

Article

Economics of Organic Carrot Production through Case Study Report

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Received: 05 October 2022; Accepted: 12 January 2023

Abstract: In their research, the authors analyze the economic effects of growing carrots in an organic production system. The goal is to confirm, based on the obtained data, the assumption that organic carrot production is financially profitable and that higher (so-called premium) prices are one of the most important factors that influence positive economic results. The data were obtained using the case study method and using analytical calculations. The established indicators of productivity, economy, and profitability of this production confirmed the initial assumption and showed that the organic system of carrot production is economically justified.

Keywords: organic production; carrot production; case study; economic efficiency; calculation.

1. Introduction

Organic agricultural production represents a production system that is still classified as alternative agriculture. During its, now decades-long development, this system has been defined differently depending on what the goal of its analysis was and what was specifically researched. Thus, among the most widely accepted definitions, the one given by Lampkin and Padel [1] stands out, who define organic agriculture as both a philosophy and a production system that aims to create an integrated, humane, economically sustainable agriculture, oriented toward environmental protection and maximum use of renewable resources produced on the farm itself. In addition, the mentioned authors believe that organic production is a system of managing ecological and biological processes to obtain an acceptable level of crop yield, animal growth, and the level of nutrients required for human nutrition. Beauchesne and Bryanti [2] define organic agriculture as a social and technological alternative to conventional production, while Cifrić [3] believes that ecological (organic) agriculture is a social innovation and should be understood as: giving up the dominance of the paradigm of industrial agriculture; the possibility of additional employment of labor on the family farm, settlement, and society; the convenience of producing quality products on small areas; encouraging the development of „closed“ production systems, with greater use of natural energy and organic processes. Regardless of the differences in definition, most authors agree that organic agriculture can be defined as a system that is in harmony with the environment [4-13], profitable for the farm [14,15-19] but with respect for the specific production characteristics of each household [20-22].

The organic production system is based on the basic standards formulated by IFOAM (International Federation of Organic Agriculture Movements), which was founded in 1972. This international association formulated the following goals (principles):

- Production of food with high nutritional value. This goal stems from the fact that food today is part of the prevention and even the treatment of diseases of modern humanity;
- Production in accordance with biological principles and cycles. This goal stems from the fact that organic production works in harmony with nature and the ecosystem;

- Encouraging biological cycles within the production system, because agrobiocenosis does not have the ability to self-regulate. Therefore, the conditions of the agrobiotope must be harmonized with the requirements of the agrobiocenosis. The dynamic balance of these relationships constitutes an agroecosystem. Preservation of the stability of agroecosystems and ecosystems, along with the rational use of natural resources, is the basis on which organic agriculture rests;
- Long-term maintenance and increase of soil fertility. This requirement stems from the importance of land for agricultural production, but also the threat of this complex system. With agrotechnical measures (crop rotation and other measures), organic agriculture achieves its goal - the preservation of "living" soil, as the basis of agricultural production;
- Maximum use of renewable energy sources within the production system, that is, the use of raw materials that are recycled, which establishes the circulation of matter, which is interrupted in conventional agriculture;
- A balanced relationship between plant and livestock production, which achieves self-sustainability;
- Domestic animals must be provided with breeding conditions that will ensure their well-being and health;
- Minimize pollution resulting from agricultural production;
- Maintenance of genetic diversity in the agricultural system and ecosystem, including the protection of biodiversity, which is particularly important for integral rural development, as well as the revitalization and preservation of the agricultural landscape;
- An organic production is a humane form of production, but also a way of life, which presupposes respect for the rights of citizens (producers) to a quality, happier life for a longer period. Sustainable development with economic and ecological profit gives the possibility for such living conditions.

In 2005, IFOAM adopted 4 basic principles of organic production, which sum up all of the above. Those principles represent the basis for the legal regulation of this production system. These are: 1) health; 2) ecology; 3) fair behavior and 4) caring. However, principles and legal regulations in organic production are still at different stages of development. In other words, the regulatory rules of the game are still being developed, are still being tested, and are therefore still subject to change, which all together increases risk and uncertainty as the main obstacles to the transition to an organic production system [23].

Although in the scientific literature, when analyzing the organic cultivation system, its biological and ecological determinants are primarily investigated, in the last few decades, the socioeconomic characteristics of this production have also come into focus. One of the important elements of the improvement and expansion of not only organic but any production is its economic justification viewed through financial results. When considering the economic characteristics of organic production, the literature often mentions factors that influence positive financial results, among which are the prices of organic products [24-29] and the cost structure of organic production [30-32,11] stand out. Accordingly, the goal of this research was to determine the economic indicators of organic vegetable production, i.e. carrots, in order to obtain data on economic effectiveness and efficiency that represent the basis for an objective economic analysis of this production system. The starting assumption was that organic production of vegetables, i.e. carrots in the observed case, is financially profitable and that higher (so-called premium) prices of organic products are one of the factors that contribute to a positive financial result.

Organic vegetables have multiple importance in nutrition, prevention, and treatment of many diseases of modern man [33] and are among the most sought-after organic products in the territory of the Republic of Serbia [34,19]. In addition, Lazić et al. [33] state that it also has horticultural significance in the arrangement of green areas and contributes to the preservation of biodiversity. Certain authors investigated the differences in the cultivation of vegetable crops in organic and conventional systems [35-38], however, Kowalczyk and Cupiał [39] point out that among these

studies there is a lack of up-to-date analysis of organic and conventional carrot production. All these characteristics together determined that when determining the economic indicators of production, vegetable production should be considered.

2. Materials and Methods

In accordance with the goal of the research, an appropriate research method was applied. Calculations represent the procedure for determining the costs of production, processing, and realization of products or services. They represent the value expression of consumption, which implies that costs are calculated as the product of the quantity of consumption and the price per unit of consumption.

Sredojević et al. [40] point out that in organic agricultural production the following most important problems are solved by applying calculations:

- Amount of necessary investments in organizing and implementing organic production and assessment of economic effectiveness;
- The upper limit of investment in means of production;
- The lower limit of the selling prices of the obtained organic products;
- Production value, costs, financial result;
- Optimal structure and volume of organic production;
- An optimum lifetime of production capacities.

The production process in the organic production system generally involves obtaining two or more organic products (main and secondary product). This is why we discuss the production line because the products are linked and cannot be produced one without the other. The procedures for compiling analytical calculations are similar for individual organic products or production lines.

Compilation of analytical calculations for individual production lines presupposes the determination of the total value of production, costs of production and sales by elements and sub-elements and, finally, determination of the financial result using the general scheme of analytical calculations [41]:

$$d = p - t$$

wherein:

d – net return, i.e. financial result (which can be profit or loss).

p – total income or value of production, for a particular line of production;

t – total costs for a particular production line;

Economic effectiveness is an absolute value measure of production and business results and is expressed in monetary units. The most frequently used indicators of the economic effectiveness of production are production value and profit.

Profit is the most important indicator in determining the net effects of any business entity, or any individual product. It expresses the value of the economic effectiveness of the achieved result within the period of one year. Profit as the difference between production value and total production costs represents the final net economic or financial result of certain production, and is calculated as follows:

$$D = VP - UT$$

wherein:

D – profit;

VP – the value of production;

UT – total costs.

If the total realized value of organic production is greater than the amount of total production costs, the agricultural company or farm will make a profit, and therefore this production will be

economically viable. Conversely, if the realized value of organic production is not sufficient to cover all production costs, the profit will be negative, i.e. the agricultural entity will operate at a loss.

The efficiency of production is expressed by the ratio of the results of the company's functioning and the investments necessary to achieve those results. The smaller the amount of resources needed to achieve the results, that is, the greater the results achieved with a certain amount of resources, the higher the efficiency of the observed farm or company and vice versa.

The economic efficiency of production is a relative measure of economic success. It is determined by comparing absolute production results and costs. Sredojević et al. [40] state economy, production profitability, and labor productivity as basic indicators of business efficiency.

Labor productivity indicators are obtained by measuring the achieved business results in relation to the volume of human labor invested. The degree of labor productivity is naturally expressed as follows:

$$PR = R/OP \text{ or} \\ PR = OP/R$$

wherein:

PR – labor productivity;

R – labor invested (in hours);

OP – the volume of production.

Thus, labor productivity expresses the expenditure of hours of human labor per unit of the product obtained or vice versa, the amount of product obtained per unit of human labor.

Unlike productivity, which observes the results achieved by engaging only one element of production (human labor), the economy looks at the results as a consequence of the engagement of all elements of production. Economy, as an indicator of the economic efficiency of production, is expressed as a coefficient, as follows:

$$EP = VP/UT$$

wherein:

EP – efficiency of production;

VP – the value of production;

UT – total costs.

Production efficiency shows us how many dinars of production value are realized per RSD of production costs and can be calculated for individual production lines or the farm as a whole. The higher this coefficient is than 1, the more economical the production and vice versa. If the efficiency coefficient is equal to one, it means that the farm or company operates at the border and that the financial result or profit is equal to zero.

The profitability of production shows and expresses the efficiency of the resources employed, as well as the profitability of the company's operations. The degree of profitability of production is expressed by the rate of profitability as follows:

$$R = D/Vp \times 100$$

wherein:

R – profitability;

D – profit;

Vp – production value.

The profitability rate calculated in this way shows the amount of realized profit for every 100 RSD of the market value of production.

The profitability of invested funds is calculated by the rate of profitability as follows:

$$R = D/K$$

wherein:

R – profitability;

D – profit;

K – capital (total employed funds).

This indicator shows the amount of realized profit for every 100 RSD invested, that is, how much percent of the invested capital will be returned to the owner of the capital through the realized profit during one production process.

Profitability can be negative, if there is a loss in production, or it can be equal to zero if there is no profit.

Empirical research was conducted using case study methods, using a survey questionnaire, within the agricultural holding located in the settlement of Kisač, which belongs to the municipality of Novi Sad and Južnobački district, and which has been engaged in organic agricultural production for more than 20 years. Carrot production was analyzed for three years, i.e. 2016, 2017, and 2018, respectively.

3. Results and Discussion

As stated by Pejanović and Njegovan [42], a case study is a part of the agro-economic analysis that aims to generate a hypothesis about the investigated phenomenon in a specific organizational context (in the example of a company or farm).

The selected farm is engaged in organic vegetable production and markets its products as such. This farm has been engaged in organic production for more than 20 years on an area of about 15 hectares. It is known for its large number of varieties and types of organic vegetables. The farm has all the necessary machinery and equipment for irrigation. The work is performed by the holder with the engagement of seasonal labor. The farm produces its seed material, as well as seedlings in a 510m² greenhouse. The producer grows carrots on two hectares. In addition, the range of vegetables includes all cabbages, and then zucchini, onions, arugula, mangold, spinach, cherry tomatoes, and eggplant which indicates the application of intensive crop rotation, which is also the basis of organic production. In addition, there is also the production of medicinal herbs from the organic production system (rosemary, mint, thyme, chives, parsley, oregano, etc.). The products of this organic producer are marketed in Novi Sad markets, and recently also in Belgrade markets, in "Mercator" and "Univerexport" supermarkets and "Moj Salaš" store.

The economic results of carrot production were obtained by applying analytical calculations, and the results are summarized in the following table (table 1) by observed years.

Table 1. Value of organic carrot production.

Year	Total yield (kg/ha)	Main product (kg/ha)	Secondary product (kg/ha)	Price (€/kg)	Production value (EUR/ha)
2016.	40.000,00	25.000,00	15.000,00	1,00	25.000,00
2017.	37.000,00	27.000,00	10.000,00	1,00	27.000,00
2018.	40.000,00	28.000,00	12.000,00	1,10	30.800,00

The yield per unit area is an important indicator in any production because it significantly affects the results achieved. The yields that have been achieved for the observed three years for organic production represent very good yields. What is specific to organic production is that only a certain part of the yield can be used for sale, and the rest falls away as a second class and a good part is wormy, due to the specificity of organic production in which treatment with chemical means is not allowed. The producer cannot use the part of the yield that belongs to the second quality class

(by-product), but in this case, gives it to the horse farm and has no income from it. The thing that had the greatest effect on the reduction of yields for the observed producer was a large amount of rain, especially in 2016, when the losses were the greatest.

The data presented to show us that due to the secondary product that cannot be sold, the value of production is significantly reduced, which is calculated as the product of the realized yield and the price, and on this farm, for the mentioned years of observation, it amounted to €25,000.00 per hectare in 2016. 27,000.00 in 2017 and 28,000.00 in 2018.

Production costs represent a very important item and special attention should be paid to their analysis. The following table shows the production costs of organic carrots in EUR per observed year.

Table 2. Production costs of organic carrots (in EUR).

Year	Material costs	Services (labor)	Other costs (storage)	Gross personal income	General household expenses	Total
2016.	5.772,00	1.200,00	850,00	5.000,00	1.000,00	13.822,00
2017.	6.457,00	1.220,00	850,00	5.400,00	1.000,00	14.927,00
2018.	7.757,00	1.220,00	850,00	6.000,00	1.000,00	13.973,00

Within material costs, the costs of basic and auxiliary materials are shown, which include the costs of seed material, fertilizer, protective agents, and packaging. They represent the largest part of the total production costs on the farm. The costs that stand out as the largest item within the material costs are the costs of packaging. In organic production, in addition to the fact that the product to be sold in large retail chains must meet certain standards in terms of appearance, some criteria must be met regarding the way the product is packaged. Therefore, it is very important that watering and irrigation are done on time so that the root keeps the correct shape for the appearance of the customers. Packages of organic carrots are small (250-300 grams, in some cases even 500 grams), and for this reason, a significant part of the investment goes to the purchase of packaging materials, so that the product looks nice and attracts the attention of customers. What is also specific about organic production and when it comes to costs, is the seed material, which is almost twice as expensive as in conventional production, and that part of the costs also significantly increases the total production costs. For the observed years on the farm in Kisač, material costs increased from year to year and in 2016 amounted to 5,772.00 euros, in 2017 they were higher and amounted to 6,457.00 euros, and in the last year of observation, in 2018 they amounted to 7,757.00 euros. The item that most affected the increase in costs from year to year was again packaging, for which larger quantities were needed due to higher yields.

Service costs. i.e. labor force on carrot production amounts to an average of around 1,200.00 euros. Other costs, in this case, storage of the product, amounted to 850 euros for five months for all three years of observation. The general expenses of the farm amounted to 1000 euros for all years of observation.

What, after packaging, represents a very high cost of production in organic production is labor costs. Extracting carrots is done manually and requires many workers. Just for harvesting carrots, the producer pays 100 daily wages to the workers for one season. Also, washing, sorting, stacking, and packing require a lot of attention and time to meet the criteria of the sellers. In the years of observation, there was also an increase in the daily wage for seasonal workers, so the costs of seasonal workers amounted to EUR 5,000.00 in 2016, EUR 5,400.00 in 2017, and EUR 6,000.00 in 2018.

The following table shows the financial result of carrot production in EUR, by observed years.

Table 3. Financial result in organic carrot production (in EUR).

Year	Production value	Total production costs	Financial result
2016.	25.000,00	13.822,00	11.178,00
2017.	27.000,00	14.927,00	12.073,00
2018.	30.800,00	16.827,00	13.973,00

The financial result of the business is determined as the difference between the realized value of production and the total costs during the business year. With this producer, the value of production was higher than the total cost of production in all three years of observation, which can be seen in Table 3. This means that a positive financial result was achieved, namely in 2016 EUR 11,178.00, in 2017 EUR 12,073.00, and in 2018 EUR 13,973.00. Due to the losses that are very common in organic production, the producer points out the production risk as the biggest problem in this type of production, because the plants are not treated with chemical means and therefore the influence of natural conditions, and above all the weather, on the production itself is even greater. Therefore, even if there is a profit on the farm, a realistic picture of the relationship between income and expenses is not shown, because a lot of money is needed to cover the losses in production.

To increase the profit, it is necessary to reduce the production costs or increase the price of carrots, in order to increase the production value. In this case, it would be best to reduce the material costs, because they have the largest share of the total costs.

The following table shows the coefficient of efficiency of carrot production by observed years.

Table 4. The efficiency of organic carrot production.

Year	Production value (EUR)	Total production costs (EUR)	Coefficient of efficiency
2016.	25.000,00	13.822,00	1.81
2017.	27.000,00	14.927,00	1.81
2018.	30.800,00	16.827,00	1.83

When we compare the value of production and the total production costs incurred in the production of carrots, we get the values of the efficiency coefficient, which are shown in Table 4. In the first two years, the efficiency coefficient on the farm was 1.81. This means that for every 100 euros invested, 181 euros of production value is realized. In 2018, the efficiency was slightly higher and amounted to 1.83, which means that 100 euros of invested funds generated 183 euros of production value.

By comparing the total costs of production and the price of carrots, the minimum amount of product that should be produced is obtained so that the farm would not be at a loss under these conditions. Therefore, the yield should be slightly more than 13.8 t/ha for 2016, 14.9 t/ha for 2017, and more than 15.3 t/ha for 2018 to cover production costs. The yield achieved above represents surplus value in its natural form.

The following table shows the degree of profitability of carrot production over observed years.

Table 5. The profitability of organic carrot production.

Year	Profit (EUR)	Production value (EUR)	The degree of profitability
2016.	11.178,00	25.000,00	44.71
2017.	12.073,00	27.000,00	44.72
2018.	13.973,00	30.800,00	45.37

The previous table shows the degree of profitability of production, which is obtained when the realized profit and the value of production are compared. In the observed years, production on the

farm was profitable, and the degree of profitability in the first two years was almost equal and amounted to 44.7%, and in 2018 it was 45.37%. The profitability rate calculated in this way shows the amount of realized profit for every 100 euros of the market value of production.

The following table shows the degree of labor productivity in carrot production by observed years.

Table 6. The labor productivity in organic carrot production

Year	The volume of production kg/ha	Hours of work invested	The degree of labor productivity
2016.	50.000,00	8.000,00	6.25
2017.	54.000,00	7.200,00	7.5
2018.	56.000,00	8.000,00	7

The degree of labor productivity is naturally expressed by comparing the volume of production and the hours of work invested.

The volume of production is obtained when the yield is multiplied by the total area. Since carrot production takes place in an area of 2 ha, and the yield of the main product was 25,000 kg/ha, 27,000 kg/ha, and 28,000 kg/ha by year, these values multiplied give the results shown in the table above.

In 2016, workers were paid 500 daily wages, which multiplied by 8 hours of work amounts to 4,000, and for 2 ha 8,000 hours of work. For 2017, this number is slightly lower because 450 daily wages were paid, so that is a total of 3,600 hours, which is 7,200 hours for 2 ha. For 2018, it is the same as for 2016, with 8,000 working hours.

The degree of labor productivity calculated in this way shows the amount of product obtained per unit of human labor. So, in 2016, 6.25 kg of carrots were obtained for one hour of work, in 2017, 7.5 kg, and in 2018, 7 kg of carrots.

To get a broader insight into the profitability of organic production, the obtained results were compared with the financial results of carrot production in a conventional production system. The farm in Begeč, municipality of Novi Sad, which produces carrots on 10 ha, and production indicators for 2017 were considered. The realized value of conventional carrot production per hectare for 2017 was EUR 11,420. The yield was 57,100 kg/ha, which is a very high yield compared to the average yield for carrots. The average price realized on the market is quite low and amounts to 0.20 EUR/kg.

The total production costs per hectare of carrots amounted to EUR 6,191, where the depreciation cost is EUR 510/ha. The largest item is the cost of materials, which amount to 2,612 EUR/ha, of which the most important item is the seed, which costs 748 EUR, and the cost of packaging, which amounts to 660 EUR. Gross personal income was 1,810 EUR/ha. The costs of mechanical services are taken from the price list of mechanical services in agriculture.

For 2017, a profit of EUR 5,229/ha was achieved. By comparing the value of production with the total costs of production, we get the efficiency of production, which in this case is 1.85, which means that in 2017, for every euro invested in the production of carrots, the farm earned EUR 1.85.

The degree of profitability of production is obtained when the realized profit and the value of production are put into a relationship. In this case, production on the farm was profitable, and the degree of profitability was 45.79%. The profitability rate calculated in this way shows the amount of realized profit for every 100 euros of the market value of production.

The degree of labor productivity is calculated by relating the volume of production to the hours of work invested. The volume of production, which is obtained when the yield is multiplied by the total area, is 571,000 kg.

In 2017, workers were paid 118 daily wages, which multiplied by 8 hours of work amounts to 944 hours of work per hectare, and for 10 hectares it is 9440 hours of work.

The degree of labor productivity calculated in this way shows the amount of product obtained per unit of human labor. So, in 2017, 60.5 kg of carrots were obtained for one hour of invested work.

From the aforementioned data, we can conclude that the yield in conventional production is much higher than in organic production, where in 2017 it was 33 t/ha, of which the main product

that was sold was only 28 t/ha. Compared with conventional production, we conclude that the yield is almost twice as low in organic production. Also, it is very important to note that there are no losses or secondary products in conventional production on this farm at all, but the entire achieved yield was sold at the price specified in the calculation.

However, the price of organic carrots is significantly higher and amounted to 0.90 EUR/kg, while for the observed year in conventional production, the price is very low and amounts to only 0.20 EUR/kg. This brings us to the value of production, which was 25,200 EUR for organic, and 11,420 EUR for conventional.

Profit was realized in both types of production, i.e. the value of the realized production was higher than the total production costs. The profit realized in organic production for 2017 was EUR 8,360, and in conventional production for the given year, the profit was EUR 5,229. In this case, the higher profit was achieved in organic production, which is primarily due to the very low price of carrots on the market when it comes to the conventional method of production, but also to the extremely high yield achieved in conventional production for the observed year.

It should be borne in mind that profits can be made in both production methods, but in Serbia, producers are still skeptical when it decides to engage in organic production. The main reason for this is the excessive risk that exists in this method of production, which primarily relates to weather conditions that can destroy crops, but also the danger of pests because organic products are not treated with chemical means.

The presented research results confirmed the assumption that premium prices are one of the main reasons for the profitability of the organic production system compared to the conventional one [17,12,43]. On the other hand, some authors [44] state that in certain conditions the production of selected vegetable crops is not economically competitive with conventional production. According to the mentioned authors, it can only be done through direct sales on the farm itself. According to Lazić et al. [33], the efficiency of vegetable growing is the result of the intensity of production, high individual and annual yields of a large number of species and varieties, and diverse biological properties, which enable intensive rotation of several species during the year, as well as the production of combined crops. This production is always more efficient if it is a closed system, balanced crop, and livestock production because the inputs are then reduced to a minimum. Bender et al. [45] state in their research that with the application of appropriate agricultural techniques, the yields of organic carrots can be equal to or even higher than the yields of conventional ones, which also affects the profit in the production itself. Of course, we should always keep in mind what Grgić et al. [44] state organic production is often complemented by other, supplementary activities in the rural area, such as agritourism.

4. Conclusions

The organic system of agricultural production has gained more importance in the past few decades. Numerous studies increasingly confirm the biological and ecological advantages of this production system compared to the conventional one. The economic effects of organic agriculture were the subject of analysis in scientific papers, but to a lesser extent than the previous two components. Agricultural producers must be familiar with the technical, technological, and economic effects of this production together with the marketing of organic products, to have positive economic results of production which contribute to the sustainability of this system of production on individual farms. Based on the case study of the economic analysis of carrot production on the farm in Kisač, which deals exclusively with organic production, it can be concluded that organic production in the Republic of Serbia can be economically efficient and that profits can be made with this type of production, but it is important to keep in mind risks that are characteristic for organic production. The specifics of agriculture, and especially the dependence on weather conditions, come to the fore in organic production more than in conventional production, because conventional production is subject to types of plant protection that are not allowed in organic, which is why it is easier to protect the crop from bad weather conditions, and thus ensure that the farm makes a profit.

As shown in the case study, organic production on the observed family farm brought profit in all three years of observation, but it is very important to point out that even if a profit was made on the farm when making conclusions about the efficiency of this production, one must also take into account losses that are not negligible and that require significant funds for their neutralization. To increase the profit, it is necessary to reduce the production costs or increase the price of the product, to increase the production value.

However, the analysis also showed that although the yields were lower in the organic system and the losses were higher, compared to the conventional system, thanks to the premium prices of carrots, organic production achieves a higher profit.

Conflicts of Interest: The authors declare no conflict of interest.

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