

ANALYSIS OF THE RESULTS OF MANAGEMENT OF PRODUCTIVE AND ECONOMIC RESOURCES ON ORGANIC FARMS SPECIALIZING IN BEEF CATTLE PRODUCTION

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Abstract: Competitiveness drives innovation, including in agriculture and the food economy. Organic farming, aligned with EU sustainability goals, responds to rising consumer demand for healthy food and environmental protection. It offers a viable option for small and medium-sized farms in the EU. This article examines resource management in organic beef cattle farms in Podkarpackie, Poland, from 2015 to 2021. Farms with over 20 cows had the highest beef production and income, while smaller herds earned less. Larger farms also faced significantly higher costs. However, profitability was not directly linked to herd size.

Keywords: Poland, organic farms, meat cattle production, economic resources management

1 Introduction

Competitiveness largely determines innovation in the modern economy, and this relationship also applies to agriculture and the food economy. In the agricultural sector, especially in the context of the implementation of the concept of sustainable development, production methods that effectively implement the assumptions of this approach are becoming increasingly competitive. Organic methods of agricultural production, which are based on management in accordance with the natural requirements of the soil, plants and animals, fit perfectly into the concept of sustainable development (Komorowska, 2009). Organic farming, in addition to producing high-quality foodstuffs, performs many important functions. It promotes the protection of groundwater and the preservation of the natural landscape, and supports the protection of biodiversity in both production areas and neighboring areas. In addition, organic farming effectively manages natural resources, contributing to the preservation of biological balance in the natural environment, and also supports the maintenance of soil fertility and the protection of the environment from pollution and contamination of agricultural origin (Oerly et al. 2022).

According to Feledyn-Szewczyk and Kopinski (2024), increased public awareness of the negative effects of modern economic and agricultural development is leading to increased consumer expectations for healthy food quality and environmental protection. In response to these needs, the European Union's Common Agricultural Policy focuses on improving the quality of food products, taking into account environmental protection. As a result, stringent requirements have been placed on farmers in recent years in areas related to environmental protection, animal welfare and food safety. One of the key elements of this policy is the promotion of organic agricultural production, which is justified both by the positive impact of organic farming on the environment and the growing demand for organic products (Başer, Bozoğlu 2023).

Today, organic production is becoming an important alternative for small and medium-sized farms in European Union countries. However, it is not an easy activity. The multiplicity of legal regulations, the need for record-keeping and control mechanisms require not only a high degree of consumer awareness, but also considerable expertise (Tyburski, Żakowska- Biemans 2007).

One of the specific activities within the organic farming system is raising beef cattle. Organic rearing of beef cattle is determined by a number of factors, which should be considered individually depending on what conditions a farm has. Large organic farms with a large acreage of meadows, especially pastures, where

animals can graze from spring to autumn, are predisposed to raising beef cattle, while it seems less effective to use this type of production on smaller farms with limited land resources (Kučević et al. 2023). In order to eliminate the use of mineral fertilization on permanent grasslands, it makes sense to raise ruminants on them in order to keep them in a high culture and obtain adequate yields. Raising beef cattle can help maintain the ecological function of grasslands, while also contributing to high-quality beef livestock. In recent years, permanent grasslands have been used for agricultural production only 60% of the time, which is a limiting factor for the source of the cheapest roughage (Szumiec et al. 2018).

A producer, engaged in raising meat cattle, should have knowledge of the trends currently occurring in the market. Raising beef cattle is a direction of production advisable for farmers who do not have a lot of capital, have little opportunity to receive cheap loans and have adequate agricultural land, while lacking cheap labor. Organic beef production based on pasture can be supported by EU subsidies for permanent grassland, as well as loans, which gives the opportunity to start the business with relatively low financial outlays (Szarek and Konopka, 2013).

By reducing the cost of feeding (maximum use of pasture), maintenance, as well as labor inputs, the chances of profitability of raising beef cattle are significantly increased. Winter feeding should be based on fodder produced on the farm (e.g. green fodder, hay, straw, root crops, cereals).

The development of the beef market at the national level should be supported by increasing its consumption, as well as providing better conditions for farmers engaged in this line of production, making it more efficient. The most important of the factors that have a significant impact on the growth, development, healthiness and productivity of beef cattle kept on organic farms is the diet. Of greatest importance is pasture feeding, which should be supplemented with hay and straw. At the end of the grazing period, it is recommended that calves be fed concentrate feed. In winter, on the other hand, feeding should be based mainly on roughage, with small amounts of concentrates and mineral supplements. In order to be able to talk about the profitability of raising beef cattle, it is necessary to reduce not only the cost of feeding, but also the labor input. This is only possible in breeding where pasture is maximally utilized and winter feeding is based on farm feed (Pomykała, 2011; Kilar et al. 2023).

Beef farms are characterized by a fairly large capital requirement, a sizable contribution of own funds, a small optimization of production, which is associated with the purchase of a fairly large number of animals and the simultaneous provision of an adequate feed base for them (Li and Wang 2023). Factors determining success in beef production can depend on or be independent of the farmer. The first group of factors includes the rate of fattening, the genetic value of the animals and the size of the herd, while the second group of factors includes the prosperity of the market, i.e. the purchase price of the raw material, which should cover the cost of producing livestock. The level of purchase prices is influenced by the situation on the EU market and the relationship of the zloty to the euro, as more than 80% of domestic production is exported (Balcerak, 2014).

Currently, Poland has a small number of beef cows and heifers, which contributes to its insignificant impact on the scale of beef production and quality. Calves for fattening, both in our country and in other European countries, are obtained primarily from herds of dairy cows (Neja, 2014). The efficiency of beef cattle breeding and production is determined approximately 60-65% by calf rearing and reproduction, 30-35% by rearing technology, and 5% by breed (Adamski and Greis, 2012; Terry et al. 2021).

2 Purpose and methods of the study

The purpose of the study was to analyze the results of the management of productive and economic resources on organic farms keeping beef cattle and specializing in the production of slaughter livestock in the Podkarpackie Province in 2015-2021. Production indicators of farms focused on raising beef cattle were analyzed. These were: production potential, assessment of production profitability and assessment of efficiency of the use of production factors.

The analysis of production performance was based on the compilation of data on labor inputs, agricultural land and capital resources. Assessment of production profitability was used to check the amount of income and costs earned by each farm group in relation to the average annual cow herd size. Evaluation of the use of factor efficiency consisted of comparing the amount of hours earned and land owned in a given cow herd size group with the amount of profit earned and beef livestock produced.

The empirical material for the study consisted of self-reported survey data from 42 individual certified organic farms keeping beef cattle and specializing in the production of slaughter livestock located in the Subcarpathian province. The size of the cow herd on the surveyed farms ranged from 3 to 35 head. The most numerous group were farms with a cow herd of 6 to 10 head. The smallest number of farms was in the group with more than 30 head of cows. The research was conducted in 2015 - 2021, and analyzed the parameters of the average annual number of beef cows, labor inputs, the amount of agricultural land, the amount of capital held, the amount of beef livestock produced, the income achieved and the costs. Farms for the purpose of the study were divided into groups, according to the criterion of the average annual number of meat cows. This division was considered appropriate, since the number of cows kept on the farm is the main factor for reproducing herd size. This is especially important on organic farms, where the ability to purchase animals from outside certified farms is fraught with procedures and a period of adjustment to the requirements for organic farms. The region covered in the study is southeastern Poland - the Podkarpackie Voivodeship.

The research used the technique of face-to-face interviewing, and questionnaires specially designed for the research in electronic form were used as a tool. Production intensity was measured by the amount of direct and total costs (PLN) incurred per hectare of farmland, and cost efficiency by the value of production obtained per 1 thousand PLN of costs incurred. With the help of indicators of land productivity (value of production in PLN/1 ha of agricultural land) and productivity of labor inputs (value of production in PLN/1AWU), as well as profitability (i.e. value of farm income in PLN/1 ha of agricultural land), the efficiency of farm production factors was determined. The share of subsidies in farm income (%) was analyzed. Basic measures of economic efficiency were calculated in accordance with the methodology adopted by the Institute of Agricultural and Food Economics - National Research Institute in Warsaw (Szumiec et al. 2018).

3 Test results

Traditional measures of farm size, include those based on measuring the three primary factors of production: land, labor and capital. Land is the primary factor of production, and is often a measure of farm size. When operating a business focused on raising beef cattle, land is the necessary feed area. Labor, on the other hand, is the intellectual and physical force that is the organizer and creative element of the production process.

Capital characterizes the objectified labor involved in the production process in the form of tools, machines, buildings and labor objects. Between the elements of the production process there are interactions often based on the principle of feedback. The appropriate arrangement of all the elements that make up the production process allows to achieve favorable economic results. Different proportions of the factors of production influence the

choice of the appropriate technology. The designated manufacturing techniques can be more earth-, labor- or capital-intensive or economical (Szarek J., 2023).

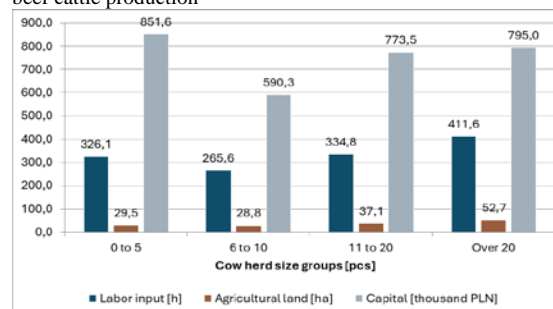
Production potential determines the amount of resources (productive forces) available to the farm that can be used for production. In addition, it determines production, income and development opportunities. An important element that co-determines the production potential of the agricultural sector is the number of people employed in it. This is because the level of employment affects labor productivity and efficiency.

The farms evaluated were characterized by labor inputs similar to their size. Slightly higher values were obtained by farms with the smallest number of cows. This was probably due to the low level of mechanization of work.

In terms of value potential, fixed assets come to the fore. They are a component of the technical equipment of farms. They are the material and technical base that makes production possible. On the degree of their use largely depends the volume of production achieved. The average level of equipment in fixed assets (capital) was in the range of 590.3 - 851.6 thousand zlotys. The amount of capital owned was shaped independently of the size of farms, the highest value was obtained by farms in the group with least number of cows. Similar results were obtained by (Szmidt 2016), who found that small organic farms had the highest level of fixed assets.

Figure 1 shows the average values of the production potential indicators of the surveyed organic farms specializing in beef cattle production.

Fig. 1: Characteristics of the average values of production potential indicators of the studied organic farms specializing in beef cattle production



Source: own elaboration

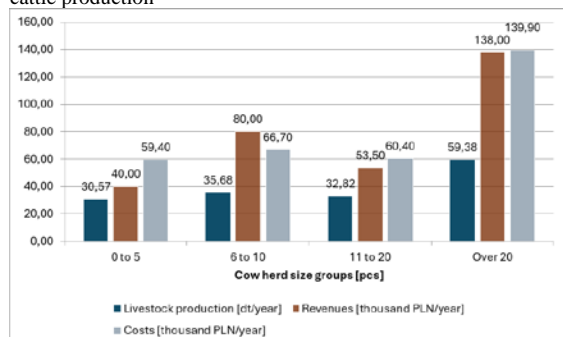
On the evaluated farms in the groups keeping more than 5 cows, the values of individual indicators increased with increasing herd size. The group of the smallest farms differed significantly from the other farms studied. The high involvement of labor inputs and the capital held may indicate the investments made to develop these farms. Analyzing the data in Figure 1, it should be noted the disproportionate ratio of the area of agricultural land of the smallest group of farms to the equipment in fixed assets. Statistical analysis, on the other hand, showed a high correlation between the size of agricultural land and the size of capital. In this case, agricultural land resources do not make a large contribution to capital. The interdependence between labor input and agricultural land size is moderate. It indicates a proportional degree of technical equipment of farms with productive means in relation to the scale of production. Due the larger scale of production on the other farms, the burden of 1 hectare of agricultural land on the cost of fixed assets compared to the small scale of production is significantly smaller.

The volume of beef livestock production, costs and income of organic farms were also evaluated. The results obtained were compared with those obtained from the entire pool of farms participating in the Polish FADN. (https://fadn.pl/wp-content/uploads/2023/04/Wyniki_2021_eko_czesc1.pdf as of 23.05.2024 pp. 58-64). According to the European System of

Accounting Data, in the 2021 fiscal year Polish organic farms obtained similar results to those obtained in this study.

Figure 2 shows the average values of production profitability indicators of organic farms specializing in beef cattle production.

Fig. 2: Characteristics of average values of production profitability indicators of organic farms specializing in beef cattle production



Source: own elaboration

Indicators of production profitability, profitability and the relative amount of costs were also evaluated. Table 1 shows the characteristics of the indicators of production profitability and the relative amount of costs on the surveyed organic farms specializing in beef cattle production in 2015-2021.

Tab. 1: Characteristics of the indicators of production profitability and the relative amount of costs on the studied organic farms specializing in the production of beef cattle

Cow herd size groups [pcs]	Livestock production [dt/year]	Revenues [thousand PLN/year]	Costs [thousand PLN/year]	Production profitability	Relative Cost Index
0-5	30,57	40,00	59,40	67%	149%
6-10	35,68	80,00	66,70	120%	83%
11-20	32,82	53,50	60,40	89%	113%
>20	59,38	138,00	139,90	99%	101%

Source: own elaboration

The profitability index provides information on the extent to which production revenues cover costs. This indicator was calculated based on the formula:

$$\text{Production profitability index} = \text{production/cost} \times 100.$$

On the surveyed farms specializing in beef cattle production under the organic farming system, for each herd size group, the production profitability rate was 67% (0-5 cows), 120% (6-10 cows), 89% (11-20 cows), 99% (over 20 cows), respectively.

The relative cost index indicates what percentage of total production is direct costs. This indicator was calculated based on the formula:

$$\text{Relative cost ratio} = \text{cost/production} \times 100.$$

On the surveyed farms specializing in beef cattle production under the organic farming system, the relative cost ratio for each herd size group was 149% (0-5 cows), 83% (6-10 cows), 113% (11-20 cows), 101% (over 20 cows), respectively.

The profitability index in only one of the groups of evaluated farms indicated that production costs were covered by income. This indicates the negative financial result of organic farms with both small and larger cow herds. Statistical elaboration of the data indicates moderate correlations between the volume of beef livestock production and the volume of income and costs. In contrast, the interdependence between the volume of income and the volume of costs is high. The group of farms with 6-10 cows shows an improvement in the economic result. The index of the relative amount of costs is also low for them. Farms in this group involving low financial outlays obtained a more favorable economic result in relation to the other groups, both those with

smaller and larger herds. The results obtained from larger farms are similar to those presented by Skarzynska et al (2008). It was indicated that increasing the scale of production brings positive financial results only if it is associated with adequate progress in production economics. This may indicate that the evaluated farms with larger cow herds have some limitations in this regard. These may be related either to the sources of inputs for production or to the sale and timing of beef livestock, the prices of which are prone to seasonal fluctuations. The farms with the smallest average annual cattle population achieved the lowest production profitability. The profitability index was relatively low, while the index of the relative amount of costs directly related to production was quite high.

The presented assessment of profitability, the magnitude of costs and revenues made it possible to assess the profitability, or as a result the unprofitability, of the production of the organic farms analyzed. During the research period, the results were certainly influenced by both the production potential of the farms, which includes the resources of land, human labor and capital, the way they are used, and dependence on external market and environmental operating conditions. In summary, these interactions resulted in varying degrees of change in the level of production, direct costs and earned income. Three of the four groups of farms (with a head of 1 to 5, 6 to 10 and more than 20 cows) achieved a negative financial result. One of the groups (with a head of 11 to 20 cows), represented by the largest number of farms (17), achieved a positive economic result. The results presented by Komorowska (2019) also indicate that farms oriented to raising slaughter cattle achieved a negative economic result. Only subsidies for the activity made it possible to offset the negative financial balance and increase economic efficiency.

The operation of a farm is possible due to the efficient use of the means of production, allowing, as a result, a source of income as well as the possibility of investment. The efficiency of the use of the farm's production factors: land, labor and capital can be determined by the productivity of land (which is determined by the value of production per unit area of agricultural land) and the potential of capital resources (fixed and current means of production, the value of which is represented by total assets).

The following economic efficiency indicators were used to determine the efficiency of factor use:

^ Land productivity (value of production/hectare of agricultural land),

^ Productivity of capital (value of output *100/total assets),

^ Asset yield (family farm income *100/total assets).

Tab. 2: The value of the land productivity index of the surveyed organic farms specializing in beef livestock production by farm group

Cow herd size groups [pcs]	Agricultural land [ha]	Revenues [thousand PLN/year]	Land productivity [PLN/year]
0-5	29,50	40,00	1355,93
6-10	28,80	80,00	2777,78
11-20	37,10	53,50	1442,05
>20	52,70	138,00	2618,60

Source: own elaboration

The above table shows the value of agricultural production per unit of agricultural land. The higher the value of the land productivity index, the more efficiently the agricultural land is used. There were no clear trends in individual groups adequate to the size of the farm. The difference between the weakest and best score was equal to PLN 1,421.85/ha of agricultural land (i.e. 51%). On farms with a weaker score, lower land productivity was due to the generation of low income, less intensive production was carried out there, and agricultural land resources were used less. A study of standard results by Juchniewicz and Zagaja (2023) on organic farms participating in the Polish FADN indicates that land productivity on farms oriented to livestock production was 1,464.84 PLN/ha and 30-50 hectare farms 1,432.15 PLN/ha, respectively. The company's own research indicates more favorable financial results obtained per hectare, that is, an average of PLN 2,066.86 in farms with an

acreage of up to 30 hectares and PLN 2,030.33 in the 37-52 hectare range.

Table 3 shows the value of the capital productivity index on the surveyed organic farms specializing in beef livestock production by farm group.

Tab. 3: Capital productivity (value of production x 100/total assets) on the surveyed farms specializing in organic beef livestock production

Cow herd size groups [pcs].	Revenues [thousand PLN/year].	Capital [thousand PLN].	Capital productivity [PLN/100 of total assets].
0-5	40,00	851,6	4,70
6-10	80,00	590,3	13,55
11-20	53,50	773,5	6,92
>20	138,00	795,0	17,36

Source: own elaboration

Productivity of capital determines the value of output per unit of capital used. To determine it, such measures of capital as the value of total assets, the value of fixed assets or the gross value of fixed assets are used in practice. The potential profitability of capital in agriculture, may differ from the actual profitability. The reason for this may be unused production resources. All fixed assets do not fully participate in the production process and for various reasons do not generate income. Current income is therefore realized only thanks to a certain portion of the used capital at the disposal of the farm. The data presented in Table 3. characterize the magnitudes of capital productivity of the studied organic farms. The discrepancies in the results indicate the varying investment resources spent on fixed assets and production technology. Low capital productivity was recorded in the group of farms keeping up to 5 head of meat cows and from 11-20 head of cows. Compared to farms in the other cow herd size groups, they generated significantly lower income in relation to the funds placed in equity. This could indicate the use of more capital-intensive production methods at the same time as low income.

Table 4 shows the profitability on the surveyed farms specializing in organic beef livestock production by farm group.

Tab. 4: Asset yield (income from family farm x 100/total assets) on surveyed farms specializing in organic

Cow herd size groups [pcs].	Revenues [thousand PLN/year].	Costs [thousand PLN/year].	Income [PLN].	Capital [thousand PLN].	Return on assets [%].
0-5	40,00	59,40	-19400,00	851,6	-228%
6-10	80,00	66,70	13300,00	590,3	225%
11-20	53,50	60,40	-6900,00	773,5	-89%
>20	138,00	139,90	-1900,00	795,0	-24%

Source: own elaboration

The data in Table 4 illustrate the effect of financial expenditures on fixed assets and the size of production-related costs on the total return in the form of income per asset yield. Most of the evaluated farm groups showed a negative financial result. Only one group with an average annual herd size of 6-10 cows per herd showed a positive economic result at an asset profitability level of 225%. Income on most of the organic farms surveyed did not allow them to exceed the profitability threshold. Many farms ended up with a negative financial result. These factors can be considered the main barriers to the development of this industry. In addition to the factors that directly affect the profitability of beef cattle production, the relationship of farms with the market, and the available forms of selling beef livestock, are important. The results of Kociszewski's (2014) study of sales channels for organic agricultural products indicate that among the most common forms of sales is farm direct trade accounting for 70%. (Rated as the most profitable). Just over

30% of farmers sell products through intermediaries to specialized buyers. The fewest farms supply wholesalers, producer groups and nearby stores. A barrier for beef cattle production is the low possibility of direct sales from the farm. What remains is trading with middlemen and receiving cattle through plants that specialize in slaughtering. Factors conducive to overcoming these constraints and at the same time a source of increased profitability for organic farms could be price increases, the development of processing systems and the development of more profitable distribution channels. These constraints are also related to consumer awareness and consumer confidence in products from organic farms.

Based on the results of the analysis of variance, Table 5 shows the dependence of production factors and production effects on farm size.

Tab 5: Dependence of production factors and production effects on farm size (results of analysis of variance) in the surveyed farms specializing in organic beef livestock production

Cow herd size groups [pcs].	Workload [h].		Agricultural land [ha].		Capital [thousands PLN].		Livestock production [kg/year]		Revenues [thousands PLN/year].		Costs [thousands of PLN/year].	
	x	SD	x	SD	x	SD	x	SD	x	SD	x	SD
0-5	326,1	66,9	29,5	15,2	851,6	420,2	3056,7a	990,3	40,0a	8,2	59,4a	21,7
6-10	265,6	131,0	28,8	15,8	590,3	583,3	3568,2a	1192,9	80,0b	30,19	66,7a	27,5
11-20	334,8	82,6	37,1	26,9	773,5	778,3	3282,4a	195,7	53,5a	45,0	60,4a	47,1
>20	411,6	94,4	52,7	7,9	795,0	67,9	5938,3b	1636,0	138,0c	28,8	139,9b	40,3
p												
	0,270		0,360		0,893		0,050*		0,010*		0,033*	

Source: own elaboration

The use of the one-way analysis of variance method, using the Fisher-Snedecor F test along with the assumption of a significance level of ≤ 0.05 , allowed us to reject the null hypothesis of no difference between the mean values. The same letter symbol next to the mean values indicates no significant difference between them in the NIR test (at $\alpha = 0.05$)

The results of the Fisher-Snedecor F-test (test probability values $p < 0.05$) indicate that the farm groups studied were significantly different from each other. The NIR test showed that livestock production is significantly higher on farms with more than 20 cows, compared to livestock production on the other farms. In contrast, earned income is highest on farms with more than 20 cows, significantly lower on farms with 6 to 10 cows, and lowest on farms with up to 5 cows and on farms with 11 to 20 cows. In addition, the study showed that annual costs are significantly higher on farms with more than 20 cows, compared to costs on other farms. The other analyzed variables (labor input, size of agricultural land, size of capital) were at similar levels in all the studied groups of farms.

Based on the value of Pearson's correlation coefficient, Table 6 presents an analysis of the interdependence between production factors and production effects on the studied organic farms specializing in beef livestock production.

Tab. 6: Interrelationships between production factors and production effects (Pearson's correlation coefficient values) in the surveyed farms specializing in organic beef livestock production

Specification	Workload	Agricultural land	Capital	Livestock production	Revenues	Costs
	<i>r</i>					
Workload	1,000	0,480* ¹⁾	0,175 ²⁾	0,406* ²⁾	-0,008 ¹⁾	0,118 ¹⁾
Agricultural land		1,000	0,776* ²⁾	0,433* ²⁾	0,410* ¹⁾	0,469* ¹⁾
Capital			1,000	-0,023 ²⁾	0,370 ²⁾	0,506* ²⁾
Livestock production				1,000	0,525* ²⁾	0,584* ²⁾

Revenues					1,000	0,850* ¹⁾
Costs						1,000

Symbol ¹⁾N = 19, ²⁾N = 15, symbol * indicates a significant correlation (at $\alpha = 0.05$)

Source: own elaboration

The results of the Student's t-test indicate that a significant correlation exists between labor input and agricultural land volume; labor input and beef livestock production volume; agricultural land volume and capital volume; agricultural land volume and beef livestock production volume; and beef livestock volume and revenue volume, among others.

Based on an analysis of the value of the correlation coefficient modulus "r", it should be concluded that the interdependence between the size of agricultural land and the size of capital, and the interdependence between the size of income and the size of costs is high. In addition, the interdependence between labor inputs and the size of agricultural land and the interdependence between labor inputs and the size of beef livestock production is moderate. The interdependence between the size of agricultural land and the size of beef livestock production is also moderate.

4 Summary

Organic farming, by its very foundation, focuses on the production of agricultural products of enhanced biological quality. When using conventional methods, this is not always fully paid attention to. It is common to strive to maximize productivity and profit putting residual effects on the environment in the background. Analysis of the productive and economic performance of farms is based on the need for rational use of all factors of production.

Beef livestock production was higher on farms with more than 20 head of cows. The volume of income was highest in the group of farms with an average annual number of cows above 20 head, and lowest in the groups of 0 to 5 and 11 to 20 head of cows in the herd. The size of costs was significantly higher in the group keeping more than 20 cows. No relationship was found between cow herd size and production profitability. Other variables (labor input, size of agricultural land, size of capital) were at a similar level in all groups of evaluated farms. Fluctuations in the level of the obtained production-economic results within each group of farms indicated the lack of influence of the scale of production on production-economic results. A comparison of factor productivity indicated that the productivity of land resources was relatively higher in medium-sized farms keeping an average of 6-10 cows per year. Production intensity was highest in the group of farms with 6-10 head of cows. Satisfactory profitability was obtained by relatively small farms (6-10 head of cows) compared to the other organic farms surveyed keeping beef cattle and specializing in slaughter cattle.

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