

**AGNIESZKA STRZELECKA, DANUTA ZAWADZKA**

Koszalin University of Technology, Poland

## **COST EFFECTIVENESS OF PRODUCTION – A COMPARATIVE APPROACH BY TYPE OF PRODUCTION**

Key words: cost effectiveness, individual farms, type of production

**ABSTRACT.** The purpose of this study is to determine the level of costs for individual commodity farms in Poland, indicate the importance of particular types of costs for shaping size changes in this economic category by type of farms and determine the relationship between costs and value of total production. The survey covered individual commodity farms in Poland. The basic source of data were statistics collected as part of the system for collecting and using accounting data from agricultural holdings (the Polish FADN). The data from 2013-2017 were used in the analyses. The research used the following categories of data made available by FADN: total production, total costs, intermediate consumption, direct costs, general economic costs, depreciation and costs of external factors. In the course of the research, it was shown that farms, regardless of the type of production, are characterized by high cost-intensity rates. The highest ratios are characteristic of farms specializing in the cultivation of herbivorous animals. The costs of agricultural activity in granivorous animal farms were higher than the value of production, hence the achievement of a positive agricultural income was possible through support received in the form of subsidies for operating activities. Regardless of the production direction, intermediate consumption had the highest share in the structure of farm costs.

### **INTRODUCTION**

Costs are labor input (remuneration for hired labor) and objectified labor (use of materials, raw materials as well as machinery and buildings) expressed in cash, necessary to achieve the objective, which, in farming, is creating an agricultural product or performing a production service [Wasilewski 2007]. A rationally managing agricultural producer, focused on income maximization, should select production factors with available technology and scientific and technical progress, in order to minimize the average cost of a production unit at a given sales volume [Skarżyńska 2010]. Tackling this research problem is important on cognitive grounds, because costs are one of the factors influencing the financial result of economic activity and the profitability of agricultural production (more on this topic in Kevin Natukunda et al. [2011], Amirmohsen Behjat and Aleck Ostry [2013], Petar Munćan et al. [2014], Agnieszka Strzelecka et al. [2018]). Research results indicate that the cost intensity of production is diversified, depending, among others, on the type of agricultural activity [Felczak 2011, Zawadzka et al. 2013] and on the size of the agricultural holding

[Dachin 2016, Sinisalo 2015]. Our previous research has shown that the highest share in the structure of total costs on commodity farms belongs to intermediate consumption (which includes direct costs and general economic costs), while the lowest – costs of external factors (salaries of hired employees, rent and interest) [Zawadzka, Strzelecka 2013]. These dependencies are similar for farms throughout the European Union. An average farm in the EU is characterized by a higher share of costs from external factors than in Poland, and a relatively lower share of intermediate consumption. The literature emphasizes that direct costs actually reflect the production efficiency of a business [Skarżyńska 2010]. They vary to a large extent depending on the type of agricultural production. The direct costs of crop production include: seed and planting material, purchased fertilizers, plant protection agents, growth regulators, insurance relating directly to a given activity, and specialized costs. The direct costs of livestock production include: animals (depending on particular activities) for livestock exchange, feed, rent for the use of fodder area leased for a period shorter than one year, animal insurance directly related to given activities, medicine and veterinary measures, veterinary services and specialized costs. Components of direct costs from outside the farm are determined based on purchase prices, while cost components produced on the farm are based on farm-gate sales prices. The exception, in case of livestock production, is own fodder from non-commodity products (e.g. maize silage), valued as the direct costs incurred to produce them. Each cost component is reduced by any subsidies granted [Skarżyńska, Jabłoński 2013]. The costs of machinery utilization have a significant impact on the costs of agricultural production. They consist of maintenance costs (depreciation, storage, insurance, costs of obtaining a loan, capital cost) and costs of use (costs of repairs, fuels and lubricants, costs of electricity and costs of auxiliary materials) [Zajac 2010]. In recent years, there have been significant changes in the technical equipment of farms. Therefore, it is important to learn about the current share of expenditure incurred in the process of utilization of technical equipment in agriculture. The results of the research presented in the literature indicate that the cost of machinery maintenance (depreciation, storage and insurance) prevails in the structure of operating costs of agricultural machinery [Kapela et al. 2016], and this high share of machinery use in the costs structure is primarily influenced by fuel costs [Grześ, Kowalik 2006]. The aim of the research is to determine the level of costs in individual commodity farms in Poland, to indicate the importance of particular types of costs for shaping changes in this economic category, broken down by type of farms, and determine the relationship between costs and the value of total production.

## MATERIAL AND METHODS

To achieve the study objective, a subjective, temporal and spatial research scope was assumed. The survey covered individual commodity farms in Poland. The basic source of data were statistics collected as part of the system for collecting and using accountancy data from agricultural holdings – the Farm Accountancy Data Network (the Polish FADN). These results are published in periodic studies of the Institute of Agricultural and Food Economics – the National Research Institute (IERiGŻ-PIB). Data from 2013-2017 were

used for analyses. The spatial scope of the study covered the entire country. Analysis of farms was based on the following agricultural types<sup>1</sup> [Floriańczyk et al. 2018]:

- field crops (mainly cereals, oil and high-protein plants for seeds and others),
- horticultural crops (mainly vegetables, strawberries, flowers and decorative plants),
- permanent crops (mainly fruit trees and shrubs, olive groves),
- dairy cows (dairy cattle, which is mainly kept for milk production),
- herbivorous animals (mainly cattle for slaughter, dairy cattle, goats, sheep),
- granivores (especially swine, poultry and animals fed with concentrates),
- mixed (includes farms that do not meet the requirements specified for specialist types).

All data presented in the study are average values for the groups of farms in question.

The following categories of data were used in the study [Floriańczyk et al. 2018]:

- total production – value of crop, animal and other agricultural production;
- total costs – all costs related to the operating activity of the agricultural holding and incurred for production in a given financial year;
- intermediate consumption – including direct costs and general economic costs;
- direct costs – those that are directly related to the production of: plants (e.g. seeds and cuttings, fertilizers, plant protection products), animals (e.g. animal fodder) and forestry production;
- general economic costs – including costs of maintaining machines and buildings, energy, services and other costs related to operating activities, which are not qualified as direct costs;
- depreciation of fixed assets;
- costs of external factors – costs related to the involvement of external factors (wages, rent and interest).

The aim assumed in this study was carried out using the following research methods: literature analysis, analysis of empirical data – using descriptive and comparative methods and statistical methods (average, stratum weights, dynamics indicators). The results of the analyses are presented in tabular and graphic form. The study presented in this paper included four basic stages. Firstly, changes in the level of total production generated in individual types of farms were determined as well as changes in the total costs incurred by these entities in 2013-2017. Next, the cost-intensity of production was assessed. For this purpose, the relation of total costs to the value of total production achieved in a given period was calculated. In the third stage of the research, the structure of costs related to farm operation was assessed, taking into account particular types of farming. The last stage included the assessment of the burden of production with direct costs and costs of external factors in individual agricultural holdings in Poland.

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<sup>1</sup> The agricultural type of a farm is determined based on the share of the value of Standard Output (SO) from individual agricultural activities in creating the total SO value of the farm [Floriańczyk et al. 2018]. In a situation whereby the share of one group of activities exceeds 2/3 of the total SO, the farm is classified as specialized, targeted at a given type of farming [Bocian et al. 2014]. Standard Output is the average value of production of specific agricultural activity (plant or animal) obtained within 1 year from 1 hectare or from 1 animal, in average production conditions for a given statistical region. When calculating this parameter, mean values from 5 years are taken into account [Goraj, Olewnik 2011].

### RESULTS

Data on the total value of production generated in each type of farm and the total costs incurred by these entities in 2013-2017 are presented in Figure 1. In the analyzed period, the highest value of agricultural products produced and the highest level of total costs were characteristic for farms specializing in breeding granivorous animals. In the years 2013-2017, the value of agricultural production for the group of entities in question was on average PLN 518.84 thousand and was nearly ten times higher than the level of production realized by herbivorous type farms. Similar conclusions are provided by cost analysis – their highest level was recorded for granivorous animal farms (average PLN 438.67 thousand), while the lowest for units specializing in herbivorous animals (PLN 56 thousand on average). For all agricultural types, the pace and direction of changes in the level of both economic categories included in the study (production and costs) were varied and no unambiguous trends were observed. It was found that regardless of production type, an increase in production was accompanied by an increase in production costs, while a decrease in the value of manufactured products was related to a reduction of costs incurred during this period (except for: field crops in 2014, herbivorous animals in 2015, when a reduction was recorded in production value with a simultaneous increase in costs, and for the permanent crops type in 2017 – a higher value of production was realized

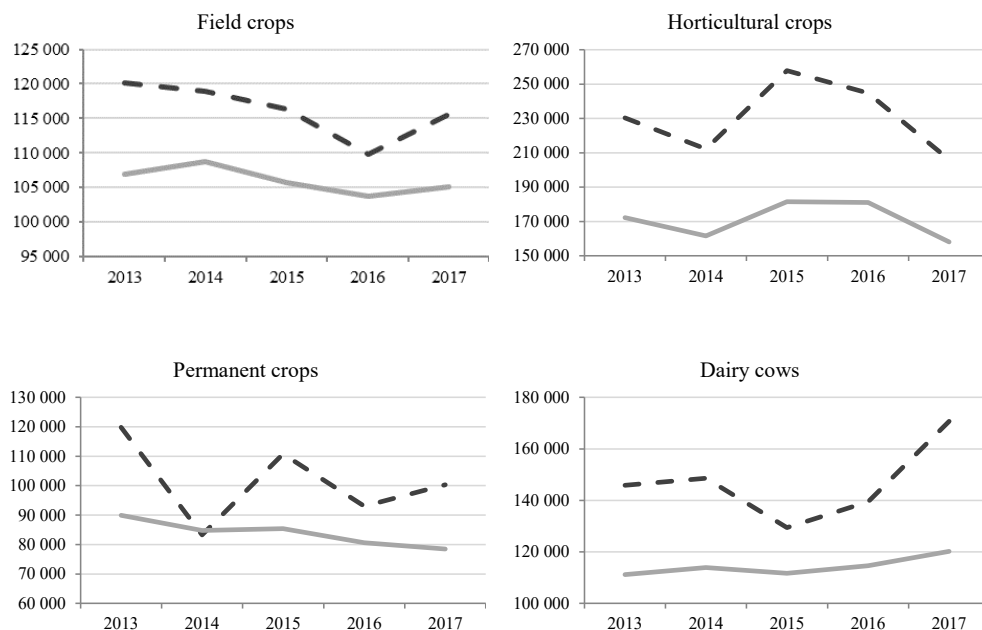
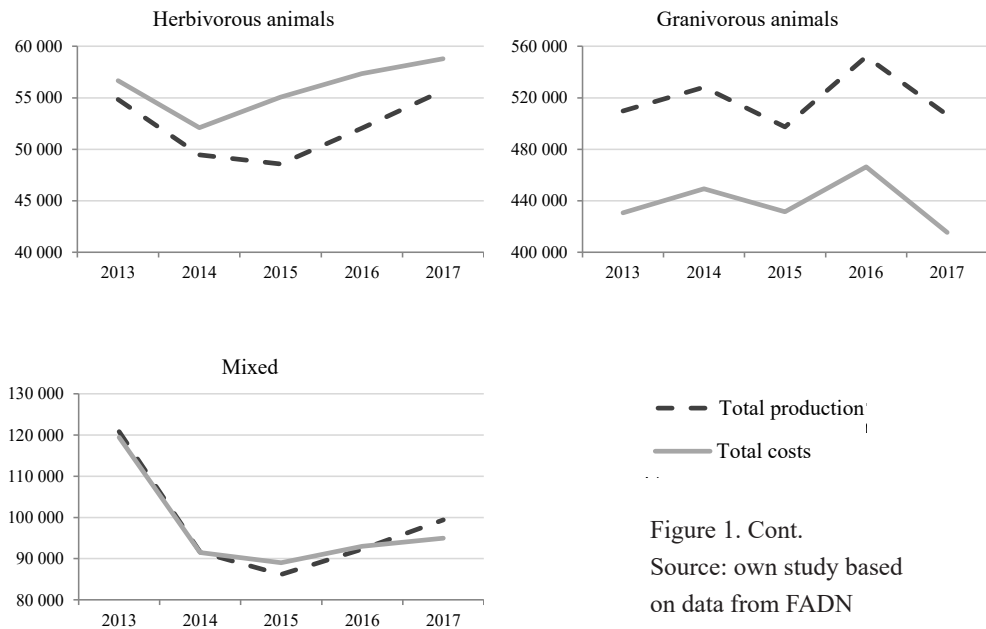


Figure 1. Total production value and total costs in individual commodity farms in Poland in 2013-2017 – including agricultural type [PLN]

Source: own study based on data from FADN



with a reduction of total costs). The next stage of the analysis included the evaluation of cost-intensity of production of researched farms (Table 1).

Farms are characterized by high cost-intensity. The highest level of the discussed indicator was characteristic for farms specialized in breeding herbivorous animals, where in the entire period covered by the analysis, the costs of conducting agricultural activity exceeded the value of production. If these farms had not received financial support in the form of subsidies for operational activities (including single area payments), the income

Table 1. The cost intensity of production in individual commodity farms in Poland in 2013-2017 – including agricultural type

Agricultural type	Cost intensity of production [%]				
	2013	2014	2015	2016	2017
Field crops	89.00	91.40	90.89	94.45	90.94
Horticultural crops	74.79	76.10	70.39	73.92	76.70
Permanent crops	75.02	101.78	77.09	86.66	78.21
Dairy cows	76.22	76.64	86.27	82.18	70.40
Herbivorous animals	103.34	105.32	113.36	110.19	105.58
Granivorous animals	84.49	85.08	86.72	84.51	81.96
Mixed	98.87	99.85	103.36	100.74	95.53

Source: own study based on data from FADN

Table 2. Cost structure in individual commodity farms in Poland in 2013-2017 – including agricultural type

Agricultural type	Cost category*	Cost structure [%]				
		2013	2014	2015	2016	2017
Field crops	TC	100.00	100.00	100.00	100.00	100.00
	TIC	69.05	68.72	67.08	66.24	65.61
	D	19.26	19.11	20.03	20.26	20.95
	TExF	11.69	12.17	12.90	13.50	13.44
Horticultural crops	TC	100.00	100.00	100.00	100.00	100.00
	TIC	68.70	68.94	70.47	69.12	68.34
	D	15.23	15.67	15.61	14.94	16.13
	TExF	16.07	15.39	13.93	15.94	15.54
Permanent crops	TC	100.00	100.00	100.00	100.00	100.00
	TIC	47.22	46.88	45.37	44.72	45.24
	D	34.50	36.13	35.90	37.27	38.28
	TExF	18.29	16.99	18.73	18.02	16.47
Dairy cows	TC	100.00	100.00	100.00	100.00	100.00
	TIC	74.62	74.80	73.38	73.13	74.17
	D	21.60	21.22	22.70	22.88	21.82
	TExF	3.78	3.98	3.92	3.99	4.01
Herbivorous animals	TC	100.00	100.00	100.00	100.00	100.00
	TIC	70.49	70.52	67.58	68.43	68.38
	D	25.47	25.64	27.96	27.05	27.29
	TExF	4.04	3.84	4.46	4.52	4.33
Granivorous animals	TC	100.00	100.00	100.00	100.00	100.00
	TIC	88.75	89.27	87.25	87.58	86.57
	D	7.69	7.33	8.92	7.72	8.51
	TExF	3.56	3.40	3.83	4.69	4.92
Mixed	TC	100.00	100.00	100.00	100.00	100.00
	TIC	74.97	74.87	73.50	72.76	72.72
	D	14.88	16.94	18.03	17.95	18.04
	TExF	10.15	8.19	8.47	9.29	9.24

\* TC – total costs, TIC – total intermediate consumption, D – depreciation TExF – total external factors  
Source: own study based on data from FADN

from the family farm<sup>2</sup> achieved in a given period would have had a negative value<sup>3</sup>. In the long run, however, this may have adverse consequences for the competitive situation of these farms, as it may result in a dependence on agricultural income support mechanisms. A high ratio of cost-intensity was also characteristic for farms with mixed production profiles

<sup>2</sup> Income from the family farm is a concept introduced by the FADN and is an economic surplus that remains for the farmer to pay for production factors (land, labor and capital) owned by the farm that are involved in its operational activity [Goraj, Olewnik 2011].

<sup>3</sup> On the basis of additional analyses, it was found that the average income from a family farm achieved by herbivorous animal farms in the whole period covered by the analysis was (on average) PLN 22.28 thousand in 2013-2017.

(the average level of the discussed indicator amounted to 99.67%, while in 2015-2016 the costs level exceeded the value of production) and farms specializing in field crops (average 91.34%). Thus, to a large extent, cost-intensity depends on the type of agricultural production. In the case of cereal crops, an increase in production intensity requires expenditures, for example in the form of mineral fertilizers. In turn, the lowest level of cost intensity was characteristic for entities specialized in horticultural crops (average 74.38%) and farms specializing in dairy cows (average 78.34%). Next, the structure of costs related to the operation of the agricultural holding was assessed (Table 2).

Regardless of the production type, the highest share in the analysed cost structure in the period covered by the analysis belonged to intermediate consumption. The significance of this cost category varied depending on the type of agricultural holding. Its highest share was observed in case of entities with a main production type in breeding granivorous animals (on average 87.88%). Next, were dairy cow farms (74.02%) and non-specialized units (73.76%, on average). In turn, the lowest values of the discussed indicator were characteristic for farms oriented towards permanent crops (on average 45.89%). The costs related to the depreciation of fixed assets were also significant for this group of holdings (on average 36.41%). In comparison, for granivorous animal type farms, depreciation accounted for an average of 8.4% of all costs related to agricultural production. It was also found that costs related to the involvement of external factors in

Table 3. Indicator of direct costs burden on production and the external factor cost burden on production in individual commodity farms in Poland in 2013-2017 – including agricultural type

Agricultural type	Years				
	2013	2014	2015	2016	2017
Indicator of direct costs burden on production [%]					
Field crops	37.45	38.07	37.80	38.67	36.01
Horticultural crops	29.82	30.77	30.43	31.26	30.37
Permanent crops	18.70	24.78	17.88	20.76	19.23
Dairy cows	38.59	38.78	42.90	40.83	35.09
Herbivorous animals	42.26	42.87	44.93	43.67	42.03
Granivorous animals	66.23	67.43	67.15	65.52	62.11
Mixed	50.48	50.88	52.14	50.15	46.91
Indicator of external factors costs burden on production [%]					
Field crops	10.40	11.12	11.72	12.75	12.22
Horticultural crops	12.02	11.71	9.80	11.78	11.92
Permanent crops	13.72	17.29	14.44	15.61	12.88
Dairy cows	2.88	3.05	3.38	3.28	2.82
Herbivorous animals	4.18	4.05	5.06	4.98	4.57
Granivorous animals	3.00	2.89	3.32	3.96	4.03
Mixed	10.04	8.18	8.75	9.36	8.83

Source: own study based on data from FADN

the production process are more important for farms oriented towards crop production (permanent crops – 17.7% on average, horticultural crops – on average 15.5% and field crops on average 12.74%), than for farms that specialize in animal production (dairy cows, herbivorous animals and granivorous animals), for which the share of the discussed cost category fluctuated around the average value of 4%. The last stage of the research consisted of the assessment of the burden of direct costs and costs of external factors on production in individual commodity farms in Poland (Table 3).

The highest indicator of the direct costs burden on production was noted for farms specializing in granivorous animals (average of 65.69% in 2013-2017). High indicators can also be seen in mixed farms (average 50.11%) and entities with herbivorous animal farms (average 43.15%). The highest burden of external factor costs on production can be seen in agricultural holdings specializing in plan production.

### SUMMARY AND CONCLUSIONS

The conducted study made it possible to formulate the following conclusions:

1. In the analysed period, the highest value of agricultural products and the highest level of total costs were characteristic for farms specializing in breeding granivorous animals.
2. Agricultural holdings, regardless of production type, are characterized by high cost-intensity indicators.
3. The highest production costs are characteristic for farms specializing in herbivorous animals.
4. Costs of agricultural activity in granivorous animal farms were higher than the value of production – thus, achieving a positive level of agricultural income was possible solely through the support received in the form of subsidies for operating activities.
5. Regardless of production type, the highest share in the structure of farm costs was attributed to intermediate consumption, and its importance varied depending on the type of agricultural holding.
6. Farms specializing in granivorous animals have the highest burden of direct costs on the production level.
7. The highest burden of external factor costs on production was recorded for entities that specialized in crop production.

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## KOSZTOCHŁONNOŚĆ PRODUKCJI – UJĘCIE PORÓWNAWCZE WEDŁUG KIERUNKU PRODUKCJI ROLNICZEJ

Słowa kluczowe: kosztouchłoność, indywidualne gospodarstwo rolne, typ rolniczy

### ABSTRAKT

Celem badań było określenie poziomu kosztów indywidualnych towarowych gospodarstw rolnych w Polsce oraz wskazanie znaczenia poszczególnych rodzajów kosztów dla kształtowania zmian wielkości tej kategorii ekonomicznej w podziale na typ gospodarstw rolnych. Określono także relację między kosztami a wartością produkcji ogółem. Badaniem objęto indywidualne towarowe gospodarstwa rolne w Polsce. Podstawowe źródło danych stanowiły statystyki gromadzone w ramach systemu zbierania i wykorzystywania danych rachunkowych z gospodarstw rolnych (Polski FADN). Do analiz wykorzystano dane dotyczące lat 2013-2017. W badaniu wykorzystano następujące kategorie danych udostępnianych przez FADN: produkcja ogółem, koszty ogółem, zużycie pośrednie, koszty bezpośrednie, koszty ogólnogospodarcze, amortyzacja oraz koszty czynników zewnętrznych. W toku badań wykazano między innymi, że gospodarstwa rolne, niezależnie od kierunku produkcji, charakteryzują się wysokimi wskaźnikami kosztouchłoności. Najwyższe relacje cechują gospodarstwa specjalizujące się w chowie zwierząt trawożernych. Koszty prowadzenia działalności rolniczej w gospodarstwach typu zwierzęta ziarnożerne były wyższe od wartości wytworzonej produkcji, dlatego osiągnięcie dodatniego dochodu rolniczego było możliwe przez uzyskane wsparcie w formie dopłat do działalności operacyjnej. Niezależnie od kierunku produkcji, najwyższy udział w strukturze kosztów gospodarstw rolnych miało zużycie pośrednie.

### AUTHORS

AGNIESZKA STRZELECKA, PHD  
ORCID: 0000-0003-4803-0092  
Koszalin University of Technology  
Faculty of Economic Sciences  
6E Kwiatkowskiego St., 75-343 Koszalin, Poland

DANUTA ZAWADZKA, DR HAB. PROF. KUT  
ORCID: 0000-0001-9353-5941  
Koszalin University of Technology  
Faculty of Economic Sciences  
6E Kwiatkowskiego St., 75-343 Koszalin, Poland