BioValue

Deliverable 3.2

Analysis of the interlinkages among value chain agents

Project Acronym	**BIOVALUE**
Project Title	Fork-to-farm agent-based simulation tool augmenting BIOdiversity in the agri-food VALUE chain
Call	SFS-01-2018-2019-2020: Biodiversity in action: across farmland and the value chain
Type	Report
Dissemination Level	Confidential
Beneficiaries	Lead: UNIBO, Contributing: NIBIO, IDENER, ECOZEPT, AUTH, EGE, GFA
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Due date of deliverable	31.03.2023

Disclaimer

Cite this deliverable as: BIOVALUE – D3.2 (2023), Deliverable 3.2 – Analysis of the interlinkages among value chain agents, 31.03.2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000499

Executive Summary

This deliverable refers to the analysis of interlinkages among value chain agents. Several aspects are considered including supply chain flows, price transmission and value creation, market and contractual power, transactions' costs, contract patterns, and attribute requirements and evaluation. The collected information has been explicitly related to direct and indirect effects on agro-biodiversity. Agro-biodiversity has not exactly the same significance in all the value chains. For some species, cultivated in a relatively high quantity (e.g. lentil), the focus is on the diffusion and use of different varieties; on the contrary, in the case of neglected species, the focus is on their introduction in the value chain as an alternative to more widespread crops.

The methodological approach was tailored to the specific characteristics of the analyzed supply chains; experts' interviews, ad-hoc survey questionnaires and focus groups were performed to key actors in every country and supply chains involved. The analysis was performed in four countries (Italy, Norway, France, Germany), for twelve value chains. The agents involved in the survey include farmers (and related organizations such as cooperatives and Producers' Organizations - POs), processors and retailers. Consumers were consulted through focus groups.

Large differences in the organization of the value chains can be appreciated across countries and value chains. Even when considering the same product, significant differences can be appreciated in the value chains of the analyzed countries. Finally, even inside the same value chain and the same country, it is normally possible to differentiate specific channels targeting mass or niche consumers targets: e.g. high price value chains dealing with organic and national products; low cost value chains dealing with imported products; short circuits dealing with local varieties, etc. A few common elements can be drafted.

Lentil is the only crop that has been analyzed in the four countries. The European demand of lentil is high. Retailers cannot find all the lentil that is required (organic and conventional) at national level and must look for other sources abroad. In the last years a relevant part of Italian production has been addressed to new pasta facilities that produces lentil pasta, increasing the need for this legume. Thus, at European level, the market for farmers seems to be guaranteed; the problem consists in the high variability of yields linked to climatic unpredictability. All the chain is strictly determined by contracts (sometimes with fixed prices, other times not) and characterized by a large number of specific products that are addressed for specific target groups: basic national production, specific geographic production (without PGI), PGI (in Italy, France, Germany) and/or organic label, imported product, product specifically addressed to pasta production. This diversity entails several varieties that, surprisingly, are normally not communicated to the consumer which recognizes and chooses the product mainly on the base of the color, size and labels/brands. Retailers are strongly interested in differentiating the references available promoting their own private labels (at lower prices compared to branded products), and maintaining the profitability of the shelves; on the contrary, agro-biodiversity is not considered a key element, since local production cannot guarantee sufficiently high and stable supplies.

Buckwheat value chain has been analyzed in Italy, Germany and Norway. In this case, nobody (in the value chain and among consumers) seems to be interested in the diversity of buckwheat varieties; on the contrary the focus should be put on the re-diffusion of this neglected species. Buckwheat, as well as lentils, has the potential to meet the growing demand for gluten-free products, and can be used for bakery products and pasta. However, it faces, even more than lentils, the challenges of low and unpredictable yields linked to climatic variability. The local production is low and national value

chains are mainly dependent by imports. Intents to develop national chains have been done. In the case of Italy, in particular, this has been done for the production of traditional pasta products (e.g. PGI Pizzoccheri made with a mix of wheat flour and buckwheat flour) or with for modern gluten-free pasta.

The other value chains analyzed are tomato, leafy vegetables and eggplant. In France, tomatoes are a highly diversified product in terms of color and shape, with an emphasis on taste quality and preservation. Retailers offer a wide range of tomatoes and are looking for varieties with interesting taste qualities, sometimes betting on novelty and originality.

Leafy vegetables (Italy and France) that are sold by modern retailers can take different forms: from fresh vegetables (first range), to packaged, cut and washed ready-to-eat products (fourth range). This sector already counts with a high number of species cultivated and sold as single or mixed products. The value chain is normally characterized by important Producers' Organizations that represent the connection between retailers and farmers, deciding the calendars of production and the distribution of the orders for specific products among their associate partners and (if necessary) external providers. All actors in the value chain face challenges related to production costs and labor supply (which can be not enough). Introducing new crop varieties/species is normally tested by POs with the collaboration of seed providers; however, these trials must face the problem of already crowded shelves and the resistance of retailers to increase the number of references which is already judged too high.

Finally, the eggplant value chain in Germany faces several challenges that make the cultivation and marketing of the crop unattractive to farmers and retailers. One major challenge is the low profitability of the crop due to high fixed costs associated with greenhouse cultivation, especially in comparison to more profitable crops such as tomatoes. The consumption of eggplants in Germany is still limited with an important share of consumers with a Mediterranean migration background. Therefore, there is a need to stimulate eggplant consumption among the wider population by developing novel processed products that require different eggplant cultivars as an ingredient.

As a conclusion, the valorization of agro-biodiversity in value chains is a theme that takes different connotations on the base of the specific product and the country. There are value chains that are already mature, as is the case of tomato, where both value chain actors and consumers appreciate the diversification of varieties, and where a balance of demand and supply for these characteristics does exist. A similar case is that of leafy vegetables, where variability depends on the number of species (and not of varieties), but where the market seems to be close to saturation (even if research for new products continues to be done). There are value chains with a moderate availability of variability, as in the case of lentils, but this variability is not strictly associated (by retailers and consumers) to specific varieties, rather to geographic specialties (with or without origin indication label) or to generic quality characteristics (red lentils, black lentils, small lentils, giant lentils). Finally, there are value chains where intra-specific variability is not an element of interest, as in the case of buckwheat, but where the need is primarily in the promotion of a crop that is neglected and underutilized.

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1. Introduction

Deliverable 3.2 refers to the analysis of interlinkages among value chain agents. The methodological approach adopted for the analysis involved the use of several tools such as supply chain flows, price transmission, and value creation, among others. The approach was tailored to the specific characteristics of the analyzed supply chains; experts interviews, ad-hoc survey questionnaires and focus groups were performed to key actors in every country and supply chains involved. The goal is to identify the main chain agents, their market and contractual power, the product's flows, contractual characteristics of exchange, transmission of price and value, and attributes required by different agents.

The collected information has been explicitly related to direct and indirect effects on biodiversity. The approach also considered how requirements for specific attributes and homogeneity may drive biodiversity reduction, while markets characterized by a high number of agents, parallel trade circuits, and diversified demand can foster biodiversity. Ultimately, the methodology aimed to provide a comprehensive understanding of interlinkages among value chain agents and their impacts on biodiversity.

Experts Interviews

The expert interviews were performed through a questionnaire designed for professionals and operators with knowledge and experience in production, processing and trade related to the value chain of the products under investigation. The goal of the interview was to gather information on the structure of the supply chain and the potential role of various actors within it, in order to obtain a clear understanding of the value chain, including its organization, the different actors involved, the flows, and modes of governance, as well as how biodiversity issues are incorporated into the value chain. In particular, the interview was structured to elicit information on various aspects of the value chain, including the roles and relationships between actors, the types of contracts used, the nature of transactions, the presence of market power and bargaining, the distribution of benefits, and the presence of standards or certifications related to biodiversity. The expert interview approach recognizes the importance of engaging stakeholders who possess knowledge and expertise in the specific value chain under investigation. The method also allows for an understanding of how biodiversity concerns are addressed or incorporated into the value chain governance and can help to identify opportunities to enhance biodiversity conservation through value chain interventions. Table 1 reports the number of experts interviewed for each national value chain.

Table 1 - Number of experts interviewed for each national value chain

COUNTRY	EXPERTS
ITALY	
Lentil	2
Fourth Range	2
Buckwheat	3
FRANCE	
Lentil	3
Young shoot	3
Tomato	4
GERMANY	

Lentil	5
Buckwheat	4
Eggplant	3
NORWAY	
Lentil	3
Tomato	2
Buckwheat	3

Supply chains actors interviews

For each country value chain, two types of questionnaires interviews were performed and intended for, respectively, abundant crops and scarce crops: the first version aimed at understanding the potentiality and feasibility of increasing the number of varieties of a target crop along the value chain; the second version aimed at introducing an underutilized crop in the national value chain. The surveys were primarily qualitative interviews, with a few quantitative farms indicators and parameters. The goal of the interviews for each value chain actor (producers, processors and retailers) was to evaluate the potential and feasibility of increasing the number of varieties of a target crop along the value chain. While the survey aimed to capture some quantitative indicators and parameters, it should be considered a qualitative interview. The qualitative approach was designed to enable the collection of valuable information from key stakeholders along the value chain, and it helped identify the challenges and opportunities that exist. The approach recognizes the importance of involving local partners as country experts in the decision-making process for selecting the appropriate questionnaire for each context. Table 2 reports the number of interviews conducted in each country for each value chain. The questionnaires can be founded in annex.

Table 2 - Number of agents interviewed for each national value chain

COUNTRY	PRODUCERS	PROCESSORS	RETAILERS
ITALY			
Lentil	4	5	3
Fourth Range	2	3	1
Buckwheat	2	2	1
FRANCE			
Lentil	3	2	1
Young shoot	3	2	2
Tomato	3	Not concerned	2
GERMANY			
Lentil	3	2	2
Buckwheat	2	2	1
Eggplant	3	Not concerned	1
NORWAY			
Lentil	1	1	Not concerned
Tomato	2	Not concerned	Not concerned
Buckwheat	2	2	1

Focus groups

In order to provide qualitative information on consumer preferences, acceptance, and expectations, focus groups have been organized with consumers. This methodology, based on consumer discussions on a given topic, allows us to focus our analysis on given topics. 8 focus groups have been planned in the 4 countries concerned by the roll out: 2 in Italy, 2 in France, 2 in Norway, and 2 in Germany. In Norway, the focus groups have not been conducted yet but are organized for April 2023 (Table 3).

To operationalize this, subcontractors were consulted in the respective countries. Ecozept set up guidelines for these focus groups discussions, which has been translated in the respective languages (by Ecozept in French and German languages and by subcontractors in Italian and Norwegian languages). Service providers supported to recruit a relevant set of 10-15 consumers in each location. Special rooms that suit the situation of conducting a focus group (a round table for 10-15 people, the possibility to audiotaping the discussions etc.) were hired. Ecozept moderated the focus groups in Germany and France but service provider have been in charge of this in Norway and Italy. The guidelines can be founded in annex.

Table 3 - Number of focus group for each national value chain

COUNTRY	NUMBER OF FOCUS GROUPS	DATES	PLACES	N° OF CONSUMERS INVOLVED
FRANCE	2	08/09/2022 & 06/10/22	Paris & Lyon	10 & 10
GERMANY	2	22/09/22 and 23/09/22	Munich	9 & 10
ITALY	2	20/09/2022	Bologna	10 & 10
NORWAY	Not done yet - 2 planned	Planned in April	Online	Around 10

2. Analysis of lentil value chain in Italy

2.1. Introduction and general information on market

In the EU, the most common legumes are pulses such as beans, peas, lentils, chickpeas, and soya beans. These have long been a part of Western diets and agricultural systems, but they have only recently risen in popularity in agri-food research (Cusworth et al., 2021). In Europe, several well-funded research projects have been carried out to analyze the agronomic applications of legumes and to assess their environmental contribution to European farming. This research interest is in line with early signals of growing consumer attention on legumes (fresh or processed) driven by the rise of plant-based and flexitarian diets (Cusworth et al., 2021).

Overall, legumes seem to account for 20-25 % of the diet in industrialized countries and 75% for those in the developing world (MIPAAFT, 2016). In Europe, consumption of pulses seems to be relatively low once it is compared to the rest of the world. However, since 2013, production has increased significantly. Indeed, EU legumes production increased by 70% over the last 5 years – and have great potential for growth based on new consumer trends.

Recent market forecasts have documented that the increase in legume consumption is due to a growing demand in health food markets (Redman, 2015) and the rise of vegetarian and vegan diets (Morris, 2018, Clay et al., 2020, Mann and Necula, 2020). In support of this, a recent Research and Markets report forecast a 4.6% growth in the global pulse market from 2019 to 2027 (Research and Markets, 2020) – motivated by markets for meat-alternative products, bio-fortification with legume grains, and ready-to-eat meals (Redman, 2015, Jha and Warkentin, 2020). In this regard, most researchers agree, indeed, that consumers will remain more willing to accept plant-based products over novel insect or cellular meat alternatives (Siegrist et al., 2018, Gómez-Luciano et al., 2019). Furthermore, agronomic research has explained how legumes can increase soil organic matter and add resilience to crop rotations (Wu et al., 2017; Considine et al., 2017), while increasing crop yields and/or profitability (Reckling et al., 2016).

In Italy, the demand of legumes has followed a negative trend over the years. According to ISTAT (National Institute of Statistics), the production of grain legume in Italy showed a decreasing trend from 1960 to 2011. CSCONFAGRICOLTURA (2016) provided three reasons for this decrease during these years: the total reduction of land available for agriculture, the reduction of farmers cultivating legumes and the decrease in demand for legumes due to the change in eating habits.

However, in line with the recent European trends, production of legumes in Italy recently presents a continuous increase. Italy is now an important country in terms of European legumes production. Soya and faba beans are the main produced dried grain legumes in Italy. It follows other grain legumes like dry beans, chickpeas and lentils. In Italy, production of lentils kept increasing from 2010 to 2018, namely from about 1700 t to 4,600 t.

Nevertheless, Italian lentils production is not able to satisfy all domestic consumption. Indeed, the demand is so high so that it is mainly covered by the imports. According to ITC (2019) Italy imported 49,400 t of lentils in 2017.

Cultivated lentil (botanically known as *Lens culinaris Medikus ssp. Culinaris)* is one of the most important cool-season grain legumes in the world together with chickpea and pea (Calles et al., 2019). Lentils (*Lens culinaris or Lens esculenta*) are edible legumes and an annual plant known for its lens-shaped seeds. Farmers know the value of legumes for their high nutritional composition (being rich in proteins) and their ability to bind nitrogen (Expert 1).

Lentils are also important in terms of biodiversity conservation, since they directly contribute to diversified landscapes, entering into agronomical rotations while at the same time providing habitats and resources to various animal species. Given the recent increasing awareness of environmental degradation, legumes have attracted the interest of different farmers for their ability to break pest or disease typical of intensive agriculture and to be cultivated using sustainable practices (Martinelli et al., 2022).

To sum up, it seems that legumes may contribute to addressing a variety of different challenges at the global scale. In Europe, legumes may help to solve the increasing plant protein production while reducing nitrogen supply. In the Mediterranean, where legumes already play an important role in people's diet, they may help address the need for diversified agroecosystems to cope with population increase and resource scarcity (Martinelli et al., 2022).

Most important lentils-based products

In the last two years, after a push by the FAO to further develop the pulses supply chain in human diets by reducing animal proteins and increasing proteins coming from vegetable sources, lentils and legumes-based (also chickpeas and peas) products have registered an increase of production (Expert 2).

On the market, lentils may be presented either dried (to be cooked) or pre-cooked and ready-to-eat inside a can or a package.

Figure 1 - Examples of lentils-based products in Italy

Sources: Carrefour.it, Valfrutta.it, Pedon.it

Other lentils-based products are easily available on the market too. Almost 50% of lentils end up in baked goods (pastas and other processed), however, it seems there is a small range of products based on different lentil varieties (Expert 2). Examples of lentils-based products are lentils chips, and other lentils-based snacks, lentils-based soups, ad lentils-based pasta, which are good gluten free options especially for celiac people.

Concerning legume-based products, the lentil pasta is the most popular one compared to the chickpea or pea pastas first of all for its very vivid colour (red or yellow lentils) and for a more neutral flavour compared to the one of chickpea or pea (Expert 1).

Figure 2 - Other examples of lentils-based products in Italy

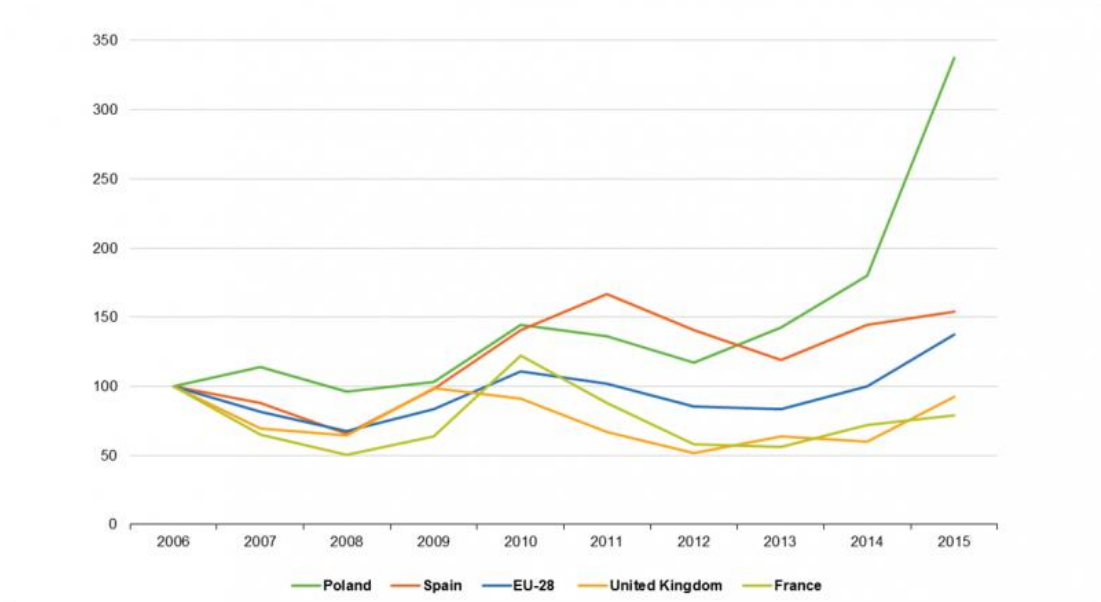
Sources: Pedon.it, Barilla.it, Pedon.it, Dimmidisi.it

Global production and intra-EU comparaison

As a food crop, the majority of lentils world production comes from Canada (2.9 million of tons in 2020, and India (1.2 million of tons in 2020), producing 58% combined of the world total. In 2020, global production of lentils was 6.5 million tons, led by Canada with 45% and India with 18% of the world total (FAOSTAT, 2020).

With a production volume of 66 thousand tons in 2017, at the global level Europe is a relatively small producer of lentils. Around 70% of European production volume occurs in Spain (24 thousand tons) and France (22 thousand tons). The lentils that Spain and France produce are mainly destined for their national markets, making them the leading consumers of lentils in Europe.

Figure 3 - Evolution of dry pulses area, by main cultivating Member States and EU-28, 2006-15



Source: Eurostat

The area used to cultivate dry pulses in the EU-28 has fluctuated between 1.5 and 2.1 million hectares over the last 10 years (Fig. 4). However, since 2013 the area has grown considerably. The increase between 2013 and 2015 was 64.7 % at EU-level. This is largely a result of the new Common agricultural policy (CAP) greening measures. The new CAP introduced the green direct payment scheme, which began to be implemented in 2015. In particular, nitrogen-fixing crops (such as dry pulses) are one of the options available for implementing the ecological focus areas (De Cicco, 2016).

2.2. The value chain network

General View

Based on the COEWEB-ISTAT database, Italy appears primarily to be an importing country of grain legumes and specifically of dried and shelled lentils (more than 62 million kg in 2020) (Table 4).
Lentils seem to be mainly imported from Turkey and Canada. Above all Canadian; often in Turkey they make a first processing of the lentil that comes from Canada.
The case of exports is very different. Italy appears to be a significant exporting country of processing legumes-based products. In 2020 Italy exported around 11 million kg of processed lentils and other dried legumes products such as flours, meal, powder etc. (Table 4).

Table 4 - Import and export of Italian dried and processed lentils (Year 2020-2021-Quantity in kg)

GOODS	2020	
	IMPORT	EXPORT
070890-Grain legumes, whether or not shelled, fresh or refrigerated (excl.peas and beans)	2.766.354	1.761.861
071340-Lentils, dried, shelled, whether or not peeled or broken	62.109.659	4.632.969
1106-Flours, meal and powder of peas, beans, lentils and other dried legumes of heading 0713, of sago or of cassava, arrowroot or salep roots or tubers, Jerusalem artichoke, sweet potatoes and roots and tubers similar to high starch or inulin content; flour, meal and powders of products of Chapter 8 "edible fruit"	7.795.909	11.434.918

Source: ISTAT, 2021

Table 5 - Import and export of Italian dried and processed lentils (Year 2020-2021-Value in Euro)

GOODS	2020	
	IMPORT	EXPORT
070890-Grain legumes, whether or not shelled, fresh or refrigerated (excl.peas and beans)	4.777.634	3.342.489
071340-Lentils, dried, shelled, whether or not peeled or broken	41.872.608	6.426.282
1106-Flours, meal and powder of peas, beans, lentils and other dried legumes of heading 0713, of sago or of cassava, arrowroot or salep roots or tubers, Jerusalem artichoke, sweet potatoes and roots and tubers similar to high starch or inulin content; flour, meal and powders of products of Chapter 8 "edible fruit"	10.957.807	23.845.166

Source: ISTAT, 2021

According to ISTAT, in 2021 in Italy lentils production was around 5 thousand tons. According to ISMEA (2023) indicates that the production is mainly located in central and southern Italy: 83% is present in the Marche, Puglia, Umbria, Sicily and Tuscany.

Lentil cultivation in Italy is mainly based on landraces, genetic material selected by farmers over time and adapted to the agro-environments. They usually take their name from the area where they are traditionally cultivated (Foti 1982). In Italy, the most famous and widespread lentils are the following:

Table 6 - Main lentils landraces in Italy

Name	Features	Region	Production area	Recognition/ Presidium	Link
Lenticchia di Altamura	Laird and Eston varieties of the Lens esculenta Moench species	Puglia Basilicata	Area appulo-lucana	IGP[1]	Link
Lenticchia di Castelluccio di Norcia	Very small with a thin skin varying in color from mottled green to light brown	Umbria	Castelluccio, frazione di Norcia	IGP	Link
Lenticchia di Santo Stefano di Sessanio	Very small with a round and flattened shape and a purplish-brown color	Abruzzo	Town of Santo Stefano di Sessanio and other close towns (L'Aquila province)	P.A.T.[2] and Slow Food Presidium	Link
Lenticchia di Ustica	Very small, dark brown color with shades from gray to light green, orange inside	Sicilia	Isola di Ustica (provincia di Palermo)	P.A.T. and Slow Food Presidium	Link
Lenticchia di Onano	Small seed flattened shape, variable color from dark lead to marbled green, to pinkish ashy	Lazio	Comune di Onano, in provincia di Viterbo	P.A.T.	Link
Lenticchia di Rascino	Small and brown seed, with few spots and reddish hues	Lazio	Altopiano di Rascino, nel comune di Fiamignano (provincia di Rieti)	Slow Food Presidium	Link
Lenticchia di Colfiorito	Small, varied in color from light	Umbria	Comune di Foligno, provincia di Perugia	P.A.T.	

[1] Indicazione geografica protetta (I.G.P.)
[2] Prodotto Agroalimentare Tradizionale (P.A.T.)

	green to dark brown to pink				
Lenticchia di Villalba	Large, green seed (green integument with yellow cotyledons)	Sicilia	Comune di Villalba, Mussomeli, Marianopoli, Vallelunga e Cammarata (provincia di Caltanissetta)	P.A.T. and Slow Food Presidium	Link
Lenticchia di Ventotene	Small size and light brown color with light pink veins	Lazio	Come di Ventotene, provincia di Latina	P.A.T.	
Lenticchia di Valle Agricola	Medium dimensions and rather dark color	Campania	Comune di Valle Agricola e nella fascia pedemontana del Massiccio del Matese in provincia di Caserta	P.A.T.	
Lenticchia nera di Leonforte o dei Monti Erei	Small, black in color, and brownish-red inside		Aree collinari dei comuni di Leonforte, Enna, Calascibetta, Marianopoli (provincia di Enna)	P.A.T. and Slow Food Presidium	Link

Some of these landraces are much appreciated as niche or specialty products and survive on farm, in marginal areas being exposed to a strong risk of genetic erosion and/or extinction (Piergiovanni 2000). Nowadays only lentil from 'Castelluccio di Norcia', which obtained the Protected Geographic Indication (PGI) by the European Community (EC Reg. no. 1065/97), has a consolidate market position.

Zaccardelli et al. (2011) investigated genetic diversity and relationships among some of aforementioned lentil landraces collected in Southern and central Italy. The results obtained showed that Castelluccio di Norcia and Villalba lentils landraces had the highest levels of genetic diversity.

However, some lentil cultivars have been promoted on farmers field mainly for commercial cultivation and reach the global market. This is the case of lentil Eston from Canada currently considered the most widespread and productive variety on earth and mainly considered for fields based on more intensive agriculture (Expert 1). In Italy, more conservative farmers, instead, prefer to opt for more traditional varieties (see examples in Table 3) that can enhance the lentil genetic resources of diversity and the best lentils' organoleptic characteristics (Expert 1)

Based on the experts' interview, it appears that lentils cultivation may sometimes be difficult to manage because of weeds' infestation and risk of crop loss (Expert 2). However, to fight this threat and better control weed problems, farmers sow the seeds in quite narrow rows (8-10 cm) and opt to plant lentils within crop rotation (Expert 1). Lentil's cultivation is, indeed, used in crop rotation with other cereals (e.g., durum wheat, spelled) and in organic farming (Expert 1). Crop rotation is employed to reduce the reliance on chemical fertilizers, herbicides and pesticides but also as a way to naturally nurture the land and build healthy soils. A basic principle of crop rotation in organic farming is not to grow the same crop in the same place two years running which - as Expert 1 stated - it might sometimes be difficult to manage in certain areas. To conclude, in Italy farmers have long been denouncing the damages caused by roaming animals such as wild boars to crops and agricultural infrastructures. Crops have been destroyed by the passage of hundreds of wild boars which have also started eating the plants of this legume (Expert 1).

Some key players are:

- Seed providers

Table 7 - Overview of lentils seed providers and cultivars offered in the market

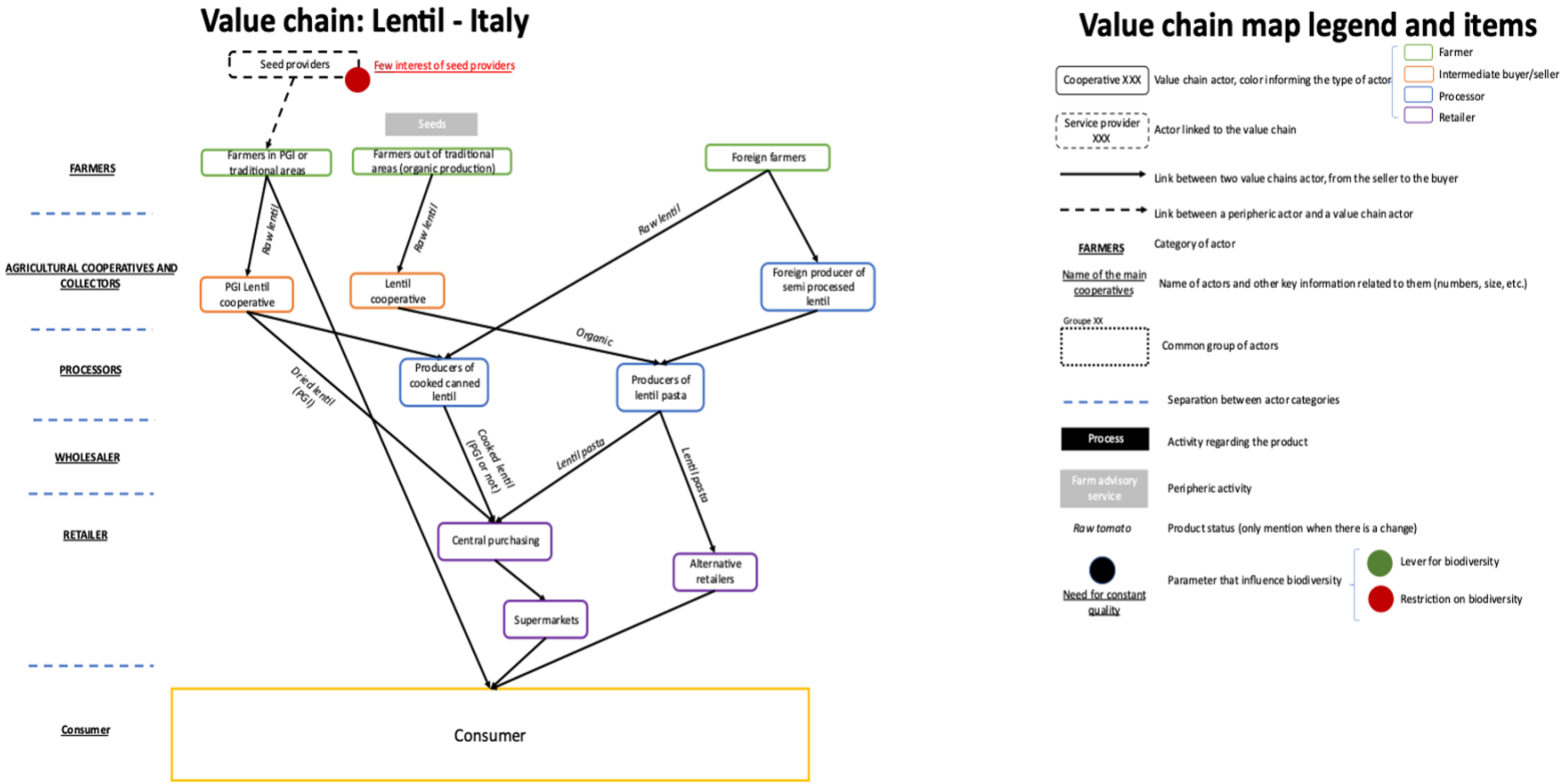
Seed provider	Cultivars
AGROSERVICE	**Lentils** • Elsa • Gaia • Itaca
CERMIS	**Legumes** • Lentils
SCIATTELLA LUIGI & FIGLI Srl	**Lentils:** • Lenticchie medie (OR: USA) • Lenticchie piccole Eston (OR: CANADA) • Lenticchie Risse Intere (OR:CANADA)

Source: UNIBO based on ASSOSSEMENTI

- Cooperatives and consortium working in the lentils industry such as:
  - *Consortium for the Protection and Enhancement of the Lentil of Altamura I.G.P.* - a consortium made up of farmers alongside with wholesalers, packers and interested public bodies working to protect the peculiarity of their lentils, history and symbol of Made in Murgia and guaranteeing the quality requirements established in the Production Regulations.
  - *Cooperative Lentil IGP of Castelluccio di Norcia* - a cooperative working with farms adopting production techniques based only on organic fertilization and working to protect the awarded Lenticchia di Castelluccio IGP mark.
- Big processors
- Big branded companies – which seem to have a great control on product choice by following consumer trends and offering trendy products to large-scale distribution.
- Large-scale retailers- which re-propose similar products using the private label brand;

Figure 4 is a simplified, static graphical representation of some key and selected elements in the lentil value chain in Italy.

Figure 4 - Lentils' value chain map in Italy



2.3. Dry Lentil

Point of view of actors

Producers

The dry lentil value chain has diverse characteristics as seen from the information provided on four farmers. Farmers A and D grow specific types of lentils that have either a local ecotype or PGI mark. Farmer A is part of a cooperative, while Farmer D is part of a consortium that provides a guaranteed minimum price to its farmers. Farmers B and C produce lentils that are not specific to any variety but are characterized by the soil and environmental factors. Farmer C sells their harvested lentils to a storage company that transforms them into pasta, while Farmer D sells their lentils to processors, and their lentils are then sold directly to large-scale distribution.

Farmer A is located in Castelluccio di Norcia and has 10 hectares of land, with 7-8 hectares devoted to lentil cultivation and the remaining 2 hectares to spelt. The farmer is part of a big cooperative, the Coop Agricola Castelluccio di Norcia, which is one of the two cooperatives in the area. However, there is no consortium for the protection of the PGI (Protected Geographical Indication) mark, which means that other operators can also grow Castelluccio di Norcia lentils. The Castelluccio di Norcia lentil is a local ecotype that has always been cultivated in the Castelluccio plain. It has a typical variegated color and does not have a particular name. The seed is 100% local, usually already owned by the farmer. To have the PGI mark, farmers do not have to be part of one of the cooperatives, they just have to grow local lentils in the territory. Farmer A's lentils are grown in mono succession and are all conventional. The regulations do not provide for mono succession in organic farming. Furthermore, organic production would increase the cost to the consumers. More than 80% of Farmer A's time is spent on the 8 hectares of lentils, with a production yield of 7-8 quintals per hectare.

Farmer B's lentil yield varies significantly depending on the season, ranging from 4 to 15 quintals per hectare. However, the yield trend does not directly affect the selling price, except when there is a generalized yield shortage, which affects the price. In 2022, Farmer B had a harvest of 400 quintals. The origin of the lentils varies, with some coming from abroad, although they are primarily produced in Umbria. There are no varieties of lentils, only production areas, such as Colfiorito, Depuy (area of France), Castelluccio, etc. The lentil characterizes itself according to the soil and other environmental factors.

Farmer C has a yield that varies between 0.3/0.4 tons to 1.5 tons/ha, with 0.3 tons/ha recorded in the year 2021/22, which is dependent on the level of rainfall. The yield between the two varieties of lentil, Eston and Crimson, is almost equivalent, although sometimes, the red one (Crimson) can produce 2 quintals less. Farmer C sells the harvested lentil to a storage company, which then transforms it into pasta. Their type of client is a warehouse that provides the seed for sowing.

Farmer D has a yield of 1 ton/ha. They cultivate a lentil of Altamura PGI, consisting of Eston and Layrd varieties, in collaboration with the CNR to recover ancient seeds, including the Altamura lentil (100 seeds) requested from the USDA. To ensure high productivity, Farmer D conducts several soil tests with experimental fields, and they obtain their seeds from companies that get seeds from Eurobanks, which are free from parasites, and from seeds imported from abroad. Farmer D is part of the Altamura Consortium, and their type of clients are processors, which account for 15% to 20% of their sales. Before sowing, all farmers in the consortium have a guaranteed minimum price, and the Altamura consortium ensures that they always get 20% more than the market value. The lentil

produced by the Altamura consortium is sold directly to large-scale distribution for transformation, and their production of Altamura is 7000 quintals.

Processors

The different processors use different strategies to ensure that their products are of high quality and that they reach the clients. The variations in their methods show the diversity of the agricultural industry and the importance of finding unique ways to succeed. Processor A purchases a large quantity of lentils from various suppliers, including Italian suppliers, and processes almost all varieties of lentils on the market. Processor B offers various lentil products and has a network of contracted farmers. Processor C specializes in dehydrated, unhusked red lentils and has a primary Italian supplier. Processor D focuses on selling dried lentils, which yield higher profits.

Processor A purchases around 3000 tons of lentils, with 10% of the total being Italian. The company processes almost all the varieties of lentils on the market, including Eston, Crimson, Dupuy, Hispanic, Beluga, and peeled yellow lentils. The suppliers can freely choose the origin of the raw materials, subject to commercial agreements. If an important customer of the large-scale retail trade requires something specific in the supply chain guarantee, the control on the seed side also starts. There are four Italian suppliers, including cooperatives and farms, and they must supply the product pre-cleaned in bags ready to be processed. An agricultural plan with audits is made with them. There is no real specialization of the supplier, also because of the agricultural rotation.

Processor B offers various types of lentils products, including dried lentils, dehusked lentils, pre-cooked lentils. The type of lentils are: green lentils, brown-red lentils, black lentils, dehusked red lentils, and dehusked yellow lentils. They have 80 providers at the regional level, both individual farms and cooperatives. The providers have long-lasting years based contracts.

Processor C offers red lentils that are dehydrated and not husked. They do not provide cooked lentils as the market is not pulling, and since all the company's products are in a premium category, they cannot go in a tin packaging. The supplier is non-member of the company group, but it is Italian. There is a primary supplier with whom they have an annual contract, and it is also a packer of bulk products that receives the raw material and packs it for the company.

Processor D prefers dried lentils because they yield more. Sales of dried lentils on total of lentils are above 80% (the remaining part is processed). Pasta with pulses flour, excluding those that are gluten-free, are still little consumed by consumers.

Retailers

The three retailers have different approaches to sourcing and producing them. Retailer A controls the entire production process, including sourcing from individual farmers and processing before sale. Retailer B offers a wide variety of lentil products, sourced from a mix of farmers and processors, and includes specific varieties for their target market. Retailer C purchases a smaller quantity of lentils and sources mainly from processors with whom they have transaction contracts, offering a limited selection of specific varieties. All retailers face the challenge of finding reliable suppliers due to the high risk and low yield of lentils.

Retailer A produces 130 references of lentils, including products such as soups, lentil flour, and more, and all the lentils they produce are Italian and controlled directly by the company. The lentil is a product on which there is a high coefficient of risk, with a yield of 5q/ha (if everything goes well), and they harvest it once every two or three years. They have an annual demand for 2000 quintals, and they collected 620 quintals this year, so they need to find other suppliers. They have ten individual farmers as suppliers with whom they have an annual supply contract before sowing, and the retailer guarantees a price that is always the same and does not fluctuate based on the market.

The main phases of their process include delivery from the farmer to the transformer, storage, pre-cleaning, selection, and decortication if needed, followed by sale to the retailer.

Retailer B purchases 1 million kg of lentils, with 80 specific products sold for the targeted market, including Eston and Castelluccio di Norcia varieties. They have 30% single farmers and 70% processors as suppliers, and their other provider is Terra di Altamura.

Retailer C purchases 33.2 tons of lentils, with five specific products sold for the targeted market, including Laird and Eston varieties. They have 43% processors as suppliers with whom they have a contract for the transaction.

Consumers

During the focus group on lentil consumers, different varieties of lentils were mentioned, including green, black, brown, red, large and small lentils, Colfiorito lentils, and Castelluccio di Norcia. Participants noted that these varieties have different tastes, cooking methods, durations, uses, and recipes, making it interesting for consumers to have access to different types of lentils. For instance, Castelluccio lentils are considered easier to cook, better, and come with a certain origin, but they are more expensive.

Participants also discussed different lentil products, including dried or pre-cooked lentils in cans, lentil pasta, lentil flour, and ready-to-eat soups or minestrone soups. Lentil pasta was seen as a novelty product, with some participants liking it, and others not. It was noted that the information about lentil pasta is only available in supermarkets, and it would be seen as positive to have more varieties of lentil in pasta (e.g., Colfiorito, Castelluccio, or red lentils) due to their healthier properties, better appearance, and taste. Some participants expressed willingness to pay 10-20% more for this product. The criteria for selecting lentil pasta were price, taste, and origin. However, others were not interested in the origin or color of the lentils but were more interested in better nutritional aspects.

Regarding lentil flour, no one in the focus group had tested it, but some participants were interested in having a diversity of flour. Chickpea flour was also mentioned.

Overall, the focus group provided insights into the consumers' preferences and priorities regarding different lentil varieties and products. The results suggest that consumers are interested in having access to a diverse range of lentil varieties and products, and they are willing to pay more for healthier and better-tasting products. The focus group highlights the importance of understanding consumer preferences and expectations to develop new lentil products that meet their needs and preferences.

2.3.1. Profitability, drivers and main variables for variety/species choice

Producers

The profitability of lentil farming and the main drivers for variety/species choice are influenced by various factors such as production costs, climate change, and seed quality. The impact of climate change on lentil farming is significant, and adaptation measures such as sowing lentils in autumn are required. Additionally, seed quality and the source of the seeds are essential considerations when selecting the lentil variety to cultivate.

Farmer A has variable costs of 1,000 euro/ha, with additional increases of about 150/200 euro per hectare. The contribution price to the cooperative has increased but has not entirely absorbed the increase in costs, partly due to the drought. The harvested lentil requires cleaning, which is done on the farm, with packing costs around 50 euro/quintal. Seed costs are 600 euro/quintal, with one quintal/ha needed. The farm also grows other ecotypes other than Castelluccio but still local

ecotypes, in close areas. The high land rental costs (more than 1,000 euro/ha) impact the profitability of the farm, and the summer drought due to climate change is a significant problem that cannot be entirely solved by adaptation measures.

Farmer B prefers dried lentils because they yield more, with sales above 80% (the remaining part is processed). Pulse pastas, excluding those that are gluten-free (they need to be certified, thus specific procedures are necessary), are still little consumed by consumers. Climate change has a considerable impact on lentil farming, with different areas sowing earlier or later. In general, the heat (temperature) and not dryness creates more problems. Heavy rain and excess water, especially in clay soils, create many problems. Late flows are also a problem. Adaptation measures to climate change include sowing lentils in autumn, which can resist more than other pulses.

Farmer D cultivates Lentil of Altamura PGI (Eston and Laird varieties) and collaborates with the CNR to recover ancient seeds. After several soil tests with experimental fields, the farm has achieved a high level of productivity. The farmer believes that it is not advisable to reseed on the farm and instead buys seeds from companies that get seeds from Eurobanks (free from parasites), with seeds imported from abroad.

Processors

The interviewed processors faced volatility in the prices of their raw materials differently: processor A, with a 37% increase in purchasing costs in 2022, did not pass this increase on to their customers. Processor B experienced a significant increase in the average price of their products sold in 2021, ranging from 10-15% up to 30%.

The processor A described in the context of the given information sources is engaged in the processing of various varieties of lentils from Canada and Italy, including Crimson lentils, which are worth half of Castelluccio lentils in Italy. The average price paid for the raw materials in 2022 was €1 per kilogram for Italian lentils, while foreign lentils cost €0.8 per kilogram (CIF). However, this price was subject to volatility, with Italian lentils being bought for as little as €0.7 per kilogram and as much as €1.4 per kilogram. In 2022, the processor experienced a 37% increase in purchasing costs, but this was not passed on to their customers.

Processor B offers various types of lentils varieties: green lentils, brown-red lentils, black lentils, dehusked red lentils, dehusked yellow lentils. Three types of product: Umbria lentils, Lentils from Altopiano di Colfiorito, Italian lentils plus 1 product with foreign lentils. In 2021 the average price of the product (€/kg) sold increased by 10/15% up to 30%.

Retailers

All three retailers differ in the lentil varieties they offer and where they source them from. Retailer A sources small brown lentils and red hulled lentils from Tuscany and Apulia, and they select suppliers based on the guarantee of the product's quality, not the lowest price. Retailer B offers lentils from Castelluccio di Norcia, Italy, and Canada, with different varieties chosen based on consumer preferences and the concept of terroir. Retailer C sources Laird lentils from Canada and Eston lentils from Canada or Ukraine, primarily based on consumer preferences.

For the retailer A, the most popular dried lentil references by volume and value include small brown lentils and red hulled lentils. It has seven suppliers for their processed lentil products, but they do not source Lentil PGI from Altamura nor do they source from producers of Castelluccio di Norcia lentils. Usually, their farmers cultivate the Robin variety of small brown lentils, and they mostly come from Tuscany or Apulia. Retailer A, tends to be strict in the initial selection of suppliers, and they try to keep the relationships long-lasting based on the guarantee of the suppliers handling the product

better, not based on the lowest price. Additionally, a supplier with different varieties of lentils is essential for the company

For Retailer B, the lentil bio variety has a 40% volume share on the total volume of the crop and comes from Castelluccio di Norcia, Italy, or Canada, and the main reason for choosing this variety is due to consumers' preferences. Lentil IGP, which has a 5%-10% volume share, also comes from Castelluccio di Norcia and is chosen for the concept of terroir and Italian brand. Finally, the lentil without certification has a 50% volume share and comes from Italy or Canada, and the main reason for the choice of that variety is to extend the range of lentils.

For Retailer C, the Laird lentil variety has a 36.6% volume share on the total volume of the crop and comes from Canada, while the Eston variety has a 61.4% volume share and comes from Canada or Ukraine. The main reason for the choice of these varieties is due to consumers' preferences.

2.3.2. Price formation and market power

Producers

All four farmers differ in how they establish their lentil selling prices and to whom they sell. Farmer A sells Norcia lentils exclusively to a cooperative, which certifies and packages the product for sale in various channels, primarily GDO. Farmer B establishes their own price for their lentils, not strictly linked to the market price. Farmer C's lentil market price is set by the Altamura Commodity Exchange or the consortium, which guarantees a minimum price and can increase if the market does. Farmer D's lentil market price is set by the Altamura consortium, and he notes that some Italian processors are buying organic hulled red lentils from Turkey instead of Italian ones, which could affect prices.

Farmer A sells Norcia lentils exclusively to the cooperative. The contribution price for these lentils is 500-600 euros per quintal, and they are sold loose to the cooperative. The cooperative then certifies the product as PGI and packages it. The main channels that the cooperative sells to are GDO (90-95%), where Norcia lentils are sold for an average price of 8 euros per kg, and other channels (5-10%). The Castelluccio specification does not provide quality standards that must be respected, but there are quality controls in the field, documentary checks and controls by certifying bodies and chambers of commerce, and control on labelling. Farmer A also sells other ecotypes to other wholesalers for a selling price of 200 euros per quintal, as the yield is higher for these ecotypes.

Farmer B establishes the lentil price based on foreign reference prices, which are typically lower. However, the company makes its own price, which is not strictly linked to the market price since it is a small company

Farmer C's lentil market price is set by the Altamura Commodity Exchange, which set the price of green lentils at 1150 euros per ton in 2022 (similar price in 2021). Farmer C's lentil market price is set by the consortium, which guarantees a minimum price. If the market increases, the price also increases.

Farmer D's lentil market price is set by the Altamura consortium (minimum guaranteed price) if the market increases. According to the farmers' D statement, the most important Italian processing company is working a lot abroad and buys organic hulled red lentils from Turkey at 150 quintals of Turkey, instead of buying Italian ones that have not yet been hulled at 180 quintals of euros.

Processors

Processors A, B, and D set their own prices, which are not necessarily tied to the international market.

Processor A determines the price in advance through contracts and agreements with suppliers. There is a reference price list, but the company often negotiates the price based on other factors and relies

on information from a trade association that provides more reliable data. However, these data are not public.

Processor B has long-lasting contracts with farmers to secure the supply of raw materials. The price it pays to the farmers is not set at the beginning but is negotiated later, offering a better deal for the farmer. In the past year, the processor B has anticipated the money for seed costs to farmers. They set the price for their products, which does not follow the stock market trends, so it is not linked to the international market. The processor suggests that the price is blocked by the supermarket; otherwise, the market will stop.

Processor D is also a farm and sets its own price, which is not tied to international price trends. Consumer prices have been revised upward by 6%. The company only outsources the processing of lentil paste to a pasta maker. They have a good relationship with large-scale retail trade and have given fair prices despite the price increases of the last year. However, the contracts will need to be reviewed in the future.

Retailers

Retailer A, B, and C all have different pricing strategies for their suppliers.

Retailer A follows a fixed price strategy for their suppliers, including farmers. They offer 160 euros per quintal and maintain the same price in all shops. They also follow the market trend and adjust the price when it goes up, but not when it goes down, to maintain the relationship with farmers. In 2022, they raised the price to 180 euros per quintal due to scarcity of supply. The price is not influenced by world market trends since farmers do not sell on international markets. However, in some cases, when local farmers receive higher proposals from other buyers, they may raise the price.

Retailer B's top-selling products are their own brand and organic versions of their own brand. DOP and Organic lentils follow the European format through contracts, whereas Canadian Eston lentils follow the market quotation.

Retailer C mainly deals with territorial and niche products of Italian origin, which have a premium label. The price for a new product is decided based on a market analysis of sales margin guarantee and price analysis of competition.

2.3.3. Feasibility, constraints and consequences of introducing more varieties/species/products

Producers

Common traits of the farmers mentioned include their interest in introducing new varieties and their concerns about price volatility. However, they differ in their opinions on the impact of introducing new varieties, on productivity and efficiency, and the potential costs and benefits of diversifying their products. Farmer A focuses on the lack of quality standards for Castelluccio lentils and the limited production area, while Farmer B notes the industry's tendency to use few varieties and how organic has helped increase awareness of the variety of lentils among consumers. Farmer C is interested in introducing new varieties but acknowledges the potential problems, such as soil adaptation and production costs. Finally, Farmer D sees the potential benefits of introducing new varieties, such as diversifying the products and improving the reputation of the enterprise in the long term, but also notes the potential increased complexity and costs associated with managing the different varieties. In particular:

According to the farmer A, the Castelluccio specification does not provide for any indications and/or quality standards that must be respected. There are only quality controls in the field: controls and documentary checks for certifying body and chamber of commerce, control in the field, labelling

control. There are no farmers and operators in the area who enter into contracts to use Norcia lentils in the production of pasta, etc. Farmer A thinks it would be interesting to evaluate, but the surface areas of Castelluccio would not allow large productions.

According to the farmer B, which is also a processor, it is often the industry that creates some problems because they tend to use little variety. Organic has helped a lot in awareness of the variety of lentils among consumers.

Farmer C did not introduce new varieties in his activity recently but he would be interested to do it with the support of the research. He thinks farmers can introduce new varieties on their own initiative but It depends on the type of variety and soil because some varieties adapt better than other (e.g., Dupoix, Layrd, other more local in the Altamura area). Overall, there are more problems than advantages to introduce more varieties at the same time.

Farmer D has not introduced new varieties in his activity recently, but he thinks that farmers can introduce new varieties on their own initiative depending on the type of soil. The main constraints and bottlenecks the farmer faces within production and marketing of the targeted crop are productivity and price volatility. According to the farmer, the introduction of new varieties may not require new techniques and standards, but there may be higher production costs with other varieties due to variable costs. The farmer disagrees that there is insufficient demand or difficulty accessing seeds and high advertising costs. However, the farmer somewhat disagrees that there are limitations linked to public policies and regulation. The expected effects from farming and trading a higher number of varieties include the improvement of the economy of farmers, the creation of stronger vertical relations, improvement of access to processing markets, and increase in the number of clients, and the revenue of clients. The expected commitments and costs from farming and trading a higher number of varieties (without increasing the cultivated area) are the increased complexity in the management of plots, increased variable costs, and a slight reduction in productivity and efficiency of processes. However, the farmer does not expect to require new dedicated spaces (including storage), structural adjustment of the farm, or increased training for workers. The farmer somewhat disagrees that there will be increased work to separate products, increased work to find clients and markets, or increased planning activities and documents. In general, introducing more varieties may have some benefits such as diversifying the products and improving the reputation of the enterprise in the long term. However, it may also result in some increased complexity and costs associated with managing the different varieties. Ultimately, the decision to introduce new varieties should be based on a thorough analysis of the expected costs and benefits, and farmers should carefully consider factors such as market demand, access to seeds, public policies and regulations, and the potential impact on productivity and efficiency of processes.

Processors

All three processors have different priorities and approaches. Processor A is interested in developing new lentil varieties, focusing on taste and variety in their products, and investing in chickpeas due to the growing consumption worldwide. Processor B values traceability in their supply chain and believes in introducing new varieties on their own initiative, but recognizes the obstacles and costs associated with doing so. Processor C focuses on internal guidelines to ensure product quality and authenticity, conducts audits and market analysis before developing new products, and previously evaluated alternative legumes but did not work on lentils due to lower market demand.

Processor A is interested in conducting research and development work on new varieties of lentils. While tests have been conducted on lentil varieties in Italy, yield problems have arisen due to humid terrain and rich soil. Organic lentil variety tests were also conducted in Kazakhstan. However, it is recognized that having many lentil varieties may increase costs such as scouting, verification, and

auditing. It does, however, improve market recognition and allows for business continuity for customers. The company is focusing on taste and the variety of pulses in its products, with the service offered to the consumer being a top priority. There is a trend in lentil product references, with dry lentils growing less while the already cooked trend is growing strongly. Processor A is investing a lot in chickpeas as consumption worldwide is exploding, and chickpeas are much more resistant from an agronomic point of view. The future prospects of managing specific and regional lentils depend on the volumes produced, the variable costs, and the relative price margins that can be guaranteed.

Processor B ensures full traceability in their supply chain through controls at the farm level with their technicians, as well as through shelf life testing and third-party audit certifications. They believe that geographical origin is more important than organic agriculture-based lentils in the market, and new varieties have not been introduced in their activity recently. However, the processor believes that they can introduce new varieties on their own initiative to differentiate their product range, particularly after recent consumer trends. The processor identifies production costs with other varieties as a bottleneck to introducing a new variety, with high costs for adapting the production line and advertising. The likelihood of introducing a new variety in the near future is a 5 out of 10. Overcoming the obstacles would require awareness of the consumer and support from retailers. The processor expects that processing and trading a higher number of varieties would increase the quantity of raw material purchased, number of providers, and revenue of processors, and improve the reputation of the enterprise in the long term. However, introducing more varieties would require new dedicated lines and spaces, increase variable costs, and increase work for selecting providers, finding clients and markets, and planning activities and documents. In summary, while the processor is open to introducing new varieties, they recognize that it would come at a cost and require structural changes to their production and supply chain. However, they see potential benefits in increasing their revenue and reputation in the long run.

Processor C currently has (in general, for all products) around 400 references which are already considered to be too many. The processor follows internal guidelines that ensure Italianity, clean recipes, territoriality, PDO/PGI, and a preference for member ingredients. When developing new products, the processor first conducts audits, analyzes market trends, and assesses requests received by sales. Then, the processor verifies the availability of suppliers, whether they are already present among members or new suppliers are sought. Next, the management team verifies the product, and the recipe is developed with the right supplier. After internal verification and evaluation of the recipe, external assessors may also be involved, followed by the development of the label. However, prior to COVID, work was done on a project to evaluate the inclusion of alternative legumes, but lentil was not worked on because market demand and the consumer is not so demanding.

Retailers

All three retailers face challenges when introducing new lentil varieties due to low sales volumes, high processing costs, and risks of products expiring. Retailer A prefers to include local suppliers of regional lentils and is strict in the initial selection of suppliers. Retailer B introduces new products upon request from providers, and their expectations of distributing a higher number of specific products produced from different varieties are not very positive. Retailer C believes that introducing new varieties to the targeted product is not feasible and that new products can be introduced as a request from providers, copying other operators, or based on their own initiative. Retailer C fully disagrees that introducing more specific products would require new dedicated lines, worsen productivity and efficiency of activity, increase variable costs, and require increased training for workers, but they fully agree that it would increase work to select providers, increase work and cost for marketing and consumer information, and increase planning activities and documents.

Retailer A faces challenges when introducing new lentil varieties due to their low sales volumes, which may lead to products expiring and high processing costs. Working on small volumes also means working with a single company, which incurs logistics and labeling costs and risks being tied to a few companies. Additionally, there is a risk of the product not selling. Four years ago, Retailer A considered buying Altamura PGI lentil, but they gave up on it due to the conditions for obtaining PGI certification. Retailer A tends to be very strict in the initial selection of suppliers and prefers guarantees that the supplier can give on the best handling of the product. The retailer also tries to include local suppliers of regional lentils because it is a type of lentil that is only sold in that region. Although it is possible that some farmers or cooperatives directly supply some regional Retailer A shops, individual shops cannot have a dedicated supply of that product. The expectations of distributing a higher number of specific products produced from different varieties include an improvement in the economy of farmers, an increase in the number of providers, and no change in the number of consumers. However, the effect on the economy of processors and the enterprise's reputation in the long term is not clear. Distributing a higher number of specific products would require new dedicated lines, may worsen productivity and efficiency of activity, increase variable costs, and increase work to select providers. However, it would not require new dedicated spaces or structural adjustment of the stores, nor would it increase the work for the management inside stores or the need for worker training.

Retailer B introduces new products upon request from providers, indicating that the retailer does not actively seek to introduce new varieties themselves. Regarding the effects of introducing more specific products, Retailer B does not expect improvements in the economy of farmers or processors and only somewhat agrees that it could increase the number of consumers. Retailer B also somewhat disagrees that fostering stronger vertical relations could be an effect and is neutral on the potential for improving the enterprise's reputation in the long term. Regarding the commitments and costs of introducing more specific products without increasing the total quantity of sales, Retailer B fully agrees that new dedicated lines and spaces would be required, as well as an increase in management work, variable costs, and work to select providers and provide marketing and consumer information. Retailer B somewhat disagrees that structural adjustments to stores would be required but fully agrees that productivity and efficiency of activity could worsen, and planning activities and documents may need to be increased. Retailer B is neutral on the requirement for increased worker training.

Retailer C believes that introducing new varieties to the targeted product is not feasible. They believe that new products can be introduced as a request from providers, copying other operators, or based on their own initiative but don't think that retailers can introduce new products produced from different varieties. They believe that retailers lack the operational tools and organizational structure to introduce new products. Regarding the effects of distributing a higher number of specific products produced from a different variety, Retailer C somewhat agrees that it can improve the economy of farmers and processors, increase the quantity of product purchased, and increase the number of providers. They neither agree nor disagree that it can increase the number of consumers and foster the creation of stronger vertical relations. They fully agree that it can improve the reputation of the enterprise in the long period. For the commitments and costs that they expect from distributing a higher number of specific products produced from a different variety without increasing the total quantity of sales of the targeted product, Retailer C fully disagrees that it would require new dedicated lines, increase the work for the management inside stores, require structural adjustment of the stores, worsen productivity and efficiency of activity, increase variable costs, and require increased training for workers. They neither agree nor disagree that it would require new dedicated spaces (including storage). However, they fully agree that it would increase work to select providers,

increase work and cost for marketing and consumer information, and increase planning activities and documents.

2.3.4. Summary

The dry lentil value chain is characterized by diversity in terms of farmers, processors, and retailers.

In terms of producers, four farmers were interviewed, each with their unique approach to lentil farming. Farmer A and D grow specific types of lentils that have either a local ecotype or PGI mark, and they have different selling prices and markets. Farmer B and C produce lentils that are not specific to any PGI mark but are characterized by the soil and environmental factors, and they sell their harvested lentils to different entities. All four farmers have expressed interest in introducing new varieties, but they differ in their opinions on the impact of introducing new varieties, on productivity and efficiency, and the potential costs and benefits of diversifying their products.

The processors, on the other hand, use different strategies to ensure that their products are of high quality and reach their customers. Processor A purchases a large quantity of lentils from various suppliers, including Italian suppliers, and processes almost all varieties of lentils on the market. Processor B offers various lentil products and has a network of contracted farmers, and Processor C specializes in dehydrated, unhusked red lentils and has a primary Italian supplier. All three processors have different priorities and approaches when it comes to introducing new varieties or products, traceability, and product quality.

Finally, retailers have unique approaches to sourcing and producing lentils. Retailer A controls the entire production process, including sourcing from individual farmers and processing before sale, while Retailer B offers a wide variety of lentil products, sourced from a mix of farmers and processors, and includes specific varieties for their target market. Retailer C purchases a smaller quantity of lentils and sources mainly from processors with whom they have transaction contracts, offering a limited selection of specific varieties. All three retailers face challenges when introducing new lentil varieties due to low sales volumes, high processing costs, and risks of products expiring. The retailers also have different approaches to setting the price and sourcing their lentils, with Retailer A and B having more control over the prices they offer to their suppliers.

2.4. Lentil Pasta

Point of view of actors

Producers

Farmer A produces red hulled lentils to make 100% lentil pasta, but the company does not produce gluten-free pasta due to contamination problems, so it cannot be certified. However, they have 99% gluten-free products. To make gluten-free pasta, one would need specific equipment, and the company would need to solve the problem in the field, which is a challenge due to the threshing machine. Despite this, there is a demand for gluten-free pasta due to different degrees of intolerance, and the market is ready to accept it. The pasta is made outside the company, and there are different pasta factories for different types of ingredients. Not all pasta factories are suitable for processing that type of ingredient, and there are not many pasta factories that process pulses. The farmer works with one pasta factory that can process the legume flour without any treatment. However, other pasta factories do heat treatment (thermo-treatment) to process the pasta better and ensure it does not fall apart. In thermo-treatment, there are losses of vitamins and other nutrients, which can impact the overall nutritional value of the pasta.

Processors

The lentil pasta procedure used by processor A was first developed in the United States and has since expanded to Northern European countries. They were the first to make pasta using 100% legume flour and water. The annual production of lentil pasta requires about 10,000 tons of raw materials, of which around 6,000 tons of pasta are produced and sold (since 1 kg of pasta requires 2 kg of lentils). The origin of the lentils depends mainly on a few factors, including the customer's request and the company's own brand name. In general, 50% of the lentils used are organic, and the remaining are conventional. When purchasing from other suppliers, the company mainly buys from Canada for the conventional product and India and Turkey for the organic product. The rest of the lentils come from various regions in Italy, such as Puglia, Calabria, Sicily, Marche, Sardinia, Tuscany, Lower Campania, Upper Lazio, and Veneto, and they also conduct trials in Piedmont. The lentil varieties used for pasta production include foreign varieties such as Krimson for red lentils, Leard, and Eston for green lentils; Italy's Agroservice (a seed distributor) is used to produce the Ithaca (red) and Elsa (green) lentil varieties. The lentil yield, which refers to the ratio of whole lentils to husked lentils, depends on the variety, ranging from 50-60%. The pasta's production has had up to 30% Italian production in the past, but this has recently been lower due to weather conditions. Finally, the company decides how much of the raw materials to buy from farmers and traders, based on actual demand, and ensures that the lentils are husked, allergen-free, and ready for milling and subsequent pasta making.

Processor B indicates that they have contracts with only one pasta factory that processes red lentils, and the lentil pasta was born as an alternative to traditional pasta and not to catch the current trend of lentil.

Retailers

According to the information provided by the retailer A, lentils represent about 6% of the canned vegetable market in Italy, with 80% of lentils being of foreign origin, mainly from the United States and Canada. Lentils are usually purchased dry and then processed and packaged in Italy. Regarding packaging, 70% of lentils are canned in sizes up to 500g, and 16% are packaged in brick format.

2.4.1. Profitability, drivers and main variables for variety/species choice

Producers

According to the farmer A (who uses an external pasta producer for this service, while he trades the processed product), the average cost for the service for the pasta factory to produce lentil pasta is almost 2.4 euro/kg. Customers for lentil pasta are mainly large-scale retail trade and a few specialized shops. Although there is potential in the consumer market due to different degrees of intolerance, the company faces challenges in obtaining certification for gluten-free pasta, as well as finding suitable pasta factories for processing pulses.

Processors

The processors A and B market presence and strategies differ significantly. Processor A serves large-scale retailers both in Italy and internationally, with 50% of customers being Italian and 50% foreign. They have both private label and their own label products, and the lentil pasta is an important ingredient rather than a standalone product. Processor A experiences stable demand, with two price revisions in 2022 due to energy and packaging costs. In contrast, Processor B has low sales for lentil pasta, accounting for only 0.08% of total turnover for pasta. Lentil pasta is sold in a few points in large-scale retail trade and not in the specialized one. Processor B has an annual contract with the retailer defining prices and quantities.

The lentil pasta processor A mainly serves large-scale retailers both in Italy and internationally, with 50% of customers being Italian and 50% foreign. Contracts with retailers are reviewed every year based on raw material trends and other factors. 85% of the brands are private label, while 15% are their own label. Prices for 2022 have seen two revisions, with energy and packaging costs being affected, but raw materials have not been affected. The lentil market has been stable for years, with no significant variations. However, due to disastrous years for the harvest, there have been recent increases in the purchase price of the raw material lentil, with an increase of 35% to 40% from 2020 to 2021. There have been even higher increases of 60% to 90% in 2022, especially in Canada's production, which has been at an all-time low, and India, which has not made any productions. This has caused tension in the markets. The processor's production volume is 4 million packs (400-500 gram packs) with lentil pasta as an ingredient.

Processor B mentions that the sales of lentil pasta are very low and likely to be abandoned, with projected sales of 115k euros out of a total of 2 million in the pasta category for 2022. This means that lentil pasta accounts for only 0.08% of the total turnover of the processor. The average price of lentil pasta for customers is around 2.20 euros per 500g (net of discounts and promotions). Lentil pasta is sold only in a few points in large-scale retail trade and not in the specialized one. The processor has an annual contract with the retailer defining prices and quantities.

Retailers

Common traits between the lentil retailers A and B include the use of annual contracts with suppliers and the preference for working with a limited number of suppliers. Both retailers also work with Italian suppliers for their lentil pasta products. Differences include the market volume they represent, with Retailer A having a larger share of the canned processed lentil market and a higher volume of lentil pasta production. Retailer B has a smaller range of lentil pasta products compared to Retailer A, with a focus on six key references. Additionally, Retailer B prioritizes having suppliers who also produce other types of pasta to streamline logistics and marketing.

According to retailer A, in 2020 the market volume for canned processed lentils, including liquid, was 14 million kg, with Retailer A representing 10% of the total. It is expected that in 2021, the volume will be 13.8 million kg, and in 2022, it will be 14.2 million kg. In terms of lentils as an ingredient, the market volume for lentil pasta is around 4 million packs (400-500 gram packs), where lentils are only a part of the total ingredients used in the pasta. The lentil pasta retailer prefers to work with a single supplier when possible in order to manage more references, make administrative procedures more efficient, and reduce logistical costs. For canned lentils, the retailer typically works with 5-6 suppliers per cooperative; for their specific case, they work with 2 suppliers for conventional lentils and 1 supplier for organic lentils. In the case of lentil pasta, they only work with 1 Italian supplier. The retailer renews their annual contracts with suppliers within 14-15 months, and in some cases, they have worked with suppliers for up to 10 years.

The lentil pasta retailer B has 6 references, which are ordered by their importance and volume/value. The most important one is red lentil risoni (300g), followed by red lentil fusilli, black lentil fusilli (gluten-free), organic lentil fusilli (500g), red lentil tagliatelle, and green lentil fusilli. The main supplier is Italian, and there are three other suppliers as well. It is important for the retailer to have suppliers who also make other pastas, not just lentil pasta, to make logistics and marketing more convenient. In some cases, the same product with the same packaging is processed by different processors.

2.4.2. Price formation and market power

Producers

Farmer A establishes the lentil price based on foreign reference prices, which are typically lower. However, the company makes its own price, which is not strictly linked to the market price since it is a small company.

Processors

The lentil pasta processor A has a supply chain contract that guarantees a minimum price for lentils, to which a supply chain premium is added. The contract is linked to a commodity exchange in Altamura where the quarterly average price is calculated. There is no difference in price between green and red lentils, but there is a difference between Organic and Conventional lentils, with Organic being 15%-30% more expensive. The processor is a market leader in Italian lentil pasta production, accounting for more than 50% of the market. The lentil pasta processor requires 12-13 thousand hectares of lentils to make a 100% Italian product, with an additional 4000-6000 hectares used for chickpeas and peas. The processor purchases from 80 farmers annually, accounting for 5%-10% of their lentil requirements. The main lentil providers are 20 cooperatives, 3 processors, and 5 traders/brokers, with the processors weighing 60%-70% due to their supply of foreign produce. The international market, particularly India and Canada, influences the Italian lentil market, with Italy not being self-sufficient in lentils. The processor has its own brand and packaging that indicates the Italian supply chain. The market recognizes an extra value in being Italian due to organic and supply chain factors, as well as the integrated production cycle. Yellow lentil paste is also available, and its paste is yellow.

Retailers

Retailer A seeks to maintain stability in consumer prices among the increased uncertainty and variability of inflation. However, there has been an increase in the sales price of their products by 20% due to the increased purchase price of more than 30%. The price difference between this retailer and a private brand is significant, with the retailer positioning themselves at a price point that is 25% to 40% less than the level at which the reference brand arrives when it is discounted.

Retailer B tries to fix a price with the supplier at the beginning of the year and tries to keep it. Promotion is a shared tool between the supplier and the retailer, and in 2022, there was no promotion, which was not liked by the customers. The quantities purchased from the supplier are centralized and not placed by individual shops, and only in some cases, there are binding references.

2.4.3. Feasibility, constraints and consequences of introducing more varieties/species/products

Processors

Both processors A and B focus on innovation and developing new products. Processor A targets a specific demographic of conscious consumers who prioritize healthy and natural products, while processor B follows internal guidelines that prioritize Italianity, territoriality, and clean recipes. Processor A experiences market fluctuations that affect legume pasta, but their products are sought after by consumers in foreign markets. Processor B has a large number of references but mentions that sales of lentil pasta are very low and likely to be abandoned.

The processor A's legume pasta initially experienced an increase in consumption until 2019, which was then followed by an adjustment due to a general increase in prices. Market fluctuations affect legume pasta more than wheat pasta, but demand in foreign markets remains constant, whereas in Italy, there has been a contraction of around 6% - 7%. The target consumers of the processor's pasta are predominantly women between the ages of 30 and 55, who are conscious consumers that buy out of demand and not necessity. They prefer high-fiber, high-protein, natural, and light products, indicating a healthy diet and sporty lifestyle. The processor offers something new to the consumer every year and focuses on innovation, with a proposal for a new fusillo containing rice and 2% spirulina algae, and high-protein pasta with a protein content of over 30%. Although processor's products are not included in the area for coeliacs, the large-scale retail trade recognizes their distinctive factor in innovation and new proposals, which is always sought after by consumers.

Processor B currently has (in general) around 400 references which are already considered to be too many. The processor follows internal guidelines that ensure Italianity, clean recipes, territoriality, PDO/PGI, and a preference for member ingredients. When developing new products, the processor first conducts audits, analyzes market trends, and assesses requests received by sales. Then, the processor verifies the availability of suppliers, whether they are already present among members or new suppliers are sought. Next, the management team verifies the product, and the recipe is developed with the right supplier. After internal verification and evaluation of the recipe, external assessors may also be involved, followed by the development of the label. However, the processor also mentions that the sales of lentil pasta are very low and likely to be abandoned.

Retailers

The common trait between Retailer A and B is that they are both considering introducing new products. Retailer A faces more challenges in introducing new lentil products due to consumer perception and difficulties in creating unique products, while Retailer B prioritizes simplifying their product offerings. Both retailers consider factors such as price, method of preparation, brand, and provenance when introducing new products, but Retailer A also takes into account consumer behavior and stock management. Finally, both retailers have different approaches to the number of references for lentil pasta, with Retailer A considering increasing references while Retailer B looks to decrease them.

Retailer A has considered introducing new products in the future, but there are constraints and considerations to keep in mind. Consumer perception of lentils is typically simplistic, especially when it comes to vegetable preserves. While organic lentils were introduced, they were not attributed to a

particular variety. Retailer A has plans to introduce new lentil products from specific territories in the future but this is dependent on demand and volumes that can be generated in the market. When it comes to pasta lentils, there are difficulties in creating products that stand out based on taste, and problems with flaking during cooking. Retailer A had previously tested a biscuit made from lentil flour but the results were unsatisfactory. The search for new products takes place both internally and from the industry, but the retailer must ensure that new products can be sold at low prices and guarantee quantity continuity of the raw materials. In introducing new products, the retailer considers consumer price sensitivity, method of preparation, functional elements, brand, and provenance. However, introducing new products based on their characteristics can be challenging, as consumer behavior and stock management must also be taken into consideration. Finally, the majority of consumers of pasta lentils are concentrated in December, and the most influential variables in new product launches for pasta and lentils are price, method of preparation, brand, and provenance.

Retailer B does not see the need to increase the number of references for lentil pasta, despite it being a popular product. In fact, they are trying to decrease the number of references instead of increasing them, as they believe they already have enough options. Therefore, the feasibility of introducing more varieties or species of lentils pasta may not be high for Retailer B. They seem to prioritize simplifying their product offerings rather than expanding them.

2.4.4. Summary

The lentil pasta value chain includes few producers, processors, and retailers. The farmer interviewed faces challenges in producing gluten-free pasta due to contamination problems; moreover, the farmer works with one pasta factory that can process legume flour without any treatment, but other pasta factories do thermo-treatment, which leads to losses in nutrients. The lentil pasta is mainly sold to large-scale retail trade and a few specialized shops, and the company establishes its own price based on foreign reference prices. There is potential for the gluten-free pasta market due to different degrees of intolerance.

The lentil pasta processor A was the first in Italy to make pasta using 100% legume flour and water and has a partnership with a famous pasta producer. The annual production requires about 10,000 tons of raw materials, of which around 6,000 tons of pasta are produced and sold. The processor purchases lentils from different sources, including Canada for the conventional product and India and Turkey for the organic product. The company decides how much of the raw materials to buy from farmers and traders, based on actual demand, and ensures that the lentils are husked, allergen-free, and ready for milling and subsequent pasta making. The processor has a supply chain contract that guarantees a minimum price for lentils, to which a supply chain premium is added; he is a market leader in Italian lentil pasta production, accounting for more than 50% of the market. The processor A has its own brand and packaging that indicates the Italian supply chain. Both interviewed processors focus on innovation and developing new products. Processor A targets a specific demographic of conscious consumers who prioritize healthy and natural products, while processor B follows internal guidelines that prioritize Italianity, territoriality, and clean recipes.

According to retailers, lentils represent about 6% of the canned vegetable market in Italy, with 80% of lentils being of foreign origin, mainly from the United States and Canada. Lentils are usually purchased dry and then processed and packaged in Italy. Retailer A has a larger share of the canned processed lentil market and a higher volume of lentil pasta production than Retailer B. Both retailers work with Italian suppliers for their lentil pasta products and have annual contracts with suppliers. The price difference between the retailers and private brands is significant, with the retailer A positioning itself at a price point that is 25% to 40% less than the level at which the reference brand

arrives when it is discounted. Retailer B prioritizes having suppliers who also produce other types of pasta to streamline logistics and marketing. Both retailers consider introducing new products, with Retailer A facing more challenges in introducing new lentil products due to consumer perception and difficulties in creating unique products, while Retailer B prioritizes simplifying their product offerings.

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3. Analysis of fourth range products value chain in Italy

3.1. Introduction and general information on market

Consumption

Ready-to-eat fresh vegetables meet the ever-increasing needs of consumers who want to combine the practicality of use with a product - among those packaged - perceived as fresh, natural and healthy.

The consumption of these products is becoming habitual in an ever higher number higher than families as evidenced by the relative penetration index (incidence of buyers IV range vegetables over those of fresh vegetables) which goes from 70% in 2011 to 81.3% in 2020, with over 19,500 buyer families in a world made up of over 24.5 thousand families (ISMEA, 2021).

Despite the interruption of the growth trend recorded in 2020 because of the COVID-19 pandemic, the spread of consumption of IV range horticultural products has now started to grow again in all types of consumers.

The distribution of the value of domestic purchases in 2020, in fact, reveals that more than half of purchases of fresh-cut vegetables (51%) is absorbed by families with one or two members while the most dynamic type in the last five years is the one with 5 or more members (+ 46% in volume and + 30% in value) which, however, is also the least interested in these products, with a 8% share of the total (ISMEA, 2021).

Looking at the distribution of the value of consumption by income bracket of the household, it emerges that, given the higher unit cost compared to fresh products (+ 340%), 55% is absorbed by high or medium-high income families, 31% from low-medium income families, the remaining 14% from those with low income, which also prove to be the most "responsive" in times of pandemic: the contraction in purchases in the last year of this category is in fact the most evident (-8.5% volumes and -13% expenditure), while purchases made by high-income families continue with a positive trend also in 2020 (ISMEA, 2021).

The Italian market

The pandemic and in particular the lockdown of spring 2020 have had a heavy impact on sales of ready-to-eat salads. In fact, in 2020, IV range vegetables in Italy marked their first decline: -4.1% the decrease in volumes sold in large-scale distribution and even more the reduction in spending is evident: -5.6% compared to 2019 due to lower average prices. It is the only segment of the vegetable category that in 2020 moved in countertrend with respect to the dynamics of the entire sector, given that the total value of purchases of other fresh vegetables in 2020 grew by 10.7%, compared to 2019, and the value of GDO sales of processed vegetables grew by 8.7% (ISMEA, 2021).

In the first two months of 2021, sales in the fourth range industry recorded a + 1.1% in terms of volume compared to in the same period of 2020, but lower average prices left spending in negative ground, which stood at -1.4% (ISMEA, 2021).

This is because of new habits of purchase in a pandemic period, characterized by a longer time spent at home the greater attention paid to spending, but also the lower need for quickly prepare a light meal to take to work. These elements favored the homemade preparations, cheaper than ready meals and with added service.

Fresh-cut vegetables, like all ready-made dishes, reflect the needs of a consumer attentive to health, but with little time to devote to preparing meals, so willing to spend more on substitutes for traditional products.

The cost of the added service of these products, although slightly down (in 2020 an average decline of 5%) is still consistent, just think that on salads the consumer price differential between product in head and product in bag - for the same weight - is 2.19 € / Kg against 7.21 € / Kg (ISMEA, 2021) (Expert 2).

Most important fourth range products

Fresh vegetables are IV range products which, after harvesting, are subjected to minimal technological processes aimed at guaranteeing their hygienic safety and enhancement, following good processing practices. These treatments are mainly based on maintaining the cold chain, in all stages from post-harvest to consumption. Therefore, fresh vegetables, packaged and ready for consumption, are defined as IV Range Vegetable Products.

Some examples of IV Range products are oft leaf vegetables such as rocket and baby green lettuce, fresh spinach and chicory, mostly washed and ready to eat (Figure 5). Also belonging to the fourth range are ready-to-eat vegetables bowls to bring to work for instance. Finally, ready-to-cook vegetables such frozen packaged spinach also belong to the IV Range category (Figure 6).

Figure 5 - Examples of fresh fourth range products in Italy

Sources: Rago group at https://www.ragogroup.com/iv-gamma/

Figure 6 - Example of frozen spinach in Italy

Sources: Orogel at https://www.orogel.it/

3.2. The value chain network

Import and export of Italian fourth range products

According to the table 7, head lettuces and lettuce (excluding hooded lettuce) are the two most imported and exported fresh or refrigerated vegetables, with high import and export figures. The import quantity for witloof chicory is significantly higher than the export value, indicating that there may be a high domestic demand for this vegetable. Chicory (except witloof) is predominantly exported, indicating that it may be a product in high demand in international markets. Spinach, tetragonie and atreplici have relatively lower import and export quantities compared to the other vegetables, indicating that they may not be as popular in terms of trade.

Table 8 - Import and export of Italian fourth range products (Year 2020-2021-Quantity in kg)

GOODS	2020	
	IMPORT	EXPORT
070511-Head lettuces, fresh or refrigerated	48.556.369	27.668.579
070519-Lettuce (Lactuca sativa), fresh or refrigerated (excluding hooded lettuce)	44.420.856	41.933.202
070521-Witloof chicory (Cichorium intybus var. Foliosum) fresh or refrigerated	11.231.090	3.182.099
070529-Chicory, fresh or refrigerated (except Witloof)	3.242.864	39.071.033
07097000-Spinach, tetragonie and atreplici, fresh or refrigerated	696.258	28.298.204

Source: ISTAT, 2021

According to the table 8, both head lettuces and lettuce (excluding hooded lettuce) have similar import and export values, indicating that there is a balance in trade for these vegetables. The import value for witloof chicory has decreased compared to the previous data, while the export value remains relatively low. This may indicate a decrease in demand for this vegetable. Chicory (except witloof) has a higher export value than import value, indicating that it may be more in demand in international markets. The export value for spinach, tetragonie and atreplici has increased significantly compared to the previous data, indicating that there may be a growing demand for these vegetables in international markets.

Table 9 - Import and export of Italian fourth range products (Year 2020-2021-Values in euro)

GOODS	2020	
	IMPORT	EXPORT
070511-Head lettuces, fresh or refrigerated	36.095.727	36.927.610
070519-Lettuce (Lactuca sativa), fresh or refrigerated (excluding hooded lettuce)	33.328.926	105.648.778
070521-Witloof chicory (Cichorium intybus var. Foliosum) fresh or refrigerated	20.697.515	3.247.015

070529-Chicory, fresh or refrigerated (except Witloof)	3.818.168	50.828.321
07097000-Spinach, tetragonie and atreplici, fresh or refrigerated	852.540	68.961.119

Source: ISTAT, 2021

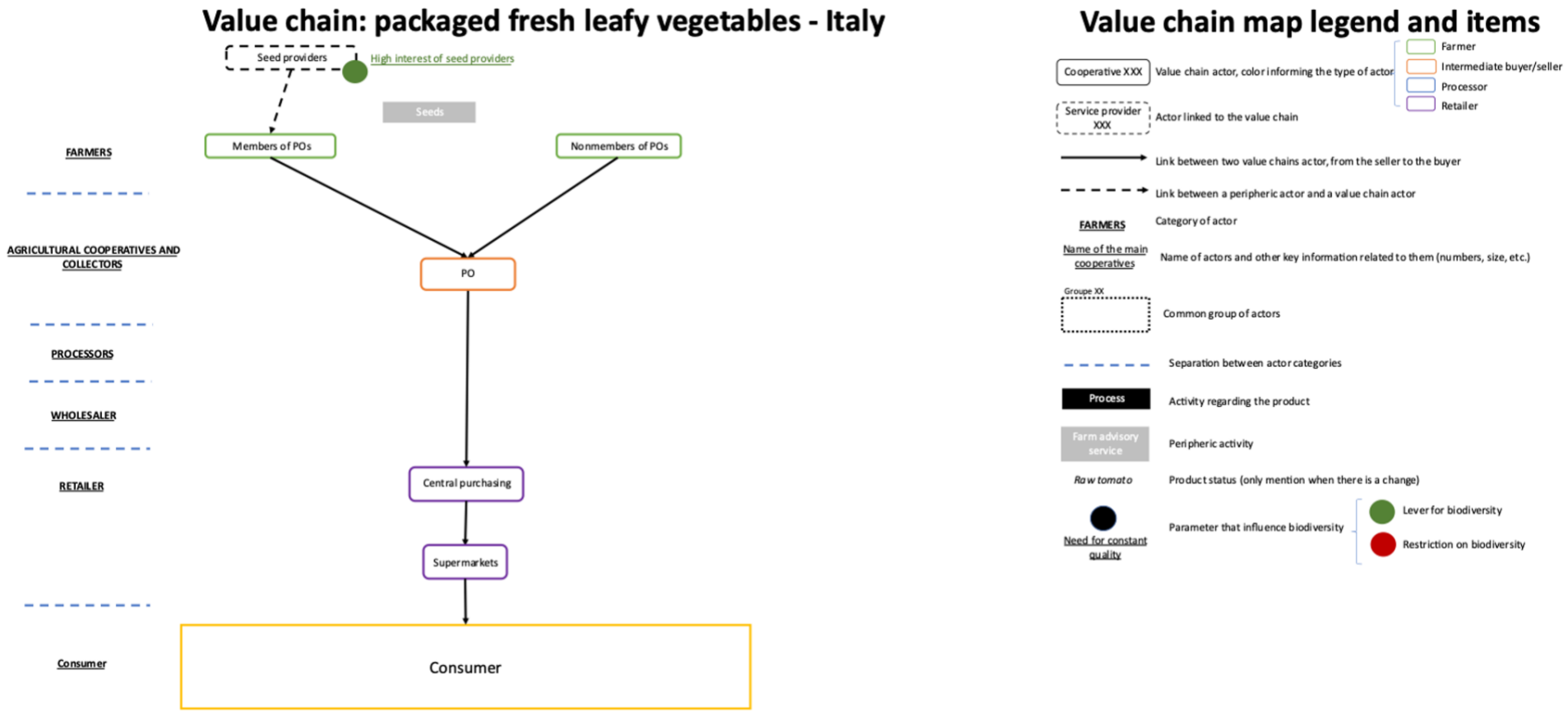
Value chain map

Figure 7 is a simplified, static graphical representation of some key and selected elements in the fourth range value chain in Italy.

After a first stage with seed providers, producer organizations - mainly consisting of farms directly producing the agricultural raw material – decide what all farmers need to grow in a homogeneous planning, then they sell the raw product to the cooperative / POs that manages the product, selects it, does qualitative sorting, processes it, packs it and puts it on the market. Then the GDO interfaces directly with the POs.

The POs working in this sector are mainly located in the North of Italy, with a production center in the North but also with a production base in the South. This is thought to have a delocalized production support, for reasons of seasonality, of different soils allowing a wider crop plan and of risk diversification (Expert 1; Expert 2).

Figure 7 - Packaged fresh leafy vegetables' value chain map in Italy



Challenges for biodiversity

Regarding biodiversity in the Italian fourth range market there are both facilitators and challenges. On the one hand, a wide range of cultivars exists and the fourth range market seems to be fairly open for new cultivars as long as they are not overly expensive to invest in comparison to competing varieties (Expert 1; Expert 2).

The introduction of new varieties is, indeed, facilitated by big companies working in the fourth range through partnerships with seed companies (e.g. Syngenta) interested to test new cultivars more genetic resistant for a sustainable production with low use of phytosanitary products. This is done through public funds investing in research and experimentation and by tying partnership with Producers Organization (Expert 2).

However, at the same time, local and / or traditional crops have been considered in this industry as "old products" which have not evolved because:

- they have no agronomic resistance;
- they hardly enter the GDO due to the complexity of the system and due to very restrictive requirements from the GDO;
- the products are not uniform while in this industry certain specifications must be respected (size, consistency, colour of the leaves);
- the system is built on very structured production lines in an extremely specialized sector, therefore there might quite high costs or challenges to adapt new cultivars to already existing infrastructure and machinery (Expert 1; Expert 2).

Point of view of actors

Producers

Both farmer A and farmer B cultivate crops conventionally and have experience working with Producers' Organizations (POs). Farmer A grows four different types of crops, including sugarloaf and radicchio, and has a signed supply agreement with a large retailer. Farmer B specializes in baby leaf production, with spinach being the most important crop, and sells 90% of their supply abroad. Both farmers use various techniques to improve the quality of their soil, with farmer B using green manure during the summer period.

The farmer A grows four different types of crops: sugarloaf, curly leaf salad, escarole, and radicchio. He uses only one variety per each crop, except for radicchio which uses the Chioggia variety. The crops are all grown conventionally, with sugarloaf being the most profitable and radicchio being the least profitable, with a cost of 8/10,000 euro per hectare. The share of each crop in the total variable production costs is not specified, but for sugarloaf, it is less than 50%. The farmer has experience in being a member of a Producer Organization (PO), where they had a contract based on provision. The farmer currently has a large retailer as their client with a signed supply agreement, which is due to the quality of their product.

The interviewed farmer B is associated with a Producers' Organisation (PO) that has state-of-the-art facilities and a packaging warehouse in Battipaglia. The farmer B's production includes 30 hectares of baby leaf, with a mix of both own production and co-production. The supply is mostly for the large-scale retail trade, with 90% of the supply abroad and 10% in Italy. The production is a mix of greenhouse and open-field cultivation, with 60% in the greenhouse and 40% in the open field. The crops include four main references that rotate in the field, with spinach being the most important crop followed by rocket and other crops in lesser percentages. The farmer B produces advanced first-range products. The spinach is the most important production with a yield of 800 grams per square

meter of land in the last year's crop. Little spinach is good for salads with a yield of 1 to 1.5 kg per square meter. The farmer B also uses green manure during the summer period to improve the quality of the soil. The yield always depends on various factors such as market demand, climate, and other factors. The products are conventional and not organic.

Processors

The processors A and B are both Producer Organisations (POs) in Italy that mainly produce and sell fresh vegetables to large-scale retail trade. Processor A has direct control over production, with a focus on IV gamma (minimally processed) vegetables, grown both in greenhouses and in open fields. Processor B sells 170,000 bags a day, weighing an average of 80/100 grams, mainly grown in the open field. Processor C produces ready-to-use soups and pre-packaged salad components sold as salads in a bag.

The processor A (PO) which is recognised by the European Union, with more than 60 members located across the main national production areas in Italy, from north to south. The processor A directly cultivates its raw materials on around 500 hectares of land, with over 200 hectares covered by modern greenhouses, ensuring year-round supply with a short and controlled supply chain. By having direct control over production, the processor A can offer its customers a wide range of vegetables, both I gamma (fresh) and IV gamma (minimally processed) with a focus on the uniqueness of the territory at an excellent quality/price ratio. Approximately 70% of the members come from Agro Pontino, with the remaining 30% being used for supplementation to cover the 12 months. In particular, the PO's members are small producers and a few cooperatives, with 98% of the farmers being individual farmers and the other 2% being small family-owned cooperatives. There are also external suppliers, who are all organisations such as traders, POs, and a few large producers with whom processor A has supply chain agreements made with contractual relations, which are renewed every three years. The farm size of PO is around 500 hectares, with its products being mainly typical IV range vegetables (rocket, lettuce, spinach, and valerian) and cooking vegetables (savoy cabbage, kale, and turnip greens). The adult vegetables are all grown in the open field, while baby leaf varieties are grown in the greenhouses.

The processor B (PO) sells 170,000 bags a day, weighing an average of 80/100 grams. Their products include lettuce, spinach, iceberg, escarole, and about 40 references in the mix. The two-thirds of the most important products include songino, rocket, and iceberg. The processor B has a contract with a single supplier and a centralized choice to sow certain varieties, they make mown and baby leaf and adult leaves in the open field. The shareholder of the PO has the option to sell 10% outside of the PO. The processor sells to 30 traditional retailers, such as GDO and supermarkets, and the contract is made on the range and variety of the range.

The processor C produces a range of ready-to-use soups, which include a soup with stars and another with lentils. The processor works together with suppliers to come up with recipes for these soups. Additionally, the processor produces a soup made with borlotti beans and buckwheat, as well as one designed for children. In addition to soups, the processor produces pre-packaged salad components, including lettuce, valerian, rocket, and julienne carrots, which are sold as salads in a bag.

Retailers

Retailer A is specialized in selling leafy vegetables in IV range, which are pre-washed, cut, and packaged for consumers' convenience. Rocket, lettuce, and valerian are the three most popular species in IV range, while spinach is the most popular cooking vegetable. The retailer A notes that the mono-varietal market is currently larger than the mixed market, but the latter is growing. Black cabbage is a new arrival in the market and has gained popularity due to media promotion and

increased home consumption during the pandemic. The retailer A also mentions PGI rocket from the Piana del Sele, which is a regional specialty and a relatively new addition to the market.

Consumers

During the focus group on spinach and IV range product consumers, participants expressed limited knowledge about spinach varieties. Diversity was more perceived in how spinach is presented (fresh, frozen, canned) or seasoned, and some participants considered if it is to be cooked or eaten raw. There was no real interest expressed in having more diversity in spinach varieties, with criteria for choosing loose spinach being freshness, colour, and full, plump, and fleshy leaves.

Regarding salad, participants named different varieties, including lettuce, endive, valerian, escarole, rocket, radicchio, red radicchio, radicchio "pan di zucchero," Iceberg, curling, and roman lettuce. They noted that these varieties have different tastes, shapes, colours, and seasonal availability, and their digestibility varies. Participants paid attention to the different varieties, origin, freshness, and appearance of salad. Supermarkets were the main source of information and purchase location for packaged salads, which were considered easier to use because they do not require washing.

Participants also discussed different uses for various salad varieties, including side dishes (lettuce, valerian, curly, iceberg, roman), cooked dishes (endive or Belgian salad, roman), pizza toppings (escarole and rocket), and in risotto or seasoned salads (radicchio). One participant expressed interest in a new wild variety of salad, which they believed would be tastier due to its lower water content compared to selected varieties.

Overall, the focus group provided insights into the limited knowledge and interest in spinach varieties among consumers. However, participants showed a desire for more diverse salad varieties, with attention paid to taste, appearance, origin, and seasonal availability. The focus group highlights the importance of increasing consumer awareness of different salad varieties and their potential benefits, such as taste and texture, and may offer opportunities for new product development.

3.3. Profitability, drivers and main variables for variety/species choice

Producers

Both farmers A and B focus on market demand in their crop selection, with farmer A using winter crops for double harvest and farmer B planning to diversify with "oriental" varieties. Farmer A emphasizes the advantages of IV range products, which can be stored longer and sold at a higher price. Both farmers also face challenges in selling their products, with farmer A trying to strike a balance between conventional and organic sales and farmer B focusing on marketing and distribution channels to improve market penetration. While farmer A leaves crop selection up to the individual farmer, farmer B's is guided on crop selection by the PO which evaluates market demand, also according to soil characteristics. Labor supply is also an issue for both farmers, with farmer B shifting towards crops that require less intervention due to labor shortages.

Almost on all crops, the farmer A makes a double harvest. Species are all purely winter, but the choice is due to the market and the customer in order to have a mixture of all of these. Rotation is always better, he cultivates grain to rest the land or he will rent new land when necessary. Radicchio depends on the variety and the profitability of the variety and area. The advantages of doing IV range is that these species can be kept in the fridge for a long time (in that case with a higher price). Other advantages are that the programmed quantity is always withdrawn, while outside the fresh-cut range the price is lower and the market is very uncertain. It is a faster work in the fourth range, what has

been harvested is sold directly without needing to be washed. The choice of crops is left to the farmer. On trial his company has a new variety of sugar loaf. 2022 planted about 3/4 ha of a new variety. As far as species are concerned, these are always the same (maybe in the future something new like mowed plants in the greenhouse). So usually species are fixed but varieties can change. There is an increase in the selling price of at least 30% for organic products. The farmer tries to make sales deals combing conventional and organic with multiple retailers.

According to the farmer B, the value chain characteristics for the vegetable product range are influenced by various factors. The choice of crops currently grown is based on market and commercial choices, suggesting that market demand plays a significant role in crop selection. Next year, the PO plans to diversify with "oriental" varieties, indicating a focus on expanding their product range to meet evolving consumer preferences. The PO evaluates and gives a directive to follow according to the market and soil characteristics of the individual members of the PO, guiding their members on what crops to produce, based on market demand and soil characteristics. This approach helps to ensure that each member of the PO produces what is most suitable for their specific soil and market conditions, thus optimizing their production efficiency. According to the PO statements, the main problem is not to produce but to sell and place the market product well. The PO helps in this sense by offering several product references to its members to capture a larger market share, suggesting a focus on marketing and distribution channels to improve their market penetration. The PO has 30 associate producers, and the number of workers per hectare in the field varies depending on what the farm grows. Mechanized crops, such as baby leaves, require a maximum of two people, while crops like radish require more manual intervention, increasing the number of people required. However, there are serious labor supply problems, leading to a shift towards crops that require less labor intervention, with arugula being the crop that requires the most assistance and control.

Processors

The value chain profitability for the processor A's vegetable product IV range is influenced by several factors. The most profitable products for the processor A are spinach and chard, and their primary focus is on vegetables for cooking. The main markets for the products are in the northern regions, accounting for 70% of sales, with the central region accounting for the remaining 30%. It is important to note that loose spinach is no longer available in supermarkets, and only the IV gamma version is sold, indicating a shift in customer demand towards pre-packaged, value-added products. Additionally, organic farming does not yield more than conventional farming, which suggests that the focus on quality and productivity is essential in the production process. Certification is crucial for the processor A's business, and certifications must be read in two ways: one type of certification for those references that the customer does not want branded (13-14 private labels), and branded products of the retail trade (about 80% of the turnover). The common basis for certification includes traceable supply chain, integrated production, specifications, and other factors that contribute to product quality. The processor A has supply chain agreements, which could include arrangements with suppliers, distributors, and retailers, that help to ensure the smooth flow of products from production to the end consumer. The processor A also plans to join a new private certification scheme next year, based on biodiversity indices such as soil and water quality, which could help to improve their competitiveness in the market. Large-scale retail demand standards of basic standards, including GLOBAL GAP, IFS, and BRCGS on sustainability, which the processor A must meet to be competitive in the market. The processor A clients on IV range are 100% between small and large-scale retail, which suggests a focus on value-added products targeted at the retail market.

Retailers

Retailer A has relations with about ten IV range suppliers, chosen based on several factors. First, suppliers who make their own brand and offer a distinctive product that interests the consumer are attractive. Additionally, they must have enough volume to handle the product at the point of sale. The breadth of assortment and the logistical element are also crucial in supplier selection. Long-term supplier relationships tend to be created, which could suggest that there is a focus on building trust and rapport with suppliers to ensure product consistency and availability. Suppliers prefer to make mono varieties, indicating a focus on producing a single type of product to ensure quality and consistency. However, bags containing salad mixes can be strategically placed at the point of sale to ensure a complete range of references. There may be both organizational and logistical impacts arising from such choices.

3.4. Price formation and market power

Producers

According to the farmer A, there was an increase in the selling price of at least 30% for organic products. The difficulty lies in the scaling crop. He tries to make sales deals combing conventional and organic with multiple retailers. The farmer B deals only with organic certification schemes.

According to the farmer B's statements, agreements between PO and individual producers can impact the market power of both parties. These agreements may involve guaranteed minimum prices for producers and can be subject to negotiation from time to time. The agreements with large-scale retail trade and producers are seen from time to time, but there is a guaranteed minimum price with the producers. With the large-scale retail trade, the price can move by very little, and there is a weekly price that is negotiated based on market conditions such as the product in the field, weather forecasts, production, etc. When working with the same client, there can be an indicative starting price. However, there is no reference price, which means that market conditions can impact the final price of agricultural products. For instance, after Christmas 2022, prices were sky-high, and rocket was sold for 1 euro/kg. Based on this, the PO proposes a price to sell well. The negotiations between farmers and retailers must consider the current market conditions, including the product availability, weather forecast, and production capacity. Understanding market conditions is critical to pricing agricultural products and maintaining competitiveness in the industry.

Processors

In terms of pricing with the processor A, the price per campaign is determined on a year-by-year basis and is subject to a fixed contract, which may be subject to subsequent agreements. However, the final settlement with partners is based on how the market performed. This implies that market conditions play a significant role in determining the final price for farmers. Furthermore, there are many specialist producers who focus on producing only one or two products. For instance, in Puglia, some farmers specialize in producing turnip tops. This specialization can lead to market power for these producers, as they become experts in their particular product, which can drive up prices due to the scarcity of supply. The search for products in specific geographic areas can also impact price formation in the agricultural industry. Farmers may look for products in areas where they are known to grow well, or where there is a high demand for a particular product. This can create price differences for the same product depending on the geographic location. In terms of pricing with large-scale retail trade, there is little bargaining margin, which means that farmers have less power in determining the price of their products. The volume/price ratio plays a crucial role in this context, as some retailers prefer to do a lot of volume for little price, while others focus on low volume and high prices. However, the capillarity and optimization of logistics and points of sale across different platforms must also be considered. Finally, the needs and demands of customers can impact price

formation in the agricultural industry. Different packaging and changing customer preferences can create price differences for the same product. Therefore, the agricultural industry needs to stay informed about customer preferences and adapt their offerings accordingly to remain competitive.

Retailers

According to retailer A, the pricing dynamics and market power in the retail industry are influenced by various factors, such as product margins, contracts, price fluctuations, and cost increases. Regarding the margins for retailer A, the focus is on overall reference margins rather than individual products. The margins depend on the pricing strategies of individual retailers, and some may focus on high margins for specific products, while others may have a more balanced approach. The annual contracts between suppliers and retailers are based on reference price lists, but there are no rigidities in the bargaining. Over the past year, many prices agreed a year ago have been revised, reflecting changes in market conditions, supply and demand, and production costs. The prices of some products, such as salads, have had significant fluctuations, but not to the same extent as lentils, which are imported from abroad and therefore subject to higher cost increases. The price fluctuations and cost increases for products can impact the market positioning of individual products, and even small increases in prices can have a significant impact on the market. It is worth noting that having a very low average price for a product, such as envelopes (ranging from min. 0.78 euro/envelope to 2.00/envelope), means that even a small increase in price can significantly shift the market positioning of the product. While suppliers may be granted price increases, the increases have not always been passed on completely to consumers. This means that the impact of cost increases on the final price of products can vary, depending on the pricing strategies of individual retailers.

3.5. Feasibility, constraints and consequences of introducing more varieties/species/products

Producers

The farmers A and B both face challenges related to production costs and labor supply, but they have different perspectives on introducing new crop varieties. Farmer A is open to the possibility and disagrees with potential costs and limitations, while farmer B suggests that the focus should be on fulfilling customer orders and that the large-scale retail trade is shifting towards the first range rather than IV range products. Both farmers prioritize meeting customer demands and maintaining high-quality standards for their crops.

According to the farmer A statements, the quality standards required by the client for the target crop include suitable size and color, particularly for curly leaf and escarole, with specific requirements for the percentage of yellow color present. However, these standards can vary depending on the customer, with higher tolerance for yellow color in Italy than abroad. The main constraints and bottlenecks that farmers face in the production and marketing of the target crop include (in order of importance): climatic conditions, high production costs, insufficient labor capacity, insufficient land, accessibility to seeds, high competition in the market, lack of infrastructure along the value chain, insufficient information on cultivation techniques, and insufficient demand. The farmer A notes that there is always less competition, possibly due to increasing costs. Regarding the limitations and bottlenecks for the introduction of the target crop for a farmer that has never farmed it, the farmer neither agrees nor disagrees that new techniques and standards are required, and that other varieties lack some necessary characteristics for processing. The farmer A somewhat disagrees that production costs with other varieties would be higher than with main varieties, and fully disagrees that there would be high costs for adapting the production line and that there is insufficient demand.

The farmer A somewhat disagrees that it is difficult to have access to seeds and that there would be high advertising costs, and fully disagrees that there are limitations linked to public policies and regulations. Farming and trading a higher number of crops in the farm can lead to various effects and expectations. The farmer A neither agrees nor disagrees that it would improve the economy of farmers and the environment, and somewhat agrees that it would increase the number of clients and foster the creation of stronger vertical relations. The farmer A also somewhat agrees that it would improve the access to processing markets and improve the reputation of the enterprise on the long term, but neither agrees nor disagrees that it would increase the revenue of clients and improve the access to retail markets. Farming and trading a higher number of crops can also entail commitments and costs, and the farmer somewhat agrees that it would increase complexity in the management of plots. However, the farmer A fully disagrees that it would require new dedicated spaces, increase the work to separate the products, worsen productivity and efficiency of processes, increase variable costs, increase work to find clients and markets, increase planning activities and documents, and require increased training for workers. The farmer A fully disagrees that it would require structural adjustment of the farm.

According to the information provided by farmer B, introducing new varieties should not be a significant challenge as there is a lot of available land, and the equipment remains the same. The main consideration would be selecting the most suitable site for production. Additionally, there is flexibility in fulfilling customer orders, with the possibility of recovering from other producers in the district. The main problem for companies is the labor variable, with the difficulty of finding labor being a significant challenge. As for prospects for the IV range, the large-scale retail trade is shifting focus back to the first range, especially abroad. While the service offered by the IV gamma is advantageous, the I gamma is perceived as more complex. Abroad, the first range is seen as a better option as it is less costly and arrives at a higher quality, not undergoing the transformations required by the IV range.

Processors

Both processor A and B face challenges in introducing new crops or varietal innovation in the IV gamma sector due to inflexible consumer demands and the need for guaranteeing the cold chain. Processor A has tried introducing new references, but even local excellence has not been successful in the IV gamma sector. Processor B believes that new crops can be introduced as long as the price aligns with production costs and innovation index. However, they face warehouse problems such as space for different species. In contrast, Processor C does not focus on innovation in IV range products and has tried sustainable packaging, but it failed due to high competition and unresponsive consumers.

According to processor A, the consumer profile for IV gamma products is diverse, with the 50-year old generation (40-60) being the most reluctant group. Income is equal for all. To vary the product offering, new references have been introduced, with a tactical approach to include new proposals and play the territory card to add a regional touch. However, the introduction of true varietal innovation has been challenging, as even local excellence has not been successful, and turning it into "Italian excellence" has also not yielded positive results. Examples of novelty products include ready bowls such as Caprese, Grana, and walnuts, as well as oriental varieties, which are still struggling to take off and remain a marginal reference. Bonduelle has also tried something new with a lettuce with a small core suitable for IV gamma, but it did not perform well. The IV gamma sector is dominated by private label products from GDO, with Bonduelle having a limited presence. The IV gamma sector is rigid due to the particular and inflexible consumer demands. Climate change is an important factor, with the need for varieties that can resist unforeseen weather events. However, experiments on this front have not yielded any interesting proposals, and varietal selection geared towards climate

change would be useful. Varieties such as beet and spinach, which are not originally intended for IV gamma, pose problems of oxidation after washing and spinning phases. The biggest challenge for IV gamma is the guarantee of the cold chain, from packaging to point of sale display. Therefore, innovation dedicated to the needs and peculiarities of the 4th range is desirable.

The information provided by processor B, suggests that new crops can be introduced as a request from providers, by copying other operators, or following research developments. Innovative countries such as America, Australia, and Japan are now testing new crops such as dwarf kale. Processor B believes that they can introduce new crops in their products as their own initiative, but the price is decided based on production costs and an index of innovation, with a good margin. They are trying to align production lines to cut costs, but they face warehouse problems such as space for different species. When asked about the main limitations or bottlenecks for the introduction of a new crop, the processor B somewhat agreed that production costs with other varieties would be higher than with main varieties, and that there would be high costs for adapting the production line. However, they disagreed that there is insufficient demand or that it is difficult to have access to raw materials, and fully disagreed that there would be high advertising costs or that there are limitations linked to public policies and regulation. Regarding the effects of processing and trading a higher number of crops and derived products, processor B somewhat agreed that it would increase the quantity of raw material purchased and foster the creation of stronger vertical relations, and fully agreed that it would improve the access to retail markets and increase the revenue of processors. processor B neither agreed nor disagreed that it would increase the number of providers or clients, and somewhat agreed that it would improve the reputation of the enterprise in the long term. When asked about the commitments and costs expected from processing and trading a higher number of crops, processor B fully agreed that it would require new dedicated lines and spaces for storage, increase variable costs, increase work to select providers and find clients and markets, and require increased training for workers. Processor B somewhat agreed that it would increase the work for the selection and separation of the raw material and require structural adjustment of the plants, but neither agreed nor disagreed on the need for increased planification activities and documents or whether it would worsen productivity and efficiency of processes.

Processor C does not innovation in IV range products. Packaging (salad in a compostable bag and recyclable tray) was tried for sustainability, but failed. The IV gamma consumer is not sensitive to this aspect. There is a lot of competition and the prices charged and practicable by processor C would be very high.

Retailers

According to retailer A, the introduction of new varieties is often driven by brand suppliers and their recipe ideas, while retailers and their suppliers also assess what is possible to offer. However, having too many references on sales shelves can be overwhelming for consumers who tend to avoid duplication with private labels. It is preferable to have fewer references that differentiate themselves in some way, such as with a different weight or price. The profile of the IV gamma consumer is diverse across social classes and age groups, with a potential geographical difference in popularity growing in the south. To attract consumers, several aspects need to be considered when launching new products in the IV gamma sector. Firstly, value needs to be clearly communicated and the reasons why the consumer should buy the product must be clear. Price is considered to be secondary to value. Secondly, envelopes with Protected Geographical Indication (PGI) products are appealing to consumers, as are products that showcase territoriality. Lastly, the nutritional aspect of the product is also a key factor to consider when launching new products.

3.6. Summary

The fourth range products value chain is made up of producers, processors, and retailers who are involved in the production, processing, and distribution of processed vegetables.

Both Farmer A and Farmer B cultivate crops conventionally and have experience working with Producers' Organizations (POs). Farmer A grows four different types of crops, including sugarloaf and radicchio, and has a signed supply agreement with a large retailer. Farmer B specializes in baby leaf production, with spinach being the most important crop, and sells 90% of their supply abroad. Both farmers use various techniques to improve the quality of their soil, with farmer B using green manure during the summer period. Both farmers A and B focus on market demand in their crop selection, with farmer A using winter crops for double harvest and farmer B planning to diversify with "oriental" varieties.

The processors A and B are both Producer Organisations (POs) in Italy that mainly produce and sell fresh vegetables to large-scale retail trade. Processor A has direct control over production, with a focus on IV gamma (minimally processed) vegetables, grown both in greenhouses and in open fields. Processor B sells 170,000 bags a day, weighing an average of 80/100 grams, mainly grown in the open field. Processor C produces ready-to-use soups and pre-packaged salad components sold as salads in a bag. The value chain profitability for the processor A’ s vegetable product IV range is influenced by several factors. The most profitable products for the processor A are spinach and chard, and their primary focus is on vegetables for cooking.

Retailer A specializes in selling leafy vegetables in IV range, which are pre-washed, cut, and packaged for consumers' convenience. Rocket, lettuce, and valerian are the three most popular species in IV range, while spinach is the most popular cooking vegetable. The retailer A notes that the mono-varietal market is currently larger than the mixed market, but the latter is growing. Black cabbage is a new arrival in the market and has gained popularity due to media promotion and increased home consumption during the pandemic. Retailer A has relations with about ten IV gamma suppliers, chosen based on several factors.

Overall, the value chain is focused on meeting customer demands and maintaining high-quality standards for their crops. The producers focus on market demand and quality of their crops, processors focus on IV range products and certifications, and retailers focus on convenience and meeting customer demands. Pricing dynamics and market power in the retail industry are influenced by various factors, such as product margins, contracts, price fluctuations, and cost increases. However, the final settlement with partners is based on how the market performed. This implies that market conditions play a significant role in determining the final price for farmers. All players in the value chain face challenges related to production costs, labor supply, and introducing new crop varieties due to inflexible consumer demands and the need for guaranteeing the cold chain.

3.7. References

ISMEA (2021). Consumi alimentari, i consumi domestici delle famiglie italiane, 1.

4. Analysis of buckwheat value chain in Italy

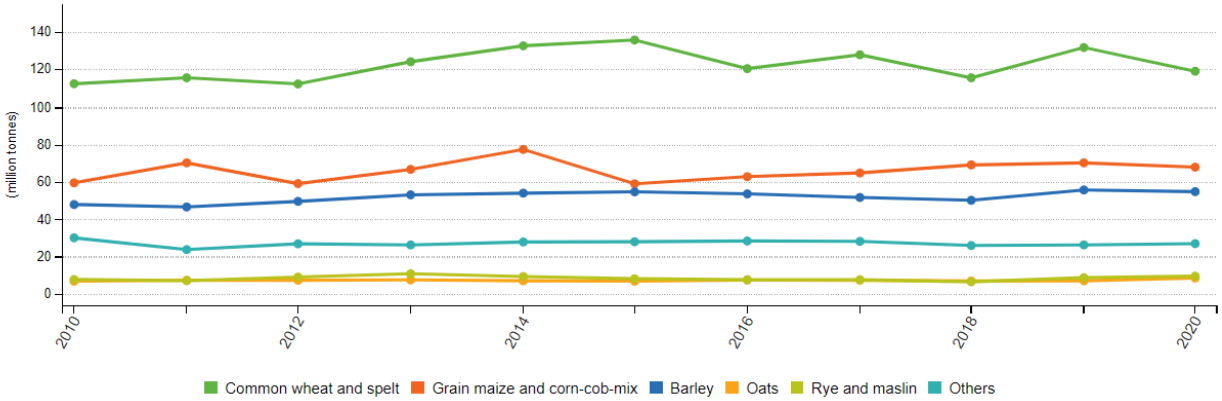
4.1. Introduction and general information on market

Consumption

The EU's cereals sector seems to be the third biggest agricultural sector in terms of output value after the vegetable/horticultural plant sector and the dairy sector.

As shown in Figure 8, in terms of quantity, wheat is by far the most popular cereal grown in the EU, making up nearly half the total. Of the remaining half of total cereal production, maize and barley, account for one third each. Maize has become the second most widely grown EU crop, overtaking barley. Other cereals grown in smaller quantities include triticale, rye, oats and spelt.

Figure 8 - EU production of main cereal, 2010-2020 (million tons)



Note: Rye and maslin' includes mixture of rye with other winter sown cereals. 'Others' includes rice, triticale and sorghum. Rye and maslin includes estimate for Italy, 2013.
Source: Eurostat (online data code: apro_cpnh1 from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agricultural_production_-_crops)

According to a policy brief by (EPRS, 2019), in the past 5 years, around 14 % of cereals has been used either for seed or for processing in non-food/non-feed industries, including bio-energy. Today, nearly two-thirds of the EU's cereals are used for animal feed and around one-third for human consumption, while only 3 % are used for biofuels.

Among these cereals, a more marginalized grain crop is buckwheat. Growing demand for healthy and nutritional agri-food products due to higher consumers' health awareness is recently increasing demand for buckwheat and buckwheat-based products. There are several applications of buckwheat in the agricultural and beverage industry following the increasing demand for gluten free and healthier products which are expected to drive the buckwheat market in the next years.

The Italian market for buckwheat

General information

Buckwheat, or Fagopyrum esculentum, is an annual herbaceous plant that has close analogies with more traditional cereals, both for cultivation and food use. However, it belongs to the Polygonaceae

family and not to the Graminaceae one. It is for this reason that it is usually defined as pseudo cereal or false cereal.

Buckwheat has an agricultural and food tradition deeply rooted in various countries around the world, including Italy. In fact, we have indications on the cultivation of buckwheat in the Veronese area at the beginning of the 1500s and in Valtellina in the second half of the same century.

Buckwheat is a rustic crop and is suitable for both integrated and organic agriculture, and for the recovery of marginal areas. Therefore, it can be an interlayer crop to be included in the crop systems as well as being a multifunctional crop (grain, forage, cover crop, disposable crop, herbal uses, honey plant).

The grain has very interesting nutritional-functional characteristics. t has a high nutritional value and contains in addition to carbohydrates and dietary fibers also important amino acids such as lysine and arginine. The fruits contain polyphenols and flavonoids, such as rutin and quercetin, as well as important trace elements such as selenium, magnesium and zinc.

Finally, the absence of gluten is certainly the property that more than any other characterizes this pseudocereal and makes it an indispensable food for celiac subjects and particularly suitable for those sensitive to gluten.

Buckwheat grain lends itself to a considerable variety of uses, also in consideration of the different traditional uses in the vast area of cultivation of this species (Bonafaccia et al., 1999).

In Europe, two species of buckwheat are mainly widespread:

- Common buckwheat (F. esculentum)
- Siberian buckwheat (F. tataricum)

Buckwheat has so far received little attention regarding breeding. It is based on some characteristics of the crop such as the triangular shape of the seeds, the uniform size of the grains and uniform ripening (specific varieties). Some varieties of buckwheat are:

- Devyatka, Lileja, Spacinska and Kora are recommendable in terms of (very high) yield
- Varieties with a shorter vegetation period such as Lileja, Spacinska and Bamby are recommended for faster plant maturation.

Even the color of the outer shell of buckwheat grains can play a fundamental role in the choice of variety. The color can vary from grey/brown to brown/black and can therefore have a significant influence on the color of the flour during the subsequent processing into flour.

Figure 9 - Buckwheat grains' outer shells

In Italy buckwheat is usually ground to obtain flour with a characteristic light gray color, due to the presence of fragments of the dark pericarp. From the grinding it is also obtained bran which can be left in the flour or can be separated depending on whether you want to obtain whole or sifted flour (Tallarico R. et al, 2014). With suitable equipment, the grain can be dehusked and used for other food preparations widespread especially in Central and Eastern Europe (Figure 10) (Tallarico R. et al, 2014).

Figure 10 - Buckwheat fractions obtainable from grinding

Source: Tallarico R. et al, 2014

Most important buckwheat-based products

Buckwheat flour is hardly baked on its own due to the absence of gluten (Pagani et al., 2000). Hence, the flour, alone or added to wheat or corn flour, can be used for the production of fresh or dry pasta, for instance, for the production of pizzoccheri (Figure 11). Buckwheat flour is also suitable for the preparation of various types of sweets, for example biscuits made from shortcrust pastry obtained with pure buckwheat flour or mixed (Tallarico R. et al, 2014).

Buckwheat-based food specialties are very numerous and are prepared in all countries where this species is traditionally cultivated. New forms of use of buckwheat are also spreading, such as flakes for the preparation of porridge or for use in breakfast, puffed grains, and numerous other dishes and confectionery specialties (Tallarico R. et al, 2014) (Figure 11).

Figure 11 - Examples of buckwheat-based products in Italy

Sources: Pizzoccheri from https://itipicidivaltellina.it/; Biscotti from Germinal Bio https://www.germinalbio.it/

4.2. The value chain network

Global production and intra-EU comparison

Total buckwheat production reached 1,810,816 tons in 2019 in the World according to (FAOSTAT, 2019). This is 13.6 % less than in the previous year and -11.7 % less than 10 years ago. The first producing country is Russia with 1,524,280 tons (surface of 1,497,783 hectares). Then follow China with 1,447,292 tons (surface of 1,683,615 hectares), Ukraine with 180,440 tons (area of 185,300 hectares), France with 127,406 tons (surface of 34,860 hectares) and Kazakhstan with 120,379 tons (surface of 141,424 hectares).

Table 10 - Global buckwheat production 1994-2020

	Asia	Europe	Americas	Africa
Production (t)	1,143,355	1.181,534	139,711	9,205
Production Share (%)	46,2	47,8	5,6	0,4

Source: FAOSTAT

Buckwheat production

Import-export of buckwheat

Based on the COEWEB-ISTAT database, Italy appears clearly to be an importing country of buckwheat. As shown in Table 2, Italy imported around 10 million kg of buckwheat in 2020.

Table 11 - Import and export of Italian buckwheat (Year 2020-2021-Quantity in kg)

GOODS	2020	
	IMPORT	EXPORT
100810-Buckwheat	10.291.727	418.738

Source: ISTAT, 2021

Table 12 - Import and export of Italian buckwheat (Year 2020-2021-Value in euro)

GOODS	2020	
	IMPORT	EXPORT
100810-Buckwheat	7.148.453	875.288

Source: ISTAT, 2021

Italian production is not sufficient to cover the growing consumption of buckwheat, so most of this pseudocereal consumption has been imported from abroad, primarily from China and Poland.

Domestic production in Italy

The number of hectares planted with buckwheat is so low that it is not registered by the National Institute of Statistics (ISTAT). However, on the basis of an estimate by AgroNotizie (2019), it emerges that the Italian production is about 3 thousand quintals for an area of about 300 hectares. Specifically,

buckwheat in Italy seems to be mainly cultivated in mountainous areas, in the regions of Trentino and Lombardy.

The interest in Italy towards this crop is growing and there are several projects that aim at its recovery. Buckwheat from Valtellina (SO) has become a Slow Food presidium and a recent project by INRAN (National Research Institute for Food and Nutrition, Rome) aims to obtain quality products in the foothills of Garfagnana (LU).

Technical aspects of buckwheat cultivation

Based on the experts' interview, buckwheat is a crop with a spring-summer cycle. It prefers a mild climate, with a good temperature range between day and night, and a moderate availability of water. Excessive heat during flowering is poorly tolerated. The year 2022 has been registered one of the worst in recent years in this regard. Many farmers have totally lost their yield because of extreme heat temperatures for a long period of time and several months of drought.

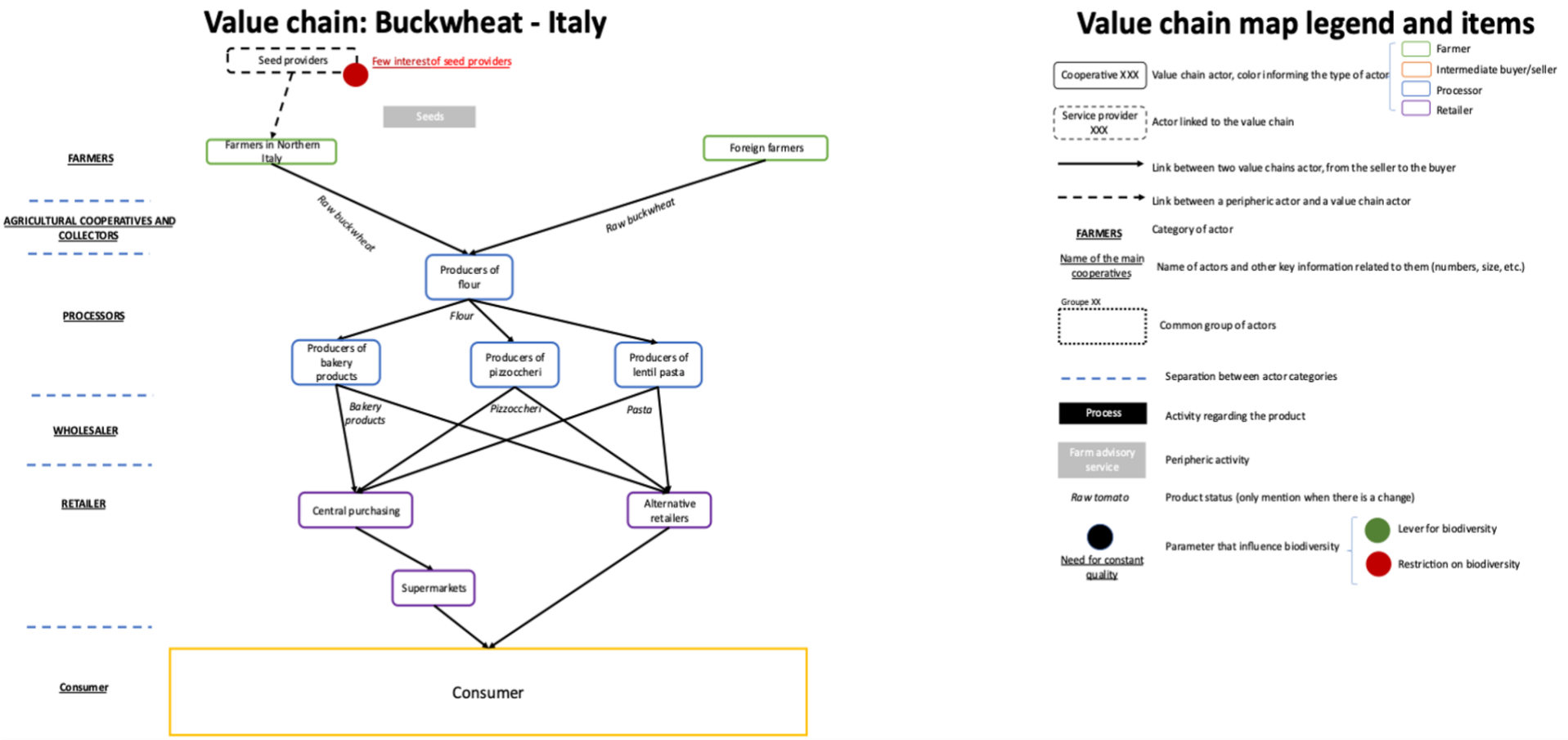
It does not require fertilization, which is why it is a perfect plant for organic cultivation. Given these basic conditions, the ideal environment for growing buckwheat is given by mountain areas (from north to south), bordering on high hills (in central-northern regions).

Buckwheat is a cultivar that perfectly fit in crop rotation and is usually alternated with other crops, given the brevity of the crop cycle, in order to make the most of the land. For example, it can be sown after the harvest of a winter cereal (second harvest), thus obtaining two productions in the same year. In the Alpine valleys, the rye-buckwheat rotation is widespread.

Value chain map of the Italian buckwheat value chain

Figure 12 is a simplified, static graphical representation of some key and selected elements in the buckwheat value chain in Italy.

Figure 12 - Buckwheat's value chain map in Italy



Some key players are:

- Cooperatives and consortium working in the lentils industry such as:
  - *Consortium Tutela dei Pizzoccheri della Valtellina IGP* - the Consortium for the protection of Pizzoccheri from Valtellina PGI, protects this traditional peasant dish which, since 2016, has obtained the green light of the European Union for the adoption of the IGP brand.
- Seed providers:
  - Biasion. Cultivars: Lileja, Darja
  - Ferri sementi. Cultivar: Lileja
- Main processors:
  - *Molino Filippini* is the main and biggest processor of buckwheat in a historic mill in Teglio, in the heart of Valtellina, promoting and enhancing the gastronomic culture of those places. They control the entire supply chain from field to table: from the careful selection of raw materials and its suppliers to their marketing. They are dedicated to the processing of gluten-free raw materials and preparations.
  - *Andriani SpA* is the biggest Italian gluten-free pasta processor, using a variety of ingredients naturally gluten-free such as: brown rice, corn, quinoa, buckwheat, amaranth, lentils, peas and others.
- Small or organic or specialized retailers:
  - *NaturaSì,* one of the most important organic retailers in Italy. This company started a project called "Le Terre di Ecor" in which motivated biodynamic and organic farms were involved. It is made up of a network of producers who are committed to adopting techniques that nourish the soil keeping it fertile and preserving biodiversity of plant species and animals living in that habitat.

Point of view of actors

Producers

Both Farmer A and B grow buckwheat, but they differ in their farming practices and crop rotation. Farmer A cultivates buckwheat conventionally, using only one variety, and it represents the majority of their variable production costs. They also grow grain maize and sell processed crops to a single retailer. Farmer B practices organic and regenerative agriculture, using the Fukuoka method, and also grows other crops such as soya, millet, and rice. They overseed the buckwheat crop with a mixture of clovers and two types of oats, and practice minimum tillage and crop rotation. Farmer B's farming practices prioritize soil health and biodiversity. They have contracts with buyers, including a gluten-free processing company, indicating a market for organic and gluten-free products.

Farmer A grows buckwheat as their main crop, using only one variety called Lileja and cultivating it on 8 hectares of conventional farmland. Buckwheat accounts for 25-30% of the farm's total variable production costs. The farm also grows grain maize, which represents 25% of the farm's total variable production costs. In addition to growing crops, the farmer also sells processed crops, with a yearly quantity of 2.8-3 tons per hectare of barley and fodder maize sold. The seed for these crops is bought at a price of 2.50-3 euros per kilogram, and the farmer's sole client is a traditional retailer. The farmer is also part of an enterprise network, although no

further details are provided about this network. Overall, the farm's focus is on the production of buckwheat, which represents the majority of their variable production costs. The farm also grows grain maize and sells processed crops such as barley and fodder maize to a single retailer. The farmer is part of an enterprise network, which may provide additional support or resources.

Farmer B practices organic and regenerative agriculture using the Fukuoka method. The main crop is buckwheat, which is grown using only one variety called Lileja. The farmer B also grows other crops such as soya, millet, and rice. The buckwheat crop is overseeded with a mixture of clovers that remain low, with two types of oats, at a rate of 35-40 kg/ha. The farmer B practices minimum tillage and trans-seeds green peas, with an agreement with a gluten-free processing company. The crop rotation includes green peas, oats, spelt, rice, soybeans, buckwheat, and millet. The choice of crops is based on market demand, with most of the products supplied through contracts. The farm has a contract with a mill for gluten-free products. The farm's practices of regenerative agriculture and the use of the Fukuoka method prioritize soil health and biodiversity. The use of clover and oats in the buckwheat crop helps to improve soil fertility and reduce erosion. The practice of minimum tillage helps to maintain soil structure and prevent compaction. The use of crop rotation helps to control pests and diseases, and improve soil health. The farmer B's direct sales are limited, with most of the products supplied through contracts. The farmer has a contract with a gluten-free processing company for the trans-seeded green pea crop. The farmer's choice of crops is based on market demand, which suggests that there is a demand for organic and gluten-free products. The farmer's contract with the mill for gluten-free products indicates that there is a market for such products.

Processors

Processor A started processing buckwheat when there were only 700-800 ha of buckwheat production in Italy. Out of these, 500 ha belonged to the processor. Buckwheat is primarily grown in Valtellina, Piedmont (Alessandria, province of Vercelli), and Piacenza, and is used as a cover crop. It is a difficult crop to cultivate as it depends heavily on the weather in June for sowing. Buckwheat has a short production cycle of four months, and almost no farmers have it as their first crop. The processor A's production is 10% buckwheat, and they buy between 3,500-4,000 tonnes of buckwheat from the largest producers in Poland, Lithuania, and Estonia. The processor A buys the buckwheat whole and processes it in-house by cleaning, hulling, milling, and making pasta. They do not buy from Russia, which is the largest producer of buckwheat. The added value of Italian buckwheat, according to the processor, is its quality, organic certification, traceability, and Italian origin. The yield of buckwheat is 60%.

Processor B use buckwheat (100% Italian origin) mainly for shortbreads, the figures for which are: 500K turnover (1% of total).

Retailers

The information provided by the retailer A states that buckwheat is a very scarce crop and processors find the product on the market to meet the retailer's needs. The yield of buckwheat is very low due to the problem of husking, with the mill having a yield of around 30%. The biggest problem with buckwheat is husking, which leads to a very low yield (around 17%). Buckwheat is very important in organic farming, and it can be grown as a second crop, keeping the field clean. However, buckwheat suffers a lot from heat and makes very few grains. Despite this, the number of farmers growing buckwheat is expanding, especially due to the advantages it offers to organic farming in the field. The retailer has contact relationships with 11 producers of buckwheat.

Consumers

During the focus group on buckwheat consumers, participants expressed limited knowledge about buckwheat varieties. Some participants believed that there was only one type of buckwheat, and others even saw it as a variety of wheat. Buckwheat products mentioned included pasta, flour, biscuits by and bread.

Regarding buckwheat flour, not all participants had tasted it, and it was noted that it is typically used to make cakes, pies, and tarts. Participants mentioned a desire for diversity in the process of making buckwheat flour, with differences in grinding and machines. They mentioned that buckwheat flour must be mixed with other flour and that there are no specific criteria for choosing it. Participants expressed interest in having more diverse options for buckwheat flour.

Buckwheat pasta was viewed as a diverse pasta, even though there is little information available, and not all participants had tested it. It was compared to pizzoccheri and macaroni and seen as beneficial for digestion, tasty, and with a good texture. Participants expressed interest in having more diverse options for buckwheat pasta, particularly for different tastes.

Overall, the focus group provided insights into the limited knowledge and interest in buckwheat varieties among consumers. However, participants showed a desire for more diverse options for buckwheat flour and pasta, indicating potential opportunities for expanding the market for these products. The focus group highlights the importance of increasing awareness and providing information about the different buckwheat varieties and products available to consumers.

4.3. Profitability, drivers and main variables for variety/species choice

Producers

The farmer A has a desire to renew the company and has chosen to introduce a new crop in rotation, which has led to product innovation in the form of buckwheat-based products. The products currently available from the farm include buckwheat flour, wholemeal buckwheat flour, and biscuits made with the whole grain of buckwheat (before the cleaning and husking process).

The farmer B has a diverse crop rotation including green peas, oats, spelt, rice, soybeans, buckwheat, and millet, with the choice of crops based on the market outlet. Most of the farm's products are supplied through contracts, including a contract with a mill for gluten-free products. The rotation changes from winter to summer cultivation, with soybeans, buckwheat, and millet replacing emmer, oats, and green peas, respectively. The farm incurs seed, sowing, harvesting, and drying costs for each crop, with drying costs amounting to around 25 euros per hectare. The farm generates 1,500 euros per hectare in revenue, with costs amounting to 515 euros per hectare. The farm's profit per hectare is 985 euros.

Processors

Processor B use buckwheat (100% Italian origin) mainly for shortbreads, the figures for which are: 500K turnover (1% of total).

Retailers

According to retailer A, the costs for the mill and main processor are established on a contract basis. In the case of the processor proposing new pasta products to the retailer, the supply of raw materials is handled directly by the processor, which may pass through mill before

reaching the retailer. Other products that pass through the mill and retailer include bakery products such as bread and sweets.

4.4. Price formation and market power

Producers

According to farmer A, in 2021, buckwheat listed at 80 euros per quintal (organic), 70 euros per quintal. In 2022, buckwheat listed 130 euros per quintal (organic), 120/110 euros per quintal (conventional).

According to farmer B, buckwheat is not traded on commodity exchanges, which makes the market more complex and causes high price volatility. The main producers of buckwheat in the world are Russia, China, and Ukraine, and the recent blockade of Russia has further complicated the situation. Due to the price volatility, it is not possible to price buckwheat to customers, especially large retailers, as prices can change within 24 hours. Overall, the lack of commodity markets for buckwheat makes the market highly unpredictable and challenging for both buyers and sellers.

Processors

Processor A states that the price for a quintal of product in 2022 is 100 euro. This price remains constant for the year; other operators pay around 80 euro per quintal.

4.5. Feasibility, constraints and consequences of introducing more varieties/species/products

Producers

According to the information provided, the farmer A faces several constraints and bottlenecks in the production and marketing of the target crop. Climatic conditions and lack of infrastructure to handle various steps along the value chain are the two most important bottlenecks. Accessibility to seeds, high production costs, insufficient information on cultivation techniques, insufficient demand, high competition at the market, insufficient land, and insufficient labour capacity are other bottlenecks. When it comes to the limitations/bottlenecks for the introduction of the target crop, the farmer A indicated that production costs with other varieties would be higher than with main varieties, and there are limitations linked to public policies and regulations. In terms of the expected effects of farming and trading a higher number of crops in the farm, farmer A mostly agreed that it would improve the environment, increase the number of clients, and improve the reputation of the enterprise on the long term. However, the farmer was neutral or somewhat in disagreement with the other expectations, such as improving the economy of farmers, foster the creation of stronger vertical relations, improve the access to retail and processing markets, and increase the revenue of clients. Farmer A fully agreed that it would reduce the risk of diseases and pests. Finally, in terms of the expected commitments and costs of farming and trading a higher number of crops in the farm, farmer A somewhat agreed that it would increase complexity in the management of plots, increase variable costs, and increase work to find clients and markets. Farmer A fully disagreed that he would require new dedicated spaces (including storage), require structural adjustment of the farm, worsen productivity and efficiency of processes, increase planification activities and documents, and require increased training for workers.

The main constraints/ bottlenecks that the farmer B faces within production and marketing of the target crop (in order of importance): climatic condition, insufficient land, lack of infrastructure to handle various steps along the value chain, accessibility to seeds, high

production costs, insufficient demand, insufficient labour capacity, high competition at the market, insufficient information on cultivation techniques.

Processors

According to the provided information provided by processor A, sowing buckwheat in Southern Italy is considered impossible. The only regions where it can be grown successfully are Valtellina, Piedmont (Alessandria, province of Vercelli), and Piacenza, and even in those areas, one must be lucky with the climate. However, it is not impossible to produce buckwheat, but it requires proper planning and structure to ensure successful production.

Processor B does not currently work with buckwheat due to concerns about its potential allergenicity and contaminating properties. In Japan, buckwheat is considered a dangerous allergen, and in Europe, it is not generally recognized as an allergen. Therefore, the processor is taking measures to minimize the risk of contamination and has decided not to make any products that are exclusively made with buckwheat. However, the processor B is open to the possibility of including buckwheat in other products, such as shortbread, and recognizes the potential nutritional benefits of buckwheat, such as its high magnesium content. The processor considers value and nutritional aspects as important factors when introducing new products to the market.

Retailers

According to retailer A, the consumer profile for the product is middle-aged to elderly individuals with a medium to high income who may also be vegetarian. When launching a new product, the elements that most appeal to consumers are price, brand, and national origin. Local origin does not seem to be as important. In terms of packaging, it is more impactful for high-value products, but it does not have a significant impact on basic references.

4.6. Summary

In summary, the buckwheat value chain involves producers, processors, and retailers, each with their unique practices and challenges.

Farmer A and B have different farming practices, with farmer B prioritizing soil health and biodiversity through organic and regenerative agriculture practices. Processor A processes buckwheat from both Italy and abroad and emphasizes the added value of Italian origin, organic certification, and traceability. Retailer A highlights the importance of clear and concise information on nutritional properties and health benefits, as well as the need for sustainable and eco-friendly production methods and traceability. Buckwheat faces challenges such as low yields, high production costs, and potential allergenicity, but also has the potential to meet the growing demand for gluten-free products. The lack of commodity markets for buckwheat contributes to its high price volatility and makes the market unpredictable and challenging for both buyers and sellers. Overall, the buckwheat value chain is characterized by its complexity and requires careful planning and coordination among all actors to ensure successful production and marketing of buckwheat products.

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5. Analysis of spinach young shoot value chain in France: case of Sonchus

5.1. Introduction and general information on market

As Sonchus is not already harvested and consumed in France, we have chosen to analyze a value chain where Sonchus could be introduced, spinach value chain, and the possibility to introduce new leafy vegetable species in it. The production, consumption and trade of spinach can be separated in two ways:

- Fresh spinach with young shoot eaten raw, notably in salad, and that of broad leaf spinach that are cooked;
- Processed spinach that can be founded frozen, in can or in other products.

Markets elements

The French consumption of fresh spinach is about 200g per capita and 19 % of households say that they buy fresh spinach at least once a year (CTIFL 2021). Fresh spinach leaves are the most important fresh end product that is either sold in bags or in crates (Figure 13).

The main places of purchase are supermarkets and hypermarkets (43% of the volume of purchases), open-air markets (32%), direct sales (14%), (CTIFL 2021) The main consumers are the elderly (CTIFL 2021). There are two main uses for fresh spinach: young shoots consumed raw in salads (small leaves) or for cooking (large leaves). These products are positioned in different market. Small fresh spinach leaves (young shoot) are normally used as a supplement for salads and are a trending product at the moment. They can be sold in packaged or un-packaged, mixed with other young shoots or alone. Young shoots represent the most dynamic segment of the 4th range and account for 43% of sales (Réussir Fruits et Légumes. 2018). It seems to be a fairly stable start-up market, a little low with Covid because it was also intended for the catering industry and in restaurants (Expert 3).

Figure 13 - Examples of processed spinach products in France

Sources: Openfoodfacts 2017, Openfoodfats 2018, APRIFEL, Sifrais,

In 2020, every French household bought 12.6 kg of frozen vegetables and spend on average 32.8 € on them (UNILET 2020). About a quarter of vegetables consumed by French adults are canned or frozen (UNILET 2020). For children, it is even a third (UNILET 2020).

While in 2020 44,700 t of frozen spinach were produced (about 16 percentage points less than in the previous five years) only 12,400 t of can were produced in the same year (UNILET 2020).

Sales of frozen spinach represented 38,000t in 2021 and sales of canned spinach 13,000t (ADEPALE 2022). In 2020, the French market for frozen spinach had a total value of 1,056 million € which represents a decrease of 2 percentage points in comparison to the average of the five previous years (UNILET 2020). Nevertheless, frozen spinach is still the second most consume frozen vegetable in France (Expert 1).

In 2020, 60 % of frozen vegetables were sold by private households and only 40 % in the out-of-home sector (UNILET 2020). Moreover, while the share of private households has increased by 12 percentage points the share of the out-of-home sector has decreased by 23 % in comparison to the five-year average (UNILET 2020). This development, however, is linked to the corona crisis which led to a large increase in consumption at home because restaurants and other out-of-home venues were forced to close their doors (UNILET 2020). Spinach with cream represented 49% of frozen spinach sold, spinach branch 33% and chopped spinach 18% (UNILET 2021). French households buy 37 % of their frozen vegetables in hypermarkets, 18 % in supermarkets, and 14 % in freeze centers (UNILET 2020).

86% of French people eat canned or frozen vegetables, at least once a week for more than one in two, throughout the year, mainly because they keep well (64%), save time (59%) and are easy to store (58%). For frozen or canned spinach, consumer rarely declare have information on variety, as well as origin. Brands seems to be a major criterion for choosing (Focus groups 2022).

Spinach production in France

In 2019, France imported around 8,500t of spinach, mainly from Spain (3,000 t / year), Belgium (2,100 t), Italy (1,500 t) and the Netherlands (1,100 t). (CTIFL 2021). Within the EU, the volume of fresh spinach traded is half that of frozen spinach (95,000t against 225,000t, 55% of which goes to Belgium). In France this represents 10,000t of fresh spinach and 20,000t of frozen spinach. (CTIFL 2021).

Exports are higher than imports (8,600 t) so France is a net exporter of spinach (CTIFL 2021). The main country to which France exports spinach is Belgium (6,600 t / year) followed by the United Kingdom (800 t) and Switzerland (600 t) (CTIFL 2021). Concerning young shoots, the production period in France is mainly between May and October, imports from Spain, Italy, Portugal and Morocco are therefore mainly between November and April (Terreazur, 2022). Both imports and exports increased consequently between 2009 (around 1,000t of imports and exports) and 2019. (CTIFL 2021).

France is the main European producer of spinach with around 120,000t produced each year and 5,700ha cultivated (CTIFL 2021). The main regions are Britany, Haut de France, Provence Alpes Cote d'Azur and Ile de France (CTIFL 2021). In 2020, 62 % of the spinach was spring spinach, 19 % fall spinach and 19 % winter spinach (UNILET 2020).

Almost three-quarters of the spinach production in France are cultivated for the processing industry (CTIFL 2021). This is equivalent to 3,500-4,000 ha and a production volume of 80,000 t (Expert 1). While a third of the processed spinach is canned, the remaining two thirds are sold as frozen spinach (Expert 1). The main regions in France where spinach is cultivated for the processing industry are the regions of Brittany (départements of Morbihan, Côtes-d'Armor, and Finistère) and Nord-Pas-de-Calais-Picardie (départements of Pas-de-Calais, Somme, Aisne, and Oise) (CTIFL 2021). Since the acreages must be located close to the processing facilities, these are also the regions where the freezing factories are located (Expert 1; UNILET 2020).

Reasons for this development are the lower yields and the decrease of farmers willing to cultivate spinach which is due to the technical difficulties of weeding and the high-quality

requirements (Expert 1; UNILET 2020). Moreover, the profits for industrial spinach farmers are quite low which makes it unattractive to cultivate this vegetable (Expert 1).

The region's most important for the fresh market are located in the region of Centre-Val de Loire (département of Eure-et-Loir) and the Southeast of France, namely in the region Provence-Alpes-Côte d'Azur (départements of Bouches-du-Rhône – Vaucluse, Ain-Rhône) (CTIFL 2021).

There is only a single organic processor of spinach in France that can cover all of the domestic demand (which is quite low) (Expert 1). Organic processed spinach is not very popular among farmers because of the problems with weeding and the low demand (Expert 1). In contrast, fresh baby spinach is often cultivated organically and without residues of pesticides (Expert 1).

For broad leaf production, it has to be adapted to winter production and to several (2 to 3) cuts – as they are planted in September, there is one cut in December, recut in January/February and then another afterwards if it doesn't bolt in March (Expert 2). It is still a niche production and it's not a value chain that asks too much for new varieties, it's more to have better quality, less inputs, no real demand from professionals. There is no real change of variety, for example in South East the main variety, one of the main variety, Racoon has been used for 8/10 years, even if they are trying to replace it. There is a need to have leaves that are visually appreciated by wholesale intermediaries (dark green and shiny) and to have good carrying capacity for hand cutting.

It is also a production that is less interesting for seed companies than young shoots or frozen spinach. This is mainly due to the fact that these producers use a lower density of seeds (25 times less), and that they make several cuts on the same production whereas the others make one cut and rest. More are needed because small leaves, take up less space and can be very dense. The seed market is much more important which leads to more research and innovation (Expert 2). This is probably reinforced by the fact that there is less structured organization behind it.

The fresh sector, and in particular the young shoot, seemed to us to be more interesting for the introduction of Sonchus, because of the greater importance of variety, the lesser process constraints, and the greater dynamism at present (see Introduction part). In the next sections, we will therefore focus on this area. In this context, we were able to interview 3 producers of young shoot, 2 structures that do packaging (called "processors") and 2 retailers who market young shoot. Their answers to the questionnaire are given in the "points of view of the actors" section.

5.2. The value chain network with a focus on fresh spinach

General information with a focus on fresh spinach and young shoot

The fresh spinach branch is small compared to processed spinach (Expert 1). A distinction must be made between the broad leaf cooking value chain and the young shoot value chain, also between producers working independently (rather broad leaf in bulk) and the integrated chain controlled by a marketing operator (rather seedling and packaged).

In the first case the value chain seems to be rather organized between producers of small units under greenhouses and wholesalers who then dispatch their production, in the form of green belts around the cities or in expedition (Expert 2). It is a rather usual arrangement that is set up between supply and demand without contractualization. The producer cuts and delivers to the shipper, who then delivers to his customers and the point of sale. Spinach is transported in the form of wooden packages (Expert 2). Connexion between farmers and wholesaler can be

done in two ways: the producer cuts when the spinach is ready with a call to the wholesaler but sometimes the other way round, the wholesalers call with a request for salad and spinach (Expert 2).

There is also the fact that spinach brings flexibility to the producers compared to lettuce or other leafy vegetable because it is possible to store it after cutting to sell it later. Salad has to be sold within a day (it is a demand from wholesalers - so you have to receive the order and cut it in the field on demand and then deliver in the same day). (Expert 2). It is a time-consuming production for farmer as it is mainly done by hand. There are also specialized company working on large leaves spinach packaging.

As far as young shoots are concerned, there are specialized companies that work with producers to market the various plants, including spinach. These companies are specialized in 4th range vegetable in general. The most important are Les Crudettes, Florette cooperative (member of AGRIAL group), Océane cooperative, or SAS Vitraprim. This last one markets 2,200t of young shoots (all species) per year, for the 4th range (Expert 3, Vitaprim, 2022).

The young shoot value chain seems really specific, concentrated and integrated (Réussir,2018, Expert 2 & 3). A large majority of volume goes through these producer organizations and companies and is under contract with the producers. They commit themselves on surfaces, prices and volumes. The calendar, the technical choices, the cultivation, etc. are made together with specific standards. The producers deliver young shoot to the producer organization, which then washes and packages the products. They have their own brand but also private label (Expert 3). Technician from the organization or the company goes around the farms, exchange with the farmers and follows the production. There are recurrent exchanges between producers and the professional organization or company (Expert 3).

This value chain is not really subject to crop substitution, and production is fairly stable because there are contracts and investments so usually the producers are specialized in young shoots production (Expert 3). If they change, there are shelters to be dismantled, specialized machines to sold, etc. These are long-term choices of production in general (Expert 3).

In winter producer organization and private companies packaging young shoots imports from Italy and Spain to be packaged and be sold in France. This is usually marked on the packaging. Their plants work all year round. Some cooperatives as AGRIAL are established in Spain and Italy, for the moment we do not know if it comes from their producers there or not. Wholesalers can also be involved in some territories to provide volumes to packaging organization.

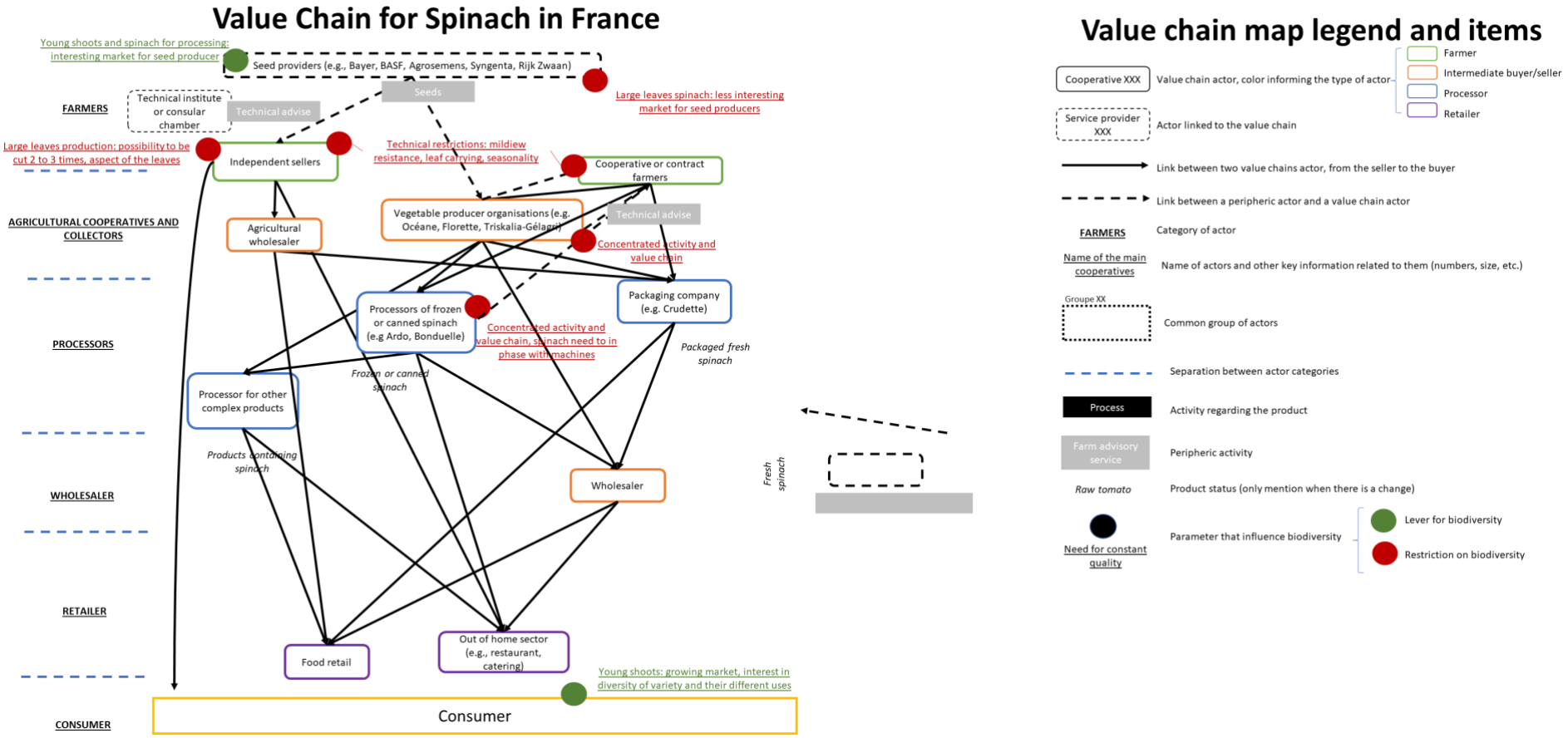
The production of young shoots packaged seems more mechanized and integrated in a value chain (Expert 3). Producer usually produce several types of young shoots: lettuce, spinach, arugula, etc. Young shoots are produced is in open field and under cold cover for spring and summer. Production under unheated greenhouse permit to harvest earlier in February or March (Expert 3). During autumn and winter, the packager imports young shoots from Spain and Italy or maybe from south east of France (Expert 3 and 2). The goal of the sellers it to have a standardized product all year round with some seasonal products as autumn or summer mixes.

Young shoots is a mechanized production, using notably harvesters with blade that passes through so that the plants rises, but there are still manual operation, as weeds removal (which is a difficult part as a molecule initially used has been banned) (Expert 3). For equipment manufacturers, the possible mechanization of many operations, particularly sowing and harvesting, has required the creation of specific equipment. (Réussir, 2018). A production cycle is usually 4 to 5 weeks, they make a single cut and then sewed again for another cycle. Varietal

choices are made in relation to the period (spring/summer) and resistance aspect to disease as mildew. Visual criteria of the product and homogeneity are also important.

the production of young shoots is generally an important pole of the producers who produce them, because it requires commitments with the downstream and investment, in equipment. They can produce other crops such as vegetables (carrots, salads, etc.). (Expert 3).

Figure 14 - Overview of the spinach value chain in France



Point of view of the actors

Farmer

The three producers are of different sizes and nature. Producer B produces 14 varieties of organic young shoots (17.5t) on 1.3ha of organic greenhouses and produces aromatic herbs on a total of 2ha. Producer A has a 30 ha farm, 10 of which are in greenhouses, used mainly to produce 250 t of young shoots in 12 different varieties, including spinach, mesclun, arugula, purslane, red mustard. Producer C produces around 1,000t of salad vegetables, half of which are young shoots and the other half lettuce. The productions are 330t of spinach, 80t of arugula and 80t of baby lettuce% on a farm of 150ha of which 40 are dedicated to young shoots. Several years ago, the cultivation of lamb's lettuce represented 80% of the young shoots and now 20.

These three growers buy seeds from 4 to 8 specialized companies. The first grower does his own trials on his farm. The organic grower B has 4 sellers, including one located in Italy who offer better prices. The two smaller structures have various clients including wholesalers, traditional or large retailers via partnership for the first, wholesalers for 50% of the production and grocery stores for the other in regular relationship for the second. It also sells marginally to consumer through an organization and to restaurant. Even. She noticed that if a customer don't want to take the product because of the price then they don't sell to those customers and don't change their prices. Farm C sells its entire production to a cooperative, fresh, washed, sometimes packaged in 4 kg boxes or bagged.

Processor

Processor A is buying and selling around 35 000t of young shoot annually (1/3 arugula, 1/3 spinach and 1/3 lettuce), selling them packaged in bags. They buy the young shoot from 20 members of the cooperative (30% of the total), from 3 own farms (in France, Spain, and England), from 20 producers under contract (Italy, south of France for the winter) and from other organizations and cooperatives (30%). Therefore, they use regular relations, contractualization and vertical integration. They have national references that must be available all year round. They have two campaigns: summer and winter, with complementary suppliers.

Processor B is buying also different kind of young shoots as lettuce, arugula, spinach, lamb's lettuce, red chard. He mentioned 3 600tons of young shoot including 2 000t of lamb's lettuce. Everything is bought in bulk, directly from cooperatives through partnership. There is a contract fixed by season and 100% of the products are contracted. There is a washing phase before young shoot are send to them. There is a follow-up of the producers. Processor B explained that there is close collaboration with seed companies to develop varieties that are more resistant. These varieties are then tested in the field with the growers. They have been working with growers for over 20 years.

They both sell the major part (respectively 70 and 75%) of their products to large national retailers via negotiations and contracts. Processor A is also selling to wholesalers through occasional relations and spot transactions. Processor B is selling to out of home sector (national restaurant groups, catering, etc.) through spot market, call for tenders and contractualization.

Retailers

The two retailers investigated are classic retailers' members of a national group. Only retailer A could inform us on the amount of young shoot sold which is around 1tons for 1st range (0,7tons for lamb's lettuce and 0.3tons for spinach) and 4tons for 4th range (3t for lamb's lettuce and 1t for spinach). They have at least 5 references of lamb's lettuce (4 for the retailer B). Both retailers buy 100% of their young shoot via the central purchasing of their groups,

though contractual relations, and vertical integration. One quoted that they have many brands such as Florette, Crudette, Bondelle or Essentiel. The second one said that around 5% of the 1st range salad they buy come from local farmers.

Conclusion

We can see that these different actors are concerned by a set of different types of young shoot with different logics. On the one hand, there is an advanced, mechanized, contractual or even integrated organisation that concerns the largest producers, the packaging actors, the classic retailers and probably the largest volumes. On the other hand, there is a more over-the-counter logic with the smallest farms. The latter seem to have a greater ability to choose. All have multiple seed suppliers.

5.3. Profitability, drivers and main variables for variety/species choice

General view

Spinach is an annual plant. It can be sown all year round. The vegetation period is particularly short: only 4 to 7 weeks. (Interfel 2022). Spinach can be grown under greenhouse conditions or in the open field. Spinach can be grown all year round, depending on the variety (some are adapted to long days and others to short days) and the soil and climate conditions. For small areas harvesting is mainly done by hand (scythe or knife) and in the open field by machine. (Doc développement durable 2022).

An important requirement for spinach varieties is their resistance against downy mildew and its different races (CTIFL 2021). Since 2015, a circumvention of the genetic resistance to spinach downy mildew (Peronospora farinosa f. sp. spinaciae) has been observed, leading to significant crop damage. It has led to necessary research for and evaluate new cultivars with new resistance to this blight and to guarantee good protection to producers (Delcassou et al. 2016).

The number of cultivars has remained stable but the share of varieties with a resistance against downy mildew has increased (Expert 1). Nevertheless, there is a constant need to develop new varieties that are immune to the newest race of downy mildew (Expert 1). Resistance to mildew is more important in organic farming because there is no product that is as effective in controlling it as in conventional farming (Expert 2). Moreover, the varieties used for processed and fresh spinach are different (Expert 1).

One consideration when choosing a fresh spinach cultivar is whether the spinach has large leaves or is to be sold as small leaves/young shoots (CTIFL 2021). There are less problems with weeds for the fresh spinach but its yields are also much lower than for industrial spinach (Expert 1).

The production of broad leaf spinach is best done under glass, mainly by hand (Expert 2). If the producers produce summer vegetables in spring and summer (tomatoes for example), in autumn and winter they produce leafy vegetables such lettuce and sometimes. Nowadays, this crop is replaced by lettuce. It is rare for a producer to produce only spinach in winter: mostly lettuce with some spinach. The advantage is that spinach is frost resistant, unlike lettuce and can be stored (Expert 2). Young shoot of spinach is less suitable for storage (Expert 2). There is also the fact that spinach brings flexibility because it is possible to store it after cutting to sell it later.

Producers sow in stages to cut little by little according to demand (not all at once) (Expert 2). Regarding greenhouse production, there are 3 hand cuts for large leaf grown under glass in winter: a first one in December with a yield of about 2kg/m2, a second one in January of 1.5kg/m2 (which is at the peak of demand and therefore the most expensive) and the last cut of1.5 to 2kg/m2 in February or march so in total around 5kg/m2 (Expert 2).In organic farming, average yields can be 12 to 20t/ha in the open field compared to 2kg/m2 under greenhouse (AgrobioBretagne, 2021).

For fresh spinach, different varieties for different seasons exist (e.g. spring, summer, fall and winter spinach) (CTIFL 2021). The choice of varieties depends on the suitable growing period (summer, spring, winter, autumn) and soil and climatic conditions, yield, growth capacity, leaf type and color, resistance (e.g., to mildew) (Seminis, 2022). The production of fresh spinach in large leaves for cooking is mainly in winter with harvests between November and March as there is little demand during the rest of the year (Expert 2).

The main drivers for using the current cultivars are their technological characteristics, their resistance against diseases such as downy mildew, their yield and that they are easy to harvest by hand (Expert 1). Also, to be taken into account are the speed of regrowth after cutting (and thus the possibility of making 3 cuts), the ease of harvesting (upright habit), and resistance to bolting (Mazollier & Delmas 2008). Having beautiful, shiny, thick green leaves is important for this market (Expert 2).

Regarding salad and young shoots, consumers seem to have a good perception of the different varieties such as battavia, romaine, lettuce, arugula, sucrine, mixtures etc. They choose a variety according to the mood of the day, the season, the choice in the shop and the use (Focus groups 2022). Price, origin (proximity is better, especially for freshness, quality and the environment) and appearance are also important criteria. Some prefer bags for convenience and others prefer bulk to avoid plastic, durability, taste, distrust for washed products (Focus groups 2022). To go for new varieties there is an interest in having a specific recipe or way of using. They find them in supermarkets or for some at the producer directly.

Point of view of actors

Farmers

All three producers named high production costs and climatic conditions as important problems they face. For grower A, the main problems encountered are the increasing production costs and the fact that fewer and fewer inputs are allowed. The need for labour is necessary for part of the weeding, but the solution found is to mechanise as much as possible, although this is not possible for weeding. The second problem is the climatic conditions, the solution is to cover the crops as much as possible and to move them into the tunnels. For the open field, the soil must be worked to evacuate water. Growers A and B face the same problems, but climatic conditions remain the main problem, especially in the face of random accidents such as rainfall or high temperatures. The use of greenhouses and their bleaching helps to mitigate this, which are inexpensive solutions. There is no real solution to the high costs of production and delivery.

All producers have a strategy based on different varieties of young shoot. The first two, A and B, produce both spinach and mesclun. Both crops are demanded by the market and are well known, mesclun is called "flagship" and spinach is disease resistant. The third producer uses spinach, arugula, and lettuce. Spinach is increasingly present in their crop rotation. They have different yields of 4.2t/ha for lamb's lettuce, 7,2t/ha for spinach (done with several cuts, up to 3), 7,5t/ha for baby lettuce and 10 to 25t/ha for arugula (up to 6 cuts). He precise that there is an important evolution of lettuce and spinach varieties, especially in relation to diseases.

Moreover until 5 years ago, customers wanted round leaves and for 3 years, more incised leaves. He quote that the burger market is a big market, they want salads that can withstand heat, and this is happening more and more . Mesclun is intersting for its color, a mix of colors, different leaves. Lamb's lettuce is a very closed sector with few actors. Spinach, has a big market in frozen and more and more they are moving towards the fresh market. Arugula represent small quantities.

Processors

Processor A explained that young lettuce, arugula, and spinach are the main young shoot used. Then the others are more anecdotal: red chard (beet) and mustard for example. Processor B mentioned: young lettuce shoots, arugula, young spinach shoots, lamb's lettuce, Red Chard. He specified that young shoots are products with great potential, they are products that are on the rise and demanded by consumers. For both these young shoots come from France (south/Normandie/west) or foreign countries as Italy, Spain or even England, depending on the season.

Lamb's lettuce is used for different reasons. For processor B it's the most widely consumed young shoot, and the French people have a real appetite for it. It is a product that holds up well during processing. For Lettuce, processor A explained that it's linked to history and consumption pattern, moreover there is a diversity within the species (shape and texture and color). For arugula and spinach these are newer species innovative with small volumes at the beginning but now important. Spinach is interesting because can be consumed raw or cooked.

Retailers

Alternative crops can be different young shoots such as spinach or lamb's lettuce. For retailer A, 90% of lamb's lettuce comes from France and 10% from Spain, while for retailer B, 100% comes from France. They both sell different brands and varieties of young shoot. the origin is mentioned on the packaging by the different brands, when it is fresh it is on the label). There is no particular reason for the choice of this type of young shoot, except that it is the one present on the catalogue of the central purchasing office. We were unable to collect any information on prices, except that they vary between species and brands. For processor A the main aspects consumer look at are price, packaging, novelty, origin, easiness to prepare and shelf life.

Conclusion

It seems that the choice of varieties is based on many criteria: resistance, field and process capacity (yields, ability to be cut several times, cultivation period, mechanisation), taste and appearance (leaf, uniformity, etc.)Diversity already present in the value chain with several species, some of which are essential, such as lamb's lettuce or even lettuce (several species/colour), and others which are more recent (e.g. spinach arugula). All diversification strategy, set of interesting criteria for the different species.

5.4. Price formation and market power

General view

For large leaves and independent farmers, there are quotation (for example mercurial in professional market as in Chateaurenard) but overall the price is direct fixed between farmer and wholesaler (Expert 2). The most interesting prices are during January and February because of high demand. There are no contracts, the price is decided in discussion at the time of selling. The wholesaler wants visual criteria and hold above all. During 2021 campaign, spinach was sold 1.2€/kg for the first cut, second 2€ or even 2.2€/kg and last one 1.10€/kg; In shop it is usually founded at 5€/kg.

Regarding integrated value chain with important processors and retailers, it seems that most of volumes are contracted with fixed prices and quotation depending on the species.

Point of view of actors

Farmers

For producers A and B, the selling prices are set by them taking into account the yield and margin targets with their customers (wholesalers and retailers). Producer A said that if customers do not want to take the product because of the price, she does not change the price and does not sell to these customers.

For producer C, the prices of the cooperative are fixed for the week and according to the grading and packaging. The young shoots are graded by quality, which affects his prices (see next section). The cooperative only serves to sell the product, it is the producers together with the cooperative who set the basic price of the product. The objective is that the cooperative's prices are in line with the market price. The production is harvested the day before for the next day, and orders are placed every day. Each week the producers communicate what they have on their plots.

Producer A's prices change between summer and winter (when it is a bit more expensive). For him, prices have not changed in recent years (except this year with inflation), unlike producer A, whose prices have doubled from 2018 to last year (from €4/kg to over €8/kg for spinach, for example). Producer C's prices are much lower, about 2.2€/kg for spinach for example, i.e.4 times less than producer A and 2 times less than producer B. For all three growers the selling prices of their different seedlings are about the same.

Producers B and C use the global gap certification High Environmental Value (HEV), and IGP “Mâche Nantaise” for C but this seems to affect the price but rather to structure the sector. On the contrary, producer A uses the organic label, which influences the price and allows it to sell at a higher price.

Processors

Processor A has two systems for the prices, with farmer it’s annual contract based on price and volumes, and with other organizations it’s mainly negotiations according to specific needs. It’s the same with processor B which is contracting its supply with contract per season (winter/summer) with fixed price for the season. With their clients it’s similar, they contract prices and volume with the large national retailers, and have negotiations or calls for tender with wholesalers and out of home sector.

Prices are confidential for both and depend on the variety. Processor B explain that they usually sell the lamb’s lettuce between 2 and 2.5€/kg. Regarding internal costs we need to distinguish between raw material and factory prices, labor is not the most important next to the others.

Regarding the launching of a new variety, processor A explained that they need to see if it is possible to produce it internally via their producers, if not via partners, see according to technical criteria: yields, mechanization, the production period (on the 4th range it is necessary that the product is available all year round, these are annual references) it must follow the young shoot scheme. Regarding the price they will investigate from the production costs and processing prices. Processor B specified that the price will be fixed in relation to other products the price must be similar to the average price of young shoots currently sold at around €2.5/kg.

Retailers

Both retailers buy all their young shoots via their group's central purchasing office, which sets the selling prices. The same would probably be true for a new variety. They could not give us

any information on prices, except that they vary between species and brands. They have organic references that are more expensive but would only represent 5% of sales for retailer A.

Conclusions

Prices depend mainly on species, although there are similar prices within each system. Non-integrated producers depend on harvest and margin in need, whereas otherwise all fixed cooperative/processor via an established system. In the same way, contractualization between processors and large retailers, at a central purchasing stage. Prices are also graduated according to size of the farmer: larger 2 times cheaper than medium farmer, itself 2 times cheaper than smaller. Processors are integrated into this with seasonal price complements. For the introduction of new products, they would look at technical and market aspects, while keeping the price in line with what is already being done.

5.5. Feasibility, constraints and consequences of introducing more varieties/species/products

Main criterions to choose suppliers and quality standards

The quality criteria required are multiple for the producers. Freshness and the absence of yellow leaves for all species and producers were mentioned. The importance of having different colours and varieties was also mentioned as being sought after by consumers. Producer A said that it is necessary to have a clean colour because depending on the colour customers do not buy because they think they are old salads. Producer B mentioned a very clean product (also without soil or insects) and a maximum variety. Producer A said that the shape of the leaf is important, e.g., for spinach it should be round. Grower C said that length and width of leaves, petiole are also important for young shoot. Its cooperative uses a grading system to determine the quality of the young shoots and therefore the price. Several criteria are presented (colour, sizer, shape, roots, etc.) with different quotes: A (less than 10 points) and B (above 10 points). It is used to fit the consumer/market expectations.

In terms of the criteria for choosing their suppliers, the packaging organisations agreed that the range of varieties and species offered is important. However, while specialisation in special products and proximity is important for processor B, it is not for processor A. The latter, however, attaches importance to reliability and regularity. In terms of expected quality criteria, they agree that resistance and absence of disease are important to have a product that is interesting in terms of field and visual appeal. It must also be free of foreign matter and have external product specifications on size and presence of damage), conservation of the product over time, processor B explained that there is a different grading for each type of baby lettuce (colour for red lettuce). The mechanical properties in the field of young shoot were also cited, in particular ability to be harvested: with shape, late flowering, notably due to mechanisation. Regarding visuals, processors named the colours and appearance of the products and A shelf life product that has been validated with customers. They also mentioned the taste (for example nutty taste for lamb's lettuce or spicy taste for arugula). Processor B added the interest of having young shoots that limit the use of plant protection products.

They choose provider which are already on the central purchasing's catalog, so the selection is made before by the wholesalers. They both mention the importance to have freshness for all young shoots, because it's consumers expectations and young shoot are not marketable anymore if they are damaged or they were sweating. Also, the visual has been mentioned by retailer B and retailer A specified that consumer are looking for larger leaves for lam's lettuce and spinach.

We can see that there is a common appeal to have clean products (disease free and washable) over time, attractive from a visual point of view (leaf shape, diversity, colour), with an interesting shelf life which sometimes comes before taste. Proximity with their suppliers is also fundamental for processors.

Introduction of new species in the value chain

For producer B the varieties are introduced at the request of customers, by the producer copying farmers or then research developments. Fighting disease and pest resistance was also mentioned. He thinks that farmers cannot introduce their own varieties on their own initiative because producers are obliged to go through seed companies to have seeds with pelleting (pelleting allows sowing with a seeder, thus sorting the seeds according to size and allowing to favour germination). On the farm, he makes his own seed for some species/varieties but sends it to the seed companies for pelleting. Farmer A mentions their client's request. She thinks that farmers can introduce new varieties because producers could test their plots and see what works best. Also, if there is a demand for different varieties, the grower will produce the requested varieties, especially for organic and short circuit growers. Producer C explains the varieties are introduced by the cooperative, depending on the agronomic qualities (e.g.: lamb's lettuce more than 10 varieties used, spinach 8 and lettuce 8). He thinks that the farmer can introduce new varieties because it is his job, easier for someone who already uses the species or a seed producer.

Both processors explain that they follow research developments to introduce new varieties. Processor A explains that it is the technicians who will look for new species and test them, then propose their marketing team. Processor B adds that the company can innovate because it has a brand, so it has a great capacity to innovate, there is no barrier, sometimes it can come from a customer request. They agree that the processors introduce varieties, particularly because they have the technical keys and are experts in the field. This requires the capacity to go and test new species. We asked the processors if they thought Sonchus could be interesting. They both said they didn't know, the first one because it is fundamental to test it, they are always looking for new varieties but few of them pass the tests. The main thing to test is taste and appearance, mechanisation (Sonchus is a plant that grows in a rosette with flowers that appear quickly which can make emanation difficult) and the absence of allergens. The second explained that historically there were questions about the development of dandelion production. But you need to have products that can withstand processing. Canada thistle could be developed but there has to be a real interest in the taste.

Retailers didn’t know if Sonchus could be introduced in their stores. They quote that new products are introduced if central purchasing is adding it to its catalog. For example, for the apples, a new variety has been introduced and a new campaign of communication has been organized to enhance the new variety. The central purchasing organizes the operation with attractive prices. They specified that Central purchasing manages everything, the shop can always ask for new varieties, but it is the central purchasing that decides. One specified that maybe hypermarkets could introduce new varieties easily, because they are bigger.

Limitations and bottleneck

For 2 farmers the fact that new technics and standards are required is seen as a strong limitation to introduce new species or varieties, while farmer C totally disagrees with this. On the fact that this leads to higher production costs, farmers A and B did not take a position as this depends on the characteristics of the new variety. On the contrary, farmer B defined this as

an important obstacle. Farmer C also saw this as an indication of higher fixed costs, A more moderate but still agreed and B not so much. Low demand was seen as more of a limitation for Farmers C and B while not for Farmer A. Farmers A and B saw access to seeds as a major constraint, because companies have little confidence and do little testing or because it is more difficult to get varieties in organic farming. Farmer B strongly agreed that new varieties could lead to advertising costs, the other two did not. He also strongly agreed that there are limitations linked to public policies and regulation, especially on organic. Farmer A added that the fact that there are new diseases to deal with on the new varieties could be an important brake. Farmer C argued that this would lead to more problems with the equipment.

The processors agreed that this would lead to more variable costs (depending on the volumes involved), that there would be difficulty in accessing this new material and that there is insufficient demand. If processor A thinks that there will be new techniques and standards required, B does not agree. Similarly, A thinks that there might be a lack of compatibility with the required process characteristics (e.g., mechanisation and year-round production), that it would require higher advertising costs, is limited by public policies and regulations and that it would not increase fixed costs, B is rather neutral on this. A also has doubts about producing large volumes of new species and acceptance of young shoots by consumers in a small market.

Only one retailer could be asked about those questions. According to him, limitation to more varieties could be an insufficient demand or higher advertising costs. At the contrary the access to new varieties wouldn't be a bottleneck. He was neutral about public policies and regulations.

Expectations

2 farmers very much or simply agreed that introducing new species would improve farmers' income or the environment, the last one strongly disagreed. Similarly, there was mixed opinion on whether it would increase the number of customers. They agreed or were neutral that it would promote strong vertical relationships and agreed that it would improve access to the retail market. They were also mixed on whether it would improve the reputation of the business (1 somewhat agree, 2 somewhat disagree), whether it would improve their customer's revenue (2 somewhat agree and 1 disagree). Organic farmer A said that it would induce more disease resistance and therefore less phytosanitary treatment

Both processors agree that new varieties could improve customer numbers and enhance the reputation of their business in the long term (if the new varieties are successful). They also agree that it does not impact on the economy of the farmer, nor does it impact on the amount of raw material purchased or suppliers. If processor B thinks it increases the processor's income, A is neutral. However, A thinks that it improves access to the retail market but does not promote the creation of stronger vertical relationships. A gives the example of the arugula which is difficult to take and then improves revenue but depends on the size of the market and volumes.

Only one retailer could be asked about those questions. Regarding expectation he was somewhat agree that it would improve the economy of farmer, the quantity of product purchased, the number of provider and foster the creation of stronger relation. He was strongly agreed that it would improve the reputation of the retail company.

Impact on their activity

While for the larger farmers (A and C), having new varieties/species would induce more complexity in the management of plots, a structural modification of the farm, unlike farmer B.

They were rather mixed on whether it would require more dedicated space or a structural adaptation of the farm. They rather agreed that it would increase the work to be done to separate the products. They all agreed that it would increase variable costs, planning activities and document, require increase training for workers. They rather agreed that it increases work to find clients and markets. Farmer C pointed out that changes between varieties ultimately lead to little change, unlike crop diversification.

For the one processor who responded, this increases the work for raw material selection, worsens the productivity and efficiency of their process, increases the work for supplier selection and planning. But it would not require structural adjustments in the factory such as dedicated lines or space, increased variable costs or work to find customers and train staff and work to separate the product.

Both retailers somewhat agreed that an increased number of young shoot varieties or species would require dedicated lines in their shops. They also agreed that it would worsen the productivity or efficiency of their activity and increase the work to select provider. They disagreed an all the other points as one somewhat/strongly agreed and the other disagreed (dedication of new spaces, increase management inside stores, require structural adjustment; increase variable costs, increase work and cost for marketing, consumer information, planification activities and document and training for worker).

5.6. Summary

The market of young shoots seems dynamic, innovative and rather diversified, however it's limited according to the actors. There is competition with the productions of neighbouring countries in the various value chains. On the other hand, about young shoots, we are dealing with a highly concentrated and integrated sector with producers' organizations or private operators who package and sell to supermarkets. Farmers (and intermediate organization) are therefore subject to significant investments and a need to make them profitable with little substitution. The main choices and organization are made at the level of these central actors. They are oriented towards large markets and global valuation. The value of the young shoot products and the income of the farmers must be preserved. The prices must be kept sufficiently high to secure the income of the value chain actors and to prevent a further decline of the production surfaces and volumes .

One of the central issues in for the varieties is resistance to diseases like mildew. Then it is highly dependent on the target market. In all cases, there is also a restriction on the choices of downstream players (visuals for wholesalers, for example). Regarding spinach, it appears that the main distinction made by the consumer is between the branches (large leaves) and young shoot (for salad) spinach and regarding their state of transformation (Focus groups 2022).

Most decisions are market-oriented and taken at the level of the intermediate structures (cooperative or company). There is therefore a search for a certain uniformity to meet their criteria (Expert 1 & 3), however, there is a certain search for new innovative products with new species for mixtures or individually (Expert 3). Well-established species such as lamb's lettuce or lettuce stand alongside new species that are making progress, such as spinach or arugula. Even within one species there is a diversity of varieties of lettuce (colour, etc.). There is therefore a certain habit of testing new varieties and putting them on the market.

The actors are looking for visually interesting products (leaf shape and colour) but also stable and reassuring (shelf life, disease, etc.) which are sometimes very important factors, beyond taste. There is also an importance of cultivation - mechanisation, disease resistance such as mildew, earliness, ability to be cut several times, yields, period.

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6. Analysis of tomato value chain in France

6.1. Introduction and general information on market

Every French household consumes about 35 kg of fresh and processed tomatoes per year which is equivalent to a yearly volume of 1,685,000 t (Tomate de Marmade 2022, Agreste 2021; Ministry of Agriculture and Food Sovereignty 2022; Planetoscope 2022). 14kg are consumed fresh and 21kg processed. This makes tomatoes the most popular vegetable in France (Franceinfo 2018). 95 % of French households say that they buy tomatoes at least once a year (CTIFL 2020). The value of the tomato consumption depends on the kind of tomato end product consumed because some products are more expensive than others (Expert 2).

The French tomato production amounts to 711,000 t and covers an acreage of roughly 4,700 ha of which 2,000 ha are in greenhouses (CTIFL 2020). 488 013 t are used for fresh market, which corresponds to 2,626ha in 2021(Interfel 2022). About a fifth (22 %) of the tomato production is used for the processing industry (CTIFL 2020). The fresh market receives 65 % of its tomatoes from the French production, the remainder is imported (CTIFL 2020). The decrease in production since 2016 can be explained by several factors: less favourable weather conditions and the increase in organic farming areas which have lower yields (SONITO 2022). For both destinations, the tomato remains a fragile product that must be put on the market quickly and handled with care (Hilmi 2005).

As it can only cover 72 % of its demand for fresh tomatoes and 15 % of its demand for processed tomatoes, France is an overall net importer of tomatoes (Agreste 2021). While it exported just over 250,000 t of tomatoes in 2020 it imported more than 500,000 t of tomatoes in the same year. This makes France the second largest importer of tomatoes in the EU behind Germany (CTIFL 2020). The total imports and exports of tomatoes were fairly stable in the period between 2010 and 2020 and hovered respectively around 500,000 t and 200,000 t per year, (CTIFL 2020).

In 2020, 34,700t of organic fresh tomatoes were consumed in France, mostly in supermarkets (42%), followed by direct sales and greengrocers (37%) and organic shops (21%- increasing). In long circuits, 57% of volumes would be imported (Agence Bio 2021). In 2020, organic canned tomatoes represented 18 % of the market share of canned tomatoes, and tomato sauces 11% (Agence Bio 2021).

We were able to interview 3 producers of tomato and 2 retailers. Their answers to the questionnaire are given in the "points of view of the actors" sections.

6.2. The value chain network

General view

The value chain for fresh tomatoes in France is highly structured (Expert 3; Expert 4). In fact, almost all of the fresh tomato producers are members of one of the cooperatives, for instance Savéol in Brittany (Expert 3). For the transport, the cooperatives sometimes work together with logistical companies that take care of the transport to the purchasers (Expert 2). In an ideal scenario, the fresh tomatoes arrive at the point of sale 48 hours after being harvested (Interfel 2022). The packaging and transporting of tomatoes also have an impact on the varieties used because those cultivars that are easy to pack and to transport are preferred by the actors in the value chain (Expert 2). Consequently, the tomato varieties should not be too soft and they

should have a high durability (Expert 2). For the direct sale of tomatoes these features are less important (Expert 2).

Overall, the most important distribution channel for the fresh tomatoes cultivated by the producer organizations is the retail trade followed by wholesale markets and direct sales to consumers (Expert 4). However, the importance of these distribution channels differs depending on the producer organization and its strategy (Expert 4). In the French market for fresh tomatoes, using contracts is more the exception than the rule (Expert 2; Expert 3). In fact, there are hardly any contracts between the producer organizations and their members, and the former are legally required to sell the tomatoes delivered by the latter (Expert 4).

Farmers that are members of a producer organization receive their seeds usually via the producer organization which might have exclusive collaborations with certain seed providers. Moreover, the farmers receive technical information from four sources, namely from experimental stations, from the CTIFL, from the seed provider or from their cooperative which usually also employs technicians (Expert 3). In most cases, the cooperatives have commissions that decide which varieties are cultivated (Expert 2; Expert 3). They are composed of technicians that follow the latest developments of the cultivar market and that are in close contact with institutions such as the CTIFL which carry out cultivar trials and present the results to the cooperatives' technicians without making a particular recommendation for any one cultivar (Expert 2; Expert 3).

In the fresh market, 80 % of the tomatoes are vine tomatoes and only 20 % are tomatoes like cocktail or elongated tomatoes (the so-called diversification market segments) (Expert 2). The ratio of 80/20 has been fairly stable throughout the last years and there has been no significant increase of the diversification tomatoes (Expert 2).

The main distribution channel for fresh tomatoes are large retailers followed by supermarkets specializing in fresh fruits and vegetables (e.g. le Grand Frais) (FranceAgriMer 2016 & Expert 2). Overall, the most important distribution channel for the fresh tomatoes cultivated by the producer organizations is the retail trade followed by wholesale markets and direct sales to consumers (Expert 4). However, the importance of these distribution channels differs depending on the producer organization and its strategy (Expert 4). For instance, there are producer organizations that mainly sell their tomatoes to wholesalers and hardly to the retail trade and vice versa (Expert 4). In contrast, the direct sale of tomatoes from producer organizations to the out-of-home sector is rare because restaurants and other out-of-home actors usually purchase their tomatoes from wholesalers or wholesale markets (Expert 4).

The considerable amount of imported tomatoes from Spain and Morocco predominantly enters the French market via the wholesale market Saint-Charles in Perpignan (Expert 2; Expert 4). From here, companies that are specialized on the international trade and transport of fresh fruits and vegetables either sell the Spanish and Moroccan tomatoes to the central purchasing offices of the retail trade, to wholesalers or to importers from other European countries (Saint-Charles International 2022; Treure 2019).

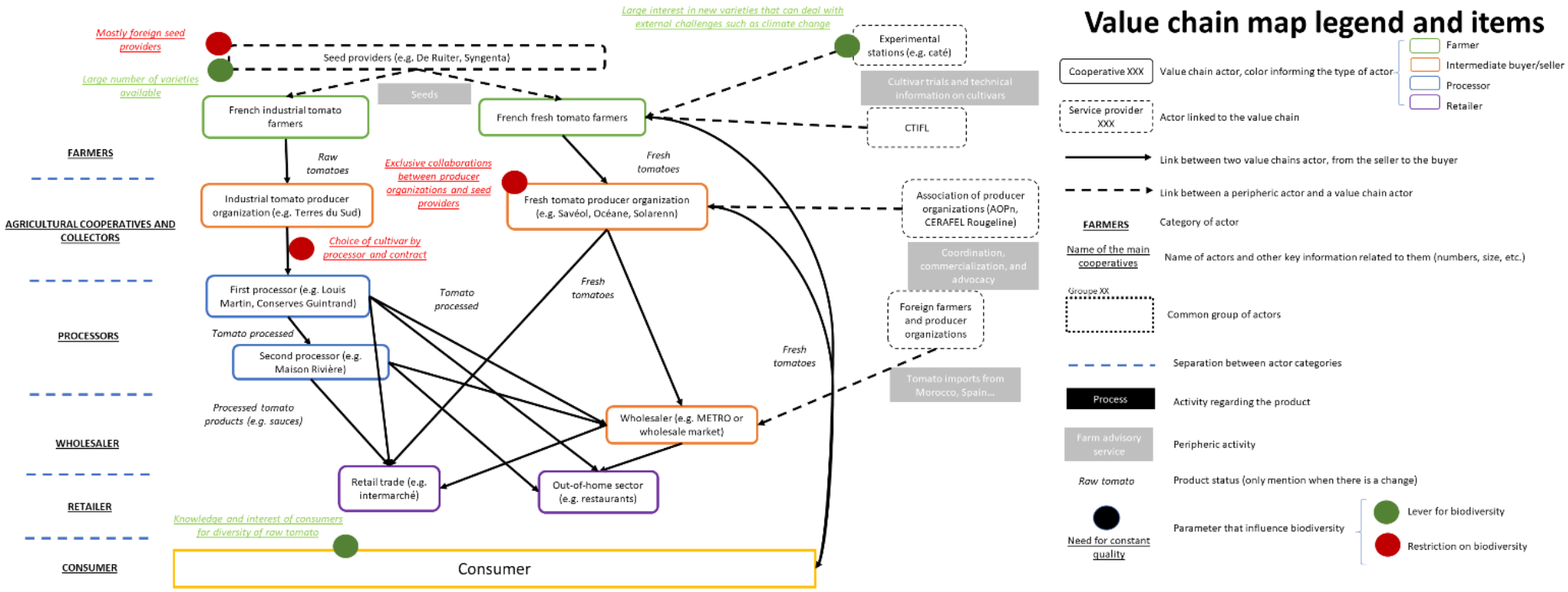
In the French market for fresh tomatoes, using contracts is more the exception than the rule (Expert 2; Expert 3). In fact, there are hardly any contracts between the producer organizations and their members, and the former are legally required to sell the tomatoes delivered by the latter (Expert 4). How prices are fixed depends largely on the cooperative and even within one and the same cooperative different systems may exist (Expert 3). The producer organizations being member of CERAFEL, for example, sell their tomatoes on auction markets (CERAFEL 2022b). Prices usually depend on the cultivation period and the segment, that is whether cherry or vine tomatoes are to be produced and may change daily (CERAFEL 2022b; Expert 2). Despite the absence of contracts between the producer organizations and their members, the producer

organizations use forecasts and their experience to cultivate the right quantity of tomatoes and to ensure remunerative prices for their members (Expert 4). Between the producer organizations and the retailers or wholesalers, however, contracts usually exist (Expert 4). These contracts fix a price as well as the quality and quantity of the tomatoes to be delivered (Expert 2).

At the moment, the soaring energy prices are the major challenge for cultivating tomatoes in greenhouses because vast amounts of energy are needed to provide ideal growing conditions for the tomatoes (Expert 2; Expert 3; Expert 4). In some cases, producers' energy bills have increased tenfold (Expert 3). The rise in gas prices increases the production costs of tomatoes in greenhouses and intensifies the price competition with tomatoes from Spain and Morocco that require less energy input in order to grow (20 minutes 2022). Possible ways to deal with this situation are the use of more efficient materials for the greenhouses, finding varieties that need less energy to grow and decarbonizing the production of tomatoes (Expert 2; Expert 4).

In the future, the restricted availability of water might become another problem for the cultivation of tomatoes, especially in the South but also in other regions of France such as in Brittany (Expert 3).

Figure 15 - Overview of the tomato value chain in France



Point of view of the actors

Farmers

3 producers were interviewed:

- A conventional producer who produces 350 tons/year of tomatoes on a surface of 3,5 ha under tunnel
- An organic producer who produces 4.75 tons/year of tomatoes on a surface of 0.045 ha under tunnel. She sells fresh and processes part of the production. 3 tons are sold fresh and 1.75 tons are used for processing.
- An organic producer who produces 50 tons/year of tomatoes on 1.5 ha. He sells 70% of the production fresh and 30% frozen.

There is a difference in yield and therefore in the volumes produced between the different producers interviewed. The two producers who produce in tunnels, despite very heterogeneous production techniques and surfaces, have similar yields between 100 tons/ha and 105 tons/ha. The second organic producer has an average yield of 33 tons/ha.

Tomato seed suppliers are mainly specialized sellers. The multiplication of seeds on the farm is also an activity carried out by one of the producers, the varieties produced vary according to the years. The purchase of grafted tomato plants is also a way to stock up, a conventional producer buys tomato plants especially for the Cornue Andes and Marmande varieties. On average, producers have 2 to 3 seed suppliers. Producers do not have preferred seed companies according to varieties, most seed companies offer all varieties. Here is the list of seed companies:

- Sativa research center that offers population strains
- Prosem: especially for the Estiva F1 variety
- Agroseeds
- Germ Kiss
- Essem'Bio
- Gauthier

We note that producers source seeds and seedlings from specialized distributors. Seed distributors offer a wide range of seeds, which offers producers the opportunity to source from the same distributor.

Distribution channels vary greatly between different producers. Organic producers will not work with mass distribution, their distribution channels are mainly oriented towards direct sales and specialized organic stores. They sell around 70% to 80% of their production volumes through these channels. Organic producers will also work to a lesser extent with processors (30% of a producer's production), restaurateurs and some wholesalers (5% and 15% of another producer's production). One of the organic producers will have partnership relations and the other producer has regular relations with its customers. As far as varieties are concerned, only one organic producer sells only heirloom tomatoes to wholesalers and restaurants. The other organic producer will not have differentiated circuits for the varieties he grows.

The conventional producer will move towards mass distribution, marketing nearly 50% - 55% of its production through central purchasing. It also markets through a market of national interest (Châteaurenard) where the clients are mainly wholesalers. The producer sign a year-round commitment (but this is not a contract) with his customers.

Retailers

Two types of distributors were surveyed, a supermarket store and a local organic specialty grocery store.

About 4 tons of tomatoes per year are sold in the grocery store (in summer every week 500 kg are sold). Tomatoes are sold in bulk without any mark of distinction (no packaging or brand.). This store sources from two types of suppliers, individual producers and wholesalers. It maintains regular relations with these suppliers, wholesalers it is necessary to make purchase orders, while producers are stoneware transactions. Both types of suppliers supply the store with all varieties of tomatoes. But some varieties such as Crimean black will be mostly bought from wholesalers because producers do little. On the other hand, the varieties Pineapple, Andean Horn and Red Ribbed tomatoes are varieties little marketed by wholesalers, they are varieties that are rather bought from producers.

For the supermarket store the main supplier is the central purchasing body. To a lesser extent the store will source from wholesalers and producers (very little volume is bought from producers). The store has established regular relationships with the various suppliers it works with. The different suppliers supply the store for all varieties of tomatoes, there is little specialization of suppliers by variety.

The distribution channels of producers are diverse, but there is little specialization of the circuits according to the varieties. In tomato production, growers seek to offer diversity to their customers. Distributors seek to offer a wide range of tomatoes and novelty, this desire is all the more present in independent stores. The independent store works with multiple suppliers and has more freedom to choose them than the mass distribution store. When stores work with central purchasing they have a range of products already preselected by the central purchasing body.

6.3. Profitability, drivers and main variables for variety/species choice – point of view of the actors

General view

Tomatoes can be cultivated in heated or non-heated greenhouses during the whole year because they are protected from rain, frost and wind (Interfel 2022; Phelippeau 2021). In fact, almost all (85-95 %) of the French production takes place in greenhouses without soil (20 minutes 2022; franceinfo 2018).

While fresh tomatoes are harvested several times a week, industrial tomatoes are harvested all together at one point in time (Expert 2). Whereas the harvest of fresh tomatoes often takes place manually, industrial tomatoes are harvest using machines that cut the whole plant and separate the tomato from other parts of the plant afterwards (Expert 1). Industrial tomatoes are planted in the beginning of June in open land and are harvested after 7 weeks, that is between the end of July and the end of September (Expert 1).

In the fresh market, the two most important seed providers are De Ruiter and Syngenta (Expert 2; Expert 3). Further players are Gautiers, Axia seeds, Rijk Zwaan, Enza, Zaden, Clause vegetable seeds, PROSEM, Vilmorin-Mikado, Graines Voltz, Monsanto/Seminis, Sakata, and Nunhems (Expert 2; Expert 3). In general, the seed providers specialize on certain types of tomatoes, either on vine tomatoes or on the diversification segment of the market (i.e. cherry tomatoes etc.) (Expert 2). While Syngenta focuses on the vine tomato segment of the market De Ruiter rather focuses on the diversification part of the market (Expert 2).

Because of the increased segmentation in the last decades the number of varieties has risen considerably and the current number of varieties in the market is high (Expert 3). At the moment, there are 50-60 varieties that are most commonly used in the fresh market (Expert 2; Expert 3). However, much more varieties exist and they come in different shapes and colors and change regularly (Expert 3). The frequency of cultivar changes depends on the segment and is longer for some varieties than for others, yet on average a tomato cultivar is used about 10 years before it is replaced (Expert 3). One reason for the regular replacement of cultivars is a kind of "fashion effect" which consists in the desire to attract consumers by offering a new product that has a different color or shape (Expert 2).

The main drivers to use the current cultivars are their high productivity and their resistance against diseases (Expert 2; Expert 3). The disease resistance is of particular importance because the use of pesticides is getting increasingly restricted which makes the use of disease-resistant varieties imperative (Expert 2; Expert 3). Besides the productivity and diseases resistance, the quality of the tomatoes, their durability, their taste, the novelty of the variety and the energy required to make them grow are factors that play a role (Expert 2; Expert 3). Conversely, a low productivity and a lack of resistance against diseases are major obstacles for taking up new cultivars which cannot be compensated by other features such as a superior taste (Expert 3). Apart from that, there are no major barriers for introducing a new variety (Expert 2).

Point of view of the actors

Characteristics of varieties grown by growers

As mentioned above, three tomato farmers were surveyed, two of which are organic. The varieties grown by the three producers are:

- Red Beef heart
- Yellow Beef heart
- Rose de Berne
- Green zebra
- Andean Horn
- Crimean Black

Organic farmers grow more varieties than conventional producers and also grow population varieties that the conventional producer does not grow (population varieties are a type of variety resulting from the multiplication by free pollination of a set of individuals). Here is the exhaustive list of varieties grown organically:

- Red round (Gloriette + Estiva F1, Do Paudex and Bolsar)
- Cherry (Onicombe, Pulcina, Tsukertrob, black cherry, Tiger)
- Sauces (Roma and Defiant)
- Ancient varieties: orange agro fruit, pineapple
- Pink Beef heart
- Valencia
- Brandywine
- White Beauty

The conventional producer grows mainly red Beef heart, the second variety is the "Crimean black" and the third variety is the yellow Beef heart. These varieties were chosen following tests he carried out, they are the varieties that adapt best. Regarding prices and yields, there is little differentiation by variety. The producer buys for all these varieties grafted plants at 1.7 € / grafted plant without taxes. The average yield of these 3 varieties is around 100 – 120 t/ha but

depending on the varieties and climatic conditions yields can vary by 20%. The producer had no knowledge of the variable costs of production and was not aware of the selling prices of its production.

One of the organic producers, grows mainly "Crimean Black", "Red Beef heart" and "Pineapple". Each variety represents between 20 and 30% of the annual harvest. The 3 varieties are sold at the same price, 1.70 € / kg in 2022 (but a few years ago he sold his production at 2.5 € / kg). Yields are similar for the 3 varieties, from 20 to 30 t/ha. Regarding seed prices are about 150 € per thousand seeds. There is a differentiation of seed prices according to type, hybrids or population not according to varieties. Population seeds are inexpensive compared to hybrid seeds. Regarding the selection criteria for varieties, they are similar for all varieties:

- Varieties that the producer has been using for a long time
- Varieties that are generally good
- Varieties that have a visual rendering
- Varieties with good agronomic qualities
- Values known to the consumer.

The last producer grows first the "Bern rose" (old variety), followed by the "Gloriette" variety and the third variety she grows is the "Black cherry". The share of volumes for each variety is not known by the producer. These varieties have been selected above all for their taste and quality. The "Rose de Berne" is the only variety that was chosen partly for its color.
Seed prices differ depending on the variety, the most expensive variety is the Gloriette:

- "Rose de Berne": 7,14 € HT / 50 seeds, 28,31 € HT / 250 seeds, 90,30 € HT / 1,000 seeds (according to the website)
- "Gloriette": 21,33 € HT / 50 seeds, 85,54 € HT / 250 seeds, 279,99 € HT / 1 000 seeds (according to the website)
- "Black Berry": 8,09€ HT / 50 seeds, 32.05€ / 250 seeds, 102.22€ / 1000 seeds (according to the website)

Despite a higher price of seeds of the "Gloriette" variety, it is sold at a lower price than the other two varieties, 3.95€/kg 2022. The "Berne rose" is sold for 6.10€/kg and the "Black Berry" is sold for 8.90€/kg. There was no fluctuation in selling prices between 2021 and 2022. The workforce represents about 27% of the turnover (turnover on tomatoes which amounts to about 13 000 €). Variable costs are low and represent only 5.4% of turnover.

We can observe that growers make little distinction between the varieties they grow. Indeed, they will not differentiate yields or production costs according to varieties. The criteria for selecting varieties are not based on prices but essentially on the quality of the varieties and the taste quality. The same criteria are sought for all varieties grown on the same farm (taste, quality, etc.).

Retailers

Depending on the store the number of varieties sold may vary (Table 12).

Table 13 - Varieties of tomatoes sold in the French supermarket store, specialized organic and local store

Varieties sold in the supermarket store	**Varieties sold at a specialized organic and local store**
Black Cluster	Beef heart
Yellow cluster	Pineapple

Beef heart	Crimean Black
Tomato bunch	Ribbed red tomatoes
Cherry tomatoes	Round tomatoes
	Andean horns
➔ In summer 5-6 varieties are sold	Black and green zebra
	Cherry tomatoes
	Rose de Berne

The supermarket mainly sells 50% or more of cluster tomatoes. The cluster tomato is mainly chosen for its price and its hold (good conservation). It is the central purchasing that supplies the store with tomatoes bunches, the production generally comes from Marmande and the South-West. The other predominant varieties in the store are beef core and round tomatoes, varieties which are produced locally. These two varieties are tomatoes of higher range, they are chosen for their taste qualities and their aspects (color, shape ...). Buying and selling prices depend on market prices and vary daily.

The 3 main varieties sold by the second store surveyed, specializing in organic and local products, are "beef heart", "pineapple" and "ribbed tomatoes". The "beef heart" variety accounts for nearly 40% of the store's tomato volumes. It is a variety chosen mainly for its color and quality. Moreover, it is a variety known and sought after by consumers, it is the variety that sells the most. Finally, it is a variety for which the offer is important, there are no problems of availability throughout the season. The second variety sold in the store is "pineapple", which accounts for 20% of tomato volumes. The original character (color, shape) and its taste qualities (fleshier less watery) are the main factors that encourage to sell and consume this variety. The last variety sold in the store is the "ribbed tomato" which accounts for 15% of the store's tomato volumes. It is a better-quality tomato but sells for more expensive.

All these varieties are supplied mainly by producers in the Toulouse region. Regarding prices, all organic varieties are sold at the same price 4.95 € / kg. Similarly, the purchase prices are similar for the 3 main varieties 3.2 €/kg, with a slight difference of 0.3 €/kg for "ribbed tomatoes" (purchase price 3.5 €/kg). To date there has been no evolution of selling prices and purchase prices, it seems that the price pass-through will be in 2023.

Like farmers, distributors are looking to sell many varieties. They are also looking for varieties with interesting taste qualities. They will sometimes bet on originality, especially in terms of color or shape. However, we can observe that the beef heart variety is a popular variety, supply and demand are at the rendezvous.

6.4. Price formation and market power

General view

The yearly average price for conventionally produced fresh vine tomatoes hovers around 2 € / kg since 2008 with a peak of 2.57 € / kg in 2020 and a low of 1.88 € / kg in 2018. In comparison, the average price for organic fresh (vine) tomatoes is usually twice as high, for instance, 5.44 € / kg in 2020 and 5.42 € / kg in 2021.

The purchasing criteria of the French for choosing fresh tomatoes are, in order of importance: taste (cited in a study as the number one choice criterion by 21% of respondents), price (16%), origin (15%), freshness (13%), variety (8%), use (8%), colour (7%), label (7%), production method (3%) and size (2%) (AOPn 2021).

Point of view of the actors

Producer prices

One of the producers works mainly in long circuits. He sells nearly 45% of his merchandise in a Château Renard market of national interest. The price is fixed everyday thanks to the fees, the producer has no power on the price in this case. On the other hand, with the central purchasing bodies with which he works, he can set the price but must nevertheless align himself with market prices if he wants to be able to sell his production.

The second producer supplies him with several organic shops and a processor. For these two types of customers the prices are set jointly.

The last producer does direct sales and works with restaurants. For these two customers, it will set the selling price according to its profit margin target. It also works with wholesalers who set the selling price of its merchandise (15% of these volumes).

Few producers provided us with data on labor costs or variable costs. On the data collected on selling prices there is little price fluctuation between 2021 and 2022. Some told us that selling prices have fallen in recent years, from €2.5/kg to €1.7/kg in 2022.

Regarding certification, 2 producers are organic. One of them says that organic makes it possible to better value production but that the price difference with conventional is small. The third producer is certified High Environmental Value, there is no added value with this certification, but it is a condition to be able to sell its production.

Resale prices

We observe different strategies for setting prices with suppliers between the two retailers. On the one hand we have a small shop that does not negotiate very much, whether with wholesalers or producers. On the other hand, we have a large retail store that will accept prices from producers but will negotiate prices with wholesalers and with the central purchasing body.

Both stores sell organic tomatoes and conventional tomatoes. They agree that organic certification allows you to sell at higher prices. The grocery store specializing in organic products and / or local products, sells conventional tomatoes between 3.45 € / kg and 3.85 € / kg while organic tomatoes are sold at 4.95 € / kg.

Pricing for a new variety

Organic producers agree that the price for a new variety would be set in a similar way to other varieties of the same family. The new variety must be accessible to the consumer so prices must be similar to the varieties already sold.

For a new product both stores claim that it would be the supplier who would set the initial price. The two stores would not negotiate prices where the suppliers are producers. According to the grocery store, the selling price would be similar to other tomatoes to make the product known and if the variety sells well then it can increase prices. Hybrids could perhaps sell for less because normally they are easier varieties to produce. The consumer price would be in the same way as today the initial price would be set by the supplier and then a margin would be applied to this price to have the consumer price. In the case of the organic and / or local specialized store all organic tomatoes are sold at the same price so a new variety would also be sold at the same price (4.95 € / kg)

Economic data by variety are not known by producers or suppliers. It is complicated to define the evolution of loads over time. We can say, however, that producers set their prices according

to charges and that they must align themselves with the market price, especially in long circuits. As for the definition of the price of a new product, producers and distributors claim that the price would be set in the same way as at present, thus considering the costs and margins of each player. In addition, it is essential that the new product be affordable for consumers, so the prices would be similar to other tomatoes already on the market.

6.5. Feasibility, constraints and consequences of introducing more varieties/species/products

General view

A potential obstacle for more biodiversity could be the close links between some cooperatives and seed providers which might make some varieties unavailable for excluded producer organizations. However, this arrangement could theoretically also stimulate competition and innovation between seed providers.

There are multiple factors that facilitate the introduction of new varieties in the future. A facilitating factor is that the producer organizations are constantly interested in finding new cultivars and that the introduction of new cultivars is therefore quite easy (Expert 2). For example, some cooperatives organize trips to gene/cultivar banks in order to find potentially interesting cultivars (Expert 2). Another potential facilitator might be that the soaring energy prices give an incentive to develop new cultivars that are more energy efficient (Expert 2). In a similar vein, the search for tomato cultivars that require less water is going to intensify as climate change progresses which could also stimulate the development of new cultivars (Expert 1; Expert 3). Moreover, the need to use less phytosanitary products pushes the tomato value chain to find cultivars that have a genetic resistance against diseases (Expert 1; Expert 2). In face of these challenges, the major task for the value chain consists in responding to them while preserving the taste of fresh tomatoes that is appreciated by consumers (Expert 2).

Expected criteria and actors influencing the choice of suppliers

Of all the producers surveyed, there are few quality expectations specific to varieties or specific to customers. The quality expectations that have been put forward are as follows:

- The taste quality because the tomato is a product that is sold fresh, so it is important to have a good taste quality
- The level of maturity (no green picking) must be optimal to have good results for training and fresh consumption.
- Good post-harvest conservation because tomatoes are a fragile product. Try to pick the tomato at maturity and keep it as long as possible
- A "beautiful" color is an important criterion for the consumer.

According to one producer, wholesalers will seek standardized products with a precise size and color. Standardization makes it easier to sell (distribution to different customers) it is a request of the downstream. Restaurants will also have expectations, especially in terms of caliber, they are looking for large calibers because it is easier to work.

When stores choose suppliers, they will favor suppliers who offer an assortment of species and varieties, they will also favor suppliers who are specialized in a production *("producers who are specialized in tomatoes generally make good quality tomatoes").* The proximity of suppliers is also a criterion put forward in the choice of suppliers. Then all expectations of quality, price, and availability are other important criteria to choose its suppliers. The main quality criteria expected are:

- Color is important for the consumer and for the organic store color makes it possible to bring to diversify it on its products
- Shelf life is an important criterion as consumers are looking for ripe tomatoes. The riper the tomatoes are, the less they keep over time

For all varieties the same quality criteria are sought even if for some varieties there are more important criteria than others. Especially for varieties with specific colors (yellow and black bunch), color takes precedence over the criterion of taste quality. For the "Roma" variety, taste quality and denser flesh are sought-after criteria. Other criteria could be put forward:

- Origin
- Different taste quality and denser flesh: if able to have tomatoes with a good taste quality because it is a product that is little transformed, often consumed in raw.
- Medium or even small calibers: large calibers sell less well and keep less.

Other potential varieties

For farmers there are many varieties that could be grown in their respective regions with interesting agronomic qualities to adapt to extreme climatic conditions or with better preservation qualities such as cocktail varieties or "Roma". There are many varieties of tomatoes on the market today but they also need to be tested.

There may be interesting Italian varieties like "marzano" that are mostly used for tomato sauce. However, there are already many varieties on the market.

How to introduce new varieties

The various growers surveyed have all recently introduced new varieties of tomatoes into their business. The number of new varieties introduced varies depending on the grower, from 5 to 2 varieties for some. Customers can also influence the introduction of new varieties, including a grower who works with a processor has introduced a variety for processing, white beauty. Here are the different varieties recently introduced by growers:

- Cocktail tomatoes
- Black Crimean change switch to a hybrid
- New variety of Yellow Beef Heart
- New variety of Marmande
- New variety of Andean Horn
- White beauty that was introduced for processing because it attracts curiosity, making a white tomato sauce is curious
- Brandywine it resists well to hot strokes

The main factors that could lead growers to introduce new varieties are:

- Interesting agronomic qualities to adapt to climatic conditions and resistant to certain pests and diseases
- To diversify production in terms of products but also colors
- To a lesser extent a producer claims to be able to introduce new varieties into his farm at the request of his customers, depending on advances in research.

Growers could introduce new varieties on their own initiative because they are already doing so and are always tempted by varieties they do not have. Organic producers are quite curious so will go more towards new varieties. Farmers who are technically picky will also go looking

for new varieties. There is no more predisposition of producers in short circuits to introduce new varieties than producers in long circuits

On the distribution side, stores are constantly integrating new varieties on their shelves. For the supermarket chain every year there are new varieties of tomatoes that are marketed. For the small store, the "Black Zebra" variety has just been integrated into the store, it has an interesting color.

New products can be introduced in both stores following the request of suppliers. It is also possible that new products are introduced as a result of consumer demands.

Production constraints

The main limitation encountered today in production is climatic conditions. The two growers who face this problem are looking to increase soil fertility and implement water-efficient irrigation systems. Other constraints were highlighted:

- The demand for labor is a real constraint for one of the producers
- Affordable prices for the consumer are another obstacle encountered by a producer. Consumers are looking for cheaper prices.

Likelihood of actors to introduce new varieties

Only two producers responded to this part.

The organic producer sees no limit to the introduction of new varieties in her activity. For the other producer, several limits were put forward, in particular more production costs and production adaptation costs. This producer also claims that there is a lack of consumer awareness and new techniques and standards are needed when introducing new varieties. Despite the stated constraints, both producers are willing to introduce new varieties into their activities (probability 8/10 for one producer and 10/10 for the second on a scale from 1 to 10).

Regarding the possibility of distributors to introduce new products, the opinion is mixed. For the small organic shop, it is quite conceivable that distributors can integrate new products on their own initiative because they already melt it. However, it is mainly independent and small distributors who will be able to do so because more room for maneuver in terms of sourcing and are stores that focus their activity on the diversity of products. For the supermarket store it is not conceivable that distributors integrate new products themselves because they do not know the criteria, it is technical and complicated. In addition, they are stores that accompany on the sale essentially.

But to introduce new varieties it is important to have products that are different (visually different in color or shape). If visually there is no distinction it will be difficult to find an interest unless qualitatively the new variety is better. The supermarket does not see too many constraints to introduce new varieties apart from the fact that it will be necessary to communicate on the new variety and this involves costs. However, since there are already many varieties in the store the probability of introducing new varieties is low. Fostering collaboration with growers could encourage the store to introduce more varieties (8/10 probability).

For the small grocery store there are few constraints to introduce new varieties. However, collaboration with growers and communication with consumers are factors that could facilitate the acceptance and sale of new varieties.

Distribution and production of a large number of varieties

Only two producers responded to this part.

The expected effects of producing more varieties are mixed between the two producers. The organic grower seeks through the marketing of a greater number of varieties to have a positive effect on the environment and increase customer income (by improving customer sales). The second producer does not believe that producing more varieties would allow more access to the processing market. He agreed with all the effects quoted in the questionnaire:

- Improving farmers' incomes
- Have a positive effect on the environment
- Increase the number of customers
- Foster stronger vertical relationships
- Improving access to retail/distribution markets
- Increase customer revenue (by improving customer sales)
- Improve the company's reputation in the long term
- Other: brings security if a variety does not work, we can catch up with another variety.

For the supermarket store the sale of a greater number of varieties does not seem to have negative effects. Selling more varieties would increase the amount of product purchased, increase the number of suppliers, and foster vertical relationships and complement product lines. For the small shop the improvement of farm income through the sale of more varieties can be done only if the producer sells more production. This store is looking to strengthen its relationships with these suppliers so it prefers to work with the products that its suppliers offer rather than working with more suppliers. Increasing the varieties in the store would not increase the number of suppliers.

Cost consequences when introducing more varieties

Only two producers responded to this part.

The production of an increased number of varieties would, according to producers, lead to an increase in variable costs. For one of the producers, there are more economic risks by growing more varieties especially in the first years (the first two years). Indeed, there would be more work on plot management, more activities and planning documents and more work to sort production (therefore increased variable costs and more spaces dedicated to cultivation).

The costs of introducing new varieties are perceived differently in different stores. For the supermarket store the sale of several varieties would involve new spaces in the store, more management work. The small shop by selling a greater number of varieties would require more training for workers. The sale of a greater number of varieties sold would, however, systematically involve more work and costs in terms of marketing and consumer information.

6.6. Summary

It should be noted that the actors in the sector (both retailers and producers) aim to offer a wide range of tomatoes (diversity in terms of color and shape). Tomatoes are products that are mainly eaten raw, so there are expectations regarding the taste quality and preservation of these products. All stakeholders, whether producers or distributors, are constantly introducing new varieties into their activity. The price does not seem to be an obstacle to the introduction of new varieties. The beef heart variety stands out from other varieties, it is produced and sold by all the actors surveyed.

Producers seek to offer diversity to their customers. The criteria for selecting varieties are not based on prices but essentially on the quality of the varieties and the taste quality. The same criteria are sought for all varieties grown on the same farm (taste, quality, etc.). We can observe that growers make little distinction between the varieties they grow. Indeed, they will not

differentiate neither yields nor production costs according to varieties. The distribution channels of the producers are diverse but there is little specialization of the circuits according to the varieties.

Like farmers, retailers also offer a wide range of tomatoes. They are also looking for varieties with interesting taste qualities. They will sometimes bet on novelty and originality, especially in terms of color or shape. It is observed that independent distributors will have more facilities to introduce new varieties and to work with several suppliers (wholesalers, producers, etc.) than supermarkets that work mainly with central purchasing bodies. When stores work with central purchasing they have a range of products already preselected by the central purchasing body.

Economic data by variety are not known by producers or suppliers. It is complicated to define the evolution of loads over time. We can say, however, that producers set their prices according to charges and that they must align themselves with the market price, especially in long circuits. As for the definition of the price of a new product, producers and distributors claim that the price would be set in the same way as at present, considering the costs and margins of each actor. In addition, it is essential that the new product be affordable for consumers, so the prices would be similar to other tomatoes already on the market.

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7. Analysis of lentil value chain in France

7.1. Introduction and general information on market

In terms of production quantity France outperforms Spain as it produces 39,994 t (45.2 %) in comparison to the 24,357 t (27.5 %) harvested from the Spanish acreage (Table 3). Again, France and Spain are followed by Greece 13,838 t / 15.6 %), Bulgaria (5,920 t / 6.7 %) and Italy (3,663 t / 4.1 %). The remaining countries only produce minor quantities of lentils.

The main unprocessed lentil product in France is dried lentils that are offered in different colors in carton boxes or bags (Expert 1). Most of the uncooked lentils sold in the French market are green lentils (48%) followed by coral red (34%) and blond (18%) ones (Creusillet 2021). The vast majority of dried lentils is sold in the retail trade and a minor share is sold either directly to the consumer or is exported (Expert 3). Moreover, lentils can serve as an ingredient in a large variety of processed products. Popular processed products containing lentils are cooked lentils in cans, stews with lentils and meat, lentil salads, meat-free patties and lentil chips. In fact, most of the canned lentils are sold with sausages added (32%) and only 11 % without any other ingredients (Creusillet 2021). Another end product is lentil flour which so far has only played a minor role but is starting to enjoy greater popularity (Expert 1; Expert 3).

In the next sections, we will focus on dry lentils value chain. In this context, we were able to interview 3 producers, 2 structures that do packaging (called "processors") and 1 retailer. Their answers to the questionnaire are given in the "points of view of the actors" sections.

7.2. The value chain network

General View

Lentils are the most popular legume among French consumers. In fact, half of the legumes sold in France in 2020 were lentils of which 29 % were green lentils and 21 % blond or red lentils (Ministry of Agriculture and Food 2020). In total, 90,000 t of lentils are consumed in France every year and the average consumption of lentils in France is 1 kg per capita which is low compared to the worldwide average of 7 kg per capita (Creusillet 2021; Green Lentils of Berry 2022).

Even though France exports about 5,000 t of lentils a year it is an overall net importer of lentils. In some years, the French production of green lentils is sufficient to cover the domestic demand but lentils with other colors are largely imported because they are hardly cultivated in France (Expert 3). Between 2016 and 2020, France consistently imported between 25,000 t and 35,000 t of lentils which is tantamount to about half of the lentils required to satisfy its domestic demand (AILB 2020; Univia Land 2022). The most important countries from which France imported lentils in 2020 (total imports of 29,116 t with a total import value of 27,185,000 US$) were Canada (12,263 t / 8,625,000 US$), China (4,152 t / 3,306,000 US$), Belgium, (3,107 t / 3,370,000 US$), and Turkey (2,889 t / 3,232,000 US$) (FAOSTAT 2022 c).

In France, lentils are produced exclusively for human consumption (Solagro & Reseau Action Climat France 2016). Both the French lentil production quantity and the area harvested saw a considerable rise in the last years (Arvalis & Terres Inovia Infos 2020). While the production quantity amounted to barely 10,000 t in 2007, this value was four times higher in 2017 when roughly 40,000 t of lentils were produced. Despite the long-term upward trend, it must be noted that in 2020 and 2021 there was a decline in acreage and production quantity which was driven by heavy rainfalls that had led to exceptionally poor harvests both in terms of harvest quantity

and quality (Autin 2020; Expert 1; Guyomard 2021; Terres Univia & Anils 2022). Between 40 % and 50 % of the lentil acreage in France is cultivated organically (Expert 2; Terres Univia & Anils 2022). Besides the organic production there exist four relevant regional lentil schemes. Firstly, the green "du Puy" lentil from the Haute-Loire region which has both a controlled and protected designation of origin (CDO & PDO) (Denhartigh & Metayer 2015). Currently, the organisation in charge of the green "du Puy" lentil scheme counts more than 650 producers that harvest about 3,000 t from a surface of 3,000 to 4,000 ha a year which is roughly a tenth of the total French lentil acreage and production (La Lentille verte du Puy 2022). The second regional scheme is the green lentil "du Berry" which has a protected geographical indication (PGI) and is partly produced under the French red label which guarantees a superior quality of the lentils (Denhartigh & Metayer 2015). However, in comparison to its green "du Puy" sibling it accounts for a much lower production surface (470 ha) and production quantity (850 t) (Denhartigh & Metayer 2015). In addition, there are two smaller schemes. Thirdly, the blond lentil "de Saint Flour" which is also produced under a red label and the association in charge aims at obtaining a PDO (Denhartigh & Metayer 2015). Currently, about 45 ha of the blond lentils de Saint Flour are cultivated and more than 50 t are sold per year, the majority directly to consumers (Denhartigh & Metayer 2015; La Lentille Blonde de Saint-Flour 2022). Finally, the "Lentillon de la Champagne" is a brand that does not hold any of the above-mentioned labels (Denhartigh & Metayer 2015). The yearly production of about 100 t is mostly sold in the out-of-home market and in delicatessen stores (Denhartigh & Metayer 2015).

In 2020, the region of Centre-Val de Loire was the region with the largest area harvested (6,429 ha) followed by the regions of the Grand Est (6,136 ha) and Occitanie (5,290 ha) (Table 4). Further regions with a large lentil acreage were Bourgogne-Franche-Comté, Nouvelle-Aquitaine, and Auvergne-Rhône-Alpes (Table 4; Terres Univia 2022).

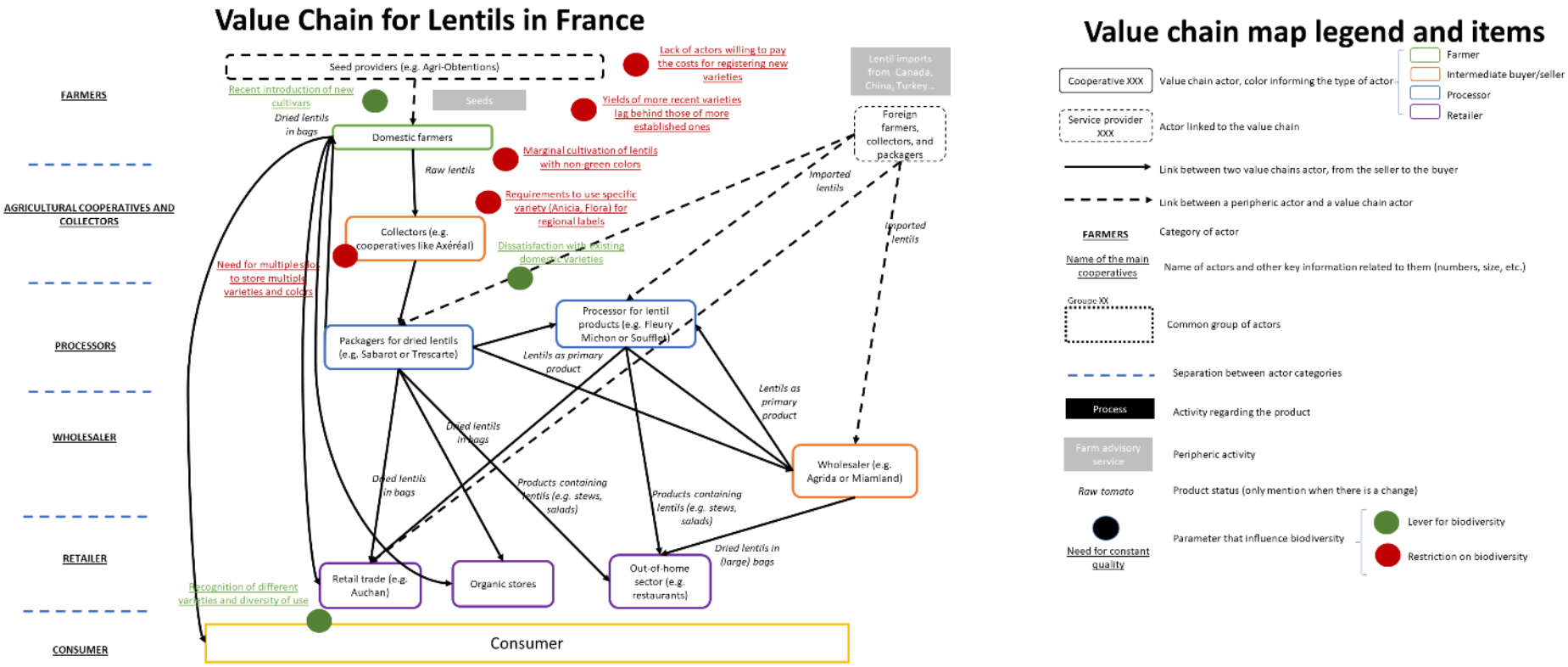
Domestic lentil farmers get their seeds from one of the seed providers, for instance, from Agri-Obtentions. Often, it is cooperatives who purchase the seeds for their members, especially if they are obliged to use certain varieties that are required to produce under a given label, e.g. the variety Anicia for the regional scheme of the green lentil "du Puy". The cooperatives are usually also taking care of the collection of raw lentils and thus are the first buyers of raw lentils (Expert 1; Simmen 2022). After the raw lentils have been collected, they must be cleaned and sorted in order to meet the high quality and purity requirements for human consumption (Expert 1; Simmen 2022). Since the cleaning and sorting is a complex process, especially if the lentils are cultivated together with a companion crop, this task is carried out by the second purchasers (Expert 3; Terres Univia & Anils 2022). Some cooperatives like "Eureden" are both first and second buyer because they carry out the tasks of collecting, cleaning, sorting, packaging and selling lentils (Expert 1).

Usually, it is specialized packagers like Sabarot or Trescarte that take care of the cleaning and sorting of lentils and that subsequently fill them into bags in order to sell them to other downstream actors (Expert 2; Expert 3). The lentils are either sold under the packager's own label or the packager uses the label of its customer, for instance, a private label of a retailer. Most of the packagers also work with imported lentils which is necessary because the availability of French lentils with a color other than green is low (Expert 2; Expert 3). Depending on the yields it might also be necessary to import green lentils in order to cover the domestic demand (Expert 3). Regardless of their color, the imported lentils have often already been cleaned and therefore only need to be filled into a bag with the desired size and the desired label (Expert 3). Working with both domestic and imported lentils helps the packagers to ensure a high utilization of their facilities and to remain profitable (Simmen 2022; Terres Univia 2022 & Anils 2022).

The amount of domestically cultivated lentils that the packagers deliver to the processing industry is limited because of the low French production quantity, the higher price in comparison to imported lentils and technical difficulties with the cooking of domestic lentils which makes them less appealing to processors than their imported counterparts (Expert 2; Expert 3). In addition, the imports help to limit the risk of supply chain issues because they diversify the origin of the lentils (Terres Univia & Anils 2022). For these reasons, the lentil processors prefer to work with imported lentils from Canada, China or Turkey which they either source via the packagers, via wholesalers or directly from abroad (Expert 3).

Almost all of the lentils harvested in France are subject to a dense system of contracts between lentil farmers and collectors (Simmen 2022; Terres Univia & Anils 2022). These two actors enter into yearly and in rare cases multiannual contracts before seeding the lentils which reduces the risk of over and underproduction (Expert 1; Simmen 2022; Terres Univia & Anils 2022). The contracts are beneficial for both sides because they allow the farmers to reduce the uncertainty to sell all of their produce and the collectors to ensure a sufficient supply of lentils (Expert 2; Expert 3; Simmen 2022; Terres Univia & Anils 2022). In addition, contracts include clauses that allow collectors to pay a bonus to the farmers if they for instance deliver lentils without traces of pesticides or to lower the prices if the lentils do not meet the quality standards because they for example contain beetles or lavaes (Expert 1). The business relationships between the collector (first buyer) and the packagers and processors (second buyers) are regulated by a code of conduct (so-called RULEGS) (Terres Univia & Anils 2022).

Figure 16 - Overview of the lentil value chain in France



Point of view of the actors

Producers

The 3 producers surveyed sell dry lentils, only one producer packs part of her merchandise in bags of 500g or 1 kilo. The areas dedicated to lentil production vary depending on the producers and the years. Yields vary greatly depending on the region and the year. Producers are not very diversified in terms of lentil varieties. Two out of three growers grow a single variety, the first one green lentil "Anicia", and the second one blond lentil "Flora". The last producer grows 2 varieties, green lentil "Anicia" and a variety of blond lentil.The three farms are:

- A farm in polyculture organic breeding, breeding is the main activity. The farm is composed of 270 ha of which 5 to 10ha are devoted to the production of lentils. This producer produces on average and depending on the cultivated area 0.5 tons to 0.25 tons. The yield for 2022 is around 500 kg/ha on this farm.
- The second farm consists of 42 ha, 90% of the areas are temporary or permanent meadows. 3 ha are dedicated to lentils. For the year 2022 this producer produced 1.1 tons, the yield of the year 367 kg/ha.
- The last farm consists of 150 ha of which 118 ha of cereals. The lentils represent 12 ha which are distributed as follows 10 ha of green lentils and 2 ha of blond lentils. In 2022, the producer produced 15 tons of green lentils and 2 tons of blond lentils. Yields for this year are around 1 t/ha, 1.5 t/ha for green lentil and 1t/ha.

Seed suppliers are different depending on the business model chosen by the producer. For the producer who is part of a cooperative, the seeds are provided by the latter. It offers advantageous prices for seeds. The second producer buys from a specialized seller and the last one sources both varieties from a seller specializing in the sale of agricultural products. We observe that there is little varietal diversity in lentils and grower source from only one type of supplier. One of the farmers, who grows the “Flora” variety, would eventually like to be able to recover part of the harvest to replant it in year y+ 1, it is necessary to have a certification of farm seed production. Seed prices vary, for the “Flora” variety the seed price is around 1.6 €/kg (100 kg of seeds per ha) is required. For the variety "Anicia" and another variety of blond lentil seed prices are around 0.24 €/kg.

Marketing channels also vary according to the objectives of the farmers. We observe that there are producers engaged in long circuits and producers in short circuits who seek to diversify their outlets. Producers' outlets are not very diversified. One of the producers works exclusively with a cooperative to which he delivers 100% of the harvest (sometimes this producer sells negligible volumes directly to consumers). To be part of the cooperative the producer must join the cooperative. The second producer sells all his production to a sorting centre which then resells the lentils. The sorting center is a tool that structures the lentil die under the AOP "Saint Flour". The producer does not have a contractual relationship with the sorting center but relations are regular. The last producer is more oriented towards direct sales. It sells 65% of its production on local markets (about 40 different markets). It distributes its production in a producers' shop (15% of volumes) with whom it has established a contract. It has transactions with small stores too (15% of volumes) with whom it has regular relationships. Occasionally, it will also deliver its production to communities for out-of-home catering (5% of volumes).

Processors

The first processor is specialized in fair trade labeled products. It buys 320 tons of lentils distributed as follows: 250 tons of green, 30 tons of roses and 20 tons of black and 20 coral tons. This structure is supplied in bulk or already packaged from 4 cooperatives, with whom it has

contractual relations (multi-year contracts). All the production purchased is sold to common retailers, 80% of the volumes are sold to central purchasing bodies and 20% are sold directly to stores.

The other structure buys 150 tons of dry lentils which will then be packaged in bags. This structure plays a cooperative and packaging role because it has its own brand. It is therefore the producers who supply this structure. There are currently between 30 and 40 producers supplying all varieties of lentils. The customers of this structure are mainly intermediaries and mass distribution about 30% of volumes. Processors absorbs 40% of the volumes of this structure. The additional 30% of the volumes went to wholesalers and out of home sector.

Retailers

The distributor surveyed is a store specializing in organic, he buys about 60 kg / year of lentils per year. It obtains all volumes from a central purchasing body with which it maintains partnership relations.

7.3. Profitability, drivers and main variables for variety/species choice

General view

Given the small size of the lentil market there is a limited number of lentil varieties available (Terres Univia & Anils 2022). Nevertheless, research institutes such as the national institute for agronomic research (INRAE) or the seed manufacturer "Agri-Obtentions" are working on increasing the number of varieties available (Expert 1; Expert 2). Their activities have contributed to the introduction of five new lentil varieties into the French cultivar catalogue in 2021 (Terres Univia & Anils 2022). However, it remains to be seen whether their yields are sufficiently high to be taken up by the market (Expert 2).

Although a dozen of lentil varieties exists and the number of cultivars in the market has experienced a boost in the last couple of years, there are three cultivars that are clearly dominating the market (Expert 1). Firstly, the most commonly used and most successful lentil variety in France remains "Anicia" which is cultivated on about 80 % of the French acreage (Chambre d'Agriculture 2004; Terres Inovia 2021b). It was introduced into the French variety catalogue in 1966 and is still the most used variety with the highest yields (Terres Univia & Anils 2022). The dominant position of the green-colored "Anicia" cultivar is reinforced by the fact that its use is one of the criteria to market under the CDO/PDO label "lentille verte du Puy" and the red label / PGI "lentille verte du Berry" which are the two most important regional schemes in France whose products are also exported to other countries (Terres Inovia 2021b). Far behind "Anicia", "Rosana" is the most popular coral red variety that was cultivated on roughly 15 % of the French lentil production surface (Terres Inovia 2021b). Thirdly, "Flora" is the most widespread blond cultivar accounting for 4 to 5 % of the total French acreage (Terres Inovia 2021b). In addition, "Flora" is the variety used by all of the roughly 30 producers forming part of the "Association Interprofessionnelle Lentille de Saint-Flour (AILB)" (AILB 2018).

Despite the decent number of cultivars available, farmers are not satisfied with the existing varieties (Expert 1). They complain that the current cultivars are vulnerable to stressors such as beetles, that they lack resistance against rain and wind and are unstable without using a companion crop (Expert 1). Furthermore, the lentil varieties grow indeterminately which is not ideal for the farmers because it makes it difficult for them to determine the ideal point of harvest (Expert 1).

Point of view of the actors

Farmers

The PDO "Saint-flour" is currently being validated at the INAO. In the specificationsof this PDO the varietychosen to be grown is the variety "Flora". It is a hardy variety, formerly grown in the region. One of the producers chose to join the PDO because the structuring project was a human project and many structures were created specifically for the PDO, including the sorting center to which it delivers its production. It sows only the variety "Flora", for this variety the yields are very fluctuating ranging from 0,4t/ha to 2t / ha. The average yield in 2022 was 1t/ha.

The second producer that produces a single variety of lentil, "Anicia" is organic and part of a cooperative system. It is the cooperative that chooses the variety, it is also the cooperative that supplies the producer with seeds. The grower has no knowledge about seed prices or why the variety is grown (he says it is the most widely grown variety). As for the "flora" variety, yields for the "Anicia" variety are very variable from 0,3t/ha to 1,8 t/ha and in 2022 0,05t/ha.

The last farmer produces 2 varieties "Anicia" and a variety of blond lentil. The variety «Anicia» represents 88% of the lentil harvest (15 t), the blonde variety represents only 12% of the harvest (2t). These opportunities are mainly direct sales in local markets. The seed price is the same for both varieties 0.24 €/kg of seeds. The variety “Anicia" was chosen by the producer because it is the best-known lentil. As mentioned above, yields vary from year to year and depending on the region. Here yields are between 0,8 t/ha and 1,5 t/ha. The second blonde variety was chosen to bring diversification and to introduce consumers to another variety. For the year 2022, the yields of the blond lentil are 1 t/ha.

Processors

Both conditioners work with the "Anicia” variety of green lentils, and for the coral lentil they work with the "Rosana" variety. Other varieties are used such as the blond lentil "flora", the varieties of black lentils "beluga" and lentillons. On average, the two processors we surveyed work with 4 or 5 different varieties.

Green lentil is the variety that sells the most through thes processor. It is the most consumed variety and for which there is always seed availability. The Gers and the Grand Est are the main supply areas for processors. One of the packers is fair trade and buys the bulk production around 2300 € / t before inflation (+ storage surcharge) or 3.05 € / kg for production in bags. Once the production is packaged, he sells it to his customers at €3.05 500g or €3,050/t (price with VAT store margin, their margin and transport). The other conditioner buys the production of organic green lentil at 1600 € / t stable price for 2 years. It resells the production in the form of sorted big bags at 2400 € 2500 € (weight of big bags). There are few variable costs on lens production, mostly fixed costs.

The coral lens is the second variety of lens conditioned by the actors. Packers source mainly from the Gers and Normandy. The coral variety was chosen on the one hand by the colour but also because it is an agronomically interesting crop, adapts to the terroirs, and is cultivated for its taste. The purchase price is around €3.30/kg (in bags) and is sold at €3.79 per 500g (VAT and charges included). The second packer buys the goods at 1700 € / t and resells it at 4200 to 4500 €. For coral lentil, the losses between selling and buying can reach almost 40%.

The third variety sold is the black variety. Production comes mainly from the Gers and the Grand Est regions. This variety is also grown mainly for its colour and taste qualities. For one of processors this variety is bought in bulk at 2650 € / t, the resale price is 3.05 € for 500g (with VAT, store margin, their margin and transport). The purchase price for the second processor is 2000 2100€/t and the resale price are 3 800€.

Little information on variable costs was provided by the respondents. Regarding the conversion coefficient, the breach is a real obstacle. Nearly 80% of the volumes are burned in some years for green lentils.

Retailer

The surveyed organic distributor sells several varieties of lentils namely blonde, green, black and coral. The main variety sold is coral lentils, variety chosen by origin, availability and quality. The second best-selling variety is green lentil, the production is of French origin. The last variety sold in this store was the blonde variety. No information on prices or costs was provided.

Conclusion

There is thus a gradient of diversity in the sector, with divergence rather limited upstream of the sector, in production by farmer, whereas it is rather diverse in sales.. Growers produce one or two varieties of lentils. Regarding yields, there is a lot of instability depending on the year and the region. The processors package all varieties of lentils but the most consumed variety is the green lentil "Anicia". The purchase and resale price of this variety are lower than other varieties of lentils. We do not observe the same consumer trends in organic specialized distribution. The retailer surveyed mainly sells coral lentil and then green lentil.

7.4.Price formation and market power

General view

When it comes to prices for lentils it must be mentioned that the prices change every year because of the weather-dependent fluctuations of yields (Expert 2). In a year after a bad harvest, for instance, the prices offered by the collectors are usually increased because they need to motivate farmers to cultivate lentils instead of other crops that seem more lucrative to ensure their supply (Expert 2). Besides the overall harvest each year and the price differential between conventional and organic produce the prices for lentils depend on two further factors, namely the distribution channel and regional schemes (Terres Univia & Anils 2022). The direct sale of organic lentils yielded an average price of about 5,000 € / t in 2020 but the costs for separating, packing and selling the lentils have to be covered by the producer (Caron 2020; “Projet Filière Lentille” 2021). The sale of organic lentils in short circuits, that is to producer stores or specialized shops yielded average prices of 3,500 € / t in 2020 of which the producers had to pay the sorting and (Caron 2020). In contrast, the sale of organic lentils in long circuits, which is the most common way of selling lentils, yielded much lower prices in 2020, namely between 1,200 € and 1,500 € / t (Caron 2020). However, when selling lentils in long circuits the producers only have to cover the costs for the pre-cleaning but not for subsequent steps (Caron 2020). Some consumers declare that they are willing to pay more for certain brands but depends on the price (Focus groups 2022).

The second factor affecting the price of lentils is regional schemes. Conventional lentils produced outside of regional schemes costed between 450-600 € / t in 2020, depending on the contract (Expert 1; “Projet Filière Lentille” 2021). The price for the green lentils “du Berry” is also fairly low, that is about 650 €/ t in 2020 (“Projet Filière Lentille” 2021). In 2018, the blond lentils “de Saint Flour” yielded 1,180 € / t if produced conventionally and 1,380€/t if cultivated organically (AILB 2018). Finally, the green lentil “du Puy” yields prices in a range of 1,700-1,800 € / t for conventional lentils and 1,800-2,200 € / t for organic ones (“Projet Filière Lentille” 2021; Solagro & Reseau Action Climat France 2016).

Point of view of the actors

Farmers

The PDO "Saint-flour" is currently being validated at the INAO. In the specifications of this PDO the variety chosen to be grown is the variety "Flora". A producer produces 100% of the variety "Flora" which is the variety listed in the specifications of the PDO, it is a rustic variety, formerly grown in the region. The selling price did not fluctuate too much between 2021 and 2022, €1.18/kg for the "flora" variety, it is the sorting center that sets the price.

The second producer that produces a single variety of lentil, "Anicia" is organic and part of a cooperative system. Sales prices in organic are a little higher than in conventional. Prices will depend on yields but are between €1.7/kg and €2.5/kg. Prices in 2021 were a little lower than prices in 2022. The cooperative's producers are represented by a few producers. These producers define jointly with the cooperative the selling price. There are premiums depending on the quality of the goods.

The last producer chose to grow the variety “Anicia" because it is the lentil best known by the consumer. It produces a second variety, a blond lentil that is sold around 6 € / kg (in 2021 the selling price was 5 €/kg). As mentioned above, yields vary from year to year and depending on the region. For all distribution channels and for both varieties, the producer sets the price taking into account its costs (cleaning, sorting, etc.). In 2021, it values the green lentil “Anicia" at 4 €/kg and with the increase in charges it sells this variety at 5 €/kg.

We observe that selling prices depend on the distribution channels. When producers work in short circuits, it is necessary to package the product, which represents additional burdens compared to producers who sell through cooperatives or sorting centers. Nevertheless, we can see that the selling prices of short-circuit lenses are higher than the long circuit selling price. The lack of information on charges does not make it possible to know the additional costs associated with packaging production.

Purchase prices

One of the processors works mainly with organic. The second also packages organic but works mainly in fair trade sectors. In fair trade chains, the price is defined according to production costs.

Both processors set prices jointly with suppliers through contracts. For one being a cooperative, cooperative contracts make it possible to set prices annually before sowing or post-sowing. He buys the production of organic green lentil at 1600 € / t, the stable price for 2 years. Thesecond processor setsprices with suppliers by multiannual contract based on production costs. Bulk production is purchased at around €2300/t before inflation or €3.05/kg for sachet production. Prices with suppliers are decided in the same way for all varieties.

The specialized and organic distribution will do the same and will set the price jointly with the supplier according to the volumes and at the fairest price. Prices are set for all varieties of lentils. We have no information regarding selling or buying prices.

Resale prices

The selling price for one of the processors that does fair trade is set jointly with customers through annual contracts. For processors, to whom it mainly sells green lentils, prices are set jointly by contract before sowing. The second processor negotiates annually the prices set by the customers.

The selling prices are fixed by variety considering volumes. The best-selling green lentil is the variety with the lowest purchase and selling prices compared to other varieties.

Pricing for a new variety

Producers' opinions differ on how to set prices for a new variety. For the producer in short circuit, the price would be fixed according to the costs of the farm and according to the availability and rarity of the new variety. The objective is that the price is affordable for the consumer. According to a second producer, the new variety must meet market criteria to be sold, but he does not know whether it will sell for more or less. Finally, the last producer thinks that there is already too much competition with other lentils so it will be complicated to put a new variety on the market, the prices will beint low for a new variety.

The distributors claim that for new varieties which fit into an existing scheme (e.g., a new variety of green lentil) the cost of the material would be fixed in relation to the varieties already marketed and according to yields. For very different varieties that would require a new marketing scheme, estimates would have to be made with customers. For fair trade chains, the price of the raw material would be set as for other varieties based on production costs. For the prices of the final product the price would be fixed in the same way.

Distribution for a new variety would set purchase prices based on volumes and with transparency in relation to production costs. The objective is for all players in the sector to be able to generate an honest margin. The consumer price for a new variety would be set the same as for suppliers, establishing a relationship of trust and transparency.

We observe that the actors surveyed define the purchase and sale prices jointly with the actors of the sector (suppliers – customers). Prices still depend on the volumes and yields of the year. Prices for new varieties would be set in the same way as varieties that already exist on the market. New varieties must be economically accessible to the consumer.

7.5. Feasibility, constraints and consequences of introducing more varieties/species/products

Factors influencing supplier selection

There are few quality criteria expected by the customers of the different producers. The most important criterion for all producers is the moisture content, it is important to have a low moisture content in the seeds for the preservation of the product. There are quality criteria expected by the cooperative in terms of the percentage of actual waste. For the producer who produces according to the specifications of the PDO lentils "Saint-Flour" several criteria are stated but the most important criterion is the size of the lentils (in addition to the moisture content). Finally in short circuit the producer has few defined quality criteria.

For the cooperative that conditions part of the production there are no criteria to consider in the choice of farmers. The co-operators choose to dedicate themselves to this crop and to supply the cooperative. The second processor pays more attention to the assortment of varieties and species when choosing its suppliers. He wants more choices to ensure a continuous supply and have more products other than lentils. The proximity of producers and a producer group that works democratically is also an important criterion when choosing suppliers.

The organic retailer surveyed considers that the assortment of varieties and species offered by suppliers are important criteria. Consumers are native to the city, looking for new products and diversity. The proximity and specialization of suppliers for specific products is an important criterion in the choice of its suppliers.

Required quality criteria

Agronomically it is important to have varieties resistant to diseases and climatic conditions to be able to ensure production volumes. These criteria are sought for all varieties, but some processors claim that these criteria are all the more important for black varieties and lentils. It is also essential to have a product free of impurities and to have a product that resists cooking. Finally, for the coral lentil, color fastness is a sought-after criterion.

The criteria required by the distributor do not vary according to variety or supplier. There is a charter in which there are quality and transparency criteria for fair remuneration. Suppliers must therefore adhere to this charter. In addition, the store is vigilant about the transport used to supply the goods, no transit by plane.

Other potential varieties

For the 3 producers surveyed, climatic conditions are one of the three main limits to lentil production today. The second constraint cited by two producers is the choice of plot. To plant lentil, it is necessary to have plots without pebbles. The only way to overcome this problem is through machinery or manual labour. The last constraints cited by some producers are the accessibility to seeds and the low valuation of lentils today.

Of the 3 producers only, one states that it is possible to make other varieties. Indeed, in his region there are other producers who grow the variety "Anicia" so there are other varieties that can be grown. Finally, among the 3 producers only one has recently introduced a new variety into its activity (the blond lentil). Another producer tested coral lentil but had a very poor harvest.

According to a processor there are now other properties that could be used for processing, including the “Crimson” variety which is produced in Canada. It is a variety especially for preserving coral lentil. The “Rainmoon” variety is an Italian variety that could also be used. One of the processors has integrated a variety of lenses into its business. The introduction of new varieties may be made following the request of a supplier or following advances in research.

How to introduce new varieties

Factors that could encourage growers to introduce new varieties are:

- For a producer, diversification is an objective of his operation, so he would be interested in introducing a new variety for diversification.
- Two other growers say they would be interested in introducing a new variety if it has better agronomic qualities. A variety less sensitive to lodging, a variety with a single flowering (two blooms lead to very dry first pods) and resistance to heat stroke (heat peaks during flowering, flowers are burned and pollination can not be done, so empty pods)
- Other factors that could encourage one of the producers to produce another variety are customer demand and market expectations.

Processors could introduce new varieties could follow the demand of suppliers or thanks to advances in research. It is important to make the link between the different actors in the sector; seed companies, producers. It is important to have expertise on varieties, so some processors will have an easier time introducing new varieties.

The introduction of new varieties, for the distributor, could be done following the request of suppliers. Today it is the market that will icniter or not the introduction of new varieties in the distribution. Organic distributors are however faced with surface problems, they are smaller

stores so there is less room to integrate new products. In addition, there are fewer organic suppliers who meet their strict quality criteria.

Limits on the introduction of new varieties

To date, it is complicated for a producer to introduce a variety on his own initiative. On the one hand, there is not enough lentil seed for growers to introduce new varieties on their own. And on the other hand, you must know the market well to be able to market and you have to be sure that customers are interested and working with the new variety. In another region, there is a land problem that prevents production on new areas (many grasslands have been classified as "sensitive grasslands"). No longer the right to change the destination of grassland, i.e., for these areas, the farmer must keep the area as permanent grassland, he can neither plough it nor convert it to arable land or permanent crop. So, it will be complicated to introduce a new variety in this context. Non-cooperative producers are those who can more easily introduce new varieties.

The limitations encountered by producers in introducing new varieties are insufficient demand, difficulty of access to seeds and additional costs for communication/advertising (2/3 producers).

For one processor the main limitation to the introduction of new varieties is that some varieties do not have the necessary characteristics for processing, that it is difficult to have access to raw materials (especially seeds), and that there are limits related to public policy and regulation. For the other processor the limits are:

- Higher production costs than with the main varieties
- Demand that is not sufficient
- There would be high advertising/communication costs
- Climate-related issues (drought, etc.)
- Factors linked to import prices

The main obstacles encountered by the distributor to introduce new products is compliance with the quality charter. In addition, it is necessary to communicate about a new product, so there are communication costs for the introduction of new varieties.

Probability of introduction of a new variety

The producer in short circuit has more predisposition to integrate new varieties into her farm despite the difficulties encountered. Other growers are more reluctant to integrate new varieties into their operations in the near future. The producer who is part of a PDO approach does not plan to integrate new varieties into his farm. Producers are looking to have varieties with more interesting agronomic and taste qualities, it is also necessary to communicate about the new varieties so that producers can integrate them into their activity.

Today, the processing actors surveyed are not ready to introduce new varieties into their activity. A variety that brings novelty should be offered and lentils should be encouraged to increase demand.

At the distribution level there are constantly new products that are introduced in the store. Despite the constraints, the probability that the distributor will introduce new varieties is high. There is a need to raise consumer awareness of new varieties in order to facilitate acceptance of the new product.

We can observe that growers and processors are less willing to introduce new varieties into their operations today. Specialized organic distribution notes a different opinion, with a desire

to constantly bring novelty in their activity the introduction of new varieties could be interesting.

Distribution and processing of many varieties

The expected effects of producing more varieties differ depending on the producers surveyed. One of the producers who produces under PDO specifications has a rather negative opinion on the production of a greater number of varieties, he mentioned that there is little advantage in producing more varieties. The other two producers have opposite views on the production of more varieties. The increase in the number of customers is the only effect on which both producers agree. This difference can be explained by the difference in the economic models chosen between the two producers, one of whom belongs to a cooperative and the other seeks to sell his entire production in a short circuit (direct sales, producers' shop). In addition, we can note that the organic producer sees environmental benefits and more resilience in terms of yields by producing several varieties. Producers claim that multiplying the number of varieties produced on the farm would lead to more work of separating products, more sorting to separate varieties. But a greater number of cultivated varieties does not lead to structural adjustments on the farm and would not have consequences on the productivity and efficiency of the technical route.

By processing more varieties, the two processors seek to increase farmers' incomes and foster stronger vertical relationships. However, both actors affirm that it is essential to work with more efficient varieties adapted to the territories. To a lesser extent, one of the processors seeks to increase the number of suppliers and increase processor revenues by working with a greater number of varieties.

Cost consequences when introducing more varieties

Packaging more varieties would have an impact on costs. In particular, processors claim that working with a greater number of varieties would lead to an increase in the work to select the raw material and suppliers. For one of the processors, it would also require more work to separate the products and would require new dedicated spaces. Finally, more work would be dedicated to activities and planning documents. The selection of new varieties is a long process and with important upstream work.

The introduction of more varieties at the distribution level would require new dedicated spaces (including storage), structural adjustment of stores and increase the work and costs of marketing and consumer information.

7.6. Summary

The French lentil value chain faces several general challenges. Firstly, there is a high fluctuation of yields depending on the weather conditions in a given year. This issue is of particular importance because it makes it difficult to motivate farmers to cultivate lentils. The difficulty of motivating farmers is exacerbated by the fierce price competition with lentils imported from abroad. Hence, to ensure a sufficient supply with domestic lentils and to reduce the reliance on lentil impots, the prices paid to producers must be attractive in comparison to other crops. Secondly, the consumption of lentils in the French population is fairly low. To respond to the challenge of a low lentil and legume consumption the actors of the value chain work on communication campaigns, that are mainly directed at younger target groups. Another way to stimulate the consumption is to support the development of new lentil products by start-ups which show a great interest in working with legumes. Thirdly, there are high investment costs

for cleaning and sorting facilities that contribute to a lack of these facilities if there are no public subsidies to support such investments.

Regarding biodiversity in the French lentil market there are both facilitators and challenges. On the one hand, there is more than a dozen of cultivars in different colors available in the French market. Some of these varieties have been introduced only recently which shows that it is possible to place new cultivars in the market despite the difficulty of finding actors that are willing to pay the costs for registering a new variety in the French catalogue. Some consumers are interested in having diversity of variety because of the variety of uses and prices it allows. Some do not share this opinion "lentils are still lentils" or "purple lentils would be strange" (Focus groups 2022). Importantly, both farmers and processors seem to be unsatisfied with the existing lentil varieties because they are vulnerable to beetles, bad weather conditions and grow indefinitely. The general dissatisfaction of farmers and processors with the current varieties might be an opportunity for diversifying the number of cultivars in the French value chain given that the performance of new cultivars is at least as good as the one of the old ones. In addition, there are organizations such as the national agronomic research (INRAE) or the seed manufacturer “Agri-Obtentions” are already making efforts to increase the diversity of varieties.

On the other hand, the classic varieties “Anicia”, “Flora”, and “Rosana” are still clearly dominant in France and in view of this dominance, it is difficult to position new varieties that are poorly known and whose yields lag the established cultivars. Moreover, the choice of cultivars is too often driven by their availability and non-green varieties are hardly cultivated. Diversifying the number and colors of lentil varieties used is necessary but impeded by the need to use multiple silos for keeping the different lentil varieties apart (Expert 1). Another factor that makes this project more difficult is that regional schemes restrict the farmer’s choice of cultivars by making the use of a specific variety mandatory.

Thanks to surveys we can maintain that there is a quite gradual within the lentil sector. Although there is an open dynamic in retail on diversity and on the French production scale (with the flagship varieties still representing most of the volumes), it seems to be rather reduced on the farm scale. Most growers grow one to two varieties. The most cultivated and best-selling variety is the green lentil "Anicia". It is a variety that is known by the consumer. It is important to highlight those yields and volumes play an important role in the construction of the price throughout the chain. For the actors surveyed, prices are defined jointly with the various links in the chain but are strictly linked to the volumes available.

Production costs, margins and variable costs are not data known by the actors surveyed. It is difficult at this stage to define at what level of the chain profit is created.

Today, all players (except distribution) are reluctant to introduce new varieties. The main criterion sought by producers in a new lentil variety is the agronomic qualities of the variety (yields, disease resistance, etc.). Seed availability is also a factor that limits the development and introduction of new varieties. The actors of the sector must work together to be able to introduce new varieties in a sustainable way (seed companies, producers, processors, distributors ...). All stakeholders agree that the new variety must meet market demand and that it must be affordable and affordable.

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8. Analysis of lentil value chain in Germany

8.1. Introduction and general information on market

The German per capita consumption of legumes, however, is quite low as it falls into the range of one to three kg per capita (BMEL 2022; Statista 2021). By comparison, the average was four kilograms per capita in Europe in 2010 and 1.4kg per year in France in 2014 (FNLS 2022, Poux 2018). Domestically produced lentils are mainly sold as dried lentils in bags either directly to the consumer, via local supermarkets, the Internet or via specialized organic stores or to the out-of-home sector (Expert 1; Expert 2; Figure 17). Popular processed end products are ready-to-eat lentils in cans and lentil stews or soups which often contain additional ingredients such as potatoes or sausages. Moreover, there are lentil crisps which are produced based on lentil flour and spreads including lentils and vegetables such as tomatoes and carrots as well as herbs. Further processed end products are gluten-free pasta, gluten-free waffles or bread and meat-free burger patties. While the dried lentils are often organic and come from the domestic production, the canned lentils and the other processed lentil products are often produced using lentils imported from abroad (Expert 1; Expert 2; Expert 4). Likewise, larger companies selling organic dried lentils, for instance "Alnatura" or "Rapunzel", usually draw on lentils that were imported because the German production is too small, too expensive and does not offer enough varieties for their needs (Expert 2).

Figure 17 - Examples of unprocessed lentil end products in Germany

Sources: Bringmeister.de 2022; Rapunzel 2022; Seeberger 2022

The fact that the domestic lentil production in Germany is small means that nearly all the lentils sold and consumed in Germany are imported from abroad. In 2020, Germany imported a total of 43,666 t of lentils with a value of 44,998,000 US$. This is the highest import value since 1961 and an increase of 52.3 % in comparison to 2010 (FAOSTAT 2022a). The main countries from which Germany imported lentils were Turkey (13,626 t / 15,934,000 US$), Canada (10,876 t / 9,855,000 US$) and the US (4,280 t / 2,629,000 US$) (FAOSTAT 2022b).

The production in Germany is not recorded systematically at the federal level. Nevertheless, the Federal Office for Agriculture and Food estimated that in 2021 2,000 ha of lentils were cultivated in Germany (BLE & BZL 2021). Given that the yield for lentils is on average 500-1,200 kg / ha one can estimate that the German lentil production volume lies between 1,000 and 2,400 t per year (Expert 1; Expert 2; Expert 4). Even though there are no data available on the

distribution of the production of lentils within Germany, it is known that there is lentil cultivation in Southern Germany, mainly in the federal states of Baden-Württemberg and Bavaria. Baden-Württemberg seems to be the most important federal state with a lentil acreage of 600 ha in 2021 which means that it accounted for roughly a third of the total German lentil acreage (Expert 1). The cultivated areas in Baden-Württemberg are concentrated on the Swabian Alb and the regions of "Heckengäu" and "Korngäu" (Blessing et al. 2020). A large part (400-450 ha) is cultivated by the organic producer organization "Alb-Leisa" (Fritschka 2022b). Bavaria appears to be the second largest federal state when it comes to the cultivation of lentils. Here, 200 ha are cultivated (Expert 5). In the federal state of Thuringia farmers cultivate lentils on an area of 50 ha (Expert 4).

In all three federal states most of the lentil acreage is cultivated organically. The reported share of organic lentils for Baden-Württemberg is 80-90 %, 87 % for Bavaria and nearly 100 % in Thuringia (Expert 2; Expert 4; Expert 5).

In the next sections, we will therefore focus on dry lentil value chain. In this context, we were able to interview 3 producers, 2 structures that do packaging (called "processors") and 2 retailers who market dry lentils. Their answers to the questionnaire are given in the "points of view of the actors" sections.

8.2. The value chain network

General overview

Getting access to seeds is often a problem for farmers willing to cultivate lentils especially if they are not a member of a producer organization (Expert 2). The only fully developed German lentil producer organization that also provides its members with seeds which it gains from the varieties it cultivates is "Alb-Leisa" (Expert 2). For the remainder of the farmers that are not a member of a producer organization there are at least three alternative ways to obtain seeds (Expert 2; Expert 3). They can firstly buy lentil seeds from abroad, for instance, the variety Anicia from France (Expert 2). Secondly, they can buy seeds from an organic German seed provider such as Naturland (Expert 2). A third option is to get seeds via processors that often have good relationships with seed providers abroad (Expert 4). In any case, the sources for obtaining seeds are manifold and for many farmers it is impossible from where they eventually get their seeds (Expert 2).

In the case of Alb-Leisa, the organic producer organization and their members are linked via yearly contracts that specify the acreage (in ha) as well as the lentil variety and the companion crop to be used (Expert 2; Fritschka 2022b). The producer organization records information about what was cultivated on a given field in previous years in order to ensure a sufficient break of at least six years between the cultivation of lentils (Fritschka 2022b). In addition, they plan which variety is going to be cultivated on which field (Expert 1).

Since the lentil farms in Germany are typically small it is usually too expensive for individual farms to buy the machines required for drying, cleaning, and sorting the lentils (Expert 4; Schmidt-Cotta et al. 2019). The drying, cleaning, and sorting, however, is an essential step especially as lentils are typically harvested together with their companion crop. The need for a thorough cleaning and sorting of the lentils from its companion crop can drive up the costs for the end product considerably (Expert 4). In view of the machinery required, the cleaning and sorting of lentils is often carried out by the producer organization or if none exists through an informal cooperation of farmers (Expert 1; Expert 4; Lauteracher Alb-Feld-Früchte 2022). The producer organization usually restricts the access to its facilities to members which means, for

instance, that conventional lentil farmers are unable to bring their harvested lentils to the organic cleaning and sorting facilities (Expert 1). In addition to the facilities ran by the producer organization, there are some independent actors such as mills that offer these services which is possible because the machinery used is not unique to lentils but can also be used for the cleaning and the separation of other crops (Expert 1; LfL 2022). Public institutions such as the Bavarian State Institute for Agriculture provide lentil farmers with contact addresses of those actors that offer cleaning and sorting services (LfL 2022). Nevertheless, the availability of cleaning and sorting facilities remains one of the greatest bottlenecks in the value chain (Expert 2). In fact, many farmers that market their lentils directly do neither have a table separator (needed to get rid of stones and contaminants of the companion crop) nor a color sorter (necessary to get rid of weeds that have a similar size and shape as some lentil varieties) (Expert 2). Instead, they draw on machines that were designed to clean and condition seeds which they often find in the surrounding area, for instance at mills or at seed conditioners (Expert 2). Even though doing so works, the resulting degree of purity and quality is not the same as can be achieved with more sophisticated cleaning machines (Expert 2). This is mainly a problem if farmers aim to sell their lentils dried in bags (Expert 4). In comparison, standards for lentils that are sold to the processing industry are slightly less strict as it often does not affect the quality of the processed end product negatively (Expert 4).

In addition to the drying, cleaning, and sorting the producer organizations can also aid their members with packaging and marketing the lentils but here the lentil farmers have greater latitude so that depending on their capacities they can choose to either package and sell the lentils themselves, for instance using an own brand, or they opt for leaving the packaging and marketing up to their producer organization (Fritschka 2022a). In the case of a producer organization like “Alb-Leisa” a specialized entity of the organization buys the lentils from the farmers and subsequently markets them under a common brand (Expert 2). The number of producer organizations packaging and marketing lentils is greater and includes for instance the company “Unser Land” in Bavaria (Expert 5). Those farmers that cultivate lentils outside of a producer organization are not tied to yearly contracts and are more flexible in marketing their lentils (Expert 2).

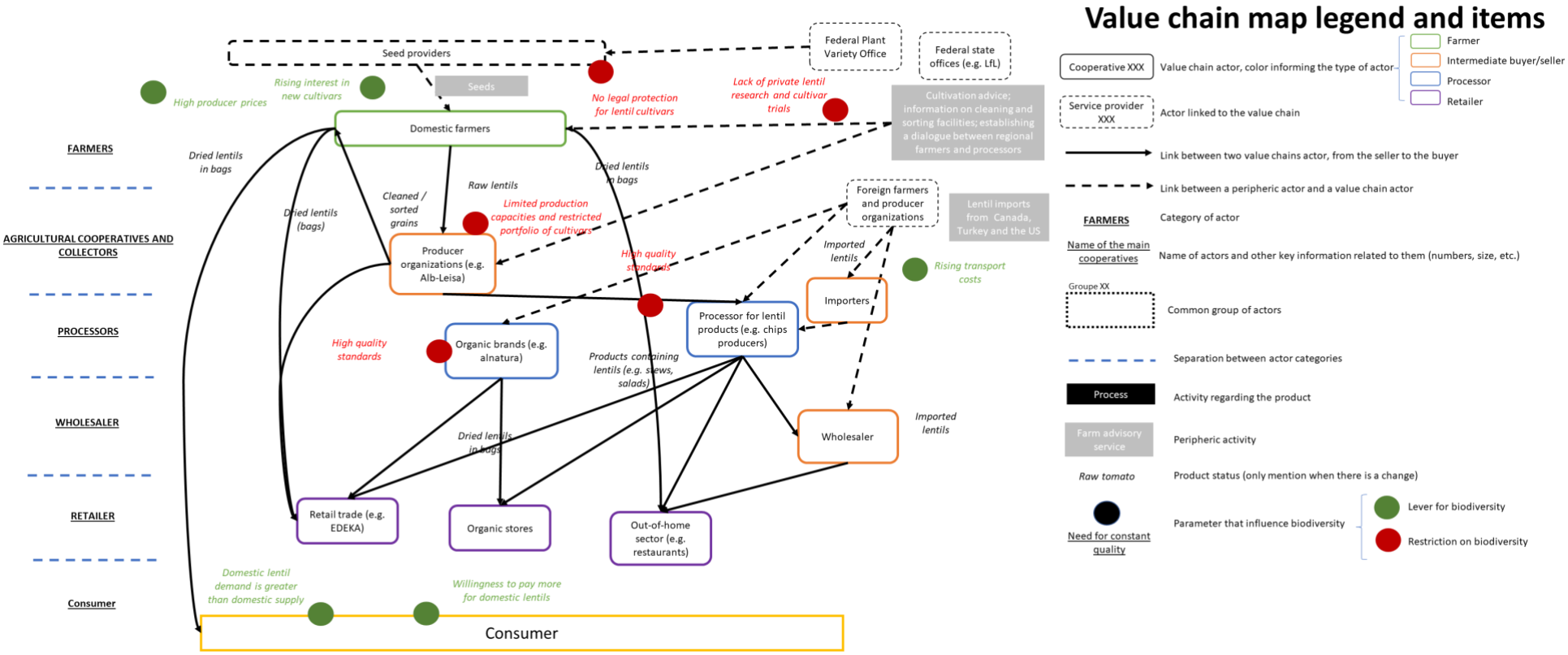
Regardless of whether they are a member of a producer organization most lentil farmers aim to sell their lentils directly to the consumer or to the out-of-home sector, for instance to local restaurants, because it is usually more profitable to do so (Expert 2; Expert 4; Expert 5). Occasionally, their lentils can also be found in the retail trade and in specialized organic supermarkets where they are sold on shelves for regional products (Expert 2). The main share of the conventional and organic lentils sold in the retail trade and even in organic stores, however, are lentils imported from abroad (Expert 1; Expert 2; Expert 4). This is true for both dried lentils sold in bags by organic brands such as “Davert” or “Alnatura” as well as for processed products such as lentil chips or lentil pasta (Expert 2). Lentils are imported either directly or via specialized import companies (Expert 4). One major reason for the widespread use of imported lentils by organic brands and the processing industry is that the output of the domestic production is simply not large enough to cover their demand and that the quality of the domestic lentils is often inferior (Expert 2; Expert 4). Moreover, processors prefer to collaborate with a dense network of producers in the form of producer organizations which are too often absent (Expert 4).

There are two major challenges plaguing the lentil value chain in Germany. The first one arises from the cultivation of lentils with a companion crop and consists in the cumbersome cleaning and sorting process of lentils post-harvest. Doing so is, however, inevitable because heavy rainfalls in summer time require farmers to cultivate lentils together with companion crops such as barley (Detsch 2021; Universität Hohenheim 2022). The purity requirements for selling

dry lentil grains to consumers are extremely high. Dried lentils sold in bags must contain 99.9-99.99 % of lentils which means that there may be only 1-2 contaminating seeds in every 5 kg (Detsch 2021). To achieve such a high level of purity, specialized machines that are often expensive and therefore scarce are needed (Universität Hohenheim 2022). The scarcity of these facilities is a problem in many regions and a factor limiting the expansion of lentil cultivation in Germany (Expert 1; Expert 4). Moreover, the cumbersome cleaning and separation process makes it necessary to continue looking out for companion crops that are easy to separate from lentils (Expert 4).

A second challenge for lentil farmers is fluctuating yields that are largely dependent on weather conditions (Gruber et al. 2018). Even though in the absence of extreme weather events lentils are a crop with a good yield that is highly profitable, bad weather conditions can lead to poor harvests and an insecure income for farmers which makes it less appealing for them to start cultivating lentils (Expert 4). The problem of fluctuating yields and the ensuing insecurity could be overcome by developing new lentil cultivars with a higher tolerance to adverse weather events and a more stable yield (Reif et al. 2020). Another way to mitigate this problem is finding a companion crop that can serve as a stabilizing additional source of income in case of poor harvests (Expert 4).

Figure 18 - Overview of the lentil value chain in Germany



Pont of view of the actors

Farmers

3 farmers were interviewed, the three of them produce organically, via Bioland label. The first one produces 1 ton of lentils per year (Le Puy variety), sold clean and ready to be cooked/eaten. He produces all his seeds at the farm. He sells 75% of his production directly to consumer at his own farm shop and the rest to 1 restaurant and 1 catering service and school kitchens on base of contractual relation and regular relations. He also produces grains, legumes, potatoes on a 75ha farm occupying 3 persons full time, 1 person 10 hours a week and 1 apprentice.

Farmer B is producing 400kg of lentils, sold ready to be eaten or cooked in small packages (in his own farm shop via farm boxes – 90% of the volumes) or without any packaging in a packaging free shop (10% - regular relations). He uses Bureau variety. He produces his own seeds and get some from regional manager of Bioland who buys them in France. The farm is 10ha with also grains and occupy 1,6 work forces.

Farmer C is producing 2 tons of marbled lentil (French variety), sold pre-dried. The cooperative is the only supplier of seeds and clients, via regular relations. They also produce different grains and legumes on 17ha.

Processors

Processor B is buying all its 350t of lentils from 140 farmers via contractual relations. They are delivered with the supporting crop. At the end they sell 80% as ready to eat/cook lentils, small share as seeds for cultivation and marginally flour. The other company is buying around 400t of lentils annually, at 40% from 5 wholesalers, 40% from import of their own and 20% from 2 cooperatives through regular transactions. They sell 380t of dried lentils and griding is in development, only in small dimensions.

The processor B is using Beluga lentils, Späths Alb-Leisa (small and large) and processor A Green lentils, Mountain lentils, Beluga lentils, Brown lentils. They both have different clients. Processor A is selling to 5 wholesalers, via spot transaction, traditional retailers (including specialized in natural food) via contractualization and consumers. Processor B is selling to different kind of clients:

- Traditional retailers for Beluga and Anicia lentils with regular relation
- To 100 non packaging shops, also online and farm shops for all varieties
- To commercial and gastronomy restaurant
- To catering (150 canteens)

Retailers

Processor A is buying 3 tons of lentils per year. Variety bought are Linsen Rot, Dupuy, Alt-Jura, Berg Linsen, Grüne Linsen, Beluga Linsen. They buy 95% of the lentils to around 25 processors as regular relations and 5% to a farmer (for Alt-Jura variety).

For the retailer B, which is selling 60kg of lentils per year, all the 8 varieties (Jura-Alb Lentils, DAVERT - Yellow Lentils, Green Delicate Lentils, Red Lentils, Green Organics are coming from 7 traders. They are bought in their online stores and then delivered by truck.

8.3. Profitability, drivers and main variables for variety/species choice

General view

Lentils grow best on a marly or sandy, calcareous and loose clay soil (Brauer 2017). They prefer a warm and dry climate but can also deal with colder temperatures and frosts in their early growing phase (Blessing et al. 2020). To avoid crop rotation diseases lentils should only be cultivated every six years or less frequently (Fritschka 2022b). Lentils are seeded in the same way as cereals and their seeding takes place between the beginning of March and the end of April (Blessing et al. 2020). Lentils have an indeterminate growth and can be harvested when their lowest shells start to become brown which is the case after 100 and 140 days (Blessing et al. 2020; Weiler 2020). Harvest takes place between the end of July and the beginning of September and is carried out using combines (Güll 2014). Rainfalls during the flowering phase and at harvest are critical and in humid years, yields are lower and problems with diseases and product quality appear more often (Expert 2). For these reasons, lentil yields are subject to considerable fluctuations depending on the weather conditions and the companion crop used (Blessing et al. 2020; Brauer 2017; Heyl 2022).

In Germany, lentils are usually cultivated together with a companion crop usually oats or barley (Brauer 2017). This practice of mixed cultivation is widespread for two main reasons. Firstly, the lentil plant itself has a low stability and therefore benefits from companion crops that can serve as a climbing aid (Brauer 2017). This is helpful, for instance, in case of heavy summer rainfalls and reduces the economic risk of a total harvest failure (Blessing et al. 2020; Universität Hohenheim 2022; Weiler 2020). Secondly, the lentil plant has a low resistance against weeds which is a real threat to high yields (Blessing et al. 2020). Using a companion crop mitigates this problem because it helps the lentil plants to better deal with weeds (Universität Hohenheim 2022; Weiler 2020). Despite these advantages of using companion crops there is also the disadvantage that cultivating lentils together with a companion crop requires specialized, expensive machines and considerable technical effort because the lentils have to be separated from the produce of the companion crop (Detsch 2021; Güll 2014; Universität Hohenheim 2022).

The purity requirements for selling dry lentil grains to consumers are extremely high. Dried lentils sold in bags must contain 99.9 to 99.99 % of lentils which means that there may be only 1-2 contaminating seeds in every 5 kg (Detsch 2021). In view of these considerations, in case of a bad harvest, it can be more economical for farmers to refrain from a thorough cleaning process and sell their entire produce as animal feed instead (Detsch 2021; Expert 3).

Shortly after harvest the lentils and their companion crop are dried at a maximum temperature of 40 °C and are sieved and cleaned for a first time in order to get rid of sand, stones and weedseeds (Fritschka 2022b). Next, the lentils and their companion crop (typically oats, wheat or false flax) are passed through a trieur which separates them by detecting differences in shape (Fritschka 2022b). Subsequently, the companion crop can be either used as animal feed, to produce brewery products or to press oil (Fritschka 2022b). The lentils themselves which still contain some impurities are passed through a weight selector that gets rid of smaller stones, remaining pieces of the companion crop and broken grains (Fritschka 2022b). The broken lentil grains are usually used to produce lentil flour or as animal feed (Expert 1; Fritschka 2022b). In a final step, the remaining lentil grains go through a color sorter which gets rid of unwanted contents and lentils whose color is not desirable (Fritschka 2022b). In some cases, the lentils are double-checked manually after the cleaning and sorting process (Expert 1). Finally, only those lentils that made it through the thorough cleaning process can be packed and transported either to a storage facility where they can stay for several years or to the point of sale (IndustrieverbandAgrar 2021).

According to the German Federal Plant Variety Office, however, there are officially no lentil cultivars protected in Germany (Expert 1; Expert 2). In fact, however, there are currently about five relevant lentil varieties used in the market (Table 4) Generally speaking, one can distinguish between small

(e.g. Anicia) and large grain varieties (e.g. Späths Alblinse I). (Blessing et al. 2020). On average, the yield of small grain varieties is larger than that of large grain varieties (Blessing et al. 2020).

The three most important varieties in Germany are the green cultivar "Anicia", the black variety "Beluga" and the "Tellerlinse" (Expert 1; Expert 4; Expert 5). On the Swabian Alb, two additional regional cultivars exist, the "Späths Alblinse I" and "Späths Alblinse II". They are cultivated by the "Alb-Leisa" producer organization which successfully rediscovered and reintroduced these varieties between 2007 and 2011 (Genbänkle 2022). Other regional varieties such as the "Kyffhäuser" or the "Dornberger" lentil from Thuringia exist but are of marginal importance to date (Expert 4).

The choice of cultivars is driven almost exclusively by their availability and farmers willing to cultivate lentils take almost any seeds they can get and that work relatively well (Expert 1; Expert 2; Expert 4). Thus, even though the actors are aware that the currently existing varieties are not ideal for the regional conditions, they opt for them anyway because there are no alternative varieties at hand (Expert 1; Expert 2). In addition to the availability, farmers take into consideration what their consumers ask for and they have to ensure that there are appropriate facilities in the surroundings where they can clean and sort the lentils (Expert 2). Other criteria important for lentil cultivars involve a high stability, a good quality and seed health, firm leaves, a homogenous growth, a rich taste, and a high protein content (Blessing et al: 2020; Expert 3; Expert 5; Universität Hohenheim 2022; Weiler 2020). While the choice of a cultivar is quite free for individual farmers the producer organization "Alb-Leisa" restricts the choice of its members to three varieties, namely Anicia, Späths Alblinse I, and Späths Alblinse II (Expert 3).

The number of cultivars has stagnated for the last years (Expert 1; Expert 2; Expert 4). Reasons for this trend are that currently no private companies are working on breeding lentil varieties because it is economically unattractive to do so (Universität Hohenheim 2022; Weiler 2020). The only actor working on breeding lentil varieties in Germany is the Keyserlingk Institute at Lake Constance (Expert 1). In addition, the fact that the German Federal Plant Variety Office does not list any lentil cultivars leads to a lack of protection of cultivars which is a further disincentive to breed new lentil varieties (Expert 1; Expert 2). Furthermore, the cleaning process restricts the number of varieties cultivated because the grains of different lentil varieties differ in size and shape which makes it necessary to adapt the settings of the cleaning and sorting machines for every cultivar used (Expert 2). Given the limited capacities the number of cultivars that are used is severely restricted and due to that, actors have little interest in adding new cultivars to their portfolio (Expert 2).

Consumer seems to have some knowledge of the different varieties: brown lentils, red lentils, yellow lentils, orange lentils, green lentils, black lentils, mountain lentils, plate lentils and Beluga lentils (focus groups.2022). Main criteria for the lentil's choice are the taste, the cooking time, if the consumer should soak it or not, the price product, the variety, the quantity/the package size (consumers prefer smaller quantities), the shelf life of the product, the nutrients of the product (for example if it contains iron or protein) and the origin (Focus groups 2022). According to consumer, each variety has his own way to be prepared, for example: the red lentils for stews and soups (e.g., Turkish lentil soup), black for salads, brown lentils with spätzle, with fried egg, stew and debreziner.

Point of view of the actors

Farmers

Farmer A is using Le Puy variety, randomly elected because of its availability and location suitability. They harvested 1600 kg in 2021 and sold 985kg of cleaned, processed into saleable lentils. Farmer B is using Bureau variety, he uses it because of experiments with several own samples and election of the one which fits the farm best; other reason is customer preference. Farmer C is using marbled lentil (French variety) because he experienced it in its cultivation and is demanded in the region.

In terms of the constraints encountered in relation to climate change, the main one seems to be decreased water availability. Farmer A states that there is a lack of proportional distribution of water during the year. Farmer B has several solutions: advancing the sowing date to take advantage of spring moisture, changing the ridge cultivation method, or changing the seed type/variations. Drought and increase in extreme heat days are also named as main hindrances with to a lesser extent increase extreme weather event. Increased precipitation is said for farmer B and increase temperature.

Processor

Both processors are using different kind of varieties. Processor B is using green Beluga lentils, Späths Alb-Leisa small, Späths Alb-Leisa large, whereas processor A is using green lentils, Mountain lentils, Beluga lentils, Brown lentils.

For processor A Mountains lentils represent 40% of the volumes sold, brown lentils 30 %mainly coming from Turkey, and in a lesser way EU, and beluga lentils for 20% coming from EU. They all are used because of the customer request. For processor B, green lentils represent 50% of the volumes, coming from Swabian Alb. They use it because of the taste and they easy to cultivate.

Retailer

Retailer A sell Linsen Rot, Dupuy, Alt-Jura, Berg Linsen, Grüne Linsen, Beluga Linsen. 20% of the sales are Alt-Jura, coming from the region .15% is Spread lentil and 10% Braune Linsen both coming from Turkey. Producer brands account for 60% of their sales, while first price 20% and the others 20.

Retailer B : Jura-Alb Lentils, DAVERT (Yellow Lentils, Green Delicate Lentils, Red Lentils), Green Organics (Red Lentils, Green Lentils). The main varieties are:

- Green lentils (organics) from outside the EU interesting for its price,
- Red lentil DAVERT from Turkey for its quality
- Alb rua from Bavaria selected for its quality and origin.

The DAVERT brands represent 59% of its sales and green organic 40%, the regional brands are rather anecdotal.

Conclusion

We can see 2 logics at farmer level- independent with own distribution channels and one in cooperative system which is supplier and seller. We can see that the further down the value chain we go, the more diversity there is, especially in the processor, which has few varieties from cooperatives and another with imports from more suppliers, especially abroad. Finally, retailers have a wide range of varieties with many suppliers.

8.4. Price formation and market power

General view

The price to be paid for the lentils is fixed between the producer organization and its members in advance but it is adaptable post-harvest (Expert 2). Post-harvest, three factors are considered when adapting prices (Expert 2). Firstly, the quality of the lentils, that is their color, size and the share of broken gains. Secondly, the final costs of production which mainly depend on how many steps of cleaning and separating the lentils must undergo. Thirdly, the absolute volume of lentils harvested that season, i.e., the total supply of domestic lentils in the market.

The cleaning and sorting of lentils costs between 0,30-1,00 € / kg depending on the steps required (Detsch 2021). The price for cleaned and saleable lentils delivered by members to producer

organizations is between 2.30-4 € per kg (Detsch 2021; Schmidt-Cotta et al. 2019). The price for uncleaned lentils is slightly lower, that is about 1.95 € / kg (Bauernzeitung 2021). Factors influencing the price paid by producer organizations are the delivery time, the quality of the grains and their purity (Expert 3). Farmers who sell their lentils directly to consumers receive on average 8-9 € per kg (Detsch 2021; Schmidt-Cotta et al. 2019). For instance, a 500g bag of organic dried lentils from Germany is usually sold for 4.50-4.90 € to the consumer (Bauernzeitung 2021; Expert 2). The imported dried lentils that are sold by organic brands such as Alnatura are sold for 1.79-2.69 € per 500g depending on the color and are therefore only half as expensive than the domestic lentils (Alnatura 2022a, b).

In addition, the prices for conventional and organic lentils from Germany are higher than those of their imported counterparts which acts as a disincentive for the processing industry (Expert 2; Expert 4). Despite the higher price for domestic lentils and their lower quality in comparison to imported lentils, some regional processors have also entered contracts with local farmers and buy the lentils they produce although they have a lower quality than imported lentils (Expert 4). This cooperation is promoted by federal state offices that moderate a dialogue between lentil producers and processors (Expert 4). Lentil processors deliberately use attractive prices as an incentive to motivate farmers to start cultivating lentils (Expert 4).

Point of view of actors

Farmers

For farmer A, the price with its clients is fixed by the farmer considering his profit margin objective and on the base of retailer market. Price of the seed is a theoretic price as they produce them themselves (4€/kg). The lentils are sold around 4€/kg (not moving from 2021 to 2022). The labor cost represents around 10% of the revenue, variable costs 35% in 2021, slightly higher in 2022, due to higher energy costs and the harvest was less than 2021.

Farmer B has the same costs for seeds, but its yields are lower (0,4t/ha) and prices are far higher (7,5€/kg in 2021 and even 10€/kg in farm shop and 8,40€/kg for the small retailer in 2022 due to higher energy costs). They do not know their labor costs because, mother-in-law do it for no payment.

Farmer C has also 1t/ha of yields but sell the lentils 2€/kg.

They all use organic label, Bioland which increase the price according to farmer A. According to B it has a high reputation and helps in the marketing. They also are in PDO/PGI labels which hasn't effect on price according to farmer A and B. This last one is using Ökoregion label and farmer C is using Swabian alb sort "Alb-Leisa – schwäbische Alb". If a new variety would be introduced for the activity, they would use the same way as it is done with the actual Le Puy lentils according to farmer A (the other didn't answered).

Processors

For processor B, they have contractualization for all the farmer with whom they work, fixed by the processor considering his profit margin and covering the costs, whereas processor A use spot market for all varieties and provider. The prices are decided in this way. Processor B buy lentils around 2,40€/kg (2,24 in 2021) and sell it around 12€/kg at the farm shop. For processor A, mountain lentils would be the most expensive (bought 2,6€/kg) again 2,4€/kg for brown variety et 2,5€/kg beluga, whereas beluga is sold at the highest price (4,8€/kg) again 3.95€ for mountain lentils and 3.7€ for brown ones. The prices seem have not changed. They both use organic label, the processor A precise that it makes the prices 50% higher.

In terms of pricing for a new variety, both would use existing and market research to compare. This would then go through an exchange, a negotiation with the producer and an agreement. The price of

the product sold would be again, through market research but then considering the higher costs for the introduction of new sorts.

Retailers

Retailer A sets its purchase prices for farmer or processor in agreement with both parties, fixed together. The fact that it is regional makes the price more interesting. For retailer B it is the providers who set their prices. Retailer A was not able to give us any information about the selling prices (purchase price 2.3€ for producer brand and 1.88€ for first price). However, retailer B paid the lowest price for green lentils (3.76 then 5.52€/kg), followed by red lentils (3.8 then 7.18€/kg) and Jura-Alb lentils (5.8 then 9.2€/kg). We note that despite a similar price paid between green and red there is a higher margin. Both sell organic lentils, at least in part, as well as PDO/PGI labels. For a new variety, retailer A specifies that he will match the wholesale price, and retailer B specifies that he will negotiate in the same way with the suppliers.

Conclusion

The farmers thus have a rather similar logic with a common production price, although quite distinct according to the agricultural models with prices ranging from 2€/kg for the cooperative farm, 4€/kg for the short circuit but high yielding farm and more than 8€/kg for the short circuit low yielding farm. The processors and retailers have their own logic, the processor sets the price with a different logic depending on the variety. They have different buying and selling prices and therefore a different value. The notable case is that beluga is bought cheaper than moutain but sold for more.

8.5. Feasibility, constraints and consequences of introducing more varieties/species/products

General view

Regarding the biodiversity in the German lentil value chain there are both facilitators and challenges. On the one hand, there is a lack of cultivars that are well-adapted to the German particularities that leads to suboptimal yields (Expert 1; Universität Hohenheim 2022). The lack of optimally performing cultivars has several reasons. Firstly, unlike for other plants there are very few cultivar trials carried out by federal state offices which leaves farmers and the other actors of the value chain largely alone in finding out which cultivars work in their own region (Expert 1; Expert 4; Expert 5). Secondly, there is a lack of actors willing to reproduce and introduce new cultivars which is a costly, lengthy, and risky process that takes at least 2 to 3 years (Expert 2; Expert 3). For instance, although a research project led by the University of Hohenheim identified several promising lentil varieties from a gene database, the project partners subsequently struggled to find actors willing to reproduce them (Expert 2). In fact, there are currently no private companies conducting research on lentil varieties because given the small size of the German market it is economically unattractive for them to do so (Expert 2). Secondly, this problem is reinforced by a lack of protection through the German Federal Plant Variety Office which officially does not list any lentil cultivars and thus disincentivizes the development of new lentil cultivars by seed companies even further (Expert 1; Expert 2; Universität Hohenheim 2022). This situation is particularly problematic for the value chain because it not only reduces incentives to breed new lentil varieties but it also enables the practice of farmers using a part of their harvest as seeds for the following year (Expert 1). Doing so, in turn, undermines the quality of the seeds used and is testimony of how difficult it is for many farmers to access high-quality seeds (Bauernzeitung 2021; Detsch 2021; Expert 2; Expert 5).

On the other hand, there are also facilitators for more biodiversity in the German lentil value chain. Since the domestic demand is much greater than the domestic supply, there is a general incentive for

farmers to start cultivating lentils (Weiler 2020). In fact, the interest for cultivating lentils and for new varieties is rising among both farmers and seed producers (Expert 1; Expert 4). A further facilitator might be that consumers are willing to pay more for regionally produced lentils and using local varieties might help to increase this willingness even further (Bauernzeitung 2021; Expert 4). Expanding the lentil production surfaces and quantities in Germany may help to increase the number of lentil varieties used because cultivating many cultivars on the small scale given to date is economically unattractive (Expert 2). Moreover, an expansion of the production is necessary if one wants to diversify the distribution channels for German lentils, for instance by supplying the processing industry and natural food wholesalers with lentils cultivated in Germany (Expert 4). Both of these actors are generally interested in sourcing more lentils from Germany but are unable to do so because they need large quantities at a consistently high quality and at a competitive price as well as a portfolio of different lentils varieties which to date cannot be provided by the domestic production alone (Expert 2; Expert 4). In view of the currently rising transport costs for imported lentils the processors and wholesalers interest in sourcing from Germany might grow even further which could prove to be an opportunity for the growth of the domestic lentil production in Germany (Expert 4).

Point of view of the actors

Standard required and choice of supplier

All farmer mentioned different standard required by their client. Farmer A mentioned the varietal purity and cleanliness of the lentils. Farmer B mentioned the processability (easier to cook) and its regionality because of the demand from consumers. Finally, farmer C specified that there is not standard required by its cooperative, only that there is a bonus for a higher degree of dryness.

Both processors choose their suppliers mainly because they are specialised in supplying lentils. Processor B adds that it is essential that they are close to the cooperative, in the Swabian Alb, that they have the right technical equipment with the capacity to produce and transport enough lentils and that they are certified organic. In terms of the quality criteria they require, processor A focuses mainly on residue free, size and uniformly matured. Processor B focuses on varietal purity because they are standardised products, weight because they pay by volume and moisture level for durability and processing difficulty. The standards used by their customers are similar. They both mention having a uniform visual, especially in terms of colour, and being clean, residue free. Processor B mentions the fact that it is ready to be cooked and packaged. Processor A and B think that the most important aspects from the consumer's point of view are notion of healthier product, national or geographical specialty, easiness to prepare and shelf life. Price and novelty seem to be important for B in contrast to A. Packaging is important for B but not for A.

Both retailers agree on the drivers for choosing their supplier, they attach importance to variety and species range as well as specialisation on the specific product and proximity. Retailer A attaches great importance to price and B to operating as a direct supplier. Retailer A was not able to answer too much about the expected quality criteria, specifying that it depends on the varieties. Retailer B said that it was important that the packaging was 500g and that it came from regional farmers for the DAVERT brand. He thinks it is important to have two different price categories between DAVERT and organic green lentils. For them, consumers pay attention to all the points requested (price, packaging, nutritional information, novelty, healthier product, national production, geographical speciality, ease of preparation, shelf life, brand).

Introduction of new variety in the value chain

Farmers B and C did not think that new varieties would be feasible in their area. Farmer A mentioned red lentils. Not all of them have introduced new varieties into their business recently. They had

different answers about how varieties are introduced into their business. According to farmer B it is only at the initiative of seed producers. According to C it is at the request of his client (cooperative) or at their initiative, out of curiosity because it could fit to the farm or the crop rotation. Finally, farmer A mentioned many ways (request from client or suggestion from seed processors or at the initiative of farmers by coping other producers or following research development (for example if new information about suitability of a variety in the local area appears). None of them mentioned the effect of policy decisions as a driver. For farmer A and B producers can introduce varieties on their own initiative, especially direct selling farmers for A because they do not have contracts or partners, for B they are Either very big farmers who can take on some risk because of their financial capacities or the smallest ones as the do it only as a hobby and do not base their income on it. C did not answer. Producers A and B are rather pessimistic that they will introduce a variety in the coming years (score of 3 on a scale of 1 to 10). They agree that the awareness of the consumer would overcome the obstacles to the introduction of varieties. Farmer B added that the access to seeds and to information about the seeds should be simplified. Farmer A added that there should be public incentives, processor, and retailer support. If these actions are put in place there is a small chance that they will introduce some - score 6 out of 10.

Processor both think that new varieties can be introduced. For processor B, for example, beluga was introduced a short time ago. Both agree that it is at the request of the customers that new varieties are introduced in your activity. Processor A adds that it can be on their initiative after studies of consumer behaviour or by copying other operators. They have different opinions on the ability of processors to launch new varieties. For processor A it is rather difficult because the trade/market structure is too tight and there is no necessity for innovations. However, they think that brand manufacturers with strong own brand can do it more easily. On the contrary, processor B thinks that it is possible for them because of their proximity to producers and retailers, and that small processors, as they can act more spontaneously, innovative staff, especially with organic farms. They are both pessimistic that they will introduce new varieties in the coming years with scores of 1 and 3 out of 10. Processor B says that they have already introduced one variety and are therefore already establishing it. For them the ways of overcoming the obstacles are downstream by raising the awareness of the consumer and the support of retailer. Processor B says that the collaboration with farmers is essential and that eventually the public incentive can play a role. Processor A names scientific research on health effects. With these conditions Processor A is rather optimistic about introducing a new variety of lens (7/10), while Processor B's opinion does not change for the reasons mentioned above.

Retailers agree that there are no other varieties not currently sold that are potentially interesting for the consumer to be used for the targeted product. Retailer A has recently introduced new varieties of lenses (unspecified), while retailer B has not. They state that new products are introduced at the request of providers or by copying other retailers. For retailer B this may also be driven by policy decisions. While retailer A thinks that retailers cannot really introduce new varieties, retailer B thinks that they can because it adds value for them, and that organic retailers can do it more easily. B is very confident about introducing new varieties in the future while A is rather neutral (5) and they agree that the potential ways of overcoming obstacles would be awareness of the consumer, farmer and processor collaboration. Retailer A adds that public incentives as well. Benefiting from these levers would make A more confident (score of 7 out of 10).

Limitations to introduce new varieties

Farmer C did not answer the following questions. Problems encountered by farmer in lentil value chain vary according to the producers. The main one according to A is an insufficient demand, follow

by insufficient labour capacity, Lack of infrastructure to handle various steps along the value chain, high competition at the market. For B it is essentially access to seeds followed by climatic conditions then insufficient land and Lack of infrastructure to handle various steps along the value chain. There is little agreement between the two farmers on the limits to the introduction of new varieties. They do not see the need for new techniques and standards as a limit, nor do they see the fact that it would generate higher advertising costs or that there is a limit related to public policies and regulation. Finally farmer B believes that other varieties will lack the characteristics required by the process, and that they would increase variable costs or production costs, and that there is a difficulty in accessing seed unlike A. The latter identifies an insufficient demand and balance between efforts and costs and the outcome gained.

Both processors fully agree that there is insufficient demand for more lens varieties. They also fully disagree that there is a limit to public policies and regulation. They disagree on the other points. Processor B fully agrees that new techniques and standards are required whereas processor A thinks the opposite; Processor A does not agree at all that there will be a problem with technical specifications or that it will impact variable or fixed costs, processor B is rather neutral on these points. Processor A fully agrees that it will require advertising costs (B neutral). Processor B strongly disagrees that it will be difficult to access these new varieties, especially because of the limited regional and organic offer.

Retailers agree that there is insufficient demand for new lentil varieties but that public policies and regulation are not a limit. However, for retailer A it is difficult to get access to new products (B neutral) and this would lead to high advertising costs (B disagree).

Effects of introduction of new varieties

Both farmers agreed that the introduction of new varieties could have a beneficial effect on the environment and improve the reputation of their enterprise on the long term. They are both neutral on the fact that it improves the access to retail market. If farmer B thinks it foster the creation of stronger vertical relation and improve access to processing market, farmer A is neutral on this. Farmer A thinks it improves the economy of farmers, while B does not agree at all. Similarly, B thinks it increases the revenue of clients, while A does not. Farmer A does not think it increases the number of clients; B is rather neutral.

Processors agreed that the introduction of new lentils varieties would have a beneficial effect on their revenue and are both neutral on the fact that it would increase the quantity of raw material purchased. They differed on other points: processor B thinks it would improve the number of providers, customers (including access to the retail market), create stronger vertical relationships and improve vertical relationships whereas A strongly disagrees with these points (except number of customers - neutral). If processor B strongly disagrees that it would improve the economy of farmers, A is rather neutral.

Retailers agreed that it would improve revenue of processors and increase the quantity of products purchased. They also agree that it would increase the number of consumers and strengthen the creation of stronger vertical relationships. While retailer B thinks it will improve the economy of farmers and the reputation of their business in the long period, retailer A is rather neutral. He also thinks it will increase the number of providers while B does not agree.

Impact on the activity of introduction of new varieties

In terms of commitments and costs, farmers agree that it increases planning activities and documents but that it does not require training for workers or increase variable costs. While farmer A thinks that it increases complexity in the management of plots and work to find clients and markets, B does

not agree at all. Similarly, A thinks it would require new space, especially for storage and worsen productivity and efficiency, B is rather neutral. It would not require structural adjustment for A.

There is rather a consensus on the effect of an increase in the number of varieties on the processors. They agree that it would increase the work for raw material selection and product separation. It would also worsen productivity and efficiency of the process and thus increase the need for planning and variable costs. They agreed that it would not increase the work of selecting suppliers or finding customers and markets. On the contrary, processor B thinks that it would require new lines and adjustment of the plants which processor A does not think at all. Processor A also thinks that this would require new dedicated spaces (including storage) (A neutral). Processor A thinks that this would not require increased training for worker.

Retailers only agreed that it would require new dedicated lines in the stores but that it would not require structural adjustment of the stores. They disagreed on the other suggestions, as B thinks it would increase management work, damage productivity and efficiency, increase variable costs, selection work and providers and marketing work for consumer information and worker training and planning, whereas A disagrees with all of these points. On the other hand, he thinks that it would require new space, especially for storage, whereas A does not.

8.6. Summary

We see that the value chain is organized in several ways. Firstly, a large majority of imports from foreign countries, with wholesalers and companies that carry this out, and a rather large diversity of varieties. On the other hand, local production, which is in the minority and largely organic, is based on farmers in short circuits and local cooperatives, with perhaps a little less diversity because of the need to have varieties adapted to the terrain, and little research and innovation (varieties coming from France in particular). The choices are thus made by the intermediaries in the structured channels or farmers in short circuits. It is nevertheless a dynamic market with a significant place for national production and a possible interest from consumers for new varieties.

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9. Analysis of buckwheat value chain in Germany

9.1. Introduction and general information on market

The most important unprocessed buckwheat end product is dried buckwheat grains (Figure 18). These are offered by different organic brands like "Davert" but also by some private labels. Besides the dried buckwheat grains a series of processed products exists (Figure 19). There are low-processed products such as buckwheat flour, flakes, groats, and puffed buckwheat as well as more processed foods like buckwheat milk, bread, and pasta.

Since buckwheat does naturally not contain gluten, it is interesting for consumers with a gluten intolerance and for those people that prefer to purchase gluten-free products for health or lifestyle reasons. In Germany, the number of people indicating that they have bought gluten-free food products in the last 14 days increased from 1.74 million in 2017 to 2.03 million in 2021 (Statista 2022a). In addition, in 2021, 8 % of respondents to an online survey said that they had tried or followed a gluten-free diet during the last year (Statista 2022b). These numbers show that the group that purchases gluten-free products extends far beyond those consumers that are affected by coeliac disease and a gluten intolerance. In fact, the trend of consuming gluten-free products as a lifestyle product is one of the reasons why the turnover made with gluten-free bakery products increased from 97 million € in 2017 to 108 million € in 2019 which corresponds to a rise of 11 % (Focus.de 2020). Likewise, the sales of confectionary rose by 88 % that is from 43.6 million € to 82 million € in the same time period (Focus.de 2020)

Buckwheat is a trendy product and meets growing demand from consumers (Expert 4).

Figure 19 - Examples of (unprocessed) buckwheat end products in Germany

Sources: Davert 2022; Fooodz.de 2022a; Kaufland 2022

Figure 20 - Examples of processed end products containing buckwheat in Germany

Sources: Bauckhof 2022; Bringmeister.de 2022; Fooodz.de 2022b, c; Reformhaus 2022; REWE 2022; Seitz 2022

In the next sections, we will focus on buckwheat flour value chain. In this context, we were able to interview 2 producers of buckwheat, 2 mills (called "processors") and 1 retailer. Their answers to the questionnaire are given in the "points of view of the actors" sections.

9.2. The value chain network

General view

In 2020, Germany imported 5,875 t of buckwheat with a value of 5,216,000 US$. In comparison to 2010 where 2,099 t with a value of 1,760,000 US$ were imported, this corresponds to an almost threefold increase. More than half of the imported buckwheat came from Poland (3,207 t; value of 2,928,000 US$) which was by far the most important country when it comes to buckwheat imports (FAOSTAT 2022b). Behind Poland, the Russian Federation (777 t / 491,000 US$) and Lithuania (600 t / 474,000 US$) came in second and third place. Other countries from which Germany imported buckwheat in 2020 where Lithuania, Hungary and Estonia.

As the production in Germany is not recorded statistically there are no official data available on the distribution of the production within Germany. It is known, however, that regions where buckwheat is cultivated include the federal states of Brandenburg, Mecklenburg-West Pomerania, and Baden-Württemberg (Expert 2; Nicolai 2020). Nonetheless, during 2022, several new projects are being tested in Bavaria, in organic farming (expert 4). In 2019, about 1,200 ha of organic buckwheat were cultivated in Germany and one can assume that there is hardly any conventional buckwheat cultivation in Germany (Expert 2; Nicolai 2020). All new projects of organizing a buckwheat supply chain seems organic. This is explained by the potential of extra value-added when selling into the organic market. As the supply chains in buckwheat are small, there is a high level of transaction costs for organizing and logistics which needs to be covered by high value added (expert 4).

The extremely small domestic buckwheat production in Germany means that nearly all of the buckwheat sold and consumed in Germany is imported.

Domestic farmers usually get their seeds either from German seed providers like Naturland or from seed providers like Sativa that are located abroad. The organic producer organization “Alb-Leisa” is a success-example of a formal group gathering the actors of the value chain. However, there are, spread all over Germany, several examples of formal and informal collaboration, especially among farmers, but as well vertically in the value chain (Expert 2, expert 4). For example, they divide the different steps required for being able to sell buckwheat, that is some dry the buckwheat while others provide the ventilated silos for storing it (Expert 2). For larger quantities, however, farmers need to cooperate with actors that have dehulling facilities because otherwise they will struggle to meet the high purity and quality standards of consumers and the retail trade (Expert 2; Marktgesellschaft der Naturland Bauern AG 2021). Here, the low availability of German mills that are able to do so leads to high costs for transportation and a loss of regionality (Bio-Buchweizen in Thüringen 2020; Nicolai 2020). On top of the cooperation among farmers, there is also a cooperation with state offices and research institutes such as the Keyserlingk-Institute at Lake Constance which play a moderating role between farmers and processors (Expert 1; Expert 2). The Bavarian State Institute for Agriculture is doing research on the economic questions of buckwheat production (expert 3). In the federal state of Baden-Württemberg, a close cooperation between the company Erdmann Hauser which uses buckwheat for its products, an institute carrying out buckwheat cultivar trials and the farmers willing to cultivate buckwheat exists (Expert 2). Through an intense cooperation these three actors have found cultivars that work well for the regional particularities and their requirements (Expert 2). In their case, the process of deciding which cultivar to use was a consensual process (Expert 2).

The bottleneck in buckwheat value chains is, as indicated, the milling level. Few mills only engage into dehulling and milling buckwheat, as it is a small production and highly technical. The technical patterns of buckwheat vary strongly among cultivars and even according to production conditions (rainy season, drought) and thus high technical competence is needed to adjust the machinery to the product (expert 4).As a consequence, in several cases, fames invest themselves into dehulling and milling facilities but this needs high investment in terms of funds (100.000 € or more) and in human capital (training, competence) (expert 4).

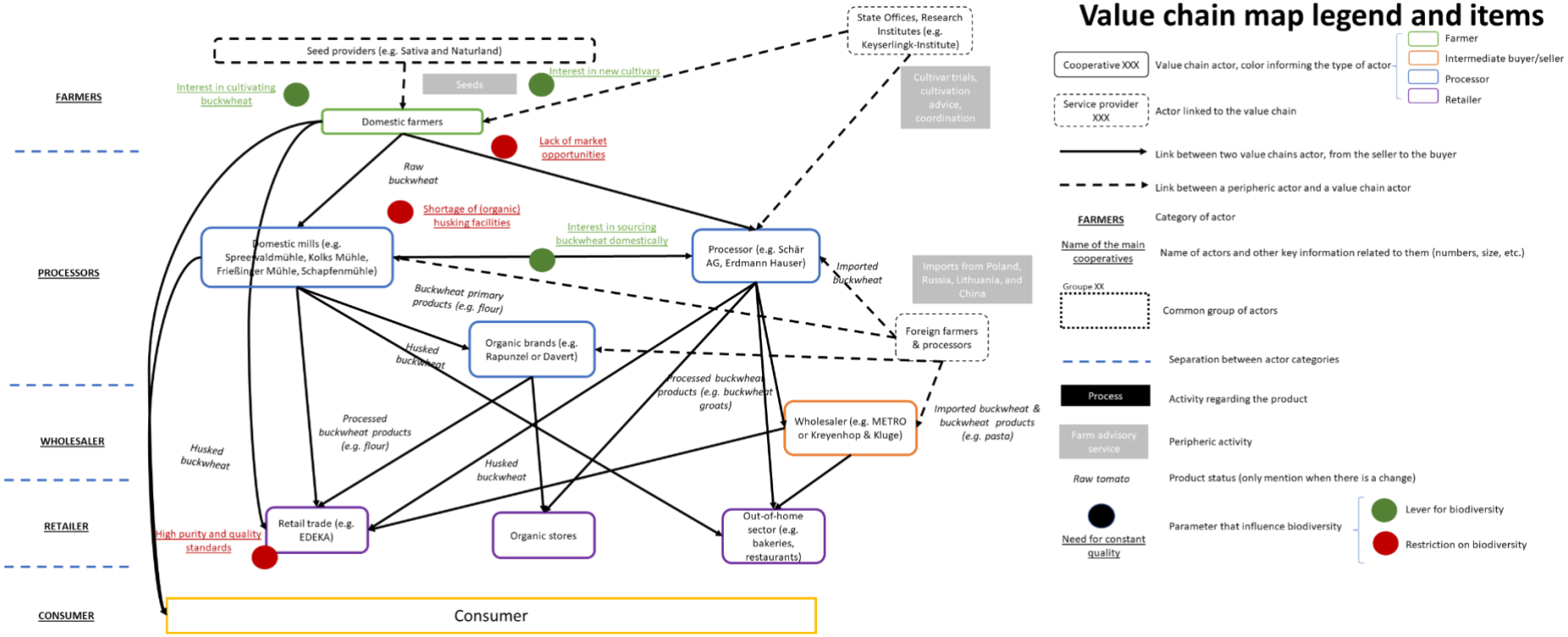
The farmers enter into contracts with domestic mills or processors that fix prices and quantities in advance (Expert 2; Nicolai 2020). The processing company in the South of Germany (Erdmann Hauser), for example, meets yearly with its buckwheat producers and makes them an attractive price offer in order to motivate them to cultivate buckwheat (Expert 2). If the harvest of the farmers exceeds the contracted quantity, they can sell it directly to consumers (Expert 2). Generally speaking, it is economically attractive for farmers to cultivate buckwheat because it can be processed to high-priced end products which promises higher producer prices (Bio-Buchweizen in Thüringen 2020). While there is some buckwheat production in the federal state of Baden-Württemberg which is used to process buckwheat end products, the processing company involved is at the moment not keen to increase its current volume of 200 t (Expert 2).

The mills produce both products for consumers and the retail trade (for example for private labels) and primary products that are used by the processors. Some processors also have own mills so that they are independent of other actors and can directly source their buckwheat from farmers (Expert 2). In view of the small domestic production both mills and processors have to rely on imported buckwheat. Likewise, organic brands such as Rapunzel or Davert get the vast majority of their buckwheat from abroad. These organic brands sell their products (mostly dried buckwheat) in the retail trade and in organic stores. The out-of-home sector, that is bakeries or restaurants, get their buckwheat from mills, the processors or from wholesalers who import specialized buckwheat products (e.g. pasta) from abroad.

There are several general challenges for the German buckwheat value chain. One of the biggest challenges is the availability of facilities that can clean, sort, and peel larger quantities of buckwheat which are essential if farmers want to sell their buckwheat to the retail trade or the processing industry (Bio-Buchweizen in Thüringen 2020; Expert 2). The scarcity of these facilities increases the costs for selling buckwheat because they might have to be transported for longer distances using trucks (Expert 2; Nicolai 2020) This hinders as well the setting-up of new projects (expert 4).

If one wants to sell buckwheat directly to the consumer, however, one can use the unpeeled grains which allows to avoid the expensive and cumbersome peeling process (Expert 1). Firstly, regarding the technical aspects the undetermined growth of many varieties makes it difficult for farmers to determine the optical harvest point (Nagel 2020). In addition, bad weather can lead to poor harvests (Expert 2).

Figure 21 - Buckwheat value chain in Germany



Point of view of the actors

The first farmer produces 400kg of buckwheat on 2ha in a 200ha organic farm, sold dried peeled, in flour and also grain. Producer B also produces on a 200ha organic farm but 10-20ha are dedicated to buckwheat and he harvests 25ha. He produces 2 varieties for an output of between 10 and 30 tonnes which he sells processed. Farmer A buys seeds from a specialised seed seller while farmer B produces his own varieties and buys a Kora variety from his cooperative. Both producers sell directly to consumers via farm shop or online shop. Farmer B also has other outlets like small, specialized companies, 5 bigger bakeries and many smaller ones through regular relation and longstanding business relationships or also to wholesalers and a cooperative. The volumes concerned vary annually. Buckwheat represents little work time for each, A specifies about 2% and B its extensive so less work/input necessary compared to the ratio of buckwheat area to total area ratio.

The first processor is buying around 130-150t of buckwheat each year (peeled excluded – 75t), and sell mainly buckwheat groats, whole grains, or flour. He is buying to 2 to 5 farmers depending on the years, also partly from cooperative or foreign traders. They sell most of the production to 7/10 other processors and also directly to consumers. Processor B is buying 2 tons of peeled buckwheat per year and sell the same products. He only buys to 2 farmers through regular relations and sell all to consumers at the mill shop or the online shop.

Only one retailer was interviewed, a specialized organic shop that sell around 50 to 100kg of buckwheat flour per year but also 20 products containing buckwheat. He buys buckwheat flour from 3 to 4 wholesaler through regular relations. He specified that the availability is extremely difficult and seasonal.

9.3. Profitability, drivers and main variables for variety/species choice

General view

Despite the small size of the German buckwheat seed market (due to the small area of cultivation), about 15 different seed varieties are available. By trend, one can observe an increase in the number of cultivars used in the last years (Expert 2). A general behavioral pattern among German buckwheat farmers is that they stick with the varieties that work well instead of experimenting with new ones (Expert 2). This risk-aversity may be a hindrance to introducing new varieties (Expert 2). Yet, in view of the low availability of varieties with a determined growth there is a general interest in introducing new varieties to find more cultivars with a determinate growth and a higher processing quality (Expert 2).

The varieties that are currently cultivated in Germany are not genuine German ones but originate from other countries. Generally speaking, while those varieties that can be milled often come from France, those that can be husked originate from Russia or Austria (Expert 2). The German seed providers that provide buckwheat seeds are for example DSV Saaten or Bioland which offer varieties such as Kora or Lifago. In the federal state of Baden-Württemberg, Russian varieties like Drushina or Devyatka are purchased from the Swiss seed provider Sativa (Expert 2). The Russian cultivars are popular among German farmers because they have a homogenous ripening which is not the case for other European cultivars (Expert 2). Further reasons for using Russian varieties are the size of their grains and the convincing taste (Expert 2). However, because they must be imported from Switzerland the prices for seeds originating from Russia are fairly high, namely 690 CHF/dt for the varieties Devyatka and Drushina respectively (Expert 2; Sativa 2022). Besides these Russian cultivars, the Austrian variety “Panda” is popular with farmers from the federal state of Baden-Württemberg (Expert 2).

Point of view of the actors

As explained above farmer A uses one variety and B uses 2. A said that buckwheat is a niche product but that any summer crop could replace it. Farmer B gave the example of lupin bean. In terms of crop choice, buckwheat seems interesting because extension of crop rotation and good for biodiversity (flowering plant) and it permit to be able to offer gluten free products. As for the problems encountered in general, they differ. Farmer A states that it is mainly insufficient demand for buckwheat, but that because there is no demand, it is a small market with almost no structure for competition. For B, it is rather the lack of infrastructure to manage the different stages of the value chain, followed by the dumping price from China. In terms of the difficulties encountered in relation to climate change, they are both affected by decrease water availability and drought and extreme weather conditions and to a lesser extent increase temperature and precipitation. A quoted that a solution can be creation of microclimates or conversion to organic.

Processor B thinks that buckwheat is hardly replaceable, as it is popular among farmers. In theory it could be replaced for its cooking ability and taste, but it could not be replaced by any explicit competitor, perhaps millet. Processor A also mentioned that it was not replaceable, as buckwheat has its own taste. Processor B chooses his suppliers according to the region because they must be local, and this is interesting because of the demand for buckwheat flour. For processor A it comes mainly from eastern Europe because too little offer in Germany, interesting because there is a demand for it, especially gluten-free, content/taste and bread industry. According to them, people who consume buckwheat flour are more likely to be middle-aged or adult and concerned about health or traditional cooking or innovation. All the elements mentioned in Q 24 would be important for the consumer (price, packaging, nutritional information, novelty, healthier product, national or geographical production, ease of preparation/cooking and shelf life).

According to the retailer it's very difficult to find a crop that could substitute buckwheat because the taste is too unique (tart, nutty) and it is a substitute itself. Moreover it is gluten-free and that is difficult to replace. He gave example of buckwheat flour, groats (best-selling product made of buckwheat) or kenel (second best-selling product made of buckwheat). These products come from, from the region (North Germany) if available; otherwise, Russia and Estonia (always germinated buckwheat seeds from there). For him these buckwheat products are part of the standard assortment of a health food retailer. According to him buckwheat is consumed by a large panel of consumer, especially those who value traditional recipes, follow a fashion and the zeitgeist. The main driver to buy buckwheat flour would be price, packaging, a notion of a healthier product, nutritional info. Shelf life and brand are not important.

9.4. Price formation and market power

In terms of product pricing, they both base their prices on their production costs, B adds that they also base their prices on the market when negotiating with buyers. The yields are quite distinct for the two producers, 0.5t/ha for A and 0.2 for B. If the former sells buckwheat on average at 3€/kg while B sells buckwheat flour at around 2.2€/kg. For weight of labor cost, B estimated impulsively at 66% of the revenue. A says that organic label (Bioland) allows them to sell for about 0.8€/kg while B says it has no impact on their prices because there is no alternative for them anyway. B also uses Bayerische Biosiegel, Tagwerksiegel.

Processor A buys on the spot market from its suppliers while processor B has prices set by provider (with consultation with him first). They both set their prices according to their margin targets. A says that it is rare to fix contracts because it is difficult (with other processors). For processor A the prices have increased from 980/740€/t in 2021 to 850/1100€ /t in 2022. For processor B the prices are

going from 21 to 22 for the purchase of 1.8 to 2.5€/kg and sold 3.5 to 4.5€ in increase because of the cost of energy. They explain that organic implies certification costs money and time (rising disproportionately fast in recent years) so it's more expensive.

The prices the retailer buy buckwheat flour is fixed together with the provider. It is sold around 3.8€/kg. They sell only organic flour, there is no designation of origin EU-wide for buckwheat.

9.5. Feasibility, constraints and consequences of introducing more varieties/species/products

Standards required and choice of provider

In terms of required standards, only farmer A mentioned the external appearance as important because of the attractiveness of the product. They both agree that new crops are usually introduced on their own initiative. For B he clarifies that this can be done Rather a mix of industry press, organic shop offer, based on market analysis of consumer preferences, or by copying other farmers or following research developments. Because there is an interest of the population in regional products and this also generates an interest in farmers or other market players and then they try to distinguish themselves from other market players and introduce new products (example Quinoa). He added that it depends on the personality. However, the financial and working capacities must be given.

The selection criteria mentioned by the two processors are very different. For processor A it is to have a quality product with food properties. He specifies that it must be in accordance with the Foodstuffs Act and free from glyphosate. For processor B it is the proximity (need to come from the region) and being organic, then the range of species and specialisation. He particularly looks at the colour because brighter are better - they are thinner skinned, milder in taste more neutral in flavour. Processor A also mentions colour as being requested by customers.

For the retailer, the main factors for selecting a buckwheat flour supplier are the organic label and proximity, if it is regional it is always preferred. He did not mentioned any other required standards.

Introduction of new varieties in the value chain

For farmer A it is rather based on intuition and entrepreneurial considerations, that it is part of their profession to use application-oriented knowledge and it depends on marketing skills.

Processors only agree that this can be done at the request of customers. However, B thinks that it is also rather provider-initiated, unlike A who thinks that processors can do it for different reasons (market research, copying other operators or following research development). B thinks they can introduce it when advantage such as higher yield or stability become apparent. Smaller processors can do it easily.

According to the retailers, new products like buckwheat flour are mainly introduced as a request from providers or as their initiative after market analysis or following research developments. Therefore, he thinks that retailers can introduce new products because there is always a demand for new goods when they are good. Smaller retailers have more independency so they can do it more easily compared to chains that are dependent on head office, slow, and need large quantities that often cannot be delivered at all for new launches.

Limitations for the introduction of new varieties

Farmers agreed that there will be no need for new techniques or standards and that there would not necessarily be problems with access to seed or with public policy or regulation. They agreed that there may be a need for advertising costs or a lack of technical characteristics of new varieties/species - notably peeling, depending on the size of the grain. Finally, while A believes that there will be higher costs for adapting production systems and insufficient demand, B did not agree. He identifies increased production costs for new varieties and drying is the biggest problem because it is harvested so late and thus needs more drying and many farmers do not know that.

The only limit to the introduction of varieties for processor A is the increase in variable costs. In contrast, B sees multiple limitations: necessity of new techniques and standard, lack of some processing characteristics, increase in variable and fixed costs, insufficient demand, difficulty to have access to new varieties, advertising costs or public policies and regulations.

According to the retailer limitations are insufficient demand, difficulty to have access to new products, cost of advertising and public policies is not limitation to introduce new buckwheat flour or products.

Effects of the introduction of new varieties

Farmer A does not really see any, while B imagines improving access to processing markets and the client's income.

Processor B sees little effect of more variety other than an improvement in farmers' income. A thinks that it may increase the quantity of buckwheat purchased, number of clients, access to retail market or their revenue.

The retailer thinks that selling more buckwheat flour could improve the economy of the farmers and processors and increase their numbers as well as the number of consumers or the amount of buckwheat flour purchased. However, he does not think that it improves the reputation of the retailer as it is not a small product like this that will have a big effect on his reputation.

Implications of the introduction of new varieties

Farmers agree that it will lead to more work to find customers and market. A is rather neutral or in disagreement with the other points whereas B agrees with the whole (increase complexity in the management of plots, require dedicated spaces, separate the product, require adjustments of the farm and worsen its productivity/efficiency, planning and require training for worker.

In terms of what this would mean for their business, they agreed that more diversity would mean more planning and documentation, product segregation and new dedicated storage space. B added that it would require more product and supplier selection, and more work to find customers and markets.

According to him it wouldn’t have the effect proposed in the Q19: it wouldn’t require new lines spaces or structural adjustment. It wouldn’t increase work for the management or training. It wouldn’t impact productivity or variable costs as well as work to selec provider or consumer information, planification.

9.6. Summary

Buckwheat value chain seems rather poorly organized, and is largely based on imports, and locally on organic farming. Intermediary uses either domestic buckwheat with little choice and varieties produced by the farm (much more limited) or imports with quality standards. Limited diversity because already specific product as such. Although the market is potentially dynamic, it remains

limited because it is more expensive than other cereals (with which it is theoretically in competition). The interest seems to be higher among organic than conventional farmers. Likewise, seed providers also appear to be interested in adding buckwheat to their portfolio.

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10. Analysis of eggplant value chain in Germany

10.1. Introduction and general information on market

Consumption

In Germany, eggplants are almost exclusively sold in the fresh market (Expert 1; Schlaghecken 2022). 85 % of the turnover made with fresh eggplants is made in the food retail trade, mainly in discounters (Expert 1). The remaining 15 % of the sales are made outside of the food retail trade, namely on weekly markets or in organic supermarkets (Expert 1).

The most important eggplant end product in Germany is fresh eggplants which are sold using varieties with a dark purple to black color and an ovoid form (Expert 1; Expert 2). Despite the dominance of fresh eggplants in Germany, the fruit vegetable is also used in some processed end products. For example, it serves as a topping for fresh and frozen pizza and it is used as an ingredient for vegetable spreads. Moreover, it is an ingredient of the Southeastern European spice paste "Ajvar" which can be used as a sauce or as a spread (Feinkost Dittmann 2022; Korfu Food 2022). Another processed product is the dish "Imam" which is also sold in cans and which combines eggplants with tomatoes, onions and herbs (Korfu Foods 2022).

In 2021, only 26 % of German households indicated that they buy eggplants at least once a year (Expert 1). This is unsurprising as eggplants hardly play a role in the German cuisine (Expert 3). Consequently, the German consumption of fresh eggplants is low, that is between 0.5-1 kg per capita per year (Expert 1; Laber 2020). However, the consumption is unequally distributed as German citizens with a Turkish, Italian or Greek migration background often consume 10 times the average amount (Expert 1; Expert 3).

According to the consumer there is not an important diversity of variety, available and at the same time, people don't really know about it neither (Focus group 2022). Some of them refer to Eggplants that have different types of colors like green, yellow and purple, with a lighter or a darker skin color, with difference differences in their shape (big, small, wider, thinner), their origins, etc. Consumers declare to pay attention on the varieties that they are buying(Focus group 2022).

For some of the consumers, the taste matters the more than color and the shape even if they are criterion for different dishes and recipes. According to the consumer the variety influence the taste, their consistencies, the difference in the firmness (for example the smaller Eggplants are milder and firmer), and therefore their way of preparation (Focus groups 2022). Some consumer think it is rather irritating or overwhelming when there is an important number of varieties, because they must choose the right products for avoiding any mistakes, that's why it is easier for them to buy only standard products.

In Germany, some products made of Eggplant are for example dips made of eggplants, baked eggplants, eggplant salad, eggplants in the can, on pizzas in restaurants (Focus groups 2022).

Eggplant production in Germany by region

The German production is extremely small and therefore not recorded statistically (Expert 1). What is known, however, is that 4,000 t of domestic eggplants were sold on German producer markets (Expert 1). Bearing in mind that eggplants are also sold directly from small farmers to consumers, one can estimate that the total German production must be slightly higher, i.e. about 5,000 t (Expert 1; Expert 3).

The small German produce mainly comes from the Lower Rhine region, the "Knoblauchsland" (close to Nuremberg), from the island of "Reichenau" which is located in the Lake Constance and from Palatinate (Staiger 2022). The cultivation areas on the island of Reichenau and in the Knoblauchsland together account for about 7 ha (Laber 2020). For most consumers, however, the regional origin of the eggplants is unimportant because the majority of them has no problems with buying eggplants that are imported from their country of origin, for instance, from Italy (Expert 3);

8 % of the fresh eggplants sold are organic (Expert 1). This is slightly less than the total share of organic vegetables in Germany (Expert 1). Organic eggplants in Germany are mostly cultivated by the small farms that sell their eggplants directly to the consumer rather than by larger ones supplying the retail trade (Expert 3).

Eggplant farmers receive their seeds from one of the seed providers, for instance from Rijk Zwaan or Enza Zaden, which often also provide cultivation advice (Expert 2; Expert 3).

10.2. The value chain network

Most of the domestic eggplant production takes place on small farms that usually sell their fresh eggplants directly to the consumer, for instance, on weekly markets or in farm shops (Expert 3). These farmers aim to offer their customers a complete range of vegetables even though cultivating eggplants is often unprofitable for them and they must make up for the losses by making profits with other crops (Expert 3). To keep fixed costs low, small farmers cultivate eggplants in simple foil tunnels rather than in cost-intensive greenhouses (Expert 3). Directly selling fresh eggplants to consumers is possible because they do not have to be washed post-harvest and can be sold without packaging in crates (Expert 3). Importantly, these small farmers hardly deliver any fresh eggplants to the retail trade (Expert 3).

In view of the small domestic production, many but not all of the larger eggplant producers are located outside of Germany, mainly in Spain and the Netherlands (Expert 1, Expert 2; Expert 3). The farmers that deliver fresh domestic eggplants to the retail trade are predominantly middle-sized or large farms (Experts 3). They can either sell the eggplants via a producer organization or if they are large enough, they might opt for selling directly to the retail trade (Expert 3). In fact, many of the larger German retailers have direct relationships with producer organizations or large eggplant farms abroad (Expert 1; Expert 2; Expert 3). When selling to the retail trade further inputs are necessary because the eggplants have to be sorted and packaged before they can be sold to the consumer (Expert 3). These tasks are usually carried out by producer organizations or specialized subcontractors that may also take care of transporting the eggplants as well as checking their quality (Expert 1; Expert 2; Expert 3). Important German producer organizations trading with fresh eggplants include Landgard, Frankengemüse and Mecklenburger-Ernte (Expert 1; Expert 3). If and how these producer organizations also trade imported eggplants depends on their organizational structure (Expert 3). Some producer organizations focus on their domestically cultivated eggplants while others have an own trade company that imports eggplants from abroad in order to be able to satisfy their customers' needs all year round (Expert 1; Expert 3). Besides the retail trade, domestic and foreign producer organizations or their individual members also deliver fresh eggplants to the out-of-home sector (e.g. restaurants) and to wholesalers such as METRO or wholesale markets (Expert 3; Reichenau Gemüse 2022).

The retail trade increasingly enters into contracts with the producers of eggplants to satisfy its constant need for larger quantities of eggplants (Expert 2; Expert 3). As their overarching goal is to secure a year-round supply of eggplants the retailers often collaborate with foreign producers that are able to cultivate eggplants in their facilities all year round (Expert 2). The contracts between retailers and eggplant producer organizations usually stipulate weekly delivery quantities and

include clauses on the target quality, the target size (usually 200-300 g per eggplant) and the target segment (Expert 2; Expert 3). Moreover, they specify the cultivation period and the price to be paid (Expert 3). Finally, retailers increasingly ask producers to cultivate certain eggplant varieties which is partly driven by the seed providers that present their cultivars to representatives of the retail trade (Expert 3). If the eggplants delivered to the retail trade do not meet the stipulated requirements, for example because they have the wrong size, the retailers may refuse to accept them (Expert 2; Expert 3). In such a case, the producer can only take the eggplants back and compost them or use them in a biogas plant (Expert 3).

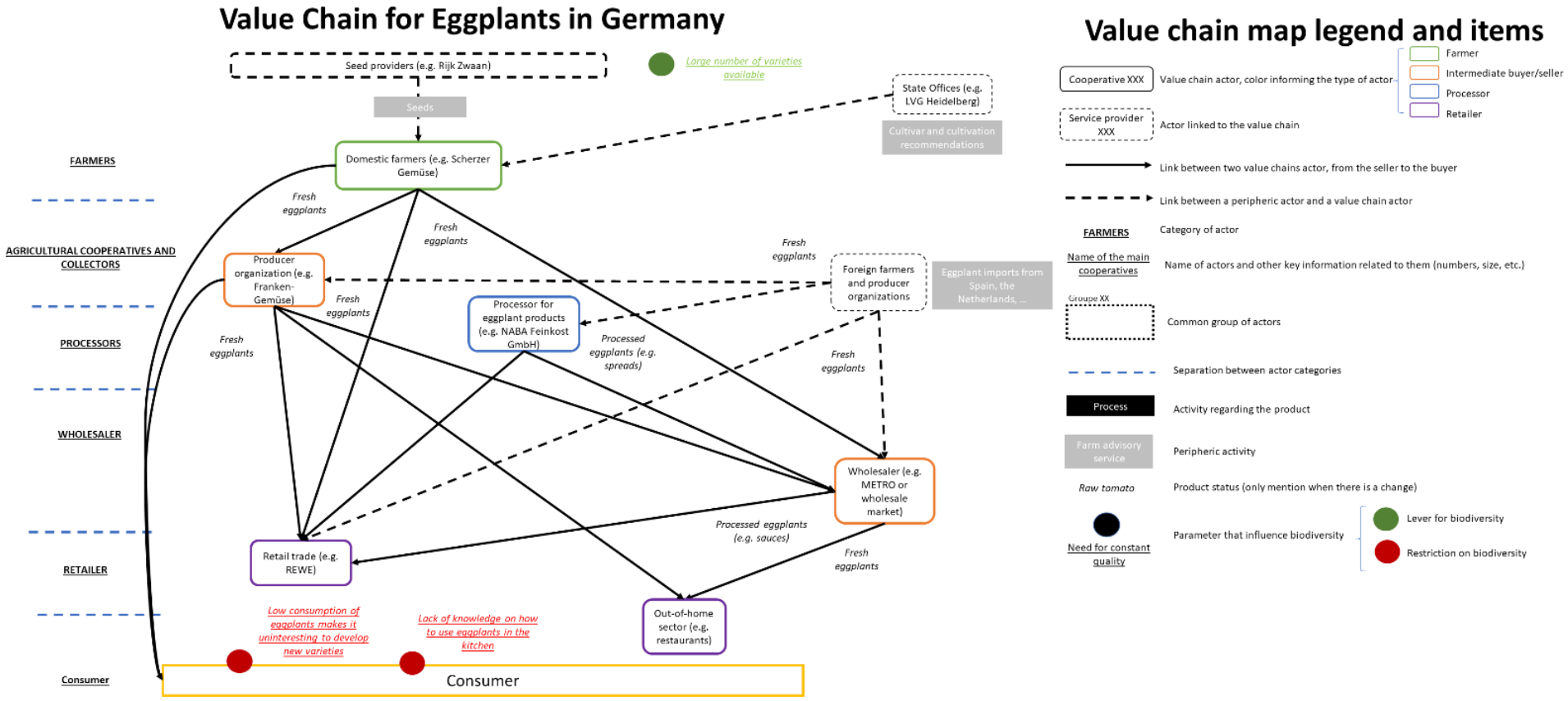
The eggplants that are used for processed products come exclusively from the foreign production (Expert 3). The processors rely on eggplant imports because they are available in larger quantities during the whole year and cheaper than their domestic counterparts (Expert 3). An example for an eggplant processor is the "NABA Feinkost GmbH" which produces organic eggplant spreads for retailers' private labels (NABA 2022). A different type of processor is "alimpex" that imports eggplants and produces Ajvar sauce which it then sells to wholesalers such as METRO (Alimpex 2022).

Wholesalers like METRO or wholesale markets can either source their fresh eggplants from domestic or foreign producer organizations or their individual members (Expert 3). Wholesalers' customers are mainly smaller retailers and restaurants that can buy fresh and processed eggplants in different forms, for example in packs of two, in crates or in slices (Expert 2; METRO 2022).

As the domestic production of eggplants in Germany is small most of the eggplants that can be bought in the German market are imported from other countries (Expert 2; Staiger 2022). The reliance on eggplants imports is particularly strong in winter time because domestic eggplants are only available between April and October (Expert 2).

The total import quantity of eggplants has increased from roughly 50,000 t in 2016 to just over 60,000 t in 2020 (FAOSTAT 2022b). Most of the eggplant imports to Germany in 2020 came from Spain and the Netherlands (FAOSTAT 2022c). While Spain accounted for 30,887 t of eggplant imports to Germany which corresponds to a value of 44,817,000 USD, the Netherlands contributed 22,022 t with a value of 34,070,000 USD.

Figure 22 - Overview of the eggplant value chain in Germany



Point of view of the actors

Presentation of the producers

Three organic eggplant producers were surveyed.

The fist farm is organic and has a total area of 2.7 ha of which 2.2 ha are devoted to the cultivation of eggplants. The area dedicated to eggplant is separated as follows:

- 1.4 ha of Black eggplant
- 0.3 ha of Striped/Graffity, cylindrical and white/violet varieties
- 0.5 ha of round violet/ white, African yellow and white

The second farm is an organic market gardening farm with open field plots and tunnel production. The area under tunnel is 0.5 ha of which 0.04 ha are dedicated to the cultivation of eggplant (0.2 ha are dedicated to the cultivation of tomatoes). He grows at least 10 varieties of eggplant but there are 2 main varieties. The production costs of eggplant cultivation represent less than 5% of the total production costs.

The last farm is organic also (certified Bioland). The total area of the farm is 2 ha (1 ha really exploited) of which 0.08 ha are cultivated under tunnel. Eggplant cultivation covers 0.0045 ha of the tunnel area. Only one variety of eggplant is grown on this farm.

Table 13. Farm characteristics of the German organic eggplant producers

	Producer 1	Producer 2	Producer 3
Total area (ha)	2,7	0.48 (subtunnel)	2 (of which 0.08 ha under tunnel)
Area dedicated to the cultivation of eggplants (in ha)	2,15	0,04	0,0045
Volumes sold (tons)	67	2	0,15
Nature of the product sold	Fresh	Fresh	Fresh
Cultivated varieties	Black Striped/Graffity Cylindrical White/violett Round violet/ white African yellow	Bartok Zora Angela (hybrid, striped), Lea (pink) Klara (white) coloured sorts in smaller quantities	Crystal F1
Certification	Organic and demeter	Organic and demeter	Bioland

The eggplant areas are relatively small, and among the 3 organic producers only one producer is specialized in the production of eggplants. Eggplant cultivation is a secondary crop for the other two producers. We can observe varying production volumes between producers. Yields are variable (2 producers have yields around 32 t/ha and one producer is 50t/ha.

The types and number of seed suppliers vary according to producers. However, there are no preferred suppliers per variety. The purchase of seedlings is also a way to stock up. The first producer sources seeds from 3 different suppliers. The nature of its seed suppliers has not been informed but are not specialized suppliers or producer organizations. The second producer for all the varieties he

grows, he sources from 4 suppliers specialized in seeds. The last producer produces only one variety of eggplant, Cristal F1, and sources the plants from another producer.

The marketing channels are diverse depending on the producers, but they all sell directly either online or on the farm. One of the producers works mainly with wholesalers to whom he sells between 85% and 90% of his production. He maintains partnership relations with the 7 different wholesalers with whom he works. The remaining 10% of its production is sold online directly to consumers, through a single platform. The second producer has his own shop on the farm where he sells his produce. He also markets his produce in a weekly market. As the first producer, it sells by delivery, it maintains partnership relations with the delivery structure. The last producer in monovarietal production, sells all of its production in direct sale. He owns a farm shop and sells vegetable baskets. For vegetable baskets there are 30 subscriptions, it has contractual relations with consumers.

Retailer

The investigated distributor sells 7 tons of eggplant per year that it sells in bulk. It sells 2 varieties of eggplant, Black Eggplant and Graffiti Eggplant. There is no specialization of suppliers according to varieties. For all varieties, 80% of this store is supplied by two traders/intermediaries. The remaining 20% of volumes are supplied by two individual producers. It has partnership relationships with all its suppliers. We observe that varietal diversity among distributors is low compared to varietal diversity found among producers.

10.3. Profitability, drivers and main variables for variety/species choice

General view

In most instances, eggplants are cultivated using seeds (Wikifarmer 2022). These are grown in a protected environment such as a greenhouse and transplanted into a field after four to six weeks (Wikifarmer 2022). Most of the eggplant cultivars in the market can be harvested 60-100 days after their transplantation (Wikifarmer 2022). The harvesting of eggplants is carried out manually using knives or scissors (Wikifarmer 2022). Subsequently, the eggplants are packed and stored for shorter time periods at temperatures between 10°C and 12°C (Staiger 2022; Wikifarmer 2022).

An overview of eggplant seed providers in Germany is given in Table 4. The most important suppliers are Rijk Zwaan, Enza Zaden and Uniseeds (Expert 2). Rijk Zwaan has a handful of varieties like “Araceli” or “Jaylo” in their portfolio. Enza Zaden offers both conventional and organic cultivars like the variety “Bartok”. Uniseeds also offers some eggplant varieties such as “Cristal” and “Amalia”. Although there is a huge variety of eggplant cultivars with different colors, sizes and forms, in Germany varieties with an ovoid form and a dark purple to black color dominate the market (Don et al. 2011; Expert 1; Expert 2; Expert 3; Schlaghecken 2022). The most widespread cultivars with these features are Kylie, Beyonce, Tracey, Bartok, Cristal, Amalia, and Jaylo (Expert 2). The dominance of varieties with an ovoid form and a dark purple to black color has been fairly stable throughout the last couple of years (Expert 2). A key factor that drives the use of these eggplant varieties is consumer demand and consumption habits that together stimulate the food retail trade’s demand (Expert 2; Experts 3). Two further reasons are that the varieties are more profitable because of higher yields and that there is more technical knowledge and know-how on them than on other cultivars (Expert 2; Expert 3). Finally, these cultivars have few thorns which are problematic when it comes to harvesting and consuming the eggplants (Expert 3).

Point of view of the actors

Producers

Table 14. Characteristics of the German organic eggplant producers

	Producer 1	Producer 2	Producer 3
Cultivated varieties	Black Striped/Graffity Cylindrical White/violett Round violet/ white African yellow	Bartok Zora Angela (hybrid, striped), Lea (pink) Klara (white) coloured sorts in smaller quantities	Crystal F1
Certification	Organic and demeter	Organic and demeter	Bioland

The first producer did not distinguish between the different varieties, he gave figures for all eggplant varieties. The average yield of eggplants is 35 tons/ha. The buying and selling prices were not communicated by the producer. Regarding the weight of labor on income, it has been estimated by the producer at around 30%.

The second producer was able to detail the information by variety. The main variety he grows is the Batok eggplant, which represents 60% of his production volumes. This variety was chosen for its quality and because it is a variety that ensures a successful crop. The yields for this variety are around 10 and 12 kg/m^2 (100 tons/ha) according to the actor. The yield calculated by dividing the areas and volumes is 50 tons/ha. The second variety, Zora, accounts for 20% of production volumes. This variety has been chosen by its quality, it that ensures a successful crop, and it is an open-pollinated variety (pollination carried out by natural means alone, without mechanical intervention by man). The seeds of this variety are 6 times cheaper than the Batok variety, 105 € for 1000 seeds. The yields for this variety are the same as the previous one, around 10 and 12 kg/m^2 (100 tons/ha) according to the actor. The yield calculated by dividing the areas and volumes is 50 tons/ha. The variable costs are the same for the two main varieties and have not changed between 2021 and 2022, they represent 15% to 20% of income. The cost of labor is also the same for these two varieties, it represents between 10% and 15% of income but it is difficult to estimate because there are many volunteers on the farm. The third variety on the farm is the Angela variety little information on this variety has been provided by the producer. The Angela variety and the other varieties represent 20% of the farm's production. All varieties are sold at the same price. Prices were not provided by the producer.

The last producer grows only one variety, Cristal F1. The grower chose this variety because the seedling grower only offers this variety. Economic data were not provided by the producer.

Retailer

The investigated retailer sells two varieties of eggplant, the black Eggplant and Graffiti Eggplant.

The Black variety accounts for 95% of the store's eggplant volumes. This variety comes from Spain and was chosen because there are no availability problems. The purchase prices have not changed between 2021 and 2022, the price is around 2.24 € / kg. The consumer selling price has also not changed between 2021 and 2022, today the kilo of black eggplant is sold at 5 € / kg.

The second variety of eggplant sold by the distributor is graffiti, it represents only 5% of the volumes of eggplants in the store. This variety was chosen like the previous one because of its availability on the market, but the production is original. The graffiti variety is bought at 3.20 € / kg, more expensive than the black variety and this price has not changed between 2021 and 2022. Similarly, the selling price has not changed between 2021 and 2022, it is around 6 € / kg.

Economic data on variable costs and labor were not provided.

10.4. Price formation and market power

General view

The prices for eggplants that are not fixed via contracts are determined by using weekly prices which depend on the supply of eggplants in the market (Expert 1; Expert 3). Generally speaking, the prices for organic eggplants are more stable than for conventional eggplants (Expert 1; Expert 3). In 2021, the average consumer price for conventional and organic eggplants taken together was 2,47 € / kg (Expert 1). The average consumer price for organic eggplants was 4,08 € / kg in the same year (Expert 1). The average price received by German eggplant producers in 2021 was 1,40 € / kg (Expert 1).

Point of view of the actors

Setting purchase prices

The first producer sellsits goods to wholesalers and online directly to consumers. For all its customers and for allthe varieties it produces the price is set by the customer. The second producer markets through its farm store, at a weekly market and offers a delivery service directly to consumers. The price is fixed in the same way for all its marketing channels and for all varieties. To set its selling price, it will compare its prices with the prices of large retailers, then will make a general increase of 20% on its cheapest range of products. The last producer markets only one variety and sells mainly directly. He will, like the previous producer, look at the prices of wholesalers and will sell these products at double the price that wholesalers offer. We observe that pricing depends on the objectives of producers. Little economic data was collected during the interviews.

The surveyed retailer markets two varieties of eggplant and sources from producers and traders. The purchase price is set independently of the varieties and suppliers. The store will take into account its profit margin target and the price set by the supplier to set its purchase price. The Black variety accounts for 95% of the store's eggplant volumes. The purchase prices for this variety have not changed between 2021 and 2022, the price is around € 2.24 / kg. The second variety of eggplant sold by the distributor is graffiti, it represents only 5% of the volumes of eggplants in the store. The graffiti variety is bought more expensive than the black variety and the price of 3.20 € / kg has not changed between 2021 and 2022.

Role of Price Certification

The first producer is labeled organic by Demeter. It is also part of an original certificate of Baden-Württemberg scheme and is certified global gap. The effects of these certifications on the price have not been communicated. The second producer is certified organic, this certification allows him to value his production at a higher price. He is seeking to introduce a public welfare certificate on his farm. The last producer is certified organic and like the previous producer, this certification allows him to value his production at a higher price.

The distributor is also certified organic but has not provided information regarding the effect of this certification on the price. Organic certification seems to be a way for producers to better value their productions.

Setting the price for a new variety

One of the producers did not answer this question.

For one of the producers the price of a new variety would be fixed in the same way as at present. The price would be set according to the prices of large retailers but this time the price would be lower than that of large retailers because customers often do not like new kinds of eggplant. For the second producer the price of a new variety would be fixed in the same way as at present. The price would be set based on wholesalers' prices only if it is a normal variety of eggplant.

The distributor would set the price according to the purchase price and apply a coefficient of 1.5: purchase price * 1.50 = price.

10.5. Feasibility, constraints and consequences of introducing more varieties/species/products

Standards required

One of the producers sells most of its production to wholesalers, traders, and intermediaries. These customers have precise criteria regarding the weight of the eggplants, it is necessary that the weight is between 250 g and 280g. Indeed, these customers sell the production in bulk and for this reason he is looking for a single size of eggplant.

The second producer sells mainly to small shops and delivers goods. There are few criteria required depending on the variety or customers. Grade/class 2 and freshness are required by all customers and researchers for all varieties. The appearance of the product is a criterion required by all customers, but it is less sought for colored varieties and old varieties because customers are aware of imperfections for their rarity. The caliber is a research criterion for the delivery of products because it is a difficult product to transport.

The last producer is exclusively engaged in direct sales. Consumers have quality expectations in terms of freshness and size regardless of the variety. However, they are rather flexible on the size and shape of the product.

The retailer is looking for suppliers who offer an assortment of varieties and species. He does not look for specialized suppliers of a product and proximity to his supplier is not a criterion either. There are no standards required.

Variety potentially cultivable on the territory

Two out of three producers did not respond to Question 12. One producer did not respond to question 13.

One of the growers says it is possible to grow pink and white eggplant varieties, but they are difficult to sell. He is constantly introducing varieties on his farm. The second grower has not introduced a new variety recently and grows only one variety.

One of the producers could introduce new varieties thanks to advances in research and above all he relies on the richness of species so he wants to diversify. The second producer could introduce new varieties following suggestions from seed suppliers, and on his own initiative if the current varieties are not satisfactory.

All of them agreed that growers can introduce new varieties on their own initiative because they are the choice to grow the varieties they want. Some producers have already introduced some species such as the Hokkaido pumpkin so why not new varieties. Small producers could more easily introduce new varieties, according to two producers. The last producer had a different opinion, he thinks that all farmers can introduce new varieties but small producers must pay attention to their profitability while large producers can incur costs and experiment.

The retailer did not see any other interesting varieties to introduce into its business and has not introduced new varieties. It could introduce new varieties at the request of suppliers. According to the store surveyed, he thinks it is difficult for retailers to introduce new varieties on their own initiative, but he thinks organic retailers are more willing to introduce new varieties.

Main production limits

For all producers, access to seeds is a real constraint. According to two producers, labor is one of the limiting factors in eggplant production. Only one producer claims that there is not enough information about production techniques and that there is significant competition in the market.

Limits to the introduction of new varieties

One of the producers did not answer the question.

The two producers who responded to the question stated that it is not necessary to have new techniques and production standards when introducing a new variety and that there are no limits related to public policy or regulation. The main problems they encountered when introducing a new variety were:

- Higher production costs than with varieties already grown
- Demand would be insufficient.

The likelihood of growers introducing a new variety varies from grower to grower. One of the producers sees no constraint and the second is mixed (5/10 probability). According to producers, there is a need to raise consumer awareness and support distributors in order to encourage the introduction of new varieties.

The main limitations encountered by the distributor to introduce a new variety is that there is not enough demand, it is difficult to have access to new varieties and that there would surely be additional communication costs. Despite these obstacles, the likelihood that the distributor will introduce a new one is significant. Collaboration with farmers and consumer awareness could be levers to encourage the introduction of new varieties.

The expected effects of production 'a greater number of varieties

Opinions on the effects on production of more varieties vary greatly among growers. Two producers see little benefit from the production of multiple varieties (either neutral or disagree). The last producer is more positive about the effects on the environment, on farm income, on the number of customers and on the reputation of the company. According to the three producers, the production of a greater number of varieties would not allow access to the processing market.

The distributor does not see any negative effects on the sale of a greater number of varieties. He says this could go a long way toward improving the store's reputation.

The effects on production costs of more varieties

Regarding the cost effects of growing a greater number of varieties, two producers have converging opinions and one has the opposite opinion. The two producers who have similar views agree that

there are additional costs associated with producing more varieties at all levels. A grower who does not see cost disadvantages by producing more varieties produces only one variety on his farm. Two producers (of opposite opinions) agreed that the production of a larger shade of varieties does not lead to structural adjustments of the farm and does not create new dedicated spaces.

The retailer sees some costs on the activity by increasing the number of varieties in the store:

- Increase the work for the management inside stores
- Worsen productivity and efficiency of activity
- Increase variable costs
- Increase work and cost for marketing, consumer information
- Increase planning activities and documents

Three of the 4 respondents say that selling more varieties leads to additional costs

10.6. Summary

A major general challenge for the German eggplant value chain is that the cultivation of eggplants is unattractive for German farmers because the profitability of the crop is low, especially in comparison to tomatoes which overall attain much higher yields (Expert 3). The low profitability is linked to the climate in Germany, which makes it necessary to cultivate eggplants in greenhouses which requires considerable investments and comes along with high fixed costs due to the energy needed for heating (Expert 3). In view of the currently soaring energy prices in Germany and elsewhere, this problem is likely to aggravate even further. Moreover, the supply of foreign eggplants is abundant and cheaper which puts a downward pressure on the prices for domestic eggplants (Expert 2).

Another general problem for the cultivation of eggplants is pests such as spindle or potato beetles which are sometimes difficult to control because the range of plant protection products allowed is getting smaller (Expert 2). In addition, bugs are becoming a problem because of climate change (Expert 2). For the eggplants that are cultivated in greenhouses it is possible to keep insects out without using chemical agents, for instance, by using nets or by increasing the air pressure (Expert 2).

Regarding biodiversity it is a challenge for the German eggplant value chain to diversify the cultivars used on a larger scale. While there already exists many varieties with different colors and shapes, the market is dominated by varieties with a dark purple to black color and an ovoid form (Expert 1; Expert 3). Other cultivars are hardly cultivated on a larger scale and only enjoy popularity among adherents of the urban gardening movement (Expert 3).

A related challenge is to stimulate the consumption of eggplants which at the moment is limited to a small group of consumers, namely those with a Mediterranean migration background (Expert 1; Expert 3). The low consumption of eggplants in Germany creates a disincentive for seed companies for whom it appears unprofitable to promote the use of new varieties on a larger scale (Expert 2). The consumption of eggplants in wide parts of the population might be low because the fruit vegetable's preparation is rather time-consuming as it has to be either cooked or fried (Expert 2). Another reason might be that there is a lack of knowledge on how to use eggplants in the kitchen because they have so far played no role in the German cuisine at all (Expert 2; Expert 3). A possible avenue to stimulate eggplant consumption in Germany could therefore be to develop novel processed products that require different eggplant cultivars as an ingredient (Expert 2).

Surveys show that the eggplant sector in Germany is underdeveloped. Indeed, the production areas and the volumes marketed are not very important. We note that there is little specialization of producers in this sector (1/3 producers is specialized) and the cultivated areas are relatively small.

The three producers surveyed are organic producers. Their marketing channels are diverse, but they all sell directly either online or on the farm. We observe that pricing depends on the objectives of producers. Little economic data was collected during the interviews. Organic certification seems to be a way for producers to better value their productions. Finally, access to seeds is one of the main constraints encountered by producers to develop varietal diversity.

We observe that varietal diversity among retailer is low compared to varietal diversity found among producers. Finally, for all players there is little specialization by variety of their suppliers and marketing channels.

The actors surveyed show a high probability of introducing new varieties into their activities. The demand for eggplant on German territory is low, it is the main constraint encountered by the actors (upstream and downstream) to introduce new varieties. In addition, the actors (3/4 actors surveyed) claim that the production/sale of a greater number of varieties would entail many additional costs.

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11. Analysis of the lentil value chain in Norway

The NVCR is part of the WP2 and specifically relates to T 3.2. We undertake several in-depth interviews with selected stakeholders in the lentil value chain in Norway to uncover details on the structure and interrelations of the value chains, and how these characteristics can affect efforts for increasing biodiversity.

The Norwegian Directorate of Health in 2015, recommended for the first-time lentils as part of a varied diet, since they often are high on nutrients. However, lentils are still not really utilized in the traditional or contemporary Norwegian diet. Moreover, domestic lentil production is on a very small scale or non-existent, and therefore the market and corresponding value chains for lentils remain limited.

The Norwegian market is characterized by relative high concentration and few actors within processing and retailing. Therefore, interviewing these actors can be particularly challenging for a couple of reasons, including -e.g., anonymity can be hard to maintain, personal opinions can be misinterpreted, interview material may not represent the official policy of the organization.

11.1. The value chain network

The main product on the Norwegian market is dried lentils; red and green lentils are sold in supermarket chains, while in addition brown, yellow and beluga lentils can be available in smaller grocery shops (some of them sell international and mostly imported food), or even online shops (Figure 22), while some cooked lentils are also available for consumers (Figure 23).

Figure 23 - Dried lentils at supermarkets in Norway

Figure 24 - Cooked lentils in Norway

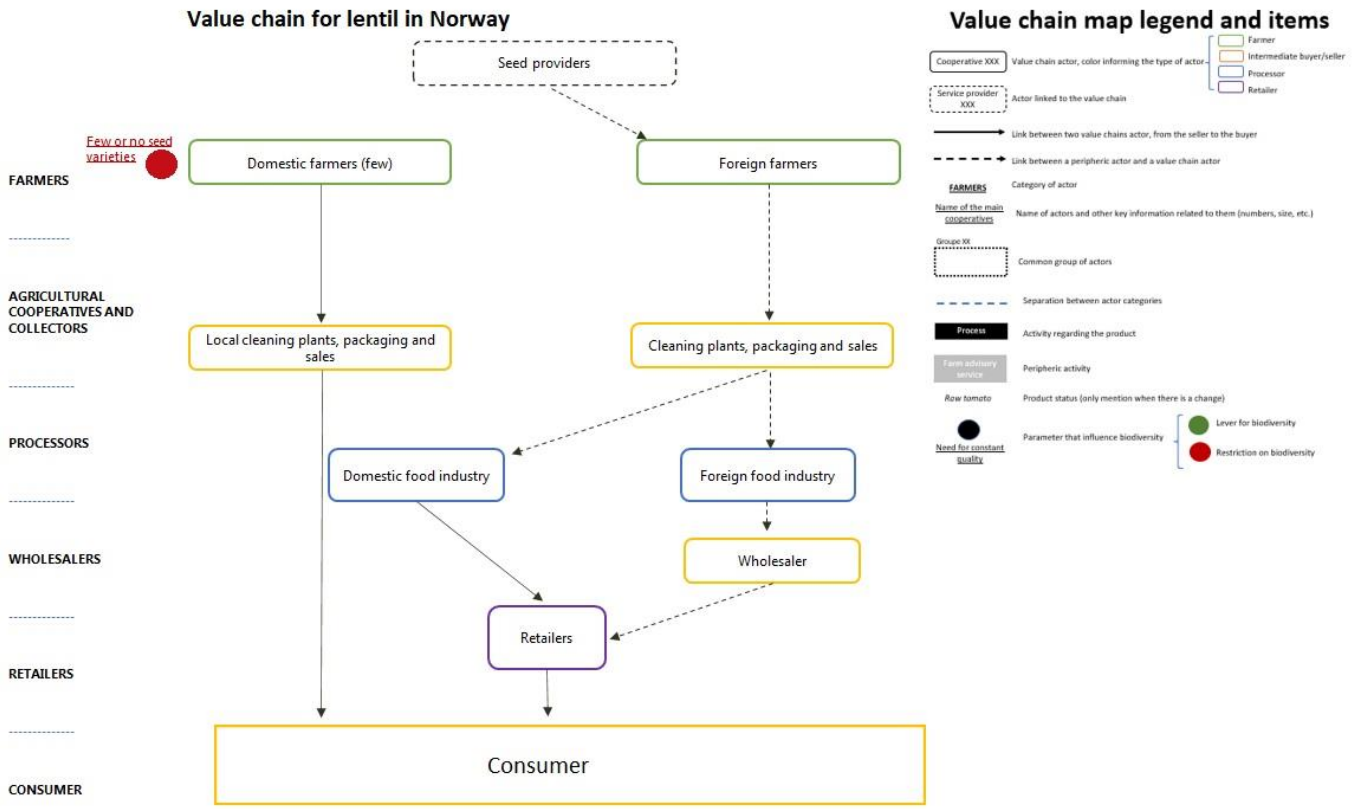
Dried lentils are also used in the food industry to produce various processed products – sometimes meat substitutes, ready-made dishes, and other plant-based products such as pasta, bread, and snacks (Figure 24).

Figure 25 - Examples of processed products containing lentils in Norway

Most, if not all, of the dried lentils consumed in the country are imported. Domestic production is extremely low or zero, depending on the year. There is only one known producer in Norway that has been active around five years, although his lentils production may not be continuous. His initial attempts to produce organic lentils faced the challenges of weed control and pesticide usage, so was restricted. Another attempt to domestically produce lentils was made around 2010 from another farmer, but apparently it was later terminated. In general, therefore the lentils in Norway are imported and these imports seem to be increasing over the last years, reflecting the general increase for demand on pulses. This background reflects to the lentil value chain that is still very small and restricted. Figure 25 provides a simplified, static graphical representation of some of the key elements in the value chain for lentils in Norway.

The bulk of the volumes come from imports that, depending on the product, follow different routes until reaching the consumers. Many of the imported volumes have already undergone at least some processing, typically they are cooked.

Figure 26 - Overview of the lentil value chain in Norway



Note that there exist no established sale channels for domestic production (due to the minimal, and sometimes non-existent) domestic production). However, this might change in the future.

A farmer we interviewed wanted to cultivate lentils out of curiosity. As he said, farmers often do small experiments. In his farm he also has, in addition, livestock production. Lentils had a small area in 2016, also a small area in 2017 (7-8 daa), in 2018 there was nothing and no cultivation until 2021. The farmer cultivates, in general, most of what is possible to thresh, and forage. Lentils are a good pre-crop, just like peas and field beans. They also leave a good amount of nitrogen and is a good pre-crop.

In 2021, there were 100 acres with lentils, and 100 kg of cleaned product per hectare with the CDC Robyn lentils. The potential is probably higher, with other varieties and perhaps also with better cultivation techniques.

Spring and sowing: lentils were sowed at the beginning of May or sometime in the change from April to May, and harvest was at the same time as the spring wheat. It is in the latter part of September.

For lentils, it is important to do good preparatory work in the spring. You have to be careful with the earthwork to remove stones, and it is also important to get it flat and nice. You drive with a low cutting table during the harvest, so it is very important to have good preparatory work. Lentils are sown shallowly with a regular sowing machine and lay at approx. 1-2 cm. When it is so shallow, it can be a challenge with germination moisture.

Weed management was done naturally with no chemicals. The farmer also did not have the opportunity to use a weed harrow, so there was a bit of manual weeding. However, he does not intend to do manual weeding any longer because he wants to be able to produce and deliver a large enough volume. To manage weeds, he sowed the lentils on an area with little weed pressure.

Harvest is around the same time as spring wheat, or maybe a little later. After all, lentils have a continuous flowering, and then an overripe and one gets seed and flower at the same time in the harvest. In that case, you just have to choose a time that you think makes sense to harvest. There is a lot of green mass and weeds that go through the machine. For conventional cultivation, it would have been nice to have an astringent, but that possibility has been taken away. If lentil production is going to continue, then it is necessary to investigate cultivation techniques a little better.

There was a tryout in 2018 or 2019, to co-grow lentils with oats. Lentils are a climbing plant, and the idea was that the lentils could climb the oats. It didn't go so well, because the farmer probably used the wrong ratio between oats and lentils, and then the lentils were probably outcompeted.

The stock height at harvest is very low and difficult to achieve threshing, and dependent on good conditions.

Like all plant production, lentil production has its peaks and then one hires in additional workers.

Lentils were delivered to processors (Moskvild) where they are cleaned. Then they were transported to Hoff. In 2021, there were 10 tonnes that Hoff bought (Hoff SA is a cooperative owned by Norwegian farmers, mainly potato farmers). They use the same threshing equipment as wheat, so there was also some wheat between the lentils. Pebbles and smaller stones could be sometimes difficult to remove.

The farmer is not interested in direct sales, and therefore he got in touch directly with Hoff. He made a batch for them of 10 tons but heard nothing more from them afterwards. There was no inquiry to buy more lentils from the farmer in 2022 and he is not producing in 2023 either. The farmer wants to only produce lentils on a contract basis.

A central processor in Norway has tried in the past to source local linter produce since the processing company is a cooperative and they wanted to use as much local produce as possible. However, the challenge they faced was the locally produced lentils were not of the right quality and therefore it was difficult to process them. Namely, the local farmer used a wheat thresher and therefore where gluten residues in the material and this created the main challenge since finished processed product should ideally be gluten-free and without allergens, something that was not possible to declare in the produce that was received. It is unclear if there has been any dialogue with the farmer to correct this or any new developments on this issue. In addition, sometime there are small stones that are found in the produced volumes, something that can also be a challenge for processing since the stone removal requires additional equipment.

Processing domestically produced lentils requires that processors purchase new equipment and cooking devices as well as proper "clean areas" around the processing units. Domestically produced lentils need to be cooked, while imported lentils need not to be cooked, (they are imported mostly from the EU, are usually dry, and need to only be soaked). In addition to cooking, domestically produced lentils need to have small stones removed etc., therefore creating some extra challenges.

Processors of lentils in Norway have the general impression is that it is mostly women who buy the finished vegetarian products. Perhaps this is because it is usually women who shop for food the most. Usually they are women under 50, not necessarily vegetarians, but people who want to reduce their meat consumption.

Processors typically consider vegan burgers and veggie buns as the most relevant finished products for the Norwegian market. However, they face a restricted vegetarian market where currently a lot of the products in Norwegian supermarkets are imported.

Processors face no regulatory challenge when it comes to lentils.

11.2. Profitability, drivers and main variables for variety/species choice

The bulk of the volume of lentils is imported in the country, therefore there are market considerations when deciding on these imports. Introducing varieties for domestic cultivation requires field trials to select proper strains that can sustain the challenging northern climatic conditions.

A farmer we interviewed explained how the seeds he used are obtained via the agricultural advisory service in Hjellestad. It was the CDC Robyn that had been bought in earlier in Norway. The farmer mostly did it because he thought it was fun and wanted to try to see if he could do it with the existing farm equipment. Moreover, lentils have been a bit of a trend and he wanted to try out.

To get hold of other varieties, the farmer has to consult with a seed company. He thinks it is from Canada that they will get the seeds. The adviser had some good alternatives that he wanted the farmer to try out, but now they have had other trial projects and cannot try too many things that they don’t know very well. Therefore, the farmer has not tested new varieties.

Norwegian processors did not have any standard requirements at the time they tried to source domestically produced lentils. When it comes to imports, Norwegian processors get a description from the wholesaler, and in addition have a requirement specification that describes how the product should be. The protein content is important and so is microbiological quality. The raw materials are mixed into a dough, so then the color is not so important unless it e.g. must be a product with corn, when the product should be yellow.

For Norwegian processors the most important thing is to bring in what fits best for the final product they aim to produce. They do not have any thoughts in relation to the variety or varieties and they believe that there aren't that many variants on offer either. Often the processors get a sample from the wholesaler they already use, then test how well the raw material fits into the production and finally order what is most suitable.

11.3. Price formation and market power

Prices vary a lot, where red lentils are usually cheaper than green lentils, while organic lentils are priced higher than conventional.

In a recent case of domestic production, the price was proposed by the farmer and the argument he used at that time was that this price was the necessary price so he would be able to deliver the products. However, Hoff was also interested to try lentils out, independent of the price. Of course,

this kind of price setting cannot be the template for how things should proceed when determining the price in the future. Price will probably depend on variety, cultivation technique, and yield. Better varieties and more experience, could probably make cultivation more efficient and then the farmer should manage to produce with a lower price.

At that time, the farmer took NOK 30/kg, and since he sold 10 tonnes he got in total NOK 300.000. That amount was not too much, and not enough for him to be willing to put lentils into a standard crop rotation. After all, harvesting lentils is different from harvesting oats.

Interestingly, the farmer does not have any certification for the lentils but as a principle he cultivates organic, and he did not used any chemicals.

Processors claim that the use of Norwegian raw materials can often affect the price of the finished product, and there is an uncertainty on whether the consumer is willing to pay for it. This can also affect the price in the market. Since the lentils is a very restricted market in Norway, in the past processors have bought directly from the farmer.

Norwegian processors do not buy certified organic lentils since it will make the final product more expensive. and the willingness to pay from customers is not there.

Processors get signals from their marketing departments that there is increasingly important to have local produce on their production lines. For example, Nyt Norge logo or alternative “produced in Norway” stickers are important (note that the former claims at least 75% of the raw materials are from Norway).

11.4. Feasibility, constraints and consequences of introducing more varieties/species/products

Lentil seeds have to be imported since there are no local strains available. The selection of the imported cultivars needs to take into account the challenging northern climatic conditions, therefore there is a need for more field trials and competence building on these issues. Some recent trials show promising results on the possibility of cultivating certain varieties in some parts in Norway (mostly in areas grain production already exist), although more research is needed.

A farmer we interviewed did not know if there is any potential for large lentil cultivation in his region. The cultivation areas, though, are in general constantly expanding, and it is possible that some varieties may also work, also in other places. Also, with a longer growing season should be easier to cultivate them. Moreover, dry conditions in late autumn could help, therefore Eastern Norway might work better. Overall, it is a matter of trying out on different areas of the country.

To have more farmers trying out lentils, mostly depends on the interest of the individual growers since they will have to put in some extra work. In Vestfold region, farmers have been traditionally eager and quick to try out new things. Perhaps this is happening because there are lots of full-time farmers there. It is difficult to experiment if you are not a full-time farmer.

The lentil cultivation only used traditional machines and there was no need for additional support. The farmer mentioned that as long as he has access with the advisors from NLR he can manage by himself. There is the understanding that there is not going to be a large increase in lentil production soon that might require a collaboration among a large team of producers.

The challenges, according to the farmer are probably threefold: harvesting, cleaning, and sales channels.

Harvesting: the lentils lie completely flat on the ground and are perhaps 5 cm above the ground. That is the challenge, although it is possible that other varieties are better than that. It is the same as with pea cultivation, where height is a challenge there too. A grass plant has more upright growth, but lentils are a climbing plant. If it has something to climb on, it will come sky high. The farmer believes in co-cultivation, but the one time he tried it he had a slightly wrong ratio on the seeds. It is a climbing plant and thus it collapses after ripening.

Cleaning: He used old seeds and fresh seeds with continuous ripening, and he thinks optical clean is the way to go, but not sure.

Sales: this is also a challenge. Perhaps through a farm shop it could be easier to sell to consumers. Sometimes it is possible to sell to neighbors. Nevertheless, it takes time to sell just a few tons. The main problem for him is that he should have been more interested in direct sales, but he already has enough work to do on the farm. Moreover, he is a bulk producer and selling lentils will be something different from what he does today. Farming is a marginal revenue industry, anyway so farmers can't try too many new things at once since it increases the uncertainty too much.

Especially when it comes to challenges on cleaning (pebbles) and traces of gluten:

The belief is that if there was a larger production volume and a big contract, then perhaps the farm could send the produce to larger processing units that have better equipment and more options when it comes to cleaning and optical purification. So, it is probably possible to clean the pebbles and perhaps also take care of some traces of gluten. The farmer does not think that pebbles are a major challenge overall.

There have been no quality standards set. The farmer has only sent in a sample, and there has been no discussion on quality standards from Hoff. Lentils were to be used as an ingredient in a vegetarian product, and the reason they wanted it is to get the Nyt-Norge label, and they (the processors) needed lentils to do that.

Norwegian processors require enough volume from domestically produced lentils in order to consider investing in a supply chain. In addition, local production will probably need more equipment therefore increasing the production costs, something that may not be supported by the current willingness to pay in the market.

11.5. Summary

Lentils, although are increasing in popularity, retain a small market in Norway. Domestic production is extremely small and some years non-existent, something that reflects to the value chain structure and the absence of sale channels for domestically produced lentils.

According to farmers we interviewed, lentils is a product that gets more popular, but the production so far has been very limited and out of curiosity. What is needed is a continuous sales channel and long-term contracts.

Processors are not particularly interested on the biodiversity elements of this value chain, but rather on the qualities of the produce and how these qualities reflect to the finished product. A major

element on their decisions is the processing costs (e.g., need to install extra equipment) and the characteristics of the final product.

Overall, the relevant market in Norway is small and concentrated. Supermarket shelf space is not cheap while there is always the danger of "cannibalism" among different varieties. Moreover, several actors have expressed their concern in various activities throughout the project that consumers can sometimes be confused from the many varieties.

12. Analysis of the tomato value chain in Norway

Tomatoes are botanically defined as fruits, since they form from a flower and contain seeds, but in most countries are treated as vegetables. Tomatoes are one of the cultivated vegetables in the world and in Norway commercial cultivation only takes place in greenhouses, although they can also be grown outdoors in some few areas.

Tomatoes in Norway are mostly sold in supermarkets and some volumes go to institutional trade: approximately 70% of the volume is directed to the various supermarket chains, while the rest 30% of produced tomatoes goes to institutional trade (e.g., restaurants, cantinas, etc.). Although we explore the whole value chain of tomatoes, we specifically focus on whole tomatoes that can be found in supermarkets. Such supermarket whole tomatoes come typically in four types: round tomatoes, cherry type tomatoes, cocktail type tomatoes, and beef tomatoes (Figure 26).

Figure 27 - Tomatoes at supermarkets in Norway

The most important quality characteristics are considered to be: size, shape, and overall condition (e.g., not having any visible blemishes or damage on the surface). Although tomatoes are most commonly sold as packaged, bulk tomatoes can also be found (Figure 26).

Apart from raw tomatoes, other tomato-based products or other secondary products are also found in the supermarkets (e.g., tomato purée, sauce, etc.), though they are usually imported due to high production costs in the country.

12.1. The value chain network

Despite the fact that domestic producers have the capacity to provide enough volumes for self-sufficiency, there have been traditionally significant imports due to the continuing high costs. Therefore, our estimates show that approximately 30% of the volume on the supermarkets in

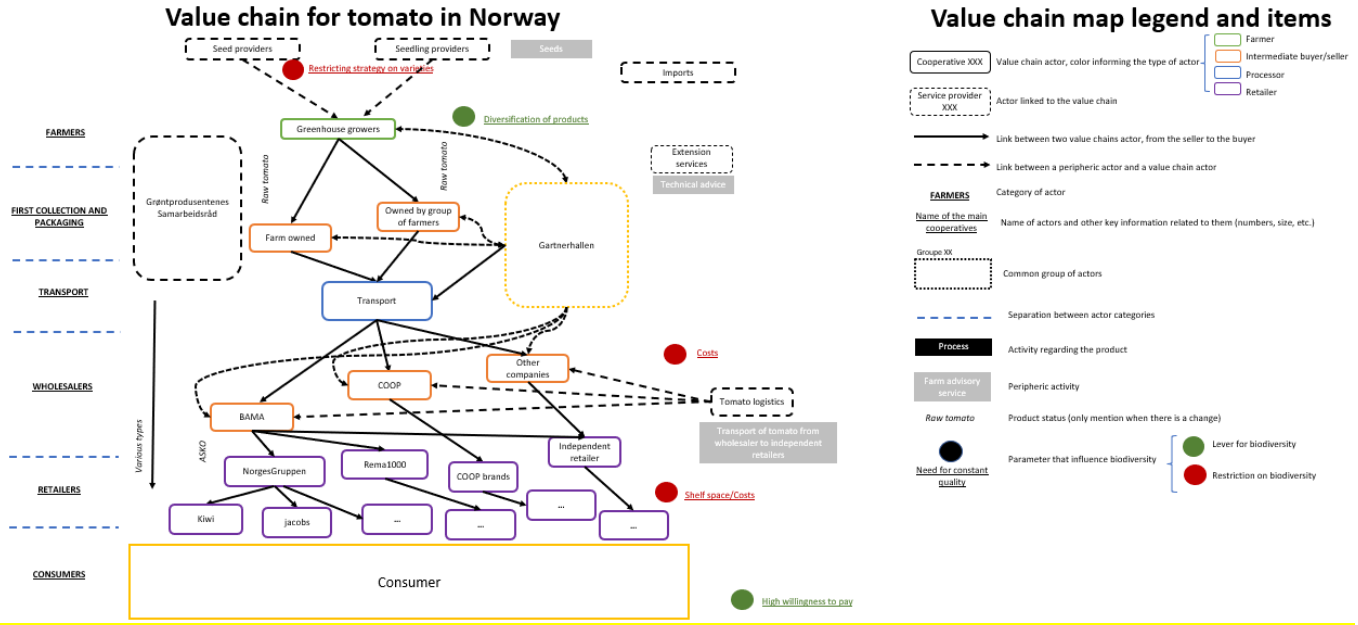
Norway are domestically produced, while the rest 70% are imported – mainly from Spain, The Netherlands, Morocco, Belgium, and Poland.

Domestic commercial production takes place exclusively in greenhouses, therefore having only minor fluctuations per year. The harvesting typically utilizes modern techniques and practices, therefore minimizing food waste and loss on the field.

Organic tomato farming remains limited and appears to be declining over the last years due to high production costs. Our estimates show that that only a very small percentage of the production can be considered as organic, approximately 2-3% of the total volume.

The overall value chain of tomatoes in Norway is restricted due to the small number of wholesalers and retailers in the country. Figure 27 is a simplified, static graphical representation of some key and selected elements in the tomato value chain in Norway.

Figure 28 - Overview of the tomato value chain in Norway



Some key players are Gartnerhallen SA, NorgesGruppen ASA, BAMA, and Reitan AS (formerly Reitangruppen). Gartnerhallen SA (https://gartnerhallen.no/) is a Norwegian producer organization covering fruit, berries and vegetables. NorgesGruppen ASA (https://www.norgesgruppen.no/) is the largest trading house. In Norway, having as its core business retail and wholesale within daily consumer goods. Bama-Gruppen AS (BAMA) (https://www.bama.no/) is the largest private distributor of fruits and vegetables in Norway. Bama is engaged in wholesale trading of both imported and Norwegian-produced fresh produce in fruits, vegetables, and flowers. Reitan AS (formerly Reitangruppen) (https://reitan.no/no) is a family-owned company with headquarters at the Lade farm in Trondheim. Reitan AS consists of three business areas: Reitan Handel is a trading house that includes the concept companies REMA 1000 (supermarket chain) in Norway.

Plant seeds are imported (mostly from the Netherlands) through a small number of foreign companies that produce and trade tomato seeds. Two suppliers are importing seeds for the Norwegian market: NORGRO AS (https://norgro.no) and LOG AS (https://www.log.no).

After leaving the greenhouses, the tomatoes are transported to packaging installations, usually owned by individuals or sometimes by a group of tomato growers. Afterwards, the produced volumes are transported to wholesaler storage units and ultimately to retailers and supermarket chains.

We interviewed a large cooperative that has become the country's largest supplier of Norwegian fruit, berries, vegetables, and potatoes, and of course tomatoes. The coop looks after the economic and commercial interests of its producers and has over 1.000 members all over Norway. Its total sales (over all its products) were over NOK 3.2 billion in 2022 and has about 65% of the market share of Norwegian-produced vegetables.

The market of fruits and vegetables in Norway is dynamic, and the coop has close connection with the other market players. Its most important task is the market-based production planning, while the coop also is responsible for managing market access and production plans; these plans are drawn up according to registered needs from their customers and the producers' production wishes and are thus built up in close interaction through the whole value chain, where the market players in the various levels cooperate to achieve market balance. The argument is that it would not be possible to achieve market balance without major players that cover the entire value chain and who have good insight of the total market and consumption patterns.

In the coop, each vegetable has its own central responsible producer that keeps close cooperation with the company, other growers, and customers. For instance, Kulturgruppen Tomat has 2 central responsible producers, one for listing goods round/cluster, and the other for special tomatoes.

We also interviewed a major tomato producer company that produces about 18.000 tons of tomatoes in greenhouses. The company is one of the two major tomato producers in Norway and produce many different tomato varieties (they produced 32 varieties this year). In addition, the company is testing out new varieties every year.

It is important to note that the processing and retailing sectors remain highly concentrated. A few large actors dominate the market while in smaller, usually niche, market segments other smaller actors are active.

12.2. Profitability, drivers and main variables for variety/species choice

The two seed importers NORGRO AS (https://norgro.no) and LOG AS (https://www.log.no)

provide individually an annual overview of available varieties in Norway. LOG provides currently over 50 different types of seeds, including caroleza (E15M.41000), annamay (coctail), favorita, sungold, tastery, vespolino, and many others (LOG updated list of seeds in Norway). NORGRO also provides several types including Redetto, Monil, Vacetto, Starbuck, Growdena F1, Gigawak F1, and many others.

According to the producer coop: there are constantly new varieties on the market, and this is largely based on what the customer needs. Restrictions on the number of varieties are largely at the market level – typically you want a relatively limited number of varieties in the shop, and it is important to have the right product mix, so that there is no "cannibalism" between the tomato products. The market is also constantly changing. Tomatoes in the low-price market are tomatoes with high yield potential. Tomatoes in the high-priced market often have lower yield potential. Although the coop does not directly work with marketing, it collaborates with the marketing companies and the organization "Opplysningskontoret for Frukt og Grønt" to promote Norwegian fruit and vegetables.

The major production company we interviewed, grows 32 varieties of tomato this year, but three are the main varieties:

Kis (from the seed company Ensa): it is a type of cherry tomato which, among other things, will be sold in 0.5 kg pails. They have 11,000 m2 of greenhouses for this variety and produce 22 tonnes a week of it. The reason for choosing this variety is that it has a nice shape (note from the interview: consumers buy mostly with their eyes), good taste, good durability and that it is resistant to a virus that is not yet found in Norwegian production, but resistance is important as a preliminary rule.

Extensa (from the seed company Ensa): It is a type of large, round tomato that is sold in bulk or in a bunch. They have 10,000 m2 of greenhouses for this variety. Their choice of this variety is based on the fact that it is easy to grow, has a good shelf life and gives a good yield.

Teistry (from the seed company Raiksma): It is a type of class 7 cherry tomato that is produced in a 10,000 m2 greenhouse. The choice of variety is justified as it is a good all-round cherry type tomato with a good yield and good taste. They sell in several locations, Meny's supermarkets with the brand Jacob's brand).

The other 29 varieties are produced on a relatively smaller scale. Their large production assortment is both to create diversity (especially for the restaurant and large household market, since chefs are often much more interested in testing out different varieties of flavors and sizes) and to test out new varieties for cultivation in Norway. For some varieties for testing, productions can be as small as just 50 plants.

In relation to profitability, the company argues that the economy on large tomatoes has seen worse, but for specialty tomatoes (such as cherry-type tomatoes) the market is on the way down. They also note that it is way more labor intensive with small tomatoes. For small producers, it is therefore now the best economy to produce large tomatoes. This is also connected with the subsidy schemes which are calculated per kilo of produce (up to a ceiling of 103.000 kilos.

In the greenhouse industry, there has also been a great deal of uncertainty regarding bedding costs and electricity support, but yesterday a two-year agreement on electricity support was reached, which means that there is now security in the economy.

The seeds are typically bought Dutch seed companies. The producer company we interviewed, together with another producer, travel once a year to these seed companies to look at new varieties. In 2022, they made contact with a new company, HV seeds, from which they try new varieties. Seeds for tomato producers from Norwegian companies are not sold, because the market is too small.

They have an agreement with farmer organizations and they sell through the processors' network to large supermarket chains (e.g. Norges Gruppen, Rema) as well as restaurants and big households.

12.3. Price formation and market power

Price formation for tomatoes in Norway follows special rules and governance framework. In general, prices are determined by an elaborate system, that is called Grøntprodusentenes Samarbeidsråd (GPS). GPS is effectively that price mediator between growers (through for example Gartnerhallen SA) and wholesalers. In practice, the wholesalers make agreements with Garterhalen SA that has its own agreements with the growers. GPS is informing the wholesalers on what is the possible price they can offer to growers and determines the price range (min, max, target price, and other price estimations) that guides the further pricing agreements among the value chain actors. When domestic prices surpass the maximum determined price, then some imports are allowed to keep the

price within the decided price range. These estimations are updated weekly and are available on online platforms (https://www.grontprodusentene.no/dashbord).

Farmers are usually organized through their coop and pricing comes after negotiations between the different market actors.

The other major production company we interviewed, explained that it is the producer organization that negotiates prices on behalf of the producers. There is a target price for round tomatoes and a fixed price is agreed for special tomatoes in the Norwegian period when there is customs protection (from 10 May to 15 October). Major supermarket chains want Norwegian production of some varieties and have entered into a fixed price. It would be a big risk to produce tomatoes in the winter without such a fixed price. It is impossible to compete against, for example, cherry tomatoes from Morocco (due to cost). Many producers also produce tomatoes a couple of months before and a couple of months after the Norwegian period since the expenses have all been spent on establishing the field, but in this period you can get almost only half the settlement for the tomatoes. Very few, if any, Norwegian producers produce tomatoes in the middle of winter.

12.4. Feasibility, constraints and consequences of introducing more varieties/species/products

On the farm/grower level there seems to be both incentives and willingness to introduce new varieties, especially since some varieties are typically associated with better taste (one of the key characteristics for assessing the marketability of the product). Moreover, any new varieties would not necessarily require substantial changes in the cultivation processes and practices, but rather some adjustments in the greenhouses (mainly related to indoor climate and fertilization. On the other hand, better taste tomatoes can achieve higher prices and, until very recently, Norwegian consumers seemed willing to pay a premium – e.g., Juanitas tomatoes from the Lauvsnes Gartneri (https://lgartneri.no/) and Skavland Gartneri (https://www.skavlandgartneri.no/), sold by BAMA; piccolo tomatoes from the Wiig Gartneri (https://www.wiig-gartneri.no/), sold in COOP.

A key challenge is on getting the necessary shelf exposure at the retail supermarket chains. Supermarkets face increasing restrictions on their physical space and, in general, retailers are not as enthusiastic as the growers when it comes to introducing new varieties and products. For some retailers the already existing product represent too many different types and introducing new varieties (and new product lines) will increase the pressure for shelf space. On the same line, wholesalers also are skeptical to new varieties since they may bring increases in certain logistical elements, including packaging and storage – e.g., varieties that have better taster appear to have shorter longevity.

The producer coop undertakes continuous innovation in tomato culture. Active work is being done with variety testing, where different varieties are tested for taste, quality, yield, durability, how they proceed through the value chain, etc.

Various special varieties are sold both in shops and in the large household market (e.g., rustic tomato under the brand name “Kort og Godt”) and various special varieties are sold to supermarkets under different brand names.

The major producer company we interviewed explained that the most important bottleneck for both current and future varieties is gaining market access. You can produce more than 50 significantly different tomatoes in Norway, but the grocery stores do not want more than 4-6 varieties of tomato

in their shops. It is feared that the different varieties will outcompete each other ("cannibalism"). In 2023, the aim is to further cut down to 2 varieties. More choices for the consumer can also result in greater wastage, if the consumer only prefers one of the varieties in the store.

In the grocery industry, you want safe products and a large volume for the varieties they have in their assortment. It is somewhat easier to enter with several varieties at the restaurant and large household market.

These challenges may be addressed from the consumers (e.g., if they demand more varieties in stores) or with fixed price agreements that can provide Norwegian goods beyond the "Norwegian period". Cultivation and available varieties are not a bottleneck. Advantages from new varieties include: greater diversity for the restaurant market and for testing new varieties.

The high concentration in the relevant markets, both when it comes to processors and retailers, brings many challenges to interviewing the relevant actors since anonymity is hard to be ensured, while personal opinions can also misrepresent official policies or be misinterpreted by the interviewer.

However, there are several key insights that were obtained through various activities in the project and are also relevant here. A key issue is the supermarket shelf space, that does not come cheap and therefore can limit new varieties. Moreover, there is also the danger of "cannibalism" among different varieties – i.e., consumers replacing one variety with another while the total consumption of the product is not really affected. In addition, there is the concern that consumers can be confused from the many varieties.

12.5. Summary

The market for tomato is important in Norway, although domestic production usually focuses on raw tomatoes. Processed tomato-products are typically imported in the country.

Domestic growers are organized usually in the coop and the pricing of the produce is a result of negotiations. Large market actors expand over the whole value chain and keep the market in balance. Such a structure is not limited to tomato, but also characterizes other fruits and vegetables.

13. Analysis of buckwheat value chain in Norway

Typically, nearly all buckwheat in Norway is imported and consumption remains very small. Currently there are no growers in Norway, although in the past there were some initiatives to cultivate buckwheat in certain areas (south and southeast) but they faced significant constraints from the lack of proper value chain channels since growers had to also develop their own sales channels for their produce.

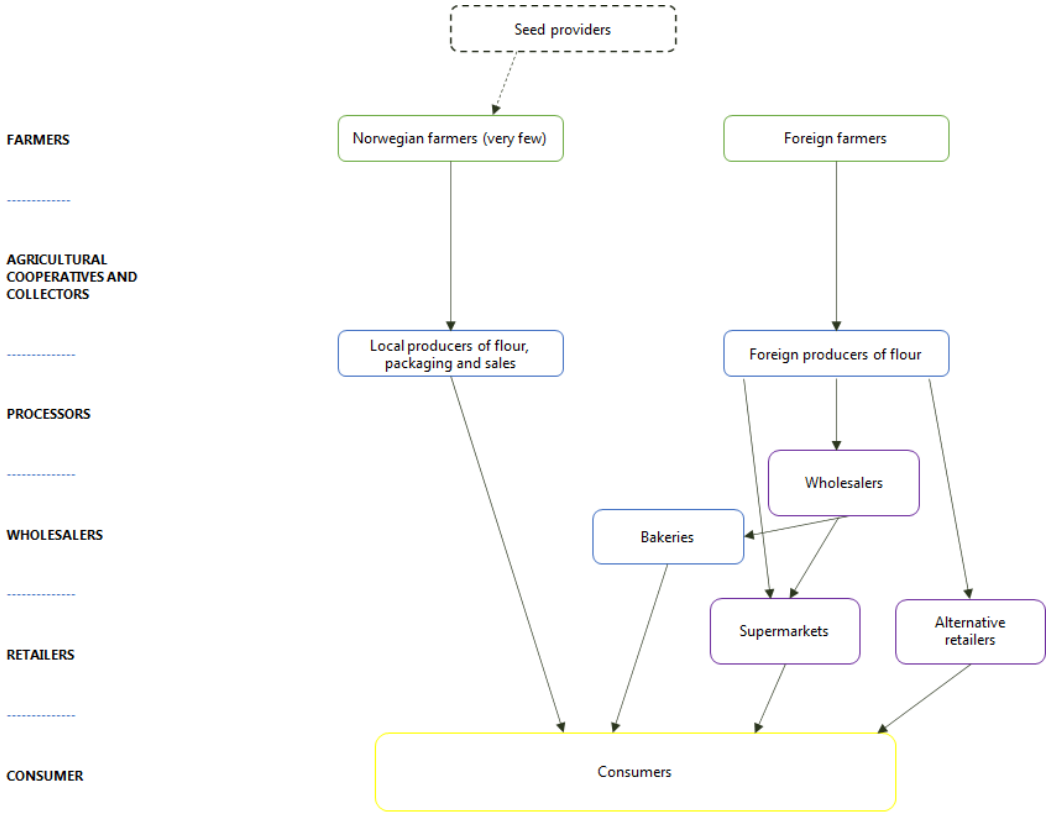
13.1. The value chain network

The market for buckwheat is very small in Norway and usually almost all volume is imported. There are currently no growers of buckwheat for food in Norway. Top five countries for buckwheat are: Poland, The Netherlands, Russia, Germany, and Lithuania. Relevant products are sold in grocery stores, in stores for health products as well as through internet-based companies. Some buckwheat and buckwheat flour are utilized by restaurants or bakeries producing different products based on buckwheat or with buckwheat as one ingredient.

Figure 29 - Examples of products with buckwheat sold in Norway

A main market segment for buckwheat is the market for gluten-free products (it is naturally free of gluten and can substitute cereals in several products). Buckwheat has a higher protein content than oats and this makes it interesting also for the production of other plant-based foods, something that is a growing market segment in Norway.

Figure 30 - Overview of the buckwheat value chain in Norway



We could not identify any specific value chain channel for domestic buckwheat production, therefore interested producers will have to invest in their own value chains, something that involves several activities, such as production, processing, marketing, and sales, either as individual producers or through a network of farmers, or alternatively in cooperation with consumers.

A production company we interviewed has tried in the past to grow buckwheat in the farm. In general, cultivation can go well in the conditions in Norway, although it can be a bit challenging to get enough ripening on some varieties. They used Lileja and Hajnalka in a three-year project where NIBIO was also involved at the beginning. They had the best experience with Hajnalka in relation to the fact that there was good enough ripening and a good yield and seed size for use as flour. They bought the seed from Strand Unikorn.

As of today, no one grows buckwheat for food in Norway. Some grow buckwheat as part of seed mixes for green manure or catch crops, which are also used for animal feed. This is widely used, among other things, in organic farming, since buckwheat in a mixture smothers many of the weeds and is a good pre-culture for other crops. Buckwheat is therefore also a good culture to include in the crop change.

One processing company we interviewed is a mill and works only with organic products that are produced in Norway. As of today, the mill grinds about 9-10 types of grain. They are particularly interested in traditional varieties, but also on trying out some new varieties. The company has contracts with 40-50 farms that grow the varieties/species the company requests.

At the moment the company does not have buckwheat products, but they have made plans for this and see opportunities in the future. Buckwheat will be relevant in the market if they can sell it with gluten-free products. However, there are strict rules for such production, and they must then have a

separate line for gluten-free production. They are therefore planning a new production facility, and then it is possible that they will also choose to have their own gluten-free line with buckwheat.

Although they do not have buckwheat, they know that there have been attempts at cultivation by a farmer in their immediate area and in any case, the company is only interested in buckwheat grown in Norway.

The potential for buckwheat in the Norwegian market is therefore on gluten-free products. Buckwheat is not a type of grain and is therefore naturally gluten-free. The same technology and type of machinery is used as for grain (thresher, dehusking machine and mill), and therefore the introduction of buckwheat will require separate production lines in order not to contaminate buckwheat with gluten. Only then can the product be sold as gluten-free. However, the market for gluten-free products in Norway is still relatively large and so there is potential.

Another processing company that was interviewed, argued that the problem with buckwheat is not the cultivation, but the handling afterwards. All products that are to be sold as gluten-free must be handled in their own machines that they do not harvest or process grain with gluten in it (separate installations). Basically, this was not a problem for them since they only have gluten-free varieties and species, but buckwheat has a triangular shape and a hard shell and therefore also requires a separate peeling machine. In the past they used an old machine for this but with that machine there was a lot of manual work and the result did not give a good enough quality of the flour/grit. To buy a separate peeling machine, will require an investment of NOK 10-15 million.

As of today, they therefore buy premium hulled buckwheat kernels from Poland and grind these themselves in their own mill into flour. They get the same price for the flour whether they have Norwegian or Polish buckwheat, which means that if they invest in a dehusking machine for their own buckwheat, it will still not result in higher income than they have today. In general, an investment in a separate peeling machine will be too expensive for them alone and can only be realized if several growers join forces.

One of the companies we interviewed has worked on the whole chain of the product since they used also to grow buckwheat. Now they refine buckwheat groats from Poland into flour and sell to large households and groceries, while they also have their own online store where they sell the same products. Therefore, the company is a (former) grower that is currently processor (grinding, packing and running a bakery) and retailer (some of the products are sold in their own online store).

The company sell three flour mixtures with buckwheat in 500 g packages for groceries and 25 kg bags for large households and bakeries. All their products are gluten-free and the company has a turnover of NOK 10 million.

13.2. Profitability, drivers and main variables for variety/species choice

Domestic buckwheat production remains very small or non-existent, and any future increase faces the challenge of cheaper imports, since buckwheat has no customs protection and is therefore difficult to compete with imported produce. The current small or non-existent production volumes also reflect on the poor infrastructure for handling the various steps in the value chain for buckwheat, therefore producers need to develop their own separate value chains.

The interviewees representing primary production confirmed that buckwheat was produced in small volumes in the past because of one project. Other crops (teff and peas) have entered the production because they are gluten-free and are nutritious alternatives.

No certification currently for buckwheat, but the product is gluten-free.

A processing company we interviewed has exclusively used to buy Norwegian production from their own contract growers in the local area. All their producers should also grow organically. They make contracts with the growers for the varieties/species they want to produce goods from (especially historic varieties/species such as einkorn).

The buckwheat they want to buy must be produced in Norway and be organic, and not be contaminated with products that have gluten.

The way the company brings in new varieties is that they test out different varieties and see how they fare both in cultivation and in the market.

Another processing company we interviewed is processing buckwheat that is imported from Poland, while in addition, they process teff that is imported from The Netherlands. The former because of its gluten-free characteristics, while the latter for its nourishing qualities and also because it is gluten-free.

Buckwheat is bought in as groats and ground into flour at their own mill and mixed into various flour mixes. Both sesame and flour, as well as baked goods (have its own bakery) will be products of buckwheat.

Another company we interviewed sells three different flour mixtures with buckwheat in 500 g packages for groceries. In addition, they sell 25 kg bags for large households and bakeries. All their products are gluten-free and they also have other gluten-free flour types: peas, rice and teff. All in all, the company has a turnover of NOK 10 million.

13.3. Price formation and market power

Today buckwheat production is mainly driven by curiosity, although some farmers see this as a potential economic niche. In particular, there might be the potential for a niche market that relates to the gluten-free foods segment. Some farmers also show an increased interest both for expanding their possibilities for crop rotation as well as for expanding biodiversity among their crops.

The exception of buckwheat from import restrictions and custom protection makes it difficult for domestic production to compete in the market, since domestic costs can be substantially higher.

Domestic production has been very limited or non-existent with one recent initiative that was part of a project.

A processing company we interviewed is selling its product to bakeries and through the supermarket chains Many and Coop Mega. In addition, the company has plans to produce various products for another supermarket chain, the Rema 1000 and its brand Kolonihagen. Moreover, the company is selling their products to the three main health food chains in Norway.

Products with the label Nyt Norge (i.e., produced in Norway) and Økologisk (i.e., organic produce) can get higher market price.

In any case, some key characteristics should be: gluten-free product, good overall quality, preferably Norwegian and self-grown, although now companies grind much of the flour itself from groats bought from abroad.

The price is determined after negotiations with the supermarket chains.

Today, a retail company we interviewed receives premium standards/quality buckwheat from Poland. For home-grown products, therefore, the quality cannot be lower. All varieties must be naturally gluten-free, and the equipment used for harvesting and possibly processing must not have been used for gluten-containing grains.

Buckwheat flour is sold in 500 g packages to the grocery market (especially Meny supermarket chain) and in 25 kilo bags to large households/bakeries. The company also has its own online store where the same products are sold. A key characteristic that is required is that the product is gluten-free.

13.4. Feasibility, constraints and consequences of introducing more varieties/species/products

One challenge is that there exist no landraces or Norwegian varieties. Moreover, local climatic conditions are characterized by a relatively short and cool summer season and there are few known buckwheat varieties that can adapt and yield good mature crops in such conditions.

One farmer we interviewed had made a few attempts to cultivate buckwheat locally and he thinks they could do it successfully also in a larger scale. That time though it was more of an experiment proposed by an adviser from NLR. In general, that farmer is willing to experiment if the NLR advisor suggest something.

Overall, it is relatively easy to grow buckwheat and a processing company we interviewed has available technology (and technical know-how) for husking and grinding. But, since buckwheat is only relevant as a gluten-free product, they must have room for a new production line for this to be relevant. They also have plans for building and developing such a production line.

On the other hand, there is great interest in new varieties/species, especially of traditional/historical importance. In addition, there are other market segments that then become relevant - such as the gluten-free market for buckwheat. The company has several special varieties in their range today and that is their advantage (in addition to the fact that their products are organic and Norwegian-produced). Because of this, they sell in health food stores, among other things.

Another market in which they are interested and in which they want to expand is the vegetarian market. Flour from legumes is particularly relevant here. Among other things, they sell pea flour for Holmen crisp's products. There is a growing market for plant products with a high protein content.

In addition, they sell legume flour as concentrate to their organic growers (who also have livestock). Since concentrate prices have increased a lot, this is profitable.

Investing in legumes with their growers is also important in terms of crop rotation, especially since the legumes are nitrogen-fixing.

One company we interviewed argued that it is possible for a processor to introduce new crops, and actually this company did it in the past – to introduce new varieties. But there is not always as much interest in the grocery market. For example, teff is somewhat difficult - a narrow market, and is much easier in The Netherlands, which has a larger population and various nationalities that have a tradition of eating teff (especially Ethiopians and Eritreans).

The main challenge for buckwheat has proven to be the handling after harvest - especially dehusking, as this requires separate machinery. Also the buckwheat grain has a triangular shape and is also very hard. To address these issues will require large investments.

In general, processors want more gluten-free alternatives to its range of flour and semolina.

All new species and varieties have their own challenges that must be dealt with. This can be difficult and require both knowledge and investment. For buckwheat, cultivation and harvesting are fine, but dehusking and cleaning the kernels is challenging and requires too much investment in new machinery. For teff, the seeds are very small and must be handled very gently when harvesting in order not to lose the crop.

In general, there is a small market but there is still demand for gluten-free products from consumers. The customers are mainly people with celiac disease or with intolerance to gluten. In addition, this market is somewhat linked to trends in nutrition (some years it was trendy not to eat gluten, but this is no longer so clear, so this market has stagnated). Also consumers who buy relatively expensive products made of flour and baked goods (flat bread).

13.5. Summary

Despite some recent initiatives, the market for buckwheat remains very small in Norway. Almost all volume is imported and there are several challenges for the domestic production -e.g., lack of sales channels for domestic production. Buckwheat can have potential for future growth, especially as an ingredient in the gluten-free market.

14. Conclusion

14.1. Lentil value chain

The lentil value chains in Italy, France, and Germany differ in terms of the actors involved, the diversity of lentil varieties, and the challenges they face.

In Italy, the dry lentil value chain is characterized by diversity in terms of farmers, processors, and retailers. The farmers have unique approach to lentil farming, processors have different strategies to ensure that their products are of high quality and reach their customers, as well as retailers have unique approaches to sourcing and producing lentils. All actors face challenges when introducing new lentil varieties due to low sales volumes, high processing costs, and risks of products expiring. The retailers also have different approaches to setting the price and sourcing their lentils. In the lentil pasta value chain, there are few producers, processors, and retailers. There is a processor market leader in Italian lentil pasta production and accounts for more than 50% of the market. The processors focus on innovation and developing new products, with processor targeting a specific demographic of conscious consumers who prioritize healthy and natural products. Retailers have different approaches to sourcing and producing lentil pasta products and have annual contracts with suppliers. The price difference between the retailers and private brands is significant, with some retailer positioning themself at a price point that is significantly lower than the level at which the reference brand arrives when it is discounted. In general, the lentil value chain faces challenges such as high fluctuation of yields, low lentil consumption, and high investment costs for cleaning and sorting facilities. There are efforts to increase the diversity of varieties, but the dominance of classic varieties makes it difficult to position new ones. All stakeholders agree that the new variety must meet market demand and be affordable and affordable. Overall, the lentil value chain shows a dynamic market with a significant place for national production and potential for innovation and new product development.

In France, the lentil value chain faces challenges such as high fluctuation of yields depending on weather conditions, fierce price competition with lentils imported from abroad, and low consumption of lentils in the French population. The actors of the value chain work on communication campaigns to stimulate consumption and support the development of new lentil products by start-ups. The high investment costs for cleaning and sorting facilities contribute to a lack of these facilities. There are facilitators and challenges in terms of biodiversity, with more than a dozen cultivars in different colors available in the French market. Both farmers and processors are unsatisfied with the existing lentil varieties because they are vulnerable to beetles, bad weather conditions, and grow indefinitely. However, the choice of cultivars is often driven by their availability, and non-green varieties are hardly cultivated. Organizations such as INRAE and Agri-Obtentions are already making efforts to increase the diversity of varieties.

In Germany, the value chain is organized in several ways. A large majority of imports from foreign countries are carried out by wholesalers and companies, and there is a rather large diversity of varieties. Local production is in the minority and largely organic, based on farmers in short circuits and local cooperatives, with perhaps a little less diversity because of the need to have varieties adapted to the terrain, and little research and innovation (varieties coming from France in particular). The choices are thus made by the intermediaries in the structured channels or farmers in short circuits. It is nevertheless a dynamic market with a significant place for national production and a possible interest from consumers for new varieties.

In Norway the lentil market is small and domestic production is extremely limited. Farmers believe that a continuous sales channel and long-term contracts are necessary to increase production.

Processors prioritize the qualities of the produce and processing costs, rather than biodiversity. The relevant market in Norway is small and concentrated, with concerns over shelf space and consumer confusion among different varieties.

Overall, the lentil value chain in these three countries faces challenges such as low consumption, high processing costs, and low sales volumes for new varieties. However, there are also opportunities for diversifying the number of cultivars in the market and increasing communication and marketing efforts to stimulate consumption.

14.2. Buckwheat value chain

The buckwheat value chain in Italy involves producers, processors, and retailers, each with unique practices and challenges. Farmers prioritize different farming practices, with some focusing on soil health and biodiversity through organic and regenerative agriculture practices. Processors process buckwheat from both Italy and abroad, emphasizing the added value of Italian origin, organic certification, and traceability. Retailers emphasize the importance of clear and concise information on nutritional properties and health benefits, as well as the need for sustainable and eco-friendly production methods and traceability. Buckwheat faces challenges such as low yields, high production costs, and potential allergenicity, but also has the potential to meet the growing demand for gluten-free products. The lack of commodity markets for buckwheat contributes to its high price volatility and makes the market unpredictable and challenging for both buyers and sellers.

The buckwheat value chain in Germany is poorly organized and largely based on imports, with limited diversity due to the already specific nature of the product. While potentially dynamic, the market remains limited due to the higher cost compared to other cereals, and the interest seems to be higher among organic than conventional farmers. Seed providers are also interested in adding buckwheat to their portfolio.

In Norway, the market for buckwheat is small, with almost all volume imported. Domestic production faces challenges such as the lack of sales channels. However, buckwheat can have potential for future growth, especially as an ingredient in the gluten-free market.

Overall, the buckwheat value chain faces challenges such as low yields and high production costs, but also has potential for growth due to its gluten-free properties and potential for use in a variety of products. Coordination among actors and the development of commodity markets could help to stabilize prices and ensure successful production and marketing of buckwheat products.

14.3. Tomato value chain

The tomato value chain in France involves a wide range of actors, including producers, processors, and retailers. Tomatoes are a highly diversified product in terms of color and shape, with an emphasis on taste quality and preservation. Producers seek to offer diversity to their customers, with the criteria for selecting varieties based on quality and taste rather than price. The distribution channels of the producers are diverse, but there is little specialization of the circuits according to the varieties. Retailers also offer a wide range of tomatoes and are looking for varieties with interesting taste qualities, sometimes betting on novelty and originality. Independent distributors have more facilities to introduce new varieties and work with several suppliers than supermarkets that mainly work with central purchasing bodies. Economic data by variety is not known by producers or suppliers, and prices are set based on the costs and margins of each actor, while ensuring affordability for consumers.

In Norway, the market for tomato is important, and domestic production usually focuses on raw tomatoes, with processed tomato products typically imported into the country. Domestic growers are organized usually in the coop, and the pricing of the produce is a result of negotiations, with large market actors expanding over the whole value chain and keeping the market in balance.

14.4. Fourth range products and young shoot

The fourth range vegetable value chain in Italy consists of producers, processors, and retailers that work together to produce and distribute processed vegetables. Farmers mainly cultivate crops conventionally, with some of them prioritizing baby leaf production and selling most of their supply abroad. Farmers focus on market demand and soil quality in their crop selection, adopting farming strategies in order to using winter crops for double harvest or planning to diversify with oriental varieties. Processors are Producer Organizations (PO) that produce and sell fresh vegetables to large-scale retail trade. Retailer are specialized in selling leafy vegetables, pre-washed, cut, and packaged for consumers' convenience. The value chain focuses on meeting customer demands and maintaining high-quality standards for their crops: processors focus on certifications schemes and retailers focus on convenience and meeting customer demands. All actors in the value chain face challenges related to production costs, labor supply, and introducing new crop varieties due to inflexible consumer demands and the need for guaranteeing the cold chain.

In France, the market for young shoots is dynamic, innovative, and diversified, but limited in size due to competition with neighboring countries in various value chains. The sector is highly concentrated and integrated, with producers' organizations or private operators packaging and selling to supermarkets, and farmers subject to significant investments to make their farms profitable. The central actors make most decisions, and they are oriented towards large markets and global valuation. The prices of young shoot products must be kept sufficiently high to secure the income of the value chain actors and prevent further decline of production surfaces and volumes. The main issue is resistance to diseases like mildew, and the actors look for visually interesting and stable products that are reassuring beyond taste. They test new varieties and put them on the market, looking for mechanization, disease resistance, yields, and period.

14.5. Eggplant

The eggplant value chain in Germany faces several challenges that make the cultivation and marketing of the crop unattractive to farmers and retailers. One major challenge is the low profitability of the crop due to high fixed costs associated with greenhouse cultivation, especially in comparison to more profitable crops such as tomatoes. Additionally, pests such as spindle or potato beetles, and bugs that are becoming a problem due to climate change, make it difficult to control the crop, and the range of plant protection products allowed is getting smaller. Furthermore, the lack of diversity in cultivars and low consumption of eggplants among the wider population creates a disincentive for seed companies to promote new varieties and retailers to introduce them into their activities.

The eggplant value chain in Germany is not specialized, and producers' cultivated areas are relatively small. The few producers that specialize in eggplant cultivation are organic, and they sell directly either online or on their farms. Organic certification is one way for producers to better value their productions. There is a high probability of introducing new eggplant varieties into the market, but the demand for eggplants in Germany is low, making it a challenge for actors to introduce new varieties, as it would entail many additional costs.

There is little varietal diversity among retailers compared to producers. The market is dominated by varieties with a dark purple to black color and an ovoid form. The lack of variety in eggplant

consumption in Germany creates a disincentive for seed companies to promote the use of new varieties. The consumption of eggplants in Germany is limited to a small group of consumers, namely those with a Mediterranean migration background. Therefore, there is a need to stimulate eggplant consumption among the wider population by developing novel processed products that require different eggplant cultivars as an ingredient.

In summary, the eggplant value chain in Germany faces challenges related to low profitability, pests, lack of diversity in cultivars and consumption, and access to seeds. However, there is a high probability of introducing new varieties into the market, and organic certification is a way for producers to better value their productions. To stimulate eggplant consumption among the wider population, there is a need to develop novel processed products that require different eggplant cultivars as an ingredient.

15. Policy recommendations

Market forces are not able, by their own, to valorize biodiversity and agro-diversity. Only for specific cases, such as the situation of tomato, agents see a favorable situation for the diversification of the supply. Tomato can guarantee a high level of diversification due to the high aggregated demand for this product and to a sufficiently high level of diversity between varieties, that permits the consumer to easily recognize them and to appreciate the specific characteristics of each of them.

On the contrary, when the demand is not very high, or when diversity is less evident to the eyesight or to the taste, the basic elements for a spontaneous valorization of agro-biodiversity are missing. These elements are normally associated to the lack of a sufficiently high and constant supply of specific local varieties, which does not permit to the modern distribution to organise logistics in sufficient volumes and to guarantee product availability for consumers.

With this situation, a policy intervention is probably required in order to enhance the preservation of local varieties, frequently associated with aspects of local history, tradition and culture. Policy intervention can intervene both at producer's and at consumer's level.

At producer's level, local institutions and farmers groups (including Local Action Groups (LAGs) and Producers' Organizations (POs)) should be fostered to develop certifications and private brands that permit to recognize local specialties. In the case of Italian and French lentils, products with PGI/PDO label are among the few local specialties that have been able to attract the interest of the large distribution and to obtain a price premium. The creation of specific POs, cooperatives or consortia that are authorized to use the label permit to increase the number of farmers interested, to increase and stabilize the annual supply, and to create a new intermediary that can make contracts with large retailers. All these aspects should be supported by local, national or communitarian schemes.

Furthermore, CAP initiatives, and in particular eco-schemes, should support the cultivation and diffusion of all underutilized species, in particular legumes and other species used in rotation with more traditional crops, as is the case of buckwheat.

For the more labor-intensive crops, such as leafy vegetable, farmers and POs have highlighted the shortage of labor force. This aspect is a threat for the sector in general; in a more specific way, it can

lead to a shift towards crops that require less labor intervention, with arugula being the crop that requires the most assistance and control. In this framework, labor policy should consider the necessities of these specific sectors. This includes issues of migration policy, since problems have begun during and after the COVID period, when the quantity of migrant labor has decreased.

From the consumer's side, some policy intervention, maybe related to the use of nudges, should be considered. It should be important to stress the ecological and cultural benefit of protecting and propagating local varieties; aspects related to health and taste should also be considered. Communication methods should use different media, highlighting the history of these product, their healthy and culinary potential, and the geographical links.

16. Market related and practical recommendations

The Italian and French lentil value chain has shown clever examples of best practices, where farmers located in areas of historical and traditional production of local specialties (somehow identifiable with local lentil ecotypes) have been able to build specific organizations (cooperatives or consortia) for the creation of IGP/DPO labels and, successively, for a common commercialization of the product. This process is able to guarantee large and stable supply and can attract the interest of both processors and large retailers. This approach is recommended wherever local production can be certified with similar labels. Labels can work as an incentive for other producers to return back to neglected species and varieties. In this way, even productions that initially seem to be marginal can gradually increase in time, attracting more and more farmers, and as a consequence, opening new markets that need high and stable supply.

In the case of leafy vegetables, POs have shown to be the functional tool to connect farmers and large retailers. POs can establish contracts with national retailers, guaranteeing quantities and standardized quality. Internally, POs decide how to share the different species needed among their members (and, if needed, recurring to external providers). Farmers can take advantages of secure and stabilized markets. POs can also have partners in a large and scattered territory in order to take advantage of different climatic conditions. This model could be exported for more critical value chains, as it is the case of eggplant in Germany. In this case a campaign at consumer level could also be necessary, an activity that POs can realize in a much more efficient way, compared to single farmers, recurring to their operational programs.

All the value chains analyzed show that contracts are the main tool used to maintain the stability of the exchanges among farmers, processors and retailers. In some cases, agreements do not establish a fixed price but leave the price to be decided at the moment of the exchange. On the contrary, contracts made with retailers normally establish a price that is valid for a determined period (for one year or less than one year). The year 2022, characterized by strong inflation of raw materials and energy, has shown that contracted prices can in some case be renegotiated and, in some case, not. The market and contractual power of the different agents involved in the relation is determinant in this relationship and indicates that aggregation and horizontal coordination is always a relevant instrument for obtaining better sale conditions and for setting up innovative supply chains. Specific certifications and labels (such as IGP and organic label) are normally able to obtain price premium in contracts, compared to standard spot markets.

Whenever quantities of local varieties and specialties are not sufficient for a large distribution, agro-biodiversity should be valorized through local channels. Even in the case of large-scale retailers, local stores should be encouraged to pursuit independent strategies that valorize local products and

varieties. Thus, they should be able to make contracts that are independent from those made at centralized level and that can encompass only products that guarantee sufficient and constant supply (in terms of quantity and quality) for national distribution. In this way, the creation of a network of regional stores each of them supplied by local products that valorize diversity would be fostered. Whenever the success obtained at local level (where the product is better known and can be better appreciated by consumers) attract new producers, the strategies previously considered (e.g. horizontal coordination through cooperatives, consortia and POs; development of new labels) can be taken in consideration to scale up the distribution to larger and larger areas and to establish marketing campaigns.

17. Annex I: Focus group guidelines

Baseline timeframe

H – 5 min	Welcome of participants: distribution of a pen and paper
H + 10 min	Introduction: - Short presentation or reminder of the context and objectives of the focus group - Presentation of the instructions - Roundtable
H + 20 min	Focus group
H + 2 h	Closing: conclusion, thanks.

H: start time of the focus group

Objectives and context: To identify consumer preferences in relation to certain food products and their biodiversity. We focus our study on 3 raw products on different countries, as described below:

Countries	Germany	Norway	Italy	France
Value chains / raw products	Buckwheat	Tomato	Sonchus (leafy vegetables – lettuce and/or spinach)	Sonchus (leafy vegetable – lettuce and/or spinach)
	Eggplant	Lentils	Lentils	Lentils
	Lentils	Buckwheat	Buckwheat	Tomato

List of end products per value chain:

Raw product	1.Tomato		2.Eggplant	3.Buckwheat		4.Lentils			5.Leafy vegetable	
Country	Norway	France	Germany	Germany	Italy	Norway	France and Germany	Norway	Italy	France	Italy
End product 1		Raw	Raw	Flour	Flour		Dried		Flour	Fresh	Fresh and unpackaged
End product 2		Coulis or sauce	Cooked (canned, caviar, etc.)	Hulled	Pasta		Canned		Pasta	Frozen or canned	Fresh and packaged

Instructions:

I'm going to ask you some questions: please feel free to say what you truly think.

- It is your personal opinion that interests us (say "I" and not "people")
- Speak loudly, not all at once
- Do not interrupt
- All opinions are interesting; no one is right or wrong (we don't censor ourselves; we don't censor others)
- MOBILE PHONES OFF
- If you have any further questions, we will be happy to answer them (if possible) at the end of the exercise.

Table talk:

Breaking the ice:

- Name - First name - Activity ➔ Everyone writes their first name on an index card
- What does diversity in food means to you? In one sentence.

Instructions for the moderator (not to be mentioned during the focus group: A difference must be made here between raw products, indicated in the questionnaire by [name of raw product] and end products indicated by [name of end product]. The different end products to be investigated for each raw products are indicated in the table on page 2.

Ask the questions below for each theme for all the value chains: ask all the questions for the product with the lowest number in the table on page 2 (for example for Norway: 1. Tomato). When the questions deal with finished products, ask the question for the 2 end products by raw product (see table on page 2). After each question, ask if there is an identical perception for the raw or end product with the second lowest number (3. Buckwheat for Norway) and then the one with the highest number (4. Lentil for Norway). Proceed in the same way for all the questions.

H+20 **40 min**	**Theme 1: importance and knowledge on biodiversity** 1. Do you know the different cultivars of [name of raw product]? What are the differences between the cultivars? 2. Do you pay attention to the cultivar of [name of raw product] you buy? Why? Specifying for different [name of end product] products *(see list)* 3. Does more diversity in a product is perceived as positive for the product? Why?
H+1h00 **40 min**	**Theme 2: product choice and price criteria, place of purchase** 4. For the different [name of end product] based on [raw product name]: What are the main criteria for choosing [name of end product]? 5. How do you find out about these criteria and cultivars? What sources of information are there in the shops? What sources of information outside the shops? 6. For criteria other than price, how do they affect the price you are willing to pay (you'd pay more/less/equal)? Especially regarding cultivars? 7. Regarding the places where you buy [name of end product] do you have a wide or narrow range of choice regarding cultivars used? 8. Do you choose certain places of purchase to have specific cultivars in [name of end product]? Does more diversity in a product is perceived as positive for the place of sale?
H+1h40 **20 min**	**Theme 3: ways of using the different end products** 9. For the different products based on [name of raw product]: how do you mainly use or cook these types of products? Does your use have an impact on your choice of cultivar or the importance of the cultivar? Why? *10. Optional question: when was the last time you tasted a new cultivar? In which condition (product, place) and how would you describe it?*
H+2h	Thank the participants

18. Annex II: Supply chains actors interviews: questionnaires

18.1. Questionnaire – Farmers – 1A

Notes in blue are for interviewers. This questionnaire integrates needs of WP3 and 8.

Questionnaire A is intended for relatively abundant crops, where we are interested in understanding the potentiality and feasibility of increasing the number of varieties of a target crop along the value chain. The choice to use questionnaire A must be done by local partners as country experts of the national value chain analyzed.

Even if we are interested in some quantitative indicators and parameters, this survey must be considered a qualitative interview, where important information can be collected even if the specific questions of the questionnaire are not completely covered. In some cases, even if true numbers cannot be collected, proxies or qualitative information is better than nothing. For example, if the respondent is not able to provide us the 2021 price of a specific variety A of lentil, it could be useful to obtain information such as:

a. *Around 20% less that this year, or*
b. *A little more than variety B*

Basic information:

A) Name of the firm: _____
B) Address: _____
C) Name of the respondent: _____

Questions at farm level:

1) What are your main farming goals: Indicate if you agree or not with the following sentences.

My main farming goals are…	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Maximizing farm profits					
- via increasing productivity					
- via reducing costs					
- via increasing product quality					
Increasing farm capital value					
Being recognized as a successful farmer					
Working independently and making own decisions					
Protecting the environment					
Making valuable contribution to your community					
Other (specify):____					

Other (specify):____					

2) Please provide information on the crops produced at your farm (including area, costs, and type of production – conventional or organic). Please use the data based on the season 2021.
Share of variable cost of each crop is not essential, but focus on total variable production costs of the farm and the share of the target crop

Farm's crops	Number of varieties used per each crop	Area (ha)	Share in total variable production costs (%)	Type (organic, conv.)
		Total arable area:	Total variable production costs:	

3) Please provide information on farm labour:

Number of persons employed in the farm: _____
Total time worked: _____person-hours/year
Share of time worked devoted to the target underutilized crop:_____-% total time worked.

Questions on a specific targeted crop:

4) Yearly quantity of crop sold *(e.g. lentil)*: _____tons
   - Specify the nature of product sold *(e.g. fresh, dried, semi-processed)*: _____
5) Name of varieties *(or other taxonomic category, depending on crop)* used: _____

Seed provider portfolio for the analyzed crop *(e.g. lentil seed)*

6) Type of provider:

Type of provider	Number of providers	Variety name(s)
Produced in farm		
Public authorities (Specify:_____)		
POs/Cooperatives		
Specialized seed seller		
Provided by the buyer		
Other		

Clients portfolio for the analyzed crop *(e.g. lentil)*

7) Type of client:

Type	Number of clients	Quantity sold on total for the crop (%)	Variety name(s)	Type of transaction*
Cooperative or PO (specify if the farmer is member or not)				
Wholesalers Traders/intermediaries				
Traditional retailers (i.e. small shops)				
Large retailers				
Processors				
Consumers				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative, other...

If for one client category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.

Notes:_____
_____
_____

8) Which quality standards is required by the client (e.g. size, color, protein content, etc.) Please specify and indicate if there are differences among varieties and/or clients, and the reasons for which that standards are required

Required standard	For which variety	For which client	For which reason

9) How is the price with clients decided? (Several options possible, if necessary indicate for which type of client)

Rank clients by importance. Insert (x) for the right combination of price formation type and client. If for one client several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Client 1 _____ Specify the variety: _____	Client 2 _____ Specify the variety: _____	Client 3 _____ Specify the variety: _____	Client 4 _____ Specify the variety: _____
Auction				
Spot market				
Fixed by the client				

Fixed by the farmer considering his/her profit margin objective				
On the base of some reference market (specify which one: _____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

Notes:_____
_____
_____

Structure of costs and prices per variety

10) Provide the following information for 3 varieties *(or other taxonomic category, depending on crop)* currently cultivated *(if more than three varieties are used, choose a mix of commercial varieties and traditional/ancient/neglected/local specialties).*
If the respondent is not able to provide a specific value (e.g., the 2021 price of variety A), it could be useful to obtain alternative proxies, qualitative or comparative information such as:
a.Around 20% less that this year, or
b.A little more than variety B

	Main variety _____	Second variety _____	Third variety _____
Volume share of the variety on total volume of the crop (%)			
Price of the seed (€/kg) in 2022			
Main reason for the choice of that variety (e.g., price, quality, availability, requirements from downstream actors)			
Typical yield of the crop (per ha)			
Average price of the product (€/kg) sold in 2021, at company gate net taxes (otherwise specify)			

Average price of the product (€/kg) sold in 2022, at company gate net taxes (otherwise specify)			
Weight of labor cost on revenue (%)			
Weight of variable costs on revenue (%) in 2021			
Weight of variable costs on revenue (%) in 2022			
Conversion coefficient from raw material to final product (ONLY if semi-processed by the farmer)			

Other prices and biodiversity aspects for the targeted crop

11) Are you dealing with certification schemes that affect the price of the product sold and how? (Yes/no + specify the effect on price)
   i. Organic _____
   ii. PDO/PGI labels _____
   iii. Other _____

12) Do you think other varieties are potentially feasible for your area? (YES/NO) ____, which ones?__

_____

13) Have new varieties been introduced in your activity recently? (YES/NO) ____

14) How would the price of the product be decided for a new variety never sold (open question)?_____

_____

15) How are new varieties introduced in your activity (or could be introduced)?
- ☐ As a request from clients
- ☐ As a suggestion from seed producers
- ☐ As your initiative:
  - ○ After market analysis on consumers' preferences
  - ○ Copying other farmers
  - ○ Following research developments
- ☐ As an effect of policy decisions

16) Do you think farmers can introduce new varieties on their own initiative? (YES/NO) ____, and why?
_____

17) Which category of farmers can do it more easily (open question)? _____

Problems and expectations

18) What are the main constraints/ bottlenecks that you face within production and marketing of the targeted crop (please specify the constraints that are unique for this crop in comparison to other crops produced at your farm)? Choose those that are applicable and rank them according to their impact on your activities (1 for highest impact). What are your current strategies to deal with these constraints?

Notice that this question is focused at crop (not variety) level. Firstly, read all the listed constraints/challenges, and then make the respondent to define the rank. Choose exclusively problems that are significant for the targeted crop, not for the farm activity in general.

Constraint/ challenge	**Rank of impact on your activity**	**Solution strategy**	**Please rank the strategies based on the costs (1 for the most costly)**
Accessibility to seeds (of species or variety)			
Insufficient land			
Insufficient labour capacity			
Insufficient information on cultivation techniques			
High production costs			
Climatic conditions			
Insufficient demand			
Lack of infrastructure to handle various steps along the value chain			
High competition at the market			
Other (specify)			
Other (specify)			

19) What are the main limitations/bottlenecks for the introduction of a new variety in your activity? Indicate if you agree or not with the following sentences.

Notice that this question explicitly refers a new variety different from the main variety(ies) normally cultivated. It can be the opinion based on a recent introduction, or the opinion based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

Limitation/Bottleneck	I fully disagree	I somewhat disagree	Neither agree nor disagree	I somewhat agree	I fully agree
New technics and standards are required					
Other varieties lack some characteristics needed for processing (which ones? _____)					
Production costs with other varieties would be higher than with main varieties (i.e., **variable costs**)					
There would be high costs for adapting the production line (i.e., **fixed costs**)					
There is insufficient demand					
It is difficult to have access to seeds					
There would be high advertising costs					
There are limitations linked to public policies and regulation					
Other _____					

20) Considering the limitations that you perceive in the introduction of a new variety, how likely would be that you introduce a new variety in your farm in the next future (score from 0 to 10, being 0 not at all likely and being 10 very likely)? _____

21) What are potential ways of overcoming the obstacles in the introduction of new varieties? (several answers)
□Public incentives
□Awareness of the consumer
□Processor support
□Retailer support
□Other _____

22) How likely is the possibility that you introduce a new variety in your farm in the next future if the incentives/facilities you indicated were provided (score from 0 to 10, being 0 not at all likely and being 10 very likely)? _____

23) Expectations: which effects would you expect from farming and trading a higher number of varieties? Indicate if you agree or not with the following sentences.
Notice that this question refers to cultivate several varieties at the same time (more than the number currently cultivated). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	I fully disagree	I somewhat disagree	Neither agree nor disagree	I somewhat agree	I fully agree
… improve the economy of farmers					
… improve the environment					
… increase the number of clients					

… foster the creation of stronger vertical relations					
… improve the access to retail markets					
… improve the access to processing markets					
… increase the revenue of clients					
… improve the reputation of the enterprise on the long term					
… Other _____					

24) Expectations: which commitments and costs would you expect from farming and trading a higher number of varieties (without increasing the cultivated area)? Indicate if you agree or not with the following sentences.
Notice that this question refers to cultivate several varieties at the same time (more than the number currently cultivated). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… increase complexity in the management of plots					
… require new dedicated spaces (including storage)					
… increase the work to separate the products					
… require structural adjustment of the farm					
… worsen productivity and efficiency of processes					
… increase variable costs					
… increase work to find clients and markets					
… increase planification activities and documents					
… require increased training for workers					
… Other _____					

25) Which climatic changes have the biggest impact on your agricultural activity (in particular on the targeted crop)? Choose those that are applicable and rank them according to their impact on your activities (1 for highest impact). What are your coping strategies in relation to the following climatic changes? What are your current actions and adaptation actions in case of forthcoming changes?
Notice that this question is focused at crop (not variety) level. Firstly, read all the listed constraints/challenges, and then make the respondent to define the rank. Start from problems that are significant for the targeted crop, and then, if you have time, consider problems for other farm activities.

Environmental changes	**Rank of the impact on agricultural activity**	**Adaptation/ Coping strategy**	**Please rank the strategies based on the costs (1 for the most costly)**
Increased temperature			
Decreased temperature			
Increased precipitation			

Decreased water availability			
Drought			
Increase in extreme heat days (days with temperature over 30 degrees)			
Extreme weather events (e.g., storms, floods)			

18.2. Questionnaire – Farmers – 1B

Notes in blue are for interviewers. This questionnaire integrates needs of WP3 and 8.

Questionnaire B is intended for relatively scarce crops, where we are interested in understanding the potentiality and feasibility of increasing/introducing this underutilized crop in the national value chain. The choice to use questionnaire B must be done by local partners as country experts of the national value chain analyzed.

Even if we are interested in some quantitative indicators and parameters, this survey must be considered a qualitative interview, where important information can be collected even if the specific questions of the questionnaire are not completely covered. In some cases, even if true numbers cannot be collected, proxies or qualitative information is better than nothing. For example, if the respondent is not able to provide us the 2021 price of crop A, it could be useful to obtain information such as:

c. Around 20% less that this year, or

d. A little more than crop B

Basic information:

D) Name of the firm: _____
E) Address: _____
F) Name of the respondent: _____

Questions at farm level:

26) What are your main farming goals: Indicate if you agree or not with the following sentences.

My main farming goals are…	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Maximizing farm profits					
- via increasing productivity					
- via reducing costs					
- via increasing product quality					
Increasing farm capital value					
Being recognized as a successful farmer					
Working independently and making own decisions					
Protecting the environment					
Making valuable contribution to your community					
Other (specify):____					
Other (specify):____					

27) Please provide information on the crops produced at your farm (including area, costs, and type of production – conventional or organic). Please use the data based on the season 2021.

Share of variable costs for each crop is not essential, but focus on total variable production costs of the farm and on the share of the target crop

Farm's crops	Number of varieties used per each crop	Area (ha)	Share in total variable production costs (%)	Type (organic, conv.)
		Total arable area:	Total variable production costs:	

28) Please provide information on farm labour:

Number of persons occupied at the farm: _____
Total time worked: _____person-hours/year
Share of time worked devoted to the target underutilized crop:_____-% total time worked.

Questions on a specific target crop:

29) Yearly quantity of crop sold *(e.g. buckwheat)*: _____tons
- Specify the nature of product sold *(e.g. fresh, dried, semi-processed)*: _____

30) Alternative crops that can substitute the target crop (*try to identify two or more*):_____

Seed provider portfolio for the analyzed crop *(e.g. lentil seed)*

31) Type of provider:

Type of provider	Number of providers	Indicate for which crop (include the target crop and the alternative crops previously identified)
Produced in farm		
Public authorities (Specify:_____)		
OP/Cooperatives		
Specialized seed seller		
Provided by the buyer		
Other		

Clients portfolio for the analyzed crop *(e.g. lentil)*

32) Type of client:

Type	Number of clients	Quantity sold on total for the target crop (%)	Quantity sold on total for a substitute crop** (%)	Type of transaction*
Cooperative or PO (specify if the farmer is member or not)				
Wholesalers Traders/intermediaries				
Traditional retailers (i.e. small shops)				
Large retailers				
Processors				
Consumers				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative

If for one client category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.

***: In general, for this question, we are interested only to the target crop and not to the potential substitute crops that farmer have, unless the potential substitutes have similar markets, destinations and processing potentials of the target crop. Examples: if we are considering buckwheat as target crop, and we have seen that potential substitutes are potatoes, we are not interested to the clients of potatoes. But if we are considering Sonchus, and we have assimilated Sonchus to lettuce, and substitutes for lettuce are other crops with similar destination (e.g. radicchio) we can consider also the clients of these crops.*

Notes:_____
_____
_____

33) Which quality standards is required by the client for the target crop (e.g. size, color, protein content, etc.) Please specify and indicate if there are differences among clients, and the reasons for which that standards are required

Required standard	For which crop*	For which client	For which reason

**: In general, for this question, we are interested only to the target crop and not to the potential substitute crops that farmer have, unless the potential substitutes have similar markets, destinations and processing potentials of the target crop. Examples: if we are considering buckwheat as target crop, and we have seen that potential substitutes are potatoes, we are not interested to the standards of potatoes. But if we are considering Sonchus, and we have assimilated Sonchus to lettuce, and substitutes for lettuce are other crops with similar destination (e.g. radicchio) we can consider also the required standards of these crops.*

34) How is the price with clients decided? (Several options possible, if necessary indicate for which type of client)

Rank clients by importance. Insert (x) for the right combination of price formation type and client. If for one client several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Client 1 _____ Specify the crop*: _____	Client 2 _____ Specify the crop*: _____	Client 3 _____ Specify the crop*: _____	Client 4 _____ Specify the crop*: _____
Auction				
Spot market				
Fixed by the client				
Fixed by the farmer considering his profit margin objective				
On the base of some reference market (specify which one: _____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

**: In general, for this question, we are interested only to the target crop and not to the potential substitute crops that farmer have, unless the potential substitutes have similar markets, destinations and processing potentials of the target crop. Examples: if we are considering buckwheat as target crop, and we have seen that potential substitutes are potatoes, we are not interested to the price formation of potatoes. But if we are considering Sonchus, and we have assimilated Sonchus to lettuce, and substitutes for lettuce are other crops with similar destination (e.g. radicchio) we can consider also the price formation of these crops.*

Notes:_____
_____
_____

Structure of costs and prices per crop

35) Provide the following information for 3 crops including the target crop and two substitute crops *(if more than two substitutes exist, choose the substitutes which are closer as market, destination, processing potential).*
If the respondent is not able to provide a specific value (e.g., the 2021 price of crop A), it could be useful to obtain alternative proxies, qualitative or comparative information such as:
a.Around 20% less that this year, or

b.A little more than crop B

	Target crop _____	Alternative crop _____	Alternative crop _____
Main reason for the choice of that crop (e.g. price, quality, availability, requirements from downstream actors)			
Typical yield of the crop (per ha)			
Average price of the product (€/kg) sold in 2021, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold in 2022, at company gate net taxes (otherwise specify)			
Weight of labor cost on revenue (%)			
Weight of variable costs on revenue (%) in 2021			
Weight of variable costs on revenue (%) in 2022			
Conversion coefficient from raw material to final product (ONLY if semi-processed by the farmer)			

Other price and biodiversity aspects for the target crop

36) Are you dealing with certification schemes that affect the price of the product sold and how? (Yes/no + specify the effect on price)

iv. Organic _____
v. PDO/PGI labels _____
vi. Other _____

37) ***NB: Only if the interviewee has never farmed the target crop.*** Do you think the target crop *(e.g. buckwheat)* is potentially feasible in your area? (YES/NO) ____, why?_____

38) ***NB: Only if the interviewee has never farmed the target crop.*** How price of the target crop *(e.g. buckwheat*) would be decided if it was never sold? _____

39) How are new crops introduced in your activity (or could be introduced)?

- ☐ As a request from clients

- ☐ As a suggestion from seed producers
- ☐ As your initiative:
  - ○ After market analysis on consumers' preferences
  - ○ Copying other farmers
  - ○ Following research developments
- ☐ As an effect of policy decisions

Notes: _____

40) Do you think farmers can introduce new crops as their own initiative? (YES/NO) ____, and why? _____

41) Which category of farmer can do it more easily (open question)? _____

Problems and expectations

42) What are the main constraints/ bottlenecks that you face within production and marketing of the target crop (please specify the constraints that are unique for this crop in comparison to other crops produced at your farm)? Choose those that are applicable and rank them according to their impact on your activities (1 for highest impact). What are your current strategies to deal with these constraints?

Notice that this question is focused at crop level. Firstly, read all the listed constraints/challenges, and then make the respondent to define the rank. Choose exclusively problems that are significant for the target crop, not for the farm activity in general.

Constraint/ challenge	**Rank of impact on your activity**	**Solution strategy**	**Please rank the strategies based on the costs (1 for the most costly)**
Accessibility to seeds (of species or variety)			
Insufficient land			
Insufficient labour capacity			
Insufficient information on cultivation techniques			
High production costs			
Climatic conditions			
Insufficient demand			
Lack of infrastructure to handle various			

steps along the value chain			
High competition at the market			
Other (specify)			
Other (specify)			

43) What are the main limitations/bottlenecks for the introduction of the target crop for a farmer that has never farmed it? Indicate if you agree or not with the following sentences.
Notice that this question explicitly refers to the limitations/bottlenecks of the target crop. It can be the opinion based on recent introduction, or the opinion based on agent's beliefs both in case he never cultivated it and in the case he is cultivating it and suppose what would happen to another farmer. Read one sentence and sign the (x) for the right answer before going to the next sentence.

Limitation/Bottleneck	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
New technics and standards are required					
Other varieties lack some characteristics needed for processing (which ones? _____)					
Production costs with other varieties would be higher than with main varieties (i.e. **variable costs**)					
There would be high costs for adapting the production line (i.e. **fixed costs**)					
There is insufficient demand					
It is difficult to have access to seeds					
There would be high advertising costs					
There are limitations linked to public policies and regulation					
Other _____					

44) Expectations: which effects would you expect from farming and trading a higher number of crops in your farm? Indicate if you agree or not with the following sentences.
Notice that this question refers to cultivating more crops than the number currently cultivated (it is not strictly related with the target crop). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… improve the economy of farmers					
… improve the environment					
… increase the number of clients					
… foster the creation of stronger vertical relations					
… improve the access to retail markets					
… improve the access to processing markets					

… increase the revenue of clients					
… improve the reputation of the enterprise on the long term					
… Other _____					

45) Expectations: which commitments and costs would you expect from farming and trading a higher number of crops in your farm (without increasing the cultivated area)? Indicate if you agree or not with the following sentences.
Notice that this question refers to cultivating more crops than the number currently cultivated (it is not strictly related with the target crop). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… increase complexity in the management of plots					
… require new dedicated spaces (including storage)					
… increase the work to separate the products					
… require structural adjustment of the farm					
… worsen productivity and efficiency of processes					
… increase variable costs					
… increase work to find clients and markets					
… increase planification activities and documents					
… require increased training for workers					
… Other _____					

46) Which climatic changes have the biggest impact on your agricultural activity (in particular on the targeted crop)? Choose those that are applicable and rank them according to their impact on your activities (1 for highest impact). What are your coping strategies in relation to the following climatic changes? What are your current actions and adaptation actions in case of forthcoming changes?
Notice that this question is focused at crop (not variety) level. Firstly, read all the listed constraints/challenges, and then make the respondent to define the rank. Start from problems that are significant for the targeted crop, and then, if you have time, consider problems for other farm activities.

Environmental changes	**Rank of the impact on agricultural activity**	**Adaptation/ Coping strategy**	**Please rank the strategies based on the costs (1 for the most costly)**
Increased temperature			
Decreased temperature			
Increased precipitation			

Decreased water availability			
Drought			
Increase in extreme heat days (days with temperature over 30 degrees)			
Extreme weather events (e.g. storms, floods)			

18.3. Questionnaire – Processors – 2A

Notes in blue are for interviewers. This questionnaire integrates needs of WP3 and 8.

Questionnaire A is intended for relatively abundant crops, where we are interested in understanding the potentiality and feasibility of increasing the number of varieties of a target crop along the value chain. The choice to use questionnaire A must be done by local partners as country experts of the national value chain analyzed.

Even if we are interested in some quantitative indicators and parameters, this survey must be considered a qualitative interview, where important information can be collected even if the specific questions of the questionnaire are not completely covered. In some cases, even if true numbers cannot be collected, proxies or qualitative information is better than nothing. For example, if the respondent is not able to provide us the 2021 price of a specific variety A of lentil, it could be useful to obtain information such as:

a. *Around 20% less that this year, or*
b. *A little more than variety B*

Basic information:

G) Name of the firm: _____
H) Address: _____
I) Name of the respondent: _____

Questionnaire on a specific target product:

2) Yearly quantity of raw material purchased *(e.g. lentil)*: _____tons
   - Specify the nature of raw material *(e.g. it could be already processed)*:_____
3) Yearly quantity of product sold *(e.g. dried lentil)*: _____tons
   - Specify the nature of product:_____
4) Name of varieties *(or other taxonomic category, depending on crop)* used: _____

Providers portfolio for the analyzed product (e.g. lentil)

5) Type of provider:

Type of provider	Number of providers	Quantity purchased on total (%)	Variety name(s)	Type of transaction*
Single farmers				
OP/Cooperatives				
Processors				
Traders/intermediaries				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative.
If for one provider category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.
Notes:_____
_____

_____

6) Importance of drivers for the choice of providers of the analyzed product. Indicate if you agree or not with the following sentences.

When I must choose a provider, it is very important to consider:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Assortment of varieties					
Assortment of species					
Specialization for specific products					
Proximity*					
Other*: _____					

*: if priorities are different for different varieties, please specify

_____
_____

7) Which quality standard is required by the processor (e.g. size, color, protein content, etc.?) Please specify and indicate if there are differences among varieties and/or providers, and the reasons for which that standards are required

Required standard	For which variety	For which provider	For which reason

8) How is the price with providers decided? (Several options possible, if necessary indicate for which type of provider).
Rank providers by importance. Insert (x) for the right combination of price formation type and provider. If for one provider several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Provider 1 _____ Specify the variety: _____	Provider 2 _____ Specify the variety: _____	Provider 3 _____ Specify the variety: _____	Provider 4 _____ Specify the variety: _____
Auction				
Spot market				
Fixed by the purchaser considering his profit margin objective				
Fixed by the provider				
On the base of some reference market (specify which one:				

_____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

Notes:_____
_____
_____

Clients portfolio for the analyzed product (e.g. lentil)

9) Type of client:

Type	Number of clients	Quantity purchased on total (%)	Variety name(s)	Type of transaction*
Wholesalers Traders/intermediaries				
Traditional retailers				
Large retailers				
Processors				
Consumers				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative

If for one client category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.

Notes:_____
_____
_____

10) Which quality standard is required by the client (e.g. size, color, protein content, etc.) Please specify and indicate if there are differences among varieties and/or clients:

Required standard	For which variety	For which client	For which reason

11) How is the price with clients decided? (Several options possible, if necessary indicate for which type of client).

Rank clients by importance. Insert (x) for the right combination of price formation type and client. If for one client several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Client 1 _____ Specify the variety: _____	Client 2 _____ Specify the variety: _____	Client 3 _____ Specify the variety: _____	Client 4 _____ Specify the variety: _____
Auction				
Spot market				
Fixed by the client				
Fixed by the processor considering his profit margin objective				
On the base of some reference market (specify which one: _____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

Notes:_____
_____
_____

Structure of costs and prices per variety

12) Provide the following information for 3 varieties *(or other taxonomic category, depending on crop)* currently processed *(if more than three varieties are processed, choose a mix of commercial varieties and traditional/ancient/neglected/local specialties).*
If the respondent is not able to provide a specific value (e.g., the 2021 price of variety A), it could be useful to obtain alternative proxies, qualitative or comparative information such as:
a.Around 20% less that this year, or
b.A little more than variety B

	Main variety _____	Second variety _____	Third variety _____
Volume share of the variety on total volume of the crop (%)			
Geographical origin of the raw product (e.g. specific regions or areas, imported by specific countries)			

Main reason for the choice of that variety (e.g. price, quality, availability, requirements from downstream actors)			
Average price paid as raw material (€/kg) in 2021, at company gate net taxes (otherwise specify)			
Average price paid as raw material (€/kg) in 2022, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold in 2021, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold in 2022, at company gate net taxes (otherwise specify)			
Weight of labor cost on revenue (%)			
Weight of variable costs on revenue (%) in 2021	+	-	
Weight of variable costs on revenue (%) in 2022			
Conversion coefficient from raw material to final product			

13) Are there alternative processing practices at present that you could use to process the target crop (YES/NO)?_____
Please list which ones and rank them according to their cost effectiveness

Rank	Practice

Processing practices can be very different depending on target product and processing plant. A few examples are: Cooking, Steaming, Baking, Broiling, Frying, Microwaving, Roasting, Hot Smoking, Chemical techniques, Mechanical techniques…

Other price and biodiversity aspects for the target crop

14) Are you dealing with certification schemes that affect the price of the product sold and how? (Yes/no + specify the effect on price)
   vii. Organic _____
   viii. PDO/PGI labels _____
   ix. Other _____

15) Do you think other varieties are potentially feasible for processing activity? (YES/NO) ____, which ones?_____

16) Have new varieties been introduced in your activity recently? (YES/NO) ____

17) How price of raw material would be decided for a new variety never sold (open question)? _____

_____

18) How price of the final product would be decided for a new variety never sold (open question)? ___

_____

19) How are new varieties introduced in your activity (or could be introduced)?
- ☐ As a request from clients
- ☐ As a request from providers
- ☐ As your initiative:
  - ○ After market analysis on consumers' preferences
  - ○ Copying other operators
  - ○ Following research developments
- ☐ As an effect of policy decisions

20) Do you think processors can introduce new varieties as their own initiative? (YES/NO) ____, and why? _____

21) Which category of processors can do it more easily: _____

Problems and expectations

22) What are the main limitations/bottlenecks for the introduction of a new variety in your activity? Indicate if you agree or not with the following sentences.
Notice that this question explicitly refers a new variety different from the main variety(ies) normally processed. It can be the opinion based on a recent introduction, or the opinion based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

Limitation/Bottleneck	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
New technics and standards are required					
Other varieties lack some characteristics needed for processing (which ones? _____)					

Production costs with other varieties would be higher than with main varieties (i.e. **variable costs**)					
There would be high costs for adapting the production line (i.e. **fixed costs**)					
There is insufficient demand					
It is difficult to have access to raw material					
There would be high advertising costs					
There are limitations linked to public policies and regulation					
Other _____					

23) Considering the limitations that you perceive in the introduction of a new variety, how likely would be that you introduce a new variety in your activity in the next future (score from 0 to 10, being 0 not at all likely and being 10 very likely)? _____

24) What are potential ways of overcoming the obstacles in the introduction of new varieties? (several answers)
□Public incentives
□Awareness of the consumer
□Farmer collaboration
□Retailer support
□Other _____

25) How likely is the possibility that you introduce a new variety in your activity in the next future if the incentives/facilities you indicated were provided (score from 0 to 10, being 0 not at all likely and being 10 very likely)? _____

26) Expectations: which effects would you expect from processing and trading a higher number of varieties? Indicate if you agree or not with the following sentences.
Notice that this question refers to process several varieties at the same time (more than the number currently processed). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… improve the economy of farmers					
… increase the quantity of raw material purchased					
… increase the number of providers					
… increase the number of clients					
… foster the creation of stronger vertical relations					
… improve the access to retail markets					
… increase the revenue of processors					
… improve the reputation of the enterprise on the long term					
… Other _____					

27) Expectations: which commitments and costs would you expect from processing and trading a higher number of varieties (without increasing the quantities of processed product)? Indicate if you agree or not with the following sentences.
Notice that this question refers to process several varieties at the same time (more than the number currently cultivated). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… require new dedicated lines					
.. require new dedicated spaces (including storage)					
… increase the work for the selection of the raw material					
… increase the work for separate the products					
… require structural adjustment of the plants					
… worsen productivity and efficiency of processes					
… increase variable costs					
… increase work to select providers					
… increase work to find clients and markets					
… increase planification activities and documents					
… require increased training for workers					
… Other _____					

Perception of consumers' needs for novel food products

28) How would you best describe your consumers/clients? Please select all that apply (*make to choose at least one age option and one income option)*.

Age
- ○ Young generation (18-34)
- ○ Middle age (35-54)
- ○ Elderly (55 and more)

Income
- ○ High income
- ○ Middle income
- ○ Low income

Other
- ○ Population concerned about food healthiness
- ○ Unhealthy people/groups with specific dietary needs
- ○ Other _____

29) From your experience, what would be the more important elements for consumers for accepting a new food product? Indicate if you agree or not with the following sentences.

For consumers, an aspect that is very important when deciding to buy a new food product is:	**I fully disagree**	**I somewhat**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**

		disagree			
Price					
Packaging					
Nutritional info					
Novelty					
Notion of a healthier product					
National production					
Geographical specialty					
Easiness to prepare/cook					
Shelf life					
Other (specify):____					

18.4. Questionnaire – Processors – 2B

Notes in blue are for interviewers. This questionnaire integrates needs of WP3 and 8.

Questionnaire B is intended for relatively scarce crops, where we are interested in understanding the potentiality and feasibility of increasing/introducing this underutilized crop in the national value chain. The choice to use questionnaire B must be done by local partners as country experts of the national value chain analyzed.

Even if we are interested in some quantitative indicators and parameters, this survey must be considered a qualitative interview, where important information can be collected even if the specific questions of the questionnaire are not completely covered. In some cases, even if true numbers cannot be collected, proxies or qualitative information is better than nothing. For example, if the respondent is not able to provide us the 2021 price of crop A, it could be useful to obtain information such as:

c. *Around 20% less that this year, or*

d. *A little more than crop B*

Basic information:

J) Name of the firm: _____
K) Address: _____
L) Name of the respondent: _____

Questionnaire on a specific target product:

30) Yearly quantity of raw material purchased *(e.g. buckwheat)*: _____tons
- Specify the nature of raw material *(e.g. it could be already processed)*:_____

31) Yearly quantity of product sold *(e.g. buckwheat flour)*: _____tons
- Specify the nature of product:_____

32) Alternative crops that can/could be processed as substitutes of the target crop in order to produce a similar target product: _____

Providers portfolio for the analyzed product (e.g. buckwheat)

33) Type of provider:

Type of provider	Number of providers	Quantity purchased on total for the target crop (%)	Quantity purchased on total for a substitute crop** (%)	Type of transaction*
Single farmers				
OP/Cooperatives				
Processors				
Traders/intermediaries				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative.
If for one provider category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.

***: For substitute crop we intend only crops that can be processed as substitutes of the target crop in order to produce a similar target product*

Notes:_____
_____
_____

34) Importance of drivers for the choice of providers of the analyzed product. Indicate if you agree or not with the following sentences.

When I must choose a provider, it is very important to consider:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Assortment of varieties					
Assortment of species					
Specialization for specific products					
Proximity*					
Other*: _____					

*: if priorities are different for different varieties, please specify
_____
_____

35) Which quality standard is required by the processor (e.g. size, color, protein content, etc.?) Please specify and indicate if there are differences among crop and/or providers, and the reasons for which that standards are required

Required standard	For which crop*	For which provider	For which reason

**: we are interested to target crop and substitute crops that can be processed to produce a similar target product*

36) How is the price with providers decided? (Several options possible, if necessary indicate for which type of provider).
Rank providers by importance. Insert (x) for the right combination of price formation type and provider. If for one provider several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Provider 1 _____ Specify the crop*: _____	Provider 2 _____ Specify the crop*: _____	Provider 3 _____ Specify the crop*: _____	Provider 4 _____ Specify the crop*: _____
Auction				
Spot market				

Fixed by the purchaser considering his profit margin objective				
Fixed by the provider				
On the base of some reference market (specify which one: _____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

**: we are interested to target crop and substitute crops that can be processed to produce a similar target product*

Notes:_____
_____
_____

Clients portfolio for the analyzed product (e.g. lentil)

37) Type of client:

Type	Number of clients	Quantity sold on total for the product derived from target crop (%)	Quantity sold on total for the product derived from substitute crop** (%)	Type of transaction*
Wholesalers Traders/intermediaries				
Traditional retailers				
Large retailers				
Processors				
Consumers				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative

If for one client category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.

***: We are interested in products that are similar to the target product, but are derived from substitute crops.*

Notes:_____
_____
_____

38) Which quality standard is required by the client (e.g. size, color, protein content, etc.) Please specify and indicate if there are differences among products and/or clients:

Required standard	For which product*	For which client	For which reason

***: We are interested in products that are similar to the target product, but are derived from substitute crops.*

39) How is the price with clients decided? (Several options possible, if necessary indicate for which type of client).
Rank clients by importance. Insert (x) for the right combination of price formation type and client. If for one client several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Client 1 _____ Specify the product*: _____	Client 2 _____ Specify the product*: _____	Client 3 _____ Specify the product*: _____	Client 4 _____ Specify the product*: _____
Auction				
Spot market				
Fixed by the client				
Fixed by the processor considering his profit margin objective				
On the base of some reference market (specify which one: _____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

***: We are interested in products that are similar to the target product, but are derived from substitute crops.*
Notes:_____
_____
_____

Structure of costs and prices per variety

40) Provide the following information for 3 crops currently processed that can be used to produce the same (or similar) target product *(One of these will be the target crop; if more than two substitute crops are processed, choose the two more important as quantity processed).*

If the respondent is not able to provide a specific value (e.g., the 2021 price of crop A), it could be useful to obtain alternative proxies, qualitative or comparative information such as:
a.Around 20% less that this year, or
b.A little more than crop B

	Target crop _____	Alternative crop _____	Alternative crop _____
Volume processed in 2021			
Geographical origin of the raw product (e.g. specific regions or areas, imported by specific countries)			
Main reason for the use of that crop compared to substitutes (e.g. price, quality, availability, requirements from downstream actors)			
Average price paid as raw material (€/kg) in 2021, at company gate net taxes (otherwise specify)			
Average price paid as raw material (€/kg) in 2022, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold in 2021, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold in 2022, at company gate net taxes (otherwise specify)			
Weight of labor cost on revenue (%)			
Weight of variable costs on revenue (%) in 2021			
Weight of variable costs on revenue (%) in 2022			
Conversion coefficient from raw material to final product			

41) Are there alternative processing practices at present that you could use to process the target crop (YES/NO)?_____
Please list which ones and rank them according to their cost effectiveness

Rank	Practice

Processing practices can be very different depending on target product and processing plant. A few examples are: Cooking, Steaming, Baking, Broiling, Frying, Microwaving, Roasting, Hot Smoking, Chemical techniques, Mechanical techniques…

Other price and biodiversity aspects for the target product

42) Are you dealing with certification schemes that affect the price of the product sold and how? (Yes/no + specify the effect on price)

x. Organic _____
xi. PDO/PGI labels _____
xii. Other _____

43) ***NB: Only if the interviewee has never processed the analyzed crop****.* Do you think the target crop *(e.g. buckwheat)* could potentially be used in your processing activity instead of alternative crops? (YES/NO) ____, why?_____

44) ***NB: Only if the interviewee has never processed the analyzed crop***. How price of raw material would be decided for this crop (*e.g. buckwheat*) that was never bought? _____

45) ***NB: Only if the interviewee has never processed the analyzed crop.*** How price of the final product (*e.g. buckwheat flour*) would be decided if it was never sold? _____

46) How are new crops introduced in your activity (or could be introduced)?

- ☐ As a request from clients
- ☐ As a request from providers
- ☐ As your initiative:
  - ○ After market analysis on consumers' preferences
  - ○ Copying other operators
  - ○ Following research developments
- ☐ As an effect of policy decisions

47) Do you think processors can introduce new crops in their products as their own initiative? (YES/NO) ____, and why? _____

48) Which category of processors can do it more easily? _____

Problems and expectations

49) What are the main limitations/bottlenecks for the introduction of a new crop in your activity? Indicate if you agree or not with the following sentences.

Notice that this question explicitly refers a new crop different from the crop(s) normally processed. It can be the opinion based on a recent introduction, or the opinion based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

Limitation/Bottleneck	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
New technics and standards are required					
Other varieties lack some characteristics needed for processing (which ones? _____)					
Production costs with other varieties would be higher than with main varieties (i.e. **variable costs**)					
There would be high costs for adapting the production line (i.e. **fixed costs**)					
There is insufficient demand					
It is difficult to have access to raw material					
There would be high advertising costs					
There are limitations linked to public policies and regulation					
Other _____					

50) Expectations: which effects would you expect from processing and trading a higher number of crops and derived products? Indicate if you agree or not with the following sentences.
Notice that this question refers to process several crops at the same time (more than the number currently processed). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… improve the economy of farmers					
… increase the quantity of raw material purchased					
… increase the number of providers					
… increase the number of clients					
… foster the creation of stronger vertical relations					
… improve the access to retail markets					
… increase the revenue of processors					
… improve the reputation of the enterprise on the long term					
… Other _____					

51) Expectations: which commitments and costs would you expect from processing and trading a higher number of crops (without increasing the quantities of processed product)? Indicate if you agree or not with the following sentences.
Notice that this question refers to process several crops at the same time (more than the number currently cultivated). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	I fully disagree	I somewhat disagree	Neither agree nor disagree	I somewhat agree	I fully agree
… require new dedicated lines					
.. require new dedicated spaces (including storage)					
… increase the work for the selection of the raw material					
… increase the work for separate the products					
… require structural adjustment of the plants					
… worsen productivity and efficiency of processes					
… increase variable costs					
… increase work to select providers					
… increase work to find clients and markets					
… increase planification activities and documents					
… require increased training for workers					
… Other _____					

Perception of consumers' needs for novel food products

52) How would you best describe your consumers/clients? Please select all that apply (*make to choose at least one age option and one income option)*.

Age

- Young generation (18-34)
- Middle age (35-54)
- Elderly (55 and more)

Income

- High income
- Middle income
- Low income

Other

- Population concerned about food healthiness
- Unhealthy people/groups with specific dietary needs
- Other _____

53) From your experience, what would be the more important elements for consumers for accepting a new food product? Indicate if you agree or not with the following sentences.

For consumers, an aspect that is very important when deciding to buy a new food product is:	I fully disagree	I somewhat disagree	Neither agree nor disagree	I somewhat agree	I fully agree
Price					
Packaging					
Nutritional info					
Novelty					
Notion of a healthier product					

National production					
Geographical specialty					
Easiness to prepare/cook					
Shelf life					
Other (specify):____					

18.5. Questionnaire – Retailers – 3A

Notes in blue are for interviewers. This questionnaire integrates needs of WP3 and 8.

Questionnaire A is intended for relatively abundant crops, where we are interested in understanding the potentiality and feasibility of increasing the number of varieties of a targeted crop along the value chain. The choice to use questionnaire A must be done by local partners as country experts of the national value chain analyzed.

Even if we are interested in some quantitative indicators and parameters, this survey must be considered a qualitative interview, where important information can be collected even if the specific questions of the questionnaire are not completely covered. In some cases, even if true numbers cannot be collected, proxies or qualitative information is better than nothing. For example, if the respondent is not able to provide us the 2021 price of a specific product A of lentil, it could be useful to obtain information such as:

e. Around 20% less that this year, or

f. A little more than product B

Basic information:

M) Name of the firm: _____
N) Address: _____
O) Name of the respondent: _____

Questionnaire on a specific targeted product

54) Yearly quantity of targeted product purchased (e.g. dried lentil): _____tons
55) Number of specific products (i.e., considering different brands and different package formats for each brand) sold by the retailer for the targeted product (e.g. dried lentil): _____
56) Name of varieties *(or other taxonomic category, depending on crop)* used for the targeted product and distributed by the retailer: _____ _____

Providers portfolio for the analyzed product (e.g. dried lentil)

57) Type of provider:

Type of provider	Number per type	Quantity purchased on total (%)	Variety name(s)	Type of transaction*
Single farmers				
OP/Cooperatives				
Processors				
Traders/intermediaries				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative.
If for one provider category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.
Notes:_____

_____
_____

58) Importance of drivers for the choice of providers of the analyzed product. Indicate if you agree or not with the following sentences.

When I must choose a provider, it is very important to consider:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Assortment of varieties					
Assortment of species					
Specialization for specific products					
Proximity*					
Other*: _____					

*: if priorities are different for different varieties, please specify

_____
_____

59) Which quality standard is required by the retailer (e.g. size, color, protein content, etc.?) Please specify and indicate if there are differences among varieties and/or providers, and the reasons for which that standards are required

Required standard	For which variety	For which provider	For which reason

60) How is the price with providers decided? (Several options possible, if necessary indicate for which type of provider).

Rank specific products by importance (put in parenthesis the variety of the targeted crop that is used for that specific product). Insert (x) for the right combination of price formation type and provider. If for one provider several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Provider 1 _____ Specify the product (variety): _____ _____	Provider 2 _____ Specify the product (variety): _____ _____	Provider 3 _____ Specify the product (variety): _____ _____	Provider 4 _____ Specify the product (variety): _____ _____
Auction				
Spot market				
Fixed by the purchaser considering his profit margin objective				
Fixed by the provider				
On the base of some reference market				

(specify which one: _____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

Structure of costs and prices

61) Provide the following information for 3 specific products *(these should be specific alternatives - from the same brand or from different brands - using the same targeted crop but different varieties)* currently distributed *(if more than three varieties are distributed, choose a mix of commercial varieties and traditional/ancient/neglected/local specialties; put in parenthesis the variety of the targeted crop that is used for that specific product)*
If the respondent is not able to provide a specific value (e.g., the 2021 price of product A), it could be useful to obtain alternative proxies, qualitative or comparative information such as:
a.Around 20% less that this year, or
b.A little more than product B

	First product (variety) _____ _____	Second product (variety) _____ _____	Third product(variety) _____ _____
Volume share of the specific product on total volume of targeted product (%)			
Geographical origin of the raw product (e.g. specific regions or areas, imported by specific countries)			
Main reason for the choice of that specific product (e.g. price, quality, availability, consumer preferences)			
Average price paid to the provider (€/kg) in 2021, at company gate net taxes (otherwise specify)			
Average price paid to the provider (€/kg) in 2022, at company			

gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold to consumer in 2021, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold to the consumer in 2022, at company gate net taxes (otherwise specify)			
Weight of labor cost on revenue (%)			
Weight of variable costs on revenue (%) in 2021			
Weight of variable costs on revenue (%) in 2022			

62) Which brand is used (in proportion to the total) to sell the product, and which is the difference in average price:

Brand	Share (%)	Price
First price		
Producer brand		
GDO brand (private label)		
Other		

Other price and biodiversity aspects for the target crop

63) Are you dealing with certification schemes that affect the price of the product sold and how? (Yes/no + specify the effect on price)

xiii. Organic _____
xiv. PDO/PGI labels _____
xv. Other _____

64) Do you think other varieties are potentially feasible to be used for the targeted product? (YES/NO) _____, which ones?_____

65) Have new varieties been introduced recently to produce the targeted product? (YES/NO) _____

66) How the price to producer would be decided for a new product (produced from a different variety) never sold? _____

67) How the price to consumer would be decided for a new product (produced from a different variety) never sold? _____

68) How are new products (produced from a different variety) introduced in your activity (or could be introduced)?
- ☐ As a request from providers
- ☐ As your initiative:
  - ○ After market analysis on consumers' preferences
  - ○ Copying other operators
  - ○ Following research developments
- ☐ As an effect of policy decisions

69) Do you think retailers can introduce new products (produced from a different variety) as their own initiative? (YES/NO) ____, and why? _____

70) Which category of retailers can do it more easily? _____

Problems and expectations

71) What are the main limitations/bottlenecks for the introduction of a new product (produced from a different variety) in your activity?
Indicate if you agree or not with the following sentences.
Notice that this question explicitly refers to a new product from a variety different from the main variety(ies) normally distributed. It can be the opinion based on a recent introduction, or the opinion based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

Limitation/Bottleneck	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
New spaces are required					
Management costs for procurement of other products would be higher than for current products (i.e. **variable costs**)					
Management costs in stores for other products would be higher than for current products (i.e. **variable costs**)					
There would be high costs for adapting the production line (i.e. **fixed costs**)					
There is insufficient demand					
It is difficult to have access to new products					
There would be high advertising costs					
There are limitations linked to public policies and regulation					
Other _____					

72) Considering the limitations that you perceive in the introduction of a new product (produced from a different variety), how likely would be that you introduce a new product in your activity in the next future (score from 0 to 10, being 0 not at all likely and being 10 very likely)? _____

73) What are potential ways of overcoming the obstacles in the introduction of new products (produced from a different variety)? (several answers)
□Public incentives
□Awareness of the consumer
□Farmer collaboration
□Processor collaboration
□Other _____

74) How likely is the possibility that you introduce a new product (produced from a different variety) in your activity in the next future if the incentives/facilities you indicated were provided (score from 0 to 10, being 0 not at all likely and being 10 very likely)? _____

75) Expectations: which effects would you expect from distributing a higher number of specific products (produced from a different variety)? Indicate if you agree or not with the following sentences.
Notice that this question refers to distribute several specific products (produced from the same crop, but different varieties) at the same time (more than the number currently distributed). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… improve the economy of farmers					
… improve the economy of processors					
… increase the quantity of product purchased					
… increase the number of providers					
… increase the number of consumers					
… foster the creation of stronger vertical relations					
… improve the reputation of the enterprise in the long period					
… Other _____ _____					

76) Expectations: which commitments and costs would you expect from distributing a higher number of specific products (produced from a different variety), without increasing the total quantity of sales of the targeted product (i.e. diversity increases but not total sales)? Indicate if you agree or not with the following sentences.
Notice that this question refers to distribute several products (produced from a different variety) at the same time (more than the number currently distributed). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**

… require new dedicated lines					
.. require new dedicated spaces (including storage)					
… increase the work for the management inside stores					
… require structural adjustment of the stores					
… worsen productivity and efficiency of activity					
… increase variable costs					
… increase work to select providers					
… increase work and cost for marketing, consumer information					
… increase planification activities and documents					
… require increased training for workers					
… Other _____					

Perception of consumers' needs for novel food products

77) How would you best describe the consumers/clients of the targeted product? Please select all that apply (*make to choose at least one age option and one income option)*.

Age

- Young generation (18-34)
- Middle age (35-54)
- Elderly (55 and more)

Income

- High income
- Middle income
- Low income

Other

- Population concerned about food healthiness
- Unhealthy people/groups with specific dietary needs
- Other _____

78) From your experience, what would be the more important elements for consumers for accepting a new food product of this kind *(e.g. lentil pasta)*? Indicate if you agree or not with the following sentences.

For consumers, an aspect that is very important when deciding to buy a new food product is:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Price					
Packaging					
Nutritional info					
Novelty					
Notion of a healthier product					
National production					
Geographical specialty					
Easiness to prepare/cook					
Shelf life					

Brand					
Other (specify):____					

18.6. Questionnaire – Retailers – 3B

Notes in blue are for interviewers. This questionnaire integrates needs of WP3 and 8.

Questionnaire B is intended for relatively scarce crops, where we are interested in understanding the potentiality and feasibility of increasing/introducing this underutilized crop in the national value chain. The choice to use questionnaire B must be done by local partners as country experts of the national value chain analyzed.

Even if we are interested in some quantitative indicators and parameters, this survey must be considered a qualitative interview, where important information can be collected even if the specific questions of the questionnaire are not completely covered. In some cases, even if true numbers cannot be collected, proxies or qualitative information is better than nothing. For example, if the respondent is not able to provide us the 2021 price of a specific product A of buckwheat, it could be useful to obtain information such as:

g. Around 20% less that this year, or

h. A little more than product B

Basic information:

P) Name of the firm: _____
Q) Address: _____
R) Name of the respondent: _____

Questionnaire on a specific targeted product

79) Yearly quantity of targeted product purchased *(e.g. buckwheat pasta)*: _____tons
80) Number of specific products *(i.e., considering different brands and different package formats for each brand)* sold by the retailer for the targeted product *(e.g. buckwheat pasta)*: _____
81) Alternative crops/species that are used to produce substitute products of the targeted one, and that are distributed by the retailer *(e.g. corn pasta, rice pasta, which are all alternative pasta used by people with Coeliac disease)*: _____

Providers portfolio for the analyzed product (e.g. dried lentil)

82) Type of provider:

Type of provider	Number per type	Quantity purchased on total for the targeted product (%)	Quantity purchased on total for a substitute product** (%)	Type of transaction*
Single farmers				
OP/Cooperatives				
Processors				
Traders/intermediaries				
Other				

*: Choose among: Auction, Spot transactions, Occasional relations, Regular relations, Contractual relations, Partnership, Vertical integration, Contribution to cooperative.

If for one provider category several types of transaction are available, include some notes to specify in which conditions/situation each type is used.
***: For substitute product we intend products with the same characteristics of the targeted product and consumed by the same niche of consumers (e.g. corn pasta, rice pasta, which are all alternatives of buckwheat pasta used by people with Coeliac disease)*
Notes:_____
_____
_____

83) Importance of drivers for the choice of providers of the analyzed product. Indicate if you agree or not with the following sentences.

When I must choose a provider, it is very important to consider:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Assortment of varieties					
Assortment of species					
Specialization for specific products					
Proximity*					
Other*: _____					

*: if priorities are different for different alternative products, please specify
_____
_____

84) Which quality standard is required by the retailer (e.g. size, color, protein content, etc.?) Please specify and indicate if there are differences among alternative/substitute products and/or providers, and the reasons for which that standards are required

Required standard	For which product*	For which provider	For which reason

**: we are interested to targeted product and substitute products that can be used by the same niche of consumers*

85) How is the price with providers decided? (Several options possible, if necessary indicate for which type of provider).
Rank specific products by importance. Insert (x) for the right combination of price formation type and provider. If for one provider several price formation types are available, include some notes to specify in which conditions/situation each type is used.

Type	Provider 1 _____ Specify the product*: _____ _____	Provider 2 _____ Specify the product*: _____ _____	Provider 3 _____ Specify the product*: _____ _____	Provider 4 _____ Specify the product*: _____ _____
Auction				
Spot market				

Fixed by the purchaser considering his profit margin objective				
Fixed by the provider				
On the base of some reference market (specify which one: _____ _____)				
Contracted together by provider and purchaser				
Set a base price plus premium for quality attributes, please specify which ones _____				
Other factors, please specify _____				

**: we are interested to targeted product and substitute products that can be used by the same niche of consumers*

Structure of costs and prices

86) Provide the following information for 3 specific products *(we are interested to targeted product and substitute products that can be used by the same niche of consumers)* currently distributed *(rank by importance)*
If the respondent is not able to provide a specific value (e.g., the 2021 price of product A), it could be useful to obtain alternative proxies, qualitative or comparative information such as:
a.Around 20% less that this year, or
b.A little more than product B

	Targeted product _____ _____	Alternative product _____ _____	Alternative product _____ _____
Volume sold in 2021			
Geographical origin of the raw product (e.g. specific regions or areas, imported by specific countries)			
Main reason for the choice of that specific product (e.g. price, quality, availability, consumer preferences)			
Average price paid to the provider (€/kg) in 2021, at company gate net taxes (otherwise specify)			

Average price paid to the provider (€/kg) in 2022, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold to consumer in 2021, at company gate net taxes (otherwise specify)			
Average price of the product (€/kg) sold to the consumer in 2022, at company gate net taxes (otherwise specify)			
Weight of labor cost on revenue (%)			
Weight of variable costs on revenue (%) in 2021			
Weight of variable costs on revenue (%) in 2022			

87) Which brand is used (in proportion to the total) to sell the product, and which is the difference in average price:

Brand	Share (%)	Price
First price		
Producer brand		
GDO brand (private label)		
Other		

Other price and biodiversity aspects for the target crop

88) Are you dealing with certification schemes that affect the price of the product sold and how? (Yes/no + specify the effect on price)

xvi. Organic _____
xvii. PDO/PGI labels _____
xviii. Other _____

89) ***NB: Only if the interviewee has never distributed the analyzed product.*** Do you think the targeted product *(e.g. buckwheat pasta)* could potentially be introduced in your stores? (YES/NO) ____, why?_____

90) ***NB: Only if the interviewee has never distributed the analyzed product***. How price to producer would be decided for this product (*e.g. buckwheat pasta*) that was never bought?
_____

91) ***NB: Only if the interviewee has never distributed the analyzed product.*** How price to consumers would be decided for this product (*e.g. buckwheat pasta*) that was never sold? _____

_____

92) How are new products (similar/substitute of the targeted product) introduced in your activity (or could be introduced)?
- ☐ As a request from providers
- ☐ As your initiative:
  - After market analysis on consumers' preferences
  - Copying other operators
  - Following research developments
- ☐ As an effect of policy decisions

93) Do you think retailers can introduce new products (similar/substitute of the targeted product) as their own initiative? (YES/NO) ____, and why?
_____

94) Which category of retailers can do it more easily? _____

Problems and expectations

95) What are the main limitations/bottlenecks for the introduction of a new product (similar/substitute of the targeted product) in your activity?
Indicate if you agree or not with the following sentences.
Notice that this question explicitly refers to a new product different from those of the same category (e.g. pasta used by people with Coeliac disease) normally distributed. It can be the opinion based on a recent introduction, or the opinion based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

Limitation/Bottleneck	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
New spaces are required					
Management costs for procurement of other products would be higher than for current products (i.e. **variable costs**)					
Management costs in stores for other products would be higher than for current products (i.e. **variable costs**)					
There would be high costs for adapting the production line (i.e. **fixed costs**)					
There is insufficient demand					
It is difficult to have access to new products					
There would be high advertising costs					
There are limitations linked to public policies and regulation					

Other _____					

96) Expectations: which effects would you expect from distributing a higher number of products (similar/substitute of the targeted product)? Indicate if you agree or not with the following sentences.

Notice that this question refers to distribute several products (similar/substitute of the targeted product) at the same time (more than the number currently distributed). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of products would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… improve the economy of farmers					
… improve the economy of processors					
… increase the quantity of product purchased					
… increase the number of providers					
… increase the number of consumers					
… foster the creation of stronger vertical relations					
… improve the reputation of the enterprise in the long period					
… Other _____ _____					

97) Expectations: which commitments and costs would you expect from distributing a higher number of products (similar/substitute of the targeted product), without increasing the total quantities of sale of the category (i.e. diversity increases but not total sales)? Indicate if you agree or not with the following sentences.

Notice that this question refers to distribute several products (similar/substitute of the targeted product) at the same time (more than the number currently distributed). The opinion is based on agent's beliefs. Read one sentence and sign the (x) for the right answer before going to the next sentence.

An increased number of varieties would:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
… require new dedicated lines					
.. require new dedicated spaces (including storage)					
… increase the work for the management inside stores					
… require structural adjustment of the stores					
… worsen productivity and efficiency of activity					
… increase variable costs					
… increase work to select providers					
… increase work and cost for marketing, consumer information					

… increase planification activities and documents					
… require increased training for workers					
… Other _____					

Perception of consumers' needs for novel food products

98) How would you best describe the consumers/clients of the targeted product? Please select all that apply (*make to choose at least one age option and one income option)*.

Age
- Young generation (18-34)
- Middle age (35-54)
- Elderly (55 and more)

Income
- High income
- Middle income
- Low income

Other
- Population concerned about food healthiness
- Unhealthy people/groups with specific dietary needs
- Other _____

99) From your experience, what would be the more important elements for consumers for accepting a new food product of this kind *(e.g. pasta used by people with Coeliac disease)*? Indicate if you agree or not with the following sentences.

For consumers, an aspect that is very important when deciding to buy a new food product is:	**I fully disagree**	**I somewhat disagree**	**Neither agree nor disagree**	**I somewhat agree**	**I fully agree**
Price					
Packaging					
Nutritional info					
Novelty					
Notion of a healthier product					
National production					
Geographical specialty					
Easiness to prepare/cook					
Shelf life					
Brand					
Other (specify):____					