



The Food and Feed Value Chain of Oats in Serbia

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1. THE FOOD AND FEED VALUE CHAIN OF OATS IN SERBIA

1.1 Oats in Serbia

Oat (*Avena sativa*) cultivation and the use of oats for livestock feed, especially horses, have long tradition in the Republic of Serbia. In 2021, oats covered a total cultivated area of 17,725 ha and yielded in total 55,954 tons with the average yield in 2020 accounted for 3.2 t per hectare (Statistical Office of the Republic of Serbia, 2022a). However, oat production in Serbia is characterized with a poor competitive position in relation to maize and wheat (e.g. according to Statistical Office of the Republic of Serbia (2022b) during winter sow in 2021, 1.81% of total cultivated area belonged to oat, while 72.2% of cultivated area was under wheat). Moreover, a constant decline in the cultivated area of oats is recorded since the period after Second World War when this practice was widely spread with over 300.000 ha used for oats production in former Yugoslavia with major share of production in Serbia. In Serbia, the reduced areas in oats are primarily a result of decreased livestock production and a negligible volume of export (Pržulj et al., 2010). The trends in total cultivated area and average yields are presented in Figure 1.

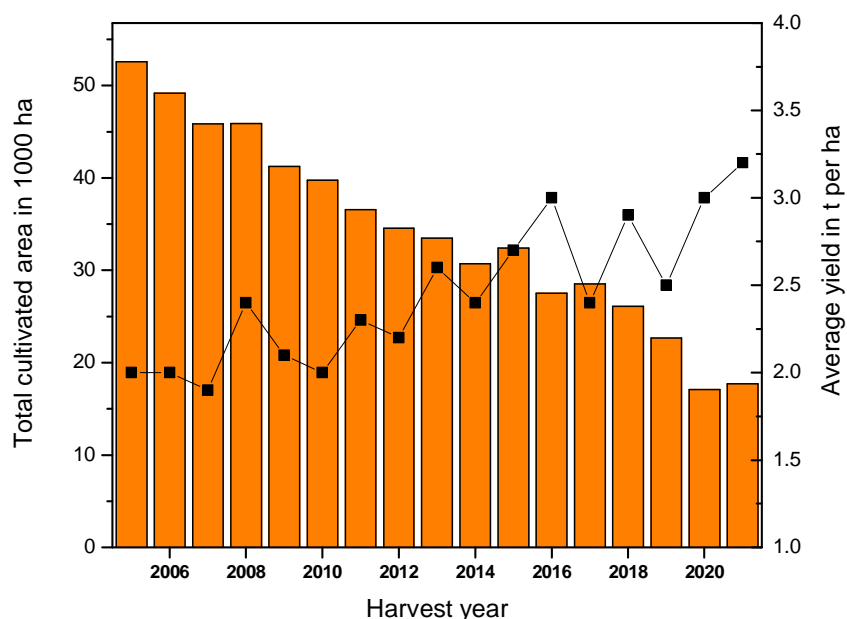


Figure 1. OATS production in Serbia: Total cultivated area and average yield (Statistical Office of the Republic of Serbia, 2022)

In Serbia, seeds from winter, spring and naked oat cultivars are available for cultivation. They are produced in two research and breeding institutes or imported. Small Grains Research Centre Kragujevac in Serbia is currently producing Vranac (facultative winter variety), Slavuj (spring variety) and Lovćen (spring variety) oat varieties, while Institute of Field and Vegetable Crops in Novi Sad is currently producing and selling NS JADAR (winter variety), DUNAV (spring variety) and NS SEDEF (naked variety). However, a lot of old oat varieties produced by Institute of Field and Vegetable Crops in Novi Sad still exist. For a long time, oat yield, especially the one of spring cultivars, was very low. However, new domestic and international winter oat varieties are characterized with yield up to 5 t/ha (Latković et al., 2005). The yields of oat per hectare increase as contemporary methods of intensive agricultural production from around 2 t/ha in 2005 to 3.2 t/ha in 2022 can be seen in Figure 1. In some locations the achievement of up to 6 t/ha in years convenient for oats production could be registered.

Due to a low yield compared to other cereals (wheat 5.7 t/ha, barley 5.6 t/ha, corn 5.9 t/ha, triticale 5.1 t/ha), oat production in cereals' growing region (northern Serbia) is suppressed (21.7% of total oat cultivated area) and it is mainly cultivated in southern Serbia (78.3% of total oat cultivated area) (Statistical Office of the Republic of Serbia, 2022b). The other reasons for its cultivation in southern Serbia are its specific growing requirements. Unlike wheat, oat is a versatile crop that can be grown under marginal environmental conditions, including cool wet climates and unfertile or arid areas (Kutasy et al., 2021).

At the other hand, oats import to Serbia permanently increases. According to the data obtained from customs administration in 2021, the quantity amounting to 3,191 t (Table 1) of oats was imported to Serbia, while only 513 t was exported. Imported quantities include also significant amount of de-hulled oat intended for processing into products for human consumption, as well as significant quantities of oatmeal.

Table 1 - Import of oat to Serbia in last 5 years

Year	Imported quantity, kg	Countries from which import is realised
2017	825,570	Czech Republic, France, Croatia, Hungary, Netherlands, Slovakia
2018	536,205	Belarus, France, Great Britain, Croatia, Hungary, Netherlands, Russia, Slovakia
2019	2,863,830	Bulgaria, Great Britain, Croatia, Hungary, Italy, Moldova, Netherlands, Russia, Slovakia
2020	5,764,690	Bulgaria, France, Croatia, Hungary, Netherlands, Russia, Slovakia
2021	3,191,155	Bulgaria, France, Greece, Croatia, Hungary, Netherlands, Romania, Slovakia

Table 2 - Export of oat from Serbia in last 5 years

Year	Exported quantity, kg	Countries to which export was realised
2017	1,321,834	Albania, B&H, Czech Republic, Germany, Hungary, Libya, Montenegro, North Macedonia, Kosovo
2018	919,530	Albania, B&H, Czech Republic, Germany, Montenegro, North Macedonia, Kosovo
2019	585,763	Albania, B&H, Czech Republic, Italy, Montenegro, North Macedonia, Ukraine
2020	270,969	Albania, B&H, Montenegro, North Macedonia, Ukraine, Kosovo
2021	513,588	Albania, B&H, Czech Republic, Montenegro, North Macedonia, Kosovo

The current Serbian market for oats is limited to feed production, oat flour and flakes products and niche, mostly imported, so called "healthy" food products for humans. Almost all oat quantities produced in Serbia are used as grain, green food and as silage for animal feed. Oat is considered a valuable cereal for animal feed since compared to other cereals it contained lower levels of carbohydrates, three times higher quantities of fat and better amino acids profile. Oats are grown as individual crops, or intercropped with fodder peas or legumes for the production of green fodder, or for storing hay, or silage (Latković et al., 2005).

Oat intended for human consumption is mostly imported and used for oat flakes, semolina, oatmeal and oat brans production, while oat drinks, cookies, bars or granola are quite new in the market.

Research activities related to oats are quite rare and the topics investigated include mainly optimisation of production technology (Aćin et al., 2012), as well as the general consideration of relevance of oats breeding (Pržulj et al., 2010) and presentation of oats varieties (Pržulj & Momčilović, 2010) production properties (Mandić et al., 2019) under different environmental conditions (Nožinić, 2009). The research related to food applications of oat are very scarce and present mainly considerations about oats convenience for food production provided by oats breeders (Pržulj, 2009) or characterisation of final products including oats in their composition (Šimurina et al., 2018).

In this report two value chains, one for animal feed and one for human food were investigated. The report is structured as follows: firstly, an overview of the interviews conducted and the whole chain mapping was presented; secondly the analysis of the food value chain and then the feed value chain were given separately; and finally a joint discussion, past challenges & successes of the value chains, current challenges and foreseen chances, limitations and synthesis was made.

1.2 Results

1.2.1 Description of the oats value chain

Due to the similar upstream actors both food and feed value chains are presented together in Figure 2. Seed production and trading in Serbia is mostly performed directly by seed breeding and research institutes or via seed production and distribution companies propagating and selling certified oat varieties. Farmers use the harvested oat either directly for their own needs to feed animals, or they sell it to feed processors and in neglected amount to collection centres and food processors. Food processors mostly use imported de-hulled grains. Further part of food value chain is multi-layered since there are various oat food products present in Serbian market. The food products made from oat grain or with oat-based ingredients (mostly oat flakes, but also oat flour, muesli bars, oat drink, etc.) are either sold from the food processor via retailers or imported. Some food processors are also wholesalers selling their products through own distribution network. Retailers mostly encompass supermarkets, healthy food stores, or (organic) specialist stores.

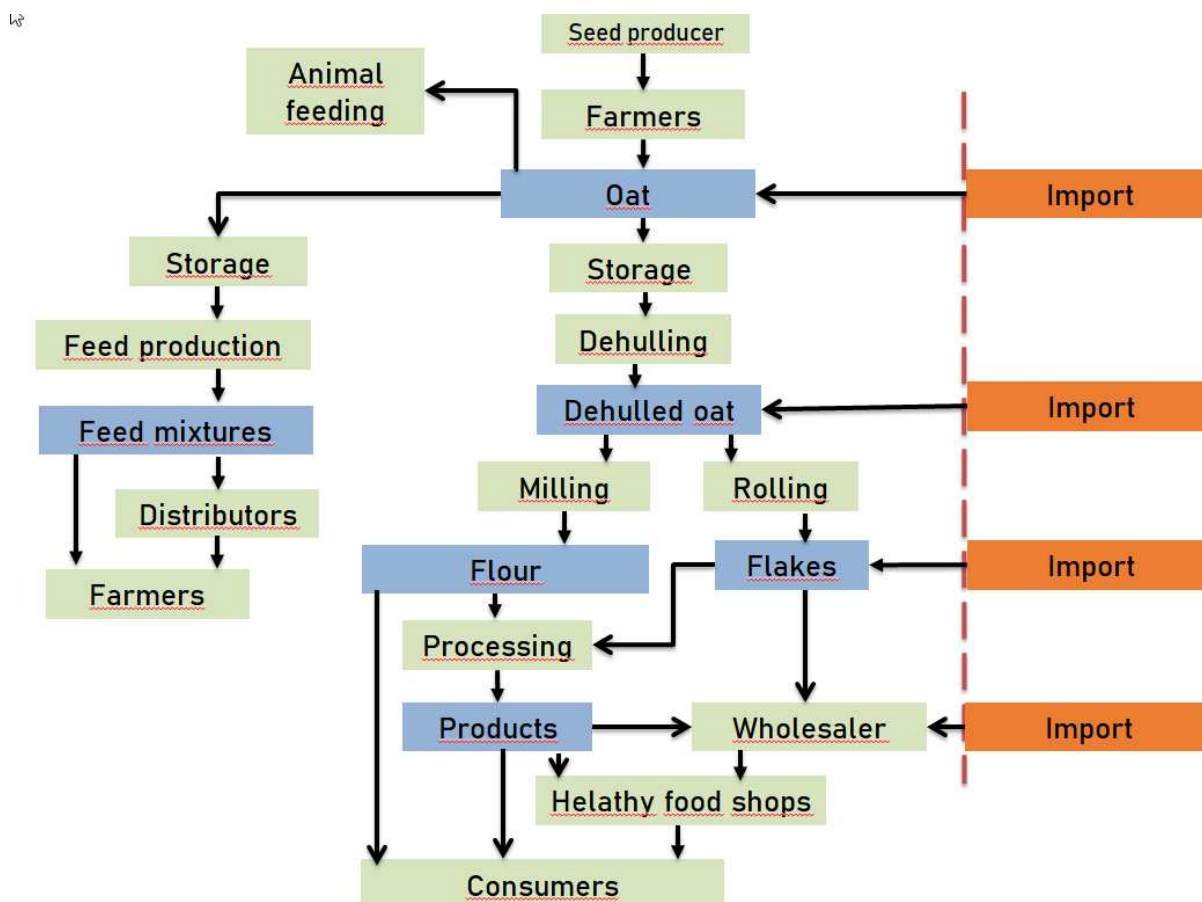


Figure 2. Mapping of oat value chains in Serbia

1.2.2 Overview of the interviews completed

The primary search for entities involved in oats production and processing in Serbia was performed using data available at the internet or previous collaboration through accredited food quality control laboratory operating at Institute of Food Technology in Novi Sad. From these sources the following actors in oats value chain in Serbia were identified:
















- Oat breeders
- Oat seed traders
- Oat processing companies
- Wholesales
- Healthy food distributors

Other interview partners were collected according to contacts from value chain actors of the upstream and downstream parts of the value chain. Oats producers were identified from the contacts with oat processors, as well as through oat grain selling offers at internet.

Based on obtained data the list of interviewees was outlined. Due to the fact that research was conducted during the COVID 19 pandemic, in order to avoid direct contact, interviewees were mainly contacted through the phone calls. With majority of the interviewees the interview was completed by telephone while the ones having deeper knowledge and understanding of the issues in oats value chain were visited and face to face interviews were conducted.

The overview of number of interviews per value chain actors¹ is provided in Table 3. In the table the method (face to face or telephone) used for conduction of the interview is presented.

Table 3. Overview of the number of interviews performed for each VC actor.

VC actors	Numbers of interview	Method
Breeders	1	
Seed producers	1	
Seed traders	1	
Farmers	3	  
Processing	4	   
Feed mills	2	 
Wholesaler	1	
Seller	1	
Advices and research	2	



Interview conducted in face to face communication with application of preventive measures regarding COVID 19 pandemic



Interviews conducted in telephone conversation

1.3 Results: feed value chain

1.3.1 Description of the oat feed value chain

Oat feed value chain in Serbia is in **maturity stage** of product life cycle. Mostly domestic varieties are sold to farmers either directly from breeding research institutes or seed production and trading companies. Both oat seed suppliers and oat producers (farmers) sell seeds and cultivate oat as the minor product, along with other cereals, legumes and oilseeds. Produced oat is used as grain, green food and as silage for animal feed. If used as grain, oat is sold from producer to feed processing companies which use it to produce feed mixtures. Feed mixtures are either sold directly from feed producers or via specialized retailers.

1.3.2 Input suppliers (breeders and seed producers, seed traders)

In Serbia, there are two domestic research institutes involved as breeders and seed producers (Small Grains Research Centre, Kragujevac and Institute of Field and Vegetable Crops, Novi Sad - IFVCNS), and a few producers and traders (Cosun seed d.o.o., Sremska Mitrovica; Semenarnacoop d.o.o., Petrovaradin; Voćka d.o.o., Stopanja, etc.) of certified seeds. Total amount of oat certified seeds in year 2020/2021 in Serbia, according to the seed certification data base, was 902,995 kg.

¹ Interviews with companies with multiple roles in value chain are presented in the table as multiple interviews

Certified seeds are produced from seeds of known genetic origin and purity, the production of which is controlled and tested, elaborated and declared in accordance with the Law on Seeds of the Republic of Serbia. Although, certification is considered to be time consuming, due to well defined procedure and experience of seed producers, in year 2020/2021, seven seed varieties were certified in Serbia according to the seed certification data base.

Oat breeding program has been revived at the Institute of Field and Vegetable Crops Novi Sad after almost fifty years. From this program the following varieties were released: in 2001 spring naked oat "Novosadski golozrni", in 2008 spring chaffy oat "Dunav", in 2009 spring chaffy oat "Vrbas" (Pržulj and Momčilović, 2010) and in 2010 winter chaffy oat "NS Jadar" and spring naked oat "NS Sedef" (Pržulj et al., 2011). According to the results from the field trials, oat variety "NS Jadar" is characterised with average yield of 5.2 t/ha (IFVSNS, 2022) and under convenient climatic conditions and application of appropriate production technology, test weight¹ of 56-58 kg, protein content of 14-15% and fat content of 6-8% (NS seme, 2022) can be achieved.

Seed producers in Serbia have expertise and excellent infrastructure for production of high quality seed, but the requirements for varieties with high technological quality regarding processing into food products are low since oat is mainly grown for feed not for food production. The problem is that sometimes in practice use of undeclared seed, so-called "seeds from the attic" occurs among the farmer, which is the problem for both oat yield and quality, and spread of diseases.

There is a well-established vertical cooperation, and in some cases even vertical integration between research and breeding institutions and the seed trading companies. Important vertical linkages reported are also the ones existing directly between research breeding institute - Institute of Field and Vegetable Crops Novi Sad and farmers, and the other between seed producers/traders and farmers. Seed is delivered to producers directly from research breeding institute or seed producers and sellers. The seed suppliers communicate with their clients and provide consulting via various communication channels: personal contacts, agricultural fairs, specialised events such as field days, presentations to existing and potential clients, but also website.

Market size for oat seed is rather small. Oat seed suppliers sell seeds as the one, minor product, from the rich assortment of other cereals, legumes and oilseeds. Due to low demands number of seed producers as well as breeding activities are limited in comparison to other crops, such as wheat, corn, soybeans, etc. In general, progress will only be achieved if demand for oat for food production in the market grows.

However, the interviewees estimated decline in demand for seeds, so the actual production seems to be sufficient or, in some years, higher than demand according to results of the stock exchange (Agrosaveti, 2022). The reason for low demand are the following: (1) decline in cattle production, (2) low demands for oat exporting, (3) utilization of farmers' own seed from previous harvest, and (4) negative impact of fluctuating prices and yields on the profitability of a crop (Pržulj et al., 2010). The reasons for low yield mostly arise from the fact that up to now, many farmers have tended to put oats in less suitable locations with a poorer water supply and in unfavourable positions in the crop rotation.

¹ Test weight, also known as *hectolitre mass*, is the weight of a standard volume of grain and is generally believed to be a measure of its bulk density.

1.3.3 Other suppliers (fertilisers and pesticides distribution)

Oats have specific requirements for mineral nutrition. They very well use hardly soluble nutrients in the soil, but at the same time respond very well to fertilization, especially with nitrogen. For oat grain yield of 3.0 t/ha: 75 kg/ha N, 36 kg/ha P₂O₅ and around 40 kg/ha K₂O is needed. Oat protection is identical to the one used for wheat, barley or rye. Pesticides against weeds and plant diseases are needed (Latković et al., 2005).

In Serbia, quality requirements for pesticides are clearly defined according to Law on plant protection agents with belonging Regulations. Before entering the market, plant protection products must be tested and registered by Plant Protection Administration, operating within the Ministry of Agriculture, Forestry and Water Management.

There is a well-established vertical cooperation between fertilisers and pesticides suppliers and farmers. In Serbia, fertilisers or pesticides distribution network is very wide and easily accessible for any farmer with excellently supplied selling points in almost any village. Both fertilisers and pesticides are sold in specialized retails such as agricultural pharmacies, or pesticides/fertilizers suppliers use their own distribution networks/logistics centres (e.g. Agromarket). Moreover, there are some companies integrating: factories for pesticide formulation, a centre for seed processing, seed collection centre, laboratories for quality testing and a distribution centre for pesticides such as Agrosava. The fertilisers and pesticides suppliers provide consulting to farmers concerning proper application.

Market demands are rather small due to low oat production compared to other cereals and oilseeds. However, since similar fertilizers and pesticides are used as for wheat, barley or rye it is hard to determine the amount of sold plant protection agents exclusively for oat production.

Fertilisers and pesticides suppliers in Serbia are mostly distributing imported products based on knowledge and technology of international corporations. Market share of domestic products is rather small. While a limitation of imported product is high price, domestic products have lower price, but the quality and concentration of such products is not guaranteed.

Recently, covid-19 pandemic and war in Ukraine have posed entry barriers and influenced higher costs of imported products.

1.3.4 Producers (farmers)

Oat producers (farmers) in Serbia are mainly cultivating oat for feed. In the diet of domestic animals, oats are used in several ways. From the un-hulled oats used to make concentrated horse feed, to hulled oats for poultry feed. Green biomass, fresh or dried, alone or in mixtures with livestock peas or legumes, is used as fodder for cattle (Latković et al., 2005).

Farmers use produced oat grains and greens directly for their animal farms or they sell them to the nearest animal farm. If sold in the form of grains, oat is distributed directly from farmer to feed producer. Sometimes feed producers are wholesalers integrating oat collection centre, feed production, seed, fertilizers and pesticides distribution. All interviewees described their business relations as stable and long-lasting. With high number of actors, regarding both, farmers that produce oats and feed mills the market of oats (and other grains) for feed production can be characterized as the market with perfect competition.

However, the production of oat is declining, as well as the demand, even in feed processing market. Several problems were encountered during farmers interviewing: (1) low price of oat compared to other cereal, (2) larger supply than demand, (3) low interest of collection centres to trade with oat, (4)

low export, and (5) decrease in cattle production. Moreover, farmers perceive that there is no appropriate support from the government through public policy measures directed at stimulation of oat production in Serbia.

Since the requirements for producing animal feed are low due to decrease in animal husbandry, farmers are not motivated to invest in knowledge and technology leading to higher quality of the product. Oat is usually produced along with other small grains, so existing infrastructure and logistic as for the other crops is used also for oats production. In Serbia, oat is grown as cleaning crop to suppress weeds, as catch crop in crop rotation with other more profitable crops and in marginal lands with low agronomic inputs. Oat is often grown as nitrogen catch crop after legumes and in fewer amounts after small grains (Latković et al., 2005). However, this is a reason for low yields of oats compared to other cereal, which represents one of the obstacles in oat cultivation.

This also contributes to low quality of produced oats. However, since quality requirements for oat for feed production are lower than for food production, produced oat mainly ends up as the raw material for feed.

Based on field trials and partly from practice, significantly higher yields of oats can be achieved in different agro-ecological regions. Comparing data on oat yields with data on barley and rye yields, oat yields are lower than both the other crops. This means that there are many untapped opportunities in the area of oat production, which should be used in future production (Latković et al., 2005). Great use value of oats, as well as the possibility of its cultivation in less favourable environmental conditions shows a trend of increasing areas under this grain in different farming production systems.

1.3.5 Collection centres and processing companies (feed mills and companies)

Oat grain is considered the best concentrated food for all types of livestock. As the highest quality fodder plant oat also serves as a fodder unit in balancing meals in livestock nutrition (Maksimović, 1988). Therefore, it is used in almost all feed mixtures.

Feed technology is well developed technology in Serbia and feed producers have also a good cooperation with feed research centres such as feed department at Institute for Food Technology in Novi Sad, where they can test their products in pilot plant and laboratory before producing larger batches. Feed companies are always investing in equipment and most of them are well equipped with different seed cleaners, mills, mixers, etc.

Feed producers sell their products either directly through their network of distribution centres located all-around cereal growing regions (e.g. Gebi d.o.o., Subotica) or via distribution to specialized retailers such as agricultural pharmacies. Some companies are performing extensive marketing in media, while the other relies on previously established cooperation with retailers

There are still demands for animal feed although animal husbandry is declining in Serbia. However, high prices of feed compared to primary agricultural product still make feed production competitive.

Recently (January 1st, 2020), a website was developed <https://otkuplijivac.rs/> to connect farmers and collection centres which could result in higher demands for oat. Website search performed on June 27th, 2022 with key words: oat and location - Novi Sad resulted in six findings of collection centres interested in oat. Most of them were mills or feed producers.

1.3.6 Retailing

Retailers selling animal feed are usually selling the other products such as seeds, pesticides, fertilizers, sometimes, also supporting equipment in agriculture, etc. Feed market is characterised with perfect competition and thus prices of animal feed are based on supply and demand. Since oat based feed is a well-established product category with long traditions its market position is stable for years.

Oat feed mixtures are sold either directly through feed company distribution centres or through specialized retailers. The retailers are establishing good vertical and diagonal linkages with wholesalers of seeds, pesticides, equipment and feed processors. There is also a possibility to order animal feed on-line (<https://sanders.rs/sr/19-prodaja>).

1.4 Results: food value chain

1.4.1 Description of the oat food value chain

Unlike oat feed value chain, oat food value chain is characterized with poor connections of food processors with the actors of the upstream processes - farmers, seed suppliers. The reason is the low technological quality of oat produced in Serbia (e.g. lower test weight than required). Therefore, almost all the oat used for food production is imported. Long time ago oat was used in breadmaking, but this practice was abandoned and most of the oats in Serbia was used just for feed. Oat consumption in Serbia revived in the late '90-ties. From then till now oat flakes are widely consumed for breakfast. In 2010-ties the assortment of food oat products was enriched with oat instant porridges. Nowadays, the dominant oat products on the market are oat grains, oat flour, oat flakes and oat porridges. In recent years, global market trends such as veganism, health/wellbeing and environmental consciousness, less meat consumption are giving new market relevance to oat products. This triggered appearance of niche products on the market such as oat based plant drink, oat cookies, oat granola, etc.

Oat food value chain is currently in Serbia in the **growing stage of product life cycle**.

1.4.2 Collection centres and processing companies (food production)

Since most of the oat based food products are imported, the interviews were completed with a few domestic oat food producers producing oat flakes, oat porridges, muesli and oat flour.

According to interviews completed, small oat food processors are reporting barriers to get into the market for oat foods due to monopoly of one oat flakes producer. This is a strong family owned company producing different kinds of cereal grains, flour, flakes equipped for all phases of grain processing including cleaning, dehulling, flakes production, milling etc. In addition to production, they are also providing cleaning technology of all kinds of cereals, seeds, oilseeds. Their customers are the largest producers of confectionery products in Serbia. Their products can be found in all healthy food stores, as well as in all wholesaling companies throughout Serbia. However, the monopoly producer reported a problem of struggling with dominance of imported oat products on the market which prevalence is the consequence of better subsidies for growing oats and better positioning of the brand name of foreign companies like, for example Dr Oetker.

On the other hand, wholegrain oat flour producers are integrating activities of collection centre and food processing or healthy food distribution centre (wholesaling) and cereal (oat) processing.

Oat processing companies developed their oat based products out of a family tradition. Other important source of knowledge were acquired from equipment manufacturers, knowledge transfer by

recruiting staff from other similar companies and consulting or by exchange of experiences with colleagues.

General food safety and quality regulations and labelling requirements are applied for oat based food products. Some of them are experiencing problems in labelling and nutritional and health claims utilization and therefore asking for a help within Universities and research Institutes. Food processors in Serbia do not have an organic certificate for oat based food, although it is a trend in other European countries.

In spite of growing trends in oat consumption such as veganism, natural food and local food consumption interviewees did not report intentions to develop new oat based food products.

Oat for food production is mainly imported which can represent a problem in a situation such as Covid-19 pandemic and war in Ukraine. More effort should be made to connect oat producers (farmers) and domestic food processors.

Recently, new oat based brand appeared on the market (<https://www.boombox.eu/rs/kontakt/>) promoting just oat based organic food products in colourful attracting packaging as 100% plant based, vegan, nutritive complete meal without added sugar developed in a cooperation with nutritionists. This brand is developed by Croatian company operating in Serbia. If, in the future, it gets important position in the market, this can trigger domestic producers to invest in innovative products' development.

1.4.3 Retailing

The food processors sell their products mainly via wholesalers and retailers - food health stores. Some of them sell their products directly via online channels to consumers.

Positioning of oat based foods in a special store departments devoted to healthy food is attracting consumers without the need to perform further marketing.

There is also significant B2B market for oat products. Oat products (flour and flakes) are sold in significant quantities (about half of produced quantities) to confectionary industry which is among the strongest industry sectors in Serbia. Confectionary producers permanently develop and place to the market novel oat based cakes, bars, bisquits and other products targeting the healthy food consumers.

1.5 Discussion

Although having a long tradition in cultivation, nowadays, oat can be considered a minor crop in the context of cereals and oilseeds production in Serbia.

It is produced mainly for feed. Although researchers and breeders managed to select and certify good quality seeds in past two decades, due to low demands and prices of oat, farmers in Serbia are growing oat as cleaning crop to suppress weeds, as catch crop in crop rotation with other more profitable crops and in marginal lands with low agronomic inputs. This results in a product of acceptable quality for feed, but at the same time of inadequate quality for food industry.

Therefore, food industry is mainly importing oat to produce oat flour or oat flakes as a major products. Other, niche oat based food products, such as oat based plant drink, oat cookies, oat granola, etc. are imported.

1.5.1 Past challenges & successes of the value chains

Breeding

Research breeding institutes in Serbia developed and certified several oat varieties with good yield and quality. The certified varieties have excellent potential to double the currently achieved yield and produce the high quality oat based food. It is one of the successes of this VC.

However, available varieties are not fully exploited by farmers resulting in low yields and quality than required for food production. Therefore, they are used for feed. In order to make the oat attractive to farmers it is needed to provide consulting in terms of the agricultural practice and possibilities to turn oat into innovative food products, appealing to consumers.

Feed value chain

Actors of the oat feed value chain are well vertically linked and/or integrated. Feed technology is well-developed. Oat producers are growing oat either for their own animal farms or in cooperation with feed producers, from which some are, besides collection of oat, providing seed distribution and fertilizers. This can be considered a success of the value chain. Some of the challenges encountered were a decline in livestock, especially horses, and necessity to adopt the feed to other animals.

Food value chain

Due to balanced amino-acids profile compared to other cereals, high content of β -glucans, current trends in healthy, vegan, local food and sustainable nutrition, oat has a potential to be turned into innovative food product for healthy life style. Therefore, oat flakes, muesli and porridges became breakfast choices for a large number of Serbian consumers. Confectionary industry, with oncreasing offer of healthy oat based products, is large B2B customer for primary oat products like flour or flakes. This can be considered a success of the value chain. However, since most of these products are imported, this also points out the major challenges for further development of the oat food value chain: (1) necessity of public policy measures and more intensive marketing to increase the number of domestic/locally produced food, and (2) investment in innovative oat based food products.

1.5.2 Current challenges and foreseen chances

Detailed overview of the main challenges in oat feed and food value chain in Serbia with recommendation for strategies to be undertaken and identification of potential benefits for actors in the value chain are provided in Table 4.

Table 4. Summary of the challenges, strategies and potential benefits for each value chain actor.

VC actor	Main challenges/opportunities (order: most important first)	Strategies undertaken/to undertake	Potential & benefits for the actor in the VC chain
Input suppliers (breeders, seed producers, seed traders)	<ul style="list-style-type: none">• Feed and food: more comparative yield to other cereals• Food: achieve seed quality necessary for food production• Feed and food: sowing of non-certified seed	<ul style="list-style-type: none">• Feed and food: organize cooperation with farmers and support - beside seeds provide them with knowledge, necessary agro-technological measures, fertilizers, etc.• Food: increase breeding	<ul style="list-style-type: none">• Feed and food: more farmers producing oats• Food: less reliance on import, higher price and demand for food grade oat, more clients• Feed and food: better yield and lower

		and trading activities for oat seeds with technological quality necessary for food products <ul style="list-style-type: none"> • Feed and food: Better education and stronger regulation 	susceptibility to plant diseases
Producers	<ul style="list-style-type: none"> • Yield • Low price compared to other cereals • Food: Demand of processors • Interest of collection centres to trade with oat 	<ul style="list-style-type: none"> • Improve agro-technological measures for better yield and quality • Take advantages of oat in crop rotation • Communication with different stakeholders for higher price/better demand/ production subsidizing • Food: Finding new processors • Negotiations with collection centre to make them interested in goods 	<ul style="list-style-type: none"> • High profitability • Diversification of production and earnings • Food: Increase in the range of food products on the market • Increase in exported quantities of oat
Feed processors	<ul style="list-style-type: none"> • Decreasing livestock production 	<ul style="list-style-type: none"> • Cooperation with livestock producers and exchange of know-how for increased livestock production • Organization in groups/syndicates and lobby for subsidies for livestock production 	<ul style="list-style-type: none"> • Increase in feed production • Less reliance on import of animal products
Food processors	<ul style="list-style-type: none"> • Reliance on imported oat • Variety of products, especially the innovative ones considered "healthy", sustainable, vegan, etc. 	<ul style="list-style-type: none"> • Public policy measure - subsidies/promotions of domestic products • Better cooperation with R&D institutes in the field of food technology and nutrition 	<ul style="list-style-type: none"> • Increased interest for oat from domestic producers • Less reliance on import • Increase in value-added products with high price • Increased supply
Retailers	<ul style="list-style-type: none"> • Food: Availability of information to consumers concerning benefits of oats • Food: Marketing of novel/domestic food products 	<ul style="list-style-type: none"> • Food: Improve communication with consumers • Food: Investment in marketing/labelling of products with signs - domestic products 	<ul style="list-style-type: none"> • Food: High profit • Food: Increased demand and number of consumers • Better image of a shop as the one selling domestic food for health and wellbeing

1.5.3 Limitations

The empirical study has followed a general guidelines prepared for the CROPDIVA project, Task 5.1. Some of the questions were adopted in order to get more honest answers from all actors of the VC. Research was conducted including uniformly actors from all stages of oat value chain in Serbia, as well as actors with different perspectives and competitive positions within each step of value chain. Thus, present analysis can be considered as objective presentation of oat value chain in Serbia. Findings from the study can be generalized for understanding other VCs that function in the same or similar context (e.g. barley).

1.6 Synthesis

Feed and food oat value chains in Serbia differ significantly. Oat value chain for feed is in maturity phase of product life cycle and comprises different VC actors: from seed breeders, producers and sellers to oat producers (farmers), feed producers and retailers. In some cases there is a vertical integration of feed producers, collection centres, seed, pesticides and fertilizer traders. The major problem encountered is decline in livestock production, especially horses in Serbia. Therefore, oat feed technology is changing towards oat utilization in pigs or birds feeding.

Unlike feed value chain, oat VC for food is in growing stage. At this moment there is one mainstream product on the market - oat flakes, and one food producer at the market having dominant role which pose barriers for entry of small food producers. Other oat food products on the market are mostly imported. Oat food VC also characterizes a reliance on imported oat since oat produced by farmers does not have a quality necessary for food production. Major opportunity for food VC development can be found in increasing consumers' interests in vegan and sustainable food products with appealing nutrition and health claims. This can motivate domestic producers to start with the production of innovative oat based food products. Confectionary industry, a stable and growing sector in Serbia is increasingly using oats as healthy ingredient in their products.

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