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Analysis of soybean production in Serbia: challenges, prospects and government support

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A B S T R A C T

The purpose of the research is to acquaint the domestic scientific, professional and general public with the prospects for the production, placement and consumption of soybeans and soybean products, as well as with the effects that such production can have on the development of the domestic (agricultural) economy. The task of the research is to provide information that is still insufficiently researched and sorely undefined in our country. The main aim of this paper is to give theoretical and practical contribution to defining a long-term development strategy on the soybean market in the Republic of Serbia, as well as to provide basic guidelines for soybean producers for the optimization of their activities. In order to provide support to the domestic agricultural and food industry, as the main pillars of sustainable protein supply, certain facts, opinions, motives, experiences and attitudes of soybean producers will be examined and specified, aiming to determine the relevant elements that are important for the improvement of soybean production on registered agricultural farms. In accordance with the methodology of scientific research work, the obtained results will be collected, processed and presented.

Keywords: soybeans, producers, motivations, challenges, strategy

И З В О Д

Основни циљ и задатак истраживања јесте упознавање домаће научне, стручне и шире јавности са перспективом производње, пласмана и потрошње соје и производа од соје, као и са ефектима које оваква производња може имати на развој домаће (пољо)привреде. Задатак истраживања јесте да пружи информације које су код нас, за сада, недовољно истражене и крајње недефинисане. Овим радом жели се дати теоретски и практичан допринос у дефинисању дугорочне развојне стратегије на тржишту соје у Републици Србији, односно основне смернице произвођачима соје за оптимизацију својих активности. У циљу пружања подршке домаћој пољопривредној и прехрамбеној индустрији, као главним стубовима одрживог снабдевања протеинима, биће испитане и прецизиране одређене чињенице, мишљења, мотиви, искуства и ставови произвођача соје, како би се утврдили релевантни елементи који су од значаја за унапређење производње соје на регистрованим пољопривредним газдинствима. У складу са методологијом научноистраживачког рада, прикупиће се, обрадити и презентовати добијени резултати.

Кључне речи: соја, произвођачи, мотивисаност, изазови, стратегија

1. Introduction

The soybean (*Glycine max*) belongs to the legume family and is considered one of the oldest cultivated crops in the world. Over the past few decades, soybeans have been gaining prominence in human nutrition alongside being a principal source of protein in animal production (due to their high protein content approximating to 40% in grains and 20% in oil) (Malidža et al., 2016). In Europe, around 70% of the need for protein-rich animal feed is met by soybean meal. As reported in the literature, the current production and processing of protein crops in Europe meet less than 3% of the actual requirement. Accordingly, more than 60% of the essential plant proteins are imported into Europe, notably from North and South America. As soybeans are referred to as "the crop of the future" and a significant portion of soybeans produced in the USA, Argentina, Paraguay and Brazil are genetically modified (GMO), Europe has been increasingly perceived as an important region for soybean production in accordance with the principles of ecology, economy and social sustainability (Vlahović and Mjerimačka, 2019). With regard to the considerations mentioned above, a number of EU-funded initiatives and projects have been launched, focusing on reducing the EU protein crop import dependency and encouraging domestic soybean production through supporting primary agricultural producers.

Soybean production is determined by two crucial factors: area and productivity. Harvested areas can sustain the farmers' interest in soybean production as they are closely connected to the food and sociocultural

needs of the community. Productivity represents the extent of use of production technology by farmers, which is affected by climate conditions, soil types, the type and extent of use of production technology, and the use of premium crop cultivars (Subandi and Kuntyastuti, 2013).

The Republic of Serbia boasts an enduring tradition of soybean production extending over four decades. The country is one of the three largest soybean producers in Europe, and the only European country which is completely self-sufficient in the production and processing of soybeans for domestic animal feed purposes (Vlahović and Mjerimačka, 2021). To date, the Serbian legislation does not permit the production and marketing of genetically modified organisms (GMO), indicating that the farm animals in Serbia are fed with domestic non-GMO soybeans of guaranteed quality and specified geographical origin. As the motivation of primary agricultural producers is directly associated with the possibility of enhancing soybean production and marketing in the future, this research attempts to establish the existing state of Serbian soybean production and forecast its potential improvements through a factual investigation of the opinions, attitudes and experiences of Serbian soybean producers.

2. Materials and methods

A survey-based field research was conducted to examine the attitudes and motivations of soybean producers in Vojvodina, Serbia. Survey research is the most important data collection method in marketing research as it provides concrete responses from respondents to a series of set questions. The questionnaire employed consists of a mix of 15 close-ended questions (with a choice of answers from a given number of options) and 12 open-ended questions (to which respondents formulate their answers freely without a given number of options). When designing the questionnaire, the following two approaches were adopted: a quantitative approach (for obtaining data on the number, location and yields of soybean producers in Vojvodina, Serbia) and a qualitative approach (for examining the farmers' motivations for soybean production in Vojvodina, Serbia, the priorities in soybean production development on the Serbian agricultural holdings considered, the most frequent issues in the Serbian soybean production, and measures for enhancing soybean production in Serbia based on the respondents' opinions). The survey was conducted from 1 to 15 December 2020 by means of personal communication with 350 soybean producers on registered agricultural holdings and at the soybean buy-up centres (silos) in Žabalj, Srbobran, Ruma, Sonta and Kovin (Map 1). It was subsequently repeated during the soybean harvest in 2021 on the same dates and on the same sample of respondents. The Statistical Package of Social Sciences (SPSS) software package was used for analysing the survey responses. A tabular and graphical representation of the results obtained was employed for a clear observation of the parameters examined.

3. Results and discussions

The soybean area in the Republic of Serbia exceeds 230,000 ha, accounting for 10.47% of the total area devoted to crops. The soybean area in the AP Vojvodina accounts for 92.3% of the total soybean area in Serbia. With an average yield of 3.2 t/ha, the total soybean production in Serbia approximates to 750,000 tonnes in grain equivalent (RZS, 2021). As reported by Vlahović and Mjerimačka (2021), the Danube Region is of utmost importance to producing non-GMO soybeans in Europe. Moreover, 91.2% of approximately 50,000 soybean producers have been registered in the districts along the Danube (www.donausoja.org). Accordingly, the present research was conducted in the Danube districts.

Map 1. Locations of the soybean buy-up centres (silos)

The first phase of the research encompassed a quantitative survey approach to collecting data on the social and economic features of Serbian soybean producers surveyed. Out of a total of 350 soybean producers surveyed in Serbia, 75 were registered in Gospođinci, the Municipality of Žabalj (accounting for 21% of the total number of respondents), followed by 59 (17%) registered in Srbobran and Sonta each, 49 (14%) registered in Žabalj, 30 (9%) registered in Ruma, and 20 (6%) registered in Apatin and Svilojevo each. Moreover, a number of soybean producers were also surveyed in Bečej, Čurug, Šajkaš, Temerin, Vrbas, Novi Sad, Kraljevci, Kovin, and Pančevo. The survey was conducted by means of personal communication with soybean producers on registered agricultural holdings and at the soybean buy-up centres (silos).

As seen in Figure 1, male respondents account for 76% of the total number of respondents, whereas female respondents account for merely 24%. Out of a total of 350 soybean producers surveyed, 266 were

male and 84 were female. The largest number of respondents aged from 35 to 55, averaging 48 in total. The youngest respondent was 18 years of age, whereas the oldest was in his nineties. The aging of the rural population in Serbia is perceived as an unsettling issue. Therefore, the Serbian government and local municipalities should focus on the education and training of young soybean producers, which ought to be provided free of cost.

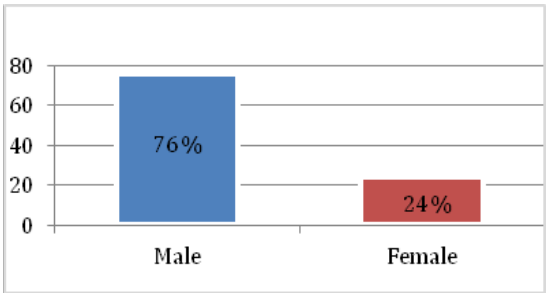

Figure 1. Respondents' gender

As seen in Figure 2, the largest number of respondents holds a secondary school qualification (55%). A two-year college (associate) qualification is held by 8% of the respondents, whereas a four-year college (bachelor's) qualification is held by 23% of the respondents. A bachelor's degree is held by the youngest respondents aged up to 30, an associate degree is held by the respondents aged 35–45, and a primary school degree is held by the 48 oldest respondents (14%). The higher level of education of younger farmers is conditioned by their interest in underpinning the practical skills, traditional production and senior family members' experience by theoretical knowledge and expert advice so as to achieve better production, marketing and economic results.

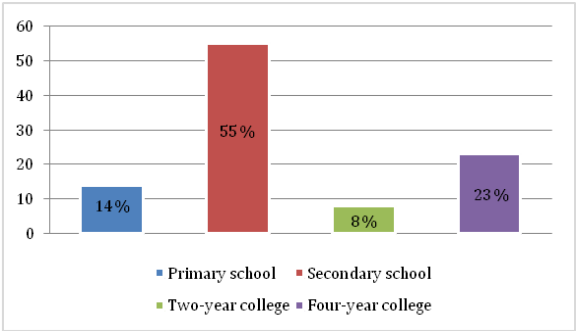

Figure 2. Respondents' education

Figure 3 (a, b) shows the status of the respondents' agricultural holdings. All the respondents' holdings have an active status in the Serbian Register of Agricultural Holdings. The results obtained in 2020 clearly indicate that 49 agricultural holdings out of a total of 350 included in the survey (14%) were in the value-added tax (VAT) system, whereas 301 agricultural holdings (86%) were out of the VAT system. In 2021, 5% of the agricultural holdings recorded an increase in the annual turnover due to a sudden increase in the soybean market price of 100% compared to that in 2020. Consequently, a larger number of the agricultural holdings observed were integrated in the VAT system, resulting in a total of 119 (34%) agricultural holdings in the VAT system and 231 agricultural holdings (66%) with an annual turnover less than RSD 8 million.

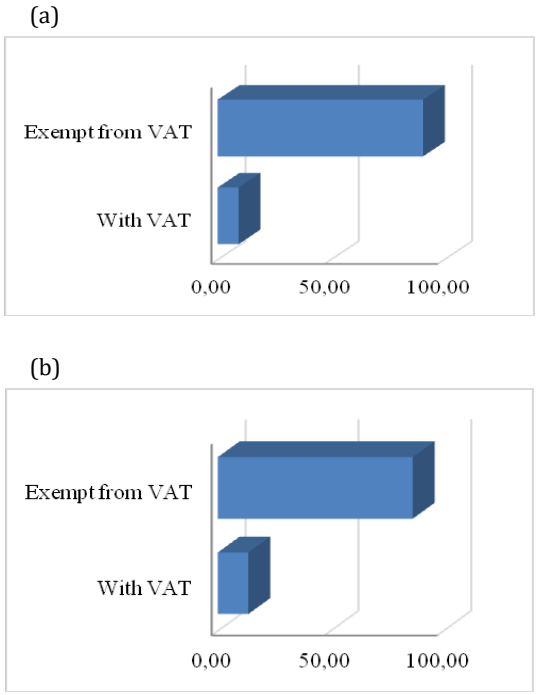

Figure 3. Status of the respondents' agricultural holdings: (a) in 2020, (b) in 2021.

Of all the respondents, 56% identified their holdings as purely agricultural holdings (generating revenue solely from agricultural activities), whereas 44% identified their holdings as mixed agricultural holdings because some family members are employed in other industries. In both 2020 and 2021, all the agricultural holdings considered were privately owned family agricultural holdings, employing exclusively the nuclear and extended family members (except in the peak season when they employed additional hired labour and plant protection experts).

As seen in Table 1, an average of 6.47 ha was devoted to soybean production on the agricultural holdings considered in 2020. The largest area devoted to soybeans (101.2 ha) was recorded on the agricultural holding in Omoljica, whereas the smallest soybean area (0.518 ha) was recorded on the agricultural holding in Sonta, which remains invariant in 2021. As the soybean buy-up price increased, the soybean producers were incentivised to increase the areas devoted to soybeans by an average of 0.80 ha in 2021.

It is noteworthy that 32% of the agricultural holdings considered, which cultivate both soybeans and other crops, maintained the 2020 sowing area structure in 2021 by utilizing new areas for the purpose of production expansion. The survey responses obtained indicate that the sowing area structure on the agricultural holdings will shift in favour of soybeans in 2022 due to a sudden increase in the price of inputs, particularly nitrogenous fertilizers. As soybean production does not rely heavily on nitrogenous fertilizers compared to other crops, an increase of 20% can be expected in the future. According to the crop production structure on the agricultural holdings, 73% of the agricultural holdings cultivate soybeans exclusively, whereas 26% of the

agricultural holdings grow other crops alongside soybeans. In addition to soybeans, they usually grow cereals (namely wheat and maize), and only 5% of the respondents produce fruit and vegetables in plastic greenhouses (which also remains invariable compared to 2020).

According to the cultivated land ownership in 2021, 74% of the respondents cultivated the land in their ownership, whereas 26% leased land for soybean production expansion, representing a 5% change compared to 2020. This is yet another indicator that the agricultural holdings used the profit gained from the soybean price increase for investments in new land purchase, soybean production expansion, and land-lease cost reduction.

Table 1.
Size of the agricultural holdings (ha)

Size of the agricultural holding	Hectares (ha) 2020	Hectares (ha) 2021	Difference (ha)
Average	6.47	7.202	+ 0.732
Max	101.2	101.2	/
Min	0.518	0.518	/

Source: Questionnaire

As seen in Figure 4, a vast majority of the respondents uphold traditional soybean production by growing the established domestic Novi Sad (NS) soybean cultivars. However, a certain portion of the respondents are willing to grow high-yielding foreign soybean cultivars under the guidance of experts. More than two-thirds of the respondents (68%) most frequently opt for the late-maturing 'NS Rubin' cultivar of the second maturity group, characterised by the great and stable potential for yields exceeding 6.5 t/ha. A total of 22% of the respondents select the mid-maturing 'NS Apolo' cultivar of the first maturity group, characterised by the potential for yields exceeding 7 t/ha. Out of the foreign soybean cultivars considered, 5% of the respondents choose the German 'Wendy' cultivar of the first maturity group, which was found very favourable for growing under the Serbian production conditions relative to the volume and stability of yield. Only 3% of the respondents grow the French 'ES Pallador' cultivar of the first maturity group, characterised by high protein and oil contents, and great yield potential. The results obtained in 2021 are fairly comparable to those obtained in 2020, indicating that soybean producers are reluctant to introduce new cultivars that have not been tried out in their region and that they stay loyal to the soybean cultivars selected (and their producers) for the guaranteed quality and yield. In 2021, only 5% of the respondents adopted an innovative approach to cultural practices, the introduction of new technologies, and the selection of more recent cultivars, which is reflected in the pilot project of cultivating the 'Vendis (RWA)' soybean cultivar (a high-yielding and mid-maturing soybean cultivar of wide adaptability with drought resistance and the potential for yields up to 7 t/ha). An increase in the productivity of soybean production requires proper soybean cultivation, i.e. superior-quality seeds and a favourable agroecosystem environment (Suhartini, 2018). It should be emphasised that a continuous use of the same cultivar can cause resistance to a number of pests, thus adversely affecting the actual yield (Effendi et al., 2011). The research results obtained in Indonesia indicate that farmers who adopt superior soybean cultivars produce yields 61% higher than those produced by inferior soybean cultivars (Tufa et al., 2019).

Sales organization on the agricultural holdings – The respondents were found to market all their agricultural products domestically. A total of 32% of the respondents stated the ownership of soybean storage facilities in 2021, which is a 9% increase over that recorded in 2020. As the soybean producers owning their own storage facilities had a profit increase of approximately 100% in 2021 compared to that in 2020 (the ownership of soybean storage facilities reduces the costs of leasing such facilities and the pressure of selling soybeans at harvest time at an unfavourable price), this was identified as the respondents' primary motivation for investments in new soybean storage facilities. Moreover, 92 respondents of a total of 350 were engaged in pig and poultry production for personal purposes alongside crop production (which is their main production activity), thus certain quantities of soybeans produced were processed on-farm into soybean meal, flour and concentrate for animal feed and, to a smaller extent, human food. As reported by Dogbe et al. (2013), who investigated the economic effects of soybean production in the Northern Region of Ghana, soybeans processed and used on-farm were identified as the non-market motivation. The authors further argue that producers never assess the financial effect of soybeans used for on-farm purposes, but measure solely the effects of soybean seed (raw material) marketing and selling. Accordingly, regardless of the market movements, soybean producers tend to cooperate with companies providing best logistically located buy-up centres, production materials, and advance payments. As a result, soybean quantities produced are usually allocated beforehand into the following three categories: for cost coverage, for personal purposes, and for profit.

The second phase of the research entailed a quantitative survey approach to collecting data on the motivations, intentions, priorities and production issues of Serbian soybean producers surveyed, as well as on the measures for intensifying the soybean production in Serbia.

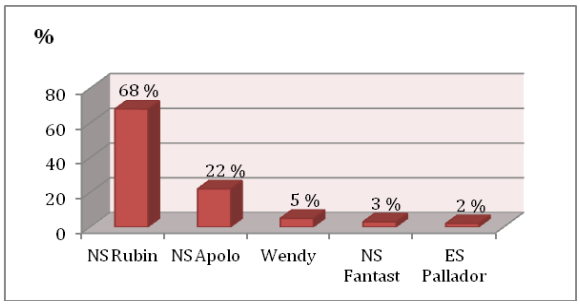

Figure 4. Soybean cultivars grown in Vojvodina, Serbia (2021)

A total of 57% of the respondents identified the vicinity of processing facilities and buy-up centres to soybean areas as the primary motivation for soybean production because of reduced transportation costs and assured marketing. The tradition of soybean production was the following motivation recognised by one-quarter of the respondents because high and stable

soybean yields reflect the favourability of local agroecological conditions for soybean production and the benefits of soybeans in crop rotations and sequencing. Moreover, the stable buy-up price of soybeans over longer periods of time and larger profit per unit area than that generated from the production of other crops were perceived as motivations for soybean production by 14% of the respondents in 2021, representing a 6% increase over that recorded in 2020. The previous movement of oil crop prices in the global market further incentivized the respondents to invest more energy and capacity in oil crop production. Therefore, 7% of the respondents answered that soybean production does not necessitate a lot of labour, but generates high yields, which in combination with stable and high price produces better financial results compared to other crops. A total of 2% of the respondents regarded unemployment (loss of work) as the primary motivation for soybean production in 2021, following the example of more experienced farmers and utilizing optimally the inherited land and available machinery (which is comparable to the results obtained in 2020). The responses collected are shown in Table 2.

Table 2.
Respondents' motivations for soybean production

Motivations for soybean production	2020 (%)	2021 (%)	Difference (%)
Processing facilities and buy-up centres located in the vicinity of the agricultural holdings/soybean areas	63	57	-6
Tradition of soybean production	25	20	-5
Higher yields per unit area	8	14	+6
Better production results per unit area compared to other crops	2	7	+5
Unemployment (loss of work)	2	2	/
Total	100	100	

Source: Questionnaire

The data collected on the priorities in soybean production development are displayed in Table 3. In 2021, a total of 46% of the respondents identified the assured marketing of soybeans as the highest priority in soybean production development, representing a 4% increase over that recorded in 2020. The availability of soybean buy-up centres and storage facilities in all seasons, i.e. the selling and storing of soybeans throughout the year were recognised as a strong motivation for a majority of the respondents. The stable price of soybeans over longer periods of time was perceived as important to soybean development by 30% of the respondents. Over the past years, the forward selling of soybeans through futures has been a constant trend among the soybean producers in the region considered, which continued in 2021. Soybean producers are often further reassured by bulk buyers' guarantees for covering the difference between the futures and actual selling price of soybeans. The cultivation of soybeans for crop rotation purposes was identified as a priority by 13% of the respondents, who emphasized the overriding importance of proper cultural practices and conscientious farming practices to improving yields and the overall long-term development of the agricultural holding. The purchase of latest agricultural machinery was a development priority for 7% of the respondents, who underscored the importance of keeping up with the cutting-edge technical and technological advancements and innovations in agriculture. Merely 4% of the respondents announced plans for soybean processing and marketing processed soybean products in the future (namely concentrates, flour, soybean meal, etc.) because raw material producers are the lowest in the production chain and need to convert to producing higher-level processed products so as to generate greater profit and added value.

The personal production of soybeans and the possibility of producing a value-added product with a higher price than that of soybean grains were identified as the decisive factors for incentivizing the respondents to introduce new processing technologies. On balance, it is of paramount importance to select high-yielding soybean cultivars suitable for processing in order to generate higher profits. Therefore, the key factor recognised for introducing technological innovations was an increase in the productivity and profitability of soybean production. According to Sembiring (2007), high-quality soybean cultivars and innovative processing technologies foster soybean productivity increase.

Table 3.
Priorities in soybean production development on the agricultural holdings considered

Priorities in soybean production development	2020 (%)	2021 (%)	Difference (%)
Assured marketing	42	46	+ 4
Stable price over longer periods of time	27	30	+ 3
Cultivation for crop rotation purposes	15	13	-2
Machinery purchase	12	7	-5
Processing	4	4	/
Total	100	100	

Source: Questionnaire
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Table 4 shows the greatest challenges facing the respondents in soybean production. In contrast to 2020, when a majority of the respondents accentuated dated machinery as the major challenge in soybean production, half of the respondents inclined towards high prices of production material and fuel in 2021. They argued that investments in soybean production are increasing, especially due to progressively rising prices of fertilizers and fuel, thus producers are forced to forward selling or taking loans in the form of production materials, which entails a subsequent repayment in commercial soybeans often at a price twice lower than that at selling time. Karić (2002) pointed out that the costs of production material are the first indicators of a need for business analysis, particularly relative to the business operations of small-sized enterprises. Accordingly, cost accounting involves recording, analyzing and reporting the total costs of production, including production material costs. As agricultural production is best monitored by bookkeeping records, analytical calculations are considered the basis of an economic analysis of such production. Using analytical calculations, Marcikić (2018) and Rimac (2019) analysed the economic effects of soybean production on small-sized agricultural holdings in Osijek, Croatia, and found that fertilizers and fuel accounted for 18% and 16%, respectively, of the total cost price of soybean production considered. Another limiting factor of the (pre)funding of soybean production on agricultural holdings was a decreasing motivation of companies for cooperation with producers (considering the market trends and daily price oscillations) as such companies are not willing to assume the risk of producers' failing to repay their loans in commercial soybeans.

Dated agricultural machinery was identified as a major issue in soybean production by 27% of the respondents. Investments in new machinery would be quite burdensome, especially for small-sized holdings, and the possibility of cooperation among such holdings was not perceived as a viable alternative. A total of 10% of the respondents recognised the shortage of quality seasonal workers and expert assistance as the chief impediment to soybean production, particularly at season peaks. Variable weather conditions seriously hinder soybean production according to 5% of the respondents. The soybean is a crop which favours a moist environment, thus drought poses the greatest hindrance to good production results. Merely 3% of the respondents highlighted the incomplete land consolidation as the critical issue in soybean production. Small and scattered fields and the inability to lease or purchase the state's arable land increase the costs of soybean production planning, forecast and organization. The same percent of the respondents claimed receiving no support whatsoever from public institutions, underscoring insufficient incentives and complicated application procedures under the auspices of relevant state Secretariats or Ministries. All the respondents agreed on the need for extension service and renowned expert assistance in resolving the soybean production issues stated above.

Table 4.
Central issues in soybean production

Issues in soybean production	2020 (%)	2021 (%)	Difference (%)
High prices of production material and fuel	29	52	+ 23
Dated agricultural machinery	45	27	-18
Quality seasonal workers	12	10	-2
Climate changes	6	5	-1
Land consolidation	4	3	-1
Insufficient incentives	4	3	-1
Total	100	100	

Source: Questionnaire

Nearly half of the respondents (46%) identified the necessity of greater state incentives for purchasing production material and fuel (in the form of subsidies or affordable loans) as a measure for intensifying the Serbian soybean production. The results obtained are consistent with those of Liu et al. (2019), who examined the farmers' motivations for soybean production in China. The present survey results indicate that 42.6% of the respondents would expand soybean areas provided more substantial incentives are offered by the state. Greater state incentives for purchasing new machinery were deemed necessary by 29% of the respondents in 2021, which would consequently increase the productivity of work and the efficiency of soybean production. The marked change in this parameter compared to that recorded in 2020 can be accounted for by the fact that the higher profits generated in 2021 were invested in purchasing additional land and new machinery. Moreover, the Prosperitati Foundation (funded by the Government of the Republic of Hungary) offered programmes and incentives for the soybean areas in ownership of the Hungarian ethnic minority in Serbia. A total of 13% of the respondents found that better education and training of soybean producers were of crucial importance, emphasizing the need for assistance from experienced producers and experts in soybean production planning.

The following five strategies, among others, could be pursued in order to enhance soybean production in Serbia: (1) an increase in selling prices, (2) the use of potentially cultivated land, (3) the intensification of crop production, (4) the improvement of production processes and (5) the consistency of state (Government) support programmes. Moreover, growing soybean cultivars of premium quality significantly contributes to enhancing soybean production. The introduction of novel superior soybean cultivars plays a key role in increasing yields, controlling pests and diseases, and minimizing the adverse effects of environmental conditions. The use of such cultivars is an attempt to increase soybean exports while decreasing the imports (Yofa et al., 2021).

Table 5.
Measures for intensifying the soybean production in the Republic of Serbia

Measures for intensifying soybean production	2020 (%)	2021 (%)	Difference (%)
Greater public incentives for production material and fuel	32	46	+ 14
Greater public incentives for agricultural machinery	43	29	-14
Better education of soybean producers	13	13	/
Land consolidation	7	7	/
Cooperation	5	5	/
Total	100	100	

Source: Questionnaire

4. Conclusions

In light of the survey responses obtained and analysed, the following motivations for soybean production were identified as primary by the producers: buy-up centres located in the vicinity of their soybean areas, tradition of soybean production, higher yields per unit area, better production results compared to other crops, unemployment, etc. The results obtained indicate that the following factors affect the soybean production and soybean area expansion in Vojvodina, Serbia: the age and income of producers, the quality of land, the prospects of soybean marketing, the buying price of soybeans, and the incentives offered by the state. The following priorities were indentified in the soybean production development on the agricultural holdings considered: assured marketing, stable price over longer periods of time, soybean cultivation for crop rotation purposes, machinery purchase, and soybean processing. Additionally, the following issues were underscored as central in the soybean production considered: high prices of production material and fuel, dated agricultural machinery, the shortage of quality seasonal workers, weather conditions, incomplete land consolidation, and insufficient state incentives. In order to intensify the soybean production in Serbia, the following measures are to be implemented: increasing state and/or provincial (Vojvodinian) incentives for purchasing new machinery, production material and fuel in the form of subsidies or affordable loans, improving the education and training of soybean producers, completing the land consolidation process, and fostering the formation of soybean.

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