of organic farming for two interviewees is the higher price one gets for organic products. But M.M. (2023) points out that selling prices should not mislead people, as one must make a careful analysis and assessments of the costs and benefits of the transition to organic because the conversion to organic must also be financially sustainable: "*I can't afford a simple ideology if I don't get anything out of it, if I go bankrupt, then there is no point in having made the conversion to organic*" (M.M., 2023).

Two of the conventional agricultural farmers based their choice mainly on the costs and losses related to organic production, as well as the perceived lack of consumer support (E.V., 2023; F.M., 2023). The interviewees report that to decide if to produce organic, there must also be a demand and acceptance from the population, however, some of them feel that there is still not much support from the population to be able to decrease conventional production, as organic agricultural products are currently more expensive and not everyone in Switzerland can afford (or wants) to spend more on food products (F.M., 2023; E.F., 2023). This lack of perceived consumer interest in organic products represents a significant challenge for some farmers, who see their possible commitment to sustainable production methods hampered by the low support from the population (F.M., 2023). It is the consumer's willingness and ability to buy organic that shapes market reality and influences the overall response to sustainability issues (F.M., 2023; E.F., 2023; USP, 2018; WWF, n.d.b.).

Two interviewees (G.H., 2023; F.V., 2023) refer also to the issue in organic production of finding workers who want to work manually to pick up the weeds since it is a task that involves many hours of working under hard conditions (as under the sun in the summer), and in organic production, phytosanitary products are not allowed, and a farmer cannot always go alone in each crop and spend hours picking up the weeds manually. G.H. (2023) also reports that even if a farmer finds people available to do these heavy manual jobs, these workers must be paid the Swiss wage, and paying people to pull weeds manually in Switzerland is extremely expensive. So, in terms of the workforce in biological farms, it can be complicated to hire and pay the workers, especially since these jobs are sometimes of short duration, so there is a tendency to hire seasonal foreign workers (G.H., 2023).

All these different factors influence the decision to cultivate with organic or conventional methods, and FSPC reports that "*we're finding it hard to motivate many more farms to go organic because those that can do so easily have already done*" (G.H., 2023). A farmer may be persuaded to convert to organic cultivation methodology if the prices of organic products are fair enough compared to the working hours and costs. O.P. (2023) believes that the organic prices offered by BioSuisse can encourage such conversion. However, it is not always easy to convince a farmer to choose a practice that requires more working hours and additional investments.

4.3 Useful Agricultural Area in Switzerland

In Switzerland, the cultivated area is steadily decreasing (see Figure 2): in 2022, the area amounted to 1.042.000 ha, while in 2000 it was 1.071.131 ha, for a total decrease of 33,762 ha (FOAG, 2023c.). The decrease in Useful Agricultural Area (UAA) is explained by the Federal Office of Agriculture by the ongoing expansion of surfaces committed for settlements and other kinds of buildings (FOAG, 2023c.). In 2022, about 58% of the total UAA was used as pasture and permanent grassland, while 38% was for large cultures, and the remaining 4% were composed of vineyards and fruit plantations (FOAG, 2023b.). The analysis of the distribution of the UAA in the different regions of Switzerland (see Figure 1) shows that in 2022, the Central Plateau (Espace Mittelland) was the region with the largest UAA, covering an area of 370.099 ha. In addition, this region produces the most cereals (52.629 ha), potatoes and sugar beets (11,178 ha), and other open land crops (24.441 ha). The second region with the largest UAA is Eastern Switzerland (Suisse Orientale) with 218.911 ha, followed by the Lemanic region (Région lémanique) with its extension of 155.533 ha. In the Lemanic region, most of the oil seeds and fruits (graines et fruits oléagineux) are cultivated, covering a total UAA of 11.909 ha with a perennial crop extension of 12.521 ha. The central part of Switzerland (Suisse Centrale) contributes with a UAA of 130.183 ha, while Northwestern Switzerland (Suisse du Nord-Ouest) and Zurich follow with 81.353 ha and 72.071 ha, respectively. The Italian-speaking region of Switzerland (Tessin) has the smallest UAA, contributing 13.861 ha (Figure 1). When looking more specifically, at the cantonal level, the canton of Bern is the one with the largest UAA, corresponding to 191.282, while the canton of Basel-Stadt shows the smallest UAA in Switzerland, accounting for 422 ha (Annex B).

Principales catégories de surface, en 2022									T 7.2.2.2.2
	Surface agricole utile	Terres ouvertes					Surface herbagère[2])	Cultures pérennes[3])	Autre surface agricole utile
	Total	Total	Céréales	Pommes de terre, betteraves	Graines et fruits oléagineux[1])	Autres terres ouvertes	Total	Total	Total
	ha	ha	ha	ha	ha	ha	ha	ha	ha
Total	**1 042 014**	**276 114**	**145 008**	**26 748**	**33 096**	**71 262**	**726 092**	**24 040**	**15 767**
Région lémanique	155 534	62 185	34 061	5 645	11 909	10 569	79 603	12 521	1 225
Espace Mittelland	370 099	97 624	52 629	11 178	9 375	24 442	266 663	2 139	3 674
Suisse du Nord-Ou	81 353	32 780	17 937	2 006	3 475	9 362	45 955	1 568	1 050
Zurich	72 072	28 610	13 964	3 478	3 163	8 005	39 718	1 532	2 211
Suisse orientale	218 911	36 323	16 809	4 064	3 735	11 714	174 451	4 386	3 751
Suisse centrale	130 183	17 465	9 032	309	1 352	6 772	108 359	777	3 582
Tessin	13 861	1 128	575	69	86	398	11 343	1 116	274

Table 3: Survey of agricultural structures. Source: FSO (2023a.).

The biological UAA has increased slowly over the last few years; in 2022, it amounted to 186.335 ha, corresponding to almost 18% of Switzerland's UAA, while conventional cultivated areas are steadily decreasing, with a total surface area of 855.679 ha in 2022 (see Figure 2) (for more details see Annex C).

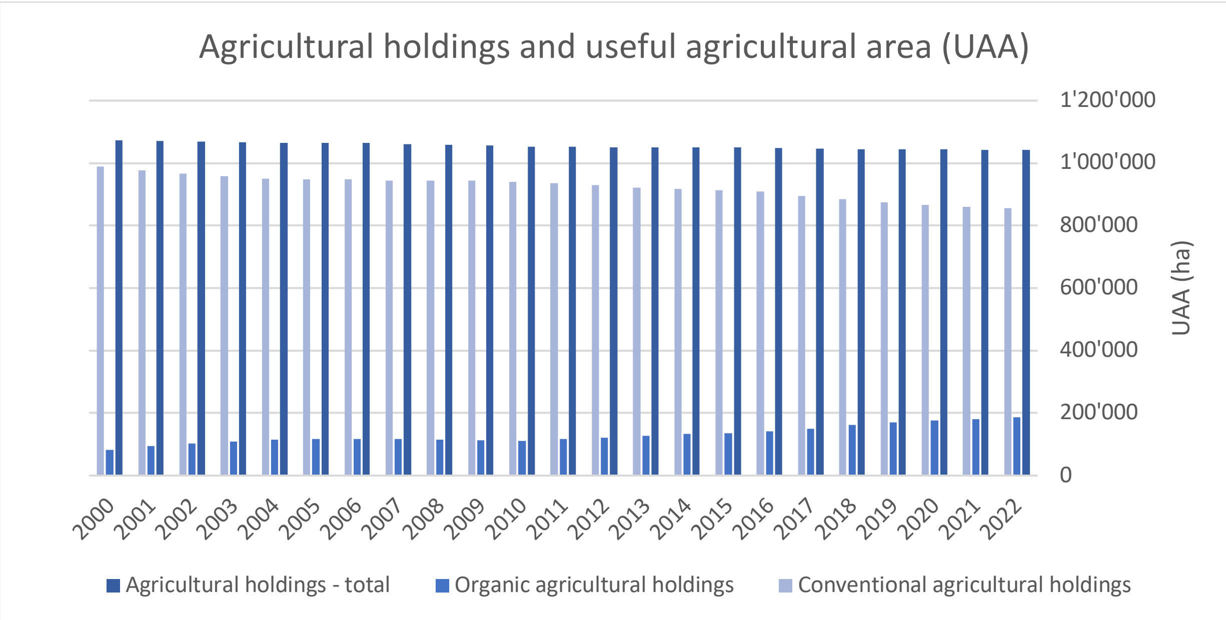

Figure 3: Number of Agricultural holdings in Switzerland in relation to their useful agricultural area (UAA). Source: FSO (2023b).

In 2022, the largest organic crops were natural meadows (without alpine pastures) (Prairies naturelles sans alpages) with a UAA of 132.917 ha; artificial meadows (Prairies artificielles) had a UAA of 17.880 ha, and the cereals had a UAA of 16,293 ha. The organic crops that decreased in 2022 were rapeseed (-31ha), tobacco (-2ha), and legumes (-19ha) (Annex D).

The cantons of Bern, Graubünden, Vaud, Zurich, and Aargau showed the strongest increase in organic cultivation areas, while the cantons of Basel city, Basel country, and Valais recorded a decrease in the organic UAA (Annex C).

Organic cultivation is attracting increased attention in Switzerland also thanks to the measures announced by BioSuisse regarding the ruminant's nutrition (Muehle Rytz, 2023; UFA, 2022c.). As a result of the implementation of this new measure (or rule), BioSuisse estimated that in Switzerland there is a need to increase the organic UAA by 15,000 ha to cover the ruminants' feed needs and that crops like rapeseed and feed wheat, as well as all leguminous grains such as soybeans and protein peas, have to be increased (Muehle Rytz, 2023; UFA, 2022c.). This is because these crops are considered to have great potential for development in the Swiss agricultural context, especially concerning products used for human consumption (G.H., 2023; Ramseyer et al., 2021). However, even if the demand for organic crops is increasing and there are different market opportunities for different crop species, the expansion of these crops is limited by the size of the Swiss territory, especially by the areas available for farming (G.H., 2023; Ramseyer et al., 2021). The limited UAA imposes the need to make choices regarding which crops in Switzerland should remain unchanged, which should be increased or decreased, or even disappear; this decision, however, is not made by the farmers, but it falls on market dynamics and policy decisions (G.H., 2023; Ramseyer et al., 2021).

4.4 Agricultural Holdings Number Evolution

Switzerland is characterized by the prevalence of family farms in its agricultural sector; moreover, more than three-fourths of the workers on a farm are close relatives (FOAG, 2023b.). The evolutionary trend of the number of farms is the same as that of the UAA, i.e., it is steadily declining: in 2022, the number of farms fell by 1.1%, reaching a total of 48.344 units (see Figure 3 and Figure 4). The cantons of Nidwalden, Ticino, and Zurich recorded higher declines, with decreases in the number of agricultural holdings of -2.9%, -2.6%, and -2.3%, respectively (Annex E). Instead, the canton of Basel-City saw a 7.7% increase in the number of farms. The cantons of Glarus, Neuchâtel, and Geneva also recorded (smaller) increases of +0.9%, +0.3%, and +1.3%, respectively (Annex E).

However, despite this steady decline, a trend is emerging: the number of farms using organic farming methods is increasing, as can be seen in Figure 3. In 2021, there were 7.670 organic farms, while in 2022, from the total of 48.344 agricultural exploitations in Switzerland, there were 7.819 farms that adopted the organic method, which is 149 more farms than the previous year (an increase of +1.9%) (Annex E; FSO, 2023c.).

The cantons that have the largest number of organic farms are Bern, with 1442 units, and Graubünden, with 1275 units. The canton of Geneva has experienced the highest growth rate of organic farmers compared to the previous year, with a significant increase of 11.9% (Annex E). On the other hand, the number of organic farms has decreased in the cantons of Graubünden (-1.3%) and Uri (-1.7%) (Annex E).

Regarding conventional farmers, a declining trend is evident throughout most of Switzerland (see Figure 2). However, there are exceptions in the cantons of Basel-Stadt and Graubünden, which show, respectively, a +10% and +0.2% increase in the number of conventional farmers (Annex E).

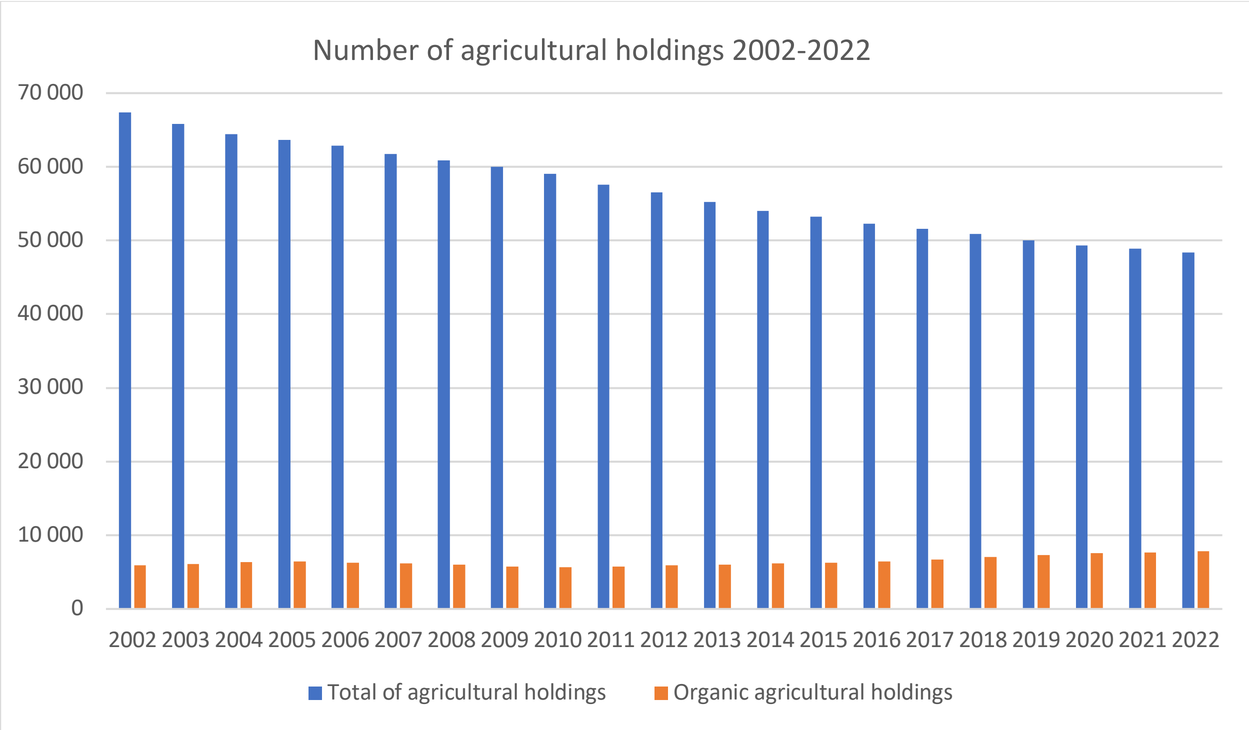

Figure 4: Change in the number of agricultural holdings between 2002-2022. Source: FSO (2023c).

In 2022, the largest number of biological agricultural holdings is recorded in the size category between 10 ha and less than 20 ha, with a total of 2233 units, while the smallest number is recorded in the less than 1 ha category, with only 58 units, even though this category recorded the most significant growth from 2021, with an increase of 28.9% (Table 4). The only two size categories in organic production that experienced a decrease are those of 3 to less than 5 ha (-1%) and those of 10 to less than 20 ha (-2.1%) (Table 4).

For conventional agricultural holdings, as previously mentioned, an overall decrease is observed. However, three farm size categories in conventional agriculture have shown a slight increase: farms of less than 1 hectare (+3.7%), farms of 30 to less than 50 hectares (+0.8%), and, finally, farms of 50 hectares and more (+2.1%) (Table 4).

	TOTATL (Numbers of agricultural holdings)			CONVENTIONAL (Numbers of agricultural holdings)			ORGANIC (Numbers of agricultural holdings)		
Size (ha)	2021	2022	VARIATION (%)	2021	2022	VARIATION (%)	2021	2022	VARIATION (%)
Less than 1 ha	2.150	2.241	+4,2	2.105	2.183	+3,7	45	58	+28,9
1 to less than 3 ha	3.179	3.156	-0,7	2.978	2.935	-1,4	201	221	+10,0
3 to less than 5 ha	2.374	2.339	-1,5	2.068	2.036	-1,5	306	202	-1,0
5 to less than 10 ha	6.108	5.921	-3,1	5.162	4.967	-3,8	946	954	+0,8
10 to less than 20 ha	13.611	13.181	-3,2	11.329	10.984	-3,4	2.282	2.233	-2,1
20 to less than 30 ha	10.119	9.966	-1,5	8.351	8.150	-2,4	1.768	1.816	+2,7
30 to less than 50 ha	8.165	8.287	+1,5	6.571	6.621	+0,8	1.594	1.666	+4,5
50 ha and more	3.158	3.253	+3,0	2.630	2.685	+2,1	528	568	+7,6
Total agricultural holdings	48.864	48.344	-1,1	41.194	40.525	-1,6	7.670	7.819	+1,9

Table 4: Survey of agricultural structures in 2022, agricultural holdings division according to their size and farming method. Source: FSO (2023b.).

The number of people employed in agriculture has also been declining constantly (FOAG, 2023b.). In 1996, there were 225.000 people employed in agriculture, whereas in 2022, 150.231 people were employed (FOAG, 2023b.; FSPC, 2023b.). However, a small rise can be observed over the past 3 years. In 2020, the number of people employed on farms amounted to 149.521, although in 2019, the amount was slightly higher than in 2022, with 150.231 workers (FOAG, 2022d.).

4.5 Oilseed Production in Switzerland

Over the past 10 years in Switzerland, there has been an increase of more than 20% in the area dedicated to the cultivation of oilseeds such as rapeseed, sunflower, and soybean, reaching a total cultivated surface of 33.571 ha in 2022 (FOAG, 2023c.). In comparison to the previous year, the 2022 soybean cultivated area has increased by 655 ha, reaching a total of 2.895 ha (+29.2%), rapeseed acreage has increased by 68 ha, reaching a total production area of 25.038 ha (+0.3%), and sunflower acreage has increased by 410 hectares, reaching 5.228 ha (+8.5%) (Annex D).

In 2022, there was a total production of 92.059 tons of rapeseed, 14.225 tons of sunflowers and 6.175 tons of soybeans (Annex F). However, the contract quantities for the 2022 crops were higher, aiming to produce 106.000 tons of rapeseed, 13.000 tons of sunflowers, and 7.500 tons of fodder soybeans (FSPC, 2021).

In the context of food security supply in Switzerland, vegetable oils and fats covered 23% of national demand in 2021, which is the lowest NSR (FOAG, 2023a.). For oilseed production in Switzerland, it is necessary to have a contract to have permission to grow a total amount of a determined oilseed crop (FOAG, 2023e.). This means that production is based on framework contracts that are established each year between the producers (farmers) and the processing facilities (oil mills and fodder manufacturers), so if a farmer wants to cultivate some oilseeds, they must have a contract that certifies that they can cultivate a total amount of a determined crop (FOAG, 2023e). These framework contracts are managed and controlled by the "Oilseed Production Pool" (OPP), which is directed by the Swiss Federation of Cereal Producers (FSPC) and is funded by a combination of equal contributions, with two-thirds coming from producers and one-third from processors (G.H., 2023; FOAG, 2023e.; FSPC, 2023b.) (see figure 4). These contracts and the OPP were created and established to provide the oilseed quantities that are requested by the market, to give the producers the most advantageous prices for their products, and to offer them the security that the quantity defined in the contract will certainly be collected by the processors with whom they established the contract (FOAG, 2023e.; G.H., 2023). This is done in order to have production and marketing conditions that are the best possible (G.H., 2023). However, there is no security that the processor will also commit to purchasing any excess amount that was produced but not previously defined in the contracts (FOAG, 2023e.).

Oilseed producers benefit from support payments (which are defined each year) offered by the OPP, and for soybean, there is also financial support for seed production (G.H., 2023; FSPC, 2023b.) (see figure 4). The FSPC interviewee added that these support payments and framework contracts are used to boost profitability and maintain diversity in oilseed production and processing in Switzerland so that the country would not have just one main oilseed crop (G.H., 2023).

This Support Payments System offered by OPP underwent a change in 2019, which was deemed necessary after observing that the rapeseed harvest was steadily declining while the sunflower harvest continued to increase and after Suisse Garantie decided that the soybeans under its contract were no longer suitable for sale for human consumption but would go to animal consumption (the OPP negotiates oilseed contracts only for human consumption) (FSPC, 2023b.). Consequently, only the soybean variety for seed production continues to benefit from OPP support payments (FSPC, 2023b.).

The specific support paid from the oilseed production pool in 2022 is given at 9.00fr./100kg for sunflower crops and 7.00fr./100kg for High Oleic, while soybean seeds were paid 15fr./100kg (FOAG, 2023e.; see figure 4).

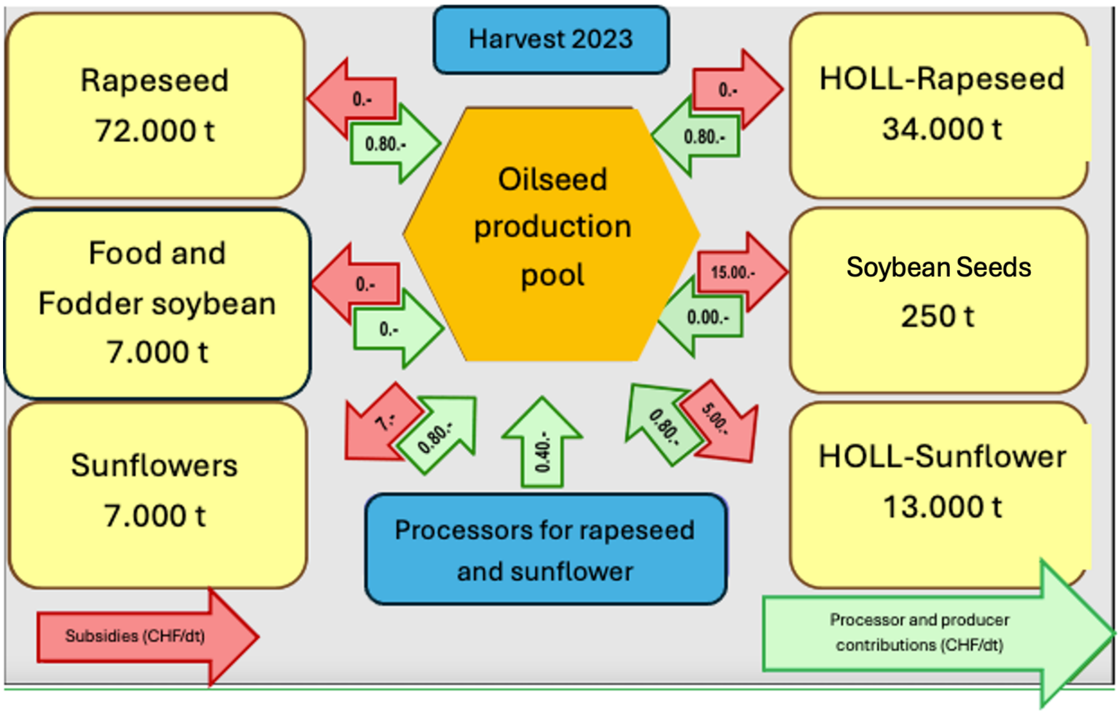

Figure 5: Oilseed Production Pool Structure, with different contributions and actors involved. The figure is a translation of the original figure in French and German. The rectangles in yellow represent the oilseed crops in which OPP is involved. The red arrows indicate the support payments paid by the OPP for the various oilseed crops and the green arrows indicate the contributions that are paid to the OPP by the various members, including those who produce the oilseeds. Source: FSPC (2023b.).

In addition to the OPP subsidies, there are also support payments given by the Swiss Confederation for the cultivation of oilseed crops. Support payments are given in accordance with the Federal Agriculture Law and following the direct payment requirements that are met for each crop (FSO, 2022). This combination of support payments aims to encourage the cultivation of different oilseed crops and support farmers who practice an appropriate crop rotation by apporting different types and families of agricultural crop plants (FSO, 2022).

The following Swiss processing facilities currently have a contract for pick-up of oilseeds (excluding organic crops) (FSPC, 2023b.):

Processors	**Crops (non organic)**
Agrokommerz AG	Fodder soybeans
Florin AG	Rapeseed, sunflower
LANDI Bucheggberg-Landshut	Rapeseed,
Nutriswiss AG	Rapeseed, sunflower
Oleificio Sabo	Rapeseed, sunflower
swisssem	Soybean seeds
UFA AG	Fodder soybeans

Among the Swiss cantons, oilseed production is predominantly distributed in three regions: Zurich, Bern, and the canton of Vaud. Vaud produces the highest quantities, accounting for 29% of the total oilseed production in Switzerland, mostly because it has the largest cultivable area (9,401 ha) (Scherer & Bolliger Maiolino, 2023). Furthermore, in 2022, in the cantons of Vaud, Bern, Aargau, and Zurich, the farmers produced the highest quantities of domestic rapeseed (about 60% of the total Swiss production) and domestic sunflower (about 64% of the total Swiss production), while near 59% of domestic soybean production is cultivated in the cantons of Vaud and Geneva (FOAG, 2023d.; G.H., 2023).

4.6 Organic Oilseed Crops

Currently, in Switzerland, the crops that have the largest area cultivated by organic methodologies are rapeseed, sunflower, and soybean (FSO, 2022). The demand for these organic crops is continuously increasing, as can also be seen from their total area, which has increased from 920 ha in 2016 to 2475 ha in 2022, which corresponds to 7.3% of the whole UAA of 2022 in Switzerland (FSO, 2023; FSO, 2022). There is a generally high demand for Swiss-produced oil. The organic rapeseed harvest has increased in 2022 compared to 2021 by about 9%, reaching a total production of 600 t, even though the cultivated surface with rapeseed has decreased by 31 ha, reaching a total surface of 429 ha (Annex D, Annex F). Although there is a strong demand for Swiss organic rapeseed, the final total quantity harvested cannot cover the growing demand because growing rapeseed in organic farming is challenging, as it is known that in organic agriculture the requirements are high in terms of soil preparation, weed control, and nitrogen supply (bioactualié, 2023; bioactualié, 2022b.).

Organic sunflower crops are also in high demand on the market, and they are a crop that is attractive for farmers even in the organic methodology (below 600 m altitude). This is because they require little maintenance and do not have many cultural management problems (bioactualié, 2022). The produced and requested quantities have steadily increased in the last 10 years, increasing by 63% in 2022 compared to the previous year, reaching a total of 1,115t (Annex F). The area cultivated with organic sunflower has also increased by 66 ha in 2022 compared to 2021, consequently reaching a total surface area of 580 ha (Annex D).

Swiss organic soybean production is also steadily growing. In 2022, the total production corresponded to 1.400 t, representing an increase of about 11% compared to the previous year (Annex F). The soybean-cultivated surface experienced one of the highest expansions, increasing by 334 ha between 2021 and 2022, reaching a total cultivated surface of 1259 ha, thus becoming the crop with the largest area cultivated with organic methods (Annex D).

The following processing facilities currently have a pick-up contract for the collection of organic oilseeds (bioactualié, 2022b.):

Transformer	Organic cultures
Mühle Rytz / fenaco	Soja (human food)
Biofarm / fenaco	Rapseed
Biofarm / fenaco / Biomühle Lehmann	Sunflower

5. Switzerland's Choice of Introducing Soybean Cultivation

In this subchapter, the reasons behind the decision to start cultivating soybeans in Switzerland will be explored. Due to the lack of information regarding these reasons, the farmers and experts interviewed for this research were asked about this topic (namely the representatives of the various Swiss agricultural sectors) in order to understand why this crop was introduced in Switzerland and why Swiss farmers cultivate it. Therefore, both the direct motivations of Swiss farmers and the views of people not directly involved in cultivation will be presented. This aspect was also evaluated as important following the interviews, as some farmers were keen to specify that there is a difference between what the "offices" believe and what actually happens on Swiss farms (E.V., 2023; A.B., 2023).

The first experiments regarding soybean cultivation were conducted in Switzerland between 1960 and 1980 by different research institutes. However, the results were considered disappointing, as this plant was not able to adapt to the local climate and develop (Schori, 2003). Despite this initial obstacle, in 1981, with the support of Nestlé, the researchers were able to implement further tests with the aim of developing varieties suitable for the Swiss climate. In 1988, after several years of experiments, the researchers finally proposed this cultivation to Swiss farmers, as they succeeded in developing varieties suitable for local cultivation[5] (Schori, 2003). In September 2002, the Federal Office of Agriculture decided to guarantee the program's capacity to select soybean varieties in response to a request from the interprofessional, justifying this with the need to keep soybeans attractive and competitive as a culture for plant and crop diversification (Schori, 2003).

In Switzerland, soybean is one of the few protein plant crops available for cultivation, and since it has the highest protein content and selling price among protein plants, it is a crop that is increasingly interesting to farmers. The fact that it was possible to develop varieties suitable for cultivation in Switzerland is considered an important aspect of the introduction and expansion of this crop (G.H., 2023). A.G. (2023) points out that if the research and development centers had not created Swiss varieties, it would not have been possible to start cultivating soybean, and that it is therefore the development of Swiss varieties that has enabled farmers to try growing this plant. Experts, however,

[5] A.B. (2023) was one of the first Swiss farmers to grow soybeans as soon as it was proposed in 1988.

state that although there are these different varieties to choose from, it is important to take into consideration that soybean is a plant that thrives in hot climates, and the current varieties cannot be grown easily at altitudes above 500 meters (G.H., 2023; M.N., 2023). Soybean cultivation in Switzerland, while in high demand, needs suitable environments for its cultivation, and therefore the areas available for production in Switzerland currently are limited to specific regions that offer more favorable climatic conditions. But generally, it is said that if maize can be produced in a region, it is also possible to grow soybeans (G.H., 2023; M.N., 2023; C.D., 2023).

According to Agroscope's expert (A.G., 2023), the main factors that first encouraged the experiments in Switzerland and that "pushed" toward the choice of soybean over another plant, were the need and desire to introduce a new legume with the ability to fix atmospheric nitrogen so that it would be beneficial for crop rotation and particularly advantageous for farms without livestock. Soybean turned out to be an outstanding plant in this regard, as it can produce a lot of protein without the need to add mineral nitrogen to the soil, as it fixes it and returns it naturally to the soil, making it a beneficial crop for Swiss agriculture (A.G., 2023). Moreover, the Confederation expressed the desire to supplement the production of indigenous oil, which was mainly made from rapeseed, allowing the supply to be complemented a little. However, soybean oil is no longer of interest to consumers, and soy protein is currently more in demand for animal feed and as meat substitute for human consumption, consequently the oil production stopped (A.G., 2023). The experts interviewed report that soybean is a particular cultivation in Switzerland, which means that the farmers had to be convinced to grow it from the start (C.D., 2023). This is because not all types of farmers are interested in it; some farmers who may find it appealing are those who specialize in large crops and who do not have livestock like cows and pigs, thanks to the plant ability to fix nitrogen (G.H., 2023; C.D., 2023). However, there are also agricultural holdings that specialize in the production of vegetables and are therefore not interested in this type of crop. (C.D., 2023; G.H., 2023).

Today, good plant sources of protein are highly demanded, and soybean has taken a leading position in plant protein production as the most protein-rich legume (O.P., 2023; A.G., 2023). Over the last ten or fifteen years, consumers have become more interested in consuming high-quality plant protein and reducing their climate footprint through dietary habits (A.G., 2023). Soybean became very interesting also because it is easy to digest and because it is possible to make a lot of soy-based products for human consumption, as can be seen from the Asian countries' food applications (even if in Europe the main uses are for soy milk and tofu) (A.G., 2023). In addition, the new BioSuisse guidelines, introduced in 2022, have increased demand for fodder of Swiss organic origin, giving a major boost to Swiss soybean production (C.D., 2023; O.P., 2023; E.F., 2023). The Swiss fodder market is still not rich enough in plant proteins, and so soybean has begun to be increasingly sought-after in Switzerland (O.P., 2023; A.G., 2023).

Between the growing consumer demand for meat substitutes and the various demands of the different Swiss food labels, Swiss farmers are increasingly tempted to introduce this crop into their rotations. According to the experts interviewed in Switzerland, the demand for soybeans has been growing, especially in the organic sector, and as a consequence, the prices offered for those who grow organic soybeans are very attractive, whether growing soybeans for human food or animal feed, so there are farmers who have extended their soybean acreage or started growing it (C.D., 2023; M.N., 2023; G.H., 2023; O.P., 2023; E.F., 2023).

6. Soybean production in Switzerland

In Switzerland, the oilseed market operates within a liberalized framework, which means that there is no direct intervention by the Confederation in the management or marketing (G.H., 2023). The Swiss Federation of Cereal Producers (FSPC) works with the processors to determine the annual production quantities of oilseeds for farmers in order to have a balance in the Swiss market. The processors communicate the quantities they wish to process and then a global quantity is defined for the processing, purchasing, and marketing of oilseeds. On this basis, the OPP draws up contracts each year with farmers who wish to cultivate soybeans (G.H., 2023; E.F., 2023). In other words, Swiss farmers must have a pre-signed contract with the OPP that grants them the right to produce soybeans in specific quantities under private law and without the involvement of federal offices. Each farmer can enroll to request to produce soybeans, however without one of these pre-signed contracts, a farmer cannot start growing soybeans (E.F., 2023; FOAG, 2022c.). In the case of conventional production, a contract is drawn up between the market partners and the FSPC in Switzerland. While in the organic sector, although there is no formal agreement between the market partners and BioSuisse, organic soybean production is also carried out under contract. Although the system is different, the principle remains the same: the contract confers the right to produce a determined quantity of organic soybeans while also guaranteeing the possibility of delivering a specific quantity to BioSuisse's partners (E.F., 2023). These collaborations encompass all aspects of production and processing (E.F., 2023).

In 2022, soybean cultivation in Switzerland was carried out by a varying number of farmers, with a variable cultivated area from canton to canton. In 18 cantons out of 26[6], soybean is cultivated by a total of 953 farmers, covering a total area of 2894.99 ha. Although the total size of the soybean cultivation area is relatively small, it has been steadily increasing since 2008 (FSO, 2022; Annex M). In the previous ten years, the area devoted to soybean cultivation has more than doubled; in particular, it is reported that the area devoted to organic soybean cultivation has increased about 15 times (Annex M; FOAG, 2023;

[6] Uri (UR), Schwyz (SZ), Obwalden (OW), Nidwalden (NW), Glarus (GL), and Appenzell Innerrhoden (IA) record zero soybean producers (Annex I)

FOAG, 2022). The canton of Vaud (VD) is the largest producer of soybeans in Switzerland, hosting as many as 279 producers for a total cultivated area of 979.24 ha in 2022. The second canton with the largest number of soybean farmers and the largest cultivated area is Zurich, hosting 149 farms active in soybean production and a total cultivated area of 328.03 ha. The third and fourth cantons with the highest number of soybean producers and cultivated area under soybean are Geneva and Bern, with respectively 99 and 91 producers and 487.93 ha and 184.69 ha (see Table 5). The last data highlights an interesting aspect: although Geneva has 99 soybean producers, the area cultivated with soybeans reaches higher values than Zurich, which has 149 producers. This occurrence also happens in other cases; for example, in the canton of Fribourg, there are 36 producers with a total soybean cultivation area of 114.56 ha, while in the canton of Aargau, the producers amount to 54 with a cultivated area of 105.86 ha (Annex I).

Canton	Number of soybean producers	Soybean cultivated area in ha
VD	279	979.2403
ZH	149	328.03
GE	99	487.93
BE	91	184.6918
TG	68	143.9862
AG	54	105.86
FR	36	114.656

Table 5: Number of soybean producers and cultivated area (in ha) by canton in 2022. Source: Federal Statistics Office (FSO) (2023). For more details see Annex. I.

Among the cantons involved in soybean production, five experienced an overall decrease in their area cultivated with soybean during the period from 2002 to 2022, although there were some years with an increase: Canton Ticino decreased from 89 ha in 2002 to 69 ha in 2022; Canton Basel-Land experienced a decrease from 78 ha to 43 ha; Canton Neuchatel decreased from 30 ha in 2002 to 28 ha in 2022; and Canton St. Gallen reduced its soybean-cultivated area from 97 ha to 26 ha in 2022. Canton Valais soybean cultivation decreased from 25 hectares to 14 hectares in 2022. (Annex I, Annex M[7]).

The variability in the numbers of producers and the UAA under soybean cultivation in the various Swiss cantons could be influenced by several factors, including the size of available agricultural land and favorable environmental conditions for soybean cultivation.

[7] For more details on the agricultural areas under soybean cultivation in each canton from 2002 to 2022 please look at Appendix M, the data in "Annex I" shows the number of producers for each canton with their respective total UAA under soybean cultivation.

A closer analysis of the size of the agricultural areas of the soybean producers reveals a predominant presence of medium to large farms that have soybeans in their crop rotation (see Figure 5). However, it should be made clear that a Swiss farm defined as large is not the same type of farm size as in other European countries. Most farms that also produce soybeans have a UAA of less than 50 ha, with a concentration in farms of 30 ha and less than 50 ha (see Figure 5). The size of the UAA among soybean producers represented by the '5 ha to less than 10 ha' and '10ha to less than 20 ha' categories have 24 and 151 producers, respectively, while the medium-sized categories, such as '20ha to less than 30ha' and '30ha. to less than 50ha', have more producers: 212 and 311 producers respectively (see Figure 5).

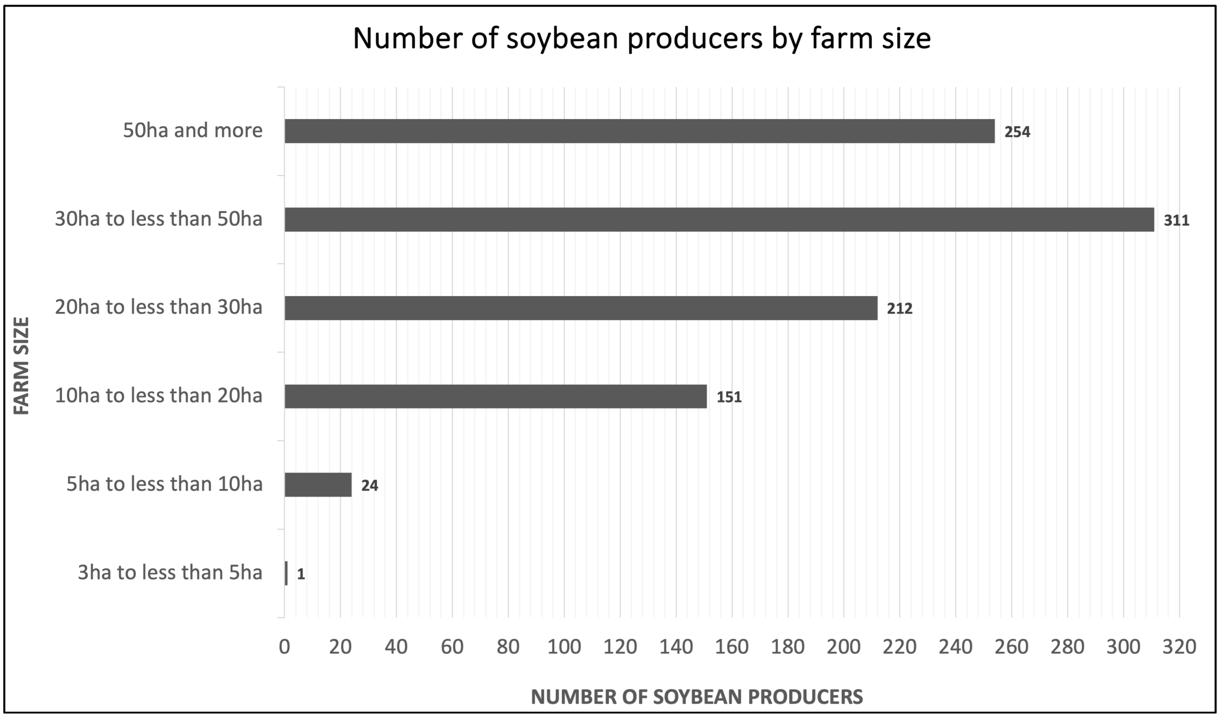

Figure 6: Number of soybean producers in relation to the agricultural holdings total UAA size. Data source: FSO (2023).

6.2 Organic and Conventional Soybean Production

Currently, in the official Swiss agricultural reports, the agricultural production sector concerning soybean production is divided between conventional production and organic (bio) production. For conventional production, the number of soybean producers in 2022 amounted to 564 units for a total cultivated area of 1636.34 (Annex N). The number of farmers that cultivated according to organic (bio) methods amounted to 389 units, with a total cultivated area with soybeans of 1258.65 ha, which is approximately 377.69 ha less than the area under conventional cultivation (Annex N). What emerges from this data is that in organic cultivation, the number of producers and the area cultivated are only slightly lower than the values of conventional production. In the last decade, the area devoted to organic soybean cultivation has increased about 15 times and is expected to increase even more (FOAG, 2023; FOAG, 2022).

However, even if the area cultivated with soybeans is generally increasing in Switzerland, the average yields have experienced a decline for both organic and conventional methods in the last 10 years. In 2012, average yields stood at 28.1 dt/ha in the conventional sector, but a more or less steady decline occurred over the following years, reaching a yield production of 20.7 dt/ha in 2022. This downward trend was also seen in the organic soybean crops, where the average yields have declined from 21.5 dt/ha in 2019 to 17.6 dt/ha in 2022 (Annex A). FiBL (2019) explains this downtrend and yield instability by citing the fact that soybean cultivation is very demanding, and farmers have limited experience.

If we look at the production volumes, the amount of soybeans produced has increased over the past two decades: in 2000, the production was 3750 tons, while in 2022, the production amounted to 6175 tons (Annex F; FSPC, 2023d.). Of these 6175 tons of soybean production, as many as 2213 tons came from organic crops, and of these 2213 tons, 1400 were used for human food (Annex F).

From the analysis of the number of producers, the area cultivated, and the production volumes, it emerges that despite the decrease in yields, the area under soybean cultivation, the number of farmers that cultivate soybeans, and the production volume have increased significantly over the past decade. This may be explained by the fact that, despite lower yields, the increase in the cultivated area has helped to maintain the production volumes.

For organic production (bio), the canton of Vaud (VD) emerges as the main producer with a cultivated area of 355 ha, followed by Jura (JU) with 134 ha and Geneva (GE) with 132 ha. In conventional production, the canton of Vaud (VD) continues to be the main soy producer, with a cultivated area of 624 ha, followed by Geneva (GE) with 356 ha and Zurich (ZH) with 229 ha (see table 6). A deeper analysis of the production methods in the different cantons shows that in the cantons of Jura (JU), Bern (BE), Thurgau (TG), Aargau (AG), Ticino (TI), Solothurn (SO), and Basel-Land (BL), the area devoted to organic soy cultivation exceeds the one devoted to conventional production (see table 6).

Canton	Total ha 2022	Bio ha 2022	Conventional ha 2022
VD	979	355	624
JU	144	134	9
GE	488	132	356
BE	185	115	70
TG	144	106	38
ZH	328	99	229
SO	136	69	67
AG	106	59	47
FR	115	57	58
TI	69	49	20
SH	77	37	40
BL	43	22	21
SG	26	9	17
NE	28	7	21
VS	14	6	9
LU	13	3	10
ZG	1	-	1
GR	0	-	0

Table 6: Hectares of soybean cultivated in each canton, divided according to the method of production. Source FSO (2023)

6.3 Customs duties and the role of supermarkets

With the outbreak of war in Ukraine, the commodity market is experiencing a significant price rise in various products (food, fuel, fertilizers, etc.), since some materials can no longer be transported and some products are no longer processed, generating significant uncertainty in the supply of various nations, including Switzerland (FSPC, 2023a.; Arndt et al., 2023; FOAG, y.2022). In Switzerland, the border protection system for feed grains was created to establish economic stability in the prices of imported products (FSPC, 2023a.). The concept is based on the fact that border tariffs decrease when the global prices in the market rise and increase when the prices in the market are falling (FSPC, 2023a.; FOAG, 2022e.). According to the FSPC, border tariffs are currently low; this is due to the fact that border protection is insufficient and too slow to keep up with world events (FSPC, 2023a.). This situation has already been the subject of FSPC criticism since December 2022, which is arguing that the situation has further worsened since 2023 (FSPC, 2023a.). Regarding soybean imports, fodder soybeans can benefit from border protection. However, currently customs duties are at zero because international prices are high (G.H., 2023; FOAG, 2022e.). The role of crop contributions is to balance the profitability of soybeans against cereals, which are well protected under Customs Protection, and although there are no customs duties for fodder soybeans, there are for soybeans used for human consumption, thus promoting local production (C.D., 2023). It should be noted that even when it comes to human food soybeans, processors are mainly interested in buying local organic soybeans. However, they will buy foreign soybeans, which are significantly less expensive, if they have the chance to import due to the customs duty (A.G., 2023).

Processors, especially fodder processors, benefit from being able to import significant quantities of raw materials at very low prices, thus putting aside local production as it is uncompetitive against foreign prices (FSPC, 2023a.). The current market situation is putting pressure on Swiss farmers, who have to sell their products at lower prices to compete with cheap imports (FSPC, 2023a.). During the interviews with the farmers, it has been pointed out by some of them that big retailers currently enjoy higher margins than the farmers who grow the food to feed the population. The farmers have shared their perception that, as a result of the war in Ukraine and after COVID-19, the big retailers have increased their selling prices even more under the pretext that energy is less available and charging costs are higher (C.C., 2023; F.C., 2023). However, while facing an increase in their expenses, the farmers do not think that they had an adequate increase in their product prices when they sell to collector centers or other retailers such as Coop and Migros (C.C., 2023; F.C., 2023). This situation results in decreased profits for farmers, who think that they are further penalized by the request to reduce the useful agricultural land in favor of biodiversity promotion as stated in the new federal law. This situation has been described as a form of "cheating" by the farmers, who face increasingly difficult challenges in maintaining the sustainability of their farms (F.C., 2023).

Also, some interviewed experts think that production prices are very low for forage soybeans in Switzerland, which does not generate interest in producing them locally. According to them, it is much easier and less expensive to import soybeans, so it is not worth growing them in Switzerland, since other crops can bring in more money (M.N., 2023; A.G., 2023).

6.4 Uses of Swiss Produced Soybeans

In the Swiss Farmers' Union report “Potential of Selected Arable Crops in Switzerland,” soybeans are described as having great economic potential as well as the potential for animal and human nutrition; moreover, it is recommended to produce soybeans for human consumption to gain access to higher value-added markets (USP, 2021). However, at the moment, in Switzerland, most of the soybean production is used directly in animal feed (FSO, 2022). In the conventional sector, as of 2018, soybeans are no longer grown for human food use but exclusively for animal feed production, whereas the organic soybean is used for both human and animal consumption (FOAG, 2023). However, the Swiss Grain Producers Association and the Association of Swiss Producers of Edible Oils, Fats, and Margarines agreed that domestic soybeans will no longer be used for edible oil production because of the low demand (FOAG, 2022). There are still some farmers who produce soybean oil themselves or have their soybeans processed into oil by a local oil mill, as is the case for the farmer E.V. who processes its own locally grown soybeans and then sells the oil on the farm (2023).

The production of soybeans for human foods in Switzerland has been increasing in the past years; today, organic soybeans are mostly used to make human food products such as tofu (1.500 tons of soy) and tempeh, which are becoming increasingly popular in Switzerland (bioactualites, 2023; FOAG, 2023e). With soybeans, there are several opportunities to produce different food products instead of just tofu, as the demand for meat alternatives is growing and soybean is one of the best substitutes in terms of protein, but in Switzerland, there is a lack of industries capable of producing these kinds of products (FOAG, 2022). Moreover, the costs of setting up such a company, and the products' final selling prices, are much higher than what it costs to import them from countries that already have established companies producing meat substitutes using soybeans (FOAG, 2022). However, as of 2021, there is a company in the canton of Berne, Luya Foods AG, which has embarked on the production of meat substitute products from the okara, which is soy pulp (FOAG, 2022).

The following sub-chapters, "Tofu Production" and "BioSuisse Fodder Production", will introduce some aspects of sustainable agriculture and organic farming in Switzerland. The subchapter on tofu production will bring up the importance of meeting strict quality standards in human food production in Switzerland and explain the process as well as the implications of sourcing soybean products locally. The subchapter about BioSuisse fodder production will introduce the recent changes in the BioSuisse policy about the use of Swiss organic fodder in ruminant nutrition, thereby introducing the challenges and opportunities associated with the local sourcing of organic protein feed such as soybeans. These chapters bring up the opportunities, challenges and importance of sustainable farming practices and local sourcing of ingredients in the contexts of environmental and social sustainability of the Swiss food industry.

6.4.1 Tofu production

The demand for Swiss organic soy for the local production of tofu has been increasing in the last few years, especially since the Corona pandemic (FOAG, 2022; FOAG, 2022c.). Currently, there are four soybean varieties from the 13 available that are considered suitable for tofu production, namely Proteix, Avelin, Aurelina, and Galek (Vonlanthen et al., 2022). After the harvest, the soybean lots are sent to the collector centers, and when the lots arrive, they are delivered to the first processing stage, where the soybeans are inspected, and it is determined whether the batch is suitable for the production of human food as the soybean grain has to meet specific criteria (such as the color) to be accepted into the human food production chain. If the criteria are not met, the nonconforming part of the harvest will be downgraded and sent to the fodder production chain (FOAG, 2022c.). When the soybeans pass this first stage of inspection, they are then washed and their moisture content is assessed, and if it exceeds a certain threshold, the batch is sent to a drying center (collector centers often have a dryer), and then for tofu production, the batch is washed a second time (FOAG, 2022c.).
Once the inspection and cleaning are finished, the soybean grains are soaked, then boiled, and finally crushed to form a kind of purée (FOAG, 2022c.). Then this purée is filtered, and a liquid part (soy milk)

and a solid part (okara) are obtained. The liquid part is finally used to produce tofu, while the solid part can be used for various other purposes (meat substitutes, animal feed, biogas, etc.) (FOAG, 2022c.).

Local Tofu Production - The Example of TiGusto in Ticino:

TiGusto is a Ticino artisanal company established in 1988, and it is the only one in the canton to process organic soybeans into tofu. There are a total of two tofu processors in Ticino, but TiGusto is the only one that processes organic products. RSI[8] describes the company's director as the inventor of Ticino's tofu (RSI, 2024), while BioSuisse refers to him as a pioneer of organic tofu processing in Switzerland (Zbinden, 2018).

TiGusto has been producing tofu since its opening, which was 36 years ago, and nowadays, it produces around 26.000 kg of tofu per year. The soybeans that are used are 100% organic from Ticino, and wherever possible, they have contracts (stipulated up to a year in advance) with the same farmers every year (TiGusto, 2023). TiGusto's company policy is based on choosing to use biological local products first, i.e., from Ticino, secondarily Swiss, and only if there is no Swiss, the primary materials are imported (TiGusto, 2023). What is important for this company is to collaborate with local firms to promote local production and processing (TiGusto, 2023). The initial goal that prompted the creation of the company and the production of tofu from its opening was to create a business that would produce a product that could help solve a problem that is still there today, which is the consumption of protein:

> *"I was interested in trying to solve problems related essentially to health, the fact of the increase in world population, the decrease in agricultural territories, environmental problems, energy problems. I found that there was a product that at least here with us (in Ticino) could solve some of these problems. Tofu is a taste-neutral product and therefore can be adaptable in classic preparations. By producing tofu, you can reduce animal products and you can indirectly contribute to improving what is the fertility of soils, as well as increase the available capacity of protein, because compared to, for example meat, soy produces much more protein per hectare while also reducing the CO2 impact" (*TiGusto, 2023*).*

Soybeans turn out to be one of the best ways to bring enough protein into people's diets, especially with the world's growing population (Messina, 2022). This is because soybeans have a higher protein content than any other legumes, making them an excellent source of healthy fat while also contributing to environmental health because they can fix atmospheric nitrogen, thereby reducing the need for fertilizer (Messina, 2022).

---

[8] RSI is the abbreviation for "Radiotelevisione Svizzera di lingua italiana", which is a Swiss public broadcasting organisatiton.

Nowadays, meat substitutes are increasingly sought after by the Swiss and world population (Herrmann & Bolliger, 2021; Piernas et al., 2021). However, according to the TiGusto director, the Ticino reality at the moment is not yet in this transit phase towards the increasing consumption of locally produced meat substitutes, although he reports that there are more and more young people who are starting to experiment with new foods and cuisines: "*You have to consider that anyway producing tofu, in Ticino, was and still is quite a challenge, because there were and still are now, a little less, but there are still, so many preconceptions. That is, if I had produced cheese or salami, it would have been completely different. But to produce a product that is not ours, of culture, that is tasteless, people do not know how to use it. These are the big limitations we still face*" (TiGusto, 2023). One solution they have tried to propose is to offer courses to teach people how to cook this product, in addition to offering free recipes on their online site (TiGusto, 2023). Zanchi reports that the only way he was able to fill the financial hole created at the small business level was to win a cantonal contract for school canteens (TiGusto, 2023). With this contract made with the canton, TiGusto was able to sell their tofu to school canteens in Canton Ticino (TiGusto, 2023).

With booming urbanization and an increasingly frantic life, people are in more and more of a hurry and are looking for almost ready-made food products that do not require too much handling (TiGusto, 2023; Public Eye, n.d.; Piao & Sung Kim 2024). Supermarkets, which have become more prevalent due to the globalization of the agricultural industry, have also had an impact on these dietary changes. They offer a variety of products that are processed overseas and cost less than locally prepared products, which hurts small local producers who see their earnings decrease because people often prefer to buy these cheaper products with a greater variety of flavors (TiGusto, 2023; Public Eye, n.d.; Borraz et al, 2014; Florez-Acosta & Herrera-Araujo, 2020). In Switzerland, Migros and Coop have almost 80% control of the food market, so in addition to being the main retailers of food products, they also have the highest profits, and being practically a duopoly, they can afford great freedom in terms of pricing and product range (Sandmeier, 2022; TiGusto, 2023). In an attempt to try to reach more customers, TiGusto decided to approach a few large retailers about selling them tofu and has been supplying Migros, Coop, and Manor for the last 10 years (in Ticino). The director reports that he could probably find more partners to resell his product in other parts of Switzerland as well, but at the moment, it is not logistically feasible for TiGusto since they already have enough work in Ticino. They also do not have a real marketing campaign and/or a person responsible for promoting their product, though they would have the capacity to triple the current production even just for the Ticino (TiGusto, 2023).

When talking about the sustainability of local food systems, it is necessary to consider not only aspects related to the environment but also economic and social aspects (Stein & Santini, 2021). Locally grown agricultural products are often more expensive than imported ones, but the local production can, for example, help create new jobs, and the money stays invested locally (Stein & Santini, 2021). However, the higher costs of locally grown products can limit local production, since not everyone wants to or can afford to spend more on food (Low et al., 2015). This is why supermarkets have become successful in

developed countries; they sell various foods at lower prices than locally produced foods, which they import from countries that are often far away from where the agricultural products are sold (Helander et al., 2024; Lawrence and Burch, 2007). Nevertheless, in the last few years, consumers have increasingly started to buy local agricultural products, even if they are more expensive. This is because they are becoming more aware of the production costs that farmers encounter and what local production brings to society (local investment, compliance with production rules, fair wages, etc.) (Stein & Santini, 2021; de Fazio, 2016; Galli & Brunori, 2015).
The TiGusto director (TiGusto, 2023) reports that he is well aware that a locally processed product comes at a higher cost than an imported one and that not everyone can spend two or three times as much for a loaf of tofu, but with the product created locally in Switzerland, you can also be sure that it is a socially sustainable product, as you can guarantee that, for example, there is no child labor and no exploitation of workers (at least for tofu production in Ticino). The director reports that, in fact, in his company policy, wages are the same for both frontier workers and Ticino workers, man or woman; they all receive the same wages, and working hours are adjusted to meet both the needs of the company and the needs of families (TiGusto, 2023). These are all components that indirectly affect the value of the product (TiGusto, 2023). The director also points out that one should keep in mind that if one buys local soybeans, the money stays spent locally. As a processor buys from the local farmer, the farmer gets the money on which he pays taxes in Ticino, and the processor also pays taxes in Ticino, so there is an economy that stays local and increases the sustainability of the local production. Whereas if you go and buy soybeans abroad, you put the local farms in crisis because they would not know to whom to sell the soybeans (TiGusto, 2023).

The director of TiGusto also reports that his company promotes a reevaluation of local agricultural products, defined as waste by large retailers. For example, they often buy agricultural products that a supermarket would define as unfit for sale (tomatoes with bruises, soybeans that are not completely yellow, etc.), but still pay the farmer the full price. In this way, products that are still of good quality are not discarded. He reports that he has had no problems reselling such products in his store (which, in any case, states on the label that they are products processed from raw materials with external defects) (TiGusto, 2023). One of the issues with food waste today is that consumers and traders prefer externally perfect products, so tons of products are thrown away every year just because they are not deemed aesthetically pleasing (USP, n.d.b.; USP, 2018; WWF, n.d.b.; Bonanno & Busch, 2015). The USP encourages consumers to go directly to the farms and buy the products that have been discarded by the retail trade to reduce food waste and make money directly for the farmers (USP, n.d.b.). In addition, the USP provides the farmers with some contacts from companies willing to buy the products rejected by big retailers (USP, n.d.b.). In addition to using soybean grains that are not necessarily perfect, TiGusto also revalorizes the waste derived from soybean processing, which amounts to 15% waste on the raw material. What they have done is revalue this 15%, and in doing so, they recover about 90% of the waste and resell it to farmers, who then use this product in animal feed. But it is not only the farmers who are interested in these waste products derived from soybean processing; TiGusto (2023) reports that they have also stipulated a contract with a company to collect the soybean pulp and use it to produce fly larvae. This way, their production waste will benefit another type of production and will not be thrown away (TiGusto, 2023).

The TiGusto director reveals a growing problem in Switzerland for those who process soybeans (but also other commodities). Namely, more and more small businesses are closing as maintenance costs are increasing, but they receive no help or support from the state (TiGusto, 2023; Public Eye, n.d.). He reports that, being a bioprocessing company, they also have machinery that must be certified and approved for this kind of production, and this machinery has high costs. In the beginning, they were able to reduce the cost of maintaining them by replacing defective parts, but nowadays, he says that such parts are often no longer available and that new machinery, in addition to costing too much money, is produced in such a way that it is not possible to replace only the defective part, but that one has to buy back the whole machinery (TiGusto, 2023).

The State offers incentives (40%) to those who want to open processing facilities, but the problem remains that nowadays, to open a business, the costs are very high, and even if the state offers money, the 60% that is left for the artisan to pay is still excessive (TiGusto, 2023). What the TiGusto director is proposing, or rather, what he would like to see proposed by the State, is a place with a centralized structure, like a food crafts center where perhaps 10–20 artisans could collaborate and try to solve together the problems that arise during the processing of agricultural products, since there is currently no such a place: "*At the municipal level we have facilities to do culture, to do music, to do events, we built them with public money. We should have exactly the same mentality at the level of local artisanal as well*" (TiGusto, 2023).

6.4.2 BioSuisse Fodder Production

In 2018, BioSuisse changed its guidelines, stating that starting in 2022, ruminants under the BioSuisse label must receive a 100% Bourgeon BioSuisse feed, which is a feed composed exclusively of organic Swiss fodder (Bioactualités, 2019b.). Moreover, the new Bourgeon regulations only authorize 5% of concentrated feeds for all animals (such as corn, soybeans, barley, etc.), a decision that turns out to be stricter than EU or Swiss organic regulations (BioSuisse, n.d.). In Switzerland, the protein component most used in concentrates for ruminants is soybean meal, which until 2022 was mostly imported, so those who supplement their forages with concentrates containing imported soybean had to make changes in their animal feed from January 2022 (Bioactualités, 2019b.). In an effort to help farmers adjust to these changes and assist those who are facing higher expenses for animal feed, reference prices and incentive contributions for bioproducts increased in 2019 (Bioactualités, 2019b.). According to BioSuisse's initial estimations, around 2.500 ha of soybean used for fodder would be needed to cover the current requirements, and so far, such areas have not yet been cultivated (Bioactualités, 2019b.). In fact, in November 2023, the delegates from BioSuisse declared that Switzerland does not have enough concentrated protein feed of Bourgeon quality for its fodder (BioSuisse, 2023). Consequently, BioSuisse approved a motion that allows manufacturers of complex feeds to use a percentage of foreign protein components (that still meets the Bourgeon label standards) for five years (BioSuisse, 2023). This percentage is calculated in relation to the total amount of concentrated feed for ruminants, which resulted in the decision to allow a percentage of 10% for the first three years and a percentage of 5% for the last two years (BioSuisse, 2023).

7. Soybean Crop Management Strategies

Nowadays, because of the increasing development of a globalized market, the agricultural market is undergoing a concentration, both horizontally and vertically (Murphy, 2006). A horizontal concentration of the agricultural sector is characterized by the fact that only a few large companies control certain stages in the agricultural market value chain, as is increasingly the case, for example, in the production and sale of seeds and agricultural machinery (Murphy, 2006). A vertical concentration of markets is characterized by large companies (or multinationals) expanding into different sectors of the agricultural market and value chain, therefore concentrating different sectors in the hands of a few players (Murphy, 2006).

Public Eye reports that the world seed market nowadays is concentrated in the hands of three multinationals: Bayer, Corteva, and Syngenta, the last of which is a multinational with Swiss provenance (Public Eye, n.d.). These companies have not only gained control over a particular sector but also possess control over other sectors of agricultural production; for example, they are also the largest manufacturers of pesticides. These companies achieved this position by progressively acquiring small companies that were unable to compete with such powerful, large corporations (Public Eye, n.d.). More and more policymakers, NGOs, consumers, and researchers are reporting their concerns about this homogenization of the market in the hands of a few players, which in turn decreases competition and choice for farmers (Dong et al., 2023). Moreover, this trend also increases the prices of products that a farmer needs to be able to produce, thus adding to their expenses, while the revenues of large companies and retailers of agricultural products, increase (Dong et al., 2023; Baker, 2019; Philippon, 2019). This concentration exacerbates inequalities and diminishes the bargaining power of small farms, which are forced to sell to large firms at rock-bottom prices while their production costs remain high or even increase further (Public Eye, n.d.). Most farmers today do not produce the inputs (seeds, pesticides, fertilizers, etc.) used on their farms because of the high cost of production, becoming increasingly dependent on buying them from multinational corporations or local retailers (Public Eye, n.d.). In Switzerland, the main inputs used to grow and maintain soybean cultivation are Swiss seed varieties, fertilizers (organic or not), and chemical herbicides. Until now, soybeans in Switzerland have not required irrigation, but due to climate change, summers are becoming drier in Switzerland as well, so soybeans may require irrigation in the future. Finally, depending on the methods used on the farm, different machines are needed for soil preparation, sowing and weeding, which can be used to a greater or lesser extent.

7.1. Swiss Soybean Varieties

As elaborated above, soybean is a plant native to subtropical regions; however, thanks to the efforts of Agroscope and his partners, it was possible to start growing this plant in Switzerland. Since 1988, in the Swiss agricultural market, it has been possible to find varieties that have adapted quite well to the local climatic conditions (FSO, 2022). In the current policy of the Swiss Agricultural Law, the soybean varieties are regulated, which means that in Switzerland it is possible to use and diffuse only the varieties that have passed a test period in Switzerland of three years and have consequently been inscribed in the national catalog of the recommended varieties (Vonlanthen et al., 2023; Vallier, 2021; A.G., 2023; Schori et al., 2003). To be included in the national catalog and the list of recommended varieties, the breeder must follow a list of strict rules, which are given in the DEFR Ordinance on Propagating Material for Field Crops and Forage Crops (1999). This ordinance states that a seed variety must pass two examinations to be accepted: the first rule concerns the examination of distinctness, homogeneity, and stability (DHS), which means that the variety must be clearly distinct from the varieties that are already registered in the national catalog, then the variety must be homogeneous (i.e., there shouldn't be too much variation in grain sizes, color, etc.), and as the last criteria, the variety must be stable (i.e., when harvested, should give in most cases a good yield at each cultivation) (Vallier, 2021). The second exam that must be passed is that of the agricultural and utilization value (or agronomic and technical value test, VAT), to show that the new variety bring additional advantages to agriculture (FOAG, 2016).

Those responsible for conducting the tests for soybean varieties are Agroscope's research stations (ACW et ART) and Delley semences et plantes SA (DSP), while the list of the recommended varieties for cereals, oilseeds, and protein crops, is documented by Swissgranum, Agroscope, and Agridea (Swissgranum, 2023; Vonlanthen et al., 2022; Vallier, 2021). Swissgranum talks about the limitation of only using the varieties that have been tested and approved in Switzerland and the objective of this list, which is to offer seed varieties that meet the needs of Swiss farmers, processors, and consumers, as well as having the assurance that that variety can grow on Swiss agricultural land (Swissgranum, 2023; E.F., 2023).

In 2023, the testing areas for the new varieties were held in 6 different locations in Switzerland according to the cultivation methods: in Nyon-Changins, Goumoëns-la-Ville, Delley and Zürich-Reckenholz, thte tests were conducted for the varieties that will be used on farms that cultivate according to the EPR, while in Grandcour et Senarclens, the tests were conducted for organic cultivation methods (Swissgranum, 2023; Vonlanthen et al., 2022).

For the year 2023, the list of recommended soybean varieties consists of 13 varieties, which are subdivided into different classes according to the earliness: very early, early, semi-early, and semi-late, with different numbers of days needed to reach maturity (A.G., 2023; Vonlanthen et al., 2022). This earliness depends on the temperature needed for the soybean to reach maturity, so in Switzerland, the "semi-early" variety is grown in the coolest areas, while if the exposure is good, the "semi-late" variety is grown, and in the best growing areas, the very early/early variety could be grown (A.G., 2023; Vonlanthen et al., 2022). Agroscope's advice is to choose an early variety if the farm is located in a limiting area because it allows to obtain the best yield as a longer cultivation period increases the possibility of obtaining a high yield (A.G., 2023).

Among the varieties grown, tested, and available in Switzerland, the following can be found: Aveline and Protéix for organic cultivation, and Galice, Gallec, Obélix, Opaline, Paprika, Tiguan, Tourmaline, and Toutatis for conventional cultivation (or following EPRs). For three of the proposed varieties, seed comes from Austria: Adelfia, Aurelina, and Merlin (these varieties have also been tested in Switzerland for 3 years, but seed multipliers are not located on Swiss territory) (Vonlanthen et al., 2022) (see figure 6). Each farmer receives an annually updated list, which is often sent by the collector centers with whom they had a contract, along with their recommendations and preferences. The soybean production contracts drawn up by the OPP are based on the quantity to be produced, not the variety. Once the contract has been signed with the OPP, the farmer is allowed to produce the quantity requested in advance but is free to choose, from the recommended list, the variety he wants to grow based on the criteria he is most interested in. However, they then have to find someone that wants to buy that variety of soybean (see figure 6 for the different criteria available). This is why farmers typically start by learning which varieties are of interest to the collector centers.

Earliness group	Very-early	Early			Semi-early			Semi-late		
Variety	**TIGUAN**	**MERLINN**	**GALLEC**	**OBELIX**	**TOUTATTIS**	**ADELFIA**	**GALICE**	**AURELINA**	**OPALINE**	**PAPRIKA**
Registration year	2016	2007	2000	2014	2016	2022	2015	2019	2009	2020
Earliness (range in days)[9]	-10	-7	-6	-4	-5	-2	-1	0	1	0
Yield	/	++	+	+++	+++	+++	+++	+++	++	+++
Cold tolerance at flowering	+	++	+	++		/	+	-	+	++
Resistance to lodging	++	+	+	+	++	++	+	++	/	++
Protein content[10]	/	/	+	+	/	++	/	+++	/	++
Oil content	Medium to High	High	Medium to Low	Medium to High	High	Medium	High	Medium to Low	Medium to High	Medium to High
Thousand grains weight[11]	Low	Low	Medium	High	Medium	Low	Medium	Medium	Medium	Low
hilum color	Light Brown	Brown	Colorless	Brown	Brown	Light	Brown	Colorless	Brown	Light Brown

Figure 7: List of recommended soybeans varieties for the 2023 harvesting with the different characteristics for each variety. The varieties Amandine, Aveline, Protéix and Tourmaline are also recognized as varieties on the recommended list of soybeans. Source: Vonlanthen et al., 2022. Figure translated from the original in French.

The system by which the Swiss manage the selection of varieties for farmers to grow does not seem appropriate to certain pro-environmental associations. According to ProSpecieRara (2019), the DHS and VAT tests have led to the total dependence of Swiss farmers on a few market players. FOAG's (2016) justification for these kinds of tests is the desire to increase Swiss agricultural productivity, but according to Vallier (2021), as a result of these tests and regulations, a small number of actors now control the variety selection and approval, and this has led to a standardized agriculture and crop cultivation, with the sole goal of producing as much as possible without thinking much about the possible environmental consequences. Vallier (2021) discusses how the DHS requirements are contributing to the homogenization of the plant species cultivated, of their varieties and genes, by stating that Swiss agriculture is following the principles of globalized agriculture rather than advocating for a more

[9] Earliness (range in days) : -6 = very early variety; -2 = medium-early variety; 0 = reference variety; 2 = mid-late variety; 4 = late variety

[10] +++ = very good; ++ = good; + = average to good; / = medium; - = medium to poor; -- = poor; --- = very weak; Blank = no information

[11] Weight of thousand grains: very large = >261g; large = 231 to 260g; medium = 231 to 260g; small = =< 200g

localized approach. The homogenization of the varieties is characterized by the fact that the seeds must be of homogeneous quality (e.g., equal grain size, equal color, etc.) and stable (i.e., the quality characteristics must be repeated in each successive generation that is cultivated), and according to the Federal Office of Agriculture (FOAG), this aspect is important as it serves to "protect the buyer against inferior seeds and seedlings" (FOAG, 2016: p. 7), in addition to facilitating the harvesting and processing of the product (Vallier, 2021; FOAG 2016).

7.2. Swiss Soybean Seeds

In Switzerland, seeds for cultivation are produced by seed producers who have a multiplication contract with a multiplication establishment, which is then in contact with the official federal body, i.e., the Service for Seeds and Plants (SSP) (FOAG, 2016). Seed producers are organized within the Swisssem Association (Association of Swiss Seed Producers), which coordinates 13 seed multiplication establishments in Switzerland, four of which generate more than 80% of Swiss cereal seed production (FOAG, 2016). One of these selections and multiplying facilities is the mentioned DSP SA (Delley semences et plantes), which is a company in the Swiss seed industry owned by Swiss seed producers who are members of Swisssem (DSP, 2023). DSP has permission to produce the soybean seed varieties recommended by Agroscope, and it provides authorization for seed multiplication to specific growers who are under contract with their company and who must regularly pass various inspections to produce seeds (Swissgranum, 2023a.; E.F., 2023; FOAG, 2016). The DSP is responsible for conservative breeding (for cereals and soybeans), i.e., ensuring that multiplied seeds give homogeneous and stable varieties, by providing pre-basic seeds (cereals, soybeans, grasses, and clover), and is also responsible for promoting varieties in Switzerland and abroad (FOAG, 2016). When the facility receives a multiplication authorization, it starts the production of first-generation seed through its contracted farmers, and then the first generation is multiplied again to obtain the second generation, which can eventually be sold to wholesalers (FOAG, 2016). But before the seeds can be sold, the multiplier must pass official controls by sending a sample of the harvested seed to the sorting station of the propagating establishment. From there, it is sent to the ART Research Station for quality control, and then it finally receives the certification for the batch (FOAG, 2016). This is because, similar to varieties, seeds can only be sold and used if the production batch has passed all stages of quality testing (UFA, 2022; FOAG, 2016). Once they pass the tests, multiplier centers can sell the seeds to wholesalers, who in turn resell them to farmers through intermediaries such as Moulin Rytz et Landi. However, because these seeds must go through various stages and policies before they can be used and sold, purchase prices for farmers are still high (UFA, 2022).

Individual smallholder farmers can be discouraged from producing their own seed because, before sowing them, they need to obtain certification of the quality of the seed, which involves several steps and has high costs (UFA, 2022). In addition, various labels, such as those of Suisse Garantie and IP-Suisse, require certified seed in order to obtain the label certification, and farms following the REP must also only use certified seed (UFA, 2022). However, most of the farmers do not seem to be bothered by the fact that they cannot produce their own soybean seed for use (ProSpecieRara, 2019). Even the farmers interviewed for this thesis did not seem to see this as a problem, as none of them expressed any interest in producing their own seed. As will be explained in more detail later in the text, for some farmers, the biggest flaw in this system concerns the fact that is possible to grow only varieties that are on the official list, and thus available for sale in the distribution centers, so even though some farmers have found varieties that are better growing on their land, it happens that those varieties are taken off the recommended list and so they can't cultivate them anymore. In addition to that, it is not always easy to receive and find Swiss seeds for cultivation. ProSpecieRara (2019) claims that the regulations governing the exchange, marketing, and distribution of seeds have also implemented measures that may potentially pose a threat to biodiversity because they standardize seeds and variety, placing the nation's food security in the hands of a small number of players (Vallier, 2021).

Soybean is a plant capable of fixing nitrogen, but it can only do that if it forms a symbiosis with a bacterium called Bradyrhizobium japonicum (A.G., 2023). This bacterium does not occur naturally in the soil in Switzerland, so soybean seeds need to be inoculated with it to allow the plant to fix nitrogen (A.G., 2023). If this is not done, it can result in a loss of 2% in protein and up to 20% in yield. This is because 2/3 of the nitrogen useful to the plant comes from this symbiosis, making this step crucial (A.G., 2023).

The inoculation must be done just before sowing (maximum 24 hours) to be effective (A.G., 2023). There are also pre-inoculation techniques; that is, before the seeds are sold, they are already inoculated by multipliers. However, the interviewed Agroscope expert advises against this technique or relying on it too much because if the pre-inoculation was done too long before the seed was sold, the bacteria may have died around the seed (A.G., 2023).

There are two methods to inoculate the bacterium with seeds (A.G., 2023; bioactualié 2007):

a) Seed inoculation: the bacteria are sold in a peat bag, which then needs to be poured into something similar to a cement mixer, and some water needs to be added. After the contents have been mixed, soybean seeds are added, and the whole thing is mixed until all the grains are well coated.

b) Inoculation with soil microgranules: the bacteria are sold in a peat bag that must be mixed with microgranules in a seed drill microgranulator on the soil.

7.3 Soil Preparation and Sowing

Soybean sowing in Switzerland begins around April, so the plant starts to develop when the weather starts to get warmer, as the most suitable time to sowing is when the soil reaches a temperature of at least 10°C (FSO, 2022; Klaiss et al., 2020). Sowing in May delays the growth of the plant, which will then reach maturity in October, and increases the risks of too much moisture in the grains, risking rotting, or, in a better-case scenario, increasing the costs of drying the grains (Klaiss et al., 2020). For organic soybean crops, FiBL and Biosuisse recommend starting planting as early as May 10 to have more favorable conditions and less competition with weeds. However, it is also possible to start planting earlier if the climatic conditions in the region where the agricultural holding is located turn out to be mild (such as in regions near a lake) (bioactualié, 2016). "*You have to get certain experiences to be able to grow the best soybeans because you also have to accept that with conventional, you have fertilizers, you have herbicides, and you can afford to sow as early as April. Here in organic, on the other hand, it is unthinkable*" (L.C., 2023).

In addition to the correct time to sow soybeans, another aspect considered important for the success of the crop is regular seeding, with more or less dense seeding depending on the variety to be grown (65 grains/m2 for early varieties, 55 grains/m2 for late varieties) (UFA, 2022b.). In general, a spacing of about 50cm is recommended (in both organic and conventional) so that weeding and harvesting can be managed better later (UFA, 2022b.).

One agricultural practice used in Switzerland to get the soil ready for soybean sowing, which is considered a good technique for both conventional and organic crops, is the application of false seeding (A.G., 2023). Once the soil has been prepared, instead of sowing soybeans, what is actually done is pretend to sow seeds, i.e., go through the field and stir up the first 2–3 centimeters of the soil surface so that the weed germination is stimulated, and after 10 days the weeds begin to sprout and come out from under the ground. After this stage, the same process is repeated to destroy young weed seedlings (A.G., 2023; bioactualié 2019). So, when the actual sowing is done, there will be fewer weeds growing among the soybean plants. This practice is mainly used in organic farming methods because synthetic herbicides cannot be used (A.G., 2023; bioactualié 2019).

Since soybean is a nitrogen-fixing plant, it is not necessary to use additional fertilizers (organic or chemical) to add nitrogen to the cropland (A.G., 2023; E.F., 2023; C.D., 2023). However, some farmers still prefer to add extra fertilizers to increase plant yields, and what is recommended in these cases is to use fertilizers that contain very low amounts of nitrogen, such as limited amounts of manure or manure compost (Klaiss, 2020). The additional use of these fertilizers on soybean crops must be handled with care because they can damage the crop and the soil. Too much nitrogen, which accumulates in the soil as a result of these fertilizations, increases the risk of weed growth and can also pose direct risks to the soybean plant, which may no longer be able to create the symbiosis with the bacterium that allows it to fix the nitrogen (Klaiss, 2020).

7.4 Vegetative Management

The soybean plant does not require a lot of inputs during the growing season; however, farmers must pay special attention to the weeds that grow between the plants and to the hydration status of the crop during flower development and ripening, as these two elements can lead to important yield losses if they are not kept under control (A.G., 2023).

Currently, soybean crops have sufficient water in most parts of Switzerland (A.G., 2023*).* Interviews with farmers confirmed that so far none of them have had such severe drought problems that they have had to irrigate their soybean crops. Sometimes, however, some farmers may decide to irrigate crops to facilitate flower formation and optimal grain growth (Schori et al., 2003). Although the soybean is a plant that is not afraid of hot temperatures, it is very susceptible to drought during the flowering period (Schori et al., 2003).

For weed control, there are a couple of options, depending on whether a farmer grows the soybean conventionally or organically. In the conventional method, selected herbicides are used to keep the crop clean; there is an herbicide that can be applied immediately after sowing and a catch-up herbicide that can be used later in different plant development stages (A.G., 2023). With the chemical control of the weeds, the farmer has more flexibility in the time limit for managing the weeds, as they do not have to wait for ideal weather conditions to weed their crops (Klaiss, 2020). Sometimes, conventional farmers also combine the use of phytosanitary products with mechanical weeding (A.G., 2023).

In organic farming, the only options for weed management, at the moment, are mechanical weeding and weeding by hand (A.G., 2023; O.P., 2023). Mechanical weeding can be performed by employing various kinds of machines that can cut between the soybean rows to clean up the growing weeds; two of the most commonly used are the crow's foot and the star weeder (Klaiss, 2020)[12]. These machines are improving every year, for instance, some weeding machines now have GPS and camera systems installed in order to be even more precise. Having cameras positioned throughout the machine helps cut down on labor and manual weeding (A.G., 2023; Klaiss, 2020). Mechanical weeding, however, requires good weather conditions to be efficient. For example, if it rains, the soybeans will get wet and lower, making mechanical work very difficult, if not almost impossible (Klaiss, 2020)._Moreover, these machines only work if the weed density is not too high and if the farmer can place the stapping at the right moment, and they only have a small window of opportunity to intervene (C.D., 2023).

The advantage of mechanical and hand weeding is that no chemical products are used, and therefore there is no residue in the soil. Additionally, some studies state that when these machines work, they aerate the soil, stimulating the microbial pathway and thus promoting nitrogen fixation by the soybean (Klaiss, 2020).

F.C. (2023) reports of his efforts to find new techniques for keeping his soybean crops without weeds because, according to him, there is currently no effective organic methodology for weeding. One method he uses on his crops is the hyper-dense seeding so that there is no more space for weeds. He does clarify, however, that this technique is only effective in places that do not receive a lot of rain. Otherwise, the

[12] Bernet et al. (2016), in the FiBL publication "Biosoja aus Europa", have made a diagram that illustrates the application of different weeding machines in organic soybean production.

plants fall to the ground due to the weight of their wet leaves, and because they are so close to one another, they later struggle to dry out. The only disadvantage he found with this method is the cost of its application because it is necessary to buy and sow a large number of seeds (F.C., 2023).

7.5 Harvest

Harvesting takes place between mid-September and October using a combine harvester. Harvesting is initiated as soon as the leaves fall off the plant, and it is possible to feel in the pods that the grains are rumbling and no longer tender (O.P., 2023; bioactualié, 2022). However, this moment does not always come at the same time every year, and the optimal harvesting conditions can be reached from one day to the next, so it is necessary to always be ready to act and go to harvest (O.P., 2023; bioactualié, 2022). When grains are sown at the proper time and receive a period of bright, dry weather just before they ripen, they naturally lose the accumulated excessive moisture, and there is no need to transport the crop to drying centers, which must be done quickly to preserve the lot quality (A.G., 2023, bioactualié, 2018). This aspect is particularly important for the production of human food and seed, as specific moisture rates (12%) are required to achieve a certain (high) quality (bioactualié, 2021). Attention must also be paid to periods of prolonged rainfall, as they can bring in excess moisture, which can lead to the growth of fungi on the surface of the soybean grains. When this happens, the grains turn dark and become unfit for human consumption, downgrading the crop to animal fodder (O.P., 2023; bioactualié, 2018). Farmers always have to monitor the weather and harvest as soon as conditions are right; in any case, they must do so before mid-October due to the weather conditions that no longer allow the grains to dry out even if there are sunny days (bioactualié, 2018). However, attention must be paid to ensure that the soybeans do not dry out too much before harvesting, because if the moisture content drops below 12%, the soybean pods are at risk of splitting, and the soybean grains are at risk of falling into the ground during harvesting or falling around during transport, making them no longer usable (bioactualié, 2022). During very dry years, farmers and collector centers have observed an increased presence of green-colored soybean grains and pods that split easily (bioactualié, 2022). Green grains are a problem for the human food supply chain, and if more than 5% green grains are present in a batch, it will be downgraded to animal fodder, as tofu retailers and buyers prefer tofu with a white color (bioactualié, 2018). However, technological development in this area is also beginning to catch on: machines are now available to sort soybeans by an optical sorter (recently introduced by Mulin Rytz) (bioactualié, 2018). With this type of machine, green grains are separated from yellow grains, and it will no longer be necessary to downgrade an entire batch. These innovations, however, do not come without cost, as the sorting expenses for the producers go up, and the price for a lot that initially had green grains in it is somewhere between the price of soybeans for human consumption and for animal consumption (bioactualié, 2018).

In Switzerland, there is full traceability from the harvest to the collection centers to the final buyer; in fact, at every sale, there is always a sample of the harvest delivered (500 g), which is kept at the collection centers if some analysis is necessary, even after a year or two. This makes it possible to retrace the route and, if there is any quality problem, determine who has produced, where, when, with which variety, etc. (G.H., 2023). According to the FSPC expert, "*We have a fairly precise harvest traceability system*" (G.H., 2023).

7.6 Crop Rotation

In Switzerland, according to the Federal Agricultural Laws, crop rotation is compulsory, and there must be a minimum of 4 crops on a farm to receive the PER, which is not necessarily the case abroad and is very specific to Switzerland (A.G., 2023). There is hardly ever a farmer who grows identical crops in succession, except in exceptional cases where there has been a problem with a specific crop (A.G., 2023). In addition to this agricultural law requirement, on each agricultural holding, there must be a maximum share for each crop; e.g., no more than 50% of arable land can be used for wheat, while for rapeseed and soybean, the maximum that can be grown on each farm is 25% of the UAA of the farm (FOAG, 2023h.; Jeangros & Courvoisier, 2019).

Soybean is a leguminous crop, which means it can be used in a long rotation, enabling a farmer to grow and rotate more crops than the 4 required while also leaving nitrogen in the soil for subsequent crops (C.D., 2023; E.F., 2023). However, it should be noted that there are agronomic regulations that state that soybeans can only be grown every 4 years on each plot, i.e., each plot of soybeans must be left to rest for 3 years after the soybean harvest, after which it can be cultivated again on that part of the land. (FOAG, 2023h.; C.D., 2023). This rule was imposed with the goal of reducing the risks of disease, damage from pests, and the spreading of weeds that can no longer be eradicated (FOAG, 2023h.; C.D., 2023). Since soybeans are harvested in late September and mid-October, wheat is considered the best crop to sow afterward (A.G., 2023; G.H., 2023; F.M., 2023; E.V., 2023). It is also possible to sow a spring crop, but most farmers sow a cereal after (A.G., 2023; G.H., 2023; F.C., 2023; M.M., 2023; A.B., 2023; L.C., 2023; F.J., 2023; F.V, 2023).

7.6.1 Soybean Direct Payment System

In Switzerland, there are legal requirements for cultivation in order to obtain some kind of financial help, i.e., direct payments, which are paid by the State for the ecological services that farmers provide (C.D., 2023; M.N., 2023; FOAG, 2023h.). There are several categories of direct payments that a farmer can receive, and one of them is the "Contribution to Special Crops," to which soybean cultivation also belongs and for which 100 CHF/ha is paid (FOAG, 2023h.). The Confederation justifies the payment of these contributions to "*ensure the production capacity and operation of certain processing chains to supply the population and ensure an adequate supply of fodder for livestock*" (FOAG, 2023h.: p. 31).

There are also programs for the contribution to the production system, i.e., a farmer receives money if, for example, he does not use herbicides. In the case of soybean, if a farmer grows it without using herbicides, he receives 250 CHF per hectare (FOAG, 2023h.). This is seen by the USP as additional aid

from the Confederation to increase sustainable production (M.N., 2023). There are other programs like this for soybeans: 250 CHF is given for appropriate soil cover, which means that after harvesting the soybean, the farmer must plant another crop and not leave the soil uncultivated. This is to avoid erosion, and the farmers also get 250 CHF if they do not work the soil deeply (respectful tillage) (M.N., 2023).
There are several types of direct support for farmers who decide to cultivate soybeans; the role of these is to balance the profitability of soybeans against that of cereals, which are well protected under Customs Protection (C.D., 2023). The contribution to special crops therefore increases the profitability of soybean cultivation, thereby also promoting local soybean production (C.D., 2023).
For organic soybean production, there are also additional contributions to balance out and strengthen the economic attractiveness compared to crops like wheat or rapeseed (C.D., 2023). The contribution for soybean organic farming is 1200 CHF/ha (FOAG, 2023h.). The other direct payments available to soybean growers are the same as for farms growing according to the PER (bioactualié, 2023b.). Some cantons further contribute a sum of money to farmers who decide to convert their farms to organic, and these contributions vary between 1,000 and 20,000 CHF/ha depending on the canton, size, and type of farm. Currently, the cantons paying these encouragement grants are Basel-land, Genève, Solothurn, Schwyz, Ticino, Uri, and Zurich (bioactualié, 2023b.).

8. Challenges and Opportunities in Swiss Soybean Cultivation

This chapter will explore and highlight the challenges and opportunities that Swiss farmers currently face in growing soybeans, whether using organic or conventional practices. Farmers' direct experiences and knowledge are compared and matched with expert information to provide a complete and in-depth picture of the situation. This analysis will also provide a first understanding of the current status of sustainable production in Swiss agricolture, including the economic, social and environmental dimensions of the Swiss food system.

8.1 Current Opportunities and Advantages from Soybean Cultivation

i) Soybean cultivation enhances crop rotation and soil health:

According to Swiss laws, it is necessary to have a minimum of 4 crop rotations, and labels such as BioSuisse and IP-Suisse also require a minimum of cultural rotations. All the farmers interviewed reported the same advantage of growing soybean, namely that it is a crop that does not require any additions (fertilizers), but rather leaves nitrogen into the soil for the next crop, thus improving soil fertility, and the benefits are well evident according to them. This makes soybeans a particularly good plant for crop rotation, and this characteristic allows the farmers to have a longer crop rotation. "You see that where you put soybeans even if you have no fertilization, you put what you want after soybeans and you see the difference" (A.B., 2023). "If we see that some plots need fertility improvement, we consider putting soybeans on it" (B.H., 2023). E.V. (2023) reported (and is the only one among the interviewees) that they started growing this crop not for financial gain or market purposes, but precisely because it is a plant that brings benefits to the agricultural land (E.V., 2023).

B.H. (2023), F.C. (202) and F.J. (2023) report that soybeans are also a good crop to try to combat weeds. This is because if a farmer continues to use crops belonging to the same botanical family, in the long run, weeds resistant to weed killers will be selected through natural selection. So, there is a need to have rotations between cultures of different botanical families, and soybean is one of the few legumes available for cultivation.

F.C. (2023) and M.M. (2023) add that soybeans are a valuable crop for farms that do not have animals and therefore do not have natural fertilizers created on their farm. F.C. (2023) reports that soybeans are a valuable crop for a lot of farms in the French-speaking part of Switzerland. This is because the cultivation of soybeans mostly solves the problem posed by the lack of natural animal fertilizers. F.V. (2023) also adds that most organic farms have at least one legume crop, usually soybean. This is because organic farms cannot add chemical fertilizers, and what is produced by the few animals on the farms is not enough to fertilize the soil. He reports that phosphorus is not an issue, but nitrogen comes in short supply.

ii) Soybean cultivation has financial incentives:

According to experts, soybean production in Switzerland is encouraged not only by the growing offers and demands of the agri-food market but also by the system of direct payments (contribution to special crops). The Confederation pays a contribution of 1.000 CHF per hectare for growing soybeans (G.H., 2023). The aim is to balance the profitability of soybeans against cereals, which are well protected under Customs Protection, so customs duties must be applied, although soybeans used for human consumption are not liable for them. The experts believe that this contribution from the Confederation increases the profitability of soybean cultivation and encourages local production (C.D., 2023; M.N., 2023). Some farmers consider the payments received for soybean cultivation an important financial part of the farm and an incentive to cultivate soybeans. As they can never have any certainty about the yield of cultivation (due to weeds, weather, etc.), these payments can help in the event of partial or complete loss, as well as compensate for the lower basic yield of organic cultivation (M.M., 2023; A.B., 2023).

According to F.V. (2023), if people are expected to begin to change their diets and consume more plant protein instead of animal protein, these alternative crops must be paid more to make farmers even more motivated to grow them. According to him, as long as other crops such as maize continue to be paid more, farmers will not be tempted to grow soybeans (F.V., 2023).

F.M. (2023) states that besides federal contributions, in the canton of Vaud there is support for crops that are adapted to climate change and which improve soil fertility, and one of these crops is soybean, which receives 200 CHF/ha (F.M., 2023). O.P. (2023) confirms that soybean is a good crop for local production in the face of climate change because, in addition to being a warm-weather plant, it will also be possible to grow it at higher altitudes than today, but only if the climate is not too dry (I.L., 2023).

iii) Soybean cultivation presents only a few crops' challenges:

Several farmers report that they have chosen to introduce soybeans into their crop rotations because it is ultimately one of the few crops that do not have many maintenance problems. Soybean is a crop that requires few inputs, just herbicides, and there are no particular insect and disease problems (yet) in either conventional or organic cultivation, so farmers do not have to worry about having to manage fungal diseases and insect infestations (M.M., 2023; F.M., 2023; C.C., 2023; A.G., 2023). F.V. (2023) points out that soybean culture is not a problematic crop at all; the only thing you have to do, according to them and according to F.C. (2023) as well, is to learn how soybean culture works by gaining experience. First, a farmer must try it one way, then another, and eventually he will get to know the crop and there are no more big problems in managing it (F.C., 2023). According to F.V. (2023), the success of soybean cultivation depends 50% on good technique and the other 50% on good management (knowing the right moment for sowing, weed management, etc.): "*Soybean is not difficult, carrots are difficult, onions are difficult, soybean is not difficult. I say to all farms that are converting to organic, do at least 20% soybean, because it is not difficult and then you can call me, I will tell you how you can do it. Soybean is really not a problem* " (F.V., 2023). F.V. (2023) states that there is no acceptable reason not to grow soybeans on organic farms.

One of the farmers interviewed reports that although cultivation turns out to be somewhat complicated, it has the advantage of reducing soil erosion due to the fact that it is a low plant and so the soil is more or less covered underneath (M.M., 2023).

iv) High demand in the market for organic soybeans:

In Switzerland, there is a growing demand for tofu and soybeans from industries that produce the vegetarian foods that consumers are increasingly requesting, as well as an increasing demand from BioSuisse regarding animal feed, which also requires more organic soybeans (F.J., 2023; L.C., 2023; A.G., 2023; E.F., 2023). This means that Swiss farmers have, at the moment, a constantly increasing possibility of cultivating more soybeans on their farms. According to experts, the demand for meat substitutes is increasing and will continue to increase in the coming years, so food soybean (which is organically produced in Switzerland) is considered to have excellent chances for development in the Swiss market, as it is the plant that contains the most plant protein and one can make a variety of products with it (O.P., 2023; M.N., 2023; C.D., 2023).

Most of the farmers interviewed reported that they decided to grow organic soybeans because, after consulting a bit about the demands of the market, they saw that soybeans are a product that is increasingly in demand by the population and processing centers, both for human and animal food, and therefore it is worth growing; indeed, the market would demand even more than what is currently produced, and the prices offered are very advantageous (A.B., 2023; M.M., 2023; F.C., 2023; F.V., 2023; F.M., 2023; F.J., 2023; B.H., 2023; C.C., 2023).

Organic farmers have perceived an increased demand for organic soybeans, especially after BioSuisse's new law, which requires that the ruminants must be fed with 100% organic fodder of Swiss origin (M.M., 2023; F.C., 2023; L.C., 2023; E.F., 2023, I.L., 2023). "Until five years ago we were producing enough, however, just after the pandemic, after this wanting to produce local, there was a strong demand and you can't keep up with it anymore" (A.B., 2023). This growing demand has also led to an increase in the purchase prices of soybeans, showing precisely that there is currently great demand and interest from the Swiss market (F.M., 2023; I.L., 2023). L.C. (2023) reports that it is difficult for a collector center not to accept organic soybeans. Farmers are encouraged to grow soybeans because there is currently a great demand for protein plants on the market, which ensures a profit (F.C., 2023; F.V., 2023). Farmers thus have the certainty that if they grow soybeans, they will be picked up by a collector center or processors.

The interviewee from Mulin Rytz stated that they too have the ability and possibility to increase the quantities of soybeans purchased (they only process organic products), both for fodder and for human food, which would allow farmers to grow more soybeans if they wanted to do so, although it must be kept in mind that a larger soybean area does not necessarily mean that the yield will be larger (I.L., 2023). In the past three years, the quantities purchased by their company (which is one of the two largest collector centers for soybeans in Switzerland) have increased with each year, and they predict that it will be the same for 2025 and 2026 (I.L., 2023). He reports that, especially in the last 5 years, processors, and retailers such as Coop, Migros, and private companies always report that they would like to have larger quantities of soybeans that they can process and resell (I.L., 2023).

L.C. (2023) reports that their initial motivation for introducing this crop was that they saw a local market opportunity in Ticino due to TiGusto's demand for soybeans for the production of tofu. As a result, they decided, in consultation with the processor, to grow soybeans and subsequently produce tofu in Ticino. “It is quite simple, if consumers want to buy, we grow it. I always read that farmers do not want that or that. None of that is true, if it is economically interesting, and there is a demand, we produce, it is simple” (F.V., 2023).

v) High economic profitability from organic soybean production:

Until 2022, organic soybean production was mainly grown with the purpose of being used for human consumption, while conventional soybean was used for fodder. However, since January 2022, because of BioSuisse's new rules, organic production has also increased for animal fodder production. (I.L., 2023; O.P., 2023; M.N., 2023). Two farmers and an expert report that the existence of a forage industry for soybeans in Switzerland is an advantage for soybean cultivation since if they have crops that are not suitable for human consumption, they can be recovered and enhanced for animal consumption and still have a good financial gain (F.C., 2023; L.C., 2023; O.P., 2023). However, this factor is not always well regarded by all farmers; some, in fact, report that they are not very happy about growing soybeans for human consumption and then having to sell the crop for animal consumption (B.H., 2023; F.V., 2023). A.B. (2023) and FiBL refers that, currently, organic soybeans are highly demanded in the fodder sector, and so the buyers are paying for them at a price very similar to that of human food soybeans (A.B., 2023; O.P., 2023). A great advantage of growing soybeans on an organic farm is that the selling price of the grains is significantly higher than that of conventionally produced grains. In organic farming, a farmer can make up to three times more (both for human food and forage) and therefore have a higher profit[13] (F.V., 2023; M.M., 2023; C.C., 2023; F.J., 2023; F.M., 2023; A.B., 2023; O.P., 2023; A.G., 2023; C.D., 2023). F.V. (2023) says that soybean has a better economic profit than wheat, and F.C. (2023) adds that although the organic cultivation requires more work to keep the soybean crop clean, the gain is so high that it is still worthwhile to enter even working manually to remove weeds (F.C., 2023). The BioSuisse organization is also seeking to motivate producers with an additional contribution of CHF 35 per quintal of soybean, thereby reinforcing its economic attractiveness compared with crops such as wheat or rapeseed (C.D., 2023)

vi) Soybean is a robust crop:

Another advantage of growing organic fodder soybeans, besides the higher price compared to conventional production, is that there is no need to have a perfect crop (degree of moisture, color, salinity, etc.) because since it is a culture that will go to feed animals, it is not necessary to have perfect grains, leading to a decrease in working hours and consequently less expenses (O.P., 2023). FiBL informs that in 2018 they created an online calculator to help the farmer choose whether to make organic food soybeans and earn more money or to make forage soybeans and have fewer labor hours, allowing farmers who would like to begin cultivating this crop to understand what the costs and benefits are relative to each type of method and product (O.P., 2023).

8.2 Challenges Related to Swiss Soybean Cultivation

i) Limited UAA in Switzerland:

The first constraint on the cultivation of soybeans is found in the location of the agricultural holdings. Although there is currently a strong demand for locally produced soybeans, their cultivation remains limited to agricultural holdings that are below 600m altitude (O.P., 2023; G.H., 2023; I.L., 2023). In

[13] Bio human soybean food: between 220.00 - 235.00 CHF / 100 kg
Bio fodder soybean: 141.00 CHF + 27.00 CHF incentive contribution = total 168.00 CHF / 100 kg
Conventional soybean: between 52.50 and 57.00 Fr. / 100 kg.
Source: BioSuisse (2024) ; Swissgranum, (2023b.)

addition to the height limit, there is also a UAA limit in Switzerland, and again, although there is a demand to produce more soybeans, the question is which crop to reduce because the agricultural area is limited and if more soybeans are grown, there will be a decrease in other crops, and if one crop is grown less, then it will need to be imported (M.N., 2023; A.G., 2023). A.G. (2023) reports that if we want to produce the amount of soybean required by the market locally, we would have to practically replace wheat cultivation with soybean. According to the experts, this is quite impossible because Switzerland needs wheat cultivation to make bread and to prepare cattle feed. Moreover, wheat culture, unlike soybean, can be cultivated on larger surfaces (up to 1000 m) without all the problems that can be encountered during soybean cultivation; for example, wheat supports drought better than soybean (A.G., 2023). At the moment, open land in Switzerland is mainly used to grow crops for direct human consumption, while most Swiss soybeans are used for animal feed (C.D., 2023). So if the area planted with human food soybeans is increased, it can be positive, but if the area planted with fodder soybean is increased, it could prove to be negative in terms of food security because if forage soybeans are grown on open land, which is scarce in Switzerland and must be used primarily for human consumption, the efficiency is lost (C.D., 2023).

ii) Limited presence of local processing/harvesting facilities:

One of the farmers interviewed reveals an attempt of a few years ago when he tried to process locally the soybeans he produced in his field and then use them for his animals. However, the processing of soybeans to make animal fodder requires special facilities that are not present in Ticino, and therefore he had to rent a truck, have the soybeans transported to a collector center for inspection, cleaning, and finally processing, and then transport the soybeans back to Ticino (A.B., 2023). The whole thing turned out to cost too much, and so the farmer reports that he has decided not to try to produce any more of his fodder from his own soybean production, at least until there are facilities in Ticino suitable for the process (A.B., 2023). Another farmer in Ticino expresses the same concerns, saying he hopes to see more mills and storage centers built there soon so he can use and perhaps sell his locally grown products rather than having to transport all of the soybeans grown in Ticino to collector centers in the German speaking or in the French-speaking Switzerland each time (L.C., 2023). The farmers report the need to value local products more and create better conditions for local (Ticino) processing and storage (L.C., 2023; A.B., 2023). The farmer in Solothurn also reports his desire to increase soybean production, especially for human food, but the limited availability of soybean processing centers for human consumption and collector centers is leading him to change his mind. The farmer reports that he has tried to grow edamame (soybean pods), and the crop also did well, but at the time of sale, he was unable to get it sold for human food as the collector center no longer had storage capacity for a soybean crop for human consumption (other than for tofu), and therefore the crop was downgraded to fodder use (F.V., 2023).

iii) Different Prices problems:

In Switzerland, agriculture has become costly because of expensive inputs, expensive labor, and expensive machinery (A.G., 2023). To have a profitable soybean culture, it is necessary to have a positive difference between the value of production and costs, but some farmers report that costs in Swiss agriculture are increasing while farmers' earnings remain the same or decrease (B.H., 2023; F.M., 2023; A.B., 2023). For example, the costs associated with fuel consumption are always increasing due to rising prices, but as pointed out by F. M. (F.M., 2023), diesel costs are costs that farmers cannot control. Nowadays, various machines make it possible to harvest in less time and with fewer dirty or damaged grains, but these modern machines are also expensive, and not all farmers can afford to buy them to harvest their soybeans. Therefore, some farmers have found alternative and currently less expensive solutions. For instance, instead of buying a new machine, one can add parts with the desired functionality as one goes along. A.B. (2023) reports, for example, that he has just installed a satellite system on the old tractor, but that still came to cost 23.000 CHF (A.B., 2023). Other farmers, on the other hand, have decided to outsource the task of planting, harvesting, and weed management to third parties, mainly because they report that since they do not have a large soybean acreage, they did not find it advantageous to buy a machine, but even this work comes at a significant cost to the farm (L.C., 2023; B.H., 2023). F.V. (2023) reports on a solution found in cooperation with other farmers in the area, i.e., a group of farmers agreed to invest together in the purchase of suitable machinery for planting, harvesting, and weed treatment in soybean crops. In this way, each farmer did not have to invest too much money, and they make agreements on an online page regarding who uses what and when. Some farmers do not feel supported at present either by the State or by any association if they encounter problems, stating that farmers are left somewhat to their own resources if there are problems with a crop and that there is no real technical support in cultivation, whether in conventional or organic production (E.V., 2023; F.J., 2023)

USP reports that conventional soybean cultivation in Switzerland is currently experiencing a decline in purchase prices and sales because there are so many other crops from which a conventional farmer can earn more money, which makes conventional soybean cultivation less attractive to Swiss farmers (M.N., 2023). This is also confirmed by the farmers interviewed, who report that it is no longer worthwhile to grow conventional soybeans in Switzerland today because, if one looks at the economic side, the cost of production remains relatively high while the profit is considered very low and therefore not worth growing (A.B., 2023; F.V., 2023). One of the three conventional farmers interviewed said that the only reason he grows soybeans on his farm is that it is a crop that brings health benefits to his soil (E.V., 2023).

In addition to having less income for conventionally produced soybeans, conventional farmers must compete with cheaper imports preferred by the retailers (I.L., 2023; A.G., 2023; M.N., 2023): "*We've been held back in soybean production now because our agri-food industry is not interested. Because they live off imports, they are more interested in buying low-cost imported products. In Switzerland, we* *import soybeans that have been shipped three times around the world. It was traded by traders 4-5-6 times; it is not paid at production, and it is produced in catastrophic conditions elsewhere"* (E.V., 2023). E.V. adds that he feels that "there's a desire to produce as little as possible in order to import the cheapest possible raw materials, and that's not fair " (E.V., 2023).

Farmers interviewed report that to have fair agriculture, the Swiss industry needs people who are interested in Swiss soybeans and who pay a good price for them. However, Swiss farmers are reporting a growing pressure they perceive from the food market; specifically, they are reporting the growing gap they have noticed between them and large retailers such as COOP and Migros. This gap pertains to what they receive in return for their soybean crops and what the distribution industries then earn, and it has been particularly felt since the COVID-19 pandemic and has worsened since the beginning of the war in Ukraine (F.M., 2023; F.C., 2023; E.V., 2023; C.C., 2023). The farmers report that their expenses are constantly increasing, but the prices at which they sell their crops have not increased for a long time, while they feel that large distributors have ever-growing profits (F.M., 2023; F.C., 2023; E.V., 2023; C.C., 2023). "In the end, we earn less money, and they still come and say, you have to reduce your arable land to promote biodiversity, so you are going to lose even more in the farmer's direct profit. It is cheating doing things like this" (F.C., 2023).

In Switzerland, there is a willingness from some consumers to buy local, but the prices of local products are higher and act as a deterrent for those who cannot afford the extra cost (A.G., 2023). This aspect leads to another challenge related to the attractiveness of cheaper imports, as it is necessary to reach a price compromise so that both the producer and the consumer will be satisfied (I.L., 2023). What the Swiss market is focusing on at the moment is offsetting the high costs of local products and promoting the consumption of local products (A.G., 2023). To achieve this, they emphasize the importance of having local agricultural products of higher quality by, for example, selecting soybeans with high protein content (A.G., 2023).

However, even if farmers are committed to having better quality products than those produced abroad, it is not always the case that processors (but also consumers) prefer to buy local products unless they are forced to by the requirements of the certifications they adhere to; instead, often the market actors prefer to import because of the higher prices of Swiss products (G.H., 2023; I.L., 2023; A.G., 2023; M.N., 2023). In addition, this request for the perfect quality of local products from both processors and consumers puts greater pressure on farmers, who are forced to work harder and invest more in soybean crop management so that they can sell a product that is deemed suitable by the agri-food market actors.

iii) Various challenges during the crop management period:

The background of the crop was defined by some farmers as being much more difficult than other crops, the most cited example being that of maize, which is easier to grow than soybean in terms of competitiveness against weeds, yield production and drought resistance. The farmers that referred to the cultivation as complicated reported that generally, soybean cultivation requires a lot of mechanical work to keep the crop clean and healthy, but often mechanical work is not enough and therefore manual intervention is also needed, which makes soybean cultivation a crop that requires several hours of work (A.B., 2023; F.C., 2023). Soybean is such a low culture that it is difficult to thresh it without having residues, especially if there are a lot of weeds. And if there is a dry period at the wrong time, the yield is minimal, and so for a farmer it is like throwing away the money he has earned for the threshing and other management practices (M.M., 2023). Correct timing is the first of the two aspects considered most challenging in soybean cultivation by both categories of methods of production. The farmers state that specifically in soybean cultivation, the challenge is to know when to sow and when to harvest, depending a lot on the weather (F.M., 2023; F.C., 2023; B.H., 2023; A.B., 2023). I.L. (2023) confirms that an important and difficult part of soybean cultivation is sowing at the correct time and that more care must be taken during this step than in other crops. L.C. (2023) reports that it takes art and luck to sow soybeans because the farmer has to find the time when the weather is perfect (no rain for a few days). If they sow at the wrong time, the problems related to weed increase a lot because it is not possible to get into the field and if they hoe, they do not destroy the weed (L.C., 2023). It is not only for sowing that the farmers have to master the correct timing, but they also must learn the right time to harvest soybeans that meet the standards of the buyers. If the farmer harvests the soybeans too early, the grains are still green and therefore very moist and not up to standards, while if the farmer waits too long to harvest, the grains become too dry. It is also explained that if the farmers harvest the crop too late, they have two additional problems, namely that the weather conditions are likely to be more adverse and that the soybean pods and granules have dried out too much and, as a result, are lost in the soil, making more difficult to harvest, as well as increasing the risk of fungal formation (B.H., 2023). However, if the soybeans do not dry enough naturally, the farmers have to transport the crop to drying centers, which further increases the costs (E.F., 2023). Other experts also report that it is becoming increasingly difficult to find the right time for planting, harvesting, and weed management because more and more people have periods that are too dry or too wet, thus greatly decreasing crop yields (A.G., 2023; I.L., 2023; O.P., 2023; G.H., 2023).

From the processor's point of view, constant quality is a must, and that is a big problem today because, for the past three years, quality has been yo-yoing due to fluctuating weather conditions. "*We've had more or less half of the soybeans arrive that we've had to pass on to the optical shooter, and the other half that we haven't had to pass on was not even pretty, so tofu manufacturers have had to go from very good quality to average or not very good quality tofu*" (I.L., 2023). I.L. (2023) states that Ticino usually produces particularly good soybeans, but this year it was different. The only regions that produced good yields and quality were Bern and Aargau (I.L., 2023). To be able to process soybeans into human food (especially tofu), there is a need to conduct perfect weeding, and this is not always possible or easy for farmers; in fact, often this work demands many hours of labor and thus results in high costs (O.P., 2023).

The second aspect seen as a major challenge by farmers, as well as experts, is that of weed management in soybean crops. Weeds turn out to be very problematic for soybean culture, as it is a plant that struggles to cover the soil, i.e., it has a small foliar surface, thus permitting sunlight to reach the soil and consequently triggering a facilitated weed growth (F.C., 2023; A.B., 2023). It follows that there are problems with impurities in the crop, with a greater risk of mold formation in the grain because the plant is covered and bent by the weed that grows more, making it difficult to dry the soybean grains before harvesting (M.M., 2023; E.V., 2023). Weed control in organic production turns out to be very complicated and it requires the use of machinery or working by hand for several hours (G.H., 2023; O.P., 2023; C.D., 2023). However, these interventions are not always successful because mechanical control only works if the weed density is not too high and only if the farmer places the strapping at the right moment (C.D., 2023). There are increasing cases of weed management problems even in conventional cultivation, as some farmers report that there are weeds that are more frequently resistant to certain herbicides, making it increasingly difficult to be able to maintain a clean soybean crop (M.N., 2023; E.V., 2023). One of the farmers reports that there are not many approved herbicides in Switzerland, so if a farmer wants to intervene beyond a certain phenological stage of the culture, there are no chemical weed killers available, and if the weed's development stages are too advanced, the farmer cannot go in mechanically to weed as they risk destroying the crop completely (B.H., 2023). To five of the farmers interviewed it happened that the situation with the weeds was so bad that they had to give up doing anything and at the end they have lost the complete soybean crop to weeds (B.H., 2023; A.B., 2023; C.C., 2023; F.M., 2023; M.M., 2023). One of these farmers reported that over the years he had experienced so much loss in soybean cultivation due to the increasing presence of weeds that he decided to stop cultivating it (C.C., 2023). One of the Ticino farmers claims that the farmers in Ticino are more affected by weed pressure in soybean crops because of the milder climate than in the rest of Switzerland, which then causes more problems in the crop management (A.B., 2023). This seems to be confirmed by the fact that of the five farmers mentioned above who have lost a whole crop to weeds at least once, four are in Ticino. However, all the farmers interviewed reported that weeds are a particular challenge in soybean crop management, whether in conventional or organic farming.

An additional problem mentioned by two farmers is the limited availability of Swiss seeds. F.M. (2023) and B.H. (2023) report that there is not much choice when it comes to buying seeds in Switzerland and that it is not even easy to find them. (B.H., 2023) reports that the variety they chose for last year (2022) was not their choice, but it was the only variety still available on the market since only the Swiss-certified seed that are on the list of recommended varieties can be grown in Switzerland. This turns out to be an issue for certain farmers, because even if some of them have found a variety that does particularly well on their soils, if that variety ends up being taken off the list of recommended varieties, they no longer have the opportunity to grow it and perhaps end up growing a variety that does not yield as well as the previous one (B.H., 2023). When one of the farmers asked for an explanation as to why the variety he was using was no longer on the market, he was told that since there was not much demand on the national market for this variety, it was decided to remove it (B.H., 2023).

<u>iv) Risks and Uncertainties in soybean organic production:</u>

Some farmers report that one of the challenges associated with growing soybeans is that the farmer is never sure that the soybeans he or she has grown and harvested will actually be bought by the collector center for the purpose for which they were grown, especially for human food consumption (B.H., 2023; F.M., 2023; F.J., 2023; C.C., 2023).

FSPC and FiBL refer to the fact that in Bio, the challenges are not posed by soybeans, but by the organic production requirements, in particular the fact that the whole farm must be certified organic, and that depending on the branches of production one has, it is not necessarily easy to do organic farming (G.H., 2023; O.P., 2023). The farmers also report that in organic farming, it is difficult and costly to keep fields clean, as weed invasion can impair quality and ventilation, affecting the farmer's harvest and profit margin (F.C., 2023; C.C., 2023; M.M., 2023). If there are 50% weeds, the soybean yields only produce half as much and the quality decreases, leading to a double loss in earnings, i.e., there is less profit because there is less yield, and also, if the quality decreases, it means that the human food soybeans are downgraded to fodder soybeans that are paid less (C.C., 2023; F.J., 2023; F.C., 2023). The challenge perceived by the farmers is to always find the correct time management so that weddings can be carried out at the right time (C.C., 2023; F.J., 2023). To be able to keep the soybean crop clean (weed-free), the farmers have to invest a lot of time in treatments, and since organic farming does not allow the use of phytosanitary products, the only other option is weeding by hand or using specific machines.

<u>v) Agronomic and workforce constraints in soybean organic production:</u>

Agronomic and workforce constraints are sometimes significant in organic soybean cultivation. The cultivation of organic soybeans is described as complex because of its labor-intensive nature and risks related to weeds and drought (M.M., 2023). In comparison, corn is considered more beneficial in terms of competitiveness and yield (M.M., 2023). If there are too many weeds, or if, for whatever reason, it is not possible to use a machine, the farmers have to go out and remove them by hand, and not all farmers are willing to do this or find people to do it (G.H., 2023; A.G., 2023; I.L., 2023; O.P., 2023; E.F., 2023). Both experts and farmers report that it is difficult for farmers to find workers willing to spend hours and hours manually weeding the fields, as well as the fact that this becomes an additional and quite onerous cost for farmers (G.H., 2023; A.G., 2023; I.L., 2023; C.C., 2023; F.C., 2023). So, if one misses the first weeding in organic farming, it has to factor into the price all the extra hand weeding or mechanical work that needs to be done.

One big difference between organic and conventional methods of cultivation that has been referred by the farmers is that in conventional production, according to them, a person can do the same thing year after year, and the yield is guaranteed at 90% success, while with organic production, what a farmer does one year and repeats the same thing the next year, they have no guarantee of the same success as the previous year. This is because in organic farming, the weather conditions are very important for all the treatments you have to do to keep the soybean crop clean (A.B., 2023). In organic farming, farmers must gain experience with a crop. To begin with, they must acknowledge that conventional farming is easier because the farmers can use herbicides or fertilizers to help the crop grow, allowing them to sow earlier than organic producers (in April). In organic production, however, it is nearly impossible to sow the soybean earlier in the year because there usually several rainy days in the period from April to May, making it difficult for farmers to get into the fields to control weeds, which could then expand and choke the soybean plant (L.C., 2023).

vi) High maintenance costs in soybean organic production:

When asked what benefits organic crops over conventional cultivation have, some farmers and experts reported that it is hard to say because, in the end, they do not really have benefits beyond the level of soil health, since it is not a plant that is easy to grow and maintain with organic methods (M.M., 2023; A.B., 2023; G.H., 2023). Organic farming, with its lower yields per hectare, offers few advantages for soybeans, which are already grown extensively in Switzerland (without insecticides or fungicides) on over 80% of the land (G.H., 2023; M.M., 2023). The price of organic production is higher, but the yield is lower (A.B., 2023).

According to B.H. (2023), the market is placing more and more pressure on producers to provide better quality goods, and collectors and processors are requesting that soybean grains have a specific moisture content that is defined as optimal and that the soybeans produced are not soiled, that is, not stained green or other colors that could impair the products' suitability for human consumption (B.H., 2023). «*If you are growing soybean for tofu...you have to be much more careful when harvesting and not have dirty seeds or all the seeds must be ripe. This is very important. Because...sometimes there are green seeds that are not ripe. And if you have more than 5% green seeds, they do not take the harvest for tofu, but they take it for cattle feed, for the animals. So, harvesting and weeding are the two most fragile areas*» (F.J., 2023). Farmers report that they must do a harvest under conditions that allow them to obtain a product that is satisfactory from the commodity point of view because otherwise the crop is paid in a lower merceological category, i.e., fodder soybeans that have a lower market price (B.H., 2023). To know what category their crop will be assigned to, farmers send samples to collector centers (in German or French-speaking Switzerland), who then assess the quality and communicate their choice, but this information is often not given beforehand, and therefore farmers often grow a crop without first knowing what price they will be sold once harvested (B.H., 2023; F.M., 2023). The organic method, even if it does not have an effect at the level of soil health, has an environmental and maintenance cost impact that is not to be underestimated: in organic cultivation, the farmers have to strip-till the crop 2-3 times, and then go up to four times with the hoe to be able to keep the weeds under control. The problem arises because these machines still run on combustion, and therefore one has to consider that all these entrances and workings contribute to some air pollution while also having high costs of fossil fuel consumption, whereas in conventional farming, usually only one weeding, maximum two, and it is possible to have clean soybean cultivation (A.B., 2023; E.V., 2023; M.M., 2023; A.G., 2023; I.L., 2023; Bos et al., 2014).

9. Synthesis

The development of a local sustainable food system involves the addition of positive value along the economic, social, and environmental dimensions (Nguyen, 2018: p. 4). The current food chain needs to be reshaped by all participants in it, from producers to consumers, to facilitate the transition towards a more sustainable food system (Willett et al., 2019). The globalization of agriculture has resulted in fewer but larger farming units, as well as greater sales of farm products to food processing companies, and contract farming, in which agricultural production is contracted between farmers and buyers, has gained popularity (wholesalers, processors, retailers) (Otsuka et al. 2016). Switzerland is characterized by medium to small farms, and the oilseed production is carried out under framework contracts between the producers (farmers) and the processing facilities (oil mills and fodder manufacturers). These contracts are established each year according to local market demand to guarantee farmers that the products they grow will be purchased and processed (FOAG, 2023e).

According to WWF and its partners, Switzerland is still far from reaching its goals to reduce the ecological sustainability gap in its agriculture (WWF, 2021; WWF, 2019). It is still unclear which policy instruments can effectively address the different food system challenges. Some researchers have noted that there are gaps in knowledge about the extent, characteristics, and drivers of policy issues, as well as a lack of knowledge about the effectiveness of different policy instruments or how different types of initiatives would affect the different stakeholders involved in food systems (Deconinck et al., 2022; Cattaneo et al., 2021; Reynolds et al., 2019). A study conducted in Switzerland states that the interpretation and implementation of Swiss agricultural policy instruments (such as direct payments) in specific sectors can affect different areas (Landis & Landolt, 2018). The authors presented examples of measures designed to ensure food security for the Swiss population, but which can sometimes be interpreted or designed in a way that damages natural resources (Landis & Landolt, 2018, p. 18). Similarly, measures designed to promote biodiversity could result in a decrease in agricultural production, which consequently negatively impacts the goals of securing food supply for the population (Landis & Landolt, 2018, p. 18). Similar concerns were raised during the interviews conducted with the farmers, who refer to a recent Federal Council decision that states that from January 2024 all Swiss agricultural holdings have to dedicate at least 3.5% of their open land to the promotion of biodiversity (OPD, art. 14a). This new agrarian law, although it has very good objectives and motivations for environmental protection, raises some concerns among some of the farmers interviewed. They believe that the requirement to dedicate a portion of their land to the promotion of biodiversity could lead to some farmers practicing less environmentally sustainable agriculture to compensate for the loss of agricultural land, ultimately conflicting with the environmental principles it seeks to promote. In addition, farmers are concerned that this reduction in the UAA will lead to a lower yield (which is already lower in organic cultivation,) and consequently a lower economic income. One of the farmers also expresses a concern that this decreases in UAA, and yields will lead to an increase in imports of agricultural products and a decrease in local production.

Today, agriculture and food industries are facing several sustainability challenges, both in terms of environmental and human health (Sumberg & Giller, 2022). The development of local food systems is seen as having excellent potential for the development of sustainable food systems because, in addition to decreasing the environmental and social impact in the producing countries, the local economies can keep money in their regions instead of investing in other distant places (Enthoven & Van den Broeck, 2021; De Schutter, 2017; Kneafsey et al., 2013). The TiGusto director also points out that one should keep in mind that if one buys local soybeans, the money stays spent locally. As a processor buys from the local farmer, the farmer gets the money on which he pays taxes in Ticino, and the processor also pays taxes in Ticino, so there is an economy that stays local and increases the sustainability of the local production. Whereas if you go and buy soybeans abroad, you put the local farms in crisis because they would not know to whom to sell the soybeans.

Over the past 30 years, several researchers have reported on the importance of developing local food systems in order to achieve a more resilient food system, but in addition to the lack of progress in implementing this strategy, there has also not been much research that confirms or refutes the benefits of its implementation (Enthoven & Van den Broeck, 2021). Switzerland tries to promote sustainability in its food chain by promoting local food production, and this applies to both organic and conventional production.

Conventional production is still the most widely used agricultural practice in Switzerland. However, since the 1990s, Switzerland has undertaken a greening of its agricultural system, and the introduction of direct payments brought a major change in this regard. Direct payments are subsidies paid by the Swiss state to farmers based on the services they provide, and which farmers can demonstrate that they have implemented following determined rules (OPD, 2013). The goal of direct payments is to ensure that Swiss farmers produce in accordance with basic principles of environmental sustainability while also meeting market requirements and being able to contribute efficiently to the national food supply (Landis & Landolt, 2018; Federal Council, 2012). There are several categories of direct payments, including one for growing certain crops, such as soybeans, which receive a contribution of CHF 100/ha (FOAG, 2023h.). There are also programs that contribute to sustainable production systems; for example, farmers receive 250 CHF/ha if they do not use herbicides (FOAG, 2023h.).

Interviews with farmers showed that they were encouraged to grow soybeans, in part because of the financial incentives offered by the federal government and some cantons. Direct payments could provide an opportunity to improve the distribution of economic value among farmers, contributing to greater equity within the agricultural sector and greater social sustainability in the food system. However, some

of the farmers interviewed raised some ethical problems related to direct payments. They report that it is not so easy for the state to verify that all the rules are actually being followed at 100% on each farm. They report the growing presence of large horticultural farms, which buy more and more land and then lease it to receive direct payments by using the work of other farmers. These agricultural facilities focus only on bureaucratic management without participating in agricultural activities, but they receive State payments from them. Public Eye (n.d.) also reports that Switzerland has experienced a decline in the number of small farms, while the large ones (with 30 ha or more) have increased (FSO, 2023c.; FSPC, 2023b.). This trend is also confirmed by looking at the federal statistical data about the evolution of farm sizes (FSO, 2023b.).
Another farmer describes how, with the new requirement of devoting a 3.5% of the farm UAA for the biodiversity promotion (OPD, art. 14a), some farmers in Switzerland form partnerships with other farmers who own land that is more suitable for biodiversity promotion. These farmers trade or sell their biodiversity quotas to other farmers, who then do not have to dedicate a portion of their land to biodiversity promotion, thus circumventing the direct payment rules and agricultural laws.
So is still unclear which policy interventions can effectively address the different food system challenges (Deconinck et al., 2022; Cattaneo et al., 2021). Nevertheless, these contributions and direct payments are considered by a study commissioned by BirdLife Switzerland, Greenpeace, Pro Natura, and WWF Switzerland to have a positive impact on the promotion of the development of sustainable agriculture in Switzerland (Landis & Landolt, 2018).

Interviewees report that to have sustainable agriculture in Switzerland, it is not only necessary to think about the environmental aspects (such as the elimination of pesticides or the promotion of biodiversity), but that it is also important to have a balance between the three main aspects, namely the ecological, the economic, and the social aspects. According to them, agriculture cannot be ecologically sustainable but economically disadvantageous for a farmer. Recent research has also highlighted the importance of this balance in agriculture, confirming that all three of these elements are necessary for sustainable agriculture, but they also highlight the fact that there is currently insufficient research analyzing all three of these elements simultaneously when examining the sustainability of agriculture (Bathaei & Štreimikienė, 2023; Ait Sidhoum et al., 2022). The PER criteria, which have to be followed to obtain the direct payments, guide Swiss agriculture toward some basic sustainable practices in conventional production, with specific rules for crop rotation, promotion of biodiversity, and limitations on plant protection products, while also offering economic profits to the farmers that respects those rules. This demonstrates that conventional production can also adopt sustainable measures, moving away from the classical definitions and applications (FOAG, 2023f.; WWF, 2019; Service de l'environnement Etat de Fribourg, 2017). A cited example of a conventional Swiss agricultural production method that differs from classical conventional ones is integrated production. Today, almost all conventional Swiss farms (95% of the total) are cultivated according to integrated specifications or by following the PER (FOAG, 2023f.; WWF, 2019; Service de l'environnement Etat de Fribourg, 2017). This method of production

has been found to be in line with the objectives of environmental and social sustainability, according to the WWF and its partners (WWF, n.d.). This because the farmers that cultivate according to the Swiss integrated production try to keep weeds, diseases, and pests under control with appropriate choices (crop rotation, variety selection, tillage, etc.) and by using as few inputs as possible (USP, 2018). The farmers interviewed who produce according to the integrated production reported that they chose this method of production because it is economically, socially, and environmentally sustainable for them. They stated that thanks to this production method, they do not risk losing an entire crop to weeds, diseases, or insects since they can use specific authorized inputs (in moderation) and therefore do not have to invest many hours and money working in the fields in an effort to keep them free of weeds. A farmer drew an interesting parallel, saying that if a person is sick and needs medicine to recover (be it to heal or to grow better), they are given them, and then doesn't see why someone could not do the same for plants, that is, give them their 'medicines' (fertilizers, herbicides, etc.) when needed and in the right amounts.
The use of inputs in the agricultural sector has been much debated in recent years, especially when it comes to sustainable agriculture. Several scientific studies have shown that these synthetic products have detrimental effects on the environment and human health, but others have reported that they have the positive aspect of ensuring a nation's food security without necessarily expanding agricultural land (Graczyk et al., 2018; Public Eye, n.d.; Clark & Tilman, 2017). The Swiss Farmers Union (USP) and other farmers associations argues that currently the complete abandonment of synthetic input products is not feasible because it increases a lot the risk of decreased yields, and as a result, it would not be possible to continuously guarantee the supply of food products (Flückiger & Porcellana, 2023).
According to WWF and its partners, Switzerland is still far from achieving its goals to reduce the environmental sustainability gap in agriculture (WWF, 2021; WWF, 2019). They argue that the approval of pesticides still has several gaps, such as the fact that pesticide manufacturers pay only a tiny amount for the costs of pesticide homologation, which in turn has the problem of not being carried out by independent organizations and is not transparent because, among other things, not everyone has access to this information (not even official cantonal authorities) (WWF, 2021; WWF, 2019). However, both environmental organizations and the Swiss Farmers' Union have recognized that this reduction in inputs is not currently feasible in Switzerland, not only because there are farmers who do not want to reduce their inputs but also because today's consumers are very demanding about the appearance of agricultural products, so farmers have to use chemical products to eliminate competition with weeds or spend many hours manually or mechanically treating crops (USP, 2018; WWF, n.d.b.).

Supermarkets in Switzerland, which are the main resellers of agricultural products, generate a significant amount of food waste because they consider some of the products unsuitable for resale if they do not meet consumer and retailer aesthetic standards. This highlights the inefficiencies present in the current food system (USP, 2018; USP, n.d.b.; USP, 2018; WWF, n.d.b.). The TiGusto director refers to his efforts to buy agricultural products that a supermarket would define as unfit for sale, while still paying the farmer the full price. In this way, products that are still of good quality are not discarded, and he reports that he has had no problems reselling such products in his store. Therefore, in order to have a local sustainable food system, it is also up to the Swiss population and retailers to change their preferences, accepting products that are not aesthetically perfect but are cultivated and transformed with more sustainable methods (USP, 2018; WWF, n.d.b).

Besides the conventional production method, there is also organic agricultural production, which has been demonstrated to have the advantage of being more environmentally sustainable since no phytosanitary products are used (Boschiero et al., 2023; Azarbad, 2022; Wittwer et al., 2021). However, this method has some aspects that can be defined as negative, such as a production with lower yields and the fact that the transition to organic farming practices can be complex, especially in certain production sectors, as also confirmed by the interviews with the Swiss farmers (Boschiero et al., 2023; Azarbad, 2022; Wittwer et al., 2021). The main difficulty with the organic method lies in weed management, which is one of the biggest problems that farmers still face today, and weeds are controlled mainly through cultural rotations, mechanical practices, and manual work. Over the years, innovative technologies and techniques have been developed to try to reduce the effects of this problem. Nevertheless, the experts interviewed report that it is becoming increasingly difficult to convince farmers to convert to organic production, because those who already had the opportunity to do so easily have already done so.

Organic farming was introduced in Switzerland in the 1930s, thanks to those farmers who first sought more environmentally friendly agricultural production methods, and since then, the number of farms producing with organic methods has been steadily increasing (Alföldi & Nowack, 2017; Figue 3). Financial support and formal recognition of organic farming, however, began in 1989 at the cantonal level. Then, in 1992, organic farming was evaluated as valuable and entitled to be protected at the federal level in the Agricultural Law as well, with the first organic farming regulation becoming effective from the beginning of January 1998 with the implementation of the “Organic Farming Ordinance” (Alföldi & Nowack, 2017).

In Switzerland, the BioSuisse association occupies a leading position in the production and certification of organic agricultural products (FSO, 2019; BioSuisse, 2019). In 2022, Switzerland had 7,819 farms adopting organic methods; of these, 7,341 were certified with the BioSuisse Bourgeon label, representing approximately 94% of organic farms in the country, while the remaining 6% of farms followed only the PER (BioSuisse, 2022). In terms of traceability, the BioSuisse label certification guarantees rigorous monitoring throughout the production chain, from the producer to the end buyer (C.D., 2023). Moreover, agricultural holdings under this label have annual controls and regular unannounced inspections every 4 or 5 years (O.P., 2023).

In 2022, BioSuisse introduced a new strict feed guideline for the ruminants, stating that it is mandatory to feed the ruminants with at least 95% roughage (grass, hay, etc.), while the remaining 5% can consist of concentrated fodder (soybeans, corn, etc.), and all of them must be sourced 100% from Swiss organic farms (BioSuisse, 2023; O.P., 2023; C.D., 2023). These new requirements, according to some interviewees, contribute to supporting and promoting local protein production, stimulating the demand for local proteins, particularly in high-protein crops such as soybeans, and consequently promoting local and sustainable products. According to most of the farmers interviewed, besides noticing an increase in demand in the local market for organic products, this decision by BioSuisse had virtually no impact on their farm, and therefore they had no opinions to express regarding this new rule. However, two organic farmers expressed their disappointment with this decision because, according to them, there is now a greater lack of plant protein in the feed of ruminants, resulting in a lower quality of meat. This is because the main sources of protein for animals, such as soybeans, have limited production in Switzerland and therefore the available quantities are mainly fed to poultry and pigs, which have a greater need for it than ruminants (M.M., 2023; BioSuisse, n. d.). Furthermore, the farmers complained that the elimination of the previously mixable 5% of conventional fodder in BioSuisse animal feed has increased their costs, bringing an additional negative impact (M.M., 2023).

This thesis highlighted that organic production is not the only path that can be taken to achieve sustainability in the food system because, as previously mentioned, sustainability is not just an ecological issue; it involves ecological, economic, and social aspects (Nguyen, 2018: p. 4). The agricultural holding conversion to organic management requires a complete adaptation of the farming management system, with more challenges for the farmers in comparison to those who decide to implement conventional farming production. The conversion process involves strategic and economic decisions to determine whether the farm is equipped (or can be) for organic production, both in terms of tools and available time, as organic production requires greater attention to crop and soil management. A farmer will not risk being in high debt to keep up with the requirements of organic production. Nowadays, with the development of new technologies and the evolution of old ones, various methods, and management strategies to cultivate soybeans are available, which can be more or less sustainable (Shea et al., 2020). The final decision on which cultivation method to adopt depends on several factors, such as cost, the personal preference of each farmer or even the ongoing preferences of consumers, which is considered a very important aspect because the consumer is the one who ultimately buys the products (Shea et al., 2020). An organic farmer points out that favorable selling prices for organic products should not mislead people into thinking that organic production is the best solution, as one must make a careful analysis and assessment of the costs and benefits of the transition to organic because the conversion to organic must also be financially sustainable for the farmers. Organic agricultural methods have a more positive impact on the environment and land health; however, it is not an easier path to produce plant and animal products (Boschiero et al., 2023; Azarbad, 2022; Wittwer et al., 2021). The interviews revealed that there are not many more advantages for farmers who decide to switch to organic production than for those who decide to remain in conventional production. In the interviews conducted with organic farmers, three main reasons were identified that have influenced the farmer's decision to start cultivating according to organic practices: for environmental and soil health benefits, for ethical values, and for economic feasibility and profitability. The interviews with conventional farmers revealed that the various restrictions imposed by the organic production requirements are a significant deterrent for farmers to convert to organic methods. The restriction that seems to deter most conventional farmers is the requirement to convert the entire farm to organic management, which involves a complex and costly process that takes at least two years.

One of the interviewed. farmers reports that Swiss farmers have to ensure the survival of the crops in order to contribute efficiently to the population's nutrition, so converting to organic, which is already known to have lower yields, increases the risk of losing high yields and to lower food security due also to the weeds management problems. In addition, the requirements of consumers and retailers, in combination with the restrictions imposed by the organic law and labels, force the farmers to spend many hours on manual or mechanical weeding, thereby generating a negative impact on farmers economic gains and on the carbon footprint due to the intensive use of tractors, which still utilize fossil fuels.

Some organic farmers also express disappointment with the market management of organic products, as retailers and consumers' requirements for perfection are imposing strict management practices on the farmers, who have to spend many hours of work in the fields and spend a lot of money to keep the fields clean. In addition, another aspect comes up that is seen negatively by some farmers and positively by others, namely that soybean lots that do not meet human food standards are downgraded to organic fodder, which is paid less than human food, even though the price of organic fodder is almost three times higher than conventional fodder.

Soybean cultivation in Switzerland began in 1988 with the research and introduction of soybean varieties adapted to Swiss climatic conditions (Schori, 2003). Today, soybean is grown in 18 of the 26 cantons, depending mainly on the geographical and climatic conditions of each canton, and the three largest producers are the cantons of Vaud, Zurich, and Geneva. In 2022, the Swiss soybean industry counted 953 soybean farmers with a cultivated area of 2894.99 ha (FSO, 2022; Annex M). In the last ten years, the soybean cultivated area has more than doubled; in particular, it is reported that the area dedicated to organic soybean cultivation has increased 15 times as a result of changes in consumer preferences and the introduction of various Swiss agri-food label rules (FOAG, 2023; FOAG, 2022; Muehle Rytz, 2023; UFA, 2022c.). However, even though the area under soy cultivation in Switzerland is generally increasing, average yields have been declining for both organic and conventional methods over the past 10 years. FiBL (2019) explains this downward trend and yield instability by the fact that soybean cultivation is very demanding, and farmers have limited experience. Soybean production volumes have, however, increased over the last two decades: in 2000, soybean production amounted to 3750 tons, but by 2022, soybean production amounted to 6175 tons (Annex F; FSPC, 2023d.). This may be explained by the fact that, despite lower yields, the increase in the cultivated area has helped to maintain the production volumes. Among the 6175 tons of soybeans produced, 2213 tons came from organic crops, of which 1400 tons were used for human consumption (mainly tofu), while the remainder were turned into animal feed (Annex F).

In economic terms, a food system is considered sustainable when all stakeholders in the food system can economically or financially sustain its activities, including wages for workers, taxes, profits for businesses, and improvements in the consumer food supply (Nguyen, 2018: p. 4). The current strong demand for locally produced organic soybeans represents an economic opportunity for Swiss farmers. This is because organic soybean production offers a significant economic gain over conventional production, with higher selling prices and potentially up to three times higher profits. This has proven to be an important incentive for farmers when choosing which crops to introduce into their rotations, as it also promotes the economic sustainability of their operations. Most of the organic farmers interviewed reported that they decided to grow soybeans because, after consulting the demands of the market, they saw that soybeans are a product that is increasingly in demand by the population and processing centers, both for human and animal food, making it worth growing. Indeed, the market would demand even more organic soybeans than what is currently produced, and the prices offered are very advantageous. While soybeans are not economically attractive to conventional farmers because they are paid very little, conventional farmers claim that they cultivate it because it is a crop that does not require a lot of inputs, and release nutrients into the soil for the following crops.

Organic farmers have perceived an increased demand for organic soybeans, especially after BioSuisse's new law, which requires that the ruminants be fed with 100% organic fodder of Swiss origin. BioSuisse estimated that, for their label requirements, in Switzerland, there was a need to increase the organic UAA by 15.000 ha to cover the current ruminants' feed needs (Muehle Rytz, 2023; UFA, 2022c.). However, a challenge for local soybean cultivation in Switzerland concerns the fact that even though there is high demand, Switzerland is a relatively small country compared to other soybean-producing regions in Europe, and therefore its UAA is limited and already used to the maximum. Therefore, according to the experts interviewed, if Swiss farmers want to increase the local production of soybeans, they have to reduce the production of another crop, which creates a vicious circle because if soybeans are substituted for another crop, the other crop will have to be imported if it is still in demand on the Swiss market.

The soybean turns out to be a plant that provides more protein per hectare than animal meat, in addition to being very self-sufficient, with no special requirements, and contributing positively to the health of the soil on which it is grown. Since soy is an important source of plant protein, promoting its local production can contribute to improving access to nutritious food for the Swiss population while also promoting food security (Messina, 2022). However, only an area planted with soybeans for human consumption can be positive for food security, while increasing the area planted with soybeans for animal feed could have the opposite effect, because if animal feed soybeans are grown on open land, which is scarce in Switzerland, the efficiency of using open land is lost (C.D., 2023).

The main challenges associated with soybean cultivation in Switzerland are related to weed control, management of sowing and harvesting times, and the need to maintain consistent product quality, and they affect both the economic and environmental sustainability of local farming practices. Difficulties in weed control, in particular, represent a significant challenge for both conventional and organic cultivation. Conventional farmers report that there are weeds that are more frequently resistant to certain herbicides, making it increasingly difficult to maintain a clean soybean crop in conventional production as well. One of the farmers interviewed says that there are not many approved herbicides in Switzerland, so if a farmer wants to intervene beyond a certain phenological stage of the culture, there are no chemical weed killers available, and if the weed's development stages are too advanced, the farmer cannot even weed mechanically as they risk destroying the crop completely (B.H., 2023). These challenges can increase production costs and reduce crop yields, affecting farmers' incomes. Retailers and consumers demand aesthetically perfect soybean grains, especially when it comes to soybeans for human consumption, so farmers are forced to use chemical products to eliminate competition with weeds or spend many hours manually or mechanically treating crops (USP, 2018; WWF, n.d.b.). On the other hand, farmers report that growing soybeans for animal consumption, while less economically profitable, has the advantage that soybeans do not have to be perfect, so they do not have to spend too many hours in the fields and can also invest less money in pre- and post-harvest treatments.

In Switzerland, agriculture in general has become costly as a result of expensive inputs, expensive labor, and expensive machinery. To have a profitable soybean culture, it is necessary to have a positive difference between the value of production and costs, but some farmers report that costs in Swiss agriculture are increasing while their earnings remain the same or decrease. Farmers report that nowadays, for organic production, it is difficult to find Swiss workers who are willing to go and pick weeds for hours in the sun; in addition to the difficulty of finding labor, they also report that it is expensive to pay the workers a Swiss wage.

Some farmers have found alternative and currently less expensive solutions for organic farming. For instance, instead of buying a new machine, they add parts with the desired functionality as one goes along; e.g., A.B. (2023) reports that he has just installed a satellite system on the old tractor, but that still came to cost 23,000 CHF. Other farmers, on the other hand, have decided to outsource the task of planting, harvesting, and weed management to third parties, mainly because they report that since they do not have a large soybean acreage, they did not find it advantageous to buy a machine, but even this work comes at a significant cost to the farm. F.V. (2023) says that one less expensive solution is cooperation with other farmers in the area, for example various farmers can invest together in suitable machinery for planting, harvesting, and weed treatment in soybean crops. In this way, no one had to invest too much money.

A problem mentioned by two farmers, for both conventional and organic methods, is the limited availability of Swiss seeds. The system by which the Swiss State manage the selection of soybean seeds varieties does not seem appropriate to certain pro-environmental associations. According to

ProSpecieRara (2019), the DHS and VAT tests have led to the total dependence of Swiss farmers on a few market players. The FOAG's (2016) justification for this type of testing is the desire to increase Swiss agricultural productivity, but according to Vallier (2021), these tests and regulations have led to the selection and approval of varieties in the hands of a few actors, which has consequently led to standardized agriculture and crop cultivation, with the sole aim of producing as much as possible without considering the possible environmental consequences. Moreover, because of the multiple steps required to obtain permission to produce seed and the high costs involved, individual farmers are discouraged from producing their own seed (UFA, 2022). Some interviewed famers state that finding seeds in Switzerland is difficult and that there is little choice when it comes to buying them. A farmer reports that the variety they chose for last year (2022) was not their choice. Instead, it was the only variety still available on the market, because in Switzerland, the choice of seeds is limited to those that are Swiss-certified and still on the list of recommended varieties. This turns out to be an issue for certain farmers, because even if some of them have found a variety that does particularly well on their soils, if that variety ends up being taken off the list of recommended varieties, they no longer have the opportunity to grow it and may end up growing a variety that does not yield as well as the previous one.

Some farmers perceive that the state and consumers do not support them enough to encourage them to produce (more) organic or to generally increase the local production. This stems from the fact that farmers are well aware that local and/or organic agricultural products cost much more than other products, and not all people in Switzerland can afford to buy more expensive food products. The development of local food systems is thus made more difficult since industries are drawn to lower-cost imports, which are then sold at lower prices. These problems are a result of the globalization of agriculture and food chains, which allowed the food industry to buy large quantities at low prices from different parts of the world (Bonanno & Busch, 2015). Retailers still tend to import agri-food products from distant regions with the justification that they have an increasing demand from consumers to have agricultural products throughout the year, and they can resell these products to the consumer at lower prices, since in most cases local products are more expensive (Bonanno & Busch, 2015). The tofu producer in Ticino also reports the increasing difficulty of competing with large retailers who offer the same product but with more variety and lower prices.

By increasing self-sufficiency in local markets, the environmental damage caused by agricultural expansion in producing countries could be reduced (Zabel et al., 2019; Boerema et al., 2016; Zander et al., 2016). Nowadays, supermarkets are the main retailers of agricultural products, buying large quantities at low prices (Bonanno & Busch, 2015). To produce the large quantities required by supermarkets, methods that focus on quantity rather than quality of product and production, such as monocultures and highly concentrated animal feeding operations, are mostly used. This leads to various environmental problems such as biodiversity loss and water pollution. (Weis 2013).

A rise in certified commodities in each market, as well as a rise in certified production areas, has been observed in the last years (United Nations, 2023; Kusumaningtyas & van Gelder, 2019). Most of these certifications require the seller to demonstrate that the soybean they are selling has been produced according to sustainable agricultural practices. The requirements for obtaining soy certification are often quite extensive, but meeting these certification criteria can result in reduced environmental damage and decreased social conflict (Schilling-Vacaflor et al., 2021). The traceability of products grown in Switzerland extends beyond the farm, from the collection centers to the processors. A sample of each harvest is kept in the collection centers, enabling products to be traced in the case of quality problems, even for 2-3 years, thus ensuring precise and effective long-term traceability (G.H., 2023; E.F., 2023). These procedures, controls, and standards help maintain high-quality standards even in conventional production in Switzerland (G.H., 2023). The Swiss market is currently concentrating on promoting the consumption of local products and offsetting their high costs, by promoting a prooduction of agricolutral productts with high quality (A.G., 2023). Nevertheless, even though farmers are committed to having higher-quality products than those produced abroad, processors do not necessarily prefer to buy local products unless they are forced to by certification requirements.

The farmers and the TiGusto director state that their expenses are constantly increasing, but the prices at which they sell their products do not follow the same trend. This is a problem recognized by various studies, which also report on the increasing dominance of these large retailers in the agri-food market, thus leading to the closure of small farmers and artisans (Augère-Granier, 2016; Carolan 2013; Competition Commission 2000; McMichael and Friedmann 2007; Young 2012; Public Eye, n.d). The TiGusto director reported that he witnessed the closure of several artisans who no longer had work to do as people no longer went to buy from them but instead preferred to go to supermarkets which offers various products at lower prices.

The interviewed farmers reported of a growing pressure from the country's food market; specifically, they are reporting a widening gap between themselves and large retailers like COOP and Migros. This gap relates to their perception that what they receive in return for their crops is a lower gain in respect to what the distribution industries earn. Various researches confirm that there can be an unequal distribution of bargaining power throughout the food supply chain. Small farmers and food processors, for example, lack access to the market unless they work with large buyers, and these buyers then exert pressure on the pricing and profit margins of agri-food products by forcing the small farmers and processors to sell at very low prices (Augère-Granier, 2016; Carolan 2013; Competition Commission 2000; McMichael and Friedmann 2007; Young 2012). The FSPC also confirms this trend in Switzerland, reporting that the current market condition puts pressure on Swiss farmers who agree to sell their products at lower prices to compete with cheap imports, thus decreasing the motivation of local producers to grow soybeans, especially in conventional production (FSPC, 2023a.).

Price equity for local producers and artisans is critical to ensuring the economic sustainability of local food system and the social well-being of farmers, as it directly impacts their incomes.

Switzerland and Europe have implemented various projects to reduce dependence on imports, but both still heavily rely on them, increasing the economic and environmental risks associated with this kind of dependency (Gebhardt et al., 2022). The implementation of sustainable local food systems and short food supply chains, although in high demand currently, is not easy to actualize (Enthoven & Van den Broeck, 2021). This is because even if there are farmers who want to start producing more and selling their products directly to the consumer, they often do not have access to enough UAA or collection and transforming centers, as stated by the interviewees of this thesis. If these centers are not available, farmers will have to invest in building them, however this can be very difficult, especially for small farmers, for whom the costs are even higher, and Switzerland is characterized by the dominant presence of small farms compared to those that can be found in other countries. The farmers interviewed confirm that even if they would like to sell and use the soybeans they grow locally, there are not enough storage and processing facilities in Switzerland at the moment. The need to transport products to distant collection centers creates difficulties for farmers and negatively affects their economic income. Improving the supply of local processing infrastructure could contribute to the economic and social sustainability of local soybean production. Moreover, creating more of these local storage and processing centers would promote job creation and support for the local economy, as well as help farmers obtain more value from their products.

10. Conclusion

The process of achieving sustainability in a local food system involves navigating through a complex web of considerations. What this thesis revealed is that organic production is not necessarily the best or only solution to achieve sustainability in the food system. As articulated by Nguyen (2018), sustainability incorporates ecological, economic, and social dimensions. While organic farming offers environmental benefits, it presents challenges for farmers in terms of the conversion process, economic viability, and labor-intensive practices. The analysis of soybean production in Switzerland reveals several challenges and opportunities in both production methods and connects them to the context of local and sustainable agriculture.
Soybean is a plant that provides more protein per hectare than animal meat, it produces naturally the nutrients that it needs to grow and so contributes positively to the soil health. From the interviews, there appears to be a general consistency regarding the advantages related to growing soybeans in Switzerland. These advantages can be summarized in five main aspects: a low number of issues related to crop management, great opportunities in the Swiss food market, the flexibility of cultivation (which can be used for both animal and human consumption), great adaptability in the crop rotations due to the

fact that the soybean plant provides natural nutrients to the soil, and the fact that the state and some cantons pay financial incentives to those who cultivate soybean.

Currently, soybeans are in high demand in the market, especially organic soybeans, which have a purchasing price that is defined by the farmers as very attractive, for both human and animal consumption. The increasing demand for soybeans, especially organic ones, represents a good economic opportunity for Swiss farmers, and the plant itself can bring benefits for environmental sustainability by also promoting soil fertility. The main challenges in soybean production perceived by the interviewees relate to the limited area available for cultivation in Switzerland, the limited presence of local processing and harvesting facilities, a too strict soybean quality evaluation for human consumption, different price problems such as competition with cheaper imports, increasing machine costs, various challenges during the organic crop management period such as weed management, agronomic and workforce constraints, the correct timing for the crop management, and the limited seed availability. These challenges pose obstacles to the economic, environmental, and social sustainability of the local food system, specifically for soybean cultivation.

Despite these challenges, the soybean production volume has constantly grown over the years, with the area devoted to soybean cultivation having more than doubled; in particular, the organic one has increased 15 times as a result of changes in consumer preferences and the introduction of various Swiss agri-food label rules, such as those recently introduced by BioSuisse regarding the nutrition of their certified animals (Muehle Rytz, 2023; UFA, 2022c.). With varieties created and tested for the Swiss market, it is possible to cultivate soybeans in different regions of Switzerland. There are farmers growing soybeans in 18 out of 26 cantons, depending mainly on the geographic and weather conditions of each canton.

Swiss organic farmers navigate a labyrinth of considerations when deciding which factors need to be considered when shifting towards more sustainable methods, especially within organic farming practices. These range from seed selection to certification requirements, all while balancing the delicate scales of economic viability. Factors such as the difficult access to affordable labor, machinery, and inputs, along with the higher working hours needed, present challenges for farmers seeking to tread the path of sustainability and organic production. The first motivations that pushed the first farmers to adopt organic methods were based on principles of soil health, biodiversity, and ecological harmony. These still rank among the primary factors that influence organic farmers' decisions to use this production method; and these days, economic viability and profitability are also important motivations. Organic production does not necessarily prove to be the best solution for the sustainability of agriculture and the food supply. Because organic cultivation requires high maintenance costs and working hours while producing lower yields, it is not necessarily the most sustainable production method for farmers given the technologies and methods currently available, even though it is the best way to keep the land and animals healthy. As mentioned by the farmers interviewed, there is also a risk of taking on too much debt to keep up with the requirements of organic production. Despite these aspects, organic production is not dependent on the input industry, so it can continue to produce food for people even in times of crisis, such as during the COVID-19 pandemic.

The integrated production and farming that follows EPR seems to be a good compromise for farmers, as the use of potentially environmentally harmful synthetics is controlled and reduced as much as possible, so farmers can still have a good harvest and decrease the risks of total losses or having to spend hours and hours in the fields to keep them clean. This method could be a good opportunity to promote the development of a sustainable food system on economic, social, and ecological levels. To encourage the transition to a local and sustainable food system in Switzerland, several strategies have been and can be implemented. These include, for example, providing financial incentives and support in accordance with the performance that farmers implement to ensure greater sustainability of the agricultural system, which was found to be an important aspect of the farm management for the farmers interviewed. Investing in research and development to improve weed control can drive an improvement in the current limitations of organic farming, while financial incentives and support mechanisms can empower farmers to embrace organic cultivation. Implementing more collaboration and communication among farmers and other local stakeholders can facilitate knowledge sharing and collective problem-solving, laying the foundation for a more resilient and equitable food system as well as promoting better social sustainability of activities in the food system. Building a more sustainable food system in Switzerland also requires raising consumer awareness of, and demand for, locally grown products, as well as increasing the availability of local infrastructure for collection and processing.

Achieving sustainability is a team effort that goes beyond individual farms; everyone, from policymakers to consumers, plays a part in shaping the food system's future. Through collaboration, innovation, and rethinking how producers and consumers interact, Switzerland can pave the way for a food system that sustains both people and the environment.

Since this research has a limited extent, for future research, it could be interesting to conduct more interviews with different farmers in different regions of Switzerland to get more points of view and better understand the needs of farmers, who often feel that they are not listened to enough by other actors in the food chain. There may be more or less opportunities and challenges perceived by different farmers. Only a limited number of farmers were found for this research, so the results cannot be considered entirely representative of the current reality of the farming system.

Unfortunately, it was also not possible to interview representatives of big retailers such as Coop or Migros to understand why they make certain purchasing choices and how they promote more local and sustainable consumption of agricultural products. Therefore, future research could explore the role of current big retailers in Switzerland in local and/or sustainable agricultural production and how their purchases influence local farmers and production methods.

Bibliography

Adamisin, P., Kotulic, R., & Vozarova, I. K. (2017). Legal form of agricultural entities as a factor in ensuring the sustainability of the economic performance of agriculture. Agric. Econ.– Czech, 63(2), pp.80–92. https://doi.org/10.17221/208/2015-agricecon

Ait Sidhoum, A., Dakpo, K. H., & Latruffe, L. (2022). Trade-offs between economic, environmental and social sustainability on farms using a latent class frontier efficiency model: Evidence for Spanish crop farms. PLoS One, 17(1), pp.1-17. https://doi.org/10.1371/journal.pone.0261190

Alföldi, T. & Nowack, K. (2017). Connaissances Bio – Faits et fondements sur l'agriculture et la transformation biologiques. pp.1-56. https://www.fibl.org/fileadmin/documents/shop/1685-connaissances-bio.pdf (Last accessed on: 18.03.2024)

Anghinoni, G., Anghinoni, F.B.G., Tormena, C.A., De Lucca E Braccini, A., Mendes, I. C., Zancanaro, L., Lal, R. (2021). Conservation agriculture strengthen sustainability of Brazilian grain production and food security. Land Use Policy, 108. https://doi.org/10.1016/j.landusepol.2021.105591

Armstrong, J. H., & Kamieniecki, S. (2019). Sustainability Policy Research: A Review and Synthesis. *Policy Studies Journal*, *47*(1), pp.45.65. https://doi.org/10.1111/psj.12320

Arndt, C., Diao, X., Dorosh, P., Pauw, K., Thurlow, J. (2023). The Ukraine war and rising commodity prices: Implications for developing countries. *Global food security*, *36*, pp.1-9. https://doi.org/10.1016/j.gfs.2023.100680

Augère-Granier, M.L. (2016). Short food supply chains and local food systems in the EU. pp.1-10. URL: https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/586650/EPRS_BRI(2016)586650_EN.pdf (Last accessed on: 26.03.2024)

Azarbad, H. (2022). Conventional vs. Organic Agriculture–Which One Promotes Better Yields and Microbial Resilience in Rapidly Changing Climates?. Frontiers in Microbiology, 13, pp.1-9. https://doi.org/10.3389/fmicb.2022.903500

Baker, J. B. (2019). The antitrust paradigm: restoring a competitive economy. Harvard University Press. pp.1-310.

Bathaei, A., & Štreimikienė, D. (2023). A Systematic Review of Agricultural Sustainability Indicators. Agriculture, 13(2), pp. 1-19. https://doi.org/10.3390/agriculture13020241

Bernet, T., Recknagel, J., Asam, L., Messmer, M. (2016). Biosoja aus Europa, Empfehlungen für den Anbau und den Handel von biologischer Soja in Europa. Available as pdf in FiBL Shop https://shop.fibl.org/chde/1690-biosoja-europa.html. (Last accessed on: 15.04.24)

bioactualié (2007). Soja – Culture. URL: https://www.bioactualites.ch/fileadmin/documents/bafr/production-vegetale/grandes-cultures/4.7.11-32_Soja.pdf (Last accessed on: 18.02.2024) bioactualié (2016). Soja bio: technique culturale. URL: https://www.bioactualites.ch/cultures/grandes-cultures-bio/legumineuses-a-graines/soja-bio-recomm#:~:text=Evitez%20les%20parcelles%20sur%20lesquelles,de%20poules%20l'ann%C3%A9e%20pr%C3%A9c%C3%A9dente (Last accessed on: 18.02.2024)

bioactualié (2018). Soja alimentaire: bien préparer la récolte Soja alimentaire: bien préparer la récolte. URL: https://www.bioactualites.ch/cultures/grandes-cultures-bio/legumineuses-a-graines/recoltesoja (Last accessed on: 18.02.2024)

bioactualié (2019). Soja bio: régulation des adventices. URL: https://www.bioactualites.ch/cultures/grandes-cultures-bio/legumineuses-a-graines/soja-sarcler-fr#:~:text=Si%20vous%20en%20avez%20la,les%207%20%C3%A0%2010%20jours (Last accessed on: 18.02.2024)

Bioactualités (2019b.). Concentrés: Pénurie de protéines en vue à partir de 2022. URL: https://www.bioactualites.ch/fileadmin/documents/bafr/magazine/archives/2019/ba-f-2019-06-cocentres.pdf (Last accessed on: 18.02.2024)

bioactualité (2020). Demeter. URL: https://www.bioactualites.ch/service/organisation-bio/demeter-vue-d-ensemble (Last accessed on: 18.02.2024)

bioactualié (2021). Récolter le soja – en espérant le soleil. URL: https://www.bioactualites.ch/actualites/nouvelle/recolter-le-soja-en-esperant-du-soleil (Last accessed on: 18.02.2024)

bioactualié (2022). Après la sécheresse, la récolte du soja. URL: https://www.bioactualites.ch/cultures/grandes-cultures-bio/legumineuses-a-graines/culture-de-soja/la-recolte-du-soja (Last accessed on: 18.02.2024)

bioactualié (2022b.). Oléagineux bio. URL: https://www.bioactualites.ch/marche/produits/grandes-cultures/oleagineux (Last accessed on: 18.02.2024)

bioactualié (2023). Colza bio. URL: https://www.bioactualites.ch/cultures/grandes-cultures-bio/oleagineux/colza (Last accessed on: 18.02.2024)

bioactualié (2023b.). Coûts et contributions. URL: https://www.bioactualites.ch/principes/reconversion/couts-et-contributions (Last accessed on: 18.02.2024)

BioSuisse (2019). Vue d'ensemble des principaux labels bio et non-bio qu'on trouve en Suisse. URL: https://www.bioactualites.ch/fileadmin/documents/ba/Aktuell/200121-principaux-labels-bio-nonbio.pdf (Last accessed on: 18.02.2024)

BioSuisse (n.d.). Un fourrage adapté aux animaux et durable. URL: https://www.bio-suisse.ch/fr/notre-engagement/bien-etre-animal/affouragement.html#:~:text=Ce%20qui%20est%20marqu%C3%A9%20bio,possible%2C%20de%20la%20ferme%20m%C3%AAme (Last accessed on: 18.02.2024)

BioSuisse (2022). Bio en chiffres 2022. URL : https://www.bio-suisse.ch/dam/jcr:8016b59b-1e29-4b56-ac97-fe10940a78d9/BiZ22_fr_230329.pdf (Last accessed on: 18.02.2024)

BioSuisse, (2023). L'élevage et le fourrage respectueux des animaux ont un prix. URL: https://www.bio-suisse.ch/fr/vivre-bio-suisse/blog/posts/2023/02/elevage-animal-et-affouragement-consommation-de-viande-responsable.html (Last accessed on: 18.02.2024)

BioSuisse (2023a.). Direttive per la produzione, la trasformazione e il commercio di prodotti gemma. URL: https://gemma.bio-suisse.ch/dam/jcr:dca7b728-936a-42db-8c84-ff0718a6107b/Bio%20Suisse%20Direttive%202023%20-%20IT%20v3.pdf (Last accessed on: 18.02.2024)

BioSuisse (2024). Prix et situation du marché. URL: https://www.bio-suisse.ch/fr/info/partner/producteurs/offensive-grandes-cultures/prix-et-situation-du-marche.html (Last accessed on: 18.02.2024)

Blay-Palmer, A., Santini, G., Halliday, J., Malec, R., Carey, J., Keller, L., ... & van Veenhuizen, R. (2021). City region food systems: building resilience to COVID-19 and other shocks. Sustainability, 13(3), pp.1-19. https://doi.org/10.3390/su13031325

Boerema, A., Peeters, A., Swolfs, S., Vandevenne, F., Jacobs, S., Staes, J., et al. (2016). Soybean Trade: Balancing Environmental and SocioEconomic Impacts of an Intercontinental Market. PLoS ONE 11(5), pp.1-13. doi:10.1371/journal. pone.0155222

Bogner, A., & Menz, W. (2002). Das theoriegenerierende Experteninterview: Erkenntnisinteresse, Wissensformen, Interaktion. Das Experteninterview: Theorie, Methode, Anwendung. pp.33-70. https://doi.org/10.1007/978-3-322-93270-9_2

Bonanno, A., & Busch, L. (Eds.). (2015). Handbook of the international political economy of agriculture and food. Edward Elgar Publishing. pp.1-384. ISBN: 978 1 78254 825 6

Borraz, F., Dubra, J., Ferrés, D., & Zipitría, L. (2014). Supermarket entry and the survival of small stores. Review of Industrial Organization, 44 (1), pp.73-93. https://doi.org/10.1007/s11151-013-9379-7

Bos, J.F., de Haan, J., Sukkel, W., & Schils, R.L. (2014). Energy use and greenhouse gas emissions in organic and conventional farming systems in the Netherlands. *NJAS-Wageningen Journal of Life Sciences*, *68 (1)*, pp.61-70. https://doi.org/10.1016/j.njas.2013.12.003

Boschiero, M., De Laurentiis, V., Caldeira, C., Sala, S. (2023). Comparison of organic and conventional cropping systems: A systematic review of life cycle assessment studies. Environmental Impact Assessment Review, 102, pp.1-17. https://doi.org/10.1016/j.eiar.2023.107187

Branca, G., Lipper, L., McCarthy, N., Jolejole, M. C. (2013). Food security, climate change, and sustainable land management. A review. Agronomy for sustainable development, 33(4), pp.635-650. https://doi.org/10.1007/s13593-013-0133-1

Breed, C. (1998). Checking out the Supermarkets: Competition in Retailing. London: Office of Colin Breed MP. pp.1-48. URL:

https://www.accc.gov.au/system/files/Niche%2520Agribusiness%2520Consulting%2520-%2520Attachment%25201.pdf (Last accessed on: 15.04.24)

Brown, O., & Sander, C. (2007). Supermarket buying power: Global supply chains and smallholder farmers. pp.1-26. URL: https://www.iisd.org/publications/report/supermarket-buying-power-global-supply-chains-and-smallholder-farmers (Last accessed on: 26.03.2024)

Brugger, D. (n.d.). Production végétale. Union Suisse des Paysans: URL: https://www.sbvusp.ch/fr/ettiquettes/production-vegetale-1 (Last accessed on: 18.04.2023)

Calicioglu, O., Flammini, A., Bracco, S., Bellù, L., Sims, R. (2019). The future challenges of food and agriculture: an integrated analysis of trends and solutions. Sustainability, 11 (222), pp.1–21. https://doi.org/10.3390/su11010222.

Campbell, C.C. (1991). Food insecurity: a nutritional outcome or a predictor variable?. The Journal of nutrition, 121(3), pp.408-415. https://doi.org/10.1093/jn/121.3.408

Carolan, M. (2013). *Reclaiming Food Security.* London: Earthscan. pp.1-216. https://doi.org/10.4324/9780203387931

Cattaneo, A., Sanchez, M.V., Torero, M., Vos, R. (2021). Reducing food loss and waste: five challenges for policy and research. Food Pol, 98, pp.1-9. https://doi.org/10.1016/j. foodpol.2020.101974.

Cho, J.Y., & Lee, E.H. (2014). Reducing confusion about grounded theory and qualitative content analysis: Similarities and differences. Qualitative report, 19(32), pp.1-20. https://doi.org/10.46743/2160-3715/2014.1028

Chourasiya, S., Khillare, P.S., Jyethi, D.S. (2015). Health risk assessment of organochlorine pesticide exposure through dietary intake of vegetables grown in the periurban sites of Delhi, India. Environmental Science and Pollution Research, 22(8), pp.5793–5806. https://doi.org/10.1007/s11356-014-3791-x

Clapp, J. (2017). Food self-sufficiency: Making sense of it, and when it makes sense. Food policy. 66, pp.88-96. https://doi.org/10.1016/j.foodpol.2016.12.001

Clark, M., & Tilman, D. (2017). Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. Environmental Research Letters, 12(6), pp.1-11. https://doi.org/10.1088/1748-9326/aa6cd5

Clémençon, R. (2021). Is sustainable development bad for global biodiversity conservation? Global Sustainability, 4, pp.1-12. https://doi.org/10.1017/sus.2021.14

Codron, J. M., Grunert, K., Giraud-Heraud, E., Soler, L. G., Regmi, A. (2005). Retail sector responses to changing consumer preferences. New Directions in Global Food Markets, 794, pp.32-46.

Competition Commission. (2000). Supermarkets: A Report on the Supply of Groceries from Multiple Stores in the United Kingdom. London: Competition Commission.

Coucke, N., Vermeir, I., Slabbinck, H., Geuens, M., Choueiki, Z. (2022). How to reduce agri-environmental impacts on ecosystem services: the role of nudging techniques to increase purchase of plant-based meat substitutes. *Ecosystem Services*, *56(1), pp.1-9.* https://doi.org/10.1016/j.ecoser.2022.101444

Cucagna, M.E., & Goldsmith, P.D. (2018). Value adding in the agri-food value chain. International food and agribusiness management review, 21(3), pp.293-316. https://doi.org/10.22434/ifamr2017.0051

Curtis, P. G., Slay, C. M., Harris, N. L., Tyukavina, A., & Hansen, M. C. (2018). Classifying drivers of global forest loss. Science, 361(6407), pp.1108-1111. https://doi.org/10.1126/science.aau3445

D'Adamo, I., Desideri, S., Gastaldi, M., Tsagarakis, K. P. (2023). Sustainable food waste management in supermarkets. Sustainable Production and Consumption, 43, pp.204-216. https://doi.org/10.1016/j.spc.2023.11.005

de Backer, K., & Miroudot, S. (2014). Mapping global value chains. pp.1-42. https://doi.org/10.2139/ssrn.2436411

Debaeke, P., Forslund, A., Guyomard, H., Schmitt, B., Tibi, A. (2022). Could domestic soybean production avoid Europe's protein imports in 2050?. *OCL Oilseeds and fats crops and lipids*, *29* (38), pp.1-15. https://doi.org/10.1051/ocl/2022031

Deconinck, K., Giner, C., Jackson, L. A., Toyama, L. (2022). Making better policies for food systems will require reducing evidence gaps. Global Food Security, 33, pp.1-10. https://doi.org/10.1016/j.gfs.2022.100621

de Fazio, M. (2016). Agriculture and Sustainability of the Welfare: The Role of the Short Supply Chain. *Agriculture and Agricultural Science Procedia, 8*, pp.461 466. https://doi.org/10.1016/j.aaspro.2016.02.044.

de Roest K, Ferrari P, Knickel K. (2017). Specialisation and economies of scale or diversification and economies of scope? Assessing different agricultural development pathways. *J. Rural Stud.* 59, pp.222–31. https://doi.org/10.1016/j.jrurstud.2017.04.013

De Schutter, O. (2017). The political economy of food systems reform. European Review of Agricultural Economics, 44(4), pp.705-731. https://doi.org/10.1093/erae/jbx009

Demeter (2022). Rapport annuel. URL: https://demeter.ch/wp-content/uploads/2023/05/Demeter_Jahresbericht_Verband2022_FR.pdf (Last accessed on: 18.02.2024)

D'Haese, M., & Van Huylenbroeck, G. (2005). The rise of supermarkets and changing expenditure patterns of poor rural households case study in the Transkei area, South Africa. *Food Policy*, *30*(1), pp.97-113. https://doi.org/10.1016/j.foodpol.2005.01.001

Donau Soja, 2024. Organisation. URL: donausoja.org (Last accessed on: 18.02.2024)

Dong, X., Balagtas, J. V., Byrne, A. T. (2023). A closer look at the relationship between concentration, prices, and market power in food retail—A monopolistic competition and differentiated products approach. Applied Economic Perspectives and Policy. 45(4), pp.2161–2182. https://doi.org/10.1002/aepp.13344

Döringer, S. (2021). The problem-centred expert interview - Combining qualitative interviewing approaches for investigating implicit expert knowledge. International Journal of Social Research Methodology, 24(3), pp.265-278. https://doi.org/10.1080/13645579.2020.1766777

DSP (2023). URL: https://www.dsp-delley.ch/en/company/portrait/ (Last accessed on: 18.02.2024)

Enthoven, L., & Van den Broeck, G. (2021). Local food systems: Reviewing two decades of research. Agricultural Systems, 193, pp.1-14. https://doi.org/10.1016/j.agsy.2021.103226

European Commission (2020). Concerne, E. N., & FR, D. (2020). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. pp.1-84. URL: https://parlament.mt/media/59752/7974-b.pdf. (Last accessed on: 10.03.2024)

Fally, T. (2012). Production staging: measurement and facts. Boulder, Colorado, University of Colorado Boulder. pp.155-168. URL: https://are.berkeley.edu/~fally/Papers/Fragmentation_US_Aug_2012.pdf (Last accessed on: 10.03.2024)

Farrell, P., Thow, A.M., Wate, J.T., Nonga, N., Vatucawaqa, P., Brewer, T., ... & Andrew, N. L. (2020). COVID-19 and Pacific food system resilience: Opportunities to build a robust response. Food Security, 12(4), pp.783-791. https://doi.org/10.1007/s12571-020-01087-y

Federal Council (2023). La Chancellerie fédérale acquiert le système de traduction automatique DeepL Pro pour l'administration fédérale. URL: https://www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-99327.html (Last accessed on: 15.04.24)

Federal Office for the Environment (FOEN) & Federal Office for Agriculture (FOAG) (2016). Umweltziele Landwirtschaft; Statusbericht 2016 [Environmental goals for agriculture; status report 2016], 1633, pp.1-114. URL: https://www.bafu.admin.ch/bafu/de/home/themen/biodiversitaet/publikationen-studien/publikationen/umweltziele-landwirtschaft-statusbericht-2016.html (Last accessed on: 10.03.2024)

Federal Office for Agriculture (FOAG) (2016). Variétés, semences et plants en Suisse. https://www.blw.admin.ch/dam/blw/fr/dokumente/Markt/Einfuhr%20von%20Agrarprodukten/Saatgetreide%20und%20Saemereien/PublSorten.pdf.download.pdf/Publication%20Varietes%20semences%20et%20plants_fr.pdf (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2022). Alternativen im Schweizer Pflanzenbau. Potenziale ausgewählter Ackerkulturen zur Lebensmittelmittelproduktion. pp.1-41. URL https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.blw.admin.ch/dam/blw/de/dokumente/ackerkulturen_zur_lebensmittelproduktion.pdf.download.pdf/Potenziale%2520ausgew%25C3%25A4hlter%2520Ackerkulturen%2520zur%2520Lebensmittelproduktion.pdf&ved=2ahUKEwjQnZaztuiFAxWdi_0HHU3vDisQFnoECBcQAQ&usg=AOvVaw26DoRzNp00MLKSdqSYQ6PY (Last accessed on: 19.03.2024)

Federal Office for Agriculture (FOAG) (2022y.). La Confédération réduit les droits de douane sur les importations d'aliments pour animaux. URL: https://www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-87482.html (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2022c.). Rapport Agricole 2022 - Marché – Produits végetaux -oléagineux. URL: https://2022.agrarbericht.ch/it/mercato/prodotti-di-origine-vegetale/semi-oleosi (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2022d.). Rapport Agricole 2022 - Structures - Exploitation. URL: https://2022.agrarbericht.ch/it/azienda/strutture/aziende (Last accessed on: 18.02.2024)

Federal Office for Agricolture (FOAG) (2022e.). La Confédération réduit les droits de douane sur les importations d'aliments pour animaux. URL: https://www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-87482.html (Last accessed on: 15.04.24)

Federal Office for Agriculture (FOAG) (2023a.). Rapport Agricole 2023 - Marché - développement du marché - taux d'autosuffisance. URL: https://www.agrarbericht.ch/fr/marche/developpement-du-marche/taux-dauto-approvisionnement (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2023b.). Rapport Agricole 2023 - Exploitation - Structures - Exploitation. URL: https://www.agrarbericht.ch/fr/marche/developpement-du-marche/taux-dauto-approvisionnement (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2023c.). Rapport Agricole 2023 - Production – Production végétale - Utilisation des surfaces. URL: https://www.agrarbericht.ch/fr/production/production-vegetale/utilisation-des-surfaces (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2023d.). Rapport Agricole 2023 - Production – Production végétale – Grandes Cultures. URL: https://agrarbericht.ch/fr/production/production-vegetale/grandes-cultures (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2023e.). Rapport Agricole 2023 - Marché – Produits végetaux -oléagineux. URL: https://agrarbericht.ch/fr/marche/produits-vegetaux/oleagineux (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2023f.). Rapport Agricole 2023 - Politique – Payments directs - 30 ans de paiements directs. URL: https://www.agrarbericht.ch/fr/politique/paiements-directs/30-ans-de-paiements-directs (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2023g.). Quantitativi commercializzati dei principi attivi di prodotti fitosanitari. URL: https://www.blw.admin.ch/blw/it/home/nachhaltige-produktion/pflanzenschutz/verkaufsmengen-der-pflanzenschutzmittel-wirkstoffe.html (Last accessed on: 18.02.2024)

Federal Office for Agriculture (FOAG) (2023h.). Paiements directs, contribution in situ, contributions à des cultures particulières et supplément pour les céréales aux exploitations à l'année. URL : Paiements directs, contribution in situ, contributions à des cultures particulières et supplément pour les céréales aux exploitations à l'année (Last accessed on: 18.02.2024)

Fédération suisse des producteurs de céréales (FSPC) (2021). Oléagineux 2022 : colza et soja toujours recherchés. URL: https://www.sgpv.ch/attribution-oleagineux-2022/ (Last accessed on: 18.02.2024)

Fédération suisse des producteurs de céréales (FSPC) (2023a.). Céréales fourragères : prix suisses sous pression. https://www.sgpv.ch/http-www-sgpv-ch-communiques-de-presse-cereales-fourrageres-prix-suisses-sous-pression/ (Last accessed on: 18.02.2024)

Fédération suisse des producteurs de céréales (FSPC) (2023b.). Pool de production oléagineux. URL : https://www.sgpv.ch/pool-de-production-oleagineux/ (Last accessed on: 18.02.2024)

Fédération suisse des producteurs de céréales (FSPC) (2023c.). Grandes cultures suisses. URL : https://www.sgpv.ch/grandes-cultures-suisses/#:~:text=Les%20producteurs%20cultivent%20de%20nombreuses%20esp%C3%A8ces%20%3A&text=C%C3%A9r%C3%A9ales%20fourrag%C3%A8res%20%3A%20orge%2C%20bl%C3%A9%20fourrager,%2C%20lupin%2C%20soja%20par%20exemple (Last accessed on: 18.02.2024)

Fédération suisse des producteurs de céréales (FSPC) (2023d.). Evolution des volumes de production en tonnes. URL: https://www.sgpv.ch/wp-content/uploads/231001_Tab-5_inlaendische-Produktion_f.pdf (Last accessed on: 18.02.2024)

Federal Statistical Office (FSO) (2019). D'une production de niche à une production agricole établie. L'agriculture biologique en Suisse entre 1990 et 2017. pp.1-4. URL : https://www.bfs.admin.ch/asset/en/7106365 (Last accessed on: 10.03.2024)

Federal Statistical Office (FSO) (2022). La produzione di semi oleosi in Svizzera Colza e girasole, l'oro giallo degli oli commestibili. pp.1-4. URL: https://www.bfs.admin.ch/asset/en/20964933 (Last accessed on: 10.03.2024)

Federal Statistical Office (FSO, 2023). Evolution du nombre d'exploitations agricoles 2002-2022.

Federal Statistical Office (FSO) (2023b.). Relevé des structures agricoles en 2022, Le bio et les volailles toujours en hausse en 2022. pp.1-6. URL: https://dam-api.bfs.admin.ch/hub/api/dam/assets/24605848/master (Last accessed on: 10.03.2024)

Federal Statistical Office (FSO) (2023c.). Relevé des structures agricoles (STRU) - Agriculture biologique: exploitations, classes de taille. URL : https://www.bfs.admin.ch/bfs/fr/home/actualites/quoi-de-neuf.assetdetail.24945777.html (Last accessed on: 10.03.2024)

Federal Statistical Office (FSO) (2023d.). Stato della popolazione alla fine del 2° trimestre 2023. URL: https://www.bfs.admin.ch/news/it/2023-0208#:~:text=Alla%20fine%20del%20secondo%20trimestre,raggiunto%208%20902%20308%20persone (Last accessed on: 18.02.2024)

Federal Statistical Office (FSO) (2023e.). Production totale de l'agriculture biologique. URL : https://www.bfs.admin.ch/bfs/en/home.assetdetail.28945037.html (Last accessed on: 10.03.2024)

Federal Statistical Office (FSO) (2023f.). Production totale de l'agriculture conventionnelle. URL : https://www.bfs.admin.ch/bfs/en/home.assetdetail.28945037.html (Last accessed on: 10.03.2024)

Federal Statistical Office (FSO) (2023g.). Production totale de l'agriculture, total. URL : https://www.bfs.admin.ch/bfs/en/home.assetdetail.28945037.html (Last accessed on: 10.03.2024)

Felley, P. (2018). « *L'agriculture conventionnelle n'existe plus* ». Interviewed by Julien Robyr. *Le Nouvelliste.* 17 october. Available at: https://www.lenouvelliste.ch/valais/l-agriculture-conventionnelle-n-existe-plus-792711 (Last accessed on: 18.02.2024)

FiBL (n.d.) Istituto di ricerca dell'agricoltura biologica FiBL. URL: https://www.fibl.org/it/chi-siamo (Last accessed on: 15.04.24)

FiBL (2019). Organic soya in Switzerland – Optimising the Swiss production chain from seeds to the final product. URL: https://www.fibl.org/en/themes/projectdatabase/projectitem/project/1053 (Last accessed on: 11.03.2024)

FIBL (2023). Requisiti per l'agricoltura biologica 2023. pp.1-8. URL: https://www.fibl.org/fileadmin/documents/shop/1680-esigenze-agricoltura-bio.pdf (Last accessed on: 18.02.2024)

Flick, U. (2007). Designing Qualitative Research. London, Los Angeles: SAGE Publications Ltd, https://doi.org/10.4135/9781849208826

Flick, U. (2009). An introduction to qualitative research (4th ed.). Sage Publications Ltd. pp.1-528. ISBN 978-1-84787-323-1

Florez-Acosta, J., & Herrera-Araujo, D. (2020). Multiproduct retailing and consumer shopping behavior: The role of shopping costs. International Journal of Industrial Organization, 68. https://doi.org/10.1016/j.ijindorg.2019.102560

Flückiger, B. & Porcellana, D. (2023). Sélection d'article sur la politique suisse: Initiative pour une eau potable propre et une alimentation saine (MCF 18.096), 2018 - 2021. Bern: Année Politique Suisse, Institut de science politique, Université de Berne. pp.1-8. URL: https://anneepolitique.swiss/fr/prozesse/59327-initiative-pour-une-eau-potable-propre-et-une-alimentation-saine-mcf-18-096 (Last accessed on: 11.03.2024)

Food and Agricultural Organization of the United Nations (FAO) (2016). The City Region Food System Approach. City Region Food System Programme. Food and Agriculture Organization of the United Nations. URL: https://www.fao.org/in-action/food-for-cities-programme/overview/crfs/en/ (Last accessed on: 15.04.24)

Food and Agricultural Organization of the United Nations (FAO) (2017). The Future of Food and Agriculture – Trends and Challenges. Rome. pp.1-180. ISBN 978-92-5-109551-5.

Food and Agriculture Organization of United Nations FAO (2020b). Mitigating risks to food systems during COVID-19: reducing food loss and waste. pp.1-6. URL: http://www.fao.org/3/ca9056en/CA9056EN.pdf (Last accessed on: 18.02.2024)

Fuchs, D., A. Kalfagianni & M. Arentsen. (2009). "Retail Power, Private Standards, and Sustainability in the Global Food System." pp. 29-59. in *Corporate Power in Global Agrifood Governance,* edited by J. Clapp and D. Fuchs. Cambridge, MA: MIT Press. ISBN: 9780262512374

Galli, F., & Brunori, G. (2015). Short Food Supply Chains as drivers of sustainable development. Evidence Document. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287). Laboratorio di studi rurali Sismondi, pp.1-93. ISBN 978-88-90896-01-9.

Galli, A., Pires, S.M., Iha, K., Alves, A.A., Lin, D., Mancini, M.S., Teles, F. (2020). Sustainable food transition in Portugal: Assessing the Footprint of dietary choices and gaps in national and local food policies. Science of the Total Environment, 749, pp.1-15. https://doi.org/10.1016/j.scitotenv.2020.141307

Garnett, P., Doherty, B., & Heron, T. (2020). Vulnerability of the United Kingdom's food supply chains exposed by COVID-19. Nature Food, 1(6), pp.315-318. https://doi.org/10.1038/s43016-020-0097-7

Gebhardt, S., Haensel, M., Schulp, C. J., Kaim, A. (2022). Ecologically and biophysically optimal allocation of expanded soy production in Bavaria, Germany. Frontiers in Sustainable Food Systems, 6(337), pp.1-15. https://doi.org/10.3389/fsufs.2022.916003

Gilgen, A., Blaser, S., Schneuwly, J., Liebisch, F., & Merbold, L. (2023). The Swiss agri-environmental data network (SAEDN): Description and critical review of the dataset. *Agricultural Systems*, *205*, pp.1-9. https://doi.org/10.1016/j.agsy.2022.103576

Giovannetti, G., & Marvasi, E. (2016). Food exporters in global value chains: Evidence from Italy. Food Policy, 59, pp.110-125. https://doi.org/10.1016/j.foodpol.2015.10.001

Gläser, J., & Laudel, G. (2004). Experteninterviews und qualitative Inhaltsanalyse als Instrumente rekonstruierender Untersuchungen. VS Verlag für Sozialwissenschaften, pp.1.340. ISBN 3-8252-2348-5

Gläser, J., & Laudel, G. (2010). Experteninterviews und qualitative Inhaltsanalyse, pp.1-347. Springer-Verlag. ISBN 978-3-531-17238-5

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., ... & Toulmin, C. (2010). Food security: the challenge of feeding 9 billion people. science, 327(5967), pp.812-818. https://doi.org/10.1126/science.1185383

Graczyk, H., Hopf, N. B., Médiouni, Z., Guseva-Canu, I., Sanvido, O., Schmid, K., & Berthet, A. (2018). Occupational exposure to plant protection products and health effects in Switzerland: what do we know and what do we need to do? Schweizerische Medizinische Wochenschrift, 148(1718), pp.1-9. https://doi.org/10.4414/smw.2018.14610

Grando, S., Carey, J., Hegger, E., Jahrl, I., Ortolani, L. (2017). Short food supply chains in urban areas: Who takes the lead? Evidence from three cities across Europe. Urban Agriculture & Regional Food Systems, 2(1), pp.1-11. https://doi.org/10.2134/urbanag2016.05.0002

Grey, S., & Patel, R. (2015). Food sovereignty as decolonization: Some contributions from Indigenous movements to food system and development politics. Agriculture and human values, 32, pp.431-444. https://doi.org/10.1007/s10460-014-9548-9

Guzman, P., & Reynolds, C. (2019). Food Hubs in the UK: Where are we and what next?. pp.1-20. ISBN: 978-1-903957-52-3

He, R., Zhu, D., Chen, X., Cao, Y., Chen, Y., & Wang, X. (2019). How the trade barrier changes environmental costs of agricultural production: An implication derived from China's demand for soybean caused by the US-China trade war. Journal of Cleaner Production, 227, pp.578-588. https://doi.org/10.1016/j.jclepro.2019.04.192

Helander, H., Schnepf, S., Stetter, T., Ferrara, F., & Leipold, S. (2024). Convenient solutions, inconvenient truths–Why supermarkets will not drive food system transformation. Ecological Economics, 218, pp.1-9. https://doi.org/10.1016/j.ecolecon.2023.108096

Herrmann, C. & Bolliger, C. (2021). Meat substitutes. Swiss Meat Substitutes Report, Federal Office for Agriculture. URL: https://www.blw.admin.ch/dam/blw/en/dokumente/Markt/Marktbeobachtung/Land-%20und%20Ernaehrungswirtschaft/fleischersatz/berichte/report_fe_2021_05.pdf.download.pdf/report_fe_2021_05_e.pdf (Last accessed on: 18.02.2024)

Hirst, P., Thompson, G., Bromley, S. (2015). *Globalization in Question*. Chichester, UK/New York: John Wiley & Sons, pp.1-304. ISBN: 978-0-745-64152-2

Humphrey, J. & Memedovic, O. (2006). Global value chains in the agrifood sector (working paper), pp.1-68. URL: http://tinyurl.com/y8qh4obd. (Last accessed on: 14.06.2023)

IP-Suisse (n.d). Qui nous sommes. URL: https://www.ipsuisse.ch/fr/consomateurs-2/a-propos-consomateurs/portrait-consomateurs/ (Last accessed on: 18.02.2024)

IP-Suisse (2019). Directives pour céréales sans produits phytosanitaires de synthèse. URL: https://www.ipsuisse.ch/wp-content/uploads/Richtlinien_Getreide_ohnePSM_F.pdf (Last accessed on: 18.02.2024)

Jackson, P., Candel, J. J., Davies, A., de Vries, H., Cristiane, D., Dragović-Uzelac, V., ... & Mathijs, E. (2020). Science Advice for Policy by European Academies a sustainable food system for the european union (Doctoral dissertation, Science Advice for Policy by European Academies), pp.1-224. hal-02934171

Jámbor, A., Czine, P., Balogh, P. (2020). The impact of the coronavirus on agriculture: first evidence based on global newspapers. Sustainability, 12(11), pp.1-10. https://doi.org/10.3390/su12114535

Jaunin, V. (2021). Rapport d'essai 2021 - Variétés de soja bio - Grange-Verney. Canton de Vaud, Département de l'économie, de l'innovation et du sport (DEIS) & Direction générale de l'agriculture, de la viticulture et des affaires vétérinaires (DGAV). URL: https://www.vd.ch/fileadmin/user_upload/themes/economie_emploi/agriculture/fichiers_pdf/Vulgarisation/Essais/Rapport_essai_soja_2021.pdf. (Last accessed on: 18.04.2023)

Jeangros, B., Courvoisier, N. (2019). Rotation des cultures en terres assolées (4e édition). URL: https://www.bonnepratiqueagricole.ch/fileadmin/user_upload/Rotation_des_cultures_4eme_edition.pdf (Last accessed on: 18.02.2024)

Jennings, S., McCormack, C., Deveze, R. (2020). Risky Business: Deforestation and social risks in Switzerland's imports of commodities. Research undertaken by 3Keel, commissioned by WWF-Switzerland, pp.1-137. URL: https://www.wwf.ch/sites/default/files/doc-2020-12/WWF-Switzerland%20Risky%20Business%202020_long%20version_final.pdf (Last accessed on: 18.04.2023)

Jia, F., Peng, S., Green, J., Koh, L., Chen, X. (2020). Soybean supply chain management and sustainability: A systematic literature review. Journal of Cleaner Production, 255, pp.1-74. https://doi.org/10.1016/j.jclepro.2020.120254

Jung, I. N., Sharma, A., & Mattila, A. S. (2022). The impact of supermarket credibility on purchase intention of novel food. *Journal of Retailing and Consumer Services*, *64*, 102754. https://doi.org/10.1016/j.jretconser.2021.102754

Kaiser, R. (2014). Qualitative Experteninterviews: Konzeptionelle Grundlagen und praktische Durchführung. Springer, pp.1-182. https://doi.org/10.1007/978-3-658-30255-9

Kakaei, H., Nourmoradi, H., Bakhtiyari, S., Jalilian, M., Mirzaei, A. (2022). Effect of COVID-19 on food security, hunger, and food crisis. In COVID-19 and the Sustainable Development Goals, pp. 3-29. https://doi.org/10.1016/b978-0-323-91307-2.00005-5

Kaplinsky R. (2013). *Globalization, Poverty and Inequality: Between a Rock and a Hard Place*. Chichester, UK/New York: John Wiley & Sons, pp.1.216. ISBN: 978-0-745-63553-8

Kessari, M., Joly, C., Jaouen, A., Jaeck, M. (2020). Alternative food networks: good practices for sustainable performance. Journal of Marketing Management, 36(15-16), pp.1417-1446. https://doi.org/10.1080/0267257X.2020.1783348

King Kullen. (2006). About King Kullen Supermarkets.

Kirchmann, H. (2019). Why organic farming is not the way forward. *Outlook on Agriculture, 48*, pp.22-27. https://doi.org/10.1177/0030727019831702

Klaiss, M., Schmid, N., Betrix, C. A., Baux, A., Charles, R., Messmer, M. M. (2020). Organic soybean production in Switzerland. OCL, 27 (64), pp.1-10. https://doi.org/10.1051/ocl/2020059

Kneafsey, M., Venn, L., Schmutz, U., Balázs, B., Trenchard, L., Eyden-Wood, T., ... & Blackett, M. (2013). Short food supply chains and local food systems in the EU. A state of play of their socio-economic characteristics. JRC scientific and policy reports, pp.1-128. https://doi.org/10.2791/88784

Konefal, J., Bain, C., Mascarenhas, M., Busch, L. (2007). "Supermarkets and Supply Chains in North America." pp. 268-288 in *Supermarkets and Agri-food Supply Chains: Transformations in the Production and Consumption of Foods,* edited by D. Burch and G. Lawrence. Cheltenham, UI(and Northampton, MA: Edward Elgar.

Korthals, M. (2001). Taking consumers seriously: Two concepts of consumer sovereignty.Journal of Agricultural Environmental Ethics, 14(2), pp.201–15. doi:10.1023/A:1011356930245.

Krön, M., & Bittner, U. (2015). Danube Soya–Improving European GM-free soya supply for food and feed. OCL, 22(5), pp.1-10. https://doi.org/10.1051/ocl/2015050

Kuckartz, U. (2014): Qualitative Inhaltsanalyse. Methoden, Praxis, Computerunterstützung. 2. Auflage, Beltz Juventa, pp.1-128.

Kuckartz, U., Rädiker, S. (2019). Coding Text and PDF Files. Analyzing Qualitative Data with MAXQDA: Text, Audio, and Video, pp.65-81. https://doi.org/10.1007/978-3-030-15671-8

Kuepper, B., & Stravens, M. (2022), Mapping the European Soy Supply Chain – Embedded Soy in Animal Products Consumed in the EU27+UK, Amsterdam, The Netherlands: Profundo. URL: https://wwfeu.awsassets.panda.org/downloads/mapping_the_european_soy_supply_chain_e4c.pdf (Last accessed on: 11.03.2024)

Kugelberg, S., Bartolini, F., Kanter, D. R., Milford, A. B., Pira, K., Sanz-Cobena, A., Leip, A. (2021). Implications of a food system approach for policy agenda-setting design. Global Food Security, 28, pp.1-11. https://doi.org/10.1016/j.gfs.2020.100451

Kusumaningtyas, R., & van Gelder, J. W. (2019). Setting the bar for deforestation-free soy in Europe. A benchmark to assess the suitability of voluntary standard systems, Amsterdam, The Netherlands, Profundo Research & Advice, pp.1-38. URL: https://www.profundo.nl/download/iucn1906 (Last accessed on: 11.03.2024)

Landis, F., Landolt, D. (2018). Étude sur la politique agricole suisse : fit for purpose PA22+, commissioned by BirdLife Suisse, Greenpeace, Pro Natura et WWF Suisse, Interface Politikstudien Forschung Beratung, Lucerne, pp.1-53. URL: https://www.wwf.ch/sites/default/files/doc-2018-11/2018-11-%C3%89tude_politique_agricole_suisse.pdf (Last accessed on: 11.03.2024)

Lang, T., Barling D., Caraher, M. (2009). *Food Policy: Integrating Health, Environment and Society.* Oxford: Oxford University Press. 4(3–4), pp.507–508. https://doi.org/10.1080/19320240903336944

Lawrence, G. & Burch, D. (2007). "Understanding Supermarkets and Agri-food Supply Chains". pp. 1-26 in *Supermarkets and Agri-food Supply Chains: Transformations in the Production and Consumption of Foods,* edited by D. Burch and G. Lawrence. Cheltenham, UK and Northampton, MA: Edward Elgar. ISBN: 9781845427269

Lawrence, G., McMichael, P. (2014). Global Change and Food Security, Introduction. In: Freedman, B. (eds) Global Environmental Change. Handbook of Global Environmental Pollution, (1), pp. 667-76. https://doi.org/10.1007/978-94-007-5784-4_114

Lee, J., Gereffi, G., Beauvais, J. (2012). Global value chains and agrifood standards: Challenges and possibilities for smallholders in developing countries. Proceedings of the National Academy of Sciences, 109(31), pp.12326-12331. https://doi.org/10.1073/pnas.0913714108

Liu, X., Yu, L., Cai, W., Ding, Q., Hu, W., Peng, D., ... & Gong, P. (2021). The land footprint of the global food trade: Perspectives from a case study of soybeans. Land Use Policy, 111. https://doi.org/10.1016/j.landusepol.2021.105764

Lorenzin, M. (2007). Pesticide residues in Italian Ready-Meals and dietary intake estimation. Journal of Environmental Science and Health, Part B, Pesticides, Food Contaminants, and Agricultural Wastes, 42(7), pp.823–833. https://doi.org/10.1080/03601230701555021

Lori, M., Symnaczik, S., Mäder, P., De Deyn, G., Gattinger, A. (2017). Organic farming enhances soil microbial abundance and activity— a meta-analysis and meta-regression. PLoS One, 12(7), pp.1-25. https://doi.org/10.1371/journal.pone.0180442

Low, S. A., Adalja, A., Beaulieu, E., Key, N., Martinez, S., Melton, A., ... & Jablonski, B. B. (2015). Trends in US local and regional food systems: A report to Congress. Trends in US local and regional food systems: A report to Congress. Department of Agriculture, Economic Research Service. pp.1-92. URL: https://www.ers.usda.gov/publications/pub-details/?pubid=42807 (Last accessed on: 15.04.24)

Marsden, T., & Sonnino, R. (2012). Human health and wellbeing and the sustainability of urban–regional food systems. Current Opinion in Environmental Sustainability, 4(4), pp.427-430. https://doi.org/10.1016/j.cosust.2012.09.004

Martin, P.Y., & Turner, B.A. (1986). Grounded theory and organizational research. The Journal of Applied Behavioral Science, 22(2), pp.141-157. https://doi.org/10.1177/0021886386022002

Martin, A. R., Cadotte, M. W., Isaac, M. E., Milla, R., Vile, D., Violle, C. (2019). Regional and global shifts in crop diversity through the Anthropocene. PLoS One, 14(2), pp.1-18. https://doi.org/10.1371/journal.pone.02097

Mason, J. (2002) Qualitative Researching. London: SAGE Publications Ltd, pp.1-234. URL: http://www.sxf.uevora.pt/wp-content/uploads/2013/03/Mason_2002.pdf (Last accessed on: 11.03.2024).

Masuda, T., & Goldsmith, P.D. (2009). World soybean production: area harvested, yield, and long-term projections. International food and agribusiness management review, 12 (4), pp.1-20. URL: https://www.ifama.org/resources/Documents/v12i4/Masuda-Goldsmith.pdf (Last accessed on: 11.03.2024).

McIntosh, W.A. (2013). Sociologies of food and nutrition. Springer Science & Business Media. ISBN 978-1-4899-1387-6

McMichael, P., & Friedmann, H. (2007). "Situating the 'Retailing Revolution.'" pp. 291-319 in Supermarkets and Agri-food Supply Chains: Transformations in the Production and Consumption of Foods, edited by D. Burch and G. Lawrence. Cheltenham, UK and Northampton, MA: Edward Elgar. pp.1-352. ISBN: 978 1 84542 726 9

Messina, M. (2022). Perspective: soybeans can help address the caloric and protein needs of a growing global population. Frontiers in nutrition, 9, pp.1-9. https://doi.org/10.3389/fnut.2022.909464

Meuser, M., & Nagel, U. (2009). The expert interview and changes in knowledge production. In A. Bogner, B. Littig, & W. Menz (Eds.), Interviewing experts. Palgrave Macmillan UK. pp. 17–42. https://doi.org/10.1057/9780230244276_2

Millard, J., Sturla, A., Smutná, Z., Duží, B., Janssen, M., Vávra, J. (2022). European food systems in a regional perspective: A comparative study of the effect of COVID-19 on households and city-region food systems. Frontiers in Sustainable Food Systems, 6, pp.1-23. https://doi.org/10.3389/fsufs.2022.844170

Morley, A., & Morgan, K. (2021). Municipal foodscapes: Urban food policy and the new municipalism. Food Policy, 103 (5), pp.1-23. https://doi.org/10.1016/j.foodpol.2021.102069

Muehle Rytz (2023). Recommandations de culture bio récolte 2024. pp.1-6. URL: https://www.muehlerytz.ch/wp-content/uploads/2021/01/Wintersaatgetreide-Bio-2023-F.pdf (Last accessed on: 18.02.2024)

Muhie, S. H. (2022). Novel approaches and practices to sustainable agriculture. Journal of Agriculture and Food Research, 10, pp.1-11. https://doi.org/10.1016/j.jafr.2022.100446

Murphy, S. (2006). Concentrated market power and agricultural trade. Ecofair trade dialogue, Discussion papers, 1, pp.1-41. URL: http://geoinovace.data.quonia.cz/materialy/ZX501_Globalni_problemy_svetove_ekonomiky/Setkani_c_2/Ecofair_Murphy_concentration_2006.pdf (Last accessed on: 13.03.2024)

Murphy, B., Benson, T., McCloat, A., Mooney, E., Elliott, C., Dean, M., Lavelle, F. (2021). Changes in consumers' food practices during the COVID-19 lockdown, implications for diet quality and the food system: a cross-continental comparison. Nutrients, 13(1), pp.1-14. https://doi.org/10.3390/nu13010020

Nicolopoulou-Stamati, P., Maipas, S., Kotampasi, C., Stamatis, P., Hens, L. (2016). Chemical pesticides and human health: the urgent need for a new concept in agriculture. Frontiers in public health, 4, pp.1-48. https://doi.org/10.3389/fpubh.2016.00148

Nguyen, H. (2018). Sustainable food systems: Concept and framework. Food and Agriculture Organization of the United Nations: Rome, Italy. pp.1-48. URL: https://www.fao.org/3/ca2079en/CA2079EN.pdf (Last accessed on: 13.03.2024)

Nyström, M., Jouffray, J. B., Norström, A. V., Crona, B., Søgaard Jørgensen, P., Carpenter, S. R., ... & Folke, C. (2019). Anatomy and resilience of the global production ecosystem. Nature, 575(7781), pp.98-108. https://doi.org/10.1038/s41586-019-1712-3

Official Journal of the European Union (2023). Parere del Comitato economico e sociale europeo sul tema «Verso una strategia sostenibile dell'UE in materia di proteine vegetali e olio vegetale». pp.1-9. URL: https://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:52022IE1100&from=EN (Last accessed on: 13.03.2024)

Oosterveer, P., & Sonnenfeld, D.A. (2012). Food, globalization and sustainability. Routledge. pp.1-282. https://doi.org/10.4324/9781849776790

Orden, D. (2020). Resilience and Vulnerabilities of the North American Food System during the Covid-19 Pandemic. EuroChoices, 19(3), pp.13-19. https://doi.org/10.1111/1746-692x.12273

Ordonnance sur les paiements directs versés dans l'agriculture (OPD) (2013). Ordonnance sur les paiements directs, OPD ; RS 910.13. URL : https://www.fedlex.admin.ch/eli/oc/2013/765/fr (Last accessed on: 13.03.2024)

Organic Farming Ordinance (1998). Ordinance on Organic Farming and the Labelling of Organically Produced Products and Foodstuff. URL: https://www.fedlex.admin.ch/eli/cc/1997/2498_2498_2498/en (Last accessed on: 29.04.2024)

Otsuka, K., Nakano, Y., Takahashi, K. (2016). Contract farming in developed and developing countries. *Annu. Rev. Resourc. Econ.* 8, pp.353–376. https://doi.org/10.1146/annurev-resource-100815-095459

Pendrill, F., Persson, U.M., Godar, J., Kastner, T. (2019). Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition. Environmental Research Letters, 14(5), pp.1-14. https://doi.org/10.1088/1748-9326/ab0d41

Pimentel, D., & Peshin, R. (Eds.). (2014). Integrated pest management: pesticide problems. Springer Science & Business Media, 3(3), pp.47–71. https://doi.org/10.1007/978-94-007-7796-5

Philippon, T. (2019). *The great reversal: How America gave up on free markets*. Harvard University Press. pp.1-304. https://doi.org/10.2307/j.ctv24w62m5

Polackova, H. (2020). Socio-economic consequences of globalization in agriculture in relation to social responsibility. In SHS Web of Conferences, 74, pp.1-6. https://doi.org/10.1051/shsconf/20207404020

ProSpecieRara (2019). Réglementation sur la diffusion des semences en Suisse et en Europe. URL: https://www.prospecierara.ch/fr/vegetaux/politique-semenciere/reglementation-sur-la-diffusion-des-semences.html (Last accessed on: 13.03.2024)

Prost, S. (2019). Food democracy for all? Developing a food hub in the context of socio-economic deprivation. Politics and Governance, 7(4), pp.142-153. https://doi.org/10.17645/pag.v7i4.2057

Piao, H., & Kim, J. S. (2024). The effect of urbanization on fast-food preferences and body mass index: evidence from China. Applied Economics Letters, pp.1–5. https://doi.org/10.1080/13504851.2024.2313556

Piernas, C., Cook, B., Stevens, R., Stewart, C., Hollowell, J., Scarborough, P., Jebb, S.A. (2021). Estimating the effect of moving meat-free products to the meat aisle on sales of meat and meat-free products: A non-randomised controlled intervention study in a large UK supermarket chain. PLoS Medicine, 18(7), pp.1-15. https://doi.org/10.1371/journal.pmed.1003715

Piketty T. (2017). *Capital in the Twenty-First Century*. Cambridge, MA: Harv. Univ. Press, 45(1), pp.172-173. https://doi.org/10.1017/S0047279415000616

Pimm, S.L., Jenkins, C.N., Abell, R., Brooks, T.M., Gittleman, J.L., Joppa, L.N., Raven, P.H., Roberts, C.M. and Sexton, J.O. (2014). The biodiversity of species and their rates of extinction, distribution, and protection. science, 344(6187), pp.1-11. https://doi.org/10.1126/science.1246752

Poore, J., & Nemecek, T. (2018) Reducing food's environmental impacts through producers and consumers. Science, 360, pp.987-992. https://doi.org/10.1126/science.aaq0216

Poudel, K., & Subedi, P. (2020). Impact of COVID-19 pandemic on socioeconomic and mental health aspects in Nepal. International Journal of Social Psychiatry, 66(8), pp.748-755. https://doi.org/10.1177/0020764020942247

Public Eye (n.d.). Le système agroalimentaire mondial. URL: https://www.publiceye.ch/fileadmin/doc/Bildung/PublicEye_Education_Agroalimentaire_Introduction.pdf (Last accessed on: 18.02.2024)

Ramseyer, N., Steiner, B., Vonlanthen, I., Brugger D. (2021). Le potentiel de certaines grandes cultures en Suisse. USP. pp.1-79. URL: https://www.sbv-usp.ch/fileadmin/sbvuspch/04_Medien/Medienmitteilungen/PM_2021/Rapport_Le_potentiel_de_certaines_grandes_cultures_en_Suisse_FR_def.pdf (Last accessed on: 13.03.2024)

Raymond, C.M., Reed M., Bieling C., Robinson G.M., Plieninger, T. (2016). Integrating different understandings of landscape stewardship into the design of agri-environmental schemes. *Environ. Conserv.* 43(4), pp.350–58. https://doi.org/10.1017/s037689291600031x

Reardon, T., Berdegué, J.A., Timmer, C.P. (2005). Supermarketization of the" Emerging Markets" of the Pacific Rim: development and trade implications. *Journal of Food Distribution Research*, *36*(1), pp.3-12. https://doi.org/10.22004/ag.econ.26754

Rees, E. (2011). Tesco and Starbucks Feel the Heat in Battle against 'Clone Town Britain. *In The Ecologist.* URL: https://theecologist.org/2011/aug/23/tesco-and-starbucks-feel-heat-battle-against-clone-town-britain (Last accessed on: 13.03.2024)

Reynolds, C., Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V.K., Jackson, P., (2019). Review: consumption-stage food waste reduction interventions – what works and how to design better interventions. Food Pol, 83, pp.7–27. https:// doi.org/10.1016/j.foodpol.2019.01.009.

Reuber, P. & Gebhardt, H. (2011). Wissenschaftliches Arbeiten in der Geographie. In: Gebhardt, H., Glaser, R., Radtke, U. und Reuber, P. (Hrsg.): Geographie – Physische Geographie und Humangeographie. 2. Auflage. Heidelberg: Spektrum Akademischer Verlag, pp.89-101.

Richter, J. (2019). Research Methodology. In: Formalisation Through Taxation. Palgrave Pivot, Cham. pp.1-122. https://doi.org/10.1007/978-3-030-29282-9

Robinson, G.M. (2006). Canada's environmental farm plans: trans-Atlantic perspectives on agri-environmental schemes. The Geographical Journal, 172(3), pp.206–218. https://doi.org/10.1111/j.1475-4959.2006.00207.x

Robinson, G.M. (2018). Globalization of agriculture. Annual Review of Resource Economics, 10, pp.133-160. https://doi.org/10.1146/annurev-resource-100517-023303

Rodale Institute. (2005). "The Supermarket Turns 75." In Bonanno, A., & Busch, L. (Eds.). (2015). Handbook of the international political economy of agriculture and food. Edward Elgar Publishing. pp.1-384. ISBN: 9781782548256

RSI (2024). L'orto inclusivo. URL: https://www.rsi.ch/rete-tre/programmi/intrattenimento/il-gioco-del-luca/%E2%80%9CL%E2%80%99orto-inclusivo%E2%80%9D--2035318.html. Aired on: 06.01.2014. (Last accessed on: 18.02.2024)

Sandmeier, M. (2022) Duel Sanglant – comment Migros et Coop tirent profit de notre appétit pour la viande, Greenpeace Suisse. URL: https://www.greenpeace.ch/fr/story-fr/88379/duel-sanglant-appetit-viande/ (Last accessed on: 13.03.2024).

Scherer, A., Bolliger Maiolino, C. (2023). Oléagineux . URL: https://www.blw.admin.ch/blw/fr/home/markt/marktbeobachtung/oelsaaten.html (Last accessed on: 13.03.2024)

Schilling-Vacaflor, A., Lenschow, A., Challies, E., Cotta, B., Newig, J. (2021). Contextualizing certification and auditing: Soy certification and access of local communities to land and water in Brazil. World Development, 140, pp.1-12. https://doi.org/10.1016/j.worlddev.2020.105281

Schmid, N. (2019). Soja bio alimentaire et fourrager: calculez vos frais de production!. In bioactualites.ch. URL: https://www.bioactualites.ch/cultures/grandes-cultures-bio/legumineuses-a-graines/soja-coutprod-fr (Last accessed on: 13.03.2024)

Schori, A., Charles, R., Peter, D. (2003). Soja: sélection, agronomie et production en Suisse. Revue suisse d'agriculture, 35(2), pp.69-76.

Service de l'environnement, etat de Fribourg (2017). Alimentation et environnement. URL : https://www.fr.ch/energie-agriculture-et-environnement/environnement/alimentation-et-environnement (Last accessed on: 13.03.2024)

Shea, Z., Singer, W. M., Zhang, B. (2020). Soybean production, versatility, and improvement. In Legume Crops-Prospects, Production and Uses. London, UK: IntechOpen. pp.1-23. https://doi.org/10.5772/intechopen.91778

Siamabele, B. (2021). The significance of soybean production in the face of changing climates in Africa. Cogent Food & Agriculture, 7(1), pp.1-16. https://doi.org/10.1080/23311932.2021.1933745

Singh, P., & Krishnaswamy, K. (2022). Sustainable zero-waste processing system for soybeans and soy by-product valorization. Trends in Food Science & Technology, 128, pp.331-344. https://doi.org/10.1016/j.tifs.2022.08.015

Sklair L. (2001). *Transnational Capitalist Class*. Oxford, UK: Wiley-Blackwell. pp.1-352. ISBN: 978-0-631-22462-4

Smart protein project, (2021). What consumers want: a survey on European consumer attitudes towards plant-based foods with a focus on flexitarians. pp.1-58. URL: https://smartproteinproject.eu/wp-content/uploads/FINAL_Pan-EU-consumer-survey_Overall-Report-.pdf (Last accessed on: 13.03.2024)

Sohidul Islam, M., Muhyidiyn, I., Rafiqul Islam, Md., Kamrul Hasan, Md., Golam Hafeez, A., Moaz Hosen, Md., ... Erman, M. (2022). Soybean and Sustainable Agriculture for Food Security. In IntechOpen eBooks. https://doi.org/10.5772/intechopen.104129

Song, X. P., Hansen, M. C., Stehman, S. V., Potapov, P. V., Tyukavina, A., Vermote, E. F., Townshend, J. R. (2018). Global land change from 1982 to 2016. Nature, 560(7720), pp.639-643. https://doi.org/10.1038/s41586-018-0411-9

Soy Network Switzerland, (2023). Network status. https://www.sojanetzwerk.ch/en/network-status/ (Last accessed on: 18.04.2023)

Sridhar, A., Balakrishnan, A., Jacob, M. M., Sillanpää, M., Dayanandan, N. (2023). Global impact of COVID-19 on agriculture: role of sustainable agriculture and digital farming. Environmental Science and Pollution Research, 30(15), pp.42509-42525. https://doi.org/10.1007/s11356-022-19358-w

Stein, A. J., & Santini, F. (2021). The sustainability of "local" food: a review for policy-makers. Review of Agricultural, Food and Environmental Studies, 103(1), pp.77–89. https://doi.org/10.1007/s41130-021-00148-w

Stephens, E.C., Martin, G., Van Wijk, M., Timsina, J., Snow, V. (2020). Editorial: Impacts of COVID-19 on agricultural and food systems worldwide and on progress to the sustainable development goals. Agricultural systems, 183, pp.1-35. https://doi.org/10.1016/j.agsy.2020.102873

Strauss, A., & Corbin, J. (1990). Basics of qualitative research. Sage publications.

Strauss, A., & Corbin, J. (1994). Grounded theory methodology. In N. Denzin & Y. Lincoln (Eds.), Handbook of qualitative research. Thousand Oaks, CA: Sage. pp. 273-285.

Suddaby, R. (2006). From the editors: What grounded theory is not. Academy of Management Journal ARCHIVE, 49(4), pp.633-642. https://doi.org/10.5465/amj.2006.22083020

Sumberg, J., & Giller, K. E. (2022). What is 'conventional'agriculture?. Global Food Security, 32, pp.1-9. https://doi.org/10.1016/j.gfs.2022.100617

Swissgranum (2023). Listes recommandées de maïs et de soja pour la récolte 2023. URL : https://www.swissgranum.ch/fr/story/listen-der-empfohlenen-mais-und-sojasorten-fuer-die-ernte-2023 (Last accessed on: 13.03.2024)

Swissgranum (2023a.). Statistique, rendements moyens (sans bio). URL: https://www.swissgranum.ch/fileadmin/user_upload/swiss-granum/dokumente/Marktzahlen/Inlandproduktion/2023-11-29_durchschnittliche_Ertraege.pdf (Last accessed on: 18.02.2024)

Swissgranum (2023b.). Recettes pour le tournesol et le soja de la récolte 2023. URL: https://www.swissgranum.ch/fr/story/recettes-pour-le-tournesol-et-le-soja-de-la-recolte-2023 (Last accessed on: 13.03.2024)

Szenderák, J., Fróna, D., & Rákos, M. (2022). Consumer Acceptance of Plant-Based Meat Substitutes: A Narrative Review. Foods, 11(9), pp.1-22. https://doi.org/10.3390/foods11091274

Templier, M., & Paré, G. (2015). A framework for guiding and evaluating literature reviews. Communications of the Association for Information Systems, 37(1), pp.212-137. https://doi.org/10.17705/1CAIS.03706

Thomé, K.M., Cappellesso, G., Ramos, E.L.A., & de Lima Duarte, S.C. (2021). Food supply chains and short food supply chains: Coexistence conceptual framework. Journal of Cleaner Production, 278, 123207. https://doi.org/10.1016/j.jclepro.2020.123207

Thompson, J.J., Brawner, J.J., Kaila, U. (2017). “You can’t manage with your heart”: risk and responsibility in farm to school food safety. Agric. Hum. Values, 34, pp.683–699. https://doi.org/10.1007/s10460-016-9766-4

Thrane, M., Paulsen, P.V., Orcutt, M.W., Krieger, T.M. (2017). Chapter 2 - Soy protein: Impacts, production, and applications. In S.R. Nadathur, J. P. D. Wanasundara, & L. Scanlin (Eds.), Sustainable protein sources, pp.23–45. https://doi.org/10.1016/B978-0-12-802778-3.00002-0

Tilzey M, Potter C. (2008). Productivism versus post-productivism? Modes of agri-environmental governance in post-Fordist agricultural transitions. In Sustainable Rural Systems: Sustainable Agriculture and Rural Communities, ed. GM Robinson,. Aldershot, UK: Ashgate, pp. 41–66. ISBN 9781315611556

Timmermann, C., Félix, G. F., Tittonell, P. (2018). Food sovereignty and consumer sovereignty: Two antagonistic goals?. Agroecology and Sustainable Food Systems, 42(3), pp.274-298. https://doi.org/10.1080/21683565.2017.1359807

Tuomisto, H. L., Hodge, I. D., Riordan, P., Macdonald, D. W. (2012). Does organic farming reduce environmental impacts?–A meta-analysis of European research. Journal of environmental management, 112, pp.309-320. https://doi.org/10.1016/j.jenvman.2012.08.018

United Nations (2018). The World Population Prospects: The 2017 Revision. United Nations, New York, USA: UN Department of Economic and Social Affairs Population Division. URL: https://population.un.org/wpp/publications/files/wpp2017_keyfindings.pdf. (Last accessed on: 18.04.2023)

United Nations (UN) (2020). Policy Brief: The Impact of COVID-19 on Food Security and Nutrition. pp.1-23. URL: https://unsdg.un.org/resources/policy-brief-impact-covid-19-food-security-and-nutrition (Last accessed on 18.02.24)

United Nations, (2023). Voluntary Sustainability Standards in International Trade. pp.1-53. URL: https://unctad.org/system/files/official-document/ditctab2022d8_en.pdf (Last accessed on: 18.04.2023)

UFA (2022). Des semences fiables ? Un must. Ufarevue, URL: https://www.ufarevue.ch/fre/production-vegetale/des-semences-fiables-un-must (Last accessed on: 13.03.2024)

UFA (2022b.). Il faut produire plus de soja. Ufarevue, URL: https://www.ufarevue.ch/fre/production-vegetale/production-fourragere/il-faut-produire-plus-de-soja (Last accessed on: 17.12.2023)

UFA (2022c.). Hausse des prix indicatifs pour les féveroles bio et le soja fourrager bio. Ufarevue, URL: https://www.ufarevue.ch/fre/newsticker/hausse-des-prix-indicatifs-pour-certaines-cultures-bio#:~:text=L'augmentation%20par%20rapport%20%C3%A0,prix%20sont%20maintenant%20de%2093. (Last accessed on: 17.12.2023)

Union Suisse des Paysans (USP) (n.d.). Production végétale. URL: https://www.sbv-usp.ch/fr/ettiquettes/grandes-cultures (Last accessed on: 13.03.2024)

Union Suisse des Paysans (USP) (n.d.b.). Luttons ensemble contre le gaspillage alimentaire. URL: https://www.sbv-usp.ch/fr/ettiquettes/gaspillage-alimentaire/ (Last accessed on: 13.03.2024)

Union Suisse des Paysans (USP) (2018). Perché le nostre piante necessitano di protezione. URL: https://www.sbv-usp.ch/fileadmin/sbvuspch/04_Medien/Publikationen/FOKUS_Pflanzenschutz_IT_k.pdf (last accessed on 18.02.24)

Union Suisse des Paysans (USP) (2021). Potential ausgewählter Ackerkulturen in der Schweiz. Bericht zur aktuellen Lage im Ackerbau und den möglichen Entwicklungen. URL: https://www.sbv-usp.ch/fileadmin/sbvuspch/04_Medien/Medienmitteilungen/PM_2021/Bericht_Potential_Schweizer_Ackerkulturen_DE_def.pdf (Last accessed on: 13.03.2024)

United States Department of Agriculture (USDA) (2023). Soybean Explorer. URL: https://ipad.fas.usda.gov/cropexplorer/cropview/commodityView.aspx?cropid=2222000 (Last accessed on: 18.04.2023)

University of Zürich (UZH) (2024). List of approved applications. URL: https://www.zi.uzh.ch/en/support/Outlook-und-Kollaboration-Office-365/thirdpartyapps/applist0.html (Last accessed on: 15.04.24)

Vallier, C. (2021). Semences et droit public suisse : alimentation, santé et environnement. pp.1-362. https://doi.org/10.13097/archive-ouverte/unige:150840

Vanclay, F. (2015) Qualitative methods in regional program evaluation: an examination of the story – based approach. In Handbook of Research Methods and Applications in Economic Geography. Cheltenham, UK; Northampton, USA: Edward Elgar Publishing. pp. 544–570. https://doi.org/10.4337/9780857932679.00034

Van Loo, E. J., Caputo, V., Lusk, J. L. (2020). Consumer preferences for farm-raised meat, lab-grown meat, and plant-based meat alternatives: Does information or brand matter?. Food Policy, 95, pp.1-15. https://doi.org/10.1016/j.foodpol.2020.101931

Via Campesina. (1996). The right to produce and access land. Rome: Via Campesina.

Viaux, P. (1999). Une 3ème voie en Grande Culture. Environnement-Qualité-Rentabilité. Agridécisions. ISBN 978-2-912199-05-8

Vicente-Vicente, J. L., Doernberg, A., Zasada, I., Ludlow, D., Staszek, D., Bushell, J., ... & Piorr, A. (2021). Exploring alternative pathways toward more sustainable regional food systems by foodshed assessment–City region examples from Vienna and Bristol. Environmental Science & Policy, 124, pp.401-412. https://doi.org/10.1016/j.envsci.2021.07.013

Virah-Sawmy, M., Duran, A.P., Green, J.M., Guerrero, A.M., Biggs, D., West, C.D. (2019).

Sustainability gridlock in a global agricultural commodity chain: Reframing the soy–meat food system. Sustainable Production and Consumption, 18, pp.210-223. https://doi.org/10.1016/j.spc.2019.01.003

Vittersø, G., Torjusen, H., Laitala, K., Tocco, B., Biasini, B., Csillag, P., ... & Wavresky, P. (2019). Short food supply chains and their contributions to sustainability: Participants' views and perceptions from 12 European cases. Sustainability, 11(17), pp.1-33. https://doi.org/10.3390/su11174800

Vittuari, M., Bazzocchi, G., Blasioli, S., Cirone, F., Maggio, A., Orsini, F., ... & De Menna, F. (2021). Envisioning the future of European food systems: approaches and research priorities after COVID-19. Frontiers in Sustainable Food Systems, 5, pp.1-9. https://doi.org/10.3389/fsufs.2021.642787

Vonlanthen T., Fuchs Z., Tallant M., Baux A. (2022). Liste recommandée des variétés de soja pour la récolte 2023. URL: https://www.agroscope.admin.ch/agroscope/fr/home/actualite/newsroom/2022/12-22-2023-sortenliste-soja/_jcr_content/par/columncontrols/items/0/column/externalcontent.bitexternalcontent.exturl.pdf/aHR0cHM6Ly9pcmEuYWdyb3Njb3BlLmNoLzAvQWpheC9FaW56ZW/xwdWJsaWthdGlvbi9Eb3dubG9hZD9laW56ZWxwdWJsaWthdGlv/bklkPTU1NDEy.pdf (Last accessed on: 13.03.2024)

Vonlanthen T., Fuchs Z., Tallant M., Baux A. (2023). Essais variétaux de soja 2022. Agroscope Transfer, 475, pp.1-51. URL: https://www.agroscope.admin.ch/agroscope/fr/home/themes/animaux-rente/ruminants/publikationen-wiederkaeuer/_jcr_content/par/externalcontent.bitexternalcontent.exturl.pdf/aHR0cHM6Ly9pcmEuYWdyb3Njb3BlLmNoL2RlLUNIL0FqYXgvRW/luemVscHVibGlrYXRpb24vRG93bmxvYWQ_ZWluemVscHVibGlr/YXRpb25JZD01NjEzNg==.pdf (Last accessed on: 18.02.2024)

Voora, V., Larrea, C., Bermudez, S. (2020). Global market report: Soybeans. Winnipeg, Manitoba: International Institute for Sustainable Development. pp.1-20. URL: https://www.iisd.org/system/files/2020-10/ssi-global-market-report-soybean.pdf (Last accessed on: 18.04.2024)

Yao, H., Zuo, X., Zuo, D., Han, L., Huang, X., Zang, C. (2020). Study on soybean potential productivity and food security in China under the influence of COVID-19 outbreak. Geography and Sustainability, 1(2), pp.163–171. https://doi.org/10.1016/j.geosus.2020.06.002

Young, E. (2012). Food and Development. London: Routledge. pp.1-432. ISBN 9780415498005

Wedeaux, B., & Schulmeister-Oldenhove, A. (2021). Stepping up? The Continuing Impact of EU Consumption on Nature Worldwide. WWF, pp.1-23. URL: https://www.wwf.nl/globalassets/pdf/stepping-up-the-continuing-impact-of-eu-consumption-on-nature-worldwide.pdf (Last accessed on: 13.03.2024)

Weis, T. (2013). The ecological hoofprint: the global burden of industrial livestock. London / New York: Zed Books. Reviewed by Feliu López-i-Gelats. Journal of Political Ecology, 21(1). https://doi.org/10.2458/v21i1.21151

Whaley, E. (2021). The role soy production plays in deforestation: A study on Paraguayan Forest. Centre for Environmental Policy. pp.1-61. https://doi.org/10.25560/94693

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., . . . Murray, C. J. L. (2019). Food in the Anthropocene: The EAT - Lancet commission on healthy diets from sustainable food systems. Lancet, 393(10170), pp.447-492. doi:10.1016/ S0140-6736(18)31788-4

Wittman, H. (2023). Food sovereignty: An inclusive model for feeding the world and cooling the planet. One Earth, 6(5), pp.474-478. https://doi.org/10.1016/j.oneear.2023.04.011

Wittwer, R.A., Bender, S.F., Hartman, K., Hydbom, S., Lima, R.A., Loaiza, V., ... & Van Der Heijden, M.G. (2021). Organic and conservation agriculture promote ecosystem multifunctionality. Science Advances, 7(34), pp.1-12. https://doi.org/10.1126/sciadv.abg6995

Witzel, A. (2000). The Problem-centered Interview. In: FQS (Forum: Qualitative Social Research), 1(1), art. 22. URL: https://www.qualitative-research.net/index.php/fqs/article/view/1132/2521#gcit (Last accessed on: 13.06.2023)

World Health Organization (WHO) (1990). Public Health Impact of Pesticides Used in Agriculture. England. pp.1-128. ISBN9241561394

World Farmers' Organisation (WFO) (2020a). Covid-19 pandemic outbreak: overview of the impact on the agricultural sector. pp.1-9. URL: https://www.fao.org/family-farming/detail/en/c/1276852/ (Last accessed on 18.02.24).

WWF (n.d.). Guide Labels Alimentaires. URL: https://www.wwf.ch/fr/guide-labels-alimentaires?f%5B2%5D=score%3AAll#guide-content (Last accessed on: 18.02.2024)

WWF (n.d.b.). Nos-objectifs - Pesticides: effets et dangers. URL: https://www.wwf.ch/fr/nos-objectifs/pesticides-effets-et-dangers (Last accessed on: 18.02.2024)

WWF (2014). The Growth of Soy: Impacts and Solutions. WWF International, Gland, Switzerland. pp.1-96. URL: http://awsassets.wwfdk.panda.org/downloads/wwf_soy_report_final_jan_19.pdf (Last accessed on: 13.03.2024)

WWF (2019). Initiative pour l'eau potable et Initiative pesticide : continuer comme jusqu'ici n'est pas une option. URL: https://www.wwf.ch/fr/medias/initiative-pour-leau-potable-et-initiative-pesticide-continuer-comme-jusquici-nest-pas-une-option (Last accessed on: 18.02.2024)

WWF (2020). Deforestation Fronts report. URL: https://www.wwf.ch/sites/default/files/doc-2021-01/Deforestation%20fronts%20-%20drivers%20and%20responses%20in%20a%20changing%20world%20-%20full%20report.pdf (Last accessed on: 18.02.2024)

WWF (2021). La réforme de l'homologation des pesticides avance péniblement. URL: https://www.wwf.ch/fr/medias/la-reforme-de-lhomologation-des-pesticides-avance-peniblement (Last accessed on: 18.02.2024)

WWF (2022). Soy / industries. URL: https://www.worldwildlife.org/industries/soy (Last accessed on: 18.04.2023)

Zabel, F., Delzeit, R., Schneider, J. M., Seppelt, R., Mauser, W., Václavík, T. (2019). Global impacts of future cropland expansion and intensification on agricultural markets and biodiversity. Nature communications, 10(1), pp.1-10. https://doi.org/10.1038/s41467-019-10775-z

Zander, P., Preissel, S., Reckling, M., Bues, A., and Schläfke, N. (2016). Grain legume decline and potential recovery in European agriculture: a review. Agronomy for Sustainable Development, 36(2), pp.1-20. https://doi.org/10.1007/s13593-016-0365-y

Zbinden, V. (2018). Pierluigi Zanchi, TiGusto: « L'avenir passe par une alimentation essentiellement végétale… ». URL: https://www.bio-suisse.ch/fr/vivre-bio-suisse/blog/posts/2018/11/pierluigi-zanchi-tigusto-lavenir-passe-par-une-alimentation-essentiellement-vegetale.html (Last accessed on: 18.02.2024)

Ziehli, K. (2023). Ausgewählte Beiträge zur Schweizer Politik: Initiative populaire fédérale « Pour une suisse libre de pesticides de synthèse » (MCF 19.025), 2016 - 2021. Bern: Année Politique Suisse, Institut für Politikwissenschaft, Universität Bern. URL : https://anneepolitique.swiss/prozesse/59937-initiative-populaire-federale-pour-une-suisse-libre-de-pesticides-de-synthese-mcf-19-025 (Last accessed on: 18.02.2024)

Zollet, S., Colombo, L., De Meo, P., Marino, D., McGreevy, S. R., McKeon, N., Tarra, S. (2021). Towards territorially embedded, equitable and resilient food systems? Insights from grassroots responses to COVID-19 in Italy and the city region of Rome. Sustainability, 13(5), pp.1-24. https://doi.org/10.3390/su13052425

Zwart, T.A., & Wertheim-Heck, S.C. (2021). Retailing local food through supermarkets: Cases from Belgium and the Netherlands. Journal of Cleaner Production, 300, pp.1-8. https://doi.org/10.1016/j.jclepro.2021.126948

Annexes

Annex A : Average yields (dt/ha)

Source : Swiss granum (2023h.). Statistique, rendements moyens (sans bio). URL : https://www.swissgranum.ch/fileadmin/user_upload/swiss-granum/dokumente/Marktzahlen/Inlandproduktion/2023-11-29_durchschnittliche_Ertraege.pdf

Durchschnittliche Erträge / Rendements moyens (dt/ha)

	Kultur	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023 *	Culture	
Brotgetreide	Weizen	-	62.2	60.4	44.1	61.4	57.1	58.3	63.3	53.2	56.1	52.6	Blé	Céréales panifiables
	Winterweizen	53.6	62.7	60.7	44.3	61.5	57.3	58.5	63.9	53.3	56.2	52.7	Blé d'automne	
	Sommerweizen	49.1	53.2	49.0	34.8	50.9	40.8	42.3	44.9	44.6	46.2	43.6	Blé de printemps	
	Dinkel	37.8	43.4	36.0	30.4	40.8	40.6	39.9	39.8	30.7	36.6	35.3	Epeautre	
	Roggen	55.1	67.2	61.8	42.4	62.0	54.5	58.7	57.5	43.6	56.5	49.0	Seigle	
	Emmer, Einkorn	38.4	38.4	36.4	30.3	40.8	40.4	37.5	34.7	30.0	32.8	32.0	Amidonnier, engrain	
	Mischel von Brotgetreide	52.9	53.6	51.9	42.4	61.9	54.5	57.4	54.2	43.7	51.0	47.2	Méteil de céréales panifiables	
and. Getreide f. Nahungsmittel	Hartweizen	-	-	-	-	-	-	-	46.2	34.0	36.8	56.7	Blé dur	Autr. Céréales à l'alimentation
	Buchweizen	-	-	-	19.1	19.2	21.4	40.7	40.1	29.1	33.9	24.6	Sarrasin	
	Hirse	25.0	22.0	21.1	21.1	42.3	40.1	47.2	33.4	32.2	30.7	29.5	Millet	
	Quinoa	-	-	-	-	-	-	24.6	25.0	24.1	18.7	20.0	Quinoa	
	Reis	-	-	50.0	48.0	48.0	48.5	48.5	48.4	38.8	38.9	38.9	Riz	
Futtergetreide	Futterweizen	64.3	72.4	67.0	47.3	72.0	63.2	65.0	70.3	54.3	61.4	58.1	Blé fourrager	Céréales fourragères
	Gerste	-	74.1	69.3	55.5	73.3	64.9	70.4	69.1	60.6	66.3	61.9	Orge	
	Wintergerste	58.8	74.8	70.0	56.4	74.0	65.7	71.0	69.9	61.4	67.0	62.6	Orge d'automne	
	Sommergerste	39.5	62.6	55.0	36.9	52.8	42.6	53.3	48.0	38.4	45.0	42.3	Orge de printemps	
	Hafer	47.4	53.1	49.0	42.2	53.8	50.7	56.3	49.7	38.4	44.8	44.9	Avoine	
	Triticale	55.1	61.0	60.5	41.5	60.3	59.5	60.2	62.9	50.8	60.1	55.4	Triticale	
	Mischel von Futtergetreide	39.2	64.1	57.6	42.3	52.8	50.4	50.7	53.1	37.9	44.9	42.2	Méteil de céréales fourragères	
	Körnermais [1]	100.9	107.8	89.9	101.9	106.9	97.8	109.0	110.0	78.6	98.9	98.9	Maïs grain	
	Körnersorghum	-	-	-	-	-	-	-	-	-	-	45.5	Sorgho à grains	

Durchschnittliche Erträge / Rendements moyens (dt/ha)

	Kultur	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023 *	Culture	
Eiweisspflanzen	Eiweisserbsen	34.0	37.4	34.5	19.8	34.9	32.1	36.2	28.5	19.4	35.8	26.9	Poids protéagineux	Protéagineux
	Ackerbohnen	25.7	29.0	26.5	26.2	29.1	26.1	31.6	20.2	21.3	26.0	20.1	Féverole	
	Lupinen	29.5	32.0	29.5	19.4	31.1	28.7	33.9	23.8	19.4	24.2	22.8	Lupins	
	Mischel Körnerleg. / Getreide	-	38.8	38.8	29.2	43.7	31.2	33.0	42.4	34.0	33.5	26.7	Mélanges oléagineux à grains / céréales	
	Linsen	-	9.6	9.8	9.7	11.6	11.0	10.5	9.8	9.7	11.7	13.7	Lentilles	
	Mischel Linsen/Getreide	-	-	-	-	-	-	-	-	-	-	20.0	Méteil de lentilles / céréales	
	Kichererbsen	-	-	-	-	-	-	-	-	-	-	11.8	Pois chiche	
Ölsaaten	Raps	32.6	40.5	37.1	34.3	38.0	34.0	29.9	34.8	30.8	36.7	32.5	Colza	Oléagineux
	Sonnenblumen	21.8	24.6	21.4	26.6	31.3	30.7	30.0	27.3	23.1	27.1	31.0	Tournesol	
	Soja	25.3	25.9	23.6	25.5	33.3	20.8	31.1	25.8	26.0	20.7	24.2	Soja	
	Leinsamen	23.1	26.4	24.5	21.1	25.2	19.6	21.3	24.6	19.4	23.1	22.8	Lin	
	Ölkürbis	6.7	6.8	7.1	6.9	7.2	7.1	7.3	7.0	6.7	8.8	7.5	Courges	
	Senf	-	-	-	-	-	14.5	14.4	14.0	13.5	14.0	14.0	Moutarde	
	Leindotter	-	-	-	21.0	20.1	20.5	17.5	22.3	14.5	11.9	12.5	Caméline	
	Mohn				20.8	19.7	11.1	10.8	12.3	8.1	9.5	9.4	Pavot	
	Saflor	-	-	-	21.9	23.1	21.2	21.8	20.4	19.2	8.0	7.5	Carthame	

* provisorisch // provisoire

Translations	
Culture /Kultur	Culture
Rendements moyens / Durchnittliche Erträge	Average yields
Céréales panifiables / Brotgetreide	Bread cereals

Autr. Céréales à l'alimentation / and. Getreide f. Nahungsmittel	Other cereals for food
Céréales fourrgères / Futtergetreide	Fodder cereals
Protéagineux/ Eiweisspflanzen	Protein crops
Oléagineux/ Olsaaten	Oilseeds
Blé/ Weizen	Wheat
Blé d'automne/ Winterweizen	Autumn wheat
Blé de printemps/ Sommerweizen	Spring wheat
Epeautre/ Dinkel	Spelt
Seigle/ Roggen	Rye
Amidonnier, engrain/ Emmer, Einkom	Starch, einkorn
Méteil de céréales panifiables/ Mischel von Brotgetreide	Bread cereal meslin
Blé dur/ Hartweizen	Hard wheat
Sarrasin/ Buchweizen	Buckwheat
Millet/ Hirse	Millet
Quinoa/ Quinoa	Quinoa
Riz/ Reis	Rice
Ble fourrager/ Futterweizen	Forage wheat
Orge/ Gerste	Barley
Orge d'automne/ Wintergerste	Autumn barley
Orge de printemps/ Sommergerste	Spring barley
Avoine/ Hafer	Oats
Triticale/ Triticale	Triticale
Méteil de céréales fourragères/ Mischel von Futtergetreide	Feed grain meslin
Mais grain/ Körnermais	Grain maize
Sorgho à grains/ Körersorghum	Grain sorghum
Poids protéagineux/ Eiweisserbsen	Protein weights
Féverole/ Ackerbohnen	Faba bean
Lupins/ Lupinen	Lupins
Mélanges oléagineux à grains – céréales/ Mischel Körnerleg. - Getreide	Oilseed - cereal mixtures
Lentilles/ Linsen	Lentils
Méteil de lentilles – céréales/ Mischel Linsen - Getreide	Lentil - cereal meslin
Pois chiche/ Kichererbsen	Chickpeas
Colza/ Raps	Rapeseed
Tournesol/ Sonnenblumen	Sunflower
Soja/ soja	Soy
Lin/ Leinsamen	Linen
Courges/ Olkürbis	Pumpkin
Moutarde/ Senf	Mustard
Cameline/ Leindotter	Camelina
Pavot/ Mohn	Poppy
Carthame/ Saflor	Safflower

Annex B : Main categories of surface area in 2022

Source: Federal Statistics Office (FSO) (2023). Relevé des structures agricoles

Principales catégories de surface, en 2022 — **T 7.2.2.2.2**

	Surface agricole utile	Terres ouvertes					Surface herbagère²)	Cultures pérennes³)	Autre surface agricole utile
	Total	Total	Céréales	Pommes de terre, betteraves	Graines et fruits oléagineux¹)	Autres terres ouvertes	Total	Total	Total
	ha	ha	ha	ha	ha	ha	ha	ha	ha
Total	**1 042 014**	**276 114**	**145 008**	**26 748**	**33 096**	**71 262**	**726 092**	**24 040**	**15 767**
Région lémanique	155 534	62 185	34 061	5 645	11 909	10 569	79 603	12 521	1 225
Vaud	107 990	53 370	29 334	5 280	9 965	8 791	48 959	4 789	872
Valais	36 271	2 104	1 034	187	89	793	27 814	6 217	136
Genève	11 273	6 711	3 693	177	1 855	986	2 830	1 515	217
Espace Mittelland	370 099	97 624	52 629	11 178	9 375	24 442	266 663	2 139	3 674
Berne	191 283	47 803	25 087	6 907	3 744	12 066	140 352	971	2 157
Fribourg	75 138	24 116	13 032	2 669	2 561	5 854	50 018	306	699
Soleure	31 273	10 480	5 748	837	1 191	2 703	20 432	166	195
Neuchâtel	31 662	4 356	2 628	179	598	952	26 526	659	121
Jura	40 744	10 869	6 135	586	1 281	2 866	29 335	38	503
Suisse du Nord-Ouest	81 353	32 780	17 937	2 006	3 475	9 362	45 955	1 568	1 050
Bâle-Ville	422	125	90	1	4	31	280	15	3
Bâle-Campagne	21 367	5 632	3 323	165	575	1 568	15 073	496	167
Argovie	59 564	27 023	14 523	1 840	2 897	7 764	30 602	1 057	881
Zurich	72 072	28 610	13 964	3 478	3 163	8 005	39 718	1 532	2 211
Suisse orientale	218 911	36 323	16 809	4 064	3 735	11 714	174 451	4 386	3 751
Glaris	6 965	98	21	1	5	72	6 769	2	95
Schaffhouse	16 027	10 221	5 526	1 194	1 750	1 752	5 157	474	175
Appenzell Rh. Ext.	11 949	34	12	0	1	21	11 671	10	234
Appenzell Rh. Int.	7 040	35	14	0	1	20	6 769	5	231
Saint-Gall	71 366	5 659	1 701	370	159	3 429	62 635	798	2 274
Grisons	56 379	2 099	1 025	89	64	921	53 247	718	316
Thurgovie	49 185	18 176	8 511	2 411	1 756	5 499	28 202	2 380	426
Suisse centrale	130 183	17 465	9 032	309	1 352	6 772	108 359	777	3 582
Lucerne	75 480	15 299	8 160	284	1 232	5 623	58 420	542	1 220
Uri	6 737	18	2	0	0	15	6 624	4	91
Schwyz	23 720	459	123	7	8	322	21 762	115	1 383
Obwald	7 768	43	7	0	0	37	7 614	6	104
Nidwald	5 907	31	2	1	0	28	5 772	4	100
Zoug	10 571	1 613	738	15	113	747	8 167	106	685
Tessin	13 861	1 128	575	69	86	398	11 343	1 116	274

1) Graines et fruits oléagineux: colza pour huile comestible, soja, tournesol pour huile comestible, courge à huile

2) Prairies artificielles, prairies naturelles et pâturages (sans les alpages)

3) Vignes et cultures fruitières

Source : OFS - Relevé des structures agricoles (STRU)

Translations	
Principales catégories de surface, en 2022	Main categories of surface area in 2022
Région Lémanique	Lemanic Region
Espace Mittelland	Cenntral Plateau
Suisse du Nord-Ouest	Northwestern Switzerland
Suisse Orientale	Eastern Switzerland

Suisse Centrale	Central Switzerland
Surface agricole utile	Useful agricultural area
Terres ouvertes	Open land
Surface herbagère	Grassland
Cultures pérennes	Perennial crops
Autres surfaces agricoles utile	Other agricultural land
Céréales	Cereals
Pommes de terre, betteraves	Potatoes, beet
Graines et fruits oléagineux	Oilseeds and oil fruits
Autres terres ouvertes	Other open land
1) Graines et fruits oléagineux : colza pour huile comestible, soja, tournesol pour huile comestible, courge à huile	1) Oilseeds and oleaginous fruits: rapeseed for edible oil, soya, sunflower for edible oil, pumpkin oil
2) Prairies artificielles, prairies naturelles et paturage (sans alpages)	2) Artificial grasslands, natural grasslands and pastures (excluding alpine pastures)
3) Vignes et cultures fruitières	3) Vineyards and fruit crops

Annex C : *Useful agricultural area (excluding alpine pastures) by canton and farming system*

Source : Federal Statistics Office (FSO) (2023b.). Relevé des structures agricoles en 2022, Le bio et les volailles toujours en hausse en 2022. https://dam-api.bfs.admin.ch/hub/api/dam/assets/24605848/master

T4 Surface agricole utile (sans les alpages) par canton et système agricole

	Total (ha)			Conventionnel (ha)			Biologique (ha)		
	2021	2022	Variation	2021	2022	Variation	2021	2022	Variation
Zurich	72 232	72 072	-160	60 750	60 171	-579	11 482	11 901	+419
Berne	191 191	191 283	+91	164 037	163 218	-819	27 154	28 065	+911
Lucerne	75 459	75 480	+22	66 601	66 477	-124	8 858	9 004	+146
Uri	6 731	6 737	+6	5 724	5 726	+2	1 006	1 011	+5
Schwytz	23 718	23 720	+1	20 779	20 660	-118	2 940	3 059	+120
Obwald	7 766	7 768	+2	5 024	4 971	-53	2 741	2 796	+55
Nidwald	5 906	5 907	+2	4 585	4 557	-28	1 320	1 350	+30
Glaris	6 928	6 965	+36	4 665	4 559	-106	2 264	2 406	+142
Zoug	10 605	10 571	-34	8 773	8 711	-62	1 833	1 860	+28
Fribourg	75 211	75 138	-73	68 474	68 249	-226	6 737	6 890	+153
Soleure	31 342	31 273	-69	25 937	25 576	-361	5 405	5 696	+291
Bâle-Ville	422	422	+0	252	253	+1	170	170	-1
Bâle-Campagne	21 423	21 367	-56	17 262	17 209	-53	4 161	4 158	-3
Schaffhouse	16 074	16 027	-47	14 808	14 761	-48	1 265	1 266	+1
Appenzell Rh.-Ext.	11 916	11 949	+34	9 028	8 972	-56	2 888	2 977	+90
Appenzell Rh.-Int.	7 057	7 040	-17	6 585	6 553	-33	472	488	+16
Saint-Gall	71 138	71 366	+228	60 936	60 996	+60	10 202	10 370	+168
Grisons	55 721	56 379	+658	18 842	18 970	+129	36 879	37 409	+529
Argovie	59 587	59 564	-24	52 540	52 086	-454	7 047	7 478	+430
Thurgovie	49 487	49 185	-303	40 968	40 394	-574	8 519	8 790	+271
Tessin	13 903	13 861	-41	10 443	10 347	-96	3 459	3 515	+55
Vaud	108 211	107 990	-221	95 572	94 903	-669	12 639	13 087	+448
Valais	36 345	36 271	-74	28 399	28 354	-46	7 946	7 917	-29
Neuchâtel	31 658	31 662	+4	27 915	27 805	-109	3 743	3 856	+113
Genève	11 227	11 273	+46	9 647	9 462	-185	1 580	1 811	+231
Jura	40 795	40 744	-51	32 061	31 740	-321	8 734	9 004	+271
Suisse	**1 042 053**	**1 042 014**	**- 39**	**860 609**	**855 679**	**-4 930**	**181 444**	**186 335**	**+4 891**

Translations	
Conventionnel	Conventional
Biologique	Organic (Bio)
Variation	Variation
For the first column, the Canton translations can be found at Annex O	

Annex D : *Major crops by farming system*

Source : Federal Statistics Office (FSO) (2023b.). Relevé des structures agricoles en 2022, Le bio et les volailles toujours en hausse en 2022. https://dam-api.bfs.admin.ch/hub/api/dam/assets/24605848/master

T5 Principales cultures selon le système agricole

	Total (ha)			Conventionnel (ha)			Biologique (ha)		
	2021	2022	Variation	2021	2022	Variation	2021	2022	Variation
Céréales	146 395	145 008	-1387	130 423	128 715	-1708	15 972	16 293	+321
Pommes de terre	10 711	10 749	+38	9 731	9 713	-18	980	1 036	+56
Betteraves sucrières	16 186	15 647	-539	15 988	15 444	-544	199	204	+5
Betteraves fourragères	371	351	-20	365	345	-20	6	6	-0
Maïs d´ensilage et maïs vert	45 667	46 636	+969	43 318	44 202	+884	2 349	2 435	+86
Colza	24 970	25 038	+68	24 510	24 609	+99	460	429	-31
Tabac	407	395	-12	402	393	-9	5	3	-2
Soja	2 240	2 895	+655	1 315	1 636	+321	925	1 259	+334
Tournesol	4 818	5 228	+410	4 304	4 648	+344	514	580	+66
Légumineuses	5 485	4 703	-782	3 911	3 148	-763	1 574	1 555	-19
Cultures maraîchères de plein champ	12 359	12 612	+253	9 436	9 503	+67	2 923	3 108	+185
Autres terres ouvertes	6 887	6 850	-37	5 596	5 517	-79	1 291	1 333	+42
Prairies artificielles	118 968	120 485	+1517	102 013	102 605	+592	16 956	17 880	+924
Prairies naturelles (sans alpages)	606 886	605 607	-1279	476 408	472 690	-3718	130 478	132 917	+2439
Vigne	13 537	13 325	-212	11 293	10 857	-436	2 244	2 468	+224
Cultures fruitières	6 950	6 841	-109	6 014	5 849	-165	935	992	+57
Autres cultures pérennes	3 798	3 875	+77	3 094	3 084	-10	704	791	+87
Cultures sous abri	737	774	+37	636	663	+27	101	112	+11
Autres SAU	14 680	14 993	+313	11 853	12 058	+205	2 827	2 935	+108
Total	**1 042 053**	**1 042 014**	**- 39**	**860 609**	**855 679**	**- 4 930**	**181 444**	**186 335**	**4 891**

Translations	
Céréales	Cereals
Pommes de terre	Potatoes
Bettraves sucrières	Sugar beets
Bettraves fourragüres	Fodder beets
Mais d’ensillage et mais vert	Silage maize and green maize
Colza	Rapeseed
Tabac	Soy
Soja	Tobacco
Tournesol	Sunflower
Légumineuses	Legumes
Cultures maraichères de plein champ	Field vegetables
Autres terres ouvertes	Other open land
Prairies artificielles	Artificial meadows
Prairies naturelles (sans alpage)	Natural meadows (without alpine pastures)
Vigne	Vineyards
Cultures fruitères	Fruit crops
Autres cultures pérennes	Other perennial crops
Cultures sous abri	Crops under cover
Autres SAU	Other UAA
Conventionnel	Conventional
Biologique	Organic (Bio)

***Annex E :** Agricultural explorations by canton and farming system*

Source : Federal Statistics Office (FSO) (2023b). Relevé des structures agricoles en 2022, Le bio et les volailles toujours en hausse en 2022. https://dam-api.bfs.admin.ch/hub/api/dam/assets/24605848/master

T1 Exploitations agricoles[1)] par canton et système agricole

	Total			Conventionnel			Biologique		
	2021	2022	Variation (%)	2021	2022	Variation (%)	2021	2022	Variation (%)
Zurich	3 149	3 078	-2,3	2 681	2 602	-2,9	468	476	+1,7
Berne	9 977	9 879	-1,0	8 556	8 437	-1,4	1 421	1 442	+1,5
Lucerne	4 402	4 357	-1,0	3 923	3 872	-1,3	479	485	+1,3
Uri	537	527	-1,9	478	469	-1,9	59	58	-1,7
Schwytz	1 509	1 486	-1,5	1 330	1 304	-2,0	179	182	+1,7
Obwald	598	595	-0,5	409	402	-1,7	189	193	+2,1
Nidwald	409	397	-2,9	329	317	-3,6	80	80	0,0
Glaris	337	340	+0,9	242	240	-0,8	95	100	+5,3
Zoug	545	541	-0,7	453	446	-1,5	92	95	+3,3
Fribourg	2 661	2 628	-1,2	2 428	2 387	-1,7	233	241	+3,4
Soleure	1 301	1 288	-1,0	1 115	1 096	-1,7	186	192	+3,2
Bâle-Ville	13	14	+7,7	10	11	+10,0	3	3	0,0
Bâle-Campagne	898	880	-2,0	732	713	-2,6	166	167	+0,6
Schaffhouse	515	504	-2,1	474	462	-2,5	41	42	+2,4
Appenzell Rh.-Ext.	672	669	-0,4	540	532	-1,5	132	137	+3,8
Appenzell Rh.-Int.	429	424	-1,2	401	395	-1,5	28	29	+3,6
Saint-Gall	3 787	3 761	-0,7	3 290	3 262	-0,9	497	499	+0,4
Grisons	2 179	2 164	-0,7	887	889	+0,2	1 292	1 275	-1,3
Argovie	3 011	2 976	-1,2	2 710	2 660	-1,8	301	316	+5,0
Thurgovie	2 483	2 464	-0,8	2 101	2 073	-1,3	382	391	+2,4
Tessin	1 059	1 031	-2,6	885	857	-3,2	174	174	0,0
Vaud	3 602	3 571	-0,9	3 201	3 142	-1,8	401	429	+7,0
Valais	2 654	2 628	-1,0	2 260	2 221	-1,7	394	407	+3,3
Neuchâtel	754	756	+0,3	638	631	-1,1	116	125	+7,8
Genève	388	393	+1,3	321	318	-0,9	67	75	+11,9
Jura	995	993	-0,2	800	787	-1,6	195	206	+5,6
Suisse	**48 864**	**48 344**	**-1,1**	**41 194**	**40 525**	-1,6	**7 670**	**7 819**	**+1,9**

Translations	
Conventionnel	Conventional
Biologique	Organic (Bio)
Variation (%)	Variation (%)
See "Annex O" for Canton translation	

Annex F : *Usable production of cereals, oilseeds and protein crops (t)*

Source : Swissgranum (2023h.). Statistique, production indigène. URL : https://www.swissgranum.ch/fileadmin/user_upload/swiss-granum/dokumente/Marktzahlen/Inlandproduktion/2023-11-29_Verwendbare_Produktion_01.pdf

Verwendbare Produktion Getreide, Ölsaaten und Eiweisspflanzen (t)
Production utilisable de céréales, d'oléagineux et de protéagineux (t)

Produkt	2016	2017	2018	2019	2020	2021	2022	2023	Produit
Raps	71'900	77'612	77'478	67'843	88'083	77'030	92'059	82'291	Colza
davon Bio	-	-	-	-	520	453	600	656	dont bio
davon HOLL-Raps (inkl. Bio)	17'650	15'000	25'300	19'800	30'035	26'967	30'839	26'007	dont colza HOLL (y.c. bio)
Sonnenblumen	13'000	16'449	16'513	17'700	12'293	11'142	14'225	19'878	Tournesol
davon Bio	462	562	450	400	586	683	1'115	1'667	dont bio
davon High Oleic (inkl. Bio)	8'784	9'074	10'011	11'331	7'151	7'353	8'675		dont high oleic (y.c. bio)
Sojabohnen	4'500	5'642	3'740	5'350	5'247	5'832	6'175	7'534	Soja
davon Bio	-	-	-	-	1'409	1'988	2'213	2'487	dont bio
davon Speisezwecke (bio)	-	-	-	-	729	1'091	1'400		dont pour l'alimentation humaine (bio)
Andere (z.B. Leinsamen, Ölkürbis) [7]	352	492	494	486	457	551	747	732	Autres (p.ex. lin, courges) [7]
davon Bio	-	-	-	-	196	260	341	328	dont bio
Ölsaaten	**89'752**	**100'195**	**98'225**	**91'379**	**106'080**	**94'555**	**113'206**	**110'435**	**Oléagineux**
davon Bio	**-**	**-**	**-**	**-**	**2'711**	**3'384**	**4'269**	**5'138**	**dont bio**
Körnerfrüchte (inkl. Saatgut)	**845'912**	**1'096'726**	**997'339**	**1'042'721**	**1'131'864**	**889'255**	**993'133**	**948'348**	**Céréales et oléo-protéagineux (y.c. semences)**
davon Bio	**-**	**-**	**-**	**-**	**77'182**	**65'053**	**74'049**	**78'019**	**dont bio**

* provisorisch // provisoire

Translations	
Production utilisable de céréales, d'oléagineux et de protégineux (t) / Vewendbare Production Getreide, ölsaaten und Eiweisspflanzen (t)	Usable production of cereals, oilseeds and protein crops (t)
Produit/Produkt	Product
Colza/Raps	Rapeseed
Dont bio/davon Bio	Of which organic
Tournesol/Sonnenblumen	Sunflower
Soja/sojabohnen	Soy
Dont pour l'alimentation humaine (bioo)/davon Speisezwercke (bio)	Of which for human consumption (organic)
Autres (p.ex. lin, courges)/Andere (z.B. Leinsamen, ölkurbis)	Others (e.g. linseed, pumpkins)
Olöagineux/ölsaaten	Oilseeds
Céréales et oléo-protéagineux (y.c. semences)/Körnerfrüchte (inkl.Saatgut)	Cereals and oilseeds (incl. seeds)

Annex G : BioSuisse producition numbers in 2022

Source : BioSuisse (2022). Bio en chiffres 2022. URL : https://www.bio-suisse.ch/dam/jcr:8016b59b-1e29-4b56-ac97-fe10940a78d9/BiZ22_fr_230329.pdf

Canal de distribution	2016 chiffre d'affaires en millions de CHF	2017 chiffre d'affaires en millions de CHF	2018 chiffre d'affaires en millions de CHF	2019 chiffre d'affaires en millions de CHF	2020 chiffre d'affaires en millions de CHF	2021 chiffre d'affaires en millions de CHF	2022 chiffre d'affaires en millions de CHF	2022 vs 2021	2022 PM en %
Coop [a]	1'118	1'199	1'394	1'428	1'628	1'651	1'592	–3,6	41,1
Migros [b]	808	889	990	1'047	1'211	1'249	1'260	0,9	32,5
Autres commerçants [c]	101	112	149	198	294	350	357	2,0	9,2
Commerce spéc. bio [d]	272	275	287	303	370	371	317	–14,5	8,2
Grands magasins et commerce spéc. [e]	74	89	87	94	134	136	139	2,5	3,6
Vente directe [f]	132	144	160	169	220	248	207	–16,5	5,3
Total marché bio	**2'505**	**2'707**	**3'066**	**3'239**	**3'856**	**4'005**	**3'873**	**-3,3**	**100,0**

a: Coop, en général; **b:** Migros, sauf en ligne; **c:** Volg, Spar, discounters, boutiques en ligne; **d:** magasins bio;
e: Manor, Globus, estimation boulangeries, boucheries, etc.; **f:** magasins de ferme

Translation	
Canal de distribution	Distribution channel
Autres commercants	Other retailers
Commerce spéc.bio	Spec.organic
Grand magasins et commerce spéc.	Department stores and spec. trade
Vente directe	Direct sales
Total marché bio	Total organic market
Chiffre d'affaire en millions de CHF	Sales in million CHF
Sauf en ligne	Except online
Boutiques en ligne	Online stores
Magasins bio	Organic stores
Estimation boulangeries, boucheries	Estimated bakeries, butchers
Magasins de ferme	Farm stores

Annex H : *Production area (ha) per canton per type of production in 2022*

Source: Federal Statistics Office (FSO) (2023). Relevé des structures agricoles

Type of production	Canton	ha 2022	Type of production	Canton	ha 2022
Bio (organic)	VD	355	Non-Bio (conventional)	VD	624
Bio (organic)	JU	134	Non-Bio (conventional)	JU	9
Bio (organic)	GE	132	Non-Bio (conventional)	GE	356
Bio (organic)	BE	115	Non-Bio (conventional)	BE	70
Bio (organic)	TG	106	Non-Bio (conventional)	TG	38
Bio (organic)	ZH	99	Non-Bio (conventional)	ZH	229
Bio (organic)	SO	69	Non-Bio (conventional)	SO	67
Bio (organic)	AG	59	Non-Bio (conventional)	AG	47
Bio (organic)	FR	57	Non-Bio (conventional)	FR	58
Bio (organic)	TI	49	Non-Bio (conventional)	TI	20
Bio (organic)	SH	37	Non-Bio (conventional)	SH	40
Bio (organic)	BL	22	Non-Bio (conventional)	BL	21
Bio (organic)	SG	9	Non-Bio (conventional)	SG	17
Bio (organic)	NE	7	Non-Bio (conventional)	NE	21
Bio (organic)	VS	6	Non-Bio (conventional)	VS	9
Bio (organic)	LU	3	Non-Bio (conventional)	LU	10
Bio (organic)	ZG	-	Non-Bio (conventional)	ZG	1
Bio (organic)	GR	-	Non-Bio (conventional)	GR	0

Annex I : *Number of soybean producers and corresponding soybean cultivation area (ha) for each Canton.*

Source: Federal Statistics Office (FSO) (2023). Relevé des structures agricoles
See “Annex O” for Cannton Abbreviations translation/meaning

Canton	Number of soybean producers	Soybean cultivated area in ha
ZH	149	328.03
BE	91	184.6918
LU	4	13.344
UR	0	0
SZ	0	0
OW	0	0
NW	0	0
GL	0	0
ZG	X	1.4016
FR	36	114.656
SO	47	135.7394
BS	0	0
BL	20	42.6951
SH	28	76.9263
AR	0	0
AI	0	0
SG	12	25.95
GR	X	0.25
AG	54	105.86
TG	68	143.9862
TI	15	68.8839
VD	279	979.2403
VS	6	14.1118
NE	8	27.57
GE	99	487.93
JU	35	143.73
Total	**953**	**2894.9964**

Annex L : *Farm Size (Total UAA) and Number of Soybean Producers, with Associated Soybean Cultivated Area (ha)*

Source: Federal Statistics Office (FSO) (2023). Relevé des structures agricoles

Soybean in Switzerland in 2022		
Total UAA size	*Number of soybean producers*	*Soybean area in ha*
Less than 1 ha	0	0
1 to less than 3 ha	0	0
3 to less than 5 ha	1	0.91
5 to less than 10 ha	24	27.8715
10 to less than 20 ha	151	253.4327
20 to less than 30 ha	212	473.9849
30 to less than 50 ha	311	937.6422
50 ha and more	254	1201.1551
Total	**953**	**2894.9964**

Annex M : *Soybean area (ha) from 2000 - 2022*

Source: Federal Statistics Office (FSO) (2023). Relevé des structures agricoles

Soybean area in hectares, 2000 to 2022

Canton	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
VD	154	38	349	563	539	267	204	142	193	253	240	221	255	315	309	327	308	319	353	411	512	612	979
GE	23	5	103	217	181	90	62	88	75	109	139	164	152	241	279	317	356	356	389	388	412	405	488
ZH	171	91	310	544	577	326	239	215	205	192	176	195	183	240	254	277	316	325	330	285	299	317	328
BE	27	15	47	53	60	35	25	22	15	15	23	31	18	37	39	45	58	53	65	79	120	146	185
TG	27	17	89	136	145	91	61	48	34	36	36	34	32	55	78	95	100	97	104	79	107	99	144
JU	23	5	24	41	26	15	12	9	8	19	23	17	21	22	25	51	47	32	45	40	86	108	144
SO	53	26	78	110	93	52	56	41	45	42	40	44	47	56	62	62	51	53	58	64	101	131	136
FR	52	17	51	89	79	41	29	23	25	24	20	22	19	23	35	37	37	38	37	35	64	97	115
AG	73	14	138	170	180	104	77	75	61	59	58	83	57	64	60	100	80	91	97	67	101	104	106
SH	23	6	61	105	108	64	41	35	31	47	46	38	39	57	69	85	84	65	60	50	48	61	77
TI	89	46	102	168	168	172	150	140	141	160	142	129	123	135	124	117	110	98	111	104	57	59	69
BL	78	28	96	131	128	82	65	66	74	63	62	61	70	95	79	111	106	75	61	42	46	36	43
NE	30	17	28	38	41	19	14	16	21	24	26	23	19	19	23	35	41	32	30	31	26	16	28
SG	97	57	90	114	128	123	94	56	36	30	26	16	12	15	16	19	24	15	11	4	14	16	26
VS	25	24	36	37	31	29	17	21	22	24	21	22	22	18	20	13	20	17	22	26	19	12	14
LU	6		3	8	10	6	6	0	4	9	9	11	15	16	24	24	22	24	18	11	15	15	13
ZG	1	1	2	3	2	3	1	1	1	2	1	1	1	1	1	2	1	2	4			2	1
GR	0								6						1	3	5	3	3			6	0
BS												10							6	4	3		
Tot	952	407	1'607	2'527	2'496	1'518	1'153	998	997	1'108	1'087	1'123	1'085	1'407	1'496	1'719	1'765	1'695	1'801	1'721	2'032	2'240	2'895

Quelle: BFS

See "Annex O" for Cannton Abbreviations translation/meaning

Annex N : *Number of soybean producers and soybean area (ha) according to production method.*

Source: Federal Statistics Office (FSO) (2023). Relevé des structures agricoles

Soybean in Switzerland 2022		
	Number of soybean producers	Soybean area in ha
Conventional	564	1636.3453
Organic	389	1258.6511

Annex O : *Canton Translations*

<u>Canton Translations</u>

Zurich (ZH)	Zürich (ZH)
Berne (BE)	Bern (BE)
Lucerne (LU)	Luzern (LU)
Uri (UR)	Uri (UR)
Schwyz (SZ)	Schwyz (SZ)
Obwald (OW)	Obwalden (OW)
Nidwald (NW)	Nidwalden (NW)
Glaris (GL)	Glarus (GL)
Zoug (ZG)	Zug (ZG)
Fribourg (FR)	Freiburg / Fribourg (FR)
Soleure (SO)	Solothurn (SO)
Bale-Ville (BS)	Basel Stadt (BS)
Bale-Campagne (BL)	Basel Land (BL)
Schaffhouse (SH)	Schaffhausen (SH)
Appenzell Rh.-Ext. (AR)	Appenzell Ausserrhoden (AR)
Appenzell Rh.-Int. (AI)	Appenzell Innerrhoden (AI)
Saint-Gall (SG)	Sankt Gallen (SG)
Grisons (GR)	Graubünden (GR)
Argovie (AG)	Aargau (AG)
Thurgovie (TG)	Thurgau (TG)
Tessin (TTI)	Ticino (TI)
Vaud (VD)	Vaud (VD)
Valais (VS)	Valais / Wallis (VS)
Neuchâtel (NE)	Neuchâtel (NE)
Genève (GE)	Geneva (GE)
Jura (JU)	Jura (JU)

Annex P : *Expert interviews Guidelines*

Name and location: -

Introduction: Could you introduce yourself and give an overview of what you do?

A. SOYBEAN PRODUCTION

1) Where is soy grown in Switzerland?

2) How long has soy been grown in Switzerland?

3) Why is soybean grown in Switzerland?

4) How many soybean growers are there?

   4.1) What has been the evolution of the number of soybean producers?

   4.2) How many farmers produce organic and conventional soybeans?

   4.3) What types of farmers (small or large) produce soybeans in Switzerland?

5) What are the main uses of soy grown in Switzerland?

6) How does soybean production in Switzerland compare with other crops in terms of surface area, yield and economic importance?

   6.1) What were the previous crops grown on the land where soybeans are currently grown?

7) What is the current demand for Swiss soybeans in the market?

8) How does local soybean production contribute to national food security and sustainability?

A.1 CHALLENGES IN SOYBEAN PRODUCTION

1) What kind of challenges are encountered with soybean cultivation?

A.2 OPPORTUNITIES IN SOYBEAN PRODUCTION

1) What opportunities are associated with soybean production?

2) Can you share some success stories or best practices from soybean growers?

A.3 SUPPORT / COLLABORATION

1) What strategies or resources are available to support farmers who grow soybeans?

2) What types of collaborations or partnerships exist between government, research institutions and local farmers in Switzerland, to support and promote local soy production?

2.1) What influence do these collaborations have on the development of a local food system?

A.4 LOCAL PRODUCTION

1) What measures are taken to ensure the traceability and quality of Swiss soybeans?

2) What regulations, initiatives or standards are in place for local sustainable soybean cultivation in Switzerland?

2.1) What techniques or technologies are used (or planned) to improve local soybean production and address sustainability concerns?

3) In Switzerland, what is the possibility of increasing local cultivation and reducing imports?

B. SOYBEAN BIO PRODUCTION

1) What factors contribute to the decision to engage in organic soybean production in Switzerland?

1.1) How suitable is Switzerland's climate for organic soybean production?

2) What are the main uses of organic soybeans in Switzerland?

3) What are the challenges involved in the transition from conventional to organic soybean production?

4) What strategies or resources are available to support farmers who decide to grow organic soybeans?

5) How can organic/organic approaches to soybean growing contribute to sustainable, environmentally-friendly farming practices?

B.1 BIO REGULATIONS

1) What regulations, initiatives or standards are in place to ensure sustainable and/or organic soybean cultivation in Switzerland?

2) What criteria must farmers meet to be considered organic soybean producers?

3) What kind of collaboration or partnership exists between the government, research institutes and local farmers in Switzerland to support and promote local organic soy production?

4) What regulations, initiatives or standards are in place for local sustainable, organic soybean cultivation in Switzerland?

Annex Q : *Interview guideline for tofu processor (TiGusto)*

Name and location: -

Introduction: Could you introduce yourself and give an overview of what you do?

A. COMPANY HISTORY/VISION

1) What are the reasons that influenced your decision to start processing soybeans

    1.1) How long have you been doing it?

    1.2) How much tofu do you produce?

    1.3) What are the reasons behind the choose to use local organic soybeans for your tofu?

2) What are the current market opportunities and demand for human food soybeans and/or tofu?

    2.1) What kinds of developments have you noticed in the demand for soybeans/tofu in Switzerland?

3) What is your company's vision regarding sustainable and local food systems?

4) Why should Switzerland produce soybeans?

B. SUPPLIERS

1) What are the main soy suppliers you use for tofu production?

2) What criteria do you use to assess the sustainability of your soy suppliers?

3) How does your company support local soybean producers in Switzerland?

C. PROCESSING

1) Ho do you process the soybean?

2) What are some challenges or opportunities related to tofu production?

    2.1) Do you have support from the government?

3) What have been the main benefits or advantages you have experienced from soybean processing / tofu production?

4) What agricultural policies or regulations impact your soybean processing operations?

5) How does your production process aim to reduce waste and maximize resource utilization?

D. TOFU PROMOTION

1) What are the main obstacles you have encountered in promoting the production and consumption of local soy-based tofu in the Swiss market?

2) How do you involve consumers in choosing sustainable and local foods?

3) How do you perceive the future prospects and opportunities for tofu production in Switzerland?

4) What policies or incentives would be helpful to further support soy transformation?

Annex R : *Farmers interview guideline*

Name and location: -

Introduction: Could you introduce yourself and give an overview of what you do?

A. SOYBEAN PRODUCTION CHOISES

1) Why do you cultivate soybean?

1.1) How long have you been growing soybeans?

1.2) What are the main uses of your soybean crop?

1.3) How did your production evolved in the years?

2) Which management practices do you implement in your soybean crops?

2.1) Which soybean varieties do you grow and why?

2.2) What specific pest/disease/weed control strategies have you employed?

3) What were the previous crops grown on the land where soybeans are currently grown?

4) Why did you choose an organic production over a conventional one (or vice versa)?

4.1) What sustainable or organic practices have you implemented in your soybean cultivation?

4.2) What benefits have you observed as a result of these practices?

4.3) What has been the impact of these practices on the yield and quality of the crop?

4.4) what are challenges of organic/conventional soybean production in Switzerland?

B. CHALLENGES & OPPORTUNITIES IN SOYBEAN CULTIVATION

1) What advantages or benefits (if any) have you found in cultivating soybean?

2) What challenges have you encountered in soybean cultivation?

2.1) how have you overcome them?

2.2) What climatic or environmental factors pose challenges to soybean cultivation?

3) What are the challenges/opportunities related to costs and profitability of local soybean production?

C. SOYBEAN MARKET OPPORTUNITIES

1) How do you see the future prospects and opportunities for soybean cultivation in Switzerland?

2) Which changes have you noticed in demand or market conditions for soybeans in Switzerland?

2.1) What are the cost and profitability challenges of local soybean production in Switzerland?

3) What cooperation do you have with Swiss retailers? (supermarkets, boutiques,etc.)

D. EXTERNAL INFLUENCES ON SOYBEAN CULTIVATION

1) What resources, organizations, or networks that help you manage the crop?

2) What specific agricultural policies or regulations in Switzerland impact or influence your soybean farming activities?

3) In which way has Biosuisse's new decision on ruminant feed influenced you?

4) Based on your experience, what advice or recommendations would you give to other people interested in soybean transformation?

__Annex S :__ Code System output with MAXQDA 2024.

Codes	N°	Subcodes	N°
Why to produce soybeans in CH	65	New propice area with climate change	7
		Increasingly favourable weather conditions	5
		Potential for commercialization	16
		CH can offer a better quality	5
		To have a local protein	8
		Local seeds availability	1
		Crop rotations	6
		Diversification	4
		Label reasons	5
		Economic profitability	4
		Farmers personal choice	4
Uses of soybeans	35	For oil	4
		for Human food	16
		For animal fodder	15
Soybean production evolution	9	High demand during COVID	4
		Soybean is under quota	5
Climate factors influencing soybean cultivation	32	High temperatures are good for soybeans	6
		Climate change brings new insects	3
		Too much rain hurts soybeans	6
		Droughts hurt soybeans cultivations	13
		Currently no need for irrigation	4
Soybeans Varieties in CH	17	Collector centres choice	4
		Precocity	3
		Quality	2
		Weeds competitiveness	1
		Yield quantity	3
		Too less	3
		Need for fodder verities	1
Helps in soybean cultivation	30	Cantonal consultation	1
		Any good help	7
		Contributions and direct payments	18
		Help is between farmers	4
Challenges of soybean organic cultivation	103	Many working hours	13
		Workforce constraints	13

		Expensive manual weeding	10
		High disel costs and machines consumption	10
		No advantages from the cultivation	3
		Less yield than conventional farming	6
		Difficult culture in bio	8
		Constant quality is a must	15
		Rules too strict in organic farming	10
		Expensive maintenance	15
Challenges of soybean cultivation	190	Weeds are very difficult to manage	42
		Difficult to predict the correct timing	22
		Limited processing/harvesting facilities	12
		Earnings are higher for supermarkets	9
		Cheaper imports	24
		Machines have high costs	10
		Conventional no attractive	15
		Difficult to find seeds in CH	2
		Risk of impurities, molds etc in soybean	1
		Yelds decrese	3
		Not weed competitive plant	7
		Not many allowed herbicides	3
		Difficult threshing	2
		Custom duties	4
		Climate problems	23
		Fodder soybean lower the food security	1
		Limited UAA	10
Opportunities Soybean cultivation	155	Brings less soil erosion	1
		No need for inputs	9
		Market Opportunities	11
		It's the Cheapest source of high protein	2
		There are Not many crop problems	20
		Favourable climatic conditions	12
		Good crop for rotation	25
		Soybeans bring better soil fertility	28
		Surplus for those who do not have animals	3

		Fodder soybean flexibility	5
		Local has better quality	5
		Less dependent on imports	3
		Conventional no need for perfection	2
		Ability to do more	11
		Financial incentives	18
Opportunities organic soybean cultivation	101	There is a high demand	40
		The prices are higher	46
		Increased Fodder demand	10
		Additional contributions	3
		High request for tofu	2
Tofu production opportunities	27	Waste product recovery	2
		Local opportunities	5
		Change in food habits	8
		Industrial has less quality	2
		Food security	4
		Local sustainability	6
Problems tofu production	21	Too strict rules	4
		No efficient collection	1
		No support from the State	7
		High machine costs	2
		People acceptance	4
		Concurrential imports	3
Considerations/recommendations for soybean cultivation	14	Investing with others	1
		Relay cropping to increase production	2
		Sow hyper dense	1
		Make false sowing	2
		Delaying sowing in organic soybean cultivation	1
		Better to make soybeans for human food	1
		Do several mechanical weeding for organic	1
		Start with little surface	5
Solutions to challenges in soybean cultivation	5	Add parts on old machines	2
		Employment of third parties	2
		Cooperation with other farmers	1
Labels	60	Demeter	3
		Suisse Garantie	10
		BioSuisse	21
		Swiss labels promote traceability	16
		IP Suisse	10
Rules for cultivation	20	PER	12
		Production contracts	8

Type of farmers	25	Family	12
		Surfaces	13
Why the farmer doesn't produce bio	14	All the cultivation must be bio	4
		The soybeans must be perfect	2
		No consumer support	5
		Too expensive product for consumer	3
Why the farmer does Bio	12	For Environmental and Soil Health Benefits	6
		For Ethical Values	4
		For economic feasibility and profitability	2
Crops cultivated before soybeans	17	poids	1
		Rapseed	2
		Carrot, potatoes, salad	1
		Cereals	7
		Sunflower	1
		Wheat	2
		Maize	3
Good Crop Management Practices	83	Choose the correct plot	11
		Sowing timing	10
		Varieties selection	17
		Cultural rotation	12
		Strapping	6
		False sowing	3
		Optical sorting	4
		Inoculation	20
Methods and uses of cultivated soybeans	140	Conventional	47
		Bio	60
		Tofu	2
		Soybean oil	6
		Fodder soybean	19
		Seeds	6
Technologies/machines for soybeans cultivation	12	Optical hoes	3
		Sensor hoe	1
		Allows to avoid chemical weeding	1
		No-tillage	4
		Tillage	1
		Intercropping does not work	1
		Weeds not necessarily bad	1
Various	87	3.5% biodiversity promotion	12
		Needs for new machines	1
		Expensive inputs in agriculture	16
		Office utility	16
		Offices interests	7

		Food safety	14
		Transformers	3
		Help from CH for farmers	16
		Soy introduction	2
Biosuisse decision influence	13	Lower growth in animals	1
		Repercussion on meat quality	2
		Ethical reasons	2
		Marketing	1
		Higher production in bio	7

Personal declaration

I hereby declare that the submitted Thesis is the result of my own, independent work. All external sources are explicitly acknowledged in the Thesis.

Andrea Martac

30.04.24, Zürich