



# The Food Value Chain of Hull-less barley in Serbia

## CROPDIVA – 5.1

Deliverable Information	
Title	<b>The Food Value Chain of Hull-less barley in Serbia</b>
Deliverable number	<b>5.1</b>
WP number	<b>5</b>
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Lead beneficiary	<b>FINS (Institute of Food Technology in Novi Sad)</b>
Type	R: Document, report
Dissemination Level	PU: Public
Due date	<b>June, 2022</b>

History of Changes	
Version 1.0	Final version (October, 2022)



This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101000847. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or [name of the granting authority]. Neither the European Union nor the granting authority can be held responsible for them.

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# 1. THE VALUE CHAIN OF HULL-LESS BARLEY IN SERBIA

## 1.1 Hull-less barley in Serbia

Most of the barley grown in ancient times all over the world was of hull-less type utilized for making flat breads, cakes and soups (Newman, & Newman, 2008). However, modern production of hull-less barley (*Hordeum vulgare* var. nudum) (95%) has shifted to East Asia; it is predominately grown in Japan, Korea, Nepal, Tibet of China and Bhutan, so that it is comparatively grown with low representation in Australia and the western world (Shaveta, Kaur, & Kaur, 2019). During the last ten years, the growing interest in the use of hull-less barley for direct human consumption and industrial processing has been noticeable, mainly due to higher levels of  $\beta$ -glucan than that of hulled barley. Still, numerous authors stated that hull-less barley has lower yields than hulled barley, which may be the reason why this variety is slowly spreading in production worldwide and in Serbia as well. Another reason for slow growth of hull-less production in Serbia is the presence of certain percentage of grains whose hull did not separate after threshing, which impose the need for additional dehulling of grains.

However, additional dehulling may cause certain technological challenges such as grain breakage due to the soft endosperm of hull-less barley. Therefore, in order to increase the interest in growing hull-less barley in Serbia, it is necessary to create varieties that are equal or close in yield and agronomic and technological properties to domestic hulled barley varieties, and from which hulls are completely removed by trashing.

There is no tradition of growing hull-less type of barley in Serbia, which is why the hull-less barley breeding programs were established in domestic institutes only in the 1990s, when the germplasm from Asia, Africa and America was introduced and tested, crossbreeds were made and the first lines and varieties of hull-less barley were created. So far, three domestic varieties of hull-less barley (Golijat, Apolon and Balsha) have been recognized in Serbia.

The hull-less barley breeding program has been based in three breeding institutes in Serbia: Centre for Agricultural and Technological Research in Zaječar, the Institute of Field and Vegetable Crops - National Institute of the Republic of Serbia in Novi Sad and Maize Research Institute in Zemun. Due to the fact that the Balsha variety was produced at the Centre for Agricultural and Technological Research in Zaječar institute, which is currently in bankruptcy, only Golijat and Apolon varieties are available on the domestic seed market.

According to the statements of breeders (literature), Golijat and Apolon are spring varieties with good biological-productive properties in terms of maturation time, lodging resistance and resistance to diseases - powdery mildew (caused by *Blumeria graminis*), leaf rust (caused by *Puccinia hordei*) and reticulate leaf spots. In terms of agricultural engineering procedures it requires early sowing and lands of moderate fertility, while its technological properties are suitable for its utilization in bakery industry and production of barley flakes.

The offer of hull-less barley products in the Serbian market is limited to several products:

1. Hull-less barley grain, traditionally called “*geršla*” which is sold packaged or in bulk – used in cooking for stews, soups or porridges
2. Hull-less barley flakes
3. Hydrothermally processed hull-less barley porridge
4. Hull-less barley flour and semolina
5. Pasta
6. Bread – mainly unleavened barley bread (Figure 1).



Figure 1 – Part of hull-less barley based products offer at Serbian market

It might seem that a variety of different products is available; they are produced in small quantities with variable availability throughout the country. However, no data is available to the consumers whether these products are produced from hull-less or hulled type of barley. Although hull-less barley is characterized by mild and pleasant taste and can be utilised as an ingredient in various foods, its consumption in Serbia is still below dietary recommendation, which is the case with barley products in general.

Data obtained from Customs administration show that annual import of hull-less barley to Serbia was negligible in the period 2017-2019, while from 2020 there has been a noticeable increase in import of hull-less barley. The main destinations from which hull-less barley is imported are France and Hungary as presented in Table 1.

*Table 1 - Import of hull-less barley grains to Serbia in last 5 years*

Year	Imported quantity, kg	Countries to which export was realised
2017	1.084	France, Hungary, Poland
2018	1.965	Belarus, France, Hungary
2019	1.005	France, Hungary
2020	10.880	France, Hungary, Russia
2021	3.486	France, Hungary, Netherlands

On the basis of data from Customs administration of Serbia certain quantities of hull-less barley are exported from Serbia with export in last five years ranging from 2 to 40 t. The main destination for export is Montenegro, North Macedonia and Bosnia and Herzegovina as shown in Table 2.

*Table 2 - Export of hull-less barley grains from Serbia in last 5 years*

Year	Exported quantity, kg	Countries to which export was realised
2017	44.000	Montenegro
2018	11.000	Montenegro
2019	4.125	B&H, North Macedonia
2020	9.305	Montenegro, North Macedonia
2021	2.000	Montenegro

## 1.2 Results

Hull-less barley value chain with involved value chain actors in Serbia was mapped as presented in Figure 2. Hull-less barley value chain and hull-less barley production and processing in Serbia are in **introductory stage** of product life cycle.

One large agricultural producer has been identified located in Northern part of the country – Vojvodina while the information of the smaller producers is not available.

### 1.2.1 Description of the hull-less barley value chain

The main hull-less barley producer is agricultural cooperative Agrodunav Karavukovo (<https://agrodunav-karavukovo.ls.rs/rs/>) which also possesses own equipment for primary processing of hull-less barley – equipment for drying and storage, cleaning of grain mass and stone milling. Likewise, Agrodunav Karavukovo possesses a small, artisanal-type bakery of small capacity. They sell dried and cleaned grain in a bulk to healthy supplies shops and to secondary processors – producers of barley flakes and instant porridge, bakeries and producers of ready-to-bake mixes. It can

be estimated that the majority of the hull-less barley production originates from Agrodunav, Karavukovo.

Although the majority of the produced hull-less barley is processed into dehulled grains, flakes, and instant porridge in the company Italico, Bečej (<https://www.italico.rs/>) there are a small number of companies involved in secondary processing of hull-less barley, as listed below:

- Vega, Čenta (flour) (<https://vega-adm.rs/>)
- Naše dobro, Bela Crkva (flour) (<https://nasedobro.com/>)
- Kao zdravlje, Brus (flour) (<https://kaozdravlje.rs/>)
- Nutricia, Borča (flour, ready-to-bake mix) (<https://nutricia.rs/>)
- Delfin, Nova Varoš (flour) (<https://www.delfin.rs/>)
- Interpak, Kraljevo (grain, flour, pasta, bran, semolina, ready-to-bake mix) (<http://www.interpak.rs/>)
- Progres, Novi Sad (ready-to-bake mix) (<https://www.pekarskicentar.rs/>)
- Pip, Novi Sad (ready-to-bake mix) (<https://www.pip-ns.com/>)
- Parfet (unleavened bread)
- BMP Nutrio (unleavened bread) (<https://www.facebook.com/bmpnutrio/>)

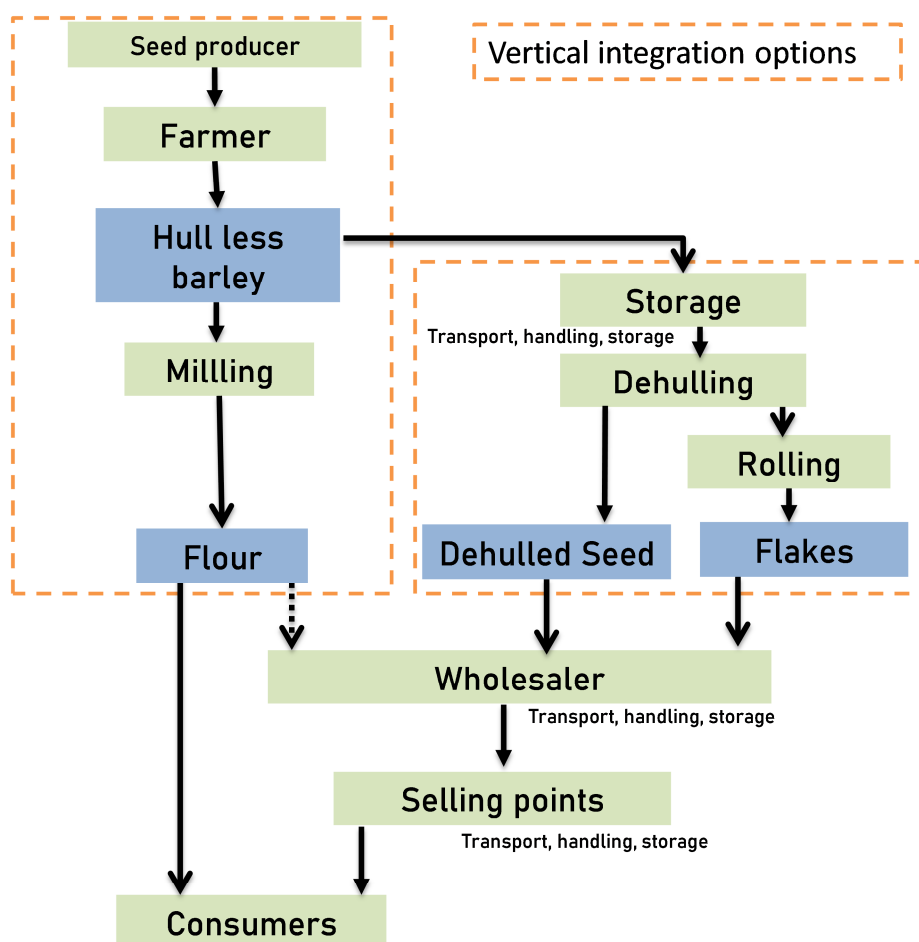


Figure 2. Mapping of hull-less barley food value chain in Serbia



Ready-to-bake mixes appeared to be very convenient for the extension of product range in bakeries in Serbia, although they contain only up to 30% of hull-less barley flour in the mixture with wheat flour.

Chrono-nutrition program established by Dr Gifing® (<http://drgifing.com/en/program-dr-gifing>) has been very popular in Serbia in the last couple of years between the obese patients. Therefore, a lot of “Chrono” ready-to-bake mixes containing barley flour are available in the market in the retail sector, so that certain number of consumers with the special needs prepare bakery products at home, convinced that in that way it would regulate both body weight and other metabolic parameters (blood sugar, cholesterol, and triglycerides) (Vesovic, Gifing, & Mihailovic, 2016).

Although there are several companies processing oat flour into cookies, there are no producers of similar products from barley in general, and hull-less barley in particular.

Distribution of hull-less barley products to the market is similar to all other products from the category of so called “healthy food products”. It is organised through the network of healthy food stores which are mainly supplied by healthy food wholesalers. There are also departments for healthy food products in almost every supermarket.

The main wholesalers are:

- Lučar, Novi Sad (<http://www.lucardoo.co.rs/>)
- Nutricija, Zemun (<https://nutricia.rs/>)
- Viva Tref, Belgrade (<https://nutricia.rs/>)
- Boneda, Belgrade (<https://boneda.rs/>)
- Biouna, Novi Sad (<https://www.bio-una.com/>)
- Biošpajz (<https://www.biospajz.rs/>)

Research activities regarding the agricultural, primary and secondary processing of hull-less barley in Serbia are scarce. Agricultural research related to hull-less barley is related to the investigations of agronomic properties of hull-less barley in comparison with hulled barley, comparison of the agronomic properties of introduced hull-less barley germplasm and domestic hull-less barley lines, the productivity of hull-less barley in organic and conventional farming and its morphological and productive characteristics in organic farming (Dodig et al., 2007; Oljača et al., 2009). Furthermore, certain research was conducted to study its importance and use in human nutrition (Pržulj, 2009; Dodig, Žilić, & Milašinović, 2007), as well as the optimization of the formulation of pure barley bread (Pojić et al., 2017).

## 1.2.2 Overview of the interviews completed








The primary search for entities involved in hull-less barley production and processing in Serbia started from seed producers and sellers who kindly provided data about their customers. The final list of hull-less barley value chain actors included:

- Hull-less barley breeder
- Hull-less barley producer
- Hull-less barley processing company
- Wholesales and healthy food distributors

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. The interview with value chain actors having deeper knowledge and understanding of the issues in hull-less barley value chain were conducted as face-to-face interviews.

The overview of interviews and the way how they were conducted per value chain actors<sup>1</sup> is provided in Table 3.

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

VC actors	Numbers of interview	Method
Breeder, seed producer and trader	1	
Farmers	1	
Processing	2	 
Wholesaler	1	
Seller	1	
Advices and research	1	



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



Interviews conducted in telephone conversation

### 1.2.3 Breeder

In Serbia there are two producers of certified hull-less barley seed (Institute of Field and Vegetable Crops, Novi Sad and Maize Research Institute, Zemun).

Institute of Field and Vegetable Crops in Novi Sad, Serbia produces one variety of hull-less barley “Golijat”, with the annual production of **about 10 t** of seeds. According to the obtained information the seed buyers apart from Agrodunav, Karavukovo are small agricultural producers with the arable fields not larger than 1 ha and the special purpose mills, since this seed is not treated.

There are ongoing activities in breeding and development of new varieties of hull-less barley, so that it expected that in three years’ time new varieties will be launched. According to the results from field trials, hull-less barley variety “Golijat” is characterised with potential to yield 3.5 t/ha under convenient climatic conditions and application of appropriate production technology. About 200-220 kg of seeds per ha are needed for sowing, depending on 1000 kernel weight. Hull-less barley “Golijat” is sold to the farmers directly from the Institute of Field and Vegetable Crops: <https://nsseme.com/proizvodi/strna-zita/jecam/#golijat>. Maize Research Institute in Zemun produces one variety of hull less barley “Apolon”, with similar yield, properties and requirements for agro-technical measures (<https://mrizp.rs/strna-zita/>).

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



Both breeding institutes - Institute of Field and Vegetable Crops and Maize Research Institute have an **expertise** and **excellent infrastructure** for production of high quality seed, but the reason for which they do not produce higher quantities is the lack of demand for seed.

Besides hull-less barley varieties "Golijat" and "Apolon", Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia in 2004 recognized the variety "Balsha" which was characterized by high and stable yield, good technological quality and high drought tolerance. However, the seeds of "Balsha" variety are not available on the market.

### 1.2.4 Input suppliers

Agro-technical measures required for hull-less barley correspond to those for small grains in general. Fertilization of barley can be done with fertilizers of organic origin such as manure, various composts, sedges and other fertilizers of organic origin. For a yield of 5 t/ha it is necessary to provide 110-120 kg of nitrogen, 70-80 kg of phosphorus and 100-120 kg of potassium.

At Serbian market wide assortment of fertilisers, herbicides and pesticides is available from import and from domestic producers. Imported supplies are of higher costs and higher quality in relation to that from domestic producers. However, after the outbreak of war in Ukraine the prices of all inputs, and particularly of fertilisers for which components were imported from Russia, increased drastically.

#### Knowledge providers and services:

Knowledge about hull-less barley production is available and provided either by breeding institutes or by the agricultural extension services. Likewise, breeding institutes once a year organizes a gathering of farmers who can meet and exchange their experiences in direct contact, or can provide the assistance on the production site on demand.

### 1.2.5 Producer

In Serbia the only major agricultural producer of hull-less barley is ZZ Agrodunav, Karavukovo, which possesses adequate machinery for agricultural production of hull-less barley: soil preparation, application of agro-technical measures and harvesting, but also the equipment for drying and preparation of hull-less barley for safe storage and storage facilities.

It is recommended that it must be grown in crop rotation because growing in monoculture brings low yields and plant diseases. Recommended pre-crops for hull-less barley are legumes, oilseed rape, sunflower, earlier maize hybrids, clover-grass mixtures and others.

Other producers of hull-less barley have production on small areas, up to 1 ha and mainly produce it for their own needs.

### 1.2.6 Collection centre

In Serbia there is no dedicated collection centre for hull-less barley, since the volume of agricultural production does not require it.

### 1.2.7 Processing firm

Hull-less barley processing in Serbia can be **divided in three distinct phases** with different positions and different roles in value chain.

The first group of hull-less barley processors are companies oriented towards primary processing of hull-less barley and barley grain in general: dehulling and milling. There are only few companies equipped for dehulling of barley grain. Although hull-less barley doesn't contain hull certain percentage of grains still possess it. This is very important since hull-less barley grain is marketed in grain form aimed at cooking.

Hull-less barley milling is performed in several companies which, mill hull-less barley along with other cereal crops wheat, corn, rye, oats etc. including dehulled barley. The primary processing of hull-less barley by milling is mainly performed in stone mills.

The second group of value chain actors are the ones oriented towards secondary hull-less barley processing – production of ready-to-bake mixes, flakes, bakery products, and pasta. The product range of hull-less barley bakery products is narrow and limited to the production of unleavened bread which is mainly sold in specialized healthy supplies stores with variable availability. There are only few bakeries which uses barley flour for the production of unleavened bread.

The third group of value chain actors are the ones oriented towards the production of animal feed. Due to high nutritional value and the absence of hull, hull-less barley is convenient for the non-ruminant animals. It is used as a coarse grain (crushed grain) mixed with other cereals, where the amount of barley in the mixture depends on the type and diet of animals.

Almost all **value chain actors in the processing step**, including the ones involved in primary processing phase stated that they **predominantly use domestic hull-less barley** as raw material. The problems that have been raised are the following:

- There are certain percentage on hulled grains which require the additional dehulling
- Additional dehulling causes grain breakage due to soft endosperm
- Broken grains are more susceptible to quality deterioration and not very well perceived by the primary and secondary processors.

Producers of bakery products for delivery of products to the selling points are using their own logistics.

Hull-less barley processors do not use the knowledge base from the research institutions which are able to assist them in the new food product development, in giving advices and optimization of the production. However, they use the services of accredited **laboratories** for testing of safety and quality of raw materials and products to test the legal compliance of product quality with regulations.

### 1.2.8 Retailing

Hull-less barley products from primary and secondary processing find their way to market in the following ways:

- Major quantity of hull-less barley seeds are directly sold from the agricultural producer to the major processors
- Major quantities of flours are delivered to wholesalers
- Somewhat lower quantities are sold to bakeries and bakery mixture producers
- Small quantities are sold to healthy supplies shops

- Small quantities are sold directly to the consumers.

The specialized final products based on hull-less barley can be rarely found in the major retail chains.

### 1.2.9 Marketing strategy

Value chain actors involved in hull-less barley value chain in Serbia do not perform almost any marketing activities. In connection with this, the consumption of hull-less barley in Serbia is not promoted to the extent that other grains or pseudo-grains are promoted. Although the existence of certain number of promotional articles is evident, the promotion of health benefits, recipes and cooking tips for utilisation of hull-less barley in daily diet is insufficient.

The consumption of hull-less barley is not widespread among consumers. Although hull-less barley products can be designated with a health claim related to barley beta-glucans and lowering of blood cholesterol and reduced risk of (coronary) heart disease, it has not been utilized in practice and for marketing purposes.

## 1.3 Discussion

Although Serbia possesses favourable conditions for small grains production, the production of hull-less barley is modest. The knowledge base for agricultural production is available and located within two breeding institutes, as well as available from national agricultural extension services. Moreover, knowledge base for primary and secondary processing of hull-less barley is available, but not utilized by processors who rely on their own resources in new product development. Therefore, there is a room for optimization of primary and secondary processing and the quality improvement of hull-less barley products that remains underutilized. All these corresponds to the fact that the value chain of hull-less barley in Serbia is in introductory phase, with low consumer demands and the lack of awareness about its health benefits.

No particular public policy measures aimed at stimulation of hull-less barley production is in force. Although the hull-less barley products can be designated with health claim, it is not utilized for marketing purposes and the demands for such products are still modest. The exceptions are ready-to-bake mixes promoted as a part of Chrono-nutrition program established by Dr Gifing® lately being very popular between the obese citizens.

There is no specialized collection centre for hull-less barley since the volume of its production does not require it. Domestic seed supply is available, but still certain producers sow their own seed from the previous harvest, which further hampers the breeding endeavours in Serbia.

### 1.3.1 Past challenges & successes of the value chain

The major challenge in hull-less barley value chain in Serbia is the lack of awareness of its potential – of farmers and of consumers. Thus, the actions targeting this issue are needed.

Utilisation of non-certified and non-treated seed is the next challenge in hull-less barley value chain which not only results in yields below the yield potential, but also hampers the breeding endeavours. Measures should target also the utilisation of **certified seed** including increase of offer which should include multiple varieties with defined recommendation for optimal production conditions and production technologies. Recommendations for **fertilisation and application of other agro-technical measures** although defined, are often not applied due to the high costs of required inputs.

In the production step inability of producers, particularly the small ones to dry and to prepare grains for market in appropriate way represent additional challenge for domestic producers. The quantities of the final products are small and of variable quality and they are mainly sold through the healthy supplies shops. Small producers are not able to pay for R&D for new food product development that would increase the product range and additionally improve the quality of existing products.

However, no research activities have been conducted so far towards solving problems in **hull-less barley value chain**. This value chain analysis should be used as the base to redefine and refocus research activities towards solving of real problems in value chain.

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

Detailed overview of the main challenges in hull less barley 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	3-5 main challenges (order: most important first)	Strategies undertaken/to undertake	Potential & benefits for the actor in the VC chain	Remarks & implications
<b>Breeding</b>	1. Existing varieties are not completely hull-less	1. Breeding of new varieties which will be completely hull less or 2. Import of varieties which are completely hull less from abroad	1. Obtaining of raw material for which additional dehulling is not necessary	Growth of interest for hull-less barley among barley processors
<b>Seed production</b>	Sowing of noncertified seed widely spread among farmers	Regulation to be enforced to prevent sowing of non-certified seed	Increased yield and decreased susceptibility to plant diseases	
<b>Production</b>	No motivation for production of hull-less barley <ul style="list-style-type: none"> <li>- Nutritional and other benefits of hull-less barley are not known</li> <li>- Hull-less barley has lower yield and the same prices as normal barley</li> </ul>	Intensification of hull-less barley related research and promotion of its advantages at all stages of value chain including consumers	Creating conditions for price differentiation of hull-less barley	
<b>Processing</b>	Processing companies are not able to utilise the benefits of hull-less	Cooperation with breeding companies towards creation and	Creation of added value products which differentiate with price in comparison to	

VC actor	3-5 main challenges (order: most important first)	Strategies undertaken/to undertake	Potential & benefits for the actor in the VC chain	Remarks & implications
	barley since available varieties require additional dehulling No information and no awareness about nutritional benefits of hull-less barley, health claims not used	spreading of completely hull-less barley varieties Intensification of cooperation with research institutions regarding hull-less barley nutritional profile and techno-functional properties related research Utilisation of relevant health claims	other barley products Increase for hull-less barley among processing companies	
<b>Retail</b>	The fact that hull-less barley is used in production is not labelled Consumers not aware about hull-less barley products	Labelling and promotion of the fact that hull-less barley was used in production	Increasing awareness about hull-less barley as nutritionally valuable ingredient among consumers	
<b>Consumers</b>	Very limited consumer group is aware about benefits of consumption of hull-less barley	Promotion of hull less barley health benefits in media and through other channels	Increasing of interest for hull-less barley products among wider range of consumers	

### 1.3.3 Limitations

Research was conducted including uniformly actors from all stages of hull-less barley 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.

The main characteristic of the hull-less barley value chain **is the lack of awareness** among all the actors in the value chain – from agricultural producers to the consumers. This situation is unjustified given the existence of a knowledge base that could support both agricultural production and processing.

## 1.4 Synthesis

Hull-less barley value chain in Serbia is in introductory phase, regardless the fact that there are domestic varieties and adequate knowledge base. The production of hull-less barley is modest. Given that the production volume of hull-less barley products is small, processors are not thinking about investing in R&D. As a result the final products are of variable quality.

No particular public policy measures aimed at stimulation of hull-less barley production is in force. Likewise, breeding institutes don't advertise enough the varieties and the benefits of production of hull-less barley. Generally, the marketing of hull-less barley products are insufficient. Although the

hull-less barley products can be designated with health claim, it is not utilized for marketing purposes and the demands for such products are still modest. The exceptions are ready-to-bake mixes promoted as a part of Chrono-nutrition program established by Dr Gifing® lately being very popular between the obese citizens.

There is no specialized collection centre for hull-less barley since the volume of its production does not require it. Domestic seed supply is available, but still certain producers sow their own seed from the previous harvest, which further hampers the breeding endeavours in Serbia.

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