



# The Food Value Chain of Lupin in Austria

## CROPDIVA – 5.1

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# ABBREVIATIONS

BMLRT	Federal Ministry Republic of Austria Agriculture, Regions and Tourism (Bundesministerium Landwirtschaft, Regionen und Tourismus)
FiBL	Research Institute of Organic Agriculture (Forschungsinstitut für biologischen Landbau)
AGES	Austrian Agency for Health and Food Safety (Österreichische Agentur für Gesundheit und Ernährungssicherheit GmbH)
ha	hectare
VC	Value chain
VCA	Value chain analysis

# 1. THE VALUE CHAIN OF LUPIN IN AUSTRIA

## 1.1 Lupin in Austria

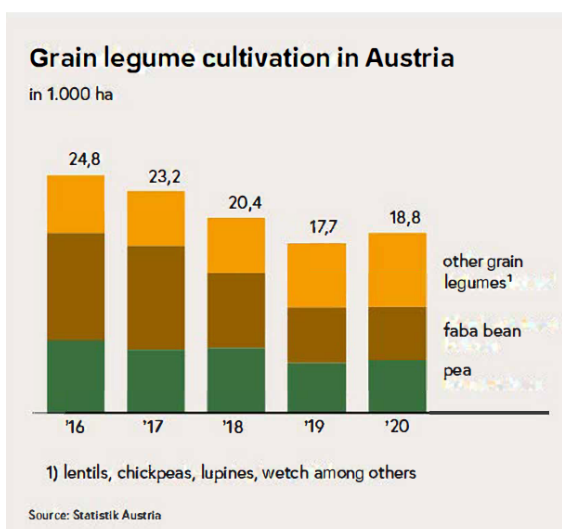
Lupin is a legume that provides benefits to the soil due to its taproot and the ability of nitrogen fixation. Furthermore, lupin has an outstanding high protein content (36 – 48 %) that can even compete to soybean protein (LfL, 2022). Despite several benefits, lupin is only marginally produced in Austria (Statistik Austria, 2020). In 2019, lupin covered a total cultivated area of 230 ha in Austria which accounts for only 0,018% of the total arable land (FAOSTAT, 2019). Graph 1 depicts the acreage of grain legumes in Austria (BMLRT, 2020). It clearly shows the overall negative trend of grain legume cultivation in Austria until 2019 with a slight recovery in 2020. In 2019, Austrian lupins yielded in total 360 tons with an average yield of 15,6 dk per hectare (Eurostat, 2019; FAOSTAT, 2019). One reason for the minor cultivation quantity may be the higher bitter substance content (alkaloids) found in bitter lupins that pose danger of poisoning for human beings and animals. Only the domestic lupin—also called the sweet lupin—is allowed to be grown in the EU because of its low alkaloid content (< 0.02 %) and the possibility of using it for both, feed and food. In practice, three species are grown as agricultural crops: narrow-leaved or blue lupin (*Lupinus angustifolius*), white lupin (*Lupinus albus*) and yellow lupin (*Lupinus luteus*) (Gresta et al., 2017).

Lupines are rarely used for food consumption in Austria. The FAOSTAT (2019) estimates an 0,7 kg per capita consumption in 2018 for the category legumes and others which includes lupin.

The cultivation area differed within the past. Compared to nowadays, more lupins were cultivated at the beginning of 2000. Since then, the area reduced due to the disease anthracnose, as well as low productivity driven by seasonal variability (Cernay et al., 2015), the low price of lupin grain (De Visser et al., 2014), and EU policies favoring the importation of soya bean. Concerns about the sustainability and dependence of non-European protein-sources, as well as potential environmental advantages, reestablished the interest in lupin and other legume crops since 2003 (Lucas et al., 2015). Since 2017, there have been increases in Austrian lupin acreage again (but, of course, in total production quantities are still insignificant compared to other legumes).

Numbers of organically grown lupin confirm these fluctuations over time. In 2002, 452 ha of organic lupins were grown in Austria. The area reduced to less than 100 ha in the following years due to the stinging disease. Since 2017, there has been a slight increase in the area of organic lupin cultivation again to 106 ha. In 2019, 152 ha of organic lupin were cultivated. Favorable conditions for the lupin can be found in Upper Austria, where lupin grows on forest edges as a wild form. Therefore, the lupin is also called “the soybean of the Mühlviertel” (the “Mühlviertel” is an important region within Upper Austria) (Landwirtschaftskammer Österreich, 2021).

We selected two specific consumer food products of lupine, one is a roasted, caffeine-free coffee substitute and the other one is a spicy sauce made of lupin and oat (amongst others). The spice sauce is an organic, vegan product used for sauces, soups, salads, etc. Both products are interesting for CROPDIVA, because they have been recently introduced to the Austrian food market and represent



Graph 1: Grain legume cultivation in Austria confirming Statistics Austria (statistik.at)

food innovations. Lupine coffee is a relatively new coffee substitute, and there are already several producers on the Austrian market. The selected spicy sauce follows the market trend of regional, vegan food products with a clear indication of origin, and is already listed in an important retail chain. There are well established spicy sauces from multinational companies like Nestlé (for e.g. Maggi) or Unilever as competitors on the market.

## 1.2 Overview of the interviews completed

The interview partners in the Austrian lupine value chain have been collected over internet desk research, review of professional, technical articles, search of business directories, and requests to associations of the Austrian agriculture (for example BioAustria, the largest association of organic farmers in Austria, or the Austrian Chamber of Agriculture, the largest governmental extension service in Austria). Furthermore the interview partners indicated relevant interview partners in the lupine value chain. Dependent on their activity and engagement with other CROPDIVA crops some interview partners – seed suppliers, processors, or wholesalers – have been interviewed also to other CROPDIVA crops. One interview partner has been interviewed about two different levels in the value chain, because he was engaged with business activities in both of them.

*Table 1. Overview of the number of interviews performed for each VC actor.*

VC actors	Number of interviews
Seed supplier, seed multiplier	2 (1 via telephone)
Seed wholesaler	2 (1 via telephone)
Producer (farmer)	3
Wholesaler	0
Food processor	4
Wholesaler	1
Retailer (directly to endconsumer)	2

Table 1 shows that 14 interviews have been made, 12 of them via Zoom video conferences and two by telephone (1 interview partner was processor and wholesaler and has been counted in each of this functions). There is a distinct wholesaler level between the “main” actors farmer, food processor and retailer. Interviews were made on each level of the value chain, except with the wholesale level between farmer and food processor. No interviews have been made in the lupin feed value chain.

## 1.3 Results: Lupine as food

### 1.3.1 Description of the lupin food value chain

The Austrian lupin value chain is multi-layered, because of a variety of lupin food products. Seeds are imported from German growers. Variety specific propagation and production is taking place in Austria and on the international market.

Austrian farmers obtain the seeds from seed wholesalers from Germany or from Austria, or from Austrian seed propagators. Farmers sell the harvested lupin (mainly white sweet lupin) either directly to the consumer or to the wholesaler or food processor. The food products made from or with ingredients of lupin (lupin coffee, spicy sauce, lupin-containing meals such as soups, chili, etc.) are sold from the food processor over wholesalers, retailers, or gastronomy to the consumer. Some food processors also sell directly to consumers. Retailers encompass a variety of outlets such as supermarkets, drug stores, health food stores, or (organic) specialist stores.

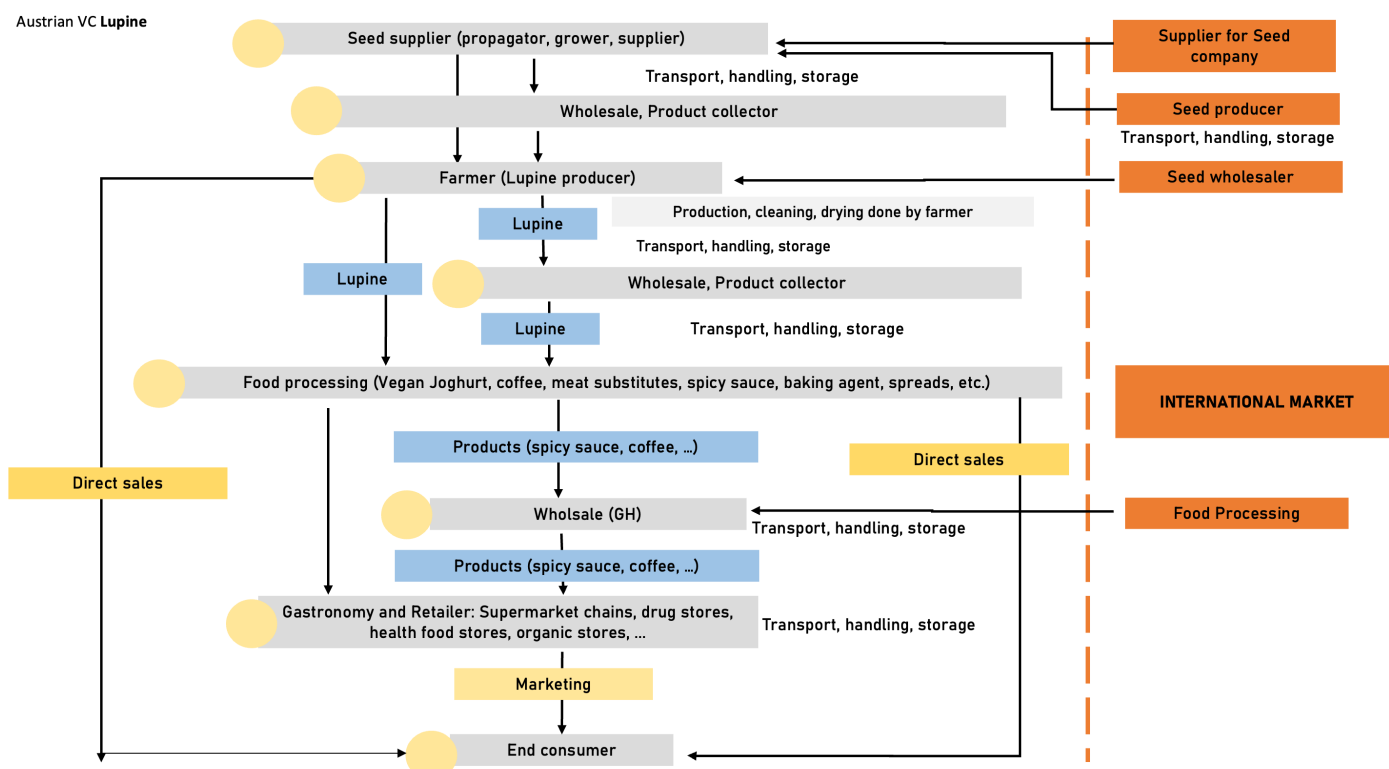


Figure 1. Austrian lupine food value chain map

### 1.3.2 Input suppliers (Growers, propagators, suppliers)

The growers in Austria get the basic seeds from a German seed supplier (Deutsche Saatgutveredelung). The basic seeds are cleaned and further prepared for propagation by local seed growers. Samples are sent to the governmental Austrian Agency for Health and Food Safety, called AGES (<https://www.ages.at/en/>) for official recognition as seed product. From the Austrian propagators the seeds are sold to farmers. The idea to sell lupin seeds came from the company culture to continuously improve the offered assortment and to be in touch with current trends. Furthermore, a sales representative of the German seed supplier contacted the Austrian grower with the idea to start propagating lupin.

#### **VC capacities and organization**

Vertical and diagonal linkages: The most important vertical linkage is a German seed company. There have been no horizontal linkages reported. One seed company is cooperating with farmers via a diagonal linkage.

Knowledge and technology of actors: Suppliers had access to knowledge from technical articles in professional journals. Existing equipment and machines were adapted but without major efforts. A challenge are anthracnose infections and the limited availability of suitable soils in Austria – lupine prefers acidic soils. Also, a specific amount of precipitation is necessary. The Eastern parts of Austria have not enough rainfall for lupin. It is more suitable for Upper Austria and the “Waldviertel” region in Lower Austria.

Entry barriers: The Austrian market for lupin is still in its infancy. In terms of the product development life cycle, it is in the development and introduction phase. There are no major entry barriers. Farmers are generally interested, and some are making first trials. Uncertainty of yields is a limiting factor. Journalists are helpful by writing articles about lupin.

#### **Resource and infrastructure**

Inputs availability: Sometimes there are contaminations in the basic seed product and a reduced germination capacity. Besides issues with the quality, in some years lower volumes are available. The biggest cost factors are for cleaning and the price of the basic seeds from the German company. The cleaning costs would be lower if more volume could be produced.

Existing and required infrastructure: As already mentioned above (under “Knowledge and technology of actors”), it was not difficult for the growers to adapt the existing equipment and machines to the production and processing of lupin seeds.

Logistical issues: Concerning logistics, 99% of the production are taken care of by the wholesalers.

Volume & capacity of processing facilities: For the following years the plan is to produce slightly more. Capacities are sufficient, only storage room is limited.

### **Market conditions**

Market trends and demand: Lupine is part of a “lifestyle product” trend, a healthy food product rich in protein, preferable for vegetarians and vegans. If wholesalers and processors see lupin as a lifestyle product, it will become a mainstream product. Short term interest is high. If lupin gets established in the food processing industry, demand is expected to grow significantly. Some relationships to customers are short-term and instable, others are long-term and stable. The seed imports from Germany are important for the Austrian market.

Marketing: The benefits and added values for the farmers are that a lot of nitrogen stays in the soils, because lupin is a legume. The roots of legumes are in symbiosis with rhizobia, which can bind nitrogen from air in the soil. Because of the flowers the field of lupin contribute to a beautiful landscape. The higher height of lupin simplifies harvesting.

Seed companies use events together with wholesalers, specialist presentations, and fairs to promote lupin seeds. Furthermore, they use social media and public relations via agricultural journals.

Distribution channels: Besides selling directly to farmers, the most important sales channels are wholesalers. A challenge is the price for the seeds. There are frequent negotiations with the customers. An important strength is seen in the capacity to process bigger volumes of seeds, a weakness is in the limited storage capacity.

### **Framework conditions**

Regulatory & institutional environment: The biggest limiting factor is that seed companies in Germany use electron treatment of seeds to sterilize them, which is not allowed for organic farming in Austria. Positive for the development is that lupin is part of subsidized alternative crops. More demand of food processing companies would be an important boost for the market.

Role of public sector (support, policies, etc.): The Austrian Chamber of Agriculture and the AGES are promoting knowledge about lupin. Subsidies from the Austrian Ministry of Agriculture help cultivating lupins and also support investments.

Consulting companies and the Austrian Chamber of Agriculture offer extension service for seed companies. The interviewed seed companies were more satisfied with the services offered by the Austrian Chamber of Agriculture.

### **1.3.3 Producers (farmer)**

One of the interviewed farmers already cultivated sweet lupin 15 years ago, as a first trial long before there was a market (he stopped cultivation briefly after the first trials). Later he started again because a food processor and a wholesaler offered him a contract for lupin. Without direct demands from them he wouldn't have started cultivating lupin. Another interviewed farmer was from an area in Upper Austria where they cultivate lupin since a long time for animal feed. Only in recent years the cooperation with food processing companies started and since then this farmer produces lupins for human consumption.

The third interviewed farmer got the idea to plant lupin based on talks with an organic extension services from Bio-Austria and FiBL (Research Institute of Organic Agriculture, <https://www.fibl.org/en/about-us>). The interviewed farmers see lupin as a good way to improve soil conditions, good for organic nitrogen enrichment and for crop rotation.

### ***VC capacities and organization***

Vertical and diagonal linkages: Important suppliers are local traders of agricultural inputs, and seed companies from Austria and Germany. There are no diagonal linkages, despite that the interviewed farmers have diagonal linkages with other crops. Two farmers reported horizontal cooperation with other farmers and vertical linkages with food processors.

Knowledge and technology of actors: The knowledge to cultivate lupins came from the Internet, talks with other farmers, own field trials and cooperation with FiBL and the extension service of the Austrian Chamber of Agriculture. The biggest challenge to cultivate lupin is the climate. Lupine needs sufficient precipitation, to be of sufficient quality for human consumption. Other important factors are the quality of seeds, the selection of fields, weed management. The right time of harvest is very important for thresh ability of lupins.

Entry barriers: For one farmer, who started 10 years ago, it was difficult to enter the market with lupin. At the beginning, skepticism about the bitter substances was a challenge. For the farmers who produced for food processors the market entry was easy. The necessary investment in drying and cleaning equipment is a limiting factor, when market demand is low. The Austrian “Lagerhäuser”, i.e. the cooperative storage facilities of the Raiffeisen cooperative, which normally take care of cleaning and drying of harvested crops, don't do it yet, because the volume of lupin on the market is too small. To exit the market again would not be difficult, however, the interviewed farmers expect a loss of synergies with other crops and customers would be disappointed.

### ***Resource and infrastructure***

Inputs availability: Concerning inputs, the limited quality of seeds is an issue. Seeds are not sufficiently pure which leads to lower germination capacity. Farmers believe that seed companies don't invest enough into lupin breeding. Sometimes the preferred variety is not available, which is a problem, because then varieties must be used, which are less suited for the local conditions. The main cost factors the interviewed farmers mentioned are high prices of seeds, the processing cost of the harvest, and energy costs. Breeding their own seeds (which is risky) and investing in photovoltaic or energy communities would be cost saving activities.

Existing and required infrastructure: The interviewed farmers process the harvest at the farm (cleaning and drying). One of the farmers outsources parts of the processing. The necessary investment in drying and cleaning equipment is a limiting factor when market demand is low. As mentioned above, the “Raiffeisen Lagerhäuser”, which normally take care of cleaning and drying of harvested crops, don't do it yet, because the volume of lupin on the market is too small.

Logistical issues: Deliveries are done via external carriers.

Volume & capacity of processing facilities: The capacity of existing infrastructure of farmers is sufficient to produce more if demand would rise.

### ***Market conditions***

A Problem in selling to consumers is that some consumers are allergic. Some get stomach problems or diarrhea. Besides that, price negotiations are difficult, and the food processors have high requirements concerning quality.

Market trends and demand: The vegan and vegetarian trend supports lupin sales, also the trend of consumers' demand for regional food and higher protein content in plant-based food. Farmers see demand slightly but constantly increasing because of higher consumer awareness for a healthy



meatless diet. Health consciousness and environmental awareness of consumers are positive for the lupin market. Negative is the allergen issue of lupin. One farmer mentioned that there is not enough done to promote lupins and that farmers are slow to adapt new crops.

Marketing: The main benefit of lupin is its healthiness (if not allergic) and consumers see it as a regional protein at a fair price. Customer relations are long term oriented. One farmer complained about volatile orders in respect to volume. There is a slight dependency on seed suppliers because of missing interest from their side to breed more and better adapted varieties. Seeds are imported from Poland, France, and Canada. In general, farmers are content with the achieved price for lupin. The price is derived in different ways: one farmer negotiated with a food processor, another one used the feed price of lupin as orientation and adds margins for processing and profit. The third one calculates his gross margin based on his production costs and looks at prices at the market.

Distribution channels: Farmers sell either directly to the food processor or to consumers. Consumers can buy either at the farm or over an online shop.

### ***Framework conditions***

Regulatory & institutional environment: There are threshold recommendations from AGES about the alkaloid content and the quality criteria of the food processor (for e.g. free of gluten). All interviewed farmers are organic certified. Additional certifications are not necessary.

Role of public sector (support, policies, etc.): Confirming the interviewed farmers, the seed law and organic standards are sufficient standards for quality assurance of lupin products. The public has increasingly demands concerning sustainability and biodiversity of agriculture but the consumers are usually not willing to pay for that. Therefore, financial support via subsidies would be beneficial to extend lupin production.

## **1.3.4 Wholesale**

We interviewed two seed wholesaler and one lupin wholesaler. There are big differences between the organic and the conventional sector. The organic sector is more flexible and more open for new crops and price is not the most important criterion. The challenge is to produce constant high yields. Lupin has high potential for market growth, if all levels of the value chain put efforts into developing the market. Seed producers have to offer more and better seeds, farmers have to produce more, food processors should offer more variety of food products and the retail has to invest in marketing of these products. Lupin is up until now more important as feed product. Food products (meat substitutes, lupin coffee, yoghurt with lupin, for example the retail brand “VegaVita” of one of the biggest Austrian retailers Billa) are still a niche. The idea to sell lupin came from its advantages as intercropping. Lupin has many advantages for soil fertility (natural nitrogen fixation) and is good against soil compactions. The organic retail showed interest in selling lupin, which was an incentive for one of the wholesalers to offer it to the market.

### ***VC capacities and organization***

Vertical and diagonal linkages: Important producers are companies offering lupin coffee (Naturata, Blue Lupi Coffee Roasting), meat substitutes (PurVegan), lupin tempeh (Vollkraft). The seed wholesalers import their seed varieties from Germany (Selina und Frieda). Important customers for the lupin wholesalers are organic food stores, organic supermarkets, and health food stores.

### ***Resource and infrastructure***

Inputs availability: The most important cost factors are production and logistic costs. Costs could be lowered over higher volume of sales, leading to higher efficiency.



### **Market conditions**

Market trends and demand: Wholesalers are aware of the most important trends, which are regionality and vegan nutrition. Their market research is based on talks with farmers, suppliers and customers. Demand for lupin is good and slowly growing. One mentioned that in the future current demand market will change to a supply market because of the climate crisis. Availability of resources will be an important future topic. Wholesalers observe that farmers are looking for crops to improve soil fertility and sustainability.

Marketing: For consumers sustainability, regionality, and transparency about origin of lupin are important to support marketing of lupin. The most important added value of lupin is its higher protein content. The wholesalers use word of mouth, their website, fairs and events for marketing communications. They are satisfied concerning price levels but emphasized that price is not the most important purchase criterion, these are service and availability. Prices are formed based on supply and demand and own gross margin cost calculations.

Distribution channels: The main distribution channel for the seed wholesaler is direct delivery to farmers. The food wholesaler is delivering to organic stores, organic supermarkets, farm shops, health food stores and gastronomy (25%), and a small share to small food processors.

### **Framework conditions**

Regulatory & institutional environment: There are no regulatory barriers for the lupin market. Confirming the interviewed wholesalers, research projects of universities could support the development of the lupin market.

Role of public sector (support, policies, etc.): The public sector doesn't play a significant role.

## **1.3.5 Food processors**

We interviewed four food processors. The produced products ranged from lupin coffee, spicy sauce, lupin coarse meal as ingredient for cereals, lupin sugo to lupin chili or lupin soup. The idea to produce lupin food products came from being a good source of protein and a meat substitute for one processor. Another one mentioned that he was looking for a regional crop that is a useful caffeine free coffee alternative. The roastery got inspired from lupin farmers and tried to roast it.

### **VC capacities and organization**

Vertical, horizontal and diagonal linkages: The food processors source lupin from organic farmers. One mentioned that unfortunately Austrian farmers often stop cultivating lupin. BioAustria (<https://www.bio-austria.at>), which is the biggest organic association of Austria, offers a list of lupin producing farmers to its members. One food processor reported a horizontal linkage to another company, producing vegetarian spreads. They use the spicy sauce made with lupin and oat for their spreads.

Knowledge and technology of actors: It was not difficult to acquire the knowledge to process lupin. The food processors looked at recipes from suppliers, talked with employees, made their own test series, and used the Internet to gain information.

Entry barriers: It was not difficult to get the product listed in various organic stores, but it was difficult to inform consumers about the new food product and to create awareness. Many consumers are not aware of lupin. The coffee consumers didn't know how to brew lupin coffee.

### **Resource and infrastructure**

Inputs availability: The food processors have sometimes problems in buying enough lupin because the available harvest volume fluctuates significantly from year to year. The volume and quality of lupin is strongly dependent on the weather conditions and the number of farmers growing lupin. One processor mentioned possible problems, if his business would be expanding, because he needs a specific variety.

If alkaloid content is too high, lupin can only be used as feed. The demand on the market is higher than the supply of high-quality lupin. One farmer invested into an irrigation system to maintain quality of lupin. One mentioned a challenge to find employees with enough knowledge about cooking. Due to the actual Ukrainian-Russian war one processor reported problems in getting packaging material. Cost factors are lupin price, energy cost, packaging cost, personal and logistic costs. To lower costs the interviewed food processors strive to produce higher volumes, one reported in investing in photovoltaics to lower energy costs.

Logistical issues: Logistic is done via postal service for small amounts and via carriers for bigger orders.

### **Market conditions**

Market trends and demand: All processors mentioned to produce more lupin in the future. Two of four processors pay attention to food trends. The vegan trend is supporting marketing of lupin but it also supports other alternative plant-based products. The trend for biodiversity, healthiness, the organic trend, and the trend towards regionality (transparent origin) are important drivers. The fact that lupin is on the allergen list is a limiting factor. The interviewed food processors use talks with consumers, suppliers, the Internet and social media to get information about market trends. Import markets are less important, if then the imports of Germany are relevant. Most processors don't export except one. He is exporting to Germany, Switzerland, Slovakia, and the Czech Republic.

The food processors see a steady, moderate growth in demand for lupin. National supermarket chains would have the biggest impact in initiating substantial growth. Oat will outpace lupin in growth rates, except food companies developed new lupin food products. Interestingly some of them mentioned that if supply of farmers grows, it will support the demand growth too.

Marketing: A challenge for marketing is to inform the consumer about the benefits and use of lupin. The interviewed food processors emphasized the need to educate consumers about lupin. Customer relationships are long-term and stable, with many regular customers. Important added values are high-quality proteins, regionality, almost no difference in taste to coffee beans. It is easy to combine lupin products with other products and lupin is a valuable ingredient for bakeries. The most efficient communication channels are – the order reflects importance – public relations resulting in press articles, presence on fairs, tastings, product sampling, and social media. Prices are either calculated based on input price of lupin plus margins or in accordance with the soybean market. All processors are satisfied with the achieved prices.

Distribution channels: The products are distributed over many different channels such as organic food stores, organic wholesalers, supermarkets, roasteries, online shops, or farm shops. In short, the food processors sell to wholesale, retail, gastronomy, and also directly to consumers.

### **Framework conditions**

Regulatory & institutional environment: The labelling of foodstuffs regulation (EU 1169/2011) is the most hindering regulatory aspect, because it contains the necessity to mention allergens. Long waiting periods for the test results about alkaloids are frustrating. The health claim regulation (Commission Regulation (EU) No 432/2012) is hindering marketing because it is not allowed to advertise positive health aspects of lupin. Food law and organic regulation (EU 834/2007) are helpful, also the regulations about primary ingredients (EU 775/2018), which regulates that the origin of the most important ingredient must be mentioned on the packaging in case of voluntary information about origin of the food product. The organic certificate is an excellent tool for marketing purposes. Three of four processors are planning to get a vegan certification. One mentioned a certification for gluten-free.

Role of public sector (support, policies, etc.): The public sector plays no role, except over regulations. The public sector should create more incentives and subsidies for farmers to grow lupin.

### 1.3.6 Retailing

We made one interview with a retailer who is selling lupin coffee to consumers. He was looking for an alternative to conventional coffee.

#### ***VC capacities and organization***

Vertical, horizontal and diagonal linkages: The retailer is selling 95% of his products to consumers over his store and his online shop, the rest is sold to hotels.

#### ***Market conditions***

Market trends and demand: Demand is slowly and constantly rising. Trend for regionality is the main reason for rising demand. Consumers want to know, where the product is coming from, and who is producing it. Some consumers want to get to know the producers personally. Transparent origin is very important. An attractive packaging is important for consumers as well.

## 1.4 Discussion

Our interviews identified several conditions about the lupin value chain, which are in many areas common for niche products but to some extent are specific for lupin. Specific for lupin are the challenges concerning bitterness, allergen content and fungus infections. Common for niche products are a lack of consumer awareness and a small array of available food products containing lupin. In the following subchapter we will summarize the main challenges and success of the lupin value chain.

### 1.4.1 Past, current, and foreseen challenges & successes of the value chain

The findings in our interviews showed that the most challenges for lupin production are still an issue, that's why we summarize them all under one chapter.

#### ***Anthracoze tolerance***

*Anthracoze tolerance* is a lupin specific and one of the most important issues for lupin cultivation. Anthracnose (*Colletotrichum lupini*) is a fungus which could lead to total loss of harvest. As mentioned in the chapter 1.1, the organic acreage of lupin in Austria declined by almost a quarter from the acreage planted in 2002, which was 152 ha in 2019. The interview partners mentioned several reasons for the strong decline in acreage, but *anthracnose* was the most important one. Other mentioned factors were *high volatility of yields* due to seasonal variability and a *low price for lupins*. There are pesticides on the market available to treat lupin seeds, but this is not an option for organic lupin. On the Austrian food market, organic lupin is way more important than conventionally produced lupin. Our interview partners only sold organic lupin to consumers.

The only solution to this dilemma is a dedicated *breeding program* to produce lupin seeds 100% free of anthracnose. But this seems to be a Catch 22 problem. Due to the low demand for lupin seeds from farmers, plant breeding companies have not much interest to invest into new breeding programs for lupin. Our interview partners emphasized that the *lupin market has potential to grow*, if more farmers would produce *high quality lupin*. But the farmers mentioned that it is *difficult to get seeds*, well adapted to local soil and climatic conditions. A rising demand for lupin food products would increase incentives for farmers to grow lupin and, in the middle and long term, this would lead to more efforts from breeding companies to deliver a bigger variety of *locally adapted lupin seeds*.

#### ***Uncertainty of yields***

Lupin is vulnerable to changing weather conditions and demands humid soils with slightly acidic pH values. These conditions are in Austria only regional and limited available. One area with best soil

conditions for lupin is the “Mühlviertel” region in Upper Austria – a region which has been traditionally used for lupin production, where granite and not limestone is the foundation of the soil resulting in lower pH values.

With respect to *climate change*, we already see a decline of annual precipitation in many Austrian areas, especially in the eastern parts of Austria, where the main lupin production areas are located. Combined with the limited assortment of well adapted lupin varieties, the threat of anthracnose infections and the volatility of precipitation many farmers stopped planting lupin in Austria. One lupin producing farmer mentioned that he invested into an irrigation system to guarantee high quality and high yields of his lupin production.

### ***Insufficient quality of lupin harvests***

Farmers, wholesalers and food processors reported that connected to the uncertainty of yields is the challenge of not reaching the necessary *quality of lupin* suitable for *food production*. Reasons for lower quality are the alcaloid contents and bitterness, which negates lupin use in food processing. In case of reduced quality farmers sell lupin as feed product. Some actors mentioned that the EU regulation 1169/2011 – labelling of foodstuffs – is a hindering regulatory aspect, because it contains the necessity to mention the allergens contained in lupin. Long waiting periods for the test results about alkaloids are another negative aspect in respect to quality.

### ***Market entry and exit***

Because of the low production volume of lupin in Austria, most farmers have to *process their lupin harvest at farm* (cleaning and drying). The necessary *investment* in drying and cleaning equipment is a limiting factor, when market demand is low. Traditionally the storage and processing facilities of the Raiffeisen Cooperatives in Austria take care of cleaning, drying, and storage of the main harvested grain crops. Those facilities are available all over the country, but because of the low volume of harvested lupins, they are not interested in providing this service. With rising demand, the investment costs for drying and cleaning facilities are neglectable. Confirming the interview partners, to *exit the market* would not be difficult, it would however be a loss of synergies with other crops and customers would be disappointed.

### ***Lack of consumer awareness***

Despite the fact that there are already some lupin food products on the market in Austria, lupin food is still a *small niche*. The assortment ranges from lupin coffee, spicy sauce, lupin coarse meal as ingredient for cereals, lupin sugo, to lupin chili and lupin soup. The motivation to offer lupin food products came from being a good source of protein and to serve as a potential *meat substitute*.

The trends to *regionality*, *vegan food*, transparency of *origin*, and the *health* trend are supporting the demand for lupin products. Nevertheless, all VC actors mentioned that there is a *lack of consumer awareness* about the benefits of lupin for biodiversity, soil fertility, and rich source of proteins. VC actors expressed the need for a concerted effort, also from the public sector to enhance and increase consumer awareness about the benefits of lupin.

### ***Lack of willingness to try new crops***

More than one actor in the lupin VC emphasized that there is a lack of willingness of farmers but also wholesalers to try new crops. This is partly related to a *lack of production knowledge*, but more so to *uncertainty* about yields and quality (see above). The extension service of the Austrian Chamber of Agriculture is providing information and offering support about lupin but could maybe intensify their efforts.

**Table 1. Challenges, strategies and potentials and benefits**

VC actor	3-5 main challenges (order: most important first)	Strategies undertaken/to undertake	Potential & benefits for the actor in the VC chain
<b>Seed supplier</b>	<ol style="list-style-type: none"> <li>1. Availability of operating material</li> <li>2. Sustainable demand</li> <li>3. Improving seed quality</li> <li>4. Sustaining interest for lupin</li> </ol>	<ol style="list-style-type: none"> <li>1. Better coordination with German breeding company</li> <li>2. Better communication with farmers</li> <li>3. Maintaining a value chain to the consumer</li> </ol>	<ol style="list-style-type: none"> <li>1. Current interest is high</li> <li>2. Long-term potential to reach acreage of peas in Austria (approx. 5600 ha in 2020, BMLRT, 2020)</li> </ol>
<b>Seed wholesaler</b>	<ol style="list-style-type: none"> <li>1. Optimization of production</li> <li>2. Optimization of use in food industry</li> <li>3. More variety of products</li> </ol>	<ol style="list-style-type: none"> <li>1. Extension service to farmers</li> <li>2. Trial cultivations under different climatic and soil conditions</li> </ol>	<ol style="list-style-type: none"> <li>1. Depending on the cultivation area there is more or less potential to successfully grow lupin</li> </ol>
<b>Producers (farmers)</b>	<ol style="list-style-type: none"> <li>1. Availability of healthy seeds in high quality</li> <li>2. Sufficient rain, need for irrigation</li> <li>3. More awareness of consumers about lupin</li> <li>4. High yields and optimal plant cultivation methods</li> </ol>	<ol style="list-style-type: none"> <li>1. Seed companies should work with Austrian farmers to propagate locally adapted seeds</li> <li>2. Continuous improvement of know how</li> <li>3. Cooperation along the value chain</li> </ol>	<ol style="list-style-type: none"> <li>1. Short term low potential for growth</li> <li>2. Long-term growth dependent from prices for meat and meat products. If they rise, demand for lupin will grow</li> <li>3. Improved soil fertility</li> </ol>
<b>Food Processor</b>	<ol style="list-style-type: none"> <li>1. More farmers cultivating lupin</li> <li>2. Purchase of suitable lupin varieties</li> <li>3. More awareness on consumer side</li> </ol>	<ol style="list-style-type: none"> <li>1. Cooperation</li> <li>2. Development of stable customer and supplier relationships</li> <li>3. Public relations</li> </ol>	<ol style="list-style-type: none"> <li>1. High potential for small scale farming to cultivate old forgotten varieties</li> <li>2. Short term potential high because demand is growing, but needs more marketing</li> </ol>
<b>Wholesaler</b>	<ol style="list-style-type: none"> <li>1. Availability of high-quality lupin</li> <li>2. Attractive prices</li> <li>3. Awareness of consumers</li> </ol>	<ol style="list-style-type: none"> <li>1. Cooperation</li> <li>2. Guarantee of product listing</li> </ol>	<ol style="list-style-type: none"> <li>1. Cultivation makes agriculture more sustainable</li> <li>2. Protein content of lupin</li> </ol>
<b>Retailer</b>	<ol style="list-style-type: none"> <li>1. More variety of lupin products</li> <li>2. Sharing of information along the VC</li> </ol>	<ol style="list-style-type: none"> <li>1. Information campaigns with consumers (presentation of producers, information about lupin)</li> </ol>	<ol style="list-style-type: none"> <li>1. Long term growth potential</li> </ol>

### 1.4.2 Limitations

The limitations of the study are related on one side to the *qualitative nature* and on the other side to the *unwillingness of VC actors* to be available for interviews. The supermarket retail sector in Austria is very competitive and highly restrictive to share information. That's why the representative of the retail level in our study is from an organic store selling to consumers and not from a nationwide supermarket chain. It wasn't possible to interview a wholesaler (collector) acting as the link between farmers and food processors. But due to the small lupin market, most farmers are selling directly to food processors and don't use a collector as a link. Concerning the qualitative nature, it is obvious that our sample of interview partner *cannot be representative for all lupin value chains* in Austria. We followed a snowball approach for our study. First, we searched for farmers or food processors in the lupin chain and then we asked them to indicate their VC partners, which we contacted for further interviews. Nevertheless, we believe that our study delivers a good description of the constraints and context of the lupin VC in Austria, because of the niche character of the lupin market, few actors are sufficient to deliver a realistic picture of the situation. Another limiting factor is that most of our interviews happened before the Ukraine war started. Insofar our study provides only limited knowledge about the impact of the war on the lupin market.

## 1.5 Synthesis

Lupin for human food consumption is a "lifestyle product". It is marketed as a healthy, regional, organic food product rich in protein, promoting biodiversity on the fields. It is a preferable trendy meat substitute for vegetarians and vegans. Because of its trendy lifestyle character, lupin is mostly offered in Austria as organic lupin, which puts special demands on pesticide resistance. Wholesalers and processors see short term growth due to the vegan trend, but even more so for the long term. One food processor even mentioned that currently the demand on the market is higher than the supply of high-quality lupin. Nevertheless, several actors emphasized in the interviews that lupin will not reach the size and extent of the oat market (reasons see below). One participant made the forecast that under positive conditions, lupin production could reach the size of pea production in Austria, which is currently around 5600 ha, which is less than 10% of the current soybean acreage in Austria (BMLRT, 2021). The current organic lupin acreage is around 150 ha. Lupin has the potential for market growth, if all levels of the value chain put a concerted effort into developing the market.

A crucial *success factor* is the quality and adaptability of seed varieties to the local conditions in Austria. The most *limiting factor* for organic lupin production is the fungus anthracnose. Currently, most lupin seed varieties are imported from Germany because the Austrian lupin seed market is too small. In short, seed producers should offer more and better seed varieties resistant to anthracnose, with low levels of alkaloids and allergens, and less demands on water and pH values. As a response to better seed varieties farmers will extent lupin acreage and food processors will offer more variety of lupin food products. All actors agreed that the national supermarket and drug store actors would have the strongest impact to stimulate growth. Especially the retail sector could address the lack of consumer knowledge about lupin with dedicated information campaigns to raise consumer awareness. The public sector mainly supports and guides the lupin market over regulations and subsidies. Several VC actors expressed the wish that the public sector should offer more incentives for farmers to grow lupin.

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