

## Costs and Profitability

### UNIT COSTS AND INCOME FROM SELECTED PRODUCTS IN 2017 – RESEARCH RESULTS IN THE AGROKOSZTY SYSTEM

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#### Abstract

*The main objective of the research was to present in 2017 the production and economic results of sweet lupine, fodder pea, field beans, soybean, cow's milk and beef cattle depending on the scale of their production. Research was held at commercial farms, which sell their production. These farms are enterprises. These farms were deliberately selected from a representative farm sample that was in the field of observation of the Polish FADN system. Data describing the researched agricultural products were collected in the AGROKOSZTY system, and then supplemented with data from the Polish FADN database.*

*The results of products were influenced by production capacity of farms, i.e. resources of land, labour and capital, their quality and the manner of use, but they were also dependent on external conditions (e.g. market, weather). These impacts resulted in varying degrees of changes in the volume of production, unit costs and price of products.*

*In 2017, the income from the surveyed agricultural products was within fairly wide limits. The positive impact of the size of the production scale was visible, although it appeared at various levels of analysis. Studies have shown that income without subsidies has ensured all plant products and milk production. On the other hand, the production of beef cattle on average in the research sample and on average in the separated ranges of the production scale was unprofitable. However, in each group there were farms in which the beef cattle production was profitable. It was mainly due to lower production costs.*

**Keywords:** unit costs, agricultural products, production scale, production profitability.

**JEL codes:** D24, O13, Q12.

## Introduction

In a market economy, costs are the main determinant characterising the thriftiness of enterprises and an important criterion for making management decisions. Achievement of the objective of maximising the economic surplus can be done by affecting revenues, but also costs. However, due to the barrier of demand and growing competition, the minimisation of costs is an important contribution to the improvement of production efficiency. Costs arise on the farm and are the result of decisions made there on (although their level may also be influenced by external factors, e.g. prices of means of production), therefore, it is possible to control them.

Due to changes occurring on agricultural markets resulting, *inter alia*, from the growing competition, producers are forced to increase both the efficiency of management and the scale of production. The increase in the scale, and thus the production volume, affects the size of sale revenues but also the costs incurred. Cost optimisation is a broad issue and it is not easy for the farmer to make the right decision regarding the intensity of production.<sup>1</sup> The farmer should take into account the level of technology, the adopted production technology, natural and economic conditions as well as the size and structure of inputs. These factors, at least to some extent, are related to the choice of production scale.

Farms operate in an environment subject to many changes, some of which are a consequence of human activities while others are accidental, beyond a man's influence. Due to the specificity of production processes in agriculture, time, which passes from the moment a decision is made to the placement of products on the market differs for plant production and for production of milk or live cattle. Therefore, costs are an important element of the profitability account, and the knowledge about their components and the existing relations both within them and between the area of revenues and income is helpful when running a farm.

The main objective of the research was to assess production and economic effects and to identify factors determining higher income from agricultural production activities (agricultural products<sup>2</sup>) studied in 2017. The level of incurred outlays and manufacturing costs was assessed, and attempt was also made to answer the question of whether the increase in the scale was economically justified. The degree of diversification of production profitability was also examined, both between groups of farms, i.e. scale ranges, and within them. The results obtained do not fully cover the issues concerning the profitability of production depending on the size of the scale, but they are a good illustration of the situation, despite the relative nature of the production volume, which was adopted as small, medium and large.

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<sup>1</sup> The volume of input of current assets per 1 ha or 1 animal indicates intensity in agriculture – see Manteuffel (1984).

<sup>2</sup> Depending on the context, the terms “agricultural production activities” and “agricultural products” are used interchangeably and these terms should be treated as identical.

## Subject and method of research

The subject of research were production and economic results of four plant production activities (sweet lupine, fodder peas, field beans and soya) and two animal production activities (dairy cows and slaughter cattle, i.e. live cattle). Empirical data characterising the studied activities was collected in 2017 on individual farms located throughout Poland. These farms were selected intentionally from a representative sample of farms which was in the field of observation of the Polish FADN. These were commodity farms that have greater development opportunities.<sup>3</sup> The selection of farms for the study of each activity was made independently. The condition was the scale of its production and the farmer's consent to carry out the research. Data describing the studied activities was collected according to the methodology of the AGROKOSZTY system (System Collecting Data on Agricultural Products). It was supplemented with data from the Polish FADN database, and then processed according to the developed assumptions.

The research covered revenues (value of potentially commodity production per 1 ha of crops, per 1 dairy cow and 100 kg of live cattle), costs and economic effects. The measure of assessment of the obtained effects were income categories (analysed without subsidies and after taking this support into account), i.e. direct surplus and income from activity; the method of their calculation is presented below:

direct surplus = value of production – direct costs,

income from activity = value of production – total costs (total direct and indirect).

Subsidies are an instrument supporting and stabilising farmers' income. The maximum amount of subsidies that farmers could receive, provided all the conditions were met, was calculated on the basis of data on the amount of subsidies received to the studied agricultural products on farms, where research was carried out, and the amounts of direct payments in 2017 complete with the rules for granting them. It should be added that the amounts of VAT owed and charged are not taken into account in the calculation of income from activity.

In the case of plant production activities, the **value of production** is the sum of the value of the main products (e.g. seeds) and by-products (e.g. straw) available on the market. It is determined according to the market sales prices or the farm-gate sales prices (i.e. on the farm). Thus, it depends on the size of plant yields and the sales price of the products. Losses are deducted from the value of production (created after the harvest, e.g. during cleaning). In the case of animal production, the structure of production value varies depending on the analysed activity. However, the product for which a given production is carried out is always referred to as the main one (e.g. milk). Independently, there may be a cattle increase (e.g. calves after weaning from a cow) and one or more by-products (e.g. culled animals). Losses are deducted from the value of production, i.e. mortalities occurring in the production process. It should be added that the value of manure and slurry produced on own farm is not taken into account when calculating the production value for animal production activities.

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<sup>3</sup> Farmers who run commodity farms, i.e. the ones whose production is intended for sale, have features typical of enterprises. Thus, farmers are essentially entrepreneurs – see Ziętara (2009).

The set of **direct costs** by which the value of production is reduced, is different for plant and animal production. Both sets reflect the costs incurred throughout the production cycle and depict the current market conditions. 12 consecutive months of the calendar year were adopted as the accounting period. Information on incurred outlays and direct costs in the case of plant production always refers to the area of the crop of the studied activity. Components of direct costs from outside the farm are determined according to the purchase price, and produced on the farm (e.g. seed material, own fodder from commodity products) – according to the farm-gate sales prices. The exception – in the case of animal production – is own fodder from non-commodity products (e.g. corn silage), which is valued according to direct costs incurred to produce them. The components of costs are reduced by the subsidies granted.

The rule regulating the inclusion of certain components of costs in direct costs is meeting the following three conditions, at the same time:

- these costs can be assigned to a specific activity without any doubt,
- their size is proportional to the scale of production,
- they have a direct impact on the size (volume and value) of production.

**Direct costs of plant production include:**

- seed and planting material (*purchased or produced on the farm*),
- fertilisers from purchase<sup>4</sup> (*without lime fertilisers*),
- plant protection products,
- growth regulators (rooting agents, growth substances, defoliant),
- insurance related directly to a given activity,
- specialist costs including:
  - specialised expenses on crop production,
  - specialist services,
  - occasional hire for specialist work.

**Direct costs of animal production include:**

- animals included in individual activities for the purpose of livestock replacement,
- fodder, which is divided into:
  - fodder from outside the farm (*mainly from purchase*),
  - fodder from own farm, which is divided into:
    - own fodder from potentially commodity products,
    - fodder from non-commodity products,
- rents for the use of fodder area leased for a period shorter than one year (*on UAA and on area not classified as UAA, e.g. mountain pastures*),
- insurance of animals relating directly to a given activity (*e.g. cows*),
- medicines and veterinary measures (*including semen for insemination*),
- veterinary services (*insemination, castration, preventive vaccinations*),
- specialist costs including:
  - specialised expenses on animal production,
  - specialist services,
  - occasional hire for specialist work.

<sup>4</sup> The cost of fertilisers from purchase also includes specialised fertilising taxes.

The accounts which they keep to calculate income from activity include direct and indirect costs. Direct costs are assigned to products directly, based on relevant source documents. On the other hand, **indirect costs** are taken from the Polish FADN database. Indirect costs can be defined as costs of production readiness, incurred for the functioning or only existence of a farms. Indirect costs of a farm are divided into real and estimated indirect costs (Goraj and Mańko, 2004).

**Real indirect costs include:**

- general economic costs – electricity, fuel, diesel fuel, current repairs, maintenance and inspections, services, insurance (e.g. of buildings, property and motor insurance), other costs, e.g. payment for water, telephone, lime fertilisers;
- taxes – agricultural, forestry, special sections, real estate and other, e.g. means of transport;
- costs of external factors – the cost of employed labour, rents and interest.

**Estimated indirect costs include depreciation of:**

- buildings and structures,
- machines and technical devices,
- means of transport,
- drainage devices,
- orchards and perennial plantations,
- intangible assets,
- completed investments in external fixed assets.

At the time of creation, indirect costs cannot be divided into products, they are costs common to the whole farm, and division keys are used to divide them. According to the applied methodology, indirect costs of a farm were divided into activities according to the share of the production value of each of them in the total value of production of the farm.

Tables presenting the research results also include data collected in the AGROKOSZTY system related to labour inputs (own and others) incurred for a given activity. This register allows for determining the labour intensity of production. In the case of plant production activities, it registers works related to pre-sowing soil preparation, maintenance and harvesting and drying grains. In the case of animal production activities, these are mainly works related to handling of the animals and giving fodder and incurred for the production of own non-commodity fodder. The register does not cover labour input which is related to the functioning of the farm as a whole. This applies to administrative work, general economic work or labour input expended on repairs of buildings or machines.

Income from activity is calculated on the basis of the number of working hours spent to produce individual products, without subsidies for 1 hour of family labour. It reflects the level of coverage of work input of a farmer and farmer's family members by income from 1 ha of crops or the production of 100 kg of live cattle. For the purposes of the analysis, family labour input was valued at the normative rate, determined on the basis of the average level of remuneration of people employed in the entire national economy in a given year (according to data of Statistics Poland),

assuming that one full-time worker is working in agriculture for 2120 hours a year. The parity payment for 1 hour of work calculated this way amounted to PLN 16.14 in 2017.<sup>5</sup> However, it should be borne in mind that the approach to the family labour inputs on individual farms in terms of value is always conventional.

The results of the studied production activities were presented on average in the research sample of farms and in groups classified according to the scale of their production. Horizontal analysis was used by comparing the parameters characterising individual farms in separate ranges of the scales. Three ranges of the scale were chosen for the analysis, i.e. small, medium and large. However, due to a rather small sample, the results for the fodder peas were presented only in two ranges of the scale (i.e. small and large), and the results for field beans and soya only on average in the research sample. The scale criterion used for plant products was the area of cultivation, for live cattle – the level of net production measured by the annual weight gain of the herd of slaughter cattle over the age of 1 (dairy and meat-dairy breeds), and for dairy cows – the scale criterion was the number of cows kept on the farm. When dividing the research sample of farms conducting particular activities into groups differing in the size of the production scale, the size of the sample and the distribution of the features which were the scale criterion were taken into account. The assumption was for the number of farms in the specified scale ranges to be as large as possible, the average level of the feature adopted as the scale criterion to be close to the median of this feature and the limits of the scale ranges to be tangent. These factors determined the choice of three or two ranges of the scale, consequently the number of farms in the specified ranges does not cover the entire research sample.

The size of the production scale ranges is relative which means that the size of the scale adopted as large can be considered small on farms with a different area structure and different production organisation. In addition, due to the targeted selection of the sample, the research results cannot be statistically generalised to all individual farms in the country. Nevertheless, they are a factor in the choice of the size of the scale which has a chance to ensure relatively high effectiveness of production. They also allow presenting certain phenomena and relations, and in this context provide a basis for formulating conclusions referring not only to the examined sample.

In a broader perspective, the research results were the subject of a publication by Skarzyńska and Abramczuk (2018) which discusses in great detail the production and economic situation of the studied agricultural production activities. In the article, the analysis of results is expressed in a synthetic manner. The results of calculations (in nominal values) are included in the tables. Due to the electronic data processing technique, in some cases the sums of components may differ from the total given.

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<sup>5</sup> Own calculations based on data of Statistics Poland.

## Research results

According to data of Statistics Poland (GUS, 2018), in 2017 the market conditions of agricultural production for the first time since 2011 were favourable for agricultural producers. This was caused by a significant increase in the prices of agricultural products sold by individual farms (17.0%), with a slight increase in the prices of goods and services purchased for the current agricultural production and for investment purposes (1.9%). In 2017, the index of price relations (“price scissors”) was favourable, amounting to 110.0%. These conditions influenced the economic results of the studied products.

In 2017, the cultivation of **sweet lupine** allowed for obtaining income from activity without subsidies, but its level was low (Table 1). On average in the sample with cultivation on the area of 5.75 ha, it amounted to 185 PLN/ha. The highest income was obtained by producers of lupine on small scale (1-2 ha) – 373 PLN/ha. Worse results were recorded for units cultivating lupine on large scale (10-50 ha) – 222 PLN/ha, and the worst on medium scale (4-8 ha) – 128 PLN/ha. The yield of sweet lupine in specified groups of farms was similar, ranging from 15.8 dt/ha to 16.6 dt/ha, while the sales price of seeds decreased along with the increase in the area of its cultivation. Producers of lupine on small scale obtained the highest price – 95.47 PLN/dt, on farms with a medium and large scale the price of seeds was lower, amounting to 81.70 PLN/dt and 80.76 PLN/dt, respectively. It is estimated that a part of the crop from farms cultivating lupine on small scale was sold in marketplaces where prices were higher than in purchasing centres (according to Statistics Poland – 2.2 times). Relatively high sale price of lupine in this group of farms determined higher revenues and had an impact on the level of income without subsidies.

Total costs incurred per 1 ha of lupine decreased with the increase of the scale. The lowest (1081 PLN/ha) were registered on farms cultivating lupine on large scale, compared to medium scale (1160 PLN) they were 6.8% lower, and to small scale (1209 PLN) 10.6%. The decrease in total costs was determined by decreasing direct costs, but also – in the case of cultivation of lupine on large scale – lower total indirect costs. To assess the efficiency of using the resources the research calculated the marginal cost of production of an additional unit, depending on the scale of production. The basis for calculating marginal and average unit costs were averaged results at the level of total costs. Medium scale was compared with small scale, and large scale with medium. The marginal analysis indicated that the increase in the scale of cultivation of lupine to medium (4-8 ha) and large scale (10-50 ha) was justified, but the results obtained for large scale were more favourable. In both ranges of the scale, the production intensity limit was not exceeded, costs were increasing more slowly than the value of production. An increase in the value of production by PLN 1 for medium scale would require an increase in costs of PLN 0.96, and for large scale – PLN 0.80. The results of the analysis show that lupine cultivated on large scale, in comparison to other ranges, were characterised by:

- high cost competitiveness – direct costs accounted for 49.2% of the generated direct surplus without subsidies, however, the advantage of large scale was small, in the case of medium scale these costs accounted for 50.6%, and small scale – 50.1%.
- relatively high economic efficiency – the profitability ratio was 120.6%, while with medium scale it was 111.0%, and with small scale – 130.9%.

The positive impact of the cultivation scale is visible at the level of (total) costs of 1 ha and production costs of 1 dt of seeds. The lowest unit costs were recorded on farms cultivating lupine on large scale – 66.98 PLN/dt, compared to medium scale (73.58 PLN/dt) they were 9.0% lower and to small scale (72.95 PLN/dt) – 8.2%. Unit costs of production of lupine seeds in the sale price on small scale accounted for 76.4%, while on medium scale – 90.1%, and large – 82.9%. This relation affected the amount of income without subsidies from growing 1 ha of lupine.

The research results indicate that income from activity without subsidies per 1 hour of family labour exceeded the parity rate of labour payment accepted for calculations (16.14 PLN/h) on average in the sample by 99.7%, while in the case of cultivation of lupine on small scale by 127.6%, on medium scale – 43.9%, and large – 173.7%.

In 2017, the producers of **fodder peas** generated income from activity without subsidies (Table 2). On average in a sample, with the cultivation of peas on an area of 3.26 ha, this income was 769 PLN/ha. In groups of farms differing in the scale of cultivation of peas, its size was similar. On small scale (1-2 ha), income without subsidies obtained from 1 ha was PLN 828, and on large scale (4-20 ha) – PLN 761. The amount of income was conditioned by revenues, and their level was strongly influenced by the price of seeds which in the case of small scale amounted to 96.05 PLN/dt and was 11.2% higher compared to large scale (86.36 PLN/dt). It is estimated that producers of peas on small scale, and thus having a smaller production volume, were looking for opportunities to sell seeds at a higher price. Probably part of the crops was sold in marketplaces where the price was much higher. According to unpublished data of Statistics Poland, in 2017 the average market price of fodder peas was 169.63 PLN/dt and was 2.3 times higher than the purchase price (75.15 PLN/dt). Total costs incurred per 1 ha of peas, on large scale of its cultivation (1,578 PLN/ha), compared to small scale (1,878 PLN/ha) were 16.0% lower. Their decrease was conditioned by lower direct costs (13.3%) and indirect costs (18.5%). The research results indicate that fodder peas grown both on a large and small scale were characterised by:

- high competitiveness in relation to incurred direct costs – on large scale these costs accounted for 48.6% of the generated direct surplus without subsidies, while on small scale – 48.4%,
- quite high economic efficiency – the profitability ratio on large scale was 148.2%, and on small scale – 144.1%.



The beneficial effect of influence of the size of the scale on the results of peas is visible at the level of cultivation costs of 1 ha and unit costs of seed production. With large scale, the production costs of 1 dt of seeds were 12.6% lower. The costs of generating PLN 1 of income from activity without subsidies were also lower – by 8.8%. The positive impact of the scale is also visible at the level of income from activity without subsidies per one hour of family labour. This income for large scale of cultivation of peas was 39.7% higher compared to small scale, and as a result the factor of the parity rate coverage was higher.

The results of cultivation of **field beans and soya** in 2017, due to the small number of farms participating in the research, were presented only on average in the research sample (Table 3). Both activities allowed obtaining income from activity without subsidies but its level was low. Field beans grown on an area of 5.26 ha provided income without subsidies in the amount of 410 PLN/ha, and soya with cultivation on the area of 6.62 ha – 533 PLN/ha. The factor which determined the amount of income was revenue, as a derivative of production and price results. In the case of field beans more favourable production results were recorded (the crop of field beans was 29.6 dt/ha, and of soya – 20.5 dt/ha), and in the case of soya – more favourable price results (the price of soya was 126.34 PLN/dt, and of field beans – 69.31 PLN/dt). The amount of income was also influenced by costs, their level per 1 ha of cultivation of field beans amounted to PLN 1,645, and per 1 ha of soya – PLN 2,052. The relation between the sales price and the unit cost of production had an impact on the amount of income. In the sample of farms cultivating field beans, this relation was 1.25, and in those cultivating soya, it was slightly more favourable – 1.26. As a result, the income from soya cultivation was higher (PLN 123 per 1 ha).

The research results show that on farms cultivating field beans, direct costs accounted for 56.2% of the generated surplus without subsidies, and on farms with soya – 50.5%. This means that the efficiency of using inputs of means of production – which express direct costs in terms of value – was greater in the case of soya cultivation. Thus, soya was more competitive in relation to the direct costs incurred. In 2017, cultivation of field beans and soya was economically efficient, the profitability ratio was 124.9% and 126.0%, respectively. However, there were units, in both groups of farms, where the limit of production profitability was not exceeded (their percentage was 21.7% and 26.7%, respectively). It should be added that income without subsidies per 1 hour of family labour exceeded the parity rate of labour payment (16.14 PLN/h) in the case of soya 5.1 times, and in the case of field beans 3.7 times.

In 2017, **milk production** allowed for obtaining income, however, its level per 1 cow significantly differed depending on the stocking density on the farm (Table 4). The best results were obtained by large-scale milk producers (55-140 cows), income without subsidies was 3,542 PLN/cow. In the production of milk on medium scale (25-45 cows), this income was 26.0% lower – it amounted to 2,622 PLN/cow. On small scale (5-15 cows), income without subsidies was 1,655 PLN/cow, and it was 36.9% lower compared to medium scale, and 53.3% – to large scale. The relation between the amount of income and the number of cows on the farm is clear.

The factor stimulating higher revenues (production value) and income growth was the milk yield of cows. It should be noted that the milk yield of cows, the price of milk, but also the cost of keeping 1 cow increased along with the size of the herd. However, the increase in revenues was stronger than the increase in costs: 8.7 pp in the case of medium scale, and 6.5 pp for large scale. As a result, an increase in income was recorded.

The marginal analysis showed that the increase in costs was justified, but the intensification of milk production on farms keeping large herds of cows (55-140 head) was more favourable. In the case of medium scale (25-45 cows), the increase in milk yield of 1 litre required an increase in costs of PLN 1.09, which was the level of average unit cost. However, with the production on large scale, the marginal cost of producing 1 litre of milk was PLN 0.99 and was 2.9% lower than the average unit cost (PLN 1.02). It should be added though that in both groups of farms the intensity limit was not exceeded, costs increased more slowly than the production value. Its increase by PLN 1 required an increase in costs in the case of medium scale of PLN 0.70, and large scale of PLN 0.65.

The beneficial effect of the scale is also the decreasing share of costs in the price of 1 litre of milk, which was 88.6% in the case of small scale, 79.0% on medium scale, and 73.4% – large scale. An increase in income without subsidies per 1 litre of milk was also recorded along with the increase in the scale. In the case of medium scale, compared to small scale, this income was 29.4% higher, and on large scale compared to medium scale – 13.6%. The positive impact of the production scale is clear; milk production on large scale was characterised by the highest:

- cost competitiveness – direct costs accounted for 54.5% of the direct surplus without subsidies, while on medium scale – 61.8%, and small scale – 59.2%,
- economic efficiency – the profitability ratio was 148.8%, on medium scale – 140.7% and small scale – 131.2%.

A positive result of specialisation of production was also lower labour input per 1 cow. Its lower level ensured higher income from activity without subsidies for 1 hour of family labour, and then a full payment for work of a farmer on farms producing milk on a medium and large scale. In the case of milk production on small scale, this was possible only in 56.4%.

In 2017, on average in the research sample and in the specified ranges of the scale, the production of **live cattle** was unprofitable (Table 5). Revenues did not provide full coverage of the costs incurred. The research results, however, refer to the average annual price conditions and do not fully reflect changes which occurred in the whole year, e.g. in the prices of feed or prices of live animals. Therefore, the interpretation of results cannot be unambiguous as the research sample included units where live cattle was profitable (these farms accounted for 31.0%).

On average in the sample, the loss on the level of income without subsidies calculated per 100 kg of live animals was PLN 58, while on small scale of production (10-30 dt) it was PLN 222, medium scale (40-80 dt) – PLN 68, and large scale (100-400 dt) – PLN 15. The main factor determining a specific level of profitability of live cattle were production costs. A decrease in revenues and costs was recorded

along with the increase in the scale. However, the dynamics of cost decrease was stronger, 15.9 pp on medium scale, and 7.2 pp on large scale. Stronger decrease in costs resulted in an increasingly smaller loss on income without subsidies and an increase in profitability expressed as a percentage relation between revenues and costs. The profitability ratio on average in the sample was 92.0%, and in subsequent scale ranges, starting from small, it amounted to 75.5%, 90.6% and 97.8%.

On average in the specified scale ranges, production of live cattle was not profitable, but the positive impact of the production scale is visible. This is proven by:

- A decrease in total costs of producing PLN 1 of production value, these costs on small scale of live cattle production amounted to PLN 1.32, on medium scale – PLN 1.10, and large scale – PLN 1.02;
- A decrease in the cost of generating 1 PLN of direct surplus without subsidies, these costs were the highest with the production on small scale – PLN 3.96, while on medium scale – PLN 2.39, and large scale – PLN 1.71;
- An increase in direct surplus without subsidies per 1 hour of total labour input, this surplus in the case of small scale of production was PLN 8.80, while on medium scale – PLN 15.72, and large scale – PLN 20.60.

The research results show that the increase in the scale to medium and large was economically justified. This is evidenced by the marginal cost of increasing production by 1 kg, which was lower than the average cost, thus causing its decrease. In the case of medium scale, the marginal cost was 14.7% lower than the average, and with large scale – 5.0%. In both groups of farms, the marginal cost was also lower than the limit cost, i.e. the sale price of live animals. The limit of production intensity was not exceeded which means that the costs were increasing more slowly than the production value.

Despite the unfavourable situation, there were farms in every scale range where live cattle was profitable. It was mainly determined by lower production costs. On average, on these farms the production profitability ratio was 120.8%, and the income from activity without subsidies – 120 PLN/100 kg of gross live animals.

### Summary

The scale of production is an important factor determining the economic effects of producing agricultural products. Larger size of production allows generating higher income, forces the use of labour-saving techniques and more intensive technologies for the production of agricultural products and has an impact on the reduction of unit labour input due to its substitution by material inputs. The managerial skills of farmers grow along with the growth in the production scale.

The accounts of costs and revenues presented in the study indicate profitability or unprofitability of the agricultural products studied. The results were affected by the production potential of farms, i.e. land, labour and capital resources, but also external operating conditions, e.g. market or weather conditions. As a result, these impacts resulted in a different degree of change in the level of production, unit costs and prices for agricultural products in the specified groups of farms.

In 2017, the cultivation of sweet lupine, fodder peas and field beans and soya, on average in the specified groups of farms was profitable, but the income obtained from production, i.e. without the support of subsidies, was low. Producers of peas were in the most favourable situation, on average in the sample income without subsidies it amounted to 769 PLN/ha, while income obtained from the cultivation of soya and field beans was 30.7% and 46.7% lower, respectively (it amounted to 533 and 410 PLN/ha), and from the cultivation of sweet lupine 75.9% (it amounted to 185 PLN/ha). Under these circumstances, the support of subsidies was of great importance. Producers of peas received PLN 1.91 to PLN 1 of income without subsidies, while in the case of field beans – PLN 3.55, soya – PLN 2.72, and lupine – PLN 7.84. The scale of cultivation of fodder peas and sweet lupine had an influence on the amount of income, but its level was low (in the case of field beans and soya, no ranges of the scale were specified due to a small sample). However, positive impact of the scale is visible, the costs of cultivation of 1 ha and of production of 1 dt of seeds with large scale were the lowest, and income from activity without subsidies per 1 hour of family labour was the highest. This income ensured full coverage of family labour inputs valued at the parity rate (16.14 PLN/h) in all groups of farms cultivating sweet lupine, pea fodder, field beans and soya.

In 2017, milk production was profitable. The research results indicate that the amount of income per 1 cow was dependent on the number of cows in the herd, which means that the best results were obtained by large-scale milk producers. The factor stimulating higher revenues and income growth was the milk yield of cows. In broader terms, it should be noted that the profitability of milk production is the result of four main conditions, i.e. the size of the cow herd, unit milk yield, milk production costs and the price of its purchase. Milk yield of cows, the price of milk and the cost of keeping 1 cow increased along with the size of the herd. However, the increase in revenues was larger than the increase in costs, and as a result there was an increase in income. The beneficial effect of the scale is visible, as evidenced by the decreasing share of costs in the price of milk (on small scale – 88.6%, medium scale – 79.0%, and large scale – 73.4%) and increase in income without subsidies per 1 litre of milk (on small scale – PLN 0.34, medium scale – PLN 0.44, and large scale – PLN 0.50). Milk production on large scale was also characterised by the highest cost competitiveness and economic efficiency. Gradually, family labour input per 1 cow decreased along with the increase in the scale, and as a consequence the level of its payment increased.

The income situation of production activities is determined by relations between the sale price of products and the unit cost of their production. In 2017, these relations were unfavourable for the producers of live cattle, hence on average in the specified ranges of the scale production of beef was unprofitable. Revenues (production values) only partially covered (total) costs incurred, the coverage rate on average in the research sample was 92.0%, while in the case of small scale of production of live cattle – 75.5%, medium scale – 90.6%, and large scale – 97.8%. The favourable effect of the scale of production is visible, it is also demonstrated by the decrease in production costs of PLN 1 of production value and PLN 1 of direct

surplus without subsidies. Despite the unfavourable situation, there were farms in every range of the scale where the production of live cattle was profitable. Lower production costs mainly contributed to this.

Summing up, it should be noted that in 2017 the level of income provided by the studied activities was within quite broad range. This was caused by a different degree of changes in the size of production, unit costs, as well as the prices of production of individual products. However, the positive impact of the scale of production was visible. Orientation of production and specialisation help in achieving the goal of obtaining income at a sufficiently high level. The size of production is important from an economic point of view, because in the absence of direct impact on prices, the farmer can decide on the production volume by determining its scale (e.g. cultivation area), at the same time taking into account effective use of production factors owned (i.e. land, labour and capital). When making decisions, various options should be assessed, because each choice has certain consequences. Cost analysis allows making economic decisions on the basis of reasonable criteria.

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**References**

- Goraj, L., Mańko, S. (2004). Systemy monitorowania sytuacji ekonomicznej i produkcyjnej gospodarstw rolnych. In: L. Goraj, S. Mańko, R. Sass, Z. Wyszowska, *Rachunkowość rolnicza* (pp. 12-91). Warszawa: Difin.
- GUS (2018). *Rolnictwo w 2017 r.* Warszawa: GUS.
- Manteuffel, R. (1984). *Ekonomika i organizacja gospodarstwa rolniczego*. Warszawa: PWRiL.
- Skarżyńska, A., Abramczuk, Ł. (2018). *Wyniki ekonomiczne wybranych produktów rolniczych w 2017 roku*. Warszawa: IERiGŻ-PIB.
- Ziętara, W. (2009). Rachunek kosztów w przedsiębiorstwach rolniczych w teorii i praktyce. *J. Agribus. Rural Dev., No. 2(12)*, pp. 303-309.

Table 1

*Production, costs and revenues obtained from the cultivation of sweet lupine in 2017 (real data)*

Specification		On average on farms growing sweet lupine	Depending on the scale of cultivation (ha/farm)		
			1-2	4-8	10-50
The number of farms in the study		163	38	49	24
Area of cultivation	(ha/farm)	5.75	1.35	5.52	17.69
Crop of seeds	(dt/ha)	15.8	16.6	15.8	16.1
Sale price of seeds	(PLN/dt)	83.33	95.47	81.70	80.76
<b>Per 1 ha of cultivation</b>					
<b>Total production value</b>	<b>(PLN)</b>	<b>1315</b>	<b>1583</b>	<b>1289</b>	<b>1304</b>
of which: seeds		1315	1583	1289	1304
<b>Total direct costs</b>	<b>(PLN)</b>	<b>454</b>	<b>528</b>	<b>433</b>	<b>430</b>
of which: seed material		192	240	194	181
total mineral fertilisers		125	167	122	96
foreign organic fertilisers		6	1	-	12
plant protection products		96	97	90	90
growth regulators		17	13	21	17
other		18	9	6	34
<b>Direct surplus without subsidies</b>	<b>(PLN)</b>	<b>861</b>	<b>1055</b>	<b>855</b>	<b>874</b>
Real indirect costs <sup>a</sup>	(PLN)	330	373	372	303
<b>Gross added value from activity</b>	<b>(PLN)</b>	<b>531</b>	<b>682</b>	<b>483</b>	<b>571</b>
Depreciation	(PLN)	259	265	249	262
including: buildings and structures		73	97	93	60
machines and devices		93	76	70	111
means of transport		86	91	79	88
<b>Net added value from activity</b>	<b>(PLN)</b>	<b>272</b>	<b>417</b>	<b>234</b>	<b>309</b>
Cost of external factors	(PLN)	87	44	106	87
<b>Income from activity without subsidies</b>	<b>(PLN)</b>	<b>185</b>	<b>373</b>	<b>128</b>	<b>222</b>
Subsidies <sup>b</sup>	(PLN)	1450	1481	1456	1439
<b>Income from activity</b>	<b>(PLN)</b>	<b>1636</b>	<b>1855</b>	<b>1584</b>	<b>1662</b>
<b>TOTAL COSTS</b>	<b>(PLN)</b>	<b>1130</b>	<b>1209</b>	<b>1160</b>	<b>1081</b>
Total labour input	(h)	5.8	10.4	5.6	5.1
including: family labour input		5.7	10.2	5.5	5.0
<b>Economic efficiency ratios</b>					
Total costs per 1 dt of seeds	(PLN)	71.60	72.95	73.58	66.98
Total costs per PLN 1 of income from activity without subsidies	(PLN)	6.10	3.24	9.05	4.86
Income from activity without subsidies per 1 dt of seeds	(PLN)	11.73	22.52	8.13	13.77
Income from activity without subsidies per 1 h of family labour input	(PLN)	32.23	36.73	23.23	44.18
Subsidies per PLN 1 of income from activity without subsidies	(PLN)	7.84	3.97	11.36	6.47
The share of subsidies in activity	(%)	88.7	79.9	91.9	86.6

<sup>a</sup> Real indirect costs without the cost of external factors.

<sup>b</sup> Subsidies include: payment for protein crops, single area payment, greening payment and additional payment. [-] – means that the phenomenon did not occur.

Source: prepared on the basis of own research.

Table 2

*Production, costs and revenues obtained from the cultivation of fodder peas in 2017 (real data)*

Specification		On average on farms growing fodder peas	Depending on the scale of cultivation (ha/farm)	
			1-2	4-20
The number of farms in the study		85	40	23
Area of cultivation	(ha/farm)	3.26	1.54	6.63
Crop of seeds	(dt/ha)	28.0	28.2	27.1
Sale price of seeds	(PLN/dt)	88.65	96.05	86.36
<b>Per 1 ha of cultivation</b>				
<b>Total production value</b>	<b>(PLN)</b>	<b>2480</b>	<b>2705</b>	<b>2339</b>
of which: seeds		2480	2705	2339
<b>Total direct costs</b>	<b>(PLN)</b>	<b>810</b>	<b>882</b>	<b>765</b>
of which: seed material		325	336	322
total mineral fertilisers		288	314	268
foreign organic fertilisers		-	-	-
plant protection products		186	219	172
growth regulators		5	0	2
other		6	12	1
<b>Direct surplus without subsidies</b>	<b>(PLN)</b>	<b>1670</b>	<b>1824</b>	<b>1574</b>
Real indirect costs <sup>a</sup>	(PLN)	401	472	353
<b>Gross added value from activity</b>	<b>(PLN)</b>	<b>1269</b>	<b>1352</b>	<b>1220</b>
Depreciation	(PLN)	336	379	278
including: buildings and structures		93	102	68
machines and devices		119	135	112
means of transport		122	141	96
<b>Net added value from activity</b>	<b>(PLN)</b>	<b>933</b>	<b>972</b>	<b>942</b>
Cost of external factors	(PLN)	164	145	181
<b>Income from activity without subsidies</b>	<b>(PLN)</b>	<b>769</b>	<b>828</b>	<b>761</b>
Subsidies <sup>b</sup>	(PLN)	1465	1474	1452
<b>Income from activity</b>	<b>(PLN)</b>	<b>2234</b>	<b>2302</b>	<b>2212</b>
<b>TOTAL COSTS</b>	<b>(PLN)</b>	<b>1711</b>	<b>1878</b>	<b>1578</b>
Total labour input	(h)	7.1	9.1	6.1
including: family labour input		7.0	8.9	5.9
<b>Economic efficiency ratios</b>				
Total costs per 1 dt of seeds	(PLN)	61.17	66.67	58.28
Total costs per PLN 1 of income from activity without subsidies	(PLN)	2.23	2.27	2.07
Income from activity without subsidies per 1 dt of seeds	(PLN)	27.48	29.39	28.09
Income from activity without subsidies per 1 h of family labour input	(PLN)	110.57	92.75	129.60
Subsidies per PLN 1 of income from activity without subsidies	(PLN)	1.91	1.78	1.91
The share of subsidies in activity	(%)	65.6	64.0	65.6

<sup>a</sup> Real indirect costs without the cost of external factors.

<sup>b</sup> Subsidies include: payment for protein crops, single area payment, greening payment and additional payment. [-] – means that the phenomenon did not occur.

Source: prepared on the basis of own research.



Table 3

*Production, costs and revenues obtained from the cultivation of field beans and soya in 2017  
(real data)*

Specification	On average on farms growing	
	field beans	soya
The number of farms in the study	23	30
Area of cultivation (ha/farm)	5.26	6.62
Crop of seeds (dt/ha)	29.6	20.5
Sale price of seeds (PLN/dt)	69.31	126.34
<b>Per 1 ha of cultivation</b>		
<b>Total production value (PLN)</b>	<b>2054</b>	<b>2585</b>
of which: seeds	2054	2585
<b>Total direct costs (PLN)</b>	<b>739</b>	<b>867</b>
of which: seed material	246	357
total mineral fertilisers	260	316
foreign organic fertilisers	-	-
plant protection products	232	143
growth regulators	0	12
other	2	39
<b>Direct surplus without subsidies (PLN)</b>	<b>1315</b>	<b>1718</b>
Real indirect costs <sup>a</sup> (PLN)	483	556
<b>Gross added value from activity (PLN)</b>	<b>832</b>	<b>1162</b>
Depreciation (PLN)	343	473
including: buildings and structures	71	71
machines and devices	132	232
means of transport	139	162
<b>Net added value from activity (PLN)</b>	<b>489</b>	<b>689</b>
Cost of external factors (PLN)	80	156
<b>Income from activity without subsidies (PLN)</b>	<b>410</b>	<b>533</b>
Subsidies <sup>b</sup> (PLN)	1454	1450
<b>Income from activity (PLN)</b>	<b>1863</b>	<b>1983</b>
<b>TOTAL COSTS (PLN)</b>	<b>1645</b>	<b>2052</b>
Total labour input (h)	7.1	6.5
including: family labour input	6.8	6.4
<b>Economic efficiency ratios</b>		
Total costs per 1 dt of seeds (PLN)	55.49	100.29
Total costs per PLN 1 of income from activity without subsidies (PLN)	4.02	3.85
Income from activity without subsidies per 1 dt of seeds (PLN)	13.82	26.05
Income from activity without subsidies per 1 h of family labour input (PLN)	59.87	83.05
Subsidies per PLN 1 of income from activity without subsidies (PLN)	3.55	2.72
The share of subsidies in activity (%)	78.0	73.1

<sup>a</sup> Real indirect costs without the cost of external factors.

<sup>b</sup> Subsidies include: payment for protein crops, single area payment, greening payment and additional payment. [-] – means that the phenomenon did not occur.

Source: prepared on the basis of own research.

Table 4

*Production, costs and revenues obtained from the production of cows' milk in 2017 (real data)*

Specification	On average on farms keeping dairy cows	Depending on the scale of production(number of cows/farm)		
		5-15	25-45	55-140
The number of farms in the study	159	37	47	24
The annual average status of dairy cows (head/farm)	32.7	9.0	32.5	81.4
Milk yield of cows (litre)	6433	4844	5917	7077
The annual average sale price of milk (PLN/litre)	1.38	1.23	1.38	1.39
<b>Per 1 dairy cow</b>				
<b>Total production value (PLN)</b>	<b>9783</b>	<b>6951</b>	<b>9072</b>	<b>10796</b>
of which: milk	8852	6023	8135	9832
calf weaned from a cow	574	610	581	560
cast dairy cow	357	318	356	404
<b>Total direct costs (PLN)</b>	<b>3520</b>	<b>2586</b>	<b>3466</b>	<b>3810</b>
of which: livestock replacement	636	529	563	764
fodder from outside the farm	1589	617	1379	1941
own commodity fodder	566	903	689	404
own non-commodity fodder	326	302	407	272
other	403	236	427	429
<b>Direct surplus without subsidies (PLN)</b>	<b>6263</b>	<b>4366</b>	<b>5606</b>	<b>6986</b>
Real indirect costs <sup>a</sup> (PLN)	1536	1359	1432	1648
<b>Gross added value from activity (PLN)</b>	<b>4727</b>	<b>3006</b>	<b>4175</b>	<b>5338</b>
Depreciation (PLN)	1138	1097	1166	1195
including: buildings and structures	324	417	326	311
machines and devices	503	393	477	601
means of transport	305	282	361	281
<b>Net added value from activity (PLN)</b>	<b>3589</b>	<b>1909</b>	<b>3008</b>	<b>4142</b>
Cost of external factors (PLN)	498	254	386	600
<b>Income from activity without subsidies (PLN)</b>	<b>3091</b>	<b>1655</b>	<b>2622</b>	<b>3542</b>
Subsidies <sup>b</sup> (PLN)	637	879	792	427
<b>Income from activity (PLN)</b>	<b>3728</b>	<b>2534</b>	<b>3414</b>	<b>3969</b>
<b>TOTAL COSTS (PLN)</b>	<b>6693</b>	<b>5296</b>	<b>6450</b>	<b>7253</b>
Total labour input (h)	77.3	182.1	80.6	46.0
including: family labour input	70.9	181.8	76.2	35.6
<b>Economic efficiency ratios</b>				
Total costs per 1 litre of milk (PLN)	1.04	1.09	1.09	1.02
Total costs per PLN 1 of income from activity without subsidies (PLN)	2.17	3.20	2.46	2.05
Total cost of fodder in direct costs (p.c.)	70.5	70.4	71.4	68.7
Cost of fodder from purchase in costs of total fodder (p.c.)	64.0	33.9	55.7	74.2
Consumption of concentrated feed per 100 litres of milk (dt)	3.06	3.33	3.33	2.85
Income from activity without subsidies per 1 litre of milk (PLN)	0.48	0.34	0.44	0.50
Income from activity without subsidies per 1 h of family labour input (PLN)	43.60	9.11	34.40	99.65
Subsidies per PLN 1 of income from activity without subsidies (PLN)	0.21	0.53	0.30	0.12
The share of subsidies in activity (%)	17.1	34.7	23.2	10.8

<sup>a</sup> Real indirect costs without the cost of external factors.

<sup>b</sup> Subsidies include: payment for cows (i.e. to heads eligible for support) per 1 dairy cow, and single area payment, greening payment and additional payment per forage area involved.

Source: prepared on the basis of own research.

Table 5

*Production, costs and revenues obtained from the production of live cattle in 2017 (real data)*

Specification		On average in farms producing live cattle	Depending on the scale of production (dt/farm)		
			10-30	40-80	100-400
The number of farms in the study		87	28	21	16
Net production of live animals (increase) <sup>a</sup>	(dt/farm)	66.11	19.33	54.93	183.37
Gross production of live animals <sup>b</sup>	(dt/farm)	108.92	36.56	100.49	277.44
The annual average sale price of live animals	(PLN/kg)	6.61	6.85	6.55	6.50
<b>Per 100 kg of gross live animals</b>					
<b>Total production value</b>	<b>(PLN)</b>	<b>661</b>	<b>685</b>	<b>655</b>	<b>650</b>
of which: live cattle		661	685	655	650
<b>Total direct costs</b>	<b>(PLN)</b>	<b>448</b>	<b>547</b>	<b>461</b>	<b>410</b>
of which: livestock replacement		289	388	314	245
fodder from outside the farm		37	43	32	41
own commodity fodder		90	86	76	95
own non-commodity fodder		22	20	29	21
other		9	10	10	8
<b>Direct surplus without subsidies</b>	<b>(PLN)</b>	<b>212</b>	<b>138</b>	<b>193</b>	<b>240</b>
Real indirect costs <sup>c</sup>	(PLN)	124	181	121	115
<b>Gross added value from activity</b>	<b>(PLN)</b>	<b>88</b>	<b>-43</b>	<b>72</b>	<b>125</b>
Depreciation	(PLN)	107	132	99	100
including: buildings and structures		34	43	29	29
machines and devices		42	52	40	39
means of transport		31	37	30	31
<b>Net added value from activity</b>	<b>(PLN)</b>	<b>-19</b>	<b>-175</b>	<b>-27</b>	<b>25</b>
Cost of external factors	(PLN)	39	46	41	40
<b>Income from activity without subsidies</b>	<b>(PLN)</b>	<b>-58</b>	<b>-222</b>	<b>-68</b>	<b>-15</b>
Subsidies <sup>d</sup>	(PLN)	80	162	90	56
<b>Income from activity</b>	<b>(PLN)</b>	<b>22</b>	<b>-60</b>	<b>22</b>	<b>41</b>
<b>TOTAL COSTS</b>	<b>(PLN)</b>	<b>718</b>	<b>907</b>	<b>723</b>	<b>665</b>
Total labour input	(h)	12.6	15.6	12.3	11.7
including: family labour input		11.8	15.2	10.9	10.8
<b>Economic efficiency ratios</b>					
Direct costs per PLN 1 of direct surplus without subsidies	(PLN)	2.11	3.96	2.39	1.71
Total cost of fodder in direct costs	(%)	33.5	27.3	29.8	38.3
Cost of fodder from purchase in costs of total fodder	(%)	24.8	28.7	23.6	26.3
Direct costs in total costs	(%)	62.4	60.4	63.8	61.7
Direct surplus without subsidies per 1 h of total labour	(PLN)	16.88	8.80	15.72	20.60
Total costs of producing PLN 1 of production value	(PLN)	1.09	1.32	1.10	1.02

<sup>a</sup> Net production of live animals is the annual weight gain of the herd of animals intended for fattening over the age of 1.

<sup>b</sup> Gain + weight of animals from purchase.

<sup>c</sup> Real indirect costs without the cost of external factors.

<sup>d</sup> Subsidies include: payment for cattle (heads eligible for support) per 100 kg of live animals, and single area payment, greening payment and additional payment per forage area involved.

Source: prepared on the basis of own research.

Table 6

*Selected descriptive statistics of the profitability ratio in specified ranges of the production scale of agricultural products studied in 2017<sup>a</sup>*

Specification	Sweet lupine			Fodder peas			Milk			Live cattle		
	1-2	4-8	10-50	1-2	4-20	5-15	25-45	55-140	10-30	40-80	100-400	
On average	130.9	111.0	120.6	144.1	148.2	131.2	140.7	148.8	75.5	90.6	97.8	
Percentile 5%	(per cent) 63.5	61.9	67.2	77.8	35.2	82.5	80.1	95.7	54.1	71.9	65.7	
Median	(per cent) 128.0	111.0	101.8	137.7	128.6	124.2	148.9	148.7	78.4	90.2	99.0	
Percentile 95%	(per cent) 259.5	189.8	274.2	281.0	290.1	227.7	206.5	212.4	109.3	122.5	157.0	
Quartile deviation	(pp) 35.4	32.6	31.3	33.4	51.7	22.5	21.6	19.8	11.5	15.5	15.4	
Position coefficient of variation	(per cent) 27.7	29.3	30.7	24.3	40.2	18.1	14.5	13.3	14.6	17.1	15.6	
Percentage of farms with the profitability ratio below 100	(per cent) 26.3	46.9	45.8	20.0	26.1	16.2	14.9	8.3	82.1	66.7	56.3	

<sup>a</sup> Criterion for the selection of the production scale as in Tables 1-2 and 4-5.

## KOSZTY JEDNOSTKOWE I DOCHODY WYBRANYCH PRODUKTÓW W 2017 ROKU – WYNIKI BADAŃ W SYSTEMIE AGROKOSZTY

### Abstrakt

Głównym celem badań była ocena w 2017 roku wyników produkcyjno-ekonomicznych lubinu słodkiego, grochu pastewnego, bobiku, soi oraz mleka krowiego i żywca wołowego w zależności od skali ich produkcji. Badania przeprowadzono w gospodarstwach towarowych, czyli takich, które swoją produkcję przeznaczają na sprzedaż, mają one charakter przedsiębiorstw. Gospodarstwa te wybrano celowo z reprezentatywnej próby gospodarstw, która znajdowała się w polu obserwacji systemu Polski FADN. Dane opisujące badane produkty zebrano w systemie AGROKOSZTY, a następnie uzupełniono danymi z bazy Polskiego FADN.

Na wyniki badanych produktów wpływ miał potencjał produkcyjny gospodarstw (tj. zasoby ziemi, pracy i kapitału), ich jakość i sposób wykorzystania, ale zależały także od warunków zewnętrznych (np. rynkowych, pogodowych). Oddziaływania te skutkowały różnym stopniem zmian w zakresie wolumenu produkcji, kosztów jednostkowych oraz cen realizacji produktów.

W 2017 roku dochód, jaki zapewniły badane produkty rolnicze, mieścił się w dość szerokich granicach. Korzystny wpływ wielkości skali produkcji był widoczny, chociaż ujawniał się na różnym poziomie analizy. Badania wykazały, że dochód z działalności bez dopłat zapewniły wszystkie badane produkty roślinne oraz produkcja mleka. Natomiast produkcja żywca wołowego średnio w próbie badawczej oraz średnio w wydzielonych przedziałach skali produkcji była nieopłacalna. Jednak w każdej grupie występowały gospodarstwa, w których żywiec wołowy był opłacalny. Głównie decydowały o tym niższe koszty produkcji.

**Słowa kluczowe:** koszty jednostkowe, produkty rolnicze, skala produkcji, opłacalność.

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