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in cooperation with
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Economic and Social Development

89th International Scientific Conference on Economic and Social Development –
"Economical, Agricultural and Legal Frameworks of Sustainable Development"

Book of Proceedings

Editors:
Nikola Curcic, Marko Caric, Svetlana Roljevic Nikolic

UNIVERSITY BUSINESS ACADEMY IN NOVI SAD

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FORMING PRICES IN THE CORN, WHEAT AND SOYA PRODUCTION CHAINS IN THE POST-COVID CONDITIONS AND THE CONDITIONS OF THE UKRAINIAN CRISIS

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ABSTRACT

In the paper, an analysis of the costs and economic efficiency of the production of the three most significant stock-exchange crops in Serbia (namely corn, wheat and soya) was carried out. The paper is aimed at comparing the costs and profits their production in the year that was stable when the market is concerned (2018) and in the year which is affected by the influence of the coronavirus pandemic and the crisis in Ukraine (2022). The results have shown that there has been a significant increase in the growth of the total costs in all the three crops, namely 74.5%, 63.6% and 66.5% in corn, wheat and soybean, respectively. Change in the structure of the costs has also been perceived, namely the total production costs in the year 2022 were dominated by direct costs, i.e. the costs of the reproduction material, 65.3%, 55.8% and 55.1%, respectively. Changes in the agricultural products supply chain have caused a drastic rise in the kernel price per unit of measure namely by 73.7% in corn, 113.1% in wheat and 119.2% in the soybean kernel. Based on the analysis of the obtained parameters, the greatest economic efficiency was perceived in the production of soybean (1.43), then wheat (0.60) and corn (0.46).
Keywords: *Costs, Crisis, Food, Inputs, Price growth*

1. INTRODUCTION

The majority of developing countries depend to a great extent on agriculture and the import of agricultural products. The occurrence of the COVID-19 virus pandemic has significantly influenced both critical aspects in the agricultural products supply chain, those aspects being offer and demand. The Ukrainian crisis has additionally made the situation more difficult. The offer of and demand for food are directly connected with the food safety aspect, which is indicative of the fact that global food safety is exposed to risk (Sharma et al., 2020). A significant rise in the prices of a reproduction material, primarily mineral fertilizers, as well as the oil prices, has influenced the drastic increase in the total costs of the production of primary agricultural products. Ukraine ensures as much as 12% of the world's export of wheat, 16% of the world's export of corn and 46% of the world's production of sunflower oil. The situation that has developed in that country has disrupted the capability of Ukraine to produce and export its main crops, thus causing higher costs in production and also creating fear of the global shortage of food. There was an evident influence of the said on the price of food at the global level in a very short time. According to the report by FAO, the basic consumer basket in the month of March was by 60% greater in comparison with the same month in the previous year, which is the biggest rise having ever been recorded since the food price index started being monitored, to be more precise since 1990. In order to ensure the secure supply of the basic foodstuffs, the European Union is planning the growth of the production of the economically most important crops inside its borders. The areas under winter wheat and barley should expand by 1%, i.e. 20.7 and 4.8 million ha, respectively, to be more precise.

There are also expectations that the areas under rye (+5.5%) will also expand and the areas under hard wheat (4%) will shrink. In order to ensure the sufficient production of corn, there is a plan not to adhere to the fallow foresting rule any longer, which will ensure additional areas for this crop in spite of the growth of the input, primarily mineral fertilizers. Given the high prices of feed, the reduced production of meat, as well as reduced demand for food, is expected to be by around 1%. A reduction in the production of grains for biofuels is also expected at the level of 8%. Projections for food demand in the European Union territory even reach as far as 159.1 million tons. The agricultural sector of the Republic of Serbia succeeds in ensuring sufficient quantities of food although, however, agricultural producers are being faced with a great pressure on the budget because of the growth of the input prices. For that reason, many producers are incapable of establishing production in the planned volume which will allow them to be able to expect an appropriate profit. In order to establish the economic sustainability and profitability of a production line, it is necessary that all the costs generated in the production process, primarily those variable costs, where significant differences can be noticed year after year, should be monitored. The coverage of variable costs presented in the percentage of the total income indicates the profitability of a production and enables the comparison of different agricultural systems and cultures (Hadelan et al., 2015). This paper is aimed at carrying out an analysis of the economic efficiency of the production of the most significant stock-exchange crops in Serbia prior to the COVID pandemic and the Ukrainian crisis in comparison with the state of the matters in the year 2022.

2. MATERIAL AND METHOD

Most frequently, costs are classified into fixed and variable. In this research study, fixed costs are excluded, implying that land is owned by the estate and that no rent is paid. In that case, variable costs represent the total costs, so the gross margin becomes the same as a profit (Adamtey et al., 2016). The variable costs included seeds, fertilizers, soil enhancers and the services of agricultural mechanization with the engaged workforce. The prices of machine services are standardized according to the Machine Service Price List for the Year 2022 issued by the Cooperative Alliance of Vojvodina and the same is valid for Serbia as a whole, whereas the prices of the reproduction material were generated through market research. Bearing in mind the fact that the production year is ongoing and that there are tendencies that the prices of primary agricultural products will change the calculations for the year 2022 were made based upon the current prices of inputs and products with the same kernel yield as per unit of soil area in both years.

The analytical calculation based on variable costs was carried out by means of the following formula (Subić et al., 2019):

$$MP = D - VT, \text{ where } D = p \times c \quad (1)$$

where the analytical elements are presented as follows:
MP – the coverage margin;
D – the total profit;
VT – the variable costs;
p – the volume of production as per unit of meausre;
c – the price of the product as per unit of measure.
Economic efficiency was calculated as follows:

$$\textit{Economic efficiency} = \textit{Coverage margin} / \textit{Total costs} \quad (2)$$

3. RESULTS AND DISCUSSION

The total costs, the value of production and the financial result in agricultural production are determined by individual factors, primarily by the prices of the input(s) and the market price of a product (Winnicki and Żuk-Gołaszewska, 2017). The costs of the production of corn, wheat and soybean, and the value of the obtained products, are shown in the tables 1 to 3. All the relevant indicators were taken into account in the calculations. The analysis of the total costs and their structure indicates significant market changes between 2018 and 2022. The total costs of the production of mercantile corn in the year 2022 are higher by 74.5% in comparison with the year 2018 (Table 1).

The specification of the costs of materials and operations		The amount	The unit of measure	The value in RSD	
				2018	2022
The direct costs – the costs of materials					
A	Seeds	2.73	s.u.	13,650	21,226
	NPK 16:16:16/ 8:20:30	500	kg	18,780	59,500
	UREA (46%N)	300	kg	11,670	30,600
	Protective agents I antiweed treatment (pre-em) Mont + Terbis II antiweed treatment Skaut + Talisman	1.4+1.5 0.15+1	l	5,800	6,500
	Total			49,900	117,826
The indirect costs – the costs of machine operations with the costs of fuel					
B	Spreading mineral fertilizer before ploughing	1	ha	1,609	2,010
	The basic processing – ploughing up to 30 cm	1	ha	10,287	12,460
	Leveling ploughing – harrowing with heavyweight harrowing machine (over 4.5 m w.w.)	1	ha	4,599	5,000
	Spreading mineral fertilizer before ploughing	1	ha	1,609	2,150
	Pre-sowing preparation – germinator work	1	ha	4,752	5,500
	Sowing (pneumatic seeder)	1	ha	3,215	3,500
	Spraying 2 x (the price of one single spraying multiplied by 2 treatments)	1	ha	6,177	7,160
	Inter-row cultivation	1	ha	2,052	1,950
	Combining corn kernels by a chopper	1	ha	13,398	14,530
	The transportation of mineral fertilizer, seeds and water for the spraying equipment			3,853	6,120
	Transportation by an 8-t double-axle trailer	1	hour	1,964	2,230
	Total			53,514	62,610
Total costs (A+B)			RSD ha^{-1}	103,414	180,436
1	Yield	8,000.00	kg ha^{-1}		
2	The kernel price		kg	19	33*
3	Total profit		RSD ha^{-1}	152,000	264,000
4	The coverage margin		RSD ha^{-1}	48,586	83,564
** Commodity Exchange Novi Sad, May 2022*					

Table 1: The analytical calculation of the production of mercantile corn in the years 2018 and 2022

In the year preceding the market crisis caused first by the occurrence of the Coronavirus, then the war raging in Ukraine, the costs of the materials and machine services had almost evenly been present (48%:52%, respectively). In 2022, however, there was a strong rise in the prices of the reproduction material that now accounts for 65% of the total production costs.

A drastic change like this in the cost structure was primarily provoked by the rise in the prices of mineral fertilizers, with the price of the NPK fertilizer recording a rise by 216.8%, and that of UREA by 162.2%. The seed material recorded an increase of 55%, whereas the costs of crops protection increased by 12.1%. On the other hand, the rise in the prices of machine services was primarily caused by the rise in the prices of oil and oil derivatives, with the total amount of these costs simultaneously being bigger by 17% in the year 2022 in comparison with the year 2018. The reduced volume of the production of the main agricultural crops in Ukraine and the exports cessation have led to a shock in the stock-exchange crops market. The growth of demand for food products both raw and processed has had an influence on the drastic rise in the price of corn that is higher by 73.7% in the year 2022 in comparison with the year 2018. Although production is significantly burdened by direct costs in 2022, the high prices of agricultural products and food have enabled the growth of gross income by 74% and the coverage margin by 73% in comparison with 2018, so it can be concluded that growing corn is still lucrative for agricultural producers (Table 1). Wheat (*Triticum aestivum* L.) is one of the most significant grown species and the basic food for more than 50% of the global population (Dolijanović et al., 2019). In developed and developing countries, the average consumption of wheat as per capita is 95 kg, or 61 kg (FAO, 2016). In Serbia, the average consumption of wheat as per capita is 180 kg, which is considerably more than the consumption rate in the majority of the European countries (USDA, 2017). Because of that, the production and price of the bread-making grain is very important not only at the national level, but also at the global level. Based on the data accounted for in Table 2, it can be noticed that even in the production of wheat, there has been a significant growth of total costs, the price of the kernel and the generated income as per unit of soil area. The total costs of wheat production in 2022 are greater by 63.6% in comparison with 2018. Besides, a change in the relationship between direct and indirect costs is also noticeable. Namely, in 2018, the indirect costs accounted for over 59.5% and the direct costs were around 40.5% of the total costs of production. In 2022, that relationship has changed in favor of the direct costs, i.e. the costs of materials, which now account for 55.8% of the total costs of production. The costs of the purchase of mineral fertilizers make up 35.4% of the total costs of wheat production. On the other hand, the price of the machine services in the period under observation have increased by 21%, which is a consequence of the growth of the price of all energy-generating products, even oil itself, in the global market. Although the costs of production have significantly increased in comparison with the year 2018, the growth of the price of wheat by 113% has ensured income greater by 113% and the coverage margin greater by 333% in 2022.

Table following on the next page

The specification of the costs of materials and operations		The amount	The unit of measure	The value in RSD	
				2018	2022
The direct costs – the costs of materials					
A	Seeds	225	kg	12,150	13,500
	NPK 16:16:16/ 8:20:30	300	kg	7,512	35,700
	SAN, AN	170	kg	3,930	18,190
	Protective agents Antiweed treatment – Lancelot 450 WG I fungicide treatment (the wheat intensive growth phase) – Falcon EC460 II fungicide treatment (of the flag leaf) – Amistar Extra III fungicide treatment (of the flowering)+the anti-insect treatment – Prosaro 250EC + Fastac	0.033 0.60 0.70 1+0.2	l, kg	14,100	17,600
	Total			37,692	84,919
The indirect costs – the costs of machine operations with the costs of fuel					
B	Spreading mineral fertilizer before ploughing	1	ha	1,609	2,010
	The basic processing – ploughing up to 20 cm	1	ha	6,349	9,600
	Pre-sowing preparation – the work of a germinator of over 4 m	1	ha	5,834	6,690
	Sowing (pne.sej)	1	ha	3,155	3,740
	Spreading mineral fertilizer – additional supplementation in the spring 2x	1	ha	3,217	2,750
	Spraying 3 x (the price of one single spraying multiplied by 3 treatments)	1	ha	9,386	10,740
	Harvest	1	ha	11,504	13,330
	The transportation of mineral fertilizer, seeds and water for the spraying equipment			4,340	5,919
	Transportation by an 8-t double-axle trailer	1	hour	1,965	2,230
	Straw baling	rolled bales up to 250 kg		9,120	10,200
	Total			55,347	67,209
Total costs (A+B)			RSD ha^{-1}	93,039	152,199
1	Yield	6,000.00	kg ha^{-1}		
2	The kernel price		kg	19	40.5*
3	Total profit		RSD ha^{-1}	114,000	243,000
4	The coverage margin		RSD ha^{-1}	20,961	90,801
* Commodity Exchange Novi Sad, May 2022					

Table 2: The analytical calculation of wheat production in the years 2018 and 2022

In soybean production, the total costs record a 64.7% growth in the period under observation. In the prior period, the costs of materials accounted for around 35%, and the mechanization costs accounted for around 65% of the total production costs. Due to the fluctuations in the market, there has been an increase in the share of the direct costs that are 55% in 2022, whereas the costs of the mechanization participate with 45% in the total costs of production. The costs of machine operations are greater by around 14%, which is the consequence of the growth of the prices of energy-generating products, oil in the first place. The growth of demand of the soya kernel at the global level has also influenced the fixing of the price of this crop on the domestic commodity exchange. The price of soybean on the domestic commodity exchange records a growth of 119% in comparison with the year 2018.

The formed kernel price exerts an influence on the gross income as per unit of measure, so the expected linear growth of gross income is around 119%. The coverage margin with the mentioned kernel yield of 4,500 kg ha^{-1} would be almost three times as big in the current circumstances in relation to the year 2018 (Table 3).

The specification of the costs of materials and operations		The amount	The unit of measure	The value in RSD	
				2018	2022
The direct costs – the costs of materials					
A	Seeds	90	kg	8,730	14,400
	NPK 16:16:16/ 8:20:30	300	kg	7,512	35,700
	SAN, AN	170	kg	3,468	17,850
	Protective agents pre-em Velton WG + Basar, post-em Corum+Dash, sorghum Floyd	0.45 +1.4 0.9+0.5 1.3	kg/l	10,800	13,500
	Total			30,510	81,450
The indirect costs – the costs of machine operations with the costs of fuel					
B	Spreading mineral fertilizer before ploughing	1	ha	1,609	2,010
	The basic processing – ploughing up to 30 cm	1	ha	10,287	12460
	Leveling ploughing – harrowing with heavyweight harrowing machine (over 4.5 m w.w.)			4,599	5,000
	Pre-sowing preparation – the work of a germinator of over 4 m	1	ha	5,834	6,690
	Sowing (pneumatic seeder)	1	ha	3,285	3,510
	Spreading mineral fertilizer – additional supplementation	1	ha	1,609	2,150
	Spraying 3 x (the price of one single spraying multiplied by 3 treatments)	1	ha	9,386	10,740
	Inter-row cultivation			2,315	2,640
	Harvest	1	ha	12,135	13,130
	Transportation by an 8-t double-axle trailer	1	hour	1,965	2,030
	The transportation of mineral fertilizer, seeds and water for the spraying equipment			5,300	6,090
	Total			58,322	66,450
Total costs (A+B)			RSD ha^{-1}	88,832	147,900
1	Yield	4,500	kg ha^{-1}		
2	Kernel price	1	kg	36.5	80.0*
3	Total profit		RSD ha^{-1}	164,250	360,000
4	The coverage margin		RSD ha^{-1}	75,418	212,100
* Commodity Exchange Novi Sad, May 2022					

Table 3: The analytical calculation of soybean production in the years 2018 and 2022

The indicators of the economic efficiency of the production of the selected crops in the year 2022 are shown in Table 4. Based upon the obtained results, it can be concluded that the best economic efficiency can be expected in the production of soybean although the production of this crop is burdened by the biggest costs as per unit of measure (RSD 32.9). The indicators of the economic efficiency of corn and wheat are considerably lesser than 1, which makes the production of these crops less cost-effective and less safe even though there has been a drastic increase in the kernel price.

The indicator	Crops		
	Corn	Wheat	Soybean
Total income, RSD ha^{-1}	264,000	243,000	360,000
Total costs, RSD ha^{-1}	180,436	152,190	147,900
Coverage margin, RSD ha^{-1}	83,564	90,801	212,100
Costs as per unit of measure, RSD kg^{-1}	22.6	25.4	32.9
Economic efficiency	0.46	0.60	1.43

Table 4: The indicators of the economic efficiency connected with the production of corn, wheat and soybean in the year 2022

4. CONCLUSION

In the paper, an analysis of the economic efficiency of the production of corn, wheat and soybean was carried out so as to establish a fact of changes in the production chain before and after the crisis caused by the Coronavirus and the developments in Ukraine. The research results have revealed that in all three crops there has been a significant growth of the total costs at the level of 63.6% all the way to 74.5% in wheat, and corn, respectively. A change has also been noticed in the structure of the costs with the growth of the directs costs at the expense of reduction in the costs of machine operations. The changes in the agricultural product supply chain have created a drastic rise in the kernel price as per unit of measure, namely by 73.7% in corn, 113.1% in wheat, and 119.2% in the soya kernel. Based on the analysis of the obtained parameters, it was determined that the production of soybean demonstrated the biggest economic efficiency, only to be followed by the economic efficiency of wheat (0.60) and corn (0.46).

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