

## ECONOMIC PROFITABILITY AND ECOLOGICAL JUSTIFICATION OF BUCKWHEAT CULTIVATION IN THE REPUBLIC OF SERBIA

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### Abstract

*The subject of research in this paper is the production of buckwheat on family farms in the Republic of Serbia. The main goal is to look at the situation, assess the economic effects of buckwheat cultivation, as well as the possibilities of improvement and greater representation of this production. Data were collected through a survey / interview with producers, from the websites of farms and institutions. Based on the buckwheat production technology, a calculation was made for one production cycle and important economic indicators were determined: production value, total costs, financial result, cost price, economy, and accumulation rate. These indicators are compared between conventional and organic production. The results show that buckwheat production is economically justified from the producer's point of view, but better effects are achieved by organic production.*

**Key words:** Buckwheat, organic production, business indicators, economic efficiency

### INTRODUCTION

Buckwheat (lat. *Fagopyrum esculentum Moench*) is a field crop that has been used for human and animal nutrition for more than 7,000 years. According to its nutritional composition, it is one of the very useful plant species [3]. He is originally from Asia. Wild plants can be found in China, and as weeds in Siberia and the Middle East. Diploid buckwheat was produced in Mongolia in the 10th century. Buckwheat has been mentioned in Europe since 1396, while in the United States it was expanded in the 17th century. Grown buckwheat was transported from China and the Himalayas first to Mongolia, Siberia and Japan, and then to Russia. From Europe and Japan, buckwheat has spread to other countries around the world [10]. Today, buckwheat is mostly grown in Eurasia, as well as in North America. Around 4,500 varieties of buckwheat are known in the world, all of which are suitable for growing in certain climatic and production conditions [5]. Buckwheat is suitable for organic production, which, in addition to achieving a more

biologically valuable grain yield, contributes to the preservation of natural resources, especially land. There are about 43.1 million ha under organic agricultural production in the world (including the area under conversion). Of these areas in the world, most are located in Oceania, about 17.3 million. ha (40%) and Europe, about 11.5 mil. ha (27%). There are about 6.6 million ha in Latin America (15%) under organic production, in Asia 3.4 million ha (8%), in North America about 3 million ha (7%) and in Africa 1.2 million ha, respectively, 3% [19]. Of the total area of Serbia 8,840,000 ha (about 70%), agricultural land is located on 5,734,000 ha, of which 4,867,000 ha are arable land. Other areas of Serbia (about 30%) are under forests. In Serbian agriculture, the leading place belongs to crop production [17]. About two thirds of agricultural production comes from farming. Cereals, especially corn and wheat, have a dominant place in the structure of production, about 31% [20]. In recent years, there has been a growing interest of agricultural producers in growing buckwheat, as well as economically important and ecologically

justified plant species. Precisely, the subject of this paper is the economic analysis of buckwheat production on family farms in the Republic of Serbia. The main goal of this research is to evaluate the economic effects per unit of measure that can be opened by growing buckwheat in different systems of conventional and organic production. The research seeks to answer a number of questions, such as: Is buckwheat production economically justified for the producer? What is the rate of accumulation that can be achieved in conventional and organic buckwheat cultivation systems? Therefore, the aim of the research is to look at the situation and possibilities of improvement from the production of buckwheat on family farms from the economic aspect. In addition to quantitative economic results, the research also analyzed the qualitative ecological effects of buckwheat cultivation.

## MATERIALS AND METHODS

The research was conducted on the basis of data from the business practice of family farms in the southwestern part of the Republic of Serbia. Data were collected during the three-year monitoring of inputs and outputs on selected farms where buckwheat is grown as the main source of income. Significant data were collected through a survey and interviews with manufacturers, as well as from the sites of important institutions, associations, associations, etc. Also, data from the databases of the Republic Statistical Office of Serbia (SORS) and the Food and Agriculture Organization (FAO) were used. Trends and structure of areas under buckwheat production in the world and in Serbia are considered. Then, a calculation of buckwheat production per unit area under conventional and organic conditions was compiled. Important economic indicators have been determined: production quality, production costs, financial result, cost per unit of measure, economy, accumulation rate, etc. By applying the SWOT analysis, the strengths, weaknesses, opportunities and threats of the current situation and further

development and improvement of buckwheat production were examined.

## RESULTS AND DISCUSSIONS

### Areas under buckwheat production in the world and in the Republic of Serbia

According to the database of the Food and Agriculture Organization [2], the total area under buckwheat in the world in the five-year period 2012-2017 ranged from 2,491,909 ha in 2012 to 3,940,526 ha in 2017 (Table 1).

Table 1. Indices of movement of areas under buckwheat production in the world, 2012-2017

Year	Areas under buckwheat in the world (ha)	Index (2012=100)
2012	2,491,909	100.00
2013	2,263,608	90.84
2014	2,002,091	80.34
2015	3,350,253	134.44
2016	2,985,282	119.80
2017	3,940,526	158.13

Source: Calculation according to data [www.fao.org](http://www.fao.org) [2].

As can be seen in Table 2, looking at the continents the largest areas under buckwheat are found in Europe, Asia and America [2]. Looking at countries in the world, the largest production of buckwheat is in Russia, followed by China, Ukraine, Brazil, America, Japan, France, Poland and Lithuania [7].

Table 2. Volume and structure of buckwheat production by continents, 2012-2017

Continent	Tons	%
Europe	8,724,197.00	53.80
Asia	6,498,013.00	40.10
America	855,786.00	5.30
Africa	138,543.00	0.80
Australia	-	-
<i>World:</i>	<i>16,216,539.00</i>	<i>100.00</i>

Source: Calculation according to data [www.fao.org](http://www.fao.org) [2].

Buckwheat is grown on about 300 hectares in the Republic of Serbia, at different altitudes. In the southwestern part of Serbia, buckwheat is grown at an altitude of 1,100 m. The largest number of farms where buckwheat is grown is located in the areas: Zlatar, Zlatibor, Tara, Javor, Rudnik, Pešter, Sjenica, Jastrebac and Čačak. Buckwheat can be successfully produced in Serbia because buckwheat yield was significantly higher than average world yielded of 1,350 kg/ha [13].

### Agro technical aspects of buckwheat cultivation

Buckwheat is an herbaceous annual plant and has a very short growing season (60-70 days), which provides the opportunity for two harvests in one year [9]. Fertilization is performed before the basic treatment in quantities of 30-60 kg/ha N, 30-60 kg/ha P<sub>2</sub>O<sub>5</sub> and 30-45 kg/ha K<sub>2</sub>O. It can be grown on slightly acidic soils, up to 5.5 pH values [16]. Of the buckwheat varieties, the most represented in Serbia are Novi Sad buckwheat and Gray dove, which are characterized by good growth and a solid tree height of 90-100 cm [15]. The plants branch well, is quite tolerant of drought, lodging and shedding of grains, and the lengths of the vegetation period vary from 80 to 110 days. They have a medium-sized grain, and the genetic yield potential is 2.5-3.0 t/ha [1].

About 80-100 kg of seeds per ha are needed for sowing. Crop care and protection measures depend on the sowing method used. Irrigation is applied in the case when buckwheat is grown as a side crop [4]. No chemical protection measures are used against insects. Due to the high content of routine that gives the buckwheat plant a slightly bitter taste, insects do not attack this plant culture. Against pathogens, only preventive measures are applied, such as disinfection of seeds and cultivation of buckwheat in the crop rotation [14]. Grain-eating birds can cause far greater damage to plants. Buckwheat can be grown as a main and as a subsequent crop after mowing winter fodder plants. The time and manner of harvesting depends on the purpose of its cultivation.

### Economic importance and nutritional value of buckwheat

It can be used as a fodder plant for making silage. Also, buckwheat can be used as a vegetable fertilizer, by plowing aboveground biomass [6]. This plant culture has good nutritional value. Buckwheat grain contains from 1.50 to 3.70% of lipids, quality and easily digestible proteins from 11 to 15%, which is an equivalent amount as 90% of the protein content of skim milk and more than 80% of egg content [11]. Of the proteins, globulins are the most abundant. The degree

of processing of buckwheat grain also depends on the content of nutrients in products or semi-finished products (Table 3).

Table 3. Nutritional value of buckwheat semi-finished products

Product	Contents (%)				
	Prote- ins	Carbo- hydrates	Fats	Fibers	Ash
Grain	12.50	73.30	2.30	10.90	2.10
Porridge	16.80	67.80	3.20	0.60	2.20
Whole wheat flour	14.10	68.60	3.50	8.30	1.80
Semi-white flour	11.70	72.00	2.50	1.60	1.80
White flour	6.40	79.50	1.20	0.50	0.90
Wheat flour for bread	11.80	74.70	1.10	0.30	0.40

Source: [3].

Buckwheat is a cereal of great nutritional value. Hulled buckwheat grains are used in the human diet in several ways. Whole grains are suitable as nutritional supplements for various stews, and flour for making polenta or for making bread with the addition of some other type of flour. From the health aspect of people, buckwheat in the diet brings blood sugar to an optimal level and helps the liver to function better. Young buckwheat grains can be left to germinate. Such sprouted buckwheat seeds are an exceptional source of chlorophyll, vitamins and enzymes.

### Economic participants in buckwheat production on a family farm in the Republic of Serbia

Buckwheat production can be economically viable only if the revenues are higher than the total costs, and the main income is obtained by selling the products on the market. The economic viability of buckwheat production on the farm is affected by several factors. Factors that affect costs are different and depend on the volume and structure of production on the farm, market conditions - demand, prices, etc., as well as socio-economic factors [8]. Revenues depend not only on the yield but also on the price at which the products are sold on the market. Producers, on the one hand, cannot influence the selling prices of their products, because they are usually formed on the market under the influence of supply and demand, but on the other hand, they can influence the cost and cost of their own products [18].

Based on the collected data and technological activities from soil preparation and sowing to harvest, calculations of buckwheat production in conventional and organic conditions were compiled (Table 4). Although on the farm in the Republic of Serbia, the production of buckwheat takes place on larger areas, for the purposes of calculation and comparative analysis; all amounts are calculated for an area of 1 ha.

Table 4. Economic indicators of conventional production of buckwheat production in the R. Serbia

Row. Number	Indicators	Conventional production
a.	Yield (kg / ha)	1,800.00
b.	Market price (€ / kg)	1.60
Amount (€ / ha)		
A.	Sales revenue	2,880.00
B.	Costs	
I	Variable costs	
1.	Seeds	170.00
2.	Fertilizer (mineral, etc)	70.00
3.	Chemical preservatives	20.00
4.	Human labor	50.00
5.	Machine operation	110.00
6.	Certification and control	-
7.	Other costs	60.00
Total (I):		490.00
II	Fixed costs	120.00
III	Total cost (I+II):	610.00
C.	Financial result	2,270.00
D.	Cost price (€ / kg)	0.34
E.	Coefficient of economy	3.72
F.	Profit rate (%)	78.82

Source: According to the data collected by the survey on family holding.

As can be seen in Table 4, in the conditions of conventional buckwheat production, the yield is 1.8 t/ha, and the market price at which the producer sells buckwheat grain is 1.60 €/kg. The total costs amount to 610 €/ha, and from the given calculation it can be seen that in their structure, a larger share consists of seed costs, about 28%, then the costs of mechanical services 18%, fertilizers about 11% and labor, about 8%. Organic production in the Republic of Serbia in recent years, with minor oscillations, has recorded an increase in both the area involved in production and the number of producers. Production took place on a total area of about 15,298 ha (with meadows and pastures), including areas in the status of conversion period. Compared to 2014 (9,547 ha), the total area in 2019 increased by 60% [20]. In the structure of organically grown field crops, buckwheat

gained increasing importance. Based on the technology of organic buckwheat cultivation, on the investigated farms in the southwestern part of the Republic of Serbia, a calculation for one production cycle was made and more important economic indicators were determined (Table 5).

Table 5. Economic indicators of organic production of buckwheat in the R. Serbia

Row. Number	Indicators	Organic production
a.	Yield (kg / ha)	1,500.00
b.	Market price (€ / kg)	2.40
Amount (€ / ha)		
A.	Sales revenue	3,600.00
B.	Costs	
I	Variable costs	
1.	Seeds	220.00
2.	Fertilizer (organic, etc)	80.00
3.	Biological protection	30.00
4.	Human labor	90.00
5.	Machine operation	70.00
6.	Certification and control	80.00
7.	Other costs	40.00
Total (I):		610.00
II	Fixed costs	120.00
III	Total cost (I+II):	730.00
C.	Financial result	2,870.00
D.	Cost price (€ / kg)	0.49
E.	Coefficient of economy	3.93
F.	Profit rate (%)	79.72

Source: According to the data collected by the survey on family holding.

He realized yield of organically produced buckwheat is 1.5 t/ha, and the market price for buckwheat produced in this way is € 2.40/kg, so a higher sales revenue is achieved compared to conventional production (Table 5). The total costs are 730 €/ha. Due to the specifics of organic production, the cost structure differs from the conventional one. The largest share belongs to the costs of seeds (30%), followed by the work of workers (13%), fertilizers (11%) and the costs of certification and control (11%). According to the established economic indicators, the production of buckwheat in both conventional and organic conditions is economically justified, because a positive financial result (profit) is achieved.

The production of buckwheat in organic conditions achieves a financial result in the amount of 2,870 €/ha, which is 26% higher than the financial result achieved by production in conventional conditions (2,270 €/ha). In both conventional and organic

production, the cost price of 1 kg of buckwheat is lower than their market (sales) prices, which means that both methods of production are economically justified. Thus, the cost price of buckwheat in conventional conditions is 0.34 €/kg and by 1.26 €/kg is lower than the market price (1.60 €/kg), and in organic production the cost price is 0.49 €/kg and is 1.91 €/kg lower than the market price (2.40 €/kg). The difference between the market price and the cost price per unit of measure is significantly larger for organically produced buckwheat, so this method of production is also economically more profitable.

Observing the coefficient of economy as a ratio of financial result and total costs ( $3.72 > 1$  for conventional and  $3.93 > 1$  for organic), buckwheat production is economical in both cases, but organic production is more economical. Both conventional and organic buckwheat production achieves a high profit rate, which means that about 80% of the realized sales revenue is made a profit. So, about 20% is enough to cover the total costs. The profit rate in organic production is more favorable compared to conventional ( $79.72\% < 78.82\%$ ).

Based on the established economic indicators, it can be concluded that the production of buckwheat per unit area and per unit of yield, is economically justified for the producer, but organic production is economically more efficient than conventional production. How much better the degree of efficiency of organic buckwheat production will be depends on a number of factors, primarily on the applied agricultural techniques, quantity and quality of yield, sales price, etc.

Overall productivity on the farm can be improved by using varieties that give higher yields and that are adapted to local conditions. Yield can be increased by good regulation of plant nutrition and effective control of weeds, pests and diseases. In order to increase the economic production of buckwheat, producers often refine or process grain on the farm. They sell buckwheat flour as final products. Also, as they make and sell ecological pillows that are filled with by-products, i.e. buckwheat flakes.

### Economic and ecological determinants of improving buckwheat production in Serbia

Using the SWOT analysis, the strengths, weaknesses, feasibility and dangers that are important for understanding the potential and possibilities of improving buckwheat production in Serbia were identified (Table 6).

Table 6. SWOT analysis of buckwheat production in the Republic of Serbia

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• As a crop, buckwheat is suitable for growing on different soils;</li> <li>• Since it is not treated with chemical pesticides, cultivation contributes to the preservation of the soil;</li> <li>• It is economically efficient in both conventional and organic growing conditions;</li> <li>• There is state support for organic production [12];</li> <li>• As a dietary product, buckwheat is gaining in importance;</li> </ul>	<ul style="list-style-type: none"> <li>• Small areas under buckwheat production;</li> <li>• Buckwheat is traditionally known as "food for the poor", so there is little interest in growing it;</li> <li>• Due to the high costs of certification and control, the share of areas under organic buckwheat production is small;</li> <li>• Insufficient promotion of the nutritional value and importance of buckwheat in human nutrition;</li> <li>• Insufficient investments in grain processing and processing capacities;</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Buckwheat cultivation can use areas that are not adequate for a more intensive plant species;</li> <li>• Investing in processing capacities and creating value-added products;</li> <li>• Available funds from IPARD and other funds;</li> <li>• In combination with bee colonies, higher buckwheat grain yield and quality buckwheat honey are achieved;</li> </ul>	<ul style="list-style-type: none"> <li>• Insufficient control of imports of semi-finished and buckwheat products and "suffocation" of domestic production;</li> <li>• Consumer distrust, because using modern additives and synthetic dyes, wheat and similar flour products are present on the market as buckwheat flour products;</li> <li>• Insufficient incentives for all segments of the value chain for products of organic origin, and thus from organic buckwheat;</li> </ul>

Source: Own concept.

In Serbia, there is a noticeable growth in the market of agricultural and food products made of buckwheat, both supply and demand, but it

is still very small and underdeveloped. Investments can influence its development due to the multiple advantages it provides to producers and consumers, but also to society in general. There are suitable soil and climatic conditions for growing buckwheat, and it is important to emphasize that the support from the state for organic production is also important. In addition to incentives for organic, there are favorable loans for investment in physical assets on the farm, which provides the opportunity to develop buckwheat production. Today, despite the better understanding of the importance of this plant culture, there are still few areas, producers, as well as yields that could meet domestic demand.

Due to insufficient import control, there is a threat to suppress the existing domestic production of buckwheat. Marketing approach to both the domestic market and exports is important. This includes market research and buckwheat products, which will meet the needs of consumers in terms of quality, range, size and method of packaging, packaging design, sales prices and the like. Opportunities but also obstacles for the development of domestic products on the food market should be recognized. It is also necessary to know and adapt to the standards of the target EU markets in other markets as well. Possibilities in improving economic efficiency and at the same time ecological justification is the organization of organic production of buckwheat, then the use of by-products from the processing of buckwheat grain, and thus the expansion of the range of products for sale on the market. One should strive to create products with added value.

## CONCLUSIONS

In the practice of agricultural production in the Republic of Serbia, buckwheat is traditionally known as food for the poor, which has had the consequence of neglecting its cultivation. The technology of growing buckwheat is known in both conventional and organic conditions, and it is only necessary to motivate producers to focus more on this plant culture. Based on the established indicators, in

relation to the conventional one, organic buckwheat production is economically more favorable for producers and a significant financial result is achieved both per unit area and per unit grain yield. Growing buckwheat in combination with keeping beehives on the farm, significant economic results are achieved. On the one hand, buckwheat is suitable for grazing bees, and on the other hand, by keeping bees, quality buckwheat honey is obtained. Observing the general interests, buckwheat is also desirable from the ecological aspect, because the technology of cultivation contributes to a more favorable physical structure, preservation of the soil and better biological balance in the environment.

This production also has social effects, because it contributes to the employment of the local population. From processed buckwheat and by-products (flakes), producers on the analyzed farms achieve significant income. The effects of buckwheat cultivation cannot be seen in the short term, but they are achieved only after a long series of years. With the improvement of the quality of final products and processes necessary to meet the needs of consumers, producers manage to create added value of buckwheat products.

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