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# **A Sociotechnical Analysis in Market Gardening Systems**

**Understanding the barriers and levers to agroecological  
soil management in Provence.**

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# 1. Introduction

The transdisciplinary research project INTERLUDE to which my internship has contributed began in 2020 and will last over a period of 36 months; it aims at building territorial approaches to reduce phytosanitary product use in vegetable production systems.

This project is divided into four case studies: two in the south of France and two in Martinique, a French region in the Caribbean Sea. These case studies all focus on the reorganization of food system stakeholders at a territorial scale and aim to promote the adoption of agroecological practices and the reduction of pesticide use.

*Ecodéveloppement*, the research unit where I carried out my internship in Avignon is mainly centered around sustainable agricultural transition through systemic and territorial approaches. Its work focuses on horticultural systems, vegetable production, fruit production as well as diversified systems including plant and animal productions. In this study, an emphasis is placed upon soil health in vegetable farms in *Provence-Alpes-Côte-d'Azur* (PACA), and more specifically on the diversification of crop rotations and on the use of organic amendments in vegetable production systems to increase soil health.

Today, the vegetable sector must reconcile multiple challenges: ensuring consumer's health and food safety, promoting sustainability of farms and reducing the environmental impacts from the production until it reaches the consumers. To meet market requirements vegetable producers are pushed to reduce their chemical inputs while maintaining their productivity and income.

The south of France is a major production area for vegetables with very input intensive specialized systems. For instance, the treatment frequency index between 2016 and 2018 was of 8 for salad and of 14 for tomato in the PACA region (AGRESTE, 2020; Ministère en charge de l'agriculture, 2016). This index was developed in 2006 to measure phytosanitary product application in farms. It is calculated annually to evaluate the number of product doses applied per hectare and helps the farmer follow the evolution of his pesticide, fungicide, and herbicide use.

In the *Provence Alpes Côte d'Azur* region, many vegetable farmers face telluric pest and disease problems such as cryptogamic diseases or parasites. For several years, vegetable farmers in the region have been confronted with problems of soil fatigue resulting from the intensification of practices (repeated mechanical interventions, use of nitrogen fertilization, soil disinfection, etc.). In addition, the progressive banning of chemical disinfection products (Gard et al., 2018) has caused a reemergence of nematodes, pathogens and telluric pests along with a decrease in yields.

A well-known pathogen called *fusarium oxysporum f.sp latucae* usually affecting tomatoes, was spotted for the first time on lettuce in the region in 2015 and is now spreading, causing great damage for producers (Garnodier et al., 2019). Root knot nematodes also represent an important soil health issue in the region. In 2009, root knot nematode infestation was the most prevalent problem with 40% of farms in Provence losing up to 100% of their yields due to this parasite (Djian-Caporalino, 2010 as cited by Boulestreau, 2021, p. 24). Today, there are few available chemical treatments for these telluric pests and with the increasing awareness on the risks of phytosanitary product application, alternative solutions must be implemented.

Thankfully, several agronomic levers have been developed to reduce the use of chemical inputs while controlling soil pests and diseases. Among these levers are crop diversification and the use of organic amendments which have been highlighted by previous research as efficient ways to restore soil ecosystem balance and increase crop resistance towards telluric pests and pathogens.

Despite these existing alternatives, producers in the region continue use phytosanitary products to deal with these issues. To understand why vegetable farmers are not reducing their chemical input use, we have analyzed the sociotechnical system at a territorial scale. More specifically we took interest in the obstacles responsible for this slow evolution and the factors which could facilitate the implementation of agroecological practices in Provence. According to a review from Wezel et al. agroecological practices can

be defined as “agricultural practices aiming to produce significant amounts of food, which valorise in the best way ecological processes and ecosystem services in integrating them as fundamental elements in the development of the practices.” (Wezel et al., 2014)

The failure of the *Ecophyto* plan is a reminder of why it is important to have a transdisciplinary and multi-stakeholder approach. The agroecological approach takes into account the whole system and not only the farm scale (Wezel et al., 2016). Innovation and change must happen on every level through the redesigning of the system on a somewhat local scale. The territorial scale is a reasonable scale to focus on, since it takes into account the values and traditions (Duru et al., 2015), but also allows for a multi-stakeholder approach through the understanding of interactions between local actors from the food system. This promotes collective action through the combination of different interests to create meaningful change. The INTERLUDE transdisciplinary research project aims to promote this approach through the reorganization of territorial stakeholders involved in the food system to reduce pesticide use.

To gain a comprehensive vision of the system, a sociotechnical analysis was carried out using a new framework developed by researchers at INRAE. This methodological framework was designed to facilitate the application of sociotechnical analyses on a territorial scale and was put to the test in this project.

To better apprehend the agricultural intensification process in France and to provide information about the vegetable production systems in Provence, the socioeconomic context will be established in the next section. The different stakeholders’ roles, their interactions and how this affect crop diversification and organic matter use will be explored. Preliminary research pointed out the fact that in most cases, the largest obstacles were related to the organization of stakeholders in the system and their interactions with farmers. Understanding the sociotechnical system and identifying potential lock-ins therefore represents an important step towards the conception of innovative agroecosystems. This work is the first step to finding territorial innovations to sustainable vegetable production which is the end goal of the overarching research project INTERLUDE. Understanding the sociotechnical system and identifying its main stakeholders is important in order to identify constraints and opportunities to innovation design and a step towards uncovering collective solutions.

## 2. Socioeconomic context of the study

### 2.1 Historical Context

Following the Second World War, agricultural models shifted from traditional animal-crop systems to more specialized and intensive models. This was one of the consequences of the Marshall Plan which allowed massive mechanization investments. At the same time, towards the end of the 1950s supermarkets emerged in France and developed rapidly until they became the main outlet for fruits and vegetables (Durbiano, 1996; Ritzenthaler, 2016). With the changes surrounding distribution channels and with the creation of the European Common Agricultural Policy in 1962, new quality norms on fruits and vegetables were introduced. These norms were meant to facilitate exchanges in Europe through the definition of calibers, sanitary requirements, and a labeling system (CTIFL, 2014). In a context of mass production and intensification of agricultural systems these norms created stricter prerequisites around visual aspects and contributed to the simplification of international exchanges (AND International, 2010).

Population growth and urbanization of society had a great impact on agriculture at the time. The beginning of mass consumerism and the expansion of cities all contributed to production intensification and to the conventional agricultural model we know today. The centralization of retailing companies in the 1980s further accentuated the influence of supermarkets on the horticultural sector. They became key players in the marketing chain, imposing their own rules over their suppliers and exacerbating competition between production basins in France (Durbiano, 1996).

In the south of France this resulted in the grouping of producers in big cooperatives and in the specialization of larger producers, some varieties were left behind and farming practices readjusted to fit supermarket requirements (Durbiano, 1996).

## 2.2 Characteristics of vegetable production systems in the PACA region

The *Provence-Alpes-Côte-d'Azur* region or PACA disposes of a diversity of agricultural systems compared to other French regions. Over the world it is well-known for its lavender, wine, and olives, but it is also a big vegetable production area (7<sup>th</sup> region for vegetable production in France)(Olivier, 2020). Wine production is very present in the *Var* and *Vaucluse* while fruit and vegetable production are mainly concentrated in the *Vaucluse* and *Bouches-du-Rhone* departments. For the most part animal husbandry is located in the Alps with a majority of sheep farms (AGRESTE, 2021).

Market gardening represents 13,300 ha out of the 581,100 ha of cultivated land in the region and is the third most developed sector behind viticulture and arboriculture. In 2019, fresh vegetables represented 436 million €, i.e 13% of the total regional agricultural production revenues (AGRESTE, 2021). In 2010 the PACA region accounted for 11% (3,390 out of 30,860) of all vegetable farms in the country (AGRESTE, 2013). Organic vegetable production is developing at a steady rate in the region with a 20% surface increase in 2019. For the same year the share of organic vegetable surfaces was of 17,8% with 2 192 ha versus 7,8% on average in France (34 668 ha) (Olivier, 2020).

The Mediterranean climate allows vegetable farmers to cultivate a large range of vegetable species all year long with annual average temperature of 15°C and average precipitations reaching 53 mm annually (Timeanddate, 2021).

PACA is the main production region in France for lettuce (27% of the national production), and also for zucchini (26% of the national production)<sup>1</sup>and garlic (9% of the national production) and second production region for tomato (23% of the national production), eggplant (22% of the national production) and pepper (19% of the national production) also known as *ratatouille* vegetables (AGRESTE, 2021; Centre technique interprofessionnel des fruits et légumes (France), 2021).

In the 1960s, greenhouses and plastic shelters started to develop in the *Bouches-du-Rhône*, allowing farmers to extend growing seasons and to increase their revenue. They were also a way to protect crops from strong winds (Mistral), and to gain better control over different parameters (Chambre d'Agriculture Provence Alpes Côte d'Azur, 2018; Richel, 2021). Nowadays, 72% of vegetable farmers in PACA cultivate vegetables in greenhouses and shelters (AGRESTE, 2014). Many sheltered systems cultivate off ground, which are out of scope for this study but in this work we focus on crops cultivated in the soil.

The average age of vegetable farmers was 48 years in 2010, with 78% over the age of 40 and 15% over the age of 60. Among the farmers of (50 years or above), 70% have uncertainties about the future of their farm with no successors to take over (AGRESTE, 2014).

In the PACA region, there are three marketing schemes which structure the management of farms quite strongly:

- Diversified vegetable farmers who sell their products directly to consumers through short marketing channels (markets, farm sales, community supported agriculture systems...)
- Specialized vegetable farmers who market almost all of their production through long marketing channels: wholesalers, or cooperatives which then sell to supermarkets or exporting companies.
- Mixed vegetable farmers who combine both marketing schemes (Chambre d'Agriculture Provence Alpes Côte d'Azur, 2018).

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<sup>1</sup>In 2019 according to the AGRESTE and CTIFL

If we compare these systems, there is a clear difference in phytosanitary use between diversified systems and specialized systems. Specialized producers use significantly more phytosanitary products than diversified producers (Jammes et al., 2019). This can be explained by the fact that diversified systems are less affected by pests and pathogens than specialized systems which cultivate few species.

### ***Production, processing, and market outlets for vegetables in Provence***

Throughout this study we have decided to focus mostly on conventional agricultural systems rather than organic systems, especially for the diversification issues. This choice comes from the assumption that the conventional systems are the ones which sell their products through longer marketing channels, and which are the most specialized as a result. Because of the requirements imposed by their clients, these producers encounter difficulties to diversify. The purpose of following section is to characterize the main stakeholders involved in the fruit and vegetable value chain as well as their operating modes. We have decided to overlook the role of certain stakeholders like seedling suppliers or seed companies, as they were not identified as barriers to crop diversification by the interviewed producers. On the contrary, they acknowledged the central role of research and development to facilitate the transition towards alternative practices.

#### ***Research & Development***

In the PACA region, there are several institutes, technical centers and experimental stations which greatly contribute to the development of innovative practices. They help farmers to choose and cultivate diversified crops through knowledge exchange. For example, APREL has conducted several trials on alternative crop protection methods, crop diversification, and reduction of chemical input application. They also contribute to numerous projects within scientific interest groups and in particular on alternative vegetable protection methods (APREL, 2021). The PACA region also has 16 DEPHY farm networks, including three in market gardening. These networks focus on the reduction of phytosanitary products, soil health and, more generally, the transition to more sustainable practices. They offer guided support by advisors and allow the creation of a knowledge exchange network available to farmers wishing to introduce a new species into their rotation for example (Direction Régionale de l'Agriculture, de l'Alimentation et de la Forêt, 2021).

#### ***Direct sale***

It is the shortest form of marketing channel with no intermediaries. Farmers who sell directly to consumers usually cultivate surfaces ranging from half a hectare to four hectares; they are usually part of the younger generations or have recently settled following a professional conversion and are eager to learn about agroecology or organic farming. In 2019 in PACA 65% of organic producers from all sectors sold their produce through at least one short marketing channel (RUBAT DU MERAC, 2019).

Producers from this category usually produce a variety of vegetables which can either be sold raw or processed to add value to their products before selling them directly to consumers. The sale is done on the farm, via local markets or via a community supported agriculture system (CSA).

Direct sales allow producers to talk to their consumers, an opportunity to provide information about their products and to make them want to try new products or simply communicate about agricultural practices. These interactions are occasions to familiarize consumers with different products which can be more difficult to sell via long circuits. For instance, at farmer's markets, consumers tend to buy several vegetables at once and can ask for recipe ideas which can push them to try new products. CSAs allow producers to choose what they want to distribute in priority; they decide what products are sold at what time through the creation of vegetable baskets. This system can serve as a financial guarantee and help producers popularize new crops or sell less common vegetables.



### *Farms combining direct sales and long channels*

These farmers can be divided into two subgroups: those selling in majority to mass distribution and those only selling a part of their products through long channels. These vegetable farmers often have access to more machinery and are more specialized than those selling exclusively through short channels. They usually have larger surfaces and have been involved in agriculture for longer (Jammes et al., 2019).

### *Cooperatives*

The grouping of producers in the form of cooperatives makes it possible to pool production and/or marketing tools and to guarantee larger production volumes. In France, 32% of fruit and vegetable volumes from French production go through these types of structures (Levet and Hutin, 2019). Because of their position in the marketing circuit, these actors could be key players in the diversification process since they can regroup smaller diversified farmers and provide them with more negotiating power towards retailers.

Cooperatives can sell to shippers, where products are transported all over the country to wholesalers or mass retailers' purchasing platforms (Levet and Hutin, 2019). They can also package their products without going through shippers and sell directly to wholesalers or mass retailers (Cavard-Vibert, 2019a, 2019b; Chaux and Foury, 1994).

### *Wholesalers*

In this category we will distinguish two types of stakeholders: shippers and market wholesalers.

Shippers are responsible for the preparation and shipping of vegetables all over the country. They usually engage in import and export of produce and in some cases, they own a production unit which allows them to secure supplies.

Large shipping companies establish agreements with producers for variety choices, production volumes and calendars. They can also work with cooperatives or producers which will either deliver pre calibrated and packaged products, or raw products which will go through their own packing station to be sorted cleaned, packed, labeled, and shipped to their clients.

Traditional shipping companies work with very different producers from small very diversified producers to massive, specialized producers. This diversity of suppliers enables them to sell a large range of fruit and vegetables to market wholesalers through verbal contracts. Larger shipping companies usually have their own brand for one or two products which they sell to mass retailers in large volumes through written contracts. Some shippers may develop a range of organic produce or old varieties to adapt to their clients' needs and demands and to stand out from competitors (Cavard-Vibert, 2019a; Chaux and Foury, 1994).

Market wholesalers are in charge of the reception and redistribution of goods. They can regroup in national interest markets or in their own premises where they will receive products directly from producers. They may source certain products from shippers to meet their customers' demands when they aren't readily available in the region. Wholesalers mainly supply catering services or small fruit and vegetable retailers; they can also sell to food processors or supermarkets (Cavard-Vibert, 2019a; Chaux and Foury, 1994).

### *Food processors*

Food processors can be divided into two categories: primary and secondary processors. We took interest in this outlet to determine whether or not processing could be an opportunity for diversification. That fact that the region is a large vegetable production area could be a potential asset to secure processor's supplies and promote the origin of products (Ministère de l'Agriculture et de l'Alimentation, 2018).

Primary processors are in direct contact with producers, they can also get their supplies from wholesalers. They receive raw agricultural products which they peel, trim, seed, cut, slice, precook, and freeze on demand for their clients. Primary processors often work with secondary processors which produce more elaborate products (Ministère de l'Agriculture et de l'Alimentation, 2018; Pouzet, 2007)

Secondary processors offer a different range of products such as canned goods, ready-made meals and more. When they do not get all their supplies from primary processors, they buy from wholesalers or shippers.

Their main customers are mass retailers, specialized retailers, and away-from-home catering services; they may also sell directly in their factory stores or online (Ministère de l'Agriculture et de l'Alimentation, 2018; Pouzet, 2007).

### *Specialized retailers*

These include fresh food specialists, organic stores, or small fruit and vegetable vendors (independent or franchised networks). They place special attention to high quality product selection by offering fresh produce and often communicate on local products. For their supply, some use wholesalers or cooperatives and sometimes call upon "local" producers capable of supplying fairly large and regular volumes (Levet and Hutin, 2019). Some fresh food retailers and organic stores have their own purchasing structure which are in direct contact with cooperatives, shippers, or producers. They may also purchase from food processors, which allows them to offer other product lines.

### *Mass retailers*

The supply circuit of fresh vegetables to supermarkets and hypermarkets varies greatly from one retailing brand to another. Most of supermarket supplies (80% by weight) are provided by central purchasing platforms which negotiate volumes and prices with their clients (cooperatives, producers, manufacturers, and wholesalers).

The additional 20% of supplies are directly secured by wholesalers, producers or cooperatives and do not go through the central purchasing office (Levet and Hutin, 2019), offering greater flexibility and an opportunity for diversification.

This type of distribution channel is the most popular amongst the French population and supplies most households. In 2019, 70 % of fruit and vegetables consumption in France is purchased in supermarkets and hypermarkets (Levet and Hutin, 2019).

### *Away from home catering*

This group of stakeholders encompasses catering services (school or company canteens, associations), as well as restaurants; resulting in a variety of operational modes, demands and suppliers.

Restaurants can either get products directly from producers, buy from small retailers or go to markets. Company or school canteens tend to use wholesalers, agri-food companies, or subcontract with specialized companies, such as *Sodexo* (Interfel, 2015). Depending on the organization and on the volumes needed they can order in bulk or plan their orders in advance.

According to their objectives, some may represent a barrier or an opportunity for new product development. Small restaurants, for example, may be looking for original, quality products to develop new recipes, offering opportunities for diversification.

Created in 2013, the *Agrilocal* association is established in 36 departments including *Bouches-du-Rhône* and *Vaucluse* (Ministère de l'Agriculture et de l'Alimentation, 2020). This association is devoted to promotion of short marketing channels and of local economy for catering services. It has created a platform to link restaurants, collective catering and local producers and has developed a real opportunity for farmers wishing to sell different products through local outlets.

## *The use of organic waste in PACA*

This work will attempt to identify the available resources available in the region as well as the factors explaining why the use of organic matter is slow to develop in the regional vegetable productions systems.

There is a clear separation between plant production and animal production areas in the PACA region. Animal husbandry, specifically sheep breeding, is mostly present in the northeastern part of the region in the Alps, while vegetable production is concentrated in the *Bouches-du-Rhône* and *Vaucluse* departments.

The separation between vegetable and animal production hinders the distribution of animal manure to vegetable farms. As a consequence, vegetable farmers usually buy fertilizers or amendments from cooperatives which sell normalized products. Still, a portion of farmers in the region (usually organic) have started to take interest in the use of compost or other types of organic amendments such as horse manure or organic waste from green space upkeep (Vian, 2012).

Equestrian facilities are well developed in the *Bouches-du-Rhône* and *Vaucluse* departments, making them an interesting source of organic matter for farmers in the area. According to the last report from *Filière Cheval SUD*, the local association dedicated to the equestrian sector, there were 39,000 documented horses/ponies in the region in 2018 (Filière Cheval SUD, 2020). Poultry farms are also quite common around vegetable production areas and could represent an easily accessible form of organic matter with good agronomic properties. In 2019 there were 1,255,000 chickens raised in PACA (AGRESTE, 2019).

According to the NFU 44-051 norm an organic amendment can be defined as “[...] vegetal and or a mix of animal and vegetal products destined to maintain or restore soil organic matter contents and to improve its physical/chemical/biological properties.” [translated] (AFNOR, 2012). Sewage sludge will be excluded from this study but all other forms of organic matters fitting this definition will be identified and considered.

## 3. State of the art

### 3.1. Sociotechnical lock-ins

Farmers have continued using phytosanitary products despite available alternatives. This can be explained through an understanding of the whole system from production to consumption. To reach this understanding we conducted an analysis and started by looking at the sociotechnical system.

A sociotechnical system can be defined as “a relatively stable configuration of stakeholder collectives, their networks, their knowledge and practices, the artifacts and technologies they use, and the rules that frame their interactions.” (Rip and Kemp 1998 as cited by Boulestreau et al., 2021)

The sociotechnical lock-in concept was theorized in the 1980s by Paul A. David. It states that when a technology is widely adopted by a group of people it becomes increasingly attractive to others and more efficient as a result (David, 1985). This phenomenon led to the development of lock-ins: certain emerging technologies were unable to develop even if they were more effective. The wide adoption of dominant technologies resulted in cost benefits and system scale economies placing emerging technologies at a disadvantage from the start and contributing to the structural organization of society around said dominant technologies.

This concept was first developed in the industrial sector and later used in various sectors, including agriculture, to explain the parameters that slow down change and which explain pesticide dependence in current agricultural systems (Cowan and Gunby, 1996; Lamine et al., 2011; Meynard et al., 2018; Vanloqueren and Baret, 2008).

A group of sociologists and agronomists from INRAE have recently tried to understand why the Ecophyto plan launched in 2008 by the French government did not reach its intended goal: reducing pesticide use by 50% by 2018. They argue that this plan failed partly because it did not consider neither the agroecosystem, nor the food system as a whole (Guichard et al., 2017). Based on the HLPE's definition, the food system involves all the elements and activities related to the production, processing, distribution, and consumption of food as well as the outputs generated from these activities (HLPE, 2014).

The reduction of pesticide use requires a systemic approach involving reorganization of local stakeholders. Today, many people still think of farmers as the only responsible party for pesticide use. It has been established that many systemic parameters come into play in farmer's practices. For a long time, farmers have been influenced by the advisory system which was mostly led by agrochemical companies. Up until now advisors in these companies, were sales technicians paid according to their sales, thus creating a bias in favor of these products (Vanloqueren and Baret, 2008). This will no longer be accepted as a recent French law passed to prevent these kinds of conflicts of interest by separating the advisory and sales services for phytosanitary product application (Ministère de l'Agriculture et de l'Alimentation, 2021). Still the market and the idea that pesticides are needed to secure yields greatly contribute to chemical input dependence (Guichard et al., 2017).

The whole production and supply chain is driven by consumer's demand and expectations. The disconnect between consumers and the agricultural world has led to a lack of knowledge about food production and constraints faced by farmers. An example of this gap has been illustrated by an unsuccessful advertising campaign for “ugly fruits and vegetables launched in 2013 by a famous French supermarket chain. This campaign aimed at fighting food waste and attempted to promote the sale of these less attractive products by selling them at lower cost. The failure of this initiative can be explained by food sociology. Debucquet and Lombart suggest that people's perception and relationship to nature impact their vision of imperfect fruit and vegetables. In their study they interviewed a sample of 30 consumers and identified two consumer profiles: the “rooted earthlings” and “uprooted pragmatics”. Rooted earthlings belong to older generations and cultivate a close relationship with nature while uprooted pragmatics are younger, from urban backgrounds and usually more distanced from nature. This last group had a positive perception of

standardized produce which were viewed as normal and easy to prepare while imperfect produce triggered their suspicion and distrust. These consumers associated imperfect produce with GMOs and lower gustatory value (Debuquet and Lombart, 2017).

The failure of the ugly fruit and vegetable campaign can partly be attributed to the misconception of product quality resulting from the rising detachment between urban consumers and food production systems. Today, with the increasing trends for zero pesticides and zero waste, some consumers are realizing they have the power to vote with their credit cards and that their choices can have powerful impacts. This growing awareness about agricultural practices could bring about change in urban population's consuming habits. It is important to educate consumers and explain that many chemical treatments could be avoided if they were more lenient visual quality norms. This change of perception on product quality would have a positive impact on the reduction of phytosanitary products use.

### 3.2. Crop diversification and organic matter application to reduce system vulnerability

Several agronomic levers can be used to reduce the use of chemical inputs while controlling soil pest and diseases. Among these levers are crop diversification and the use of organic amendments. Organic matter application is an important lever but must not be used on its own to be efficient against telluric pests and fungi. It should be part of a systemic approach and combined with a diversified crop rotation to successfully improve soil health. An experiment carried out by a local experimental station suggests that the reduction of pesticide use related to telluric issues is only possible through a combination of several agronomic levers such as diversification and the use of organic matter in great quantities (Gard et al., 2018).

#### Crop diversification

Crop diversification is an important agronomic lever to disrupt the development of certain pests. It allows for a better control of populations while limiting the use of phytosanitary products (He et al., 2019; Ratnadass et al., 2012). Diversification can be done several ways: through the implementation of new species in time (cover crops, catch crops...) which will have agronomical properties; in space to increase biodiversity (intercropping, flower strips...), and finally through the incorporation of a new cash crop in the crop rotation. This last option raises multiple questions related to the marketing and sales of this new crop.

For this study, we have made the choice of focusing on the last type of diversification: the introduction of a new cash crop in the rotation. This allowed us to study the whole chain from production to distribution which would not have been possible if we had chosen to look at other forms of crop diversification.

This new crop can be a resistant or non-host species or variety, which can be useful for pest control especially when a specific pest has been identified as an issue (Casagrande et al., 2017; Djian-Caporalino et al., 2009; Morel et al., 2020). In general, the introduction of different species in crop rotations facilitates pest control by increasing the complexity of the trophic network and therefore the resilience of the system. Unfortunately, it would have been unrealistic to study all forms of crop diversification.

There are some obstacles to the implementation of a large number of crops at many levels in the food system: supply, production, retailing, marketing, and in the general organization between stakeholders. A research paper based on the analysis of 25 European case studies on crop diversification highlights different types of barriers from the production to the consumer level (Morel et al., 2020).

The results of this study reveal that the main barriers surrounding this issue are found at the production stage. The most common obstacles for producers seem to be lack of technical knowledge and experience, unsuitable equipment, unavailability of locally adapted plant material and the risk diversification represents to them (Morel et al., 2020). However, these obstacles may vary from one farming sector to another, cereal crops are not faced with the same issues as vegetables for instance. Cereal producers wishing to start producing legumes may find it difficult to access varieties that are well adapted to their systems because

little research is done on diversification species like chickpeas, or lupin. The way cereals are processed, and their distribution channels also differ from those of vegetables (Meynard et al., 2020).

The study from Morel et al. (2020) was conducted in very different types of systems, including all kinds of diversification methods, while we will only be looking at the barriers linked with the introduction of a new cash crop in market gardening systems. In addition, the obstacles faced by other European countries can be different from those faced in France, and more specifically in the PACA region. For example, a Swedish vegetable farmer may be more impacted by the weather and the short growing season while a vegetable farmer in the south of France may have more issues with the marketing of his products.

We hypothesized that the other major holdbacks in the region are related to logistics and marketing. Indeed, adding a new species into the crop rotation can mean smaller volumes and new crops which can be harder for wholesalers to manage. Additionally, marketing smaller volumes for a larger number of products is less interesting economically for them (Meynard et al., 2018; Morel et al., 2020).

Some of the crops produced may also be imported at a lower price from abroad making it difficult for locally grown produce to compete, unless these crops are easily available and have superior quality. The insufficient collaboration between the actors in marketing channels is also mentioned as a barrier in the study by Morel et al. 2020. For example, research may be conducted on how to cultivate a specific crop species but if the way this crop behaves in a crop rotation is not studied, it can be riskier for farmers to implement this new crop into their rotation.

Both studies agree on the fact that consumer's habits can form a potential hinderance. Consumers are more familiar with mainstream products and more likely to buy them. They may not want to buy new products, neither would they want to pay more for them (Meynard et al., 2018; Morel et al., 2020).

Meynard et al. 2018 analyze the sociotechnical lock-ins for the introduction of legumes and the obstacles to their development in Northern France. Indeed, today it is well established that legumes possess interesting agronomic, environmental, and dietary characteristics, yet the development of these crops is relatively slow. They argue in their study that the way industrials and most stakeholders in agriculture have structured themselves favors major crops. This is what they call the interconnected self-reinforcement mechanism (Meynard et al., 2018). Meynard et al. 2018 and Morel et al. 2020, agree that this is due to the optimization of logistics, the high demand for these products and the cost advantages of economies of scale. But also by the fact that industrials have adapted to these major crops with specific machinery. Major crops are easily accessible and therefore available for agri-food businesses and the stakeholders are used to working with the same network of people.

This interconnected self-reinforcement mechanism creates a complex situation where the dominant system is so well optimized that it makes it difficult to change. One possible way to create meaningful change is by taking a systemic approach and understand what the stakeholder's individual interests have in common to find a desirable outcome.

Other factors can also intervene in the sociotechnical landscape and change stakeholder's habits, goals, and expectations and it is important not to overlook them. The sanitary crisis we are facing today is one example of such factors: during the lock-down period consumers changed their purchasing habits and turned to direct sale at the farm.

### *Organic matter to enhance soil health and reduce chemical inputs*

Studies show that in addition to boosting plant productivity, composts and soil amendments encourage high microbial diversity in the soil, thereby boosting the resilience of microbial communities and making it less sensitive to disturbances such as pathogens (Mehta et al., 2014; Usero et al., 2021). Using organic amendments can also improve plant vitality since they enhance soil's nutrient and water holding capacities and therefore have an indirect impact on their tolerance to potential attacks. Some types of amendments release chemical compounds which can also help to create a hostile environment to telluric pests or parasites (Collange et al., 2011). For composts the maturation stage can influence their efficiency on telluric pathogen

and parasite control. For instance, stable composts may not have a sufficient effect on root-knot nematodes due to their slow release of chemical compounds resulting in low nematocidal product concentrations (Collange et al., 2011).

Different organic amendments and fertilizers will have effects on soil properties such as pH, micro- and macronutrient contents, which in turn will affect the microbial communities present. For livestock manure, for example, the animal species, the feed, the storage, the litter, and the management of the manure will have an impact on the composition and effects of this OM on the soil (Rayne and Aula, 2020).

An Australian study on the effects of sawdust and chicken litter amendment combinations on the control of root knot nematodes in sweet potatoes and tomatoes, found that compost stimulated natural enemies present in the soil, which helped reduce the number of root knot nematode eggs (Stirling, 2021). The study concludes that more research should be conducted on different types of composts as they are a great way to increase soil health and should be implemented in systems struggling with root knot nematodes.

In contrast to the diversification issue, it is assumed that the use of organic amendments is a simpler change to operate and requires less adaptation on the farmer's end (Wezel et al., 2014). However, in the PACA region the availability of organic matter, transportation and how it is composted, and spread are real concerns to be addressed for vegetable farmers.

So far, no study has applied the sociotechnical analysis to this topic, the groundwork for these questions will be the identification of the offer and the analysis of the structural organization surrounding the actors involved with organic matter production, transformation, or distribution for vegetable producers in the region.

## 4. Goals and main questions raised

What are the socio economic and technical factors which hinder the reduction of phytosanitary products in market gardening systems in Provence? What changes can be operated to facilitate the adoption of agroecological practices?

This work as well as other projects from the *Ecodéveloppement* research unit helped to define the PACA case study and to formulate the following goal: understanding how to promote the coordination and reorganization of stakeholders to encourage crop diversification and the use of organic matter as levers to increase soil health. More specifically, during my internship I focused on the barriers and levers to the use of organic amendments and crop diversification which we chose to address separately one after the other.

When determining the action plan, we debated whether diversification and use of organic matter should be looked at together. Indeed, from an agronomic standpoint crop diversification and the use of organic amendments are complementary to prevent telluric pests and diseases and maintain a healthy soil. However, from a methodological standpoint, separating both issues was more coherent and realistic since the scope as well as the stakeholders involved in each issue were different. For crop diversification the scope was centered around conventional production systems while the organic matter issue involved all vegetable production systems including organic ones.

After gaining a basic understanding of the vegetable production systems in Provence through literature review based on scientific papers, grey literature, and preliminary interviews, a few more specific questions emerged. The following 8 questions have served as a foundation to identify the main barriers and levers to facilitate agroecological transition in Provence.

### Crop diversification

- To what extent do mass retailers and food processors impact agricultural practices, especially the introduction of new crops?
- Could the territory's mass retailers and food processors develop new strategies and markets to encourage agroecological practices in vegetable production?
- Are retailer's marketing strategies barriers to crop diversification?
- To what extent are quality norms and European standards obstacles to crop diversification?

### Organic matter

- Are there enough local resources available to supply vegetable farm's demand?
- How can we best use the resources available to create organic amendments with soil-health boosting properties?
- What are the technical and organizational barriers to the composting of fresh plant material?
- How can the stakeholders from the PACA region (and perhaps other territories) be coordinated so that vegetable farmers have access to organic matter?



# 5. Methodology

## 5.1 Sociotechnical analysis

The analysis of the sociotechnical system is a means to better apprehend a given system and to identify obstacles and opportunities for change. It can help understand the issues stakeholders are faced with, their interactions, their desires and how they place themselves with regard to a specific problem. In this case, this method was used to understand the cause of the lock-ins around pesticide use in market gardening systems particularly looking at crop diversification and the use of organic amendments.

More specifically, the system of interest is the Provençal vegetable production basin in the southeastern part of the country, around Avignon. This area was not only chosen because it is a major fresh vegetable producing area in France, but also because vegetable growers in the area are confronted with telluric pest and disease problems and are struggling to find sustainable alternatives.

The method was based on a methodological guide (Casagrande et al., 2021) created by researchers from INRAE after a series of studies on sociotechnical systems in agriculture (Belmin et al., 2018; Boulestreau et al., 2021; Della Rossa et al., 2020). The INTERLUDE research project will be the first to test this method and to evaluate it. This methodological guide for the socio-technical diagnosis of obstacles and opportunities for change in food systems describes the 5 steps to conduct a sociotechnical diagnosis which are listed below.

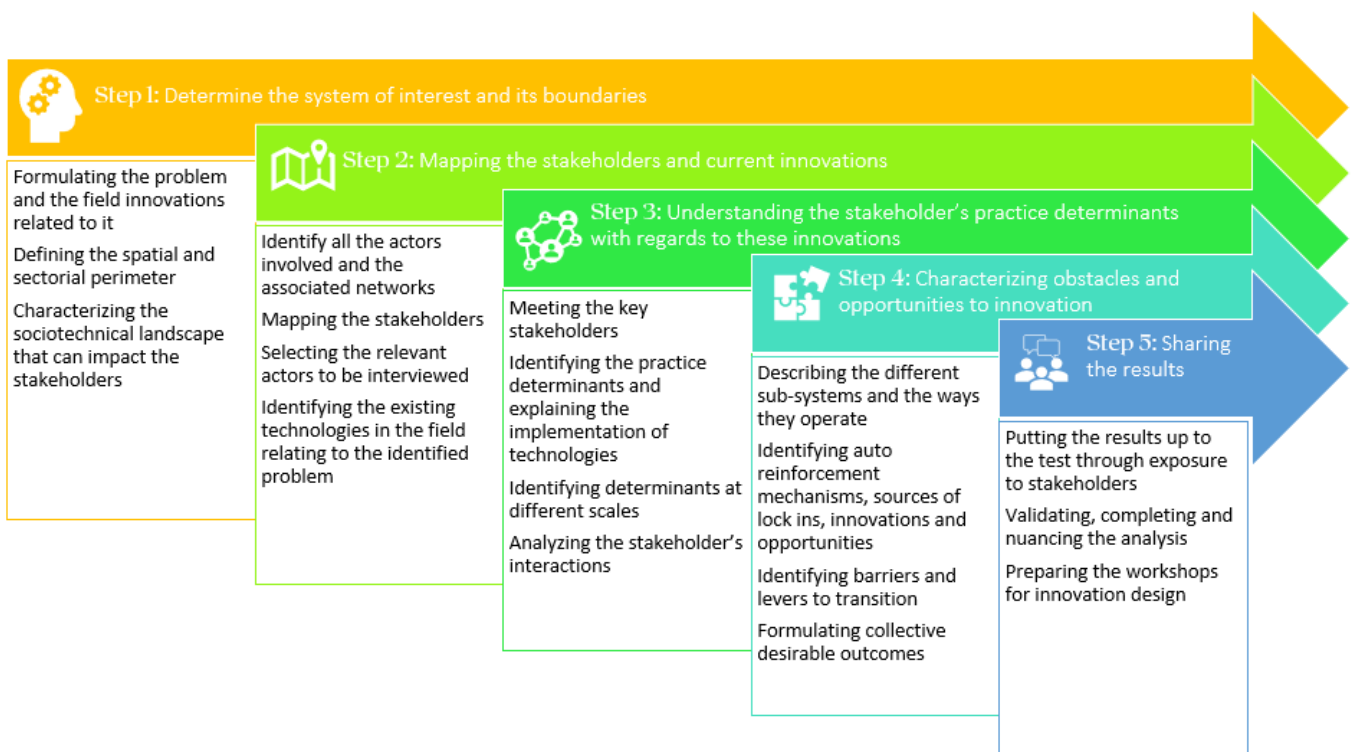
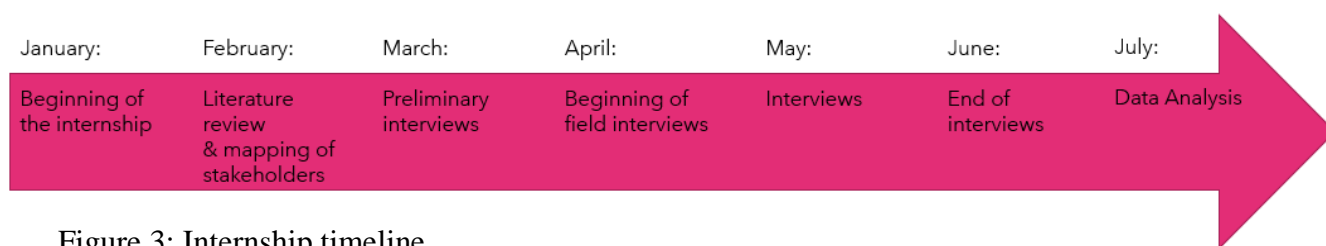


Figure 1: Steps to conduct a sociotechnical diagnosis (adapted from Casagrande et al., 2021)

## 5.2 Application of the sociotechnical diagnosis to the vegetable sector in Provence

Figure 3 shows the scheduling of the project tasks.



**Figure 3:** Internship timeline

Unfortunately, due to time constraints during this 6 months period my work has been dedicated to the first 4 steps and I carried out the steps 2, 3 and 4. The application to the case study may stray from the steps listed in the previous section. This section is meant to describe the way the methodology was applied to our case study before and during my internship.

The first two steps of the sociotechnical analysis method are meant to get familiarized with the area and its stakeholders and are somewhat connected.

### **Step 1: Determining the system of interest and its boundaries**

The case study originated from a field observation: the overuse of phytosanitary products in vegetable production systems and the aspiration for change towards agroecological practices.

The focus on sustainable management of soil health to reduce pesticide was further defined following previous work. In particular, Yann Boulestreau's PhD work around rootknot nematodes in sheltered vegetable systems (Boulestreau, 2021). His research had already highlighted the main issues faced by vegetable farmers in the area. His work focused on nematodes in sheltered vegetable systems and somewhat oriented the scope of this study towards the agroecological management of soil health to reduce pesticide use in Provençal vegetable production systems.

To gain further understanding of the sociotechnical landscape, my INRAE tutors carried out some preliminary interviews with technical advisors closely involved in the INTERLUDE project as partners. As advisors they are in contact with producers regularly and were able to give a global view of their issues and what influenced their practices. This preliminary work helped define the boundaries of the sociotechnical analysis and established the framework for my internship.

For the beginning of my internship, I conducted preliminary research to understand the sociotechnical context and learn about the main stakeholders involved in the issues of crop diversification and organic matter use respectively. The first two weeks were dedicated to grey literature on the main telluric pests and diseases in market gardening as well as some ways to control them using agroecological practices.

### **Step 2: Mapping the stakeholders and current innovations**

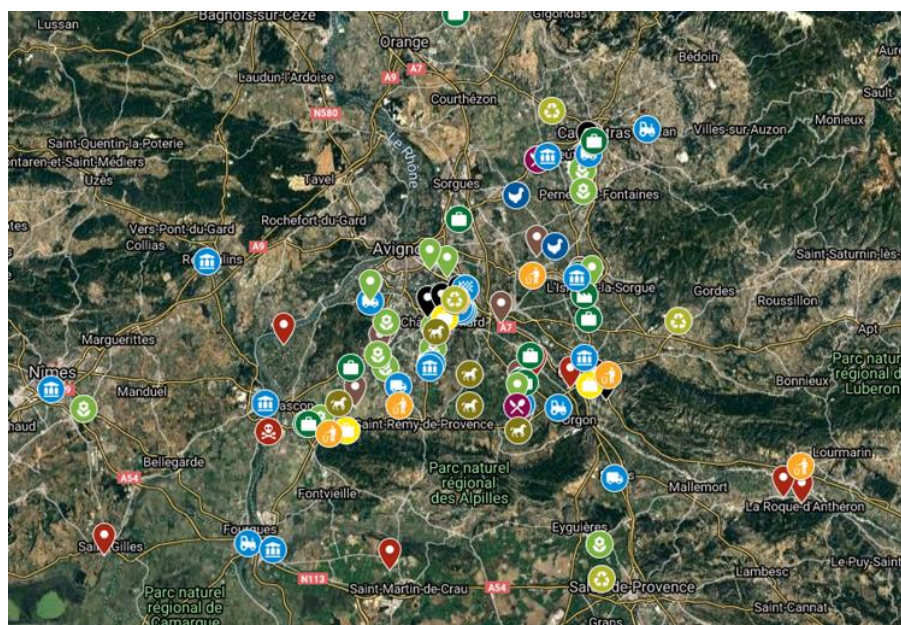
After gaining a better understanding of the issues, I dedicated a large part of this phase to gain knowledge about the stakeholders involved in the diversification issue. To create an efficient working plan the internship was divided in two parts: one dedicated to the use of organic matter and the other on crop diversification. Since the two issues were complementary and the methodology quite similar, we decided to focus first on the crop diversification issue and later the use of organic matter. The literature research for both issues was conducted in the beginning and towards the end of the internship using Elsevier, HAL, Web of Science and Researchgate primarily.

This preliminary research consisted of identifying as many relevant stakeholders as possible on the territory, using google maps as well as online directories, I identified about 60 stakeholders which I placed on a map<sup>2</sup>.

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<sup>2</sup> See Figure 2

The different types of stakeholders were symbolized using different icons and colors (i.e in red: cooperatives, in brown: producers, in yellow: national interest markets...). In parallel, I wrote a description of each type of stakeholder involved in either one of the 2 issues: crop diversification and organic matter use. This document consisted of an introductive part about the overall problem, separate paragraphs about the stakeholders, describing their roles and how they were relevant to each issue and examples of how they could contribute to crop diversification or the development of organic matter use in the PACA region. For each stakeholder were associated hypotheses I would later use to draft my interview guides. Along with this document I created two diagrams to represent the interactions between stakeholders<sup>3</sup>.



**Figure 2:** Mapping of stakeholders

This map served as a basis for the definition of our perimeter within our study area. I realized that most of the identified stakeholders were found within a 40km radius of the INRAE research station. This study area encompassed three departments: *Vaucluse*, *Bouches-du-Rhône* and the *Gard* departments which are all major vegetable production zones in the region.

While constructing the map I created an excel sheet to keep track of all the types of stakeholders and listed all of them including their addresses and contact information. This list was later used to sample stakeholders for the interviews.

The list was sent to technical advisors working at the local chambers of agriculture, also involved in the INTERLUDE project. Unfortunately, we realized that because of their technical activities, they knew very well the farmers of the area, but weren't much in contact with retailers and wholesalers and were unable to tell us which stakeholders we should meet.

### **Step 3: Understanding the stakeholder's practice determinants**

From there, we decided to call upon a private advisor also involved in the project who was more engaged in the marketing side. We carried out a preliminary interview and asked him for contacts toward the end of the interview. We then decided to use the snowball sampling method also known as the chain referral sampling method. This method was very efficient to get into contact with wholesalers, food processors and retailers which we have little contact with. People were also more inclined to accept an interview if they knew the person which introduced them to the project. To begin the technical advisor referred us to a vegetable producer which was then able to put us in contact with their clients or suppliers such as shippers,

<sup>3</sup> See Figure 4 & 5

purchasing platforms or composting platforms. We also benefited from the guidance of an expert from the Regional Center for Innovation and Transfer of Agri-food Technologies which helped us identify relevant food processors.

Through this method I was able to create a list of relevant contacts including wholesalers, vegetable producers, food processing companies, cooperatives, seed companies and seedling nurseries, organic fertilizer manufacturing companies, composting platforms, horse stables, poultry farmers and more. Because of the imparted time, choices had to be made to select which groups to focus on and for each group, which stakeholders to interview. To address entirely the first question on crop diversification a comprehensive review of different retailing brands should have been conducted. In this paper the question will be partially addressed. However, this topic will be further developed during the INTERLUDE research project.

The choice of interviewees was guided by their potential interest and ability to answer questions and hypothesis raised in section 4 (mainly concerning the sale of vegetables and the management of organic matter in the region).

When the interviewee was not able to call their contact and refer me directly, I was usually given permission to reach out to them in their name which was more efficient than calling random people on my contact list.

Prior to interviews I had created three standard interview guides: one for farmers, one for wholesalers and one for agri-food industrials. These three guides had similar structures with each time questions to understand the functioning of the company, the interviewee’s job and questions relative to potential barriers and levers to crop diversification.

I carried out 30 semi-structured interviews in total, most alone and some in pairs with one of my supervisors. These can be categorized as follows: 22 for diversification and 21 for organic matter although only 8 were specifically interviewed solely on the topic of organic matter. Out of these interviews there were 6 producers, 6 wholesalers, 3 people working in distribution companies, 4 agri-food processors, 1 agri-food advisor, 3 agricultural advisors, 2 researchers, 1 person working for a waste recycling company, 1 person in charge of municipal waste collection, 1 person in charge of the horse sector in PACA and 1 local politician. Some of these stakeholders were located in the study area while others were located outside of this territory but strongly influenced local stakeholder’s actions.

Interviewed vegetable farmers’ profile types:

Surfaces ranging from 2,4 ha to 1800 ha	1 mixed system with organic and conventional vegetables 1 organic system 4 conventional systems	All producers had a significant part of their system involving sheltered vegetable systems some cultivated vegetables outdoors.	<ul style="list-style-type: none"> <li>• All sold their produce through long marketing channels.</li> <li>• 3 sold their products to food processors</li> <li>• 1 sold small portions through direct sale on the farm.</li> </ul>
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Due to the sanitary crisis, it was at times, difficult to obtain formal interviews with stakeholders. Fortunately, because of the context many seminars and presentations which are normally organized in small conference rooms with a limited audience were organized online, recorded, and published on social media platforms making them easily accessible to a vast audience. These webinars served as a context overview and were used as a means to collect data on both crop diversification and organic matter use in addition to the interviews.

Webinars attended for crop diversification:

Organisation	CTIFL	CTIFL & ITAB	APREL
Subject	Agroécologie: les attentes du consommateur, comment y répondre ? <i>Agroecology: consumer's expectations, how to address them?</i>	Quelles sont les techniques de production de légumes en agriculture biologique ? <i>What are the techniques for organic vegetable production?</i>	Café Technique Bioagresseurs Telluriques  <i>Workshop on experimentation results to fight against telluric pests</i>
Date	February 1st. 2021	December 4th 2020	February 4th. 2021

Webinars attended for organic matter:

Organisation	IRAEE <i>Network for agriculture, energy and the environment</i>	IFCE <i>French institute for horses and horseback riding</i>	Comité Régional d'Equitation de Provence Alpes Côte d'Azur <i>Regional Committee for horseback riding</i>
Subject	Agr'air project on air quality in PACA	<ul style="list-style-type: none"> <li>• Comment Mieux gérer son fumier. <i>How to manage horse manure better.</i></li> <li>• Compostage de fumier équin et bovin dans un lycée agricole <i>Horse manure composting in an agricultural high school</i></li> <li>• Le lombricompost : du fumier de cheval à la fertilisation du sol <i>Vermicomposting: from horse manure to soil fertilization</i></li> </ul>	Webinaire sur la gestion du Fumier <i>Webinar on horse manure management</i>
Date	March 2021	<ul style="list-style-type: none"> <li>• November 27th. 2020</li> <li>• April 14th 2021</li> <li>• December 1st 2020</li> </ul>	April 12th 2021

#### Step 4: Characterizing obstacles and opportunity to innovation

After the data collection process and the analysis of individual interviews conducted in step 3, step 4 was dedicated to synthesis and cross analysis of all interviews to understand the stakeholder's individual desirable outcomes and finding out if and how they could converge.

Some interviews were recorded which facilitated the transcription process, for a minority of interviews I had to take notes along the way. I was then able to transcribe the information collected and to extract the elements in interview grids and mind maps<sup>4</sup>. For the mind maps I used the free version of *Xmind*, a software

<sup>4</sup> Interview grids and mind maps can be found in appendix 6 and 7.

tool to create visual charts, mind maps and more. I created two separate ones for each topic and divided them the same way: barriers on one side and levers on the other.

For each interview I selected the relevant information which I placed on the mind map. In order to analyze the collected data and categorize the results, I created a code for each interview and marked it next to each branch on my mind map. This allowed me to easily retrieve the information from the transcripts and see if multiple people shared similar concerns. In order to increase the genericity of the data and to maximize the reliability of the results, the information only stated by one person and not mentioned in the literature was not included.

### 5.3 Consistency and trustworthiness:

While the questions varied from one group of stakeholders to another, the structure of the interview guides and the core elements of the questionnaires remained the same throughout the interviews for each category of actors<sup>5</sup> (for producers the guides were structured in 6 sections: General presentation of the farm, Management of soil health, Market outlets, Diversification, Organic Matter, Research and development). In some cases, questions were taken out or added to adapt to their systems.

The goal of the first interviews was to confirm or refute the information found during the preliminary research stage. The snowball sampling method enabled us to highlight the existing connections between stakeholders and helped to cross check the information collected throughout the data collection process.

Once we had gained sufficient experience and a better understanding of the different types of stakeholders, the time spent on the different parts of the questionnaire shifted from the general questions to the most specific questions. In the beginning a significant part of the interview time was dedicated to the understanding of the stakeholder's company and work. After a few interviews extra focus was granted towards identifying the obstacles and levers to crop diversification or the use of organic matter.

Throughout this work presentations were given to experts from technical and research institutes working on other case studies of the INTERLUDE project. When the information collected was unclear, we were able to go back and contact the interviewees which could give additional information. In other instances, the research project's partners intervened to give their expertise and peer review our data and analysis based on their own experience. To maximize the reliability of the results, the information only stated by one person and not mentioned in the literature was overlooked.

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<sup>5</sup> The interview guides can be found in appendix 1, 2 and 3.

## 6. Results

This section presents an overview of the current situation in Provence regarding the interactions between stakeholders for crop diversification and organic matter use and then presents the barriers and levers which hinder their development for vegetable producers.

### 6.1 Overview of the stakeholders and their interactions for diversification

The figure presented below was based on literature, qualitative interviews as well as a diagram created by the french technical institute for fruits and vegetables (CTIFL), depicting the different distribution channels and the corresponding volumes of fruits and vegetables on a national level<sup>6</sup> (Levet and Hutin, 2019). A first version of this diagram was created before the interview process and later readapted to fit the territorial scale. It was created to represent the flow of vegetables from producers to consumers in the region. The pathways followed by products are represented as arrows, the thicker the lines the bigger the flow of products (although the proportions are not exactly respected since regional quantitative data to support this representation is unavailable at this time). The brown arrows leaving the production box represent the different pathways vegetables can go through and each time they go through a different link of the distribution chain the color of the arrows change.

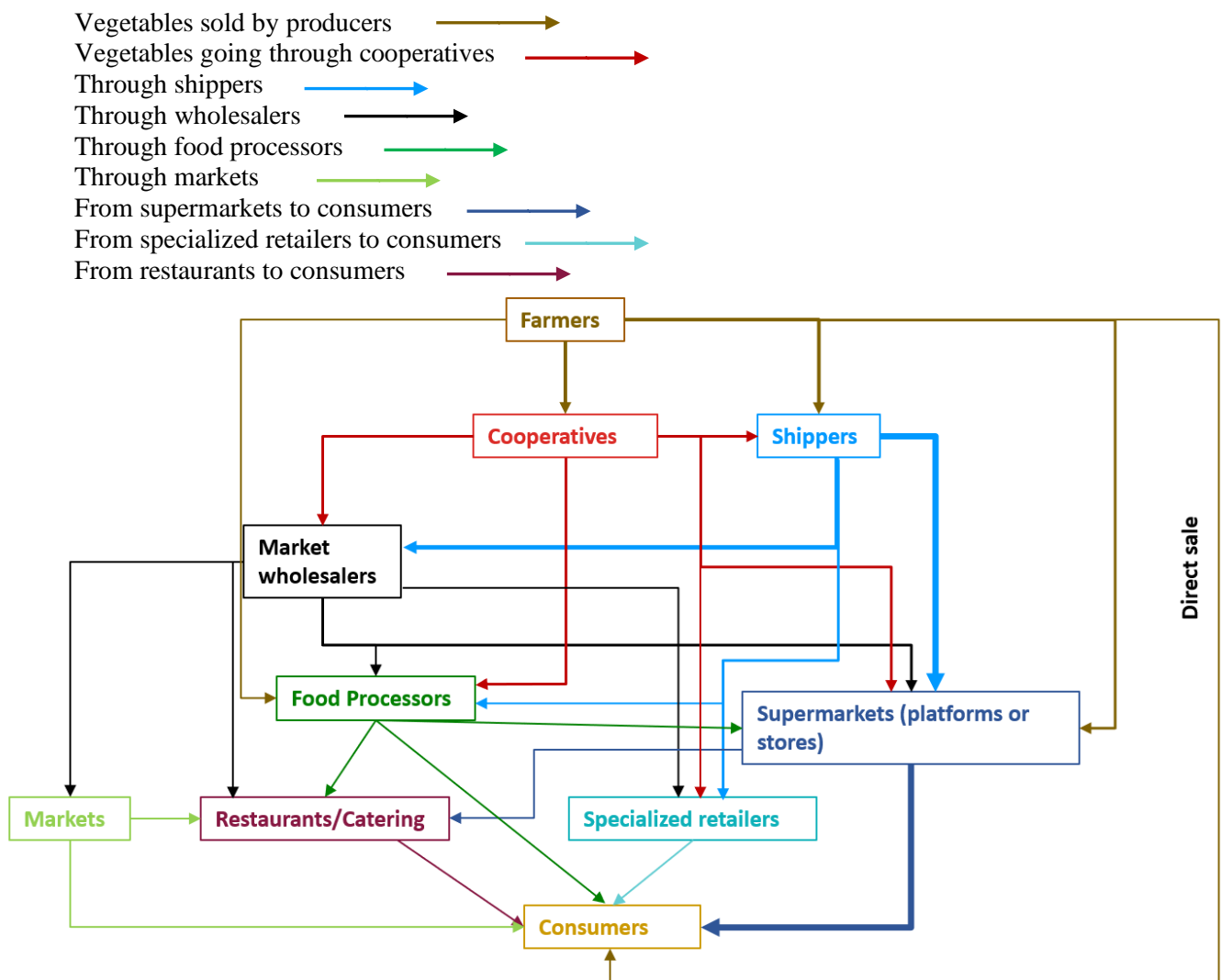


Figure 4: Vegetable distribution channels in Provence

<sup>6</sup> Available in appendix 4

As described in section 2.2, there are different types of distribution channels for vegetable producers in Provence. This diagram illustrates in greater detail these channels with a bigger emphasis on long marketing channels which represent larger volumes. Producers selling through long marketing channels are usually more specialized as a result of their obligation to supply large volumes to mass retailers. In France, households mainly purchase their fresh fruits and vegetables via supermarkets (70%), on this account we explored their practices and supply strategy for vegetables and how it affects crop diversity in the fields.

This figure shows the importance of wholesalers and supermarkets which share a large proportion of the product flow. Supermarkets can either get their supplies directly from producers through their purchasing platforms or from wholesalers or cooperatives which will go through their purchasing platforms. In Provence, it is quite common for big retailing companies to contact producers directly thus bypassing wholesalers. To maintain their activity, wholesalers choose to work with restaurants, catering services, agri-food industry.

Cooperatives are quite numerous in Provence, but they mainly commercialize fruits. Cooperatives for vegetables are not as numerous but rather well known and well established among mass retailing. The most famous ones have developed famous brands such as *Les Paysans de Rougeline*, but these are mostly off-ground cultivation systems which are out of scope for this study. For this reason, we have not collected data specifically on cooperatives but rather on mass retailers and food processors, in particular on their supplying systems.

- Supermarket's supplying systems

Most Supermarkets are organized around purchasing platforms where most product's prices are negotiated. All over the country supermarket floor managers oversee the supply of their shelves on a local level; they know what vegetables to order and in what quantities. Every day, they call buyers from their purchasing platforms who are in charge of fulfilling these orders. In most cases, platform buyers call producers to negotiate prices and volumes early in the growing season.

Some retailing companies have national platforms, others have regional platforms where buyers are responsible for specific lists of products. In some cases, supermarket floor managers choose to bypass purchasing platforms and contact local producers directly to avoid paying extra fees, but this represents a small portion of volumes.

In the territory, we identified 9 platforms and surveyed one of them. The head of the buying department was able to share his experience working for the same large, specialized retailing company for 27 years. He explained that most experimented buyers are in charge of more delicate produce such as berries which are less predictable, while beginners start with apples or potatoes which can be stored easily. However, most vegetables cannot be stored for a long time and the entire supply chain must be very reactive and well organized to guarantee product freshness. As a result, supermarket buyers and floor managers must know 48 hours in advance what produce they need and in what quantities. Depending on the type of retailers some will favor lower price, whereas others will choose quality and geographical origin. All year-round mass retailers import produce when they are out-of-season in France to provide a constant range of vegetables.

To be able to sell their products to supermarket chains, farmers and agri-food companies must go through an audit to be referenced. Producers are usually referenced for large volumes of a single product; they must be able to fulfill their orders regularly and respect a list of requirements established with the buyers. Once they are referenced, an oral or written contract specifies the supply volumes and the price for a given period. Most supermarket chains have private labels which can have even more technical specifications: for example, no pesticide application after the flowering stage for strawberries. Depending on the vegetables, farmers can be guided towards certain varieties. Supermarkets tend to suggest "popular" varieties they know consumers will buy and are familiar with.



Vegetable producers are required by supermarkets to caliber and pack their produce according to specific norms; cooperatives can take care of the conditioning and quality control for their members. Packaging requirements vary depending on retailers, some provide producers with reusable plastic containers, others have cardboard containers, but every supermarket brand has its operating mode regarding conditioning: container size/color/material for packaging etc.

Farmers either deliver their products to the closest logistical platform or pay a carrier which will do it for them. The products will then go through quality control and be sent to the assigned supermarkets either that same day or the following day. This is the regular pathway for producers, cooperatives or wholesalers selling their vegetables directly to supermarkets.

- Food processors' supplying systems

As indicated in section 2.2, agri-food processors can be divided into two categories: primary processors and secondary processors. The first is in direct contact with producers while the second usually works with preprocessed products. Raw agricultural products are cut or frozen according to demand for secondary processors which prepare more elaborate dishes like ratatouille or soups.

From my surveys, I noticed that primary processors work jointly with producers to agree on what kinds of vegetables they should plant and which volumes they need. There are two types of supplying arrangements: those for farmers who produce vegetables specifically to agri-food processors and those for farmers selling mostly fresh produce and sparing their second-choice products for agri-food companies.

The process channel is demand-driven: primary processors only order vegetables they are asked to transform by their clients. Some vegetables require specific machinery to be prepared, (e.g.: green beans go through trimmers to separate and cut them on each end), which implies a certain specialization of processing chains. When they are not equipped, primary processors subcontract these operations to other companies.

In Provence, most of production is sold as fresh produce and primary processors cannot always find enough locally produced vegetables; as a result, they purchase vegetables from other regions or countries.

Due to the lack of primary processors, secondary processors order pre-processed vegetables from other regions. Vegetables grown in Provence are sent to the closest factory for the first processing steps and later transported to back to Provence where they are cooked and transformed into readymade products.

There is a growing concern over the origin of products with the rising demand for “made in France”, but the gap between secondary food processors and farmers contributes to the slow evolution of supplying practices.

- **The wide range of stakeholders involved in the supply chain and their conflicting interests does not encourage dialogue between them. The market outlets for diversified productions are still limited and need to be secured to encourage the introduction of new crops into rotations.**

## 6.2 Overview of the stakeholders and existing projects on organic amendments in Provence

Unlike in the previous section where the focus was drawn on marketing operations and retailers, here we focused on the supply and management of resources.

We consider two categories of organic matter, those originating from vegetal sources and those from animals. Figure 3 gives an overview of the different organic matter sources and their pathway to potential users.

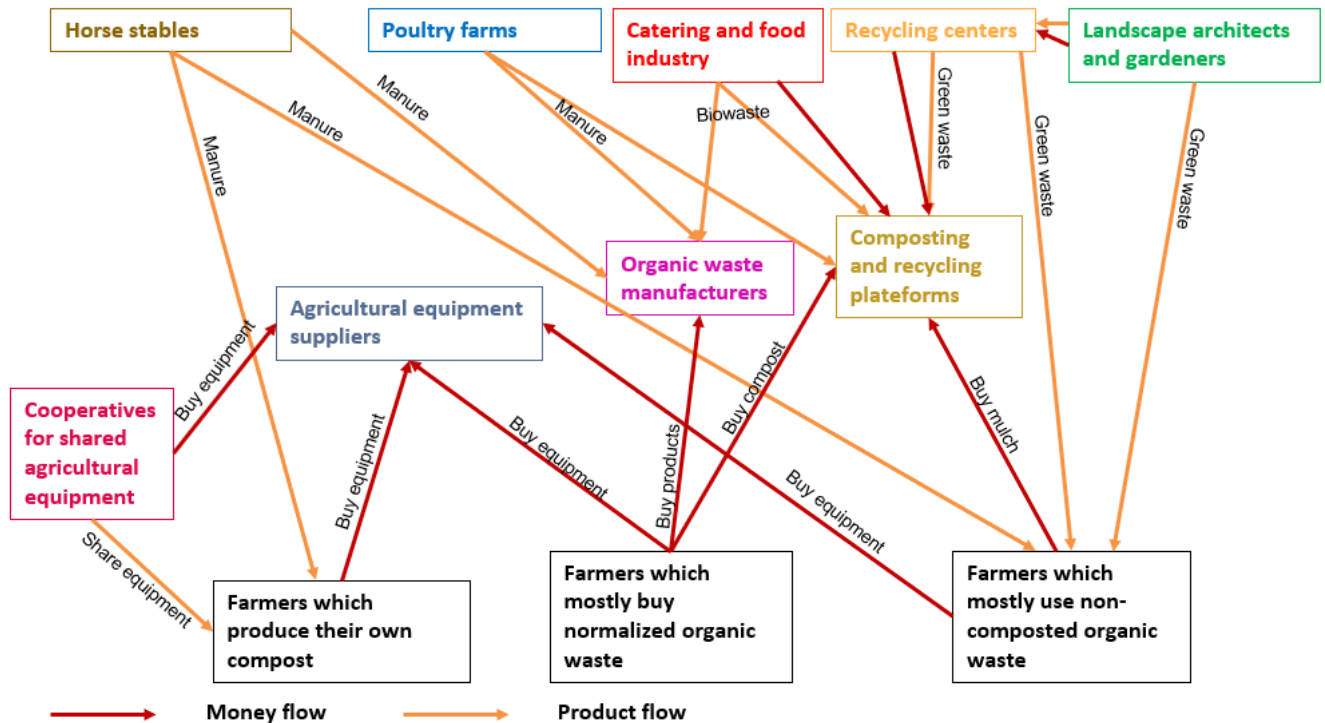


Figure 5: Pathways for organic waste in Provence

There are 32 composting platforms in the PACA region, most of them are located in *Alpes-de-Haute-Provence*, *Bouches-du-Rhône* and *Var* departments; the largest units are in *Bouches-du-Rhône* and *Vaucluse*. Composting facilities differ in the type of inputs processed - food biowaste, wood, food processing industry waste, green waste, livestock manure - as well as in their treatment capacity, which ranges from less than 2,000 tons of waste per year to over 10,000 tons per year (Groupe Energies Renouvelables Environnement et Solidarités, 2007).

The 3 largest composting platforms produce around 80% of the organic amendments in the region<sup>7</sup> and all of them are located in the study area:

- In Tarascon  $\approx$  120 000 tons/year
- In Châteaurenard  $\approx$  80 to 90 000 tons/year
- In Châteauneuf-les-Martigues  $\approx$  15 000 tons/year

These platforms charge for incoming waste and later sell normalized products to regional farmers. Some provide extra services, for instance in Tarascon the platform offers delivery and spreading services for their customers thanks to support from contractors.

<sup>7</sup> According to an interviewed compost engineer from Veolia

Beside these commercial channels, new projects supported by local municipalities and ADEME have emerged to encourage recycling of organic matter into usable amendments for vegetable growers:

A project in sheltered vegetable systems was launched by the Chamber of agriculture in the *Bouches-du-Rhône* department in 2016. Experimentations were carried out between 2017 and 2018 among a group of farmers to test the role of organic amendments on soil health. The results have shown positive effects of green waste or horse dung compost on soil structure and overall soil quality. Farmers have spread 30 to 40 tons per ha per year over a period of at least 5 years (Tosello, 2018). These regular compost applications have shown the restoration of the ecosystem equilibrium, resulting in better soil structures and less problems with soil pests or pathogens. The development of microorganisms and mycelia creates an antagonistic relationship with pests and pathogens which limits their emergence and increases aggregate stability in the soil (Rayne and Aula, 2020; Tosello, 2018).

Burning of green waste has always been illegal but somewhat tolerated for farmers. To deter from illegal burning, a decree published in March 2021 increased the fine by 70%. Consequently, more people have started to take their gardening waste to municipal recycling platforms which are overwhelmed. To tackle this issue, PACA's municipalities have looked for new outlets to dispose of their organic waste. Among these initiatives, Chamber of agriculture in the *Bouches-du-Rhône* in partnership with the Aix-Marseille-Provence metropole puts farmers in contact with green waste disposal units to guarantee free delivery of normalized compost or mulch (Chambre d'Agriculture Bouches-du-Rhône, 2020).

Within the framework of the ADAMOS program, thanks to funding from ADEME<sup>8</sup>, wine growers and vegetable farmers in the Arc valley have been able to benefit from mulch deliveries from the Aix-Marseille-Provence metropolitan area's landfills (Association Régionale de Gestion et d'Etude des sols naturels et agricoles, 2019).

The *Communauté d'Agglomération Luberon Monts de Vaucluse*, is also developing a partnership with the CIVAM PACA group to deliver green waste free of charge to farmers (Chambre d'Agriculture Bouches-du-Rhône, 2020).

Apart from green waste, there are other sources of organic matter which must be recycled. Available recycling solutions are methanization to produce biogas, or compost production on dedicated platforms. Other outlets are offered by industrial companies which use this raw material to produce more elaborate products i.e.: pet food or fertilizers. Organic waste manufacturers elaborate inputs for crop nutrition and soil fertility maintenance. Most of them collect raw material from other industries and process it to develop several ranges of products according to the needs of their customers. OvinAlp, a manufacturer based in the Alps, collects sheep manure, composts it, and then develops several normalized products sold to agricultural product suppliers. Some companies also offer delivery services to their customers and lend spreading equipment or spread it for them.

Since 2012, big organic waste producers, generating over 120 tons per year, have the legal obligation to develop separate outlets to recycle biowaste. The law will be extended to all organic waste producers in January 2024, regardless of the quantity they produce (Terrestris, 2020). This will affect most canteens, restaurants, retailers, and agri-food industrials which will be forced to find sustainable ways to recycle their waste.

An alternative for producers looking for free or cheaper organic amendments are professional arborists, landscape architects and gardeners which pay fees to dispose of their green waste in recycling centers. To avoid paying such fees, some try to get rid of their shredded wood and other forms of green waste by giving

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<sup>8</sup> ADEME: the national agency for ecological transition

them away for free. Others develop their own platforms to make compost and sell it to professionals or amateur gardeners.

As explained in section 2.2, there are limited sources of animal manure in the vegetable production zones, where organic matter is needed. However, there are two resources which could be better exploited by vegetable farmers: poultry and equine manure.

In 2019 an Environmental and Economic Interest group was developed to help a group of poultry farmers better valorize their waste and in particular by-products such as manure or carcasses.

These products bear great agronomic value, especially for market gardening, yet links between farmers and vegetable farmers have to be organized to make better use of this local resource. A few options were explored by a group of students (Bouche et al., 2021):

- composting manure on site and delivering normalized compost to vegetable farmers;
- exchanging manure with fermented forest litter from specialized recycling platform;
- selling the manure to a composting platform for 10€ a ton without quality control testing.

Out of these three options the one with the least constraints for poultry farmers was the second one. The fermented forest litter can be used as bedding to limit the development of pathogens in poultry houses and exchanged with free poultry manure. The poultry manure will then be used by the local recycling platform to create more elaborate products potentially available for vegetable farmers. The other two options were not selected largely because of economic reasons.

The same kind of initiatives are starting to develop in PACA, especially in the *Var* department where there are many horse stables and horse racing facilities. Another Environmental and Economic Interest group was recently launched as part of a call for projects from ADEME. The aim of this project is to improve air quality in Provence through the sustainable management of organic waste such as green waste and horse manure. The objective of this project is to reduce particles (PM2.5, PM10...) and ammonia emissions in the atmosphere. In the *Var* department the organic producer's association is developing a partnership between a horse stable and 5 farmers (4 vegetable farmers and 1 wine producer) to create a composting platform where they would share equipment. The horse stable would get rid of the manure for free and the 5 farmers would be able to make their own compost from a mix of green waste and horse dung.

Another national project recently began to find sustainable ways to manage horse manure in equestrian structures. This program called Val'fumier was engaged by the National Equestrian Group (GHN) and was conducted in three French regions from 2019 to 2020. A recent report based on 1056 interrogated structures presents the current situation in these three regions (IFCE, 2020). The main findings reveal that most horse stables store their manure on concrete platforms or directly on the ground and either donate it, exchange, or pay to evacuate it. Overall, these structures perceive manure as a burden and do not take much time to think about how to manage this resource sustainably.

The best solution for all would be to create partnerships amongst these different stakeholders while taking into consideration their individual desires and limitations. The next section will further expose the levers and barriers to the development of sustainable management.

- **The emerging projects in the region could be a model to organize the market on a local level. There is still a need for public incentives and support to scale up organic waste recycling and use.**

### 6.3 Barriers to crop diversification

#### Textbox 1: Synthesis of main barriers to crop diversification

The following bullet points outline the most mentioned barriers to crop diversification and will be developed further in this section. These points were extracted from a mind map which served as a basis for the analysis of the interviews. All of the findings listed in this textbox have been stated by at least 2 different sources. We chose to exclude the ones which were only mentioned by one source to enhance the consistency of the results.

- The laborious supermarket referencing and purchasing system: discourages some farmers from being referenced for more than one crop.
- The power struggle between supermarket, buyers and farmers.
- There are not many 1<sup>st</sup> processors in the region, moreover, 1<sup>st</sup> processors do not necessarily buy local products; they choose products according to quality, price, terroir of origin (marketing image). It is therefore difficult for producers to start cultivating less popular species because outlets are not guaranteed.
- Different packaging according to products and customers: producers and wholesalers have to manage the complexity of these requirements.
- Agri food processors (primary and secondary) only process what they have already sold: they work by contracts with their customers. They only place orders with producers for products that they are sure to sell, which puts prejudice on niche products.
- Retailers prioritize low prices and as a result local farmers may be at a disadvantage in comparison to foreign products.
- Labor force: difficult to find and to manage.
- Quality standardization: limits the sale of non-standard products with minor visual defects.
- Complexity of financial aid files (for farmers and wholesalers) + slow decision-making process by public financing institutions.
- Supermarket specifications + segmentation by products and by brand which do not consider the whole agroecosystem but only one product at a time.
- Regional specialization: vegetables are associated with regions/terroirs (asperge de Lauris, melon de Cavaillon, endive du nord, carottes de Créances, betterave rouge du Loiret...)
- Large and very specialized producers are sufficient to meet the market demand for certain niche products.

## *Social barriers to the lack of knowledge of other stakeholder's issues*

Throughout the interviewing process, I noted that the different links of the distribution chain work independently and are often unaware of the challenges faced by other parties. In particular, mass retailers take little consideration for the needs and constraints faced by producers while food processors are often disconnected from the production step. Moreover, multiple interviewees mentioned they regretted that fact that consumers are not as familiar with the agricultural world as they were a generation ago.

- Relationship between mass retailers and producers

The way supermarket's purchasing departments work is a hindrance for crop diversification. Platform buyers rarely have agronomic training, nor do they understand the benefits of crop diversification or rotations. They usually have marketing backgrounds and have little knowledge about agronomy and the challenges faced by vegetable farmers. Because of the centralization of purchasing platforms, buyers are relatively far from production sites and rarely visit them, as a result they are not aware of farmer's constraints. They are usually in charge of a limited number of referenced products with very different origins and characteristics. They contact the same list of farmers regularly and negotiate volumes and prices for one reference. Discussions are generally done over the phone; this leaves little time to talk about agroecological practices. According to a purchasing platform manager, some supermarket buyers never see the products they order and do not feel concerned by production issues. This way of functioning does not take the agroecosystem as a whole but only part of it. The buyers usually have little interest in the farmer's crop rotation or any of the other products he could offer.

A specialized producer explained the type of market outlet as an important barrier to crop diversification:

« Pour notre circuit de vente à nous oui, voilà honnêtement on sert quand même des clients qui veulent un certain volume, plutôt que de la diversification. C'est-à-dire que à nous ils nous achètent de la tomate, à un autre producteur il va acheter le concombre, à un autre producteur il va acheter le melon...à un autre producteur il achète le poivron... C'est plutôt ça qui les intéresse, les clients qu'on sert nous hein ! Que d'acheter plusieurs produits au même exploitant. Y'a une simplification de logistique pour eux, de commandes, voilà et je pense qu'ils se rendent compte quand même que quand une exploitation est spécialisée dans un certain produit au niveau qualité et quantité ça doit correspondre. »

*We serve clients which prefer getting large volumes rather than diversified products. That means they get their supply of tomatoes from us, their cucumber from another, their cantaloupe from another...That's what our clients are interested in at least, rather than buying many different products from the same producer. It's simpler for them from a logistical point of view, for the ordering and I think they noticed that when a farmer is specialized, they can get a certain kind of quality and quantity.*

Another one of the farmers I interviewed, mentioned in April that he already knew when his customer would organize its next discount campaign on cucumbers. He explained that when supermarket marketing departments develop advertising and product discount campaigns, they usually print flyers and leaflets in January for summer sales. It means that prices and volumes are set for products which sometimes have not even been planted, independently of natural and meteorological hazards (spring frosts, droughts, floods...). As a result, pre-negotiated prices force producers to sell below production cost. Conversely, in the event of overproduction farmers are forced to find other outlets for their produce (wholesalers, food processors...) and in some cases must throw away their products. A buyer from a specialized vegetable retailing chain gave me an example of this kind of system malfunction: a producer called him to sell his strawberry production which ripened earlier than foreseen. Unfortunately, the supermarket had planned a discount campaign two weeks later and was unable to buy his production.

Some mass retailers have developed advertising campaigns praising the benefits of agroecology which seldom translate into concrete action. In certain instances, they have reviewed their technical specifications

to orient producers towards the reduction of pesticide use while establishing slightly higher price commitments. However, the systemic approach pruned by agroecology is not considered in mass retailer's supplying system which remains specialized and centered around price negotiations.

- Relationship between food processors and producers

The same way platform buyers and producers are disconnected there is little to no dialogue between production and the final processing step. This results in a disengagement among these two professions and a partial vision of vegetable production systems. Secondary food processors are not usually in direct contact with producers, when they want to develop a recipe with a new vegetable, they ask primary processors or wholesalers to look for this product. In some cases, if it is not available, producers can decide to diversify their production to satisfy the demand. When a farmer spontaneously decides to develop a produce to diversify his crop rotation, he can inform his clients, but in the end, he depends on the final processor to sell his production. This lack of systemic vision of distributors and processors creates a status quo situation.

### ***Economic barriers***

The price of products remains the dominant criterion for agri-food industry, wholesalers, and supermarkets. Other criteria such as local production, zero pesticide residues etc. can be put into the equation if this added value is profitable to them. Given the increased risks associated with practice changes, the higher production costs and investments required for their agroecological transition, producers should be offered higher prices for their produce. Unfortunately, most of these parameters are not taken into consideration in price negotiations. This section describes the reality behind vegetable producers' insufficient gratification by mass retailers.

- Linked to mass retailers

Supermarkets are known to put pressure on farmers to provide regular volumes, high-quality produce and low cost all year round. This power struggle between production and mass retailers is mainly a result of profit imbalance between retailing companies and producers which sometimes sell their produce at a loss while profit margins stay stable for supermarkets. A vegetable producer I interviewed mentioned that during December of 2020, supermarket buyers bought his salads around 15 to 20 cents each while the production cost was 28 cents. At this time restaurants were closed due to the Covid 19 pandemic and there was a salad overproduction. However, supermarkets did not change their prices and continued to sell them at around 1€ a piece.

This imbalance is reinforced by the supermarket buyers' remuneration scheme. When they are able to negotiate lower prices with farmers, Buyers can get bonuses on their wages. This creates a hierarchy between buyers and farmers which are often reminded that they are easily replaceable if they do not cooperate. As a result, buyers are not perceived as business partners or clients by farmers but rather as coercing people. This power struggle does not encourage farmers to reduce their pesticide use or to take risks since their main preoccupation is to sell their produce at the lowest price.

Quote from a technical advisor, original and translated citation:

« l'acheteur est payé sur le grattage qu'il fait, enfin ça doit dépendre des structures, mais une partie de son salaire c'est les primes qui sont liées à « combien j'ai réussi à gratter de l'argent par rapport à l'année dernière » un acheteur il négocie quoi...il n'est pas là pour faire du *win-win*. [...] donc il y a un vrai blocage parce que tant que l'acheteur n'est pas un gars de confiance qui se base sur les coûts de production pour faire quelque chose de juste et d'équitable - enfin le monde des bisounours quoi - ça sera très compliqué d'avoir une relation de confiance qui permette d'aborder un peu d'autres sujets que le prix. »

*Supermarket buyers are paid according to the discounts they are able to negotiate, it certainly depends on the company they work for, but a part of their wage is based on how much they were able to negotiate from one year to the next. So structurally, a buyer negotiates...he's not there to*

*create a win-win situation. So there's a real deadlock, because as long as the buyer isn't someone farmers can trust, it'll be difficult to start talking about something else than the price. - a technical advisor*

In addition, farmers are rarely compensated for developing agroecological practices. When they are, these compensations do not cover all additional risks. An interviewee working for a famous mass retailer declared they can only compensate farmers with a 15% price increase on products grown using agroecological practices, arguing this was the maximum price difference consumers would be willing to pay for. This raises ethical questions since supermarkets tend to make more profit claiming that these products are healthier and environmentally friendly.

- Linked to food processors

Agri-food companies must respect certain rules for product labelling to avoid misleading consumers. If a product indicates it is **local** or **from Provence** this means the quantity of ingredients from Provence represents a large proportion of the product content, otherwise it can be misleading to the consumer. When given the choice between a French pepper and a Spanish pepper, food processors will most likely choose the cheapest, especially if this pepper is not the main ingredient in the recipe. As a result, local producers will have more difficulties selling their produce unless they represent large volumes in a recipe labelled as local or Provence origin.

A producer explained that when he was going through his transition to organic, his produce were less beautiful because he had to go through an adaptation phase. He was lucky to sell his produce to a primary food processor which didn't care about visual defects. This shows that food processing industry could be an interesting outlet for vegetable farmers choosing to start a new crop since this outlet is much less demanding in terms of visual quality. Unfortunately, farmers lack interest for industrial outlets, and seldom take advantage of this market.

Vegetable producers in Provence prefer to sell fresh produce as they believe they can get higher margins. Food transformation is seen as a secondary commercial outlet for vegetables with visual defects. As a result, many farmers will offer to sell their second-choice vegetables to agri-food processors but without real contract agreements. Transformation is viewed as a security option in case vegetable quality is not good enough to be sold directly on the fresh market. If producers had a separate production system for food industry only, they could save a lot of production costs and make more profit since these products do not require as much attention.

### ***Barriers related to equipment/inputs***

- Linked to producers and wholesalers

The differentiated packaging requirements according to products and customers was also cited as an obstacle to crop diversification by seven different stakeholders. These demands make the work more complicated for producers and wholesalers which have to manage different packages per produce and per client.

- Linked to food processors

Primary food processors owning their factories can invest in machinery from time to time in order to process a wider range of vegetables. Although most vegetables go through more or less the same process for washing and freezing, for other operations such as cutting, specific machinery may be needed (e.g. green beans or peas). Food processors will only invest in this type of equipment if they have contracts and big volumes to process. Otherwise agri-food companies do not have the guarantee that they will sell significant volumes and do not invest in new machinery to process less common vegetables.



- Linked to producers

A large producer mentioned that the development of new resistant varieties was an obstacle to crop diversification. He thought that there wasn't enough research to develop new varieties for certain crops which discouraged producers from cultivating more uncommon vegetables. Interviewing seed breeders could have given us more insight on this issue.

Equipment's economic profitability can also affect the introduction of certain vegetables in crop rotations. Another diversified producer mentioned he was grateful he inherited from his parent's spinach harvester which allowed him to be more efficient and reduce his production costs:

“We know someone who cultivates spinach, they are 5 and when they harvest them, they prepare 200 crates a day when we can make 400 with only 3 workers thanks to the harvester.”

This same producer explained us that he could only efficiently produce radish if he invested in a radish harvester: “we tried cultivating radish, but we would need a harvester because harvesting by hand isn't profitable...we could barely pay our workers.” Unfortunately, he did not cultivate enough surface to justify such an investment (50 000 to 60 000€).

### ***Labor force barriers***

Qualified labor is rare and usually it takes time to teach and manage employees on diversified farms which contributes to farmer's idea that is better to have a few species rather than a diversified system.

For farmers choosing to diversify, the availability of work force will come into account when choosing which crops are grown. A cantaloup producer wanting to start growing tomatoes will need more labor force. The new crop introduced in the rotation should require equivalent labor force, time, and fit into the crop calendar to avoid the significant overlapping of workloads. Some crops like tomatoes and cucumbers require attention at the same period, this will need to be considered when deciding which crops to implement.

Since agricultural workers can be difficult to find, a lot of the labor force on vegetable farms comes from abroad. Foreign workers often come for 6 months on a seasonal contract and then, because of their work permit expiration, must leave for 2 months before coming back to work again. To get around this law, many farmers create two separate structures and alternate between these structures to keep their workers all year round without a two-month interruption. Visas can also be complicated to obtain for people coming from outside of Europe, like Maghreb counties. With the pandemic, many workers stayed stuck in their home country unable to come to work on time.

In PACA, much of the employees are seasonal foreign workers, this can lead to communication and relationship issues. A producer mentioned that some of his employees could not get along together or simply would not understand each other because of language barriers. The same producer told us some workers would simply not show up to work some days, without informing him. Another large producer admitted that managing employees was the hardest part of his job, especially since they sometimes had to retrain new people each season.

### ***Red tape & legal barriers***

Regulatory and administrative barriers and European quality norms hinder practice change. Public subsidies are insufficient to incentivize vegetable producers because of the administrative burden they represent.

Public funds such as the FEADER from the European Union is redistributed on a national and regional level through subsidies. These are available to encourage sustainable development and innovation within the agricultural sector. There are investment subsidies which can help invest in certain types of machinery or infrastructures.

When asked about their financial aids, wholesalers either did not know they were eligible nor were they aware of their existence. Out of the 6 interviewed vegetable producers most rarely received any financial aid. They usually did not take the time to fill out the paperwork, either because they did not to rely on subsidies or simply because application forms were too complex and time consuming.

The European regulation N° 543/2011 details the rules for the application of Council Regulation (EC) N° 1234/2007 in respect of the fruit and vegetables and processed fruit and vegetables sectors. The CEE- ONU norm on product standardization are a part of this European regulation and impose quality standards for the marketing and quality control of fresh fruit and vegetables. These standards are specified for 11 products: apples, citrus fruit, kiwifruit, lettuces, curled leaved and broad-leaved endives, peaches and nectarines, pears, strawberries, sweet peppers, table grapes and tomatoes. The CEE ONU norms involve further quality standards on 50 products like for tomatoes or apples. The application of the CEE ONU norms are not mandatory but most mass retailers choose to apply them and impose them in their production specifications.

According to the European law N° 543/2011, all products must follow minimum quality standards to be sold through mass retailing systems as fresh produce. Products respecting the minimum quality requirements must be: intact, sound, clean, fresh in appearance, practically free of pests or damage caused by pests, free of moisture or foreign taste and smell (European Commission, 2011).

Fruits and vegetables can be classified into 3 categories: extra, class 1 and class 2. According to their caliber and visual aspect like color or deformities they will be classified in either of these categories, extra being the best and class 2 being the bare minimum. An excerpt of these marketing standards applied to tomatoes can be found in appendix 5.

Products must go through quality checks and be certified to avoid violating these regulations. When this happens, companies can get fined by the General Directorate for Competition, Consumer Affairs and Repression of Fraud. Mass retailers must therefore follow these European regulations. They usually sell extra or class 1 products because they do not have the logistics to sell class 2 products. However, the application of these laws differs from one company to another. Their tolerance towards quality standards can also vary according to product availability. For instance, in the event of a product shortage due to climatic events, some companies may choose to sell slightly altered products to satisfy the demand, but in which case they risk getting fined.

These norms push supermarkets to always offer at least class 2 or extra products, meaning fruit and vegetable which do not fit into these imposed “beauty standards” are often rejected.

### ***Sectorial and market barriers***

- Regional specialization

Diversified crop rotations including vegetables such as fennel, lamb’s lettuce or chard are not very common in PACA. Mass retailers usually get their supplies in other regions or countries where they are produced on large scales in specialized systems. The market demand for these products is not as important and most of the time specialized producers are sufficient to meet this demand. This leaves little space for newcomers with smaller volumes.

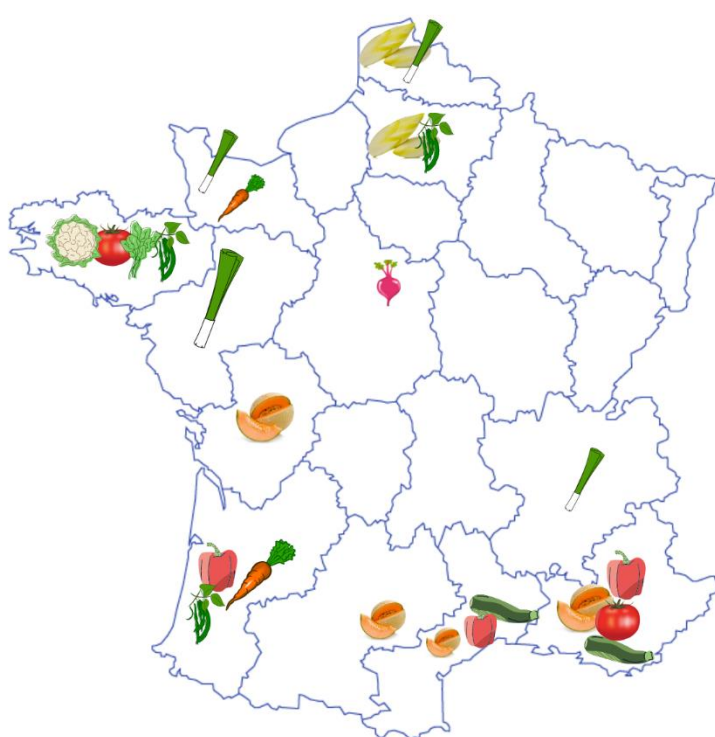
Price wise, imported products remain more interesting but do not necessarily respect the same social and environmental regulations: supermarket buyers mainly take the price difference into account and not the social or environmental footprint.

In France as in many countries, certain regions are known for specific productions, these production basins often lead to inter-regional competition. This is also a prominent phenomenon in vegetable production. Consumers associate certain regions/ terroirs to specific products and tend to be more attracted towards quality labels such as protected geographical indications (IGP in France) and unconsciously associate regions to certain vegetables.

During one interview a food processor stated :

« Les légumes rentrent dans les catégories : la courgette de provence c'est la vraie courgette tandis que la courgette d'Ile de France ça va faire bizarre quoi. Pomme de terre provence ça fais pas rêver alors que les pommes de terre Val de Loire c'est plus parlant. Les légumes sont vraiment très identifiés à des régions.»

*Vegetables are categorized, the zucchini from Provence is considered as the real zucchini whereas a zucchini from Ile de France sounds weird to people. The same thing is true for potatoes, potatoes from provence is not appealing to people while potatoes from Val de Loire are much more enticing. Vegetables are strongly associated with regions.*



Share of national production per region	
Beetroots	48% Centre
Bell peppers	19% PACA 18% Aquitaine 11% Languedoc-Roussillon
Carrots	24% Aquitaine 13% Basse-Normandie
Cantaloup	21% Midi-Pyrénées 20% Languedoc-Roussillon 16% PACA 14% Poitou-Charentes
Cauliflower	81% Bretagne
Endives	54% Nord Pas de Calais 34% Picardie
Green beans	29% Bretagne 25% Aquitaine 19% Picardie
Leek	24% Basse-Normandie 11% Pays de la Loire 10% Rhône-Alpes
Spinach	48% Bretagne
Tomatoes	23% Bretagne 23% PACA
Zucchini	26% PACA 17% Languedoc-Roussillon

**Figure 6:** Map of vegetable production basins in France

Figure based on the most recent numbers from 2017-2019 from the National technical institute for fruit and vegetables (Centre technique interprofessionnel des fruits et légumes (France), 2021).

The vegetable sector is facing the specialization of its stakeholders. They have progressively organized themselves around brands such as *Perle du Nord* in the north for endives, or in the south *Les paysans de Rougeline* which are well known for their tomatoes. This results in further specialization and reinforcement mechanisms creating a lock-in situation in which stakeholders are structurally organized to deal with these products. The structures are able to meet mass retailers' standards while continuing to offer lower prices and large volumes.

- Mass retailer's specifications and referencing system

Supermarkets favor some varieties because of conservation properties or consumer preference. A producer mentioned he chose his seeds according to supermarkets preferences: between two salad producers, they would choose the one growing blonde Batavia lettuce rather than green ones. From an agronomic point of

view, varieties imposed by supermarkets are not always the most resistant. This often leads farmers to plant the exact same variety at the same time which facilitates disease and pest propagation.

Farmers must often wait from 6 months to a year before they are referenced in a supermarket system. The referencing process is very costly for supermarkets (10 000 € per reference, according to a Group Innovation Director from one of the largest mass retailing companies in the world), as a result when a farmer gets referenced for a product, it is for a long time. Two of the farmers I met admitted they felt very lucky to be referenced by one of the largest retailing brand in the world. One of them told me his parents used to sell their produce to this retailer and he took over. Another one had to wait a year and a half to finally get a spot to sell his salads. This mandatory procedure is discouraging farmers wishing to sell multiple vegetables.

### ***Mindset barriers***

Farmers close to retirement are usually less prone to change and face difficulty for the transmission of their farm. A couple I interviewed admitted they had been following a production routine for years and did not want to change their habits because they would soon be retiring. They were still unsure what to do because none of their children wanted to take over the farm. This is not an isolated case in the region as 70% of vegetable farmers over 50 years old declared being uncertain about the future of their farm during the last agricultural census (AGRESTE, 2014).

This same senior couple was relatively specialized with a simple crop rotation including tomato and salad for the past 30 years. They had followed their family footsteps and continued cultivating the same crops. Most of the farmers I interviewed took over the family business and continued cultivating more or less the same crops as their parents since they knew how to grow these crops and could keep the same clients. At this time, vegetable farming was already very specialized and chemical inputs were used more systematically, this was the norm and unfortunately today some farmers still think this way.

Five interviewees, mostly producers and wholesalers viewed organic agriculture as a separate system with specific standards, involving different consumers and stakeholders. Most of them perceived organic products as a way to attract new clients rather than a path toward more sustainable systems; they considered this approach as a trend driven by certain privileged customers and unable to replace conventional systems. A producer mentioned he would never become organic because he believed they would not be fulfilling their role to feed the population:

« Personnellement le bio strict j'y ai jamais cru parce que je me suis toujours dis qu'en tant qu'agriculteurs on a une devoir et ce devoir c'est de nourrir le peuple et malheureusement on a un devoir de rendement. »

*Personally, I've never believed in organic agriculture because I've always believed that as a farmer I have a duty to feed the population and unfortunately we have the obligation to produce high yields.*

→ **The barriers listed in this section reveal the multidimensional aspect of the crop diversification problem. The way the system is organized makes it impossible to address this issue without a combination of levers involving multiple stakeholders.**

### **6.4 Levers to crop diversification**

The following levers could help unlocking the previously described barriers to crop diversification. Some of the following levers were mentioned by interviewees or deduced from the overall understanding of the system combined with some research.

## ***Knowledge levers***

- Raising awareness among platform buyers

As mentioned above, there exists a gap between production and distribution, in which purchasing, and marketing departments do not feel involved in production issues. This can be attributed to retailers' poor experience concerning agronomy or agroecology creating a detachment between them and farmers.

An agroecological transition can only be accomplished through a systemic approach which encourages knowledge sharing among food systems' stakeholders.

Given their significant influence, mass retailers have the responsibility to facilitate exchanges and information flow throughout the distribution chain. Organizing events to encourage knowledge sharing about agroecology and initiate dialogue is one of the ways to bridge this gap and create better relationships between producers and retailers. Educating supermarket buyers on agronomy could contribute to shifting their perception of farms from single product suppliers to complex systems with interacting crops and elements.

Diversification in the field must go hand in hand with buyers' diversification. Supporting buyers' versatility and adaptability is essential to encouraging systemic vision. Rather than having someone specialized in exotic fruit and apples for instance, buyers could be in charge of purchasing a list of vegetables from the same producer and follow their production calendar along with the potential issues they could face. The goal of this approach being to promote dialogue and trust between buyers and producers.

## ***Economic levers***

As mentioned in the previous section, supermarket buyers' remuneration schemes call for relentless price negotiations with farmers. This creates an unbalanced dynamic between farmers which sometimes do not get compensated accordingly to the quality they provide, and buyers which are not inclined to learn about sustainable practices.

Through our understanding of the system and our interviewees' experience we were able to identify concrete ways to promote trusting relationship amongst farmers and buyers. The following ideas are intertwined and would have to be combined to other levers to create long lasting change:

- Finding an indicator other than the price to establish bonuses on platform buyer's wages. The idea would be to encourage buyers to purchase quality products rather than to push towards lower prices. Similarly, to the current system, buyers would receive bonuses if they favored products cultivated according to agroecological practices. This may motivate buyers to take interest in farmer's practices and to understand the crop rotation as a whole.
- Encouraging partnerships rather than hierarchical relationships by developing multi-year contracts between retailers and producers with minimum commitments on price and production surfaces which would allow producers to plan diversified crop rotations in advance.
- A young company<sup>9</sup> developed in 2020 has developed a new model based on transparency and agroecological transition. The concept is based on an app where consumers can get their groceries delivered at home. For each purchase made, the consumer receives a detailed receipt including what each share of the price goes into, including the company's own profit margins. Thanks to established partnerships based on agroecological transition, this retailer is committed to providing fair wages to their suppliers.

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<sup>9</sup> <https://www.omie.fr/>

## ***Technical lever***

- Simplifying packaging system

Packaging was pointed out as a complex issue by wholesalers and farmers selling to mass retailers, especially when multiple products were involved. Retailers could provide the same reusable containers which would be recorded in a computer system thanks to an electronic chip or QR code for traceability. Creating standardized packaging systems would facilitate logistics especially for producers selling diversified products through long distribution channels.

## ***Levers linked to the sector***

- Simplifying referencing systems

In Provence some vegetable producers sell their produce directly to local supermarkets without going through referencing procedures developed by mass retailers. This is a controversial topic as some producers which are not referenced think it is a great way to sell multiple produce locally with better margins while others which are referenced think it disrupts other producers' organization. The issue lies in the fact that most supermarkets do not have people in charge of certifying product quality. This can cause customer dissatisfaction if low quality products are sold. To address this topic, fruit and vegetable floor managers could get trained as certifiers or establish written agreements with producers to certify product quality. A last option could be the development of specific fruit and vegetable sections for local products with more flexibility on product standardization similar to zero waste grocery shops.

Facilitating referencing systems could make producers more willing to offer diversified products to distributors. Most of the interviewees mentioned it was difficult to sell multiple products through supermarkets due to the cumbersome referencing system. To facilitate this process, which is usually done through the phone, a faster referencing process could be developed. Farmers would have the possibility to contact the closest supermarket fill in a form and shorten the referencing process from several months to a few days. As an alternative, retailers could develop systemic referencing processes. Producers and wholesalers often mentioned they could not sell multiple products to mass retailers because over the years their names had been associated to one produce.

This idea can be summarized by a wholesaler's quote:

« La GMS ils ont une image de tel fournisseur c'est tel(s) produit(s) et pour en sortir c'est compliqué, c'est-à-dire qu'aujourd'hui je travaille beaucoup avec Carrefour c'est mon plus gros client, ils m'achètent des salades et des courgettes et quand je leur propose des poivrons ils me disent non mais j'ai pas besoin de toi j'ai déjà mes fournisseurs. »

*Mass retailers associate each of their suppliers with one product and to get out of this idea it's difficult for example today I work a lot with Carrefour they're my biggest client, they buy salad and zucchini from us and when I offer peppers, they tell me they don't need me because they have other suppliers for that product.*

To go against this tendency, buyers should have access to the full range of products cultivated by a producer instead of having one referenced product per farmer.

- Partnerships between local producers and food processors

Many of the fruit and vegetable agri-food companies in PACA are concentrated in the *Vaucluse* and *Bouches-du-Rhône* departments and the majority are secondary processors (Ministère de l'Agriculture et de l'Alimentation, 2018). Their geographical proximity to vegetable farms could be an opportunity to develop shorter supply chains and to establish partnerships with local producers.

An example of a successful partnership is an artisanal organic cannery working directly with farmers to create soups and other preparations. Their goal is to limit waste by processing seasonal production surplus,

or ugly fruit and vegetables for local canteens and farmers. They also have their own brand and sell their products in nearby organic grocery stores in limited volumes.

Secondary processors could create separate production lines for the development of regional products which would be sold in a local perimeter. The first processing and secondary processing step would be operated in the same location partly mechanized and partly by hand as it is already the case for most companies in the region which is characterized by a large number of small companies (Ministère de l'Agriculture et de l'Alimentation, 2018).

These kind of initiatives could be an opportunity for producers wanting to diversify their crop rotation especially with consumers rising demand for local and zero waste produce.

### ***Legal levers***

- Facilitating access to quality labels for producers

In November 2018 the first *Egalim* law was enacted to promote equity and sustainability within food systems. A part of this law mentions supply requirements for collective catering, it states that at least half of the products must benefit from official signs indicating quality and origin or other quality labels. This has spread the popularity of environmental certification labels and High Natural Value labels (HVE in French) and encouraged a shift towards more agroecological practices.

Since 2018, the HVE label has become prominent and will soon become a requirement for producers selling their products to mass retailers or catering services. Most interviewed wholesalers explained that this label was becoming the norm for producers selling their vegetables through long marketing channels and that they were pushing producers to get certified. The demand to get certified comes from mass retailers however this certification is usually at the producer's own personal expenses. Some food processors or large wholesalers sometimes have their own technicians which can help accompany producers towards practice changes, but this is rarely the case. Providing such technical assistance could help guide producers towards certifications like HVE.

### ***Organizational levers***

- Sharing certification costs

To incentivize farmers to change their production practices, certification costs could be spread out between producers and mass retailers through the support of advising departments which would provide free advising services to help producers get on the right path. This may accelerate change and take a burden off producers which would perhaps feel less forced.

- Developing cooperation and sharing resources among vegetable producers

An interviewee working in a national wholesaler's network explained that there was an issue with the supply of wholesalers which would either favor the same large cooperatives or specialized producers with significant production capacity. She asserted that it was in vegetable producers' best interest to develop collective organizations. One could imagine a system where producers exchange their equipment or fields from one year to another to avoid planting the same botanical families on the same land from one year to another.

The best way to promote diversified farms is to preserve an intermediary between producers and retailers to take charge of logistics and product marketing. Today many vegetable producers in PACA spend large portions of their time organizing the logistics around product sales which takes away from their already limited time to tend to their crops. This work can be done by cooperatives or other types of collective organizations which exist in the region but are not as developed as in the north of France.

- **The combination of these levers could help to increase vegetable producer's ability to negotiate prices and contracts while securing outlets for potential niche vegetables.**

## 6.5 Barriers to the development of organic matter use

### Textbox 2: Synthesis of main barriers to crop diversification

Like in the previous section the bullet points in this box summarize the most mentioned barriers to the use of organic matter (stated by at least 2 different sources).

- The storage of organic matter must be done in particular conditions and respect a spreading plan, many regulations overlapping but not always the same from one type of OM to another: European regulation, French and regional regulations.
- Composting facilities are considered classified installations for environmental protection. (ICPE) which implies a number of rules: eg: composting facilities must have specific approval to process certain types of waste such as animal by-products (Doligez, 2019; Rubio et al., 2019).
- Over 1000 tons of organic matter treated per year: obligation to declare a composting project to the town hall.
- Manure pits must be of at least: 2m<sup>2</sup> per horse for 2 months of storage or 4,6m<sup>2</sup> per horse for 6 months of storage (Doligez, 2019).
- Storage in the field is tolerated for maximum one year and it must be moved from one year to the other (and must not return to one same location before 3 years) (Rubio et al., 2019).
- Global Gap certification implies traceability on inputs meaning farmers can't use a neighbor's animal manure on their crops: the amendments must be normalized.
- Presence of plastic residues, scrap metal when the mulch comes from recycling centers.
- Farmer's preference for commercial and normalized organic matter.
- Vegetable farmers, poultry farmers and horse facilities don't necessarily have the required equipment for composting or transportation.
- The source of organic matter may be far from the farmers: high cost for delivery.
- Vegetable farmers don't always the space to make or store compost/mulch.
- Delivery may be an issue when trucks cannot access the farms.
- Lack of awareness on benefits of organic amendment use for soil health.



## ***Regulatory and administrative barriers***

- Administrative inertia and lack of follow up

Chambers of agriculture and associations such as the CIVAM or Agribio encourage stakeholder interaction and connection through training, projects, and shared equipment groups. Such projects have emerged over the past 5 years but have been fairly few in number. When discussing this issue with a town hall representative he partly attributed this delay to administrative inertia (red tape). He deplored France's excessive bureaucracy and added that European and national financial aid projects were never easy to obtain. Because of the technical turnover and small financial resources, projects can also be abandoned halfway. According to an agronomist formerly working at the chamber of agriculture, technical advisors are often young and not very well compensated, this results in frequent staff changes and inconsistency. This combined with the various overlapping regulations enhances project development complexity.

- Multiple regulations affecting production

Organic matter is rigorously framed by European, national, and regional rules. As such, storage and spreading must be done in particular conditions according to the type of organic matter.

The Sanitary departmental regulations (RSD) apply to all equestrian structures and defines the rules on manure storage. The minimal distances for any equestrian installation including manure storage areas must be at least:

- 200 m away from a fish farm or a bathing area
- 50 m from housings and recreational areas
- 35 m from water sources, banks, wells
- 5 m from roads

According to the law, composting facilities are categorized as classified installations for environmental protection (ICPE). As a result, they must have specific approval to process certain types of waste like animal by-products (Doligez, 2019; Rubio et al., 2019).

If a composting platform handles over 1000 tons of organic matter (plant waste or animal manure) per year this platform is subject to town hall declaration. If it processed biowaste from food processing industries the limit is lowered to 700 tons per year (Rubio et al., 2019). Depending on equestrian structures and the way horses are kept the manure production can vary between 9 to 12 tons per horse per year with on average 46 horses per facility (Damiens, 2017; Doligez, 2020). This amounts to approximately 500 tons of manure per facility on average.

According to the directive on nitrates horse manure must be stored 2 months in a manure pit before it can be transported and stored somewhere else. This manure pit must measure at least: 2m<sup>2</sup> per horse if the manure is stored up to 2 months and 4,6m<sup>2</sup> per horse if it is stored for up to 6 months (Doligez, 2019).

Based on the responses of 1056 equestrian facilities surveyed nationally, 50% declared they stored their manure on bare ground in a field (IFCE, 2020). In France this type of storage for manure is tolerated for maximum one year provided that it is not always done on the same location and only if the manure has been stored in a manure pit for minimum 2 months beforehand. In the last case scenario windrows must be moved from one year to the other and must not return to one same location before 3 years (Rubio et al., 2019).

## ***Quality and traceability barriers***

- Certification imposing traceability

Certifications like Global Gap<sup>10</sup> can cause complications for the development of “homemade” compost or non-standardized organic matter. In order to fulfill these requirements, producers have to keep detailed records of every input they use in their crops which pushes farmers to use normalized commercial inputs such as organic amendments which are less beneficial for soil life.

A producer mentioned during an interview:

“Our neighbor is a sheep farmer, but I can’t use his manure because of Global Gap because it’s not a standardized product;”

- Insufficient quality, lack of technical specification of composts

A group of poultry farmers in the *Vaucluse* and *Bouches-du-Rhône* were exploring the possibility of creating a shared composting platform to sell their manure to local farmers. Eleven vegetable farmers were surveyed by bachelor students in 2021 to get a better idea of their expectations and interests. The report revealed that most vegetable farmers wanted composted manure (Bouche et al., 2021). Interviewed vegetable farmers also indicated they wished for lab tests to certify the compost quality and composition in order to satisfy their norms’ traceability requirements. The supplementary costs for poultry farmers to certify the quality of compost led them to abandon the idea of making their own. After evaluating the best possible solutions for poultry farmers, the report concluded that composting would take poultry farmers too much time, money and would likely not guarantee the best compost quality.

Due to the incoming growth of green waste, a number of municipal recycling centers are offering free mulch deliveries to farmers. Unfortunately, these products often do not go through sifting processes which leaves plastic residues, scrap metal and other unwanted objects which then land in farmers’ fields and does not encourage them to continue using compost or mulch.

- Lack of trust in non-conventional products

Green waste can be variable in quality and in its composition but in general it has a high carbon to nitrogen ratio. This type of organic amendment can generate nitrogen deficiency when it is not used regularly, in this case a complementary source of nitrogen can be used to prevent this (Chambre d’Agriculture du Var, 2019). On the other hand, fresh manure especially poultry manure can provide nitrogen burn due to excessive nitrogen content and must be quickly incorporated to the soil to avoid volatilization (Gazeau, 2012).

A farmer declared that non composted horse manure could contain unwanted seeds and bring weeds into crops, he added that the composting process was complicated, and that most producers he knew preferred buying normalized produce rather than making their own compost.

## ***Technical barriers to compost production and spreading***

A good composting process involves an adequate mix of organic matter with a carbon to nitrogen ratio close to 30, sufficient oxygenation and about 50 to 60% water content (Bouvier, 2012). To obtain optimal parameters and reach the right temperature increase, windrows must be turned over regularly and watered. This process requires time and equipment, and farmers’ busy schedules make it difficult for them to find enough time to maintain a compost. Vegetable farmers usually do not own the adequate tools for composting such as tipping trailers which are necessary to create windrows. This is mostly due to the fact that market gardening does not require much machinery compared to cereal cultivation for instance.

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<sup>10</sup>Sets standards for good agricultural practices. More information available at: <https://www.globalgap.org>

To avoid leaching and fully benefit from organic matter's properties compost or manure must be spread quickly following its delivery. Since vegetable farmers do not usually own manure spreaders, they can either borrow or lease this kind of equipment, but this often means they are not free to decide when they can use it.

Peri urban equestrian structures are faced with similar issues, they rarely own the appropriate equipment or sufficient storage space to make compost. In addition, equestrian facilities view manure as waste and generally do not want to spend time composting it. It is especially difficult for them to evacuate their manure when they are close to cities. The animals in these facilities spend more time in stalls which results in greater manure production and daily maintenance. This is not a problem for horses which have access to pasture all day.

Depending on the type of litter used by equestrian structures horse manure can be difficult to compost. For instance, when straw is present in the mix it is preferable to shred it before composting it. On the other hand, manure with wood chip litter is often less oxygenated and contains more lignin which takes longer to degrade (Mouton, 2012).

### ***Logistical and storage barriers***

Transporting raw organic matter to composting facilities is quite costly on the long run and is discouraging for poultry farmers or equestrian facilities which try to find local alternative outlets. Unfortunately, such outlets like free giveaway or trading with local farmers, are usually short-term solutions and are not enough to evacuate the totality of the volumes produced. In addition, appropriate tools for composting or to create mulch (shredders, tipping trailers) can be costly and small organic matter producers are not always inclined to invest in such equipment on their own.

The study on poultry farmers found that the majority of surveyed vegetable farmers prefer getting delivered because they do not own the equipment and prefer paying instead of having to take time to pick it up themselves (Bouche et al., 2021). A project manager working for the regional horse association mentioned that equestrian centers were not well equipped to deliver horse manure and when they were, they refused to go over a 15 km radius because of financial and environmental costs. These same issues were also pointed out by poultry farmers.

A local advisor specialized in waste recycling and delivery admitted that organic matter transportation was a recurring problem in his work for the promotion of compost and mulch use. He stated in his interview that vegetable farmers usually have small surfaces and in the majority of cases the entire space is used for cultivation, leaving little space for storage. The size of vegetable farms could also occasion accessibility problems for delivery trucks which were unable to reach their destination.

According to a compost engineer from a local composting platform there were more requests from other agricultural sectors such as arboriculture of cereal cropping which he thought could be explained by the fact that these farmers were more equipped than vegetable farmers to spread these products.

### ***Implementation and organizational constraints***

Given the technical and organizational limitations, vegetable farmers prefer using readymade commercial fertilizers which they can spread by hand rather than making their own compost which can be unpredictable. Others are simply used to proceeding a certain way and do not want to change their ways. Although there is a strict framework to limit burning, this practice is anchored in the agricultural world, people believe it avoids disease spreading and it is also much less constraining than to bring green waste to recycling platforms. Collective composting is seen as complicated as it demands land, organization and equipment sharing.

A recycling center manager mentioned during an interview that he thought there was a lack of communication on mulch availability in the region and thought that vegetable farmers would use it more if they knew they could get it delivered for free. Two technical advisors mentioned there is a lack of

organization between equestrian facilities, professional arborists and vegetable farmers which could bypass large composting platforms and create partnerships.

### ***Barriers related to knowledge***

According to a technical advisor from the chamber of agriculture, the use of locally produced compost, mulch of fresh manure by vegetable farmers is still anecdotal and is mostly popular amongst organic vegetable farmers which are more informed on the benefits of organic matter use on soil health. The lack of knowledge on composting and on the benefits of organic matter was pointed out by four technical advisors. This was mostly attributed to the force of habit especially for older generations which took less interest in new practices and preferred working the same way they always had.

Out of 6 interviewed producers, two mentioned they used mulch on their crops as a means to fight against a soil pathogen while the others did not mention organic matter as a lever to improve soil health but they rather perceived organic amendments as a means to boost their soil's organic matter content and improve crop growth without considering the entire soil ecosystem.

In a webinar on horse composting regulations, an expert on horse care and nutrition stated that organic vegetable farmers did not necessarily know that they could use horse manure in their crops because of their organic label. This stems from a confusion between the different requirements and a lack of communication on the benefits of compost use.

A wine grower shared his experience with horse manure composting on a webinar organized by the regional horse association. Following up on his first attempts using homemade horse compost he concluded: "If we add up the economic and social barriers, it is sometimes better to buy a fertilizer than to make compost: there is a risk of making a bad compost and that it does not have the expected properties on the soil because of fast mineralization."

- **Cost and transportation are the main issues hindering the development of local organic matter and vegetable producers still need to be convinced of the benefits of its use. In addition, the use of organic matter requires specific equipment and training.**

## 6.6 Levers to the development of organic matter use

### ***Technical levers***

- Sharing techniques for composting

Horse manure represents a great potential resource for market gardening in PACA due to the number of equestrian structures, but its composting is quite technical. Following multiple tests with horse manure composting, a wine grower mentioned three techniques to improve manure composting. On his first attempt his compost failed because it was too dry and compact. To address these problems, he tried mixing the horse manure with plant material with higher humidity contents, this allowed for a rapid increase in temperature. He also experimented with a shredder to break down dry manure and accelerate the thermophilic phase.

The last technique he tried out was certainly the easiest to implement for vegetable farmers which do not own a shredder. This technique consists of sowing the windrows with radish and mustard. He explained that the tap roots improve water and oxygen infiltration and could help compensate for physical or mechanical turning. This process also captures and stores excess nitrogen which could otherwise be lost through leaching.

A solution for small equestrian facilities wishing to find solutions for manure management is vermicomposting which requires very little investments and little maintenance. The first step is to create windrows measuring maximum 1,20 m to keep oxygen flow and then to add the earthworms in a mix of horse manure and green waste such as to maintain a 40/60 carbon ratio. This method to manage horse manure only requires a bit of watering with a simple pierced hose and earthworms which will then reproduce on their own.

- Partnerships and pooling of resources

Another commonly mentioned obstacle to the use of compost is the lack of spreading equipment on vegetable farms. We have identified two potential available levers in the region. Equipment sharing could be a potential solution for vegetable farmers which produce their own compost. This can be done through equipment sharing cooperatives or through the creation of collective composting platforms. Another already existing option is by calling upon large local composting platforms or operators which offer spreading services. An interviewee mentioned that his parents used to pay a private operator to spread their compost but that these kind of arrangements are rare to find today.

The previous examples dealt with the recycling of organic matter involving its transportation. But a technical advisor also mentioned cover crop grazing by sheep was an emerging practice for organic producers. This type of agreement between sheep farmers and vegetable farmers has a great potential. On one end the sheep farmer gets to benefit from free forage for his flock and the vegetable farmer benefits from free sheep droppings without having to mechanically remove his cover crop.

### ***Regulatory levers***

- Improving the organization around local resource recycling

The new decree reinforcing the framework around green waste burning has generated an increase in the volumes collected by municipalities. Meanwhile the law on biowaste has contributed to the development of outlets for the recycling of organic waste into reusable resources for local farmers. Considering that in 2024 all biowaste producers, companies, or individuals, will be required to recycle their biowaste, this trend will continue to grow in the next years.

As a result of these regulatory evolutions, municipalities have started to reflect on alternatives for the evacuation of their compost and mulch which may improve the organization and the quality of products generated by this outlet in the future and inspire vegetable farmers to buy more of these products.

## *Economic levers*

- Sharing costs through collective partnerships

Equestrian facilities view horse manure as a burden and look for solutions to evacuate manure for free or at low costs (IFCE, 2020). As a result, horse manure is an abundant and financially accessible resource in the region. Partnerships between farmers and horse stables exist but are not well developed in PACA. When they do exist, these relationships rarely involve vegetable farmers but rather cereal producers which can trade straw or hay in exchange for manure.

The Environmental and Economic interest group involving vegetable farmers, a wine producer and a horse stable in the *Var* department could be replicated if it succeeds. Today this project has just begun but the end goal would be to create a collective composting platform which could equally benefit all parties. Today they are looking to work with a professional arborist which could provide green waste to balance out the manure and accelerate the composting process. If this project accomplishes its goal, the horse stable would have a long-term outlet for its manure and the farmers would be able to produce their own compost without having to deal with time, equipment, transportation, or storage issues while being able to manage the quality of the end product. Additionally, this would minimize costs for all parties as well as address multiple technical and organizational problems.

- **The organic resources available in the region could be better managed to allow vegetable farmers to use it in their fields. In order to achieve a better organization of stakeholders, small initiatives must continue to be supported by municipalities. Associations and technical institution also have an important role to endorse the use of organic matter by providing information on these resources and by helping to match supply and demand.**

## 7. Discussion

### *Potential limits to keep in mind regarding the sampling*

#### Conventional vs. organic farming

Out of 6 interviewed vegetable farmers 4 had conventional systems, one had a mixed system, and one was organic. A choice was made to focus on conventional systems which are the main targets for the reduction of chemical inputs. We hypothesized that these stakeholders would have less developed agroecological practices and be more inclined to sell their products through longer marketing channels. Consequently, we assumed that the pressure of the supply system would generate lock-ins, preventing them from evolving towards agroecological practices. Because of these initial assumptions, the sample includes a majority of conventional systems, and the analysis is mainly focused on the current lock-ins. Favoring organic systems could have helped identify potential solutions and find transposable alternative models.

On the specific topic of organic matter, previous interviews with local technical advisors, conducted at the beginning of the project, led us to hypothesize that the main constraints were the availability of the resources and the organization of stakeholders; the type of market gardening system (organic or conventional) being a secondary factor in the use of organic amendments. For this reason, we decided to include both organic and conventional systems on this topic. However, we have seen that the way vegetable farmers view and use organic matter also depends on whether they are organic or conventional which should be studied further.

#### Sampling methods

The snowball sampling method is a simple and efficient method to identify interviewees but can be limiting if the goal is to target specific types of people. We asked at the end of each interview to be directed towards producers which had diversified their crops, or which used organic matter. However, we could not control who the interviewee would put us in contact with. To have more control over the relevance of the interviewees regarding our topics, pre-interviews could have been done beforehand to determine whether or not they were in the best position to answer our questions for instance if we had decided to focus specifically on producers with telluric problems. This approach would have been possible if the number of producers in the targeted group was large enough to make a selection, which unfortunately was not the case because of the wide range of stakeholders interviewed during these 6 months.

Most of the stakeholders we interviewed were categorized in one of the two topics we wanted to address. For crop diversification we chose to question people involved in the food supply chain while, for organic matter, we contacted technical advisors and project managers in this field. Producers were interrogated on the two topics since both of them were relevant to production. Throughout the interviewing process we noticed that some vegetable producers would engage more on one of the two topics. In some cases, producers would elaborate more on the topic of crop diversification and overlook the use of organic matter under the assumption that there were insufficient resources available. Perhaps this would not have been the case if we had selected two different groups of farmers for each topic separately. One groups would have been questioned about crop diversification while the other group would have had questions about organic matter use.

## *A systemic approach to food systems to achieve more sustainability*

The self-reinforcement mechanism described by Meynard et al. (Meynard et al., 2020) shows that most of the barriers which hinder the development of sustainable food systems are intertwined and require a systemic approach. To unlock this complex situation, all stakeholders must get involved to facilitate the transition towards agroecological systems.

In the current food system, distributors play a prominent role which impacts agricultural practices. Their marketing strategy is based on offering the most competitive prices to their customers often neglecting environmental and societal costs.

The economic factor is one of the main factors coming into play in consumer's decision-making process along with the variety and origin of the product. The type of production model is the last criteria which guides consumers' buying habits. The CTIFL found that only 13% of the surveyed French consumers would agree to spend 20% more for "agroecological" fruits and vegetables which is less than the 25% required to create an interesting niche (CTIFL, 2021). There is a paradox between the consumer's expectation for healthy and environmentally friendly products and the constant search for the smallest price tags. However, this paradox can be partly explained by the lack of understanding and knowledge about the food systems.

Agroecology is still an obscure concept for a wide part of the population, according to a survey conducted by the French technical institute for fruits and vegetables (CTIFL), half of the French population does not know what agroecology stands for. Only 20% of the population declared they knew what agroecology was but, when asked to explain, few were able to give a complete explanation (CTIFL, 2021). This lack of understanding of agroecology coupled with the myriad of labels which are not always clear to consumers, can explain why agroecology is not a sufficient argument for consumers (Commandeur, 2020).

To help vegetables farmers gain more economic recognition for their work. It is necessary to raise consumer's awareness on the impact of their every day dietary and lifestyle habits and to recreate a strong connection between people, their food and the way it is produced. To create new markets for agroecological products, it is necessary to educate consumers on the benefits of agroecology in terms of public health and environmental preservation. This is one of the conditions to make them accept the price difference between conventional and agroecological products. This work has not directly interviewed any consumers, but their point of view would be worth including in future research to understand the barriers and levers on their level.

Today some mass retailing companies are developing new initiatives to meet consumers expectations for less pesticides. But still a lot of work remains to support producers in their efforts towards less pesticide use (Ducos, 2020). This can be done through the hiring of technical advisors by mass retailing companies which can help guide producers toward change without establishing additional costs for producers. In parallel, supermarkets must also change their buying practices. Mass retailers dispose of sufficient financial flexibility to share the risks of the agricultural transition if they accept to use a part of their profit margins to accompany these changes (Greenpeace, 2018). Relationships with farmers should no longer be based on unethical price negotiations but rather on constructive partnerships based on transparency and trust.

To build sustainable food systems, the different stakeholders of the supply chain must work together. Currently producers, processing and distribution companies act independently according to their own goals and concerns. This is further accentuated by the power imbalance between mass retailing companies and their suppliers. Governments can play a role by creating legal frameworks to address this imbalance; in France the first *Egalim* law was enacted in 2018 to instigate fair incomes to producers and to reinforce the sanitary, environmental, and nutritional quality of products. Because of some loopholes, this law did not reach its goals. In March 2021, the *Egalim 2* was drafted by the parliament in an effort to introduce new guarantees for farmers. Some of the main propositions are:



- The obligation for food processors to establish pluriannual written contracts with producers for at least 3 years, to provide them with more visibility. In addition, buyers will no longer be able to automatically reduce prices on a contract if they find lower prices elsewhere.
- Farmers will no longer risk financial penalties from retailers when they are unable to honor their contracts due to natural hazards.
- The experimentation of a price tunnel will be conducted for a 5-year duration. This clause plans to establish a price range defining the maximum and minimum prices for products.
- Promotion campaigns organized by mass retailers will be allowed only in the event of overproduction (after authorization of public authorities and an interprofessional agreement). This could prevent situations faced by producers when they are unable to supply a last-minute advertising campaign.
- A new indicator the “remuneration score” will be tested for 5 years to display the impact of the price proposed to the farmer on his income. This proposal intends to inform consumers and may encourage supermarket buyers to guarantee fair wages to farmers.
- For food processors, it will no longer be possible to put a French flag on a product without specifying where the ingredients come from. Until now, they were allowed to use a French flag on the product label even if the ingredients were not from France. In the future, only products for which the main ingredient was produced in France will be able to put a French flag on their packaging (République Française, 2021).

Fostering cooperation and collective action between farmers could be a promising path to establish a more favorable balance of power for producers and to prevent retailing companies from creating unhealthy commercial competition. This cooperation should go beyond specialized sectors and federate various vegetable farmers. Encouraging collective action in PACA would not only benefit farmers wanting to grow new crops, it would also facilitate the shift towards more sustainable systems on a more general level. As much as it is important to encourage collective action, such initiatives must be advertised, and information must be available to all and not only to already convinced parties. Research and technical institutes play an important role to support pioneering initiatives. Successful projects can motivate other more skeptical farmers to evolve.

In PACA, an opportunity worth developing would be the creation of collective composting platforms. Partnerships between vegetable growers and other stakeholders like horse stables or professional arborists could provide cost effective solutions for vegetable farmers wishing to amend their soil. The first step to the introduction of animal manure into vegetable systems is through cooperation between animal farmers and vegetable farmers. The most natural way of combining crop diversification and animal manure would be to reincorporate animals into vegetable systems to create combined crop animal systems as recommended by the High Level Panel of Experts (HLPE, 2019). An ideal system would integrate animals into vegetable production, mixing grain crops or cover crops to introduce new species. This way, open field vegetables would be put into rotation including grain crops or vegetables used for animal feed. More research must be conducted to evaluate the viability of such systems for vegetable farmers as it is well known that animals require constant care and add additional constraints.

### ***From the identification of barriers and levers to pesticide reduction to the design of innovative territorial food systems***

As we have seen farmer’s decisions in the field are greatly influenced by external factors such as norms market conditions, and the overall organization of the food supply chain. The combination of all these parameters can create a lock-in situation which requires a multi scale approach. To build on the sociotechnical analysis, and imagine sustainable food systems, finding coupled innovation is key. We must not only integrate innovations at the field scale but also consider a larger scale which can impact change positively or negatively. Meynard et al. define coupled innovations as an approach “involving production, processing, distribution and/ or consumption [...] to take into account the synergies and antagonisms that could occur.” (Meynard et al., 2017)

An example of a coupled innovation to create new outlets could involve building local partnerships between vegetable producers, food processors and retailers to elaborate new recipes incorporating less common vegetable species/varieties. Social media and the digital society add a new dimension by involving consumers in the product conception. New startups are using this model to empower consumers and allow them to express their needs and give their opinion. This new means of communication facilitates dialogue between processors and consumers on product composition, origin of ingredients and their price. In case of abnormal meteorological event or pest attacks leading to production disturbances, consumers could be notified of price fluctuations. This way consumers would understand farmer's constraints and be more inclined to accept these fluctuations. The risks taken by farmers would then be acknowledged and rewarded accordingly.

### ***Promising projects to reduce pesticide use, beyond crop diversification and organic amendment***

On a more long-term approach we must consider European regulations' impact on food systems. In France, 67% of food wastage occurs before it even reaches the consumer because of the downgrading and sorting of "non-conforming" products: 32% is lost at the production stage, 21% throughout the processing stage and 14% through distribution (ADEME, 2016). This generates economic, societal, and environmental costs which could be avoided if these non-conforming products were sold. This raises the question of the compatibility of the quality norms with the objective of pesticide reduction.

As awareness for food waste rises, new grocery store concepts are emerging. Near Brittany a zero-waste retailing chain has become very popular: *NOUS anti-gaspi*. This brand has opened 18 stores over the past 4 years in the northwestern part of France. Unfortunately, these kinds of initiatives have yet to develop in the south of France. These stores offer what "normal" supermarkets choose not to sell and educate their customers about the risks and challenges faced along the distribution chain and those faced by producers. Products are sold at lower cost (on average 30% less), which attracts consumers wishing to make good deals. In addition, producers get to sell the abnormal vegetables they would usually have to throw away (NOUS anti-gaspi, 2019). These outlets create opportunities for producers growing vegetables using less phytosanitary products.

These types of initiatives challenge what society views as quality and contribute to the evolution of consumer habits. It is the retailers' job to bridge the gap between producers and consumers and one way to do so is by explaining why some products don't fit the norm and encouraging perception change.

For consumers, fighting food waste could significantly increase household's purchasing power and bring about changes in consumption habits. In France the majority of food waste occurs at the consumption stage, this means that 20 kg of food is wasted per year per capita. Consumers could be saving on average 159€ per year and put more money into quality products such as organic vegetables (ADEME, 2016).

## 8. Conclusion

To understand the current lock-in around phytosanitary products use it is important to remember that farmers are part of a food system involving multiple stakeholders which greatly influence their choices. To encourage practice change at the production scale, the whole system must adapt accordingly.

When it comes to mass retailers a few main points stand out. First of all, the relationship between producers and buyers is a great hindrance to the evolution of practices. The extensive power struggle based on price negotiations and the organization of purchasing platforms reinforces producer's tendency towards intensive production systems with recurring crops, reliant on mineral fertilizers and phytosanitary product application. Purchasing platforms are often detached from production either geographically or through the superficial relationship they share over the phone. Referencing procedures are an additional burden for producers willing to diversify their production.

Another major barrier to crop diversification lies in the outdated normalization system which imposes unrealistic beauty standards for fruit and vegetables. Most fruits and vegetables sold in France go through mass retailers which are forced to apply European norms and who voluntarily choose to apply CEE ONU requirements involving specific quality requirements on a larger range of produce. These norms are problematic for the reduction of phytosanitary product application since they were built for a conventional model and have not been adapted to fit evolving agricultural practices. They make it more difficult for farmers to limit their pesticide and fungicide use and contributes to a false idea that beautiful equals healthy. These standards have contributed to the idea that fresh produce should always look perfect and have disconnected consumers from the reality of production.

Regarding the use of organic matter, the barriers observed on the territory reflect a more general issue in France which is a consequence of the specialization of the French agriculture and the segmentation between animal husbandry and vegetal production. Looking through this larger lens, we can probably transpose part of the results to many other regions in France. Some parts of the country face great problems with nitrogen pollution (green algae in Brittany), while other parts of the country like Provence, lack animal manure which is a valuable resource for soil amendment and optimal plant growth. The main problems surrounding the development of organic matter in the *Vaucluse/Bouches-du-Rhône* area is the lack of organization between the different resources available and vegetable farmers. which mostly use normalized fertilizers and have little experience with other types of products such as compost or mulch. Throughout this study we were able to bring forward several exploitable resources like horse, poultry manure or green waste as well as emerging projects establishing a framework for vegetable farmers willing to use organic amendments in their crops. Still, awareness must be drawn to the existing initiatives and training on compost production and use should target a larger audience.

Field work is required in order to quantify the available resources adapted to vegetable farmer's needs and to guide waste producers towards cost effective recycling options. In addition, research and experimentation must still be conducted to evaluate the best way to use them efficiently against telluric pest emergence and development.

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## 10. Appendices

Appendix 1: Interview guide for vegetable farmers

### **Guide d'entretien**

#### **Maraîchers**

Se présenter

Puis-je enregistrer ?

Projet INTERLUDE : INnovations TErritoriales pour la Réduction des produits phytopharmaceutiques en production LégUmière DURABLE

Favoriser les réorganisations des acteurs des filières amont et aval à l'échelle du territoire, pour faire évoluer les stratégies de ces acteurs et permettre l'adoption de leviers agroécologiques.

Première étape du cas d'étude PACA (mon stage):

Analyse des relations entre acteurs, conséquences sur la capacité des agriculteurs à adopter des pratiques agroécologiques)

Objectifs de l'entretien : Comprendre les freins à la diversification des cultures et à l'utilisation de MO avec un focus sur la gestion de la santé des sols.

Je vais vous questionner sur : l'entreprise, votre gestion de la santé du sol, la vente, votre expérience de diversification, la gestion de la matière organique, vos finances, le réseau collaboratif et enfin vos attentes vis-à-vis de la recherche.

Pourrions-nous faire le tour de votre exploitation à la fin de l'entretien?

#### Description EA

- 1 Parlez-moi de votre exploitation. Quand vous êtes-vous installé, Combien d'hectares cultivez-vous ? Y'a-t-il des abris, des cultures de plein champ, des cultures autres que des légumes ? (quelle est votre formation ?) Quelle part de votre production est cultivée sous abri ?
- 2 Pourriez-vous me lister les cultures que vous cultivez (en plein champ et ou sous abris) ? Quels sont les facteurs qui entrent en compte le processus de choix des cultures?
- 3 Pouvez-vous me décrire vos rotations typiques (une sous abris et une en plein champ)?
- 4 Quelle est la logique derrière votre rotation ? (Comment choisissez-vous les rotations en fonction des caractéristiques des parcelles?)
- 5 Comment choisissez-vous les espèces et variétés dans vos rotations ? Comment surmontez-vous les problèmes de calendrier ?
- 6 Pouvez-vous me parler de votre matériel ? Combien de tracteurs/ outils attelés etc ?
- 7 Est-ce que vous achetez souvent des machines ? Lesquelles avez-vous acheté récemment ? Pourquoi ?
- 8 Avez-vous remboursé les frais liés à l'achat de votre matériel ? L'avez-vous acheté grâce à des subventions ou grâce à des fonds personnels ?
- 9 Pratiquez-vous un travail du sol ? Avec quelles machines ?
- 10 Avez-vous bricolé vos machines pour qu'elles s'adaptent mieux à vos besoins ou avez-vous construit quelque chose pour répondre à vos besoins ?
- 11 Combien de personnes travaillent sur l'exploitation ? Combien d'employés avez-vous ? Avez-vous des saisonniers ? Avez-vous des employés réguliers ou devez-vous chercher des nouveaux chaque année ?



- 12 Est-ce que vous faites appel à des services externes ? (pour le travail du sol, l'épandage, récoltes ou d'autres opérations) ? A qui faites-vous appel ? Est-ce que c'est rentable ?
- 13 Que se passe-t-il avec vos résidus de cultures/ déchets verts ? Les laissez, compostez ou brûlez-les-vous ? Pourquoi ?

#### Gestion de la santé des sols

- 14 Est-ce que la santé des sols est quelque chose d'important pour vous ? Pourquoi ?
- 15 Avez-vous des problèmes de ravageurs du sol et sur quelle culture ? Quel est votre principal ravageur ? Quel est son évolution (aggravation/stable/réduction) ; gravité (effets sur le rendement) ? Comment tentez-vous de résoudre ce problème ?
- 16 Avez-vous des problèmes de maladies du sol et sur quelle culture ? Quelle maladie représente le plus gros problème ? Comment tentez-vous de résoudre ce problème ?
- 17 Utilisez-vous des pesticides ? Lesquels ? Utilisez-vous des pesticides biologiques ou naturels ?
- 18 Comment décidez-vous quand traiter ? Que pensez-vous de votre gestion des pesticides ? Êtes-vous satisfait des résultats ?
- 19 Est-ce que la santé de votre sol a changé depuis que vous avez repris la ferme ? Avez-vous fait des études de sols ? Si oui avez quels sont les résultats ? Le taux de matière organique a-t-il augmenté ?
- 20 (Quel processus utilisez-vous pour améliorer la santé de vos sols ?)
- 21 En général qu'est-ce qui vous pousse à changer de pratiques ?

#### Valorisation/ commercialisation

- 22 Quel est votre schéma de vente ? A qui vendez-vous vos produits ? Est-ce par la vente au détail, internet, vente à la ferme, à des restaurants ? Êtes-vous impliqué dans des circuits courts (vente directe, AMAP, marchés) ?
- 23 Savez-vous où se retrouvent vos produits ? A qui ils sont vendus ? Localement ou non ?

24 Avez-vous constaté une évolution de la demande, des attentes des consommateurs ? Pensez-vous que cela influence vos choix de cultures ?

25 Avez-vous tenté de diversifier vos cultures par le passé ? Dans quel but ? Comment cela s'est-il passé ? Quels ont été les facteurs de réussite/d'échec ?

### Diversification

#### Intrants

26 Achetez-vous vos semences/ plants ? Qui sont vos fournisseurs ? Achetez-vous de hybrides F1 ou des variétés modernes ? Ou plutôt des semences biologiques ou variétés anciennes ? Produisez-vous vos propres plants ?

27 Avez-vous des problèmes de disponibilité de certains plants/ certaines espèces ?

28 D'après vous y'a-t-il une offre assez importante et accessible de variétés résistantes ? L'offre est-elle accessible en termes de coûts ?

29 De votre point de vue y'a-t-il un frein à la diversification des cultures lié à la sélection ou au manque d'accès à certains plants/variétés ? Tendance vers la sélection et le développement d'un nombre limité d'espèces ?

30 Y'a-t-il un manque d'échanges au sujet de vos besoins avec vos fournisseurs ?

31 Y'a-t-il plus d'opportunités de diversification en plein champ ?

#### Equipements

32 Avez-vous des installations de stockage/conservation ? Est-ce que vous pensez que vous auriez la place pour conserver une nouvelle culture ?

33 Avez-vous déjà eu besoin de certains types d'installations/ de matériel pour la diversification ? Quels ont été les problèmes rencontrés ? Avez-vous eu des problèmes pour trouver ce que vous cherchiez ? Le matériel en question était-il abordable ?

34 Est-ce qu'une CUMA serait un moyen de dépasser vos freins en matière d'équipement (MO et diversification) ? Pourquoi ? Les outils sont-ils réellement adaptés ? Les réseaux sont-ils spécialisés ou généralistes ? Les règles organisationnelles sont-elles un frein important à l'utilisation du matériel ?

- 35 Rencontrez-vous de problèmes sanitaires liés à l'utilisation de matériel de CUMA, des problèmes d'organisation avec les autres utilisateurs en termes de timing ? A votre avis les maraichers de la région ont-ils régulièrement recouru aux services des CUMA ? Pourquoi ?

#### Main d'œuvre

- 36 Est-ce que la main d'œuvre est un frein à la diversification pour vous ?

#### Valorisation

- 37 Pensez-vous que le circuit de vente par lequel vous passez est une opportunité/un frein à l'implantation d'une nouvelle culture ?
- 38 Avez-vous tenté d'apporter de la MO ? Sous quelle forme ? Dans quel but ? Comment cela s'est-il passé ? Quels ont été les facteurs de réussite/d'échec ?

#### Matière Organique

##### Intrants

- 39 Achetez-vous des engrais de synthèse ? Lesquels ? Comment vous fournissez-vous ? Ne serait-ce pas plus rentable d'acheter du compost/ le faire vous-même ?
- 40 Est-ce que vous utilisez du fumier ou du compost... Quel type ? Combien dépensez-vous par an pour cet achat ? Comment le stockez-vous ?
- 41 Comment vous fournissez-vous en matières organiques? (achat, autoproduction, échange)? Est-elle facilement accessible (disponibilité, volumes, couts) ?
- 42 Est-ce que vous disposez du matériel d'épandage adéquat (CUMA, mis à disposition par le fournisseur...)?

##### Equipement

- 43 Avez-vous déjà eu besoin de certains types d'installations/ de matériel pour un changement de pratiques pour l'apport de matières organiques ? Quels ont été les problèmes rencontrés ? Avez-vous eu des problèmes pour trouver ce que vous cherchiez ? Le matériel en question était-il abordable ?
- 44 Y'a-t-il un accompagnement suffisant en cas de problèmes techniques sur les machines (service de réparation) ?

##### Main d'œuvre

- 45 Est-ce que c'est un frein pour l'apport de matières organiques compostés ?

### Chiffre d'affaires/aspects financiers

- 46 Etes-vous satisfait de votre CA ? Vous permet-il d'investir dans du nouveau matériel (épandeur)? Est-ce que votre CA est concentré sur une période précise de l'année (saison de culture) ou régulier tout au long de l'année ?
- 47 Pensez-vous qu'introduire une nouvelle culture pourrait améliorer la régularité des flux de revenus
- 48 Comment estimeriez-vous la part d'aides financières dans votre CA ? Pensez-vous que vous pourriez recevoir des aides pour vous diversifier ou pour l'apport de matières organiques sur votre exploitation ? Les mobilisez-vous ? Pourquoi ? A votre avis ces aides sont-elles des mesures suffisamment incitatives pour les changements de pratiques ?

### Réseau/collaboratif

- 49 Faites-vous parti d'une coopérative ? Est-ce que vous trouvez qu'elle vous aide vis-à-vis de la question de la diversification ?
- 50 Considérez-vous que la stratégie commerciale des coopératives est un frein à la diversification ?
- 51 D'après vous la commercialisation des produits issus de la diversification est-elle plutôt initiée par les producteurs ou par les consommateurs ? (la motivation des agriculteurs à se diversifier pousse-t-elle les coopératives à proposer de nouveaux produits ou la demande pour de nouveaux produits vient-elle des coopératives) ?
- 52 Qu'est-ce que vous pensez du collectif ? Travaillez-vous en collaboration avec d'autres agriculteurs ?
- 53 Pensez-vous que cela serait utile pour diversifier vos rotations/ gérer les bioagresseurs du sol ? A votre avis quels pourraient être les avantages au collectif ?(échange de savoir, savoir-faire, matériel, regroupement pour achat d'intrants en commun)

### R&Développement

- 54 Avez-vous assez de temps pour acquérir de nouvelles connaissances et améliorer vos compétences ? Pensez-vous avoir accès à suffisamment de ressources de formation ?
- 55 Les stations d'expérimentation répondent-elles à des réelles problématiques de terrain ? Les essais conduits reflètent-ils vos besoins ? Quelles sont vos attentes ? Demandes vis-à-vis de la R&D ?

56 Que pensez-vous du futur de votre exploitation ? Quels sont vos objectifs et vos attentes pour le futur?

## Appendix 2: Interview guide for wholesalers

### **Guide d'entretien Grossistes/Expéditeurs**

Se présenter

Puis-je enregistrer ? (RGPD)

Projet INTERLUDE : INnovations TERRitoriales pour la Réduction des produits phytopharmaceutiques en production LégUmière DURABLE

Favoriser les réorganisations des acteurs des filières amont et aval à l'échelle du territoire, pour faire évoluer les stratégies de ces acteurs et permettre l'adoption de leviers agroécologiques.

Première étape du cas d'étude PACA (mon stage):

Analyse du système sociotechnique (relations entre acteurs (maraîchers, grossistes, centrales d'achats, coopératives...), conséquences sur la capacité des agriculteurs à adopter des pratiques agroécologiques pour la gestion agroécologique de la santé des sols.)

Contexte : Il existe plusieurs leviers techniques pour améliorer la santé des sols, permettant ainsi de réduire l'utilisation de produits phytosanitaires. Je m'intéresse à l'un d'eux : la diversification des rotations, donc le fait que l'agriculteur essaye de remplacer des cultures sensibles à certains bioagresseurs par des cultures résistantes ou non hôtes, pour réduire les intrants phytosanitaires.

Objectifs de l'entretien : Comprendre les freins à la diversification des cultures, c'est à dire ce qui empêche les agriculteurs de diversifier leurs cultures, que ces freins soient internes à leur exploitation ou liés à d'autres acteurs.

Je vais vous questionner sur : l'entreprise, sa stratégie, les approvisionnements et la logistique, les machines, la vente et votre expérience par rapport à la diversification.

Pourrions-nous faire le tour de vos installations ? (pour la fin)

#### Présentation de l'entreprise

- 1 Quelle est l'histoire de votre entreprise ? (Quelles sont vos valeurs ?)
- 2 Combien avez-vous de salariés ?
- 3 Quelle est la mission de votre entreprise ?
- 4 Quel est votre métier ? En quoi consiste-t-il ? Pouvez-vous me parler des autres différents métiers de l'entreprise (commercial, la personne en relation avec les producteurs, accompagnement technique, planification, l'agréateur, etc) ?
- 5 Avez-vous un contact direct avec les producteurs ?
- 6 Combien de tonnes de légumes traitez-vous par an ? Quel est votre chiffre d'affaires ?
- 7 Êtes-vous spécialisé dans certains produits ?
- 8 Comment préparez-vous vos produits ?
- 9 Pouvez-vous me décrire le cycle d'un légume type ? (entre l'approvisionnement et le moment où il est livré au client)

### Stratégie de l'entreprise

- 10 Quelle est votre clientèle ? Est-elle plutôt locale ou sur l'ensemble du territoire (part du local, volumes)? Quels sont leurs demandes ?
- 11 Quelles est votre offre ?
- 12 Quels sont les principaux défis de votre entreprise ?
- 13 Avez-vous développé une démarche RSE ?
- 14 Est-ce que vous avez des démarches dites « agroécologiques » ? est-ce que vous portez un intérêt particulier aux producteurs qui adoptent des pratiques agroécologiques ou qui essaient de réduire l'usage des produits phytosanitaires ? Pourquoi ?(offre en volume ?) (par rapport au chiffre d'affaire)
- 15 Avez-vous des démarches « locales » ? Comment sont-elles construites ? Avec la production ?
- 16 Quelles sont vos priorités et comment les définissez-vous ?
- 17 Que pensez-vous du futur de votre entreprise? Quels sont vos objectifs et vos attentes pour le futur ?

### Approvisionnement/ Logistique

- 18 Comment se déroulent vos approvisionnements ?
- 19 Avec quelles entreprises travaillez-vous pour l'approvisionnement? Qui sont vos fournisseurs en légumes ?
- 20 Quels sont vos critères de choix en légumes ? Arrive-t-il que l'offre en légumes soit insuffisante ?
- 21 Quels sont les difficultés rencontrées au niveau du stockage ?
- 22 Pouvez-vous me décrire les flux entrants? (Volumes ? Fréquence d'approvisionnement ?)

### Machines/Services

- 23 Pouvez-vous me lister vos machines ? Vos machines sont-elles facilement adaptables à différents légumes? Pour quels légumes est-ce problématique ?
- 24 Quand investissez-vous dans des nouvelles machines ? Bénéficiez-vous d'aides pour cela ?
- 25 Est-ce que vous faites appel à des prestataires de services pour le conditionnement ? Si oui, à qui faites-vous appel ?

### Vente/Consommateurs

- 26 A qui vendez-vous vos produits ? Localement ou non ? Combien d'intermédiaires y'a-t-il (entre vous et les consommateurs)? Pouvez-vous me décrire la répartition entre acteurs? (pourcentage/volumes) (segmentation des clients)
- 27 Avez-vous constaté une évolution de la demande, des attentes des consommateurs ? Y'a-t-il une demande pour des produits avec peu de produits phytosanitaires, zéro résidu de pesticides ? Pensez-vous que cela influence votre offre ?

### Expérience de diversification

- 28 Qu'est-ce que vous pensez de la diversification des cultures légumières ? Qu'est-ce que cela vous évoque ?
- 29 Dans quelle mesure pourriez-vous être amenés à varier votre offre ?
- 30 A quelle fréquence recherchez-vous de la nouveauté en légumes ? Quels sont les facteurs qui vous poussent à chercher de nouveaux produits ?
- 31 Avez-vous du mal à trouver certains types de légumes, lesquels ?
- 32 Avez-vous du mal à écouler certains légumes, lesquels ?
- 33 Qu'est-ce que vous mettez en place pour résoudre cette situation ?
- 34 Avez-vous déjà tenté d'élargir votre offre ou des producteurs vous ont-ils déjà sollicité pour vous proposer de nouveaux produits ? Comment cela s'est-il passé ? Quels ont été les facteurs de réussite/d'échec ? Etes-vous confronté à des freins matériels, structurels, de logistique, de stockage (pas assez d'offre, coûts, équipement) ?
- 35 D'après vous quel(s) pourraient-êtres les intérêt(s) à proposer des légumes issus de la diversification des cultures (tels que le fenouil, la patate douce, le navet) ?
- 36 D'après vous la commercialisation des produits issus de la diversification est-elle une approche plutôt initiée par les producteurs ou par vos clients ?
- 37 Quelles sont vos attentes/demandes vis-à-vis de la R&D pour favoriser les légumes de diversification ?

#### Conclusion

- 38 Pourrions-nous faire le tour de vos installations ?
- 39 Quels autres contacts suggérez-vous ? Des structures qui seraient par exemple moins spécialisées que la vôtre ? Ou avec des stratégies qualité différente notamment par rapport à la réduction des produits phytosanitaires ou la diversification des cultures ?

#### Appendix 3: Interview guide for food processors

## **Guide d'entretien IAA**

Se présenter

Puis-je enregistrer ? (RGPD)

Projet INTERLUDE : INnovations TERRitoriales pour la Réduction des produits phytopharmaceutiques en production LégUmière DURABLE

Favoriser les réorganisations des acteurs des filières amont et aval à l'échelle du territoire, pour faire évoluer les stratégies de ces acteurs et permettre l'adoption de leviers agroécologiques.

Première étape du cas d'étude PACA (mon stage):

Analyse du système sociotechnique (relations entre acteurs, conséquences sur la capacité des agriculteurs à adopter des pratiques agroécologiques pour la gestion agroécologique de la santé des sols)

Contexte : Il existe plusieurs leviers techniques pour améliorer la santé des sols, permettant ainsi de réduire l'utilisation de produits phytosanitaires. Je m'intéresse à l'un d'eux : la diversification des rotations, donc le fait que l'agriculteur essaye de remplacer des cultures sensibles à certains bioagresseurs par des cultures résistantes ou non hôtes, pour réduire les intrants phytosanitaires.

Objectifs de l'entretien : Comprendre les freins à la diversification des cultures, c'est à dire qu'est ce qui empêche les agriculteurs de diversifier leurs cultures, et en particulier en ce qui nous concerne aujourd'hui , les freins liés aux opérateurs de la transformation comme vous.

Je vais vous questionner sur : l'entreprise, sa stratégie, les approvisionnements et la logistique, les procédés de transformation, les machines, la vente et votre expérience par rapport à la diversification.

#### Introduction/Présentation

- 1 Quel est votre métier ? En quoi consiste-t-il ?
- 2 Quelle est l'histoire de votre entreprise ? (Quelles sont les valeurs de l'entreprise ?)
- 3 Quelle est votre clientèle ? sur le territoire ?

#### Stratégie de l'entreprise

- 4 Pouvez-vous me décrire la gamme des produits élaborés dans votre entreprise, quels sont vos produits phares ? quels sont les principaux légumes utilisés pour ces produits ?
- 5 Quels sont vos critères de qualité ? êtes-vous sensibles aux pratiques des producteurs de légumes et notamment aux pratiques phytosanitaires ? à la présence de résidus de pesticides dans les légumes ?
- 6 Avez-vous développé une démarche RSE ? Avez-vous des démarches dites « agroécologiques » ? Quelle est la part de ces produits dans votre offre?
- 7 Avez-vous des démarches d'approvisionnement local des légumes ? Si oui : Comment sont-elles construites ? Avec la production ? Si non : pourquoi ?
- 8 Quelles sont vos priorités et comment les définissez-vous ?

#### Approvisionnement/ Logistique

- 9 Avec quelles entreprises travaillez-vous pour l'approvisionnement ? Qui sont vos fournisseurs en matières premières (légumes) ? Avez-vous un contact direct avec les producteurs ? Producteurs locaux ou hors-territoire ? De quelles natures sont vos relations avec les producteurs (contractuelle, irrégulière...) ?
- 10 Quels sont vos critères de choix de matières premières ? Y'a-t-il suffisamment d'offre pour les légumes que vous recherchez tout au long des saisons ?
- 11 Sous quelles formes les légumes arrivent-ils chez vous (calibrés ? lavés ? prédécoupés ?) ?
- 12 Pouvez-vous me décrire les flux entrants? (Volumes ? Fréquence d'approvisionnement ?)
- 13 Quels sont les difficultés rencontrées au niveau du stockage des produits bruts (en amont de la transformation) ?

#### Procédés/Machines/Services

- 14 Pouvez-vous me parler de vos procédés de transformation ?
- 15 Les machines sont-elles facilement adaptables ?
- 16 Quand investissez-vous dans des nouvelles machines ? Bénéficiez-vous d'aides pour cela ?
- 17 Est-ce que vous faites appel à des prestataires de services pour une des étapes de transformation ou de conditionnement? Si oui, à qui faites-vous appel ?
- 18 Avez-vous des problèmes récurrents en lien avec les procédés de transformation lors de l'élaboration d'un nouveau produit? Qu'est ce qui présente le plus gros problème ? Comment traitez-vous ce problème?
- 19 Comment gérez-vous vos déchets? Pensez-vous à la valorisation de vos co-produits ?



### Marketing/R&D/Consommateurs

- 20 Quel est votre stratégie marketing ? A qui vendez-vous vos produits ? Localement ou non ? Combien d'intermédiaires y'a-t-il entre vos produits et le consommateur ? Pouvez-vous me décrire les flux ? Volumes ? A quelle fréquence approvisionnez-vous vos clients ?
- 21 Avez-vous constaté une évolution de la demande, des attentes des consommateurs ? Pensez-vous que cela influence vos choix de recettes ?

### Stratégie d'innovation et expérience de diversification

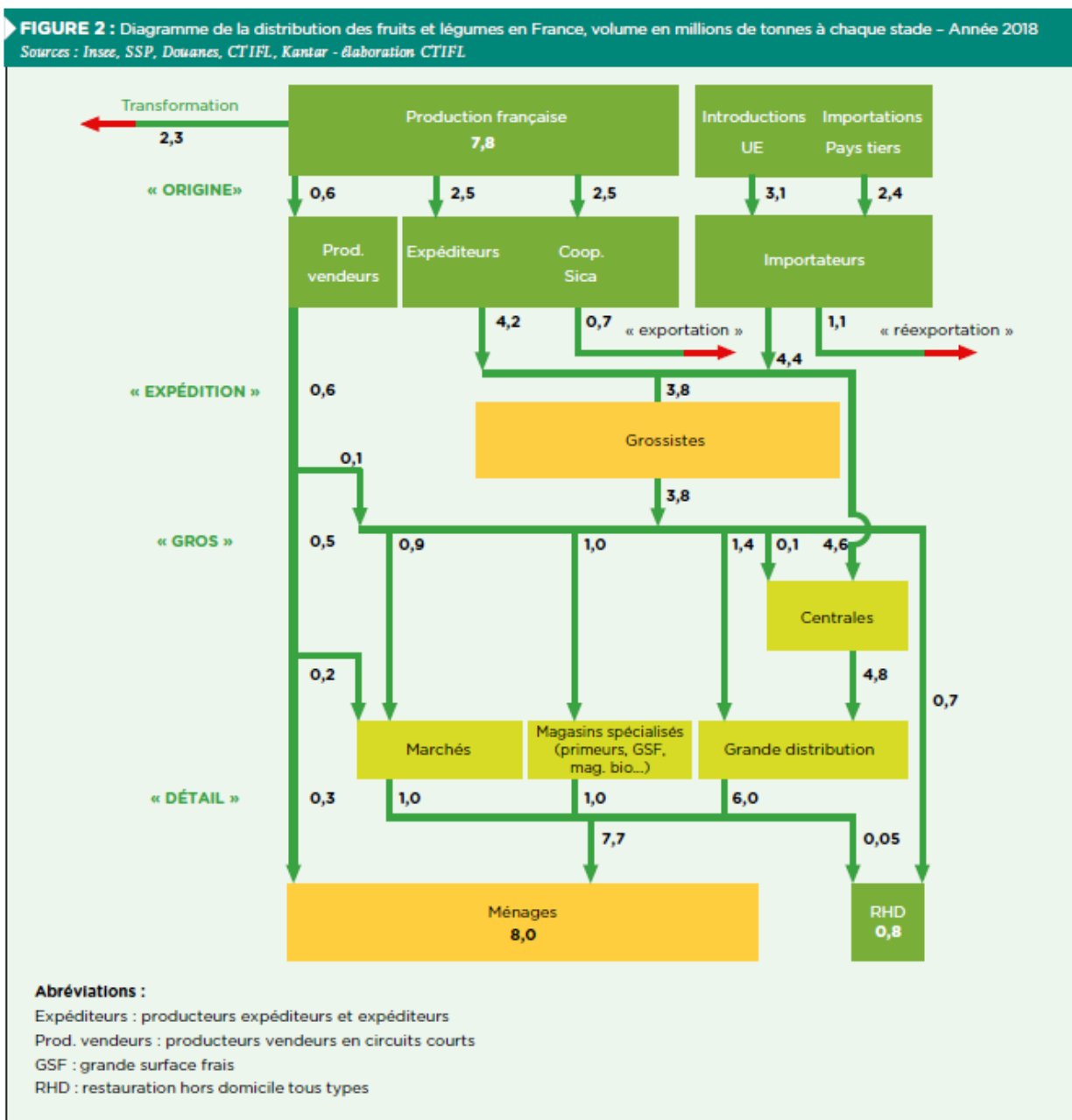
- 22 A quelle fréquence élaborerez-vous de nouveaux produits/recettes ?
- 23 Comment décidez-vous qu'il est temps d'innover ? Quelle est votre stratégie d'innovation ?
- 24 Quels sont les facteurs qui entrent en compte dans le processus d'innovation ?
- 25 Comment ces innovations influent-elles sur les approvisionnements ?
- 26 Avez-vous déjà tenté de faire évoluer votre gamme de produits en intégrant des légumes de diversification (légumes « rares », nouveaux légumes...)? Comment cela s'est-il passé ? Quels ont été les facteurs de réussite/d'échec ?
- 27 D'après vous quel(s) pourraient-êtré les intérêt(s) à vous engager dans une démarche d'innovation avec des légumes de diversification (c'est-à-dire en ajoutant des légumes tels que le fenouil, la patate douce, le navet...)?
- 28 Quels seraient les produits pour lesquels vous pourriez être amenés à utiliser des légumes de diversification ?
- 29 Si les producteurs de la région se mettaient à produire plus de patate douce, de blette ou de fenouil par exemple pour avoir des modes de production plus AE, pourriez-vous utiliser ces produits ?
- 30 Pourriez-vous adapter vos process de transformation ?
- 31 Seriez-vous prêts à changer vos recettes pour permettre aux producteurs d'avoir des modes de production plus agroécologiques et de réduire l'utilisation de produits phytosanitaires en diversifiant leurs cultures ?
- 32 Si les producteurs locaux réduisaient les surfaces d'aubergine (courgettes ou d'autres légumes sensibles aux bioagresseurs et qu'ils n'arrivent pas à cultiver avec moins de produits phytosanitaires) par exemple qu'est-ce que vous feriez ?
- 33 Est-ce que vous réduiriez la part de ces légumes dans vos recettes ou est-ce que vous iriez vous approvisionner ailleurs ?
- 34 Imaginons que vous cherchiez à utiliser plus de légumes de diversification, seriez-vous confrontés à des freins matériels, structurels, de logistique, de stockage (temps nécessaire à la mise au point d'une nouvelle recette, coûts, équipement, savoir-faire)? Difficultés d'approvisionnement, manque de producteurs, manque de débouchés ?
- 35 D'après vous la commercialisation des produits issus de la diversification est-elle plutôt initiée par les producteurs ou par les consommateurs ?
- 36 Quelles sont vos attentes/demandes vis-à-vis de la R&D pour vous aider développer des produits avec des légumes de diversification ?

### Conclusion

- 37 Quels sont vos principaux défis ?

- 38 Que pensez-vous du futur de votre entreprise ? Quels sont vos objectifs et vos attentes pour le futur ?
- 39 Pourrions-nous faire le tour de vos installations ?
- 40 Quels autres contacts suggérez-vous ? Des structures qui seraient par exemple moins spécialisées que la vôtre ? ou avec des stratégies qualité différente notamment par rapport à la réduction des phytos ou la diversification des cultures.

Appendix 4: Distribution channels for fruits and vegetables in France in millions of tons, data from 2018



(Levet and Hutin, 2019)

## Appendix 5: European quality regulations, example for tomatoes

### **I. DEFINITION OF PRODUCE**

This standard applies to tomatoes of varieties (cultivars) grown from *Solanum lycopersicum* L. to be supplied fresh to the consumer, tomatoes for industrial processing being excluded.

Tomatoes may be classified into four commercial types:

- 'round',
- 'ribbed',
- 'oblong' or 'elongated',
- 'cherry' tomatoes (including 'cocktail' tomatoes).

### **II. PROVISIONS CONCERNING QUALITY**

The purpose of the standard is to define the quality requirements for tomatoes, after preparation and packaging.

#### **A. Minimum requirements**

In all classes, subject to the special provisions for each class and the tolerances allowed, the tomatoes must be:

- intact,
- sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded,
- clean, practically free of any visible foreign matter,
- fresh in appearance,
- practically free from pests,
- free from damage caused by pests affecting the flesh,
- free of abnormal external moisture,
- free of any foreign smell and/or taste.

In the case of trusses of tomatoes, the stalks must be fresh, healthy, clean and free from all leaves and any visible foreign matter.

The development and condition of the tomatoes must be such as to enable them:

- to withstand transportation and handling, and
- to arrive in satisfactory condition at the place of destination.

## B. Classification

Tomatoes are classified in three classes, as defined below:

### (i) 'Extra' Class

Tomatoes in this class must be of superior quality. They must be firm and characteristic of the variety and/or commercial type.

Their colouring, according to their state of ripeness, must be such as to satisfy the requirements set out in the third paragraph of point A above.

They must be free from greenbacks and other defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

### (ii) Class I

Tomatoes in this class must be of good quality. They must be reasonably firm and characteristic of the variety and/or commercial type.

They must be free of cracks and visible greenbacks. The following slight defects, however, may be allowed provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- a slight defect in shape and development,
- slight defects in colouring,
- slight skin defects,
- very slight bruises.

Furthermore, 'ribbed' tomatoes may show:

- healed cracks not more than 1 cm long,
- no excessive protuberances,
- small umbilicus, but no suberization,
- suberization of the stigma up to 1 cm<sup>2</sup>,
- fine blossom scar in elongated form (like a seam), but not longer than two-thirds of the greatest diameter of the fruit.

### (iii) Class II

This class includes tomatoes which do not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified above.

They must be reasonably firm (but may be slightly less firm than in Class I) and must not show unhealed cracks.

The following defects may be allowed provided the tomatoes retain their essential characteristics as regards the quality, the keeping quality and presentation:

- defects in shape and development,
- defects in colouring,
- skin defects or bruises, provided the fruit is not seriously affected,
- healed cracks not more than 3 cm in length for round, ribbed or oblong tomatoes.

Furthermore, 'ribbed' tomatoes may show:

- more pronounced protuberances than allowed under Class I, but without being misshapen,
- an umbilicus,
- suberization of the stigma up to 2 cm<sup>2</sup>,
- fine blossom scar in elongated form (like a seam).

### III. PROVISIONS CONCERNING SIZING

Size is determined by the maximum diameter of the equatorial section, by weight or by count.

The following provisions shall not apply to trusses of tomatoes and to cherry tomatoes, and are optional for Class II.

To ensure uniformity in size, the range in size between produce in the same package shall not exceed:

- (a) For tomatoes sized by diameter:
  - 10 mm, if the diameter of the smallest fruit (as indicated on the package) is under 50 mm,
  - 15 mm, if the diameter of the smallest fruit (as indicated on the package) is 50 mm and over but under 70 mm,
  - 20 mm, if the diameter of the smallest fruit (as indicated on the package) is 70 mm and over but under 100 mm,
  - there is no limitation of difference in diameter for fruit equal or over 100 mm.

### IV. PROVISIONS CONCERNING TOLERANCES

At all marketing stages, tolerances in respect of quality and size shall be allowed in each lot for produce not satisfying the requirements of the class indicated.

#### A. Quality tolerances

##### (i) 'Extra' Class

A total tolerance of 5 per cent, by number or weight, of tomatoes not satisfying the requirements of the class but meeting those of Class I is allowed. Within this tolerance not more than 0,5 per cent in total may consist of produce satisfying the requirements of Class II quality.

##### (ii) Class I

A total tolerance of 10 per cent, by number or weight, of tomatoes not satisfying the requirements of the class but meeting those of Class II is allowed. Within this tolerance not more than 1 per cent in total may consist of produce neither satisfying the requirements of Class II quality nor the minimum requirements, or of produce affected by decay. In the case of trusses of tomatoes, 5 percent, by number or weight, of tomatoes detached from the stalk is allowed.

##### (iii) Class II

A total tolerance of 10 per cent, by number or weight, of tomatoes satisfying neither the requirements of the class nor the minimum requirements is allowed. Within this tolerance not more than 2 per cent in total may consist of produce affected by decay. In the case of trusses of tomatoes, 10 percent, by number or weight, of tomatoes detached from the stalk is allowed.

#### B. Size tolerances

For all classes: a total tolerance of 10 per cent, by number or weight, of tomatoes not satisfying the requirements as regards sizing is allowed.

(European Commission, 2011)

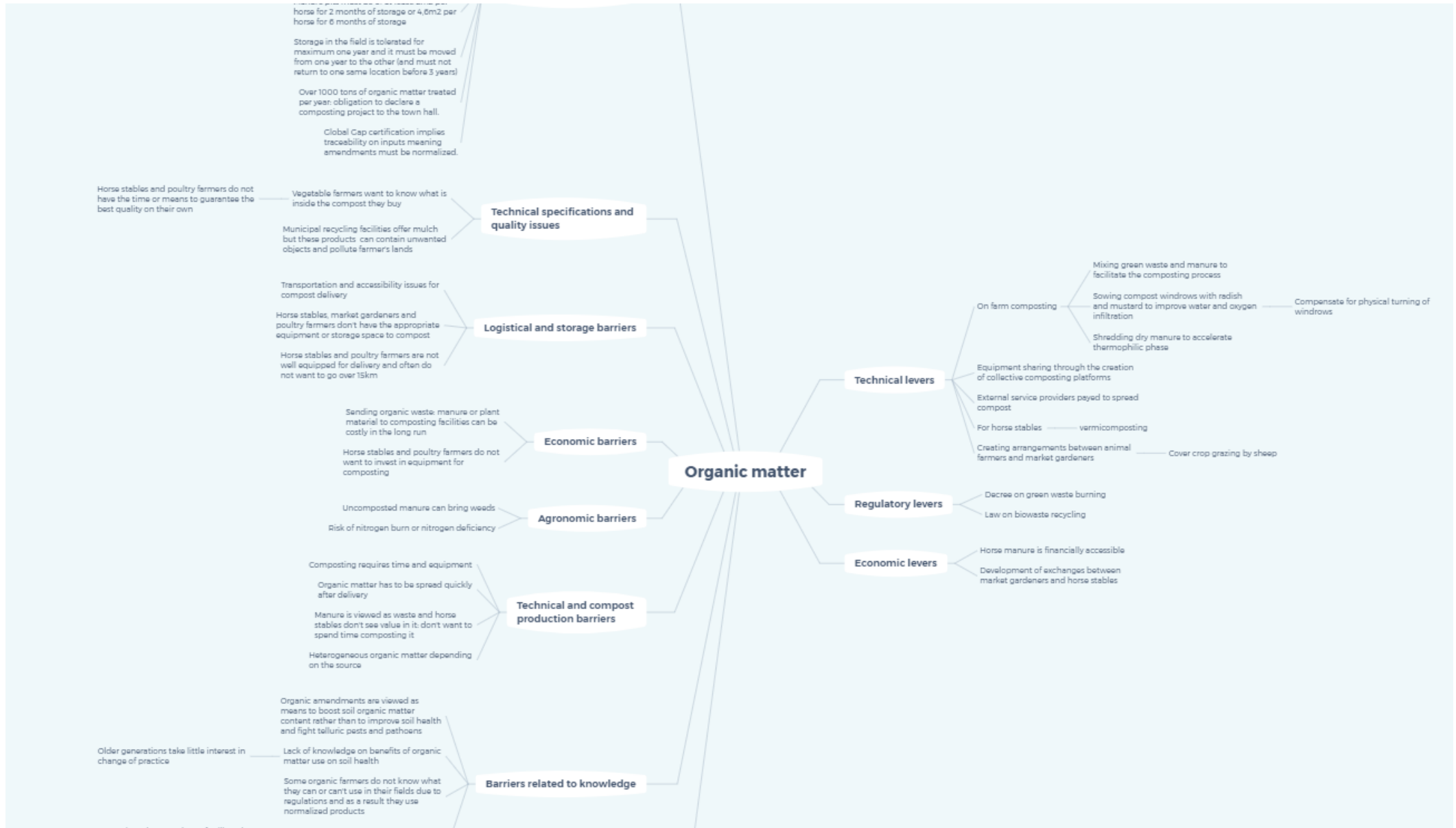
More information available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011R0543#>

### Appendix 6:

Grid for data analysis

	Sectorial barriers	Knowledge barriers	Economic Barriers	[...]
1 <sup>st</sup> Interview	Verbatim			
2 <sup>nd</sup> Interview	Verbatim			
[...]				
	Sectorial levers	Knowledge levers	Economic levers	[...]
1 <sup>st</sup> Interview				
2 <sup>nd</sup> Interview				
[...]				

## Appendix 7: Mind maps for crop diversification and organic matter (overview and zoomed screenshots)



The storage of organic matter must be done in particular conditions and respect a spreading plan, many regulations overlapping but not always the same from one type of OM to another: European regulation, French and regional regulations.

Composting facilities are considered classified installations for environmental protection. (ICPE) which implies a number of rules: eg: composting facilities must have specific approval to process certain types of waste such as animal by-products

According to the directive on nitrates horse manure must be stored 2 months in a manure pit before it can be transported and stored somewhere else

Manure pits must be of at least: 2m<sup>2</sup> per horse for 2 months of storage or 4,6m<sup>2</sup> per horse for 6 months of storage

Storage in the field is tolerated for maximum one year and it must be moved from one year to the other (and must not return to one same location before 3 years)

Over 1000 tons of organic matter treated per year: obligation to declare a composting project to the town hall.

Global Gap certification implies traceability on inputs meaning amendments must be normalized.

### Regulatory/administrative barriers



Horse stables and poultry farmers do not have the time or means to guarantee the best quality on their own

Vegetable farmers want to know what is inside the compost they buy

Municipal recycling facilities offer mulch but these products can contain unwanted objects and pollute farmer's lands

### Technical specifications and quality issues

Transportation and accessibility issues for compost delivery

Horse stables, market gardeners and poultry farmers don't have the appropriate equipment or storage space to compost

Horse stables and poultry farmers are not well equipped for delivery and often do not want to go over 15km

### Logistical and storage barriers

Sending organic waste: manure or plant material to composting facilities can be costly in the long run

Horse stables and poultry farmers do not want to invest in equipment for composting

### Economic barriers

Uncomposted manure can bring weeds  
Risk of nitrogen burn or nitrogen deficiency

### Agronomic barriers

Composting requires time and equipment

Organic matter has to be spread quickly after delivery

Manure is viewed as waste and horse stables don't see value in it: don't want to spend time composting it

Heterogeneous organic matter depending on the source

### Technical and compost production barriers

## Organic matter

Older generations take little interest in change of practice

Organic amendments are viewed as means to boost soil organic matter content rather than to improve soil health and fight telluric pests and pathoens

Lack of knowledge on benefits of organic matter use on soil health

Some organic farmers do not know what they can or can't use in their fields due to regulations and as a result they use normalized products

"sometimes better to buy a fertilizer than to make compost: there is a risk of making a bad compost and that it does not have the expected properties on the soil because of fast mineralization."

Lack of technical support for optimal composting

**Barriers related to knowledge**

Preference for normalized commercial products which are easier to use and more predictable

Anchored habit

Farmers believe it is best to avoids disease

Requires land, organization and equipment sharing

Burning green waste is easier than bringing to recycling platforms

Collective composting is seen as complicated

**Implementation and organizational constraints**

# Organic matter

## Technical levels

- On farm composting
  - Mixing green waste and manure to facilitate the composting process
  - Sowing compost windrows with radish and mustard to improve water and oxygen infiltration ——— Compensate for physical turning of windrows
  - Shredding dry manure to accelerate thermophilic phase
- Equipment sharing through the creation of collective composting platforms
- External service providers payed to spread compost
- For horse stables ——— vermicomposting
- Creating arrangements between animal farmers and market gardeners ——— Cover crop grazing by sheep

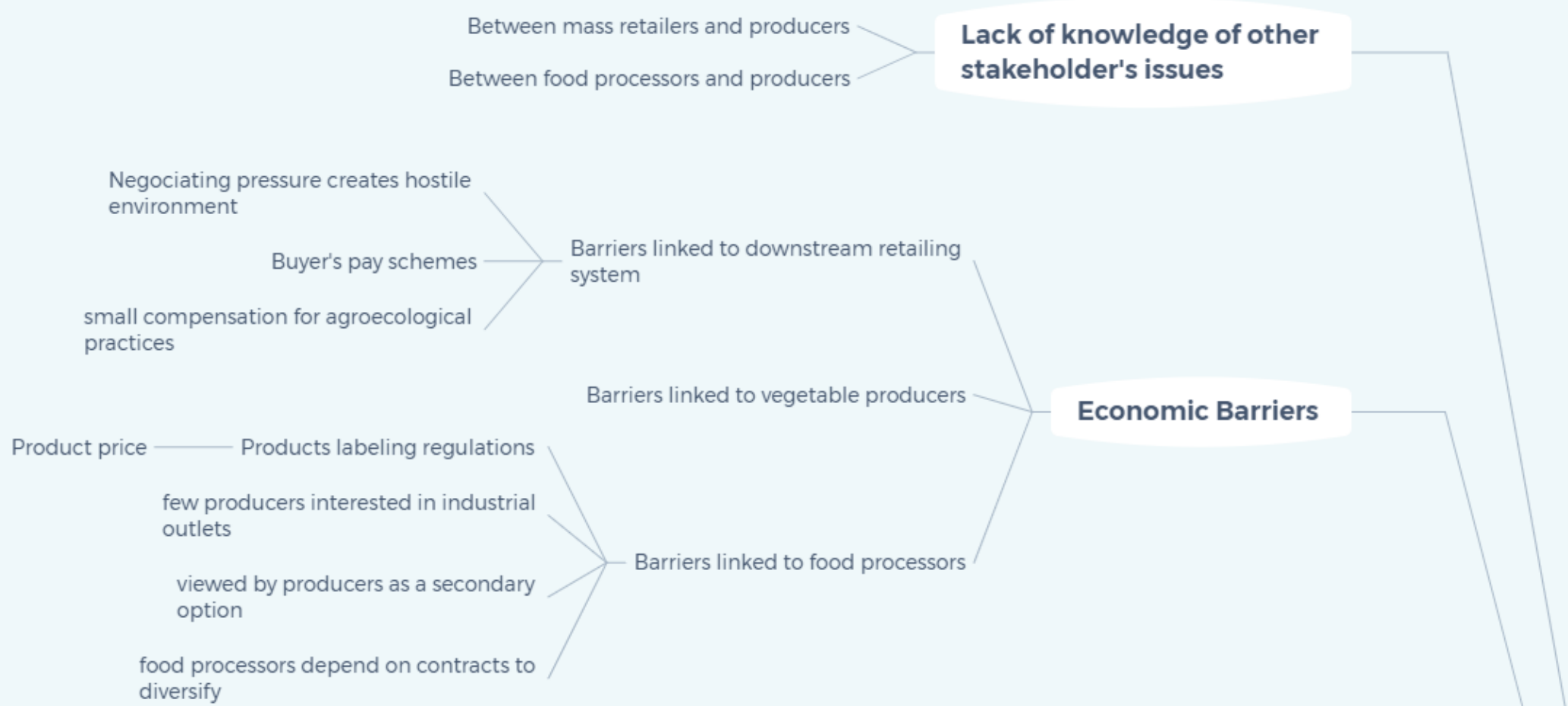
## Regulatory levels

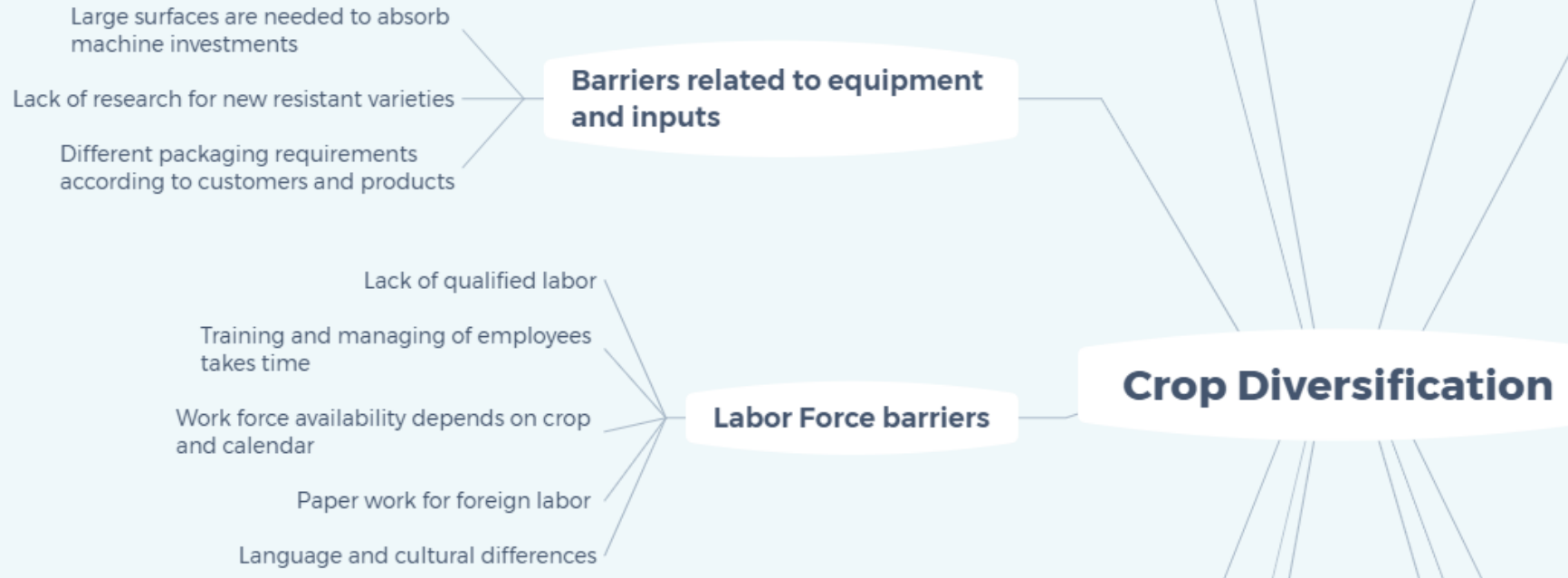
- Decree on green waste burning
- Law on biowaste recycling

## Economic levels

- Horse manure is financially accessible
- Development of exchanges between market gardeners and horse stables







- specialized producers are sufficient to meet niche markets
- Imported produce is sometimes more interesting price wise
- Certain vegetables are associated to certain regions
- Certain varieties are favored/ imposed by supermarkets
- The cumbersome referencing system
- Structural organization around products per region

### Sectorial and market barriers

- Farmers close to retirement are less prone to change
- Organic is seen as a completely different system and seen as insufficient to feed the world

### Mindset barriers

- Complex paperwork
- no time to apply to financial aid
- Takes time to receive the money
- For producers
- European norms on product standardization

### Red tape and legal constraints







# 11. Abstract

To meet societal expectations and address environmental and health preoccupations, the market gardening sector is confronted with increasing pressure to produce with less chemical inputs while providing fresh, tasty, good-looking, and affordable vegetables. To face these challenges, it is necessary to have a systemic approach of the sector. A sociotechnical analysis was carried out in Provence to identify the factors hindering the development of agroecological practices to reduce phytosanitary use in market gardening systems. This paper focuses on two soil health management practices: crop diversification and organic matter use. Alongside with a literature review, thirty semi-directive interviews were conducted with producers, agronomists, agri-food industrials, and retailers to understand their interactions and gather information about parameters influencing vegetable producers marketing and agricultural practices. Findings from this work point to the lack of interconnection between stakeholders in the food supply chain which goes against the agroecological approach on food systems, the major impact of mass retailers' marketing strategies, as well as the inconsistency between the societal demand to decrease pesticide use and European quality norms. On another note, the slow development of organic matter use results from a poor structuration of the sector in PACA along with a lack of knowledge about its value in the management of soil health. To create meaningful change, such problems require a systemic approach to establish partnerships between vegetable producers and retailing companies and between organic matter producers and potential users through collective initiatives and training.



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