



# The Feed Value Chain of Triticale in Serbia

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# 1. THE VALUE CHAIN OF TRITICALE IN SERBIA

## 1.1 Triticale in Serbia

Triticale is in Serbia used as culture important in crop rotation and convenient for utilisation as animal feed. According to the official data from Statistical office of the Republic of Serbia<sup>1</sup> the areas used for production of triticale are permanently increasing and trend up to 30.000 ha (Figure 1).

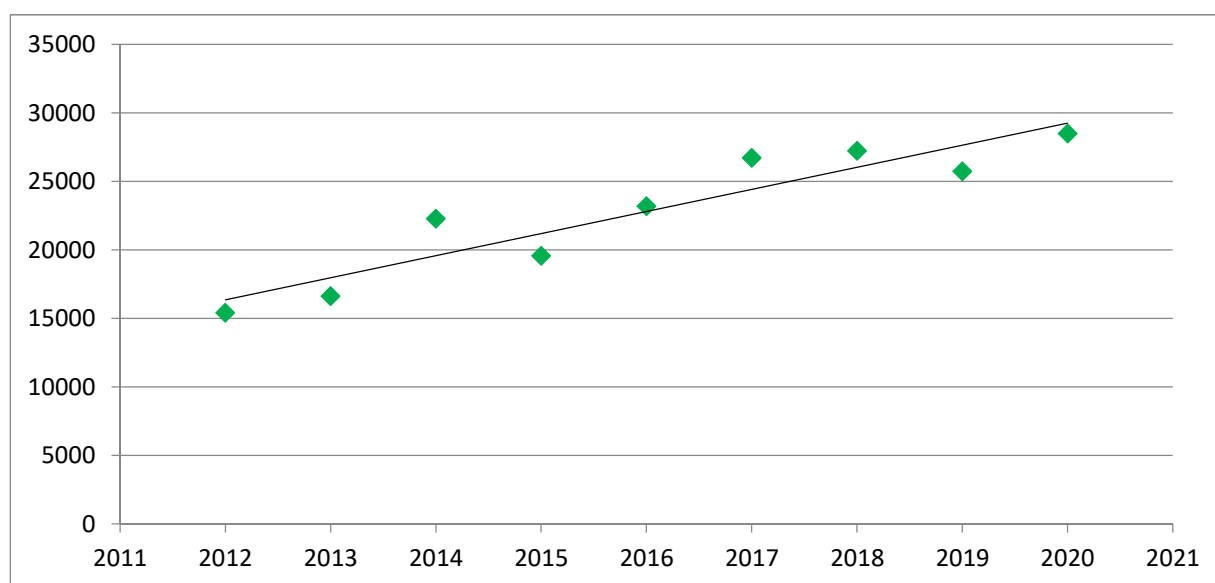


Figure 1: Increasing trends of areas used for TRITICALE production in Serbia (ha)

Official data from FAOstat<sup>2</sup>, provided in table 1 also point out at increasing trend in triticale production in Serbia. According to calculated data from FAOstat annual production of Triticale in Serbia is about 100.000 t with increasing trends during last five years.

Table 2 – Triticale production in Serbia – areas, yields and produced quantities

Year	Area (ha) (official)	Yield (t/ha) (calculated)	Quantity, t (calculated)
2016	23.191	4,325	100.301
2017	26.718	3,689	98.586
2018	27.233	4,165	113.439
2019	25.725	3,974	102.231
2020	28.495	4,436	126.404

<sup>1</sup> <https://www.stat.gov.rs/>

<sup>2</sup> <https://www.fao.org/faostat/en/#data/QCL>

Average yields of triticale per hectare are actually at the level of about 4 t/ha but with appropriate agro technical measures it can be over 6 t/ha, making triticale an attractive small grain in crop rotation system, particularly to large farms which apply appropriate production technology.

On the basis of data obtained from Customs administration Serbia is both, exporter and importer of triticale grain.

Annual quantities of imported Triticale grain are increasing reaching from 877 t in 2017 almost 1.400 t in 2021 (Table 2), representing roughly about 10% of domestic production. Triticale was, during last five years, mainly imported from Russia, meaning that due to the outbreak of war and changes in trade conditions with Russia the situation in triticale supply in the future might change. Import from other countries is realised in small, sometimes negligible, quantities.

*Table 2 - Import of triticale to Serbia in last 5 years*

Year	Imported quantity, kg	Share of import from Russia, %	Other countries from which import was realised
2017	867,196.40	82%	Denmark, France, Greece, Hungary, Poland,
2018	1,023,530.00	93%	Bulgaria, France, Greece, Hungary, Italy, Poland
2019	1,155,615.00	89%	Greece, Hungary, Poland, Sweden, Ukraine
2020	1,014,056.00	80%	Bulgaria, Greece, Hungary, Poland
2021	1,399,168.50	95%	Bosnia and Herzegovina, Bulgaria, Greece, Poland, Slovenia

Triticale is also exported from Serbia. Annual export of triticale from Serbia is characterised with decreasing trend from 1250 t in 2017 to 718 t in 2021. The main export market for triticale from Serbia is Bosnia and Herzegovina to which 60 – 80 % of total export is delivered.

*Table 3 - Export of triticale from Serbia in last 5 years*

Year	Exported quantity, kg	Share of export to B&H, %	Other countries to which export was realised
2017	1,250,650	77	Albania, Bulgaria, Croatia, MA, Montenegro, North Macedonia, Romania, Slovenia, Uzbekistan, Kosovo
2018	1,157,790	71	Bulgaria, Greece, Croatia, Italy, Montenegro, North Macedonia, Romania, Slovenia, Ukraine, Kosovo
2019	789,870	68	Albania, Bulgaria, Croatia, Italy, Montenegro, North Macedonia, Slovenia
2020	718,625	61	Croatia, Iraq, Montenegro, North Macedonia, Romania, Slovenia, Turkey, Uzbekistan, Kosovo
2021	875,449	60	Croatia, Iraq, Montenegro, North Macedonia, Romania, Slovenia, Kosovo

Beside the production of triticale grain, triticale is in Serbia also used for production of green mass which is ensilaged. Obtained silage is used for the following purposes:

- Feeding of animals
- Green energy production

Government support for production of green energy from renewable sources which was launched in 2017, resulted in increased interest of large agricultural companies and cooperatives in production of triticale for green mass which will be used for production of biogas. Areas used of such production are not included in statistics presented above, but unofficial data areas under triticale for this purpose may be even larger than areas under triticale for grain production.

Although there were some investigations regarding technological properties of triticale for food production, at Serbian market there are no food products obtained by triticale processing.

In this report two value chains, one for animal feed and one for green energy production were investigated. In the first part of the report triticale value chain map is presented and overview of the interviews conducted is provided. In the second the analysis of the feed value chain is provided followed by the green energy value chain analysis in which points which are different in comparison to feed value chain are emphasized. Finally a joint discussion, past challenges and successes of the value chains, current challenges and foreseen chances, limitations and synthesis was made.

## 1.2 Results

### 1.2.1 Description of the triticale value chain

Triticale value chain with involved value chain actors in Serbia was mapped as presented in Figure 2.

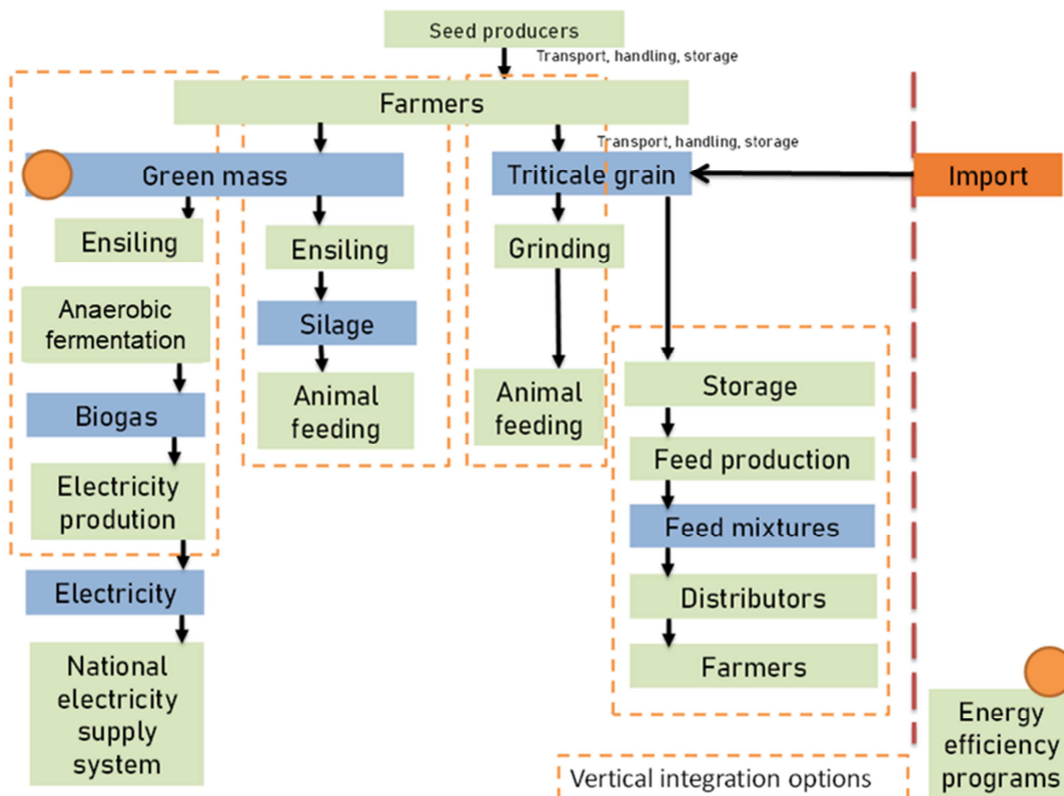


Figure 2. Mapping of triticale value chain in Serbia

In Figure 2 two branches of triticale value chain are presented:

- Value chain of triticale green mass utilisation and
- Value chain of triticale grain utilisation

Triticale green mass is increasingly used for ensiling, i.e. preservation of plant green mass through fermentation of sugars to acids which result in decrease of pH and enable extension of period in which green mass can be used. Obtained silage was until few years ago used only as animal feed while after introduction of public policy programmes for support of green energy production it is increasingly used as raw material for biogas production, which is further converted into electric energy which is supplied through the national electricity supply system.

Triticale grain is used for animal feeding; either by farmers which beside production of field crops have also animal husbandry part of their production cycle, or, regularly, triticale grains are sold to feed mills which use it as raw material for feed mixtures production.

Both branches of triticale value chain are to high extent vertically integrated. Production of triticale and its utilisation for animal feeding is regular practice for many farms with diversified production which includes field crops production and animal husbandry. Production of biogas from triticale green mass is also conducted by large farms which produce triticale for their own needs of biogas production. Beside the farms the only other actors involved in triticale value chain are feed mills which buy triticale grain from farmers, or import it and incorporate it in feed mixtures that they produce. Feed mills, especially the large ones have usually their own distribution network through which they supply farmers with their products, but feed mixtures are also offered in general stores offering all supplies needed for agricultural production.

There are several institutes involved in plant breeding that created triticale varieties, and which supply the market with sufficient quantities of triticale seed.

Triticale value chain for feed in Serbia is in maturity phase of product development cycle. Value chain of production of electricity from triticale green mass was initiated 5 years ago, but considering that it is quite simple it also reached maturity after short period of time.

There is no food value chain for triticale in Serbia, and no triticale based products are offered to the consumers.

### 1.2.2 Overview of the interviews completed










The primary search for entities involved in triticale production and processing of triticale in Serbia started from advisor from the extension service who kindly provided data about involved value chain actors and their contacts. The final list of value chain actors includes:

- Triticale breeders and seed suppliers
- Producers of triticale green mass
- Producers of triticale grain
- Feed mills

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 interviews were completed by telephone while the ones having deeper knowledge and understanding of the issues in triticale value chain were visited and face to face interviews were conducted.

The overview of number of interviews per value chain actors<sup>1</sup> is provided in table 1. In the table the method (face to face or telephone) used for conduction of the interview is presented.

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

VC actors	Numbers of interview	Method
Breeder, seed producer and trader	1	
Seed traders	1	
Tritical green mass producers	1	 
Triticale grain producers	2	 
Feed mills	2	 
Advices	1	



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 Suppliers

#### Breeders

The offer of triticale seed in Serbia is diverse. According to the seed certification data base total production of certified triticale seed in Serbia was 2340 t. Seed production is realised by large number of companies, with 3 main seed producer having share of more than 60 % in total seed production: (Cosun seed d.o.o., Sremska Mitrovica, BC doradni centar, Kula and Institute of Field and Vegetable Crops, Novi Sad.

In seed production different varieties from different sources are represented, but more than 75% of produced seed belong to 4 most widely used varieties: variety Amarillo 105 from producer Cosun seed from France, BC Goran from producer BC Institute from Croatia, NS Odisej from producer Institute of Field and Vegetable Crops, Novi Sad and KG20 from producer Small Grains Research Centre, Kragujevac both from Serbia. Remaining 25% are triticale varieties from mentioned and other private breeding companies from Serbia which are represented in production with small shares.

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.

<sup>1</sup> Interviews with companies with multiple roles in value chain are presented in the table as multiple interviews

Triticale varieties, for which seed is available in Serbia, differ in terms of height, time of sowing and maturation and grain properties (grain size, test weight, protein content). Winter and facultative varieties are represented in seed offer.

Seed producers in Serbia have expertise and excellent infrastructure for production of high quality seed.

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.

## **Input suppliers**

Supplies for production of triticale are more or less identical to the one used for wheat, barley or rye.

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.

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 triticale 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.

## **Knowledge providers and services**

The main research activities related to triticale are being performed in Institutes which are dealing with triticale breeding activities. Existing research is related to determination of production and processing value of developed triticale varieties (Đurić et al. 2015), optimisation of application of mineral fertilisers (Lalević Et al., 2019) and nitrogen (Lalević and Biberdžić, 2016) quantities for achievement of high yields of triticale, determination of sowing recommendations in dependence of variety (Popović and Malešević, 2011), investigation of influence of extreme weather conditions (Nožinić et al, 2009) on triticale yields and grain quality etc.

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.

The fertilisers and pesticides suppliers provide consulting to farmers concerning proper application.

There is a strong Centre for feed technology in Institute of Food Technology in Novi Sad which provides knowledge transfer service, product control and research and development services to feed producers.

### **1.3.2 Producer**

The production of triticale in Serbia is increasing, as well as the demand, mainly as the consequence of support from state and other different donors to investment in green energy production. Triticale producers (farmers) in Serbia were cultivating triticale for feed but nowadays the production of triticale as raw material for green energy production, especially among large farmers is increasing.

Among triticale producers there are both, large agricultural companies with diversified production and small farmers.

In Serbia, triticale intended for feed production is grown as cleaning crop to suppress weeds and in marginal lands with low agronomic inputs. This might be the reason for lower yields achieved in production of triticale in comparison to genetic potential of used varieties.

In feeding of domestic animals, triticale is used in the form of green biomass, fresh, ensiled or dried or in the form of grinded triticale grains in feed mixtures. Farmers use produced triticale grains and greens directly for their animal farms or they sell them to the nearest animal farm.

If sold in the form of grains, triticale is mainly sold directly from farmer to feed mill. All interviewees in this stage of value chain described their business relations as stable and long-lasting. With high number of actors, regarding both, farmers that produce triticale and feed mills the market of triticale (and other grains) for feed production can be characterized as the market with perfect competition.

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. Triticale is usually produced along with other small grains, so existing infrastructure and logistic as for the other crops is used also for triticale production.

### **1.3.3 Collection and processing companies**

Feed production sector is well developed in Serbia, with large number of companies with different competitive strength at the market. Feed mills mainly have their own storage capacities and they purchase triticale from farmers and store it in their own storages.

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 or via distribution to specialized retails 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.

### **1.3.4 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 and market position of feed products is stable for years.

Feed mixtures are sold either directly through feed company distribution centres or through specialized shops. 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>).

### **1.3.5 Marketing strategy**

Some feed producers occasionally run promotion campaigns for their products but in general in feed value chain there are little or no marketing activities. No marketing activities are related to triticale.

## **1.4 Results: Green energy value chain**

### **1.4.1 Suppliers**

Regarding the seed, fertilisers, pesticides and other supplies the same finding presented under the feed value chain section apply.

In the field of green energy production from agricultural raw materials there is a number of knowledge providers from researchers in public research institutions to domestic and foreign consultants who support establishment of green energy production plant.

### **1.4.2 Production and processing**

Production of triticale as raw material for green energy production is realised by farms, i.e. large agricultural companies in which production of triticale and its utilisation for green energy production are vertically integrated. The goal of triticale production in this case is obtaining of the highest possible yield of green biomass and production technologies applied are adjusted according to this goal. Large companies engaged in this field employ experience agricultural engineers which organise the production in accordance with recommendations for achievement of desired goal of production.

The initiative from the government for investment in green energy production plant was launched in 2017, with financial support to companies planning the investment in this field. Investment in green energy production plant is also supported by EU Instrument for Pre-Accession Assistance for Rural Development as well as by other donors.

Based on these initiatives a number of large agricultural companies decided to invest in plants for green energy production (Stricky et al., 2014). These are mainly companies in which different sectors of agricultural production are horizontally integrated with large areas of arable land used for production of diverse crops including increasingly triticale intended for green energy production.

After harvest of green biomass it is ensiled and silage is used for both: biogas production and animal feeding. For biogas production farms have large fermentors in which green biomass of triticale and other crops is used along with waste from other production sectors (livestock production for example) in order to obtain methane. Obtained biogas (methane) is used in generators to obtain electricity.

### **1.4.3 Retail**

The field of green energy production is legally defined and all produced energy has to be incorporated in state electro-distribution system. The prices of produced electric energy are defined administratively.

Farms using green biomass from triticale and other crops, beside financial effects from sold electric energy have also the benefits of treatment of waste from other production sectors in their own plants.

## **1.5 Discussion**

Triticale is in Serbia crop which is produced quite often. Triticale producers (farmers) in Serbia were cultivating triticale for feed, mainly as the small grain crop which contributed to weed elimination in the fields in the crop rotation, but nowadays the production of triticale as raw material for green energy production, especially among large farms is increasing. In spite of production of triticale at quite large areas, and existence of awareness that triticale can be used also in food production, until now nor utilisation of triticale for food production, neither triticale based food products at the market were recorded. Among consumers triticale is accepted as feed crop and there is no demand for triticale based food products, since consumers do not have information about that triticale can be used as food product ingredient.

The market of supplies for triticale production is well supplied with all inputs including certified seed of varieties with different production properties, harvesting time and seed quality. Technology for triticale production is well known to the farmers and they are well equipped for production of this crop.

In previous time triticale was used only for feed, in form of ensiled green mass or as a component for feed mixture production. Feed mixtures production industry is well developed with large number of companies in this sector and with well-developed retail networks.

With introduction of support for green energy production from the government production of triticale as raw material for green energy production expanded and it is still increasing.

In both value chains products are in maturity stage of their life cycle with stable position at the market.

### **1.5.1 Past challenges & successes of the value chain**

In the case of production of triticale for feed and for green energy production it seems that all challenges were successfully overridden. These sectors are well functioning and production of triticale for these purposes have increasing trend. Feed and green energy value chains of triticale are the examples of successful value chains.

The main challenge regarding triticale in Serbia is the absence of any utilisation of this crop in food production.

## 1.5.2 Current and foreseen challenges and chances of the value chain

Detailed overview of the main challenges in value chain of triticale in Serbia with recommendation for strategies to be undertaken and identification of potential benefits for actors in the value chain are summarised in Table 4. Having in mind that described value chains of triticale intended for feed and green energy production are successful in this section challenges which prevent utilisation of triticale for food and strategies for initiating utilisation of triticale for food are outlined.

*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"> <li>Identification of varieties with good properties for food production</li> </ul>	<ul style="list-style-type: none"> <li>Investigation of existing triticale varieties in terms of their convenience for food production</li> </ul>	<ul style="list-style-type: none"> <li>Initiation of triticale based food production, opening of additional marketing channel for triticale</li> </ul>
Input suppliers (researchers)	<ul style="list-style-type: none"> <li>Investigations regarding utilisation of triticale in food production and development of triticale based products are missing</li> </ul>	<ul style="list-style-type: none"> <li>Initiation of R&amp;D activities regarding utilisation of triticale in production of different foods</li> <li>Promotion of triticale as food ingredient</li> </ul>	<ul style="list-style-type: none"> <li>Creation of knowledge needed for initiation of triticale based food production</li> <li>Creating awareness about triticale and its benefits as food ingredient among consumers</li> </ul>
Producers	<ul style="list-style-type: none"> <li>Yields under genetic potential of produced varieties</li> <li>Inputs lower than recommended</li> </ul>	<ul style="list-style-type: none"> <li>Positioning of triticale as crop with high market potential</li> </ul>	<ul style="list-style-type: none"> <li>Increasing yields</li> <li>Better grain quality</li> </ul>
Collection centres	<ul style="list-style-type: none"> <li>Collection centres for triticale available only as integrated activity of feed producers</li> </ul>	<ul style="list-style-type: none"> <li>Forming of collection centres for triticale intended for food production</li> </ul>	<ul style="list-style-type: none"> <li>Forming of lots of triticale intended for food production</li> </ul>
Processors	<ul style="list-style-type: none"> <li>Existing producers of cereal based food do not consider triticale as potential raw material</li> <li>There are no companies specialised for triticale based food production</li> </ul>	<ul style="list-style-type: none"> <li>Support to utilisation of triticale in food production through subsidies or granting of innovation projects</li> </ul>	<ul style="list-style-type: none"> <li>Initiation of triticale based food production</li> </ul>
Retail	<ul style="list-style-type: none"> <li>Triticale based food can be placed to the market through existing retail channels for cereal based food and healthy food</li> </ul>	<ul style="list-style-type: none"> <li>Create awareness about triticale based food products among retailers</li> </ul>	<ul style="list-style-type: none"> <li>Placing of triticale based food product to the market.</li> </ul>

### 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 triticale 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 value chain in Serbia in past years.

### 1.6 Synthesis

Triticale value chains in Serbia in the case of feed production and utilisation of triticale for green energy production can be assessed as successful value chains. However, there is no utilisation of triticale for food production. Utilisation of triticale as food ingredient is an opportunity for further development of triticale exploitation in Serbia.

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