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Costs and profitability

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UNIT COSTS AND EARNINGS OF SELECTED PRODUCTS IN 2012 – RESULTS OF RESEARCH IN "AGROKOSZTY" SYSTEM

The paper is another part of the series presenting production and economic outcomes of plant and animal production in AGROKOSZTY system. The research in 2012 covered maize for dry grain, edible potatoes, bovine animals for fattening (i.e. beef cattle) and dairy cows on conventional farms, and dairy cows on organic farms. The individual farms covered by the research were purposely selected from a representative sample of farms in the field of observation of Polish FADN. Therefore average results obtained in the researched set of farms are influenced solely by the structure of this set and the results in selected groups of farms. Therefore the results should not be directly translated into average results for the country.

The research aimed at showing the benefits resulting from running production activities on a large-scale farm. It was also attempted to assess effectiveness of use of inputs and activity from the angle of fulfilment of the criterion of economic effectiveness. The assessment also covered labour intensity of production and the possibility to pay for the own labour input.

Keywords: unit costs, agricultural products, production scale, production profitability, management income.

Introduction

The study is another one in a series presenting production and economic outcomes of plant and animal production in AGROKOSZTY system. In 2012, the subjects of the research on conventional farms included maize for dry grain, edible potatoes, bovine animals for fattening (i.e. beef cattle) and dairy cows. The selection of activities resulted from the adopted research plan, individual activities appear regularly in the research, typically in two or three year intervals. The research has also been carried out on organic farms, where dairy cows have been the subject of the research.

Individual farms, where production activities have been researched, were not a representative sample for a group of farms with a specific type of production. They have been purposely selected from a representative sample of farms in the field of observation of Polish FADN. Therefore average results obtained in the researched set of farms are influenced solely by the structure of this set (taking into account the volume of production of specific types of activities) and the results in selected groups of farms. Resulting differences in the level and structure of production and inputs, accompanied by a not very numerous research sample, result in a situation where the results obtained for researched populations should not be directly translated into average results in the country.

However, the calculations presented provide a credible picture of profitability of production in delimited groups of farms, which reflects the trends in costs and may serve the study of correlations between profitability of productions and its primary determinants.

The primary objective of the research of production activities in conventional farms was to demonstrate the benefits resulting from running production on a farm in a larger scale. An attempt was made to assess effectiveness of use of inputs and assessment of the activity from the angle of fulfilment of the criterion of economic effectiveness. Labour intensity of production and the possibility to pay for the own labour input were also subject to assessment. Despite the fact that volumes of productions considered small, medium or large are of relative nature, the results of the research are an important premise in the issue of selection of scale, which could ensure relatively high effectiveness of production.

The results for production of milk in organic farms were presented against the background of results from previous years. The period of 6 years was covered by a comparative analysis. The strength of this research lies in its substantial cognitive value and the opportunity to demonstrate (on the basis of credible source data) changes in the level and relation of inputs, costs and changes in the level of income.

Methodology of research

The calculations of costs and incomes for production activities were made on the basis of data collected in the AGROKOSZTY system and in Polish FADN.

AGROKOSZTY system collects – for individual activities in plant and animal production – the data on the level of production, inputs and direct costs.

The data facilitate calculation of gross margin. The structure of the value of production and direct cost by nature is in line with the premises of the European Union formulated in the context of calculation of the standard gross margin (Augustyńska-Grzymek I. et al., 2000).

In calculations for individual activities in plant and animal production the value of production is the sum of the value of primary products (e.g. grain, seeds) and by-products (e.g. straw), which are traded in the market. It is defined according to the market sales prices or according to sales prices loco farm (i.e. on a farm). In case of plant production it depends on the harvest of plants and sales price of products. Various types of losses (per 1 hectare) are deducted from the value of production. In case of animal production the structure of the value of production differs depending on activity under analysis. However, the product for which the production is carried out always continues to be defined as the primary one (e.g. milk). Independently there may be an increase on (e.g. calves after weaning) and one or more by-products (e.g. eliminated animals). Losses, that is animals fallen in the production process (calculated per 1 animal or per 100 kilograms of live weight) are deducted from the value of production. When calculating the value of production in animal production, the value of manure and slurry generated in one's own farm is not taken into account.

Direct costs are components of the costs, which can be assigned to specific activity without a doubt, their amount is proportional to the scale of production and they have direct impact in the size (volume and value) of production.

In plant production, direct costs include:

- seeding and planting material (*purchased or produced on a farm*)
- purchased fertilisers1 (*without agricultural limestone*)
- plant protection products
- growth regulators (*rooting hormones, growth stimulants, defoliants*)
- insurance related directly to a given activity
- specialised costs including:
  - specialised expenditure for plant production
  - specialised services
  - occasional hire for specialised work.

In animal production, direct costs include:

- animals entering individual activities for the purpose of herd replacement
- feeds, which are divided into:
  - feeds from outside of the farm (*primarily purchase*)
  - feeds from own farm, which are divided into:
    - ◊ own feeds from potentially commercial products
    - ◊ own feeds from non-commercial products

[1] The cost of purchased fertilisers includes specialised fertiliser taxes.

- land lease for using land for feeds rented for a period shorter than a year (*on agricultural land and in areas not included in agricultural land, e.g. in mountain pastures*)
- insurance of animals, related directly to specific activity (*e.g. cows, heifers*)
- veterinary medicine and products (*including semen for insemination*)
- veterinary services (*insemination, castration, preventive vaccinations*)
- specialised costs, including:
  - specialised expenditure for animal production
  - specialised services
  - occasional hire for specialised work.

The set of direct costs, which are deducted from the value of production, is different for plant and animal production. However in both cases they reflect current market conditions.

Components of direct cost coming from outside of a farm are priced according to purchase prices, while components of cost produced on a farm (e.g. seeding material, own feeds from commercial products) – according to sales prices loco farm. The exception – in case of animal productions – are own feeds from non-commercial products (e.g. silage from maize), which are priced according to direct costs incurred for their production. Individual components of costs are reduced by amounts of subsidies granted.

The cost accounting for animal production does not take into account the value of by-products of plant production (e.g. straw, beetroot leaves), produced on own farm and used as feed or bedding.

Specialised costs are a specific item of direct costs. These are costs having a direct connection with specific activity and increasing quality and value of the final product. For plant production, an example of specialised cost is the cost of energy carriers used for drying of products, preparation of products for sale or carrying out of analyses facilitating definition of fertilising needs of plants. For animal production specialised costs include the cost of litter used in a production process of a given activity, cost of products for conservation and storage of feeds, classification of animals or disinfection of animal houses.

The accounting leading to calculation of income from activity both direct and indirect costs are shown. The level of indirect cost was established on the basis of data from Polish FADN. Indirect costs could be defined as cost of readiness for production, they are incurred due to functioning or just due to existence of a farm. They are divided into real and estimated indirect costs.

Real indirect costs include:

- overheads – electrical energy, heating fuel, power fuel, current repairs, maintenance, services, insurance (buildings, property, vehicles), other costs, e.g. fees for water, phones;
- taxes – agricultural, forest, on special agricultural production, real property and others, e.g. on means of transport;
- cost of external inputs – hired labour, lease, interest on loans.

Estimated indirect costs include: depreciation of building and structures, machinery and technical equipment, means of transport, amelioration, orchard and multi-annual plantations, intangible and legal assets and completed investments in third party fixed assets. The cost of depreciation calculated for individual activities shows the level of wear of fixed assets involved in production process. However, this cost is reduced by the amount of received subsidies to investments, used by farmer under the support for agriculture from EU funds and the state budget. In case of research of activities, both the number of farms and their distribution in groups designated according to a specific criterion may be different. Therefore the strength of impact of this factor (i.e. subsidies to investments) on the amount of annual depreciation is also different.

In the calculations made, indirect costs were divided between activities carried out in a given farm, according the the share of production value of each of them in the total value of production of this agricultural holding. For this purpose, farms carrying out activities studied in the AGROKOSZTY system were identified in Polish FADN database; the algorithm for allocation of indirect costs was applied individually to individual farms and activities.

Accounting of unit costs of activities in plant and animal production is connected with a structure of costs of a farm presented in Individual Farm Report – Polish FADN (Goraj L., Mańko S., 2004). As a consequence, the same terminology was adopted for income categories in activity accounting. Accounting covering total costs (direct and indirect) facilitates definition of profitability of production; their additional advantage is the fact that they facilitate definition of a unit cost of a product, which is often compared to the price of this product. The diagram of accounting of costs and revenues for agricultural production activities is presented below.

Diagram 1

The manner of calculation of individual income categories

I		**Value of production**
II	-	*Direct costs*
III	**=**	**Gross margin without subsidies**
IV	-	*Real indirect costs (with the exclusion of external inputs)*
V	**=**	**Gross value added on activity**
VI	-	*Estimated indirect costs – depreciation*
VII	**=**	**Net value added on activity**
VIII	-	*Costs of external inputs*
IX	**=**	**Income on activity without subsidies**
X	+	*Subsidies*
XI	**=**	**Income on activity**

Income on activity is a margin generated after deduction of direct and indirect costs from the value of production and addition of subsidies. This income category is adequate for assessment of results in a longer perspective, with the assumption that production capacity of a farm is retained at a stable level. When calculating income on activity, the amounts of output and input VAT are not taken into account.

The item of subsidies only includes those directly related to individual activities. These are primarily complimentary area payments. Accounting does not include the single area payment, as pursuant to relevant provisions it is paid for agricultural land owned by a farmer (on a day defined in an act) and eligible for this payment.

Tables presenting results also include data on labour inputs (own and external) on a given activity, collected in the AGROKOSZTY system. This registry facilitates definition of labour intensity of production. In case of plant production, work related to pre-seeding preparation of soil, maintenance work and work related to harvesting and drying of grain is registered. In case of animal production activities this is primarily work related to handling of animals and feeding, as well as work connected with production of own non-commercial feeds. Work related to functioning of a farm as a whole is not subject to registration. This pertains to administrative work, general management, or work devoted to repairs of buildings or machinery.

On the basis of the number of working hours devoted to production of individual products, the income from activity per 1 hour of own work is calculated. This income category reflects the degree of coverage of labour inputs of a farmer and his family by income from activity obtained from 1 hectare of crops or production of 100 kilograms of beef livestock. For the needs of the analysis, work of a farmer was priced according to a prescriptive rate, defined on the basis of average level of remuneration of workers employed in national economy in a given year (according to GUS). It was assumed that one fully employed person worked in agriculture for 2200 hours a year. 1 hour of own work thus calculated was priced at PLN 12.82 in 2012. It should be emphasised though that on individual farms presentation of own labour inputs in terms of value is always of symbolic nature.

When assessing effectiveness of production in groups of farms differing by the size of scale, the level of the value of production and its total cost were analysed; the profitability indicator is an expression of relation of these variables. Selected statistical measures were used to describe it and assess the level of diversification in groups of farms: 5% and 95% percentile, median, quartile deviation, positional coefficient of variation. Marginal cost was also calculated; it is a measure of reaction of total costs to an increase in the volume of production. Therefore it points to dynamics of costs depending on the volume of production (Runowski H., 2003).

For agricultural production activities researched in organic farms, the methodology of accounting changes only in the area of direct costs. This results

from the specificity of principles of organic farming. These principles are subject to national and EU legal regulations[2].

In plant production, mineral fertilisers, products improving soil fertility and plant protection products may only be used, when their application is in line with the principles of organic production. There is a ban on use of nitrogen mineral fertilisers which are commonly used in conventional agriculture. Taking into account limited possibility to use mineral fertilisers (only natural fossils available), often manure, composts and green fertilisers are used. Moreover, for production of organic plant products organic seeding material should be used, from own organic farm or purchased certified one.

In animal production carried out in organic farms, from the point of view of restrictions imposed by legal provisions, it is most important to provide animals with feeds of organic origin. There is a ban on application of industrial concentrates and complete mixes, as well as feeds produced with GM plants. Feed protein in animal nutrition may come from leguminous plants, including field beans, peas and lupin. Cereals and grains of leguminous plants should be used as concentrated feeds. Also, by-products of agri-food industry may also be used, e.g. cereal bran, dry beet pulp, oilcakes of oil plants (rape, sunflower). It is prohibited to use growth stimulants, synthetic amino acids and antibiotics, which is one of the reasons why animals grow slowly, retaining natural immunity and viability. All young mammals should be fed natural milk, ideally from their mothers, for an adequate period. Extended period of animal use is an additional advantage of organic breeding of animals and is related to low level of cow elimination indicator, which reduces the cost of herd replacement (Żukowski K., 2009).

Research results

The results of research of production activities in conventional farms were presented as averages for a researched population. However, in order to show differences in the level of inputs and obtained production and economic results, farms were grouped according to the scale of production of individual activities. For the needs of analysis three ranges of scale were selected (small, medium and large). The scale criterion applied for plant production activities was the area under cultivation, for beef livestock – the level of net production measured by annual weight gain obtained from a herd of bovine animals for fattening older than 1 year (dairy and meat-dairy breeds), and for dairy cows – number of cows kept on a farm.

The analytic approach and the manner of presentation of results of milk production in organic farms was limited due to a small number of organic farms keeping dairy cows, which were included in the studies of AGROKOSZTY system. For this reason production and economic results were presented as average values in a research sample of farms.

[2] Detailed principles for implementation of Council Regulation (EC) No 834/2007 on organic production, labelling and controls are regulated by Commission Regulation (EC) No 889/2008 of 5 September 2008, while the Act on organic farming (2009) is the national act establishing the status of organic farming in Poland.

The calculations presents, in a much broader perspective, were subject of the publication entitled "Economic results of selected agricultural products in 2012" (published by IERiGŻ-PIB, Warsaw 2014), which extensively discussed economic situation of agricultural production activities under research.

In this study the research results and their analysis were presented in a synthetic manner, with attention paid only to most important issues. Results of calculations and costs incurred by farmers (in nominal values) were included in tables. Due to electronic data processing technology, in some cases sums of components may differ from "total" values provided.

The research carried out made it possible to demonstrate profitability or unprofitability of analysed production activities. Results were influenced by production potential of farms, i.e. land, labour and capital resources, their quality and the manner of use, but they also depended on external conditions of functioning, e.g. weather, market. These influences resulted in a varying degree of changes in the level of production, unit costs, as well as exercise prices of individual agricultural products in designated groups of farms. However, excluding influences of weather factors, which are belong control of farmers, it was concluded that to a large extent economic results were influenced by managerial and organisational capacities of farmers and their attempts to increase both technological and economic effectiveness of production.

In 2012, the income situation of **maize** cultivated for dry grain was favourable (Table 1). On average, in a population of farms under research, with a cultivated area at 24.03 hectares, producers achieved income from activity without subsidies at the level of PLN 1881/hectare. In delimited ranges of scale of cultivation, the level of this income was subject to substantial variations. Maize cultivated on a medium scale (10-25 ha) turned out to be economically most profitable - the income without subsidies reached the level of PLN 2085/ha. Results of maize cultivated on a small (2-8 ha) and large (30-80 ha) scales were poorer - the income amounted to PLN 1338 and 1766/ha respectively. The advantage of medium scale was determined by exceptionally favourable production results (89.2 dt/ha). The sale price of grain was also high (PLN 81.31/dt), although its level in designated ranges of scale was quite balanced (it was in the range of PLN 79.06-81.31/dt). The research showed that cultivation of maize on a small scale was most cost-consuming, while with the increase of scale the level of costs systematically decreased. A very large decrease of the cost of depreciation of committed fixed assets was recorded, which was lower by 35.2% with large scale in comparison to small scale.

Marginal analysis showed that both with medium and large scale the marginal cost of production of 1 dt was lower than the border cost, i.e. price of grain. The limit of intensity of production was also not exceeded. However, at a given level of intensity, the medium scale of cultivation provided more favourable results. It is evidenced by the fact that the marginal cost was 3.0% lower than the average cost, while with large scale it was higher by 1.4%.

Considering profitability of maize cultivation from the quotient approach (Table 6), the highest average level of profitability coefficient (the ratio of the value of production to total costs) was recorded with the medium scale (140.3%). However the highest value of percentile 95% (214.7%) was found in farms cultivating maize on a large scale. Also in this sample the share of farms, where maize was unprofitable was lowest (13%). The favourable effect of scale is clear. Another benefit of cultivation of maize on a large scale was lower labour intensity, which had an impact on the amount of income per 1 hour of work of a farmer. The own labour inputs were paid for in all ranges of scale, but the income on activity without subsidies was higher than the parity rate (PLN 1/hour) 6.8 times in a small scale of cultivation, 13.7 time with medium and as much as 15.5 time with the large scale. With inclusion of subsidies in the calculation, the number of time the parity rate would be covered would be even higher.

Cultivation of **edible potatoes** was profitable in 2012. On average, in a population under research, with a cultivated area at 5.74 hectares, income from activity without subsidies amounted to PLN 2781/hectare (Table 2). Its level was substantially diversified in groups of farms with different areas of potato cultivation. With a small scale (1-3 ha) it amounted to PLN 3093/ha, medium (5-10 ha) – PLN 1206/ha, while large scale potato producers (13-30 ha) obtained PLN 3338 from 1 ha. The results of calculations prove that the scale of cultivation of potatoes differentiated two factors determining economic outcomes, i.e. the level of crops and the sale price, which generated a specific level of income, while the cost of cultivation of 1 ha (total of direct and indirect costs) were quite similar in designated groups of farms. A clear increase of harvest of potatoes was recorded with the increase of scale. The strength of its influence on economic results was very high. The influence of the sale price was weaker, moreover, its variability across groups of farms was not one way. It is assessed that the period in which bulbs were sold played an important role.

Statistical analysis of profitability of potato cultivations confirms conclusions coming from the analysis of data in the table (Table 6). The average level of the profitability indicator was highest in farms growing potatoes on a large scale (146.2%). Also in this group, the area designated by percentile 5% and 95% was narrowest, i.e. the area where 90% of observations were, and the lowest share of farms (13%) where edible potatoes were an unprofitable activity.

The marginal analysis also confirmed the advantage of large scale cultivation of potatoes. This is confirmed by the comparison of extreme values – the cost, in case of which there is a necessity to minimise, and income without subsidies – where the objective is maximisation. In the context of income it should be stated that with large scale the marginal income without subsidies (obtained from an increase in production by 1 dt) was by 24.6% higher than its average level. With medium size of scale the marginal income was 5% lower than average. This dependencies found their expression at the level of income from 1 ha of edible potatoes.

The positive effect of scale is clear, which is confirmed by systematic decrease of unit costs and labour intensity of production. Moreover, with large scale the profitability of own labour inputs was highest. The labour inputs of a farmer and his family were paid for already at the level of income from activity without subsidies, and its level per 1 hour of own work with small scale was higher that the parity rate for work (PLN 12.82/hour) 2.7 time, with medium scale 1.3 times, and large as much as 4.9 times. Taking into account the support in the form of the single area payment it is estimated that it was also possible to cover the estimated cost of other inputs, i.e. land and capital.

In 2012 the economic results of **live cattle** production (pertains to bovine animals for fattening of dairy and dairy-meat breeds) were negative in a decisive majority of farms (Table 3). On average in the research sample (net production of 42 dt of live animals per year) and with small (4-16 dt) and medium (20-40 dt) scale of production, a loss was recorded. In large scale production of live animals (50-260 dt) one could conclude that income covered the costs incurred. The level of costs was decisive, which clearly lowered with the increase of scale (with low scale the cost of production of 1kg amounted to PLN 8.26, medium PLN 7.72, while with large scale – PLN 6.71). The decrease of costs was determined by direct and indirect costs. The sale price of live animals was also important – in the research sample it achieved the level which was higher than the average purchasing price across the country – from 3.4 to 6.3% depending on a group of farms. Small scale producers of live animals obtained the lowest price (PLN 6.62/kg), while medium scale producers got the highest price PLN 6.80/kg). Depending on actual circumstances, income generated from sales of 100 kg of live animals covered the cost incurred with small scale of production in 80.1%, with medium scale in 88.0% and with large scale– in 99.6%.

Losses in production of live cattle decreasing with the increase of scale and the impact of scale on the level of losses are explained by marginal calculation. With medium scale of production the marginal cost was 2.9% lower than the average cost, while with large scale it was lower by 9.8%. Moreover, in case of medium scale the marginal cost of production of 1 kg of live animals was 10.3% higher than the break-even cost, i.e. sales price of live animals, while in farms producing live animals on a large scale it was 9.4% lower. It means that the increase of scale to the large size was economically justified. It is also evidenced by the fact that with medium scale of production of live animals the increase of costs by 9% was higher that the increase of the value if production, while with the large scale it was 8% lower.

Subsidies (CAP and SAP) to committed feed area (i.e. area allocated to production of own feeds from non-commercial products) eliminated the loss on production in case of small and medium scale, and with large scale they guaranteed certain level of income. As a result own work of a farmer was paid for in 50% of the parity rate. However, it was only possible thanks to subsidies.

The research proved however that despite generally negative situation, there were farms in each range of scale, where live bovine animals were a profitable activity, Assessing the scale of this phenomenon from the perspective of the entire research sample – in every fourth farm. Lower production costs were primarily decisive (Table 6).

In 2012 milk production made it possible to obtain income, but its level varied in researched groups of farms (Table 4). The dependence between the amount of income per one cow and the number of cows in a farm is clear. The best results were achieved by farmers keeping large herds, i.e. from 50 to 130 cows – the income from activity without subsidies, calculated per one animal amounted to PLN 2701. With medium scale, 15-45 cows, it was at the level lower by 23.6% (PLN 2064). Farmers keeping small herds (5-10 cows) were in the worst situation, in these farms income from activity without subsidies amounted to PLN 820/1 cow.

Low milk yield of cow producing in a low scale (4060 litres of milk) resulted in situation, where the cost of production of 1 litre of milk was 3.8 higher than its sale price; as a consequence the value of milk sold did not cover the cost of keeping the cow. In this situation the income was generated solely by revenue from sales of calves and culled dairy cows.

The analysis showed that with the increase of the number of cows their productivity and the price of milk both increased, these two factors determined economic results. However, the increase of productivity of cows in subsequent groups of farms required involvement of increasing inputs. Their level represented in terms of value was higher than the total costs (direct and indirect together) with large scale of production in comparison to low scale it was higher by 1.7 times (i.e. PLN 2902/1 cow).

The profitability indicator in each group of farms exceeded 100% (Table 6). With medium and large scale it oscillated around 136%, while with small scale it amounted to 118.6%. The variability is clear, but primarily between the small scale and two remaining ones, i.e. medium and large, which were characterised by a similar variability of profitability of milk production. This is confirmed by the similar value of coefficient of variability (12.5 and 15%), but also by the percentage of farms, where milk production was unprofitable (6 and 8%). For comparison, in the sample of farm producing milk on a small scale, entities suffering loss represented 33%.

The diagram of unit costs of milk production resembles letter U – with small scale it was highest (PLN 1.09), with medium scale it fell to the lowest level (PLN 1.00), to increase again with the large scale (PLN 1.04), but not reaching the level of the small scale. However, the higher costs incurred in subsequent ranges of scale were justified, which is shown by the marginal calculation. Both with the medium and large scale, the increase of the value of production was stronger than the increase of costs.

The labour inputs per 1 cow, which was several times lower, was a positive effect of scale and specialisation of production at the same time. Comparing

extreme ranges of scale, the difference was 3.1 times in favour of the large one. This factor had a large impact on income from activity without subsidies per 1 hour of own work. Its level in relation to the parity rate of payment for work points to positive effect of scale. In farms producing milk on medium and large scale the income without subsidies per 1 hour of own work was higher than the parity rate by 1.4 and 4 times respectively. In milk production on a small scale, own work was paid for only in 29%. In this context the impact of subsidies to committed feed area (CAP and SAP) on results became visible. Thanks to subsidies own work was paid for in 54% of the parity rate.

The analysis of results in groups of farms differing in the size of scale proves that the level of income from activity without subsidies obtained from the unit of production increases with the increase of scale. It happens though that these are farmers producing on the medium scale that achieve the highest income. In 2012 this was the case with maize, exceptionally favourable production results were decisive. Nevertheless the advantage of large scale is clear; the percentage of farms, where cultivation of maize turned out to be unprofitable was the lowest – 13% against 18% with the medium scale.

The increase of the scale of production – due to a higher level of specialisation and mechanisation of work – would typically be connected with much lower labour inputs, which results in a situation, where profitability of work is higher. As a result covering of alternative cost of land and capital could be expected. It is very important, because ultimately it is the ability to cover alternative costs that decides about competitiveness of production activities, and farms as a result.

In summary one could state that targeting of production is not always the objective, but it definitely is means of achieving of an objective, e.g. higher profitability of agricultural production activities. Targeting, i.e. specialisation of production in a farm is typically connected with simplification of its organisation (organisation of plant production is evidenced by the structure of crops, and of animal production – structure of population of animals), and – as a consequence – with production on a larger scale. The farmers' choice of a scale of production in individual activities results from many reasons; one of these could be circumstances in which a given farm operates. The size of production is very important from the economic point of view, as with the absence of direct influence over prices, a farmer can decide about the size of production through definition of its scale (e.g. area of crops), taking into account at the same time possibilities in the area of effective use of inputs owned.

The pursuit of more effective management of inputs results in an interest in the level of costs incurred. Costs play a special role in the decision making process, both as parameters and selection criteria. The access to and the use of information on costs is a necessary condition of making rational decisions. Specialised and developing commercial farms have large information needs, and cost accounting is not solely the measurement of inputs, but also the tool to

support processes of planning and control of use of resources, costs and risks in the framework of management of these holdings. The research of agricultural production activities carried out in AGROKOSZTY system meets such expectations. Of course one needs to be aware that results of this research do not exhausts the issues related to cost management, profitability of production or rational management. However, the calculations made are a good illustration of situation on farms participating in the research, they reflect the trends and facilitate explanation of changes taking place.

In comparison to conventional farming, which gives preference to intensive production technologies, organic farming is considered to be more environment friendly. In case of organic animal production, with the ban on the use of industrial feeds and other feed additives, growth stimulants or synthetic aminoacids, the most effective species of livestock is cattle, as volume feeds are the foundation of nutrition of these animals. This is why grasslands play an important role in organic farms, where feeds coming from them may fully cover nutrition needs of cattle. Rational use of feed base owned is an important factor, which is decisive for effective **organic milk production**. It should be added that cows of highly productive breeds should not be kept in organic farms, as they have high nutrition requirements and are also more susceptible to a variety of diseases. Various factors are decisive, when it comes to effectiveness of milk production in organic farms. The more important ones include the scale of its annual production, the area of grassland or the number of cows in a herd.

It is estimated that in the conditions of Polish agriculture, organic production of milk may be an opportunity to improve income for some of farms, particularly in the South-East. The condition is however that dairies in these areas will undertake buying such milk, and its prices will be adequately higher in comparison to milk purchased from conventional farms. This fact could be a premise to undertake this type of production, particularly in regions with a high share of grasslands. In this context the knowledge of economic aspects of production becomes very helpful, i.e. what area of grassland, system of grazing, number of animals on a farm and annual scale of milk production will make it profitable in Polish conditions.

The presented results of research give the right to certain statements, even with the variability of farms in the research sample over years in mind, and the fact that it was not excessively numerous. Organic farms, where dairy cows were covered with the research, were located in regions with the highest concentration of organic production, i.e. regions of Małopolska, Pogórze, Mazovia and Podlasie.

The research showed that price results of average in the analysed sample of organic farms were poorer in comparison to prices of milk in individual farms in the region (according to GUS data). Particularly large differences in milk prices – to the detriment of organic farms – were recorded in the regions of Mazovia and Podlasie. The situation was similar in term of milk yield. This fact explains relatively intensive nature of milk production in many farms of this region.

In 2006-2012 (with the exception of 2010), the value of production total per 1 cow remained at a stable level in researched organic farms; when comparing extreme values, the variability amounted to 1.2 times (Table 5). Total costs (direct and indirect together) of keeping cows demonstrates much higher variability and their increase over these years was rather substantial. In 2011, when they were highest, the increase of cost of 88.2% was recorded in comparison to the lowest level in 2006. As a result, income from this activity without subsidies per 1 cow was characterised by a decrease, although this was not a one way decrease. However, comparing extreme years of the research, the level of this income (in 2012 – PLN 959 against PLN 1822 in 2006) decreased by 47.4%. In 2012, a decrease of income was recorded despite the scale of production larger by 45.8%, with the volume of annual production of milk as the measure. In 2012, the profitability indicator for milk production was at the average level of 128.4%, but its range designated by percentile 5% and 95% ranged between 91.0-201.7%. It means that there were farms in the sample, where milk production was not profitable (every fifth one in the sample). In 2006-2012 the share of such farms in the sample amounted from 14 to 38% (Table 7).

The research carried out shows that production of milk in organic farms brings income, which is comparable to that of conventional farms keeping small herds of cows (5-10 animals). In both cases subsidies, as an instrument of income support, play an important role, though the scale of this support is much larger in organic farms. Nevertheless, income calculated with subsidies (complementary payments, organic payments and the single area payment) per one hour of own work, failed to fully pay for it. This was decided by a relatively low level of income, but there was also a significant influence of high labour intensity of milk production in organic farms. The exception was 2006, when income per 1 hour of own work was higher by more than 8% than the parity rate of payment for work (PLN 9.76/hour). In the remaining years of the study the work of a farmer and his family was only partially paid for.

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Table 1

Production, costs and income obtained from cultivation of maize for grain in 2012 (real data)

Specification		Average in farm growing maize for grain	Depending on the scale of cultivation (ha/farm)		
			2-8	**10-25**	**30-80**
Number of farms under research		69	20	21	17
Area under crops	(ha)	24.03	4.19	15.28	51.94
Yield of dry grain	(dt/ha)	88.6	83.5	89.2	82.7
Sale price of dry grain	(PLN/ dt)	79.02	79.06	81.31	81.06
			Per 1 ha of crops		
Total value of production	**(PLN)**	**6998**	**6601**	**7255**	**6701**
of which: dry grain		6998	6601	7255	6701
Total direct costs	**(PLN)**	**2498**	**2560**	**2495**	**2450**
of which: seeding material		478	468	470	486
mineral fertilisers total		1186	1061	1069	1260
external organic fertilisers		8	4	39	-
plant protection products		184	210	176	187
growth regulators		-	-	-	-
other		642	817	741	516
Gross margin without subsidies	**(PLN)**	**4500**	**4042**	**4761**	**4251**
Real indirect costs[a]	(PLN)	1367	1428	1369	1309
Gross value added on activity	**(PLN)**	**3133**	**2613**	**3392**	**2942**
Depreciation	(PLN)	794	1038	965	673
of which: buildings and structures		150	219	160	139
machinery and equipment		366	413	435	304
means of transport		274	381	365	229
Net value added on activity	(PLN)	2339	1575	2427	2269
Cost of external inputs	(PLN)	459	237	342	502
Income on activity without subsidies	**(PLN)**	**1881**	**1338**	**2085**	**1766**
Subsidies[b]	(PLN)	209	212	198	212
Income on activity	**(PLN)**	**2090**	**1549**	**2283**	**1978**
COSTS TOTAL	***(PLN)***	***5117***	***5264***	***5170***	***4934***
Labour inputs total	(hours)	11.8	17.3	12.6	11.8
including: own labour inputs		10.0	15.4	11.9	8.9
Measures of economic effectiveness					
Total costs/1 dt of dry grain	(PLN)	57.78	63.04	57.94	59.69
Total costs per 1 PLN of income on activity without subsidies	(PLN)	2.72	3.94	2.48	2.79
Subsidies per 1 PLN of income on activity without subsidies	(PLN)	0.11	0.16	0.10	0.12
Share of subsidies in income on activity	(%)	10.0	13.7	8.7	10.7
Income on activity/1 dt of dry grain	(PLN)	23.60	18.56	25.59	23.93
Income on activity/1 hour of own work	(PLN)	209.88	100.73	191.59	222.60

[a] Real indirect cost without the cost of external factors.

[b] Subsidies include the complementary area payment.

(-) – means that a given phenomenon did not occur.

Table 2

Production, costs and income obtained from cultivation of edible potatoes in 2012 (real data)

Specification			Average in farm growing edible potatoes	Depending on the scale of cultivation (ha/farm)		
				1-3	**5-10**	**13-30**
Number of farms under research			117	59	22	15
Area under crops		(ha)	5.74	1,71	7,04	19,21
Potato yield[a]		(dt/ha)	297	249	267	322
Sale price of bulbs		(PLN/dt)	32.93	40,87	30,48	32,83
				Per 1 ha of crops		
Total value of production		**(PLN)**	**9783**	**10181**	**8127**	**10566**
of which:	potatoes		9783	10181	8127	10566
Total direct costs		**(PLN)**	**3394**	**2760**	**3477**	**3817**
of which:	seeding material		1449	1447	1651	1498
	mineral fertilisers total		1183	746	965	1521
	external organic fertilisers		25	64	68	-
	plant protection products		572	381	599	640
	growth regulators		32	16	26	39
	other		132	107	168	118
Gross margin without subsidies		**(PLN)**	**6390**	**7421**	**4650**	**6749**
Real indirect costs[b]		(PLN)	1589	2073	1694	1352
Gross value added on activity		**(PLN)**	**4800**	**5348**	**2956**	**5397**
Depreciation		(PLN)	1400	1839	1400	1192
of which:	buildings and structures		355	507	252	334
	machinery and equipment		515	655	517	432
	means of transport		524	664	630	424
Net value added on activity		**(PLN)**	**3400**	**3509**	**1556**	**4205**
Cost of external inputs		(PLN)	620	416	350	867
Income on activity without subsidies		**(PLN)**	**2781**	**3093**	**1206**	**3338**
Subsidies		(PLN)	-	-	-	-
Income on activity		**(PLN)**	**2781**	**3093**	**1206**	**3338**
COSTS TOTAL		***(PLN)***	***7003***	***7088***	***6921***	***7228***
Labour inputs total		(hours)	91.8	101,2	93,2	82,6
including: own labour inputs			68.8	90,7	70,7	53,3
Measures of economic effectiveness						
Total costs/1 dt of potatoes		(PLN)	23.57	28,46	25,96	22,46
Total costs per 1 PLN of income on activity without subsidies		(PLN)	2.52	2,29	5,74	2,17
Income on activity/1 dt of potatoes		(PLN)	9.36	12,42	4,52	10,37
Income on activity/1 hour of own work		(PLN)	40.41	34,11	17,07	62,57

[a] Potato yield after deduction of losses in storage.

[b] Real indirect cost without the cost of external factors.

(-) – means that a given phenomenon did not occur.

Table 3

Production, costs and income obtained from production of beef cattle in 2012 (real data)

Specification		Average in farms producing beef cattle	Depending on the scale of production (dt/farm)		
			4-16	**20-40**	**50-260**
Number of farms under research		85	22	23	19
Net production of live animals (gain)[a]	(dt/farm)	42.12	9.20	30.21	96.04
Gross production of live animals[b]	(dt/farm)	70.71	17.95	60.84	153.77
Average annual sales price of live animals	(PLN/kg)	6.68	6.62	6.80	6.68
		Per 100 kg of live animals gross			
Total value of production	**(PLN)**	**668**	**662**	**680**	**668**
of which: live animals		668	662	680	668
Total direct costs	**(PLN)**	**481**	**517**	**491**	**471**
of which: herd replacement		298	317	326	287
feeds from outside of farm		41	30	30	54
own commercial feeds		105	137	97	92
own non-commercial feeds		29	24	30	28
other		8	10	10	9
Gross margin without subsidies	**(PLN)**	**187**	**144**	**188**	**198**
Real indirect costs[c]	(PLN)	127	145	142	105
Gross value added on activity	**(PLN)**	**60**	**-1**	**47**	**93**
Depreciation	(PLN)	100	116	111	78
of which: buildings and structures		23	37	28	19
machinery and equipment		41	44	44	29
means of transport		36	34	39	30
Net value added on activity	**(PLN)**	**-40**	**-117**	**-65**	**15**
Cost of external inputs	(PLN)	22	47	28	18
Income on activity without subsidies	**(PLN)**	**-62**	**-164**	**-92**	**-3**
Subsidies[d]	(PLN)	13	15	10	14
Income on activity	**(PLN)**	**-49**	**-149**	**-82**	**11**
COSTS TOTAL	***(PLN)***	***730***	***826***	***772***	***671***
Labour inputs total	(hours)	10.8	21.1	12.1	8.5
including: own labour inputs		10.5	20.3	12.0	8.1

[a] Net production of live animals is an annual weight gain achieved in a herd of animals for fattening above 1 year of age.

[b] Gain+ weight of animals from purchase.

[c] Real indirect cost without the cost of external factors.

[d] Subsidies include complimentary area payment and the so-called animal payment to committed feed area.

Table 4

Production, costs and income obtained from production of milk in 201 (real data)

Specification		Average in farms keeping dairy cows	Depending on the scale of production (number of cows/farm)		
			5-10	**15-45**	**50-130**
Number of farms under research		175	40	78	24
Average annual population of dairy cows	(animals)	25.8	7.5	24.1	72.9
Milk yield	(litres)	6135	4060	5755	7073
Average annual sales price of milk	(PLN/litre)	1.23	1.05	1.20	1.28
			Per 1 dairy cow		
Total value of production	**(PLN)**	**8479**	**5240**	**7818**	**10024**
of which: milk		7562	4308	6886	9046
calf weaned from cow		547	629	536	554
eliminated dairy cow		370	302	395	424
Total direct costs	**(PLN)**	**3505**	**2554**	**3316**	**4034**
of which: herd replacement		550	461	595	646
feeds from outside of farm		1361	330	1072	1853
own commercial feeds		757	1137	844	598
own non-commercial feeds		420	375	435	437
other		417	251	371	500
Gross margin without subsidies	**(PLN)**	**4974**	**2686**	**4502**	**5990**
Real indirect costs[a]	(PLN)	1391	965	1251	1684
Gross value added on activity	**(PLN)**	**3583**	**1721**	**3251**	**4305**
Depreciation	(PLN)	971	816	942	1069
of which: buildings and structures		232	300	208	249
machinery and equipment		450	288	426	531
means of transport		284	222	302	288
Net value added on activity	**(PLN)**	**2612**	**904**	**2309**	**3237**
Cost of external inputs	(PLN)	359	84	244	535
Income on activity without subsidies	**(PLN)**	**2253**	**820**	**2064**	**2701**
Subsidies[b]	(PLN)	156	195	155	155
Income on activity	**(PLN)**	**2409**	**1015**	**2219**	**2856**
COSTS TOTAL	***(PLN)***	***6226***	***4420***	***5753***	***7322***
Labour inputs total	(hours)	109.6	223.9	114.2	72.9
including: own labour inputs		99.0	219.6	111.8	53.1
Measures of economic effectiveness					
Total costs/1 litre of milk	(PLN)	1.02	1.09	1.00	1.04
Total costs per 1 PLN of income on activity without subsidies	(PLN)	2.76	5.39	2.79	2.71
Subsidies per 1 PLN of income on activity without subsidies	(PLN)	0.069	0.238	0.075	0.057
Share of subsidies in income on activity	(%)	6.5	19.2	7.0	5.4
Income on activity/1 litre of milk	(PLN)	0.39	0.25	0.39	0.40
Income on activity/1 hour of own work	(PLN)	24.33	4.62	19.86	53.81

[a] Real indirect cost without the cost of external factors.

[b] Subsidies include complimentary area payment and the so-called animal payment to committed feed area.

Table 5

Production, costs and income obtained from production of milk in organic farms in 2012 against the background of previous years (real data)

Specification		Average in organic farms keeping dairy cows					
		2006	**2007**	**2008**	**2009**	**2011**	**2012**
Number of farms under research		29	19	29	20	18	15
Average annual population of dairy cows	(animals)	6.6	5.8	6.5	8.9	9.4	10.1
Milk yield	(litres)	3347	3383	3330	3346	3100	3188
Average annual sales price of milk	(PLN/litre)	0.86	0.93	0.94	0.83	1.02	1.04
		Per 1 dairy cow					
Total value of production	**(PLN)**	**3736**	**3926**	**3888**	**3669**	**4080**	**4339**
of which: milk		2838	3075	3088	2749	3151	3306
calf weaned from cow		676	638	591	703	690	749
culled dairy cow		221	213	208	217	239	283
Total direct costs	**(PLN)**	**1014**	**1443**	**1444**	**1259**	**1673**	**1440**
of which: herd replacement		315	292	294	309	342	349
feeds from outside of farm		41	177	86	138	393	148
own commercial feeds		491	731	803	506	620	638
own non-commercial feeds		32	47	76	91	94	73
other		134	197	185	214	223	231
Gross margin without subsidies	**(PLN)**	**2722**	**2483**	**2444**	**2410**	**2408**	**2899**
Real indirect costs[a]	(PLN)	456	778	831	663	837	955
Gross value added on activity	**(PLN)**	**2266**	**1705**	**1612**	**1748**	**1571**	**1944**
Depreciation	(PLN)	374	585	718	764	892	815
of which: buildings and structures		140	210	219	233	232	205
machinery and equipment		117	196	217	248	347	339
means of transport		108	173	235	244	281	238
Net value added on activity	**(PLN)**	**1892**	**1120**	**894**	**984**	**679**	**1129**
Cost of external inputs	(PLN)	70	84	122	114	201	171
Income on activity without subsidies	**(PLN)**	**1822**	**1036**	**772**	**870**	**478**	**959**
Subsidies[b]	(PLN)	491	729	725	855	773	562
Income on activity	**(PLN)**	**2313**	**1765**	**1497**	**1724**	**1251**	**1521**
COSTS TOTAL	***(PLN)***	***1914***	***2890***	***3115***	***2799***	***3602***	***3380***
Labour inputs total	(hours)	259.3	324.4	237.7	227.0	241.3	219.4
including: own labour inputs		258.9	322.2	237.0	226.7	240.5	218.6
Measures of economic effectiveness							
Total costs/1 litre of milk	(PLN)	0.57	0.85	0.94	0.84	1.16	1.06
Total costs per 1 PLN of income on activity without subsidies	(PLN)	1.05	2.79	4.03	3.22	7.53	3.53
Subsidies per 1 PLN of income on activity without subsidies	(PLN)	0.27	0.70	0.94	0.98	1.62	0.59
Share of subsidies in income on activity	(%)	21.2	41.3	48.4	49.6	61.8	37.0
Income on activity/1 litre of milk	(PLN)	0.69	0.52	0.45	0.52	0.40	0.48
Income on activity/1 hour of own work	(PLN)	8.94	5.48	6.32	7.61	5.20	6.96

[a] Real indirect cost without the cost of external factors; [b] Subsidies include complimentary area payment, animal payment and organic payments to committed feed area.

Table 6

Selected descriptive statistical data concerning the profitability indicator in delimited ranges of the production scale of the production activities examined in 2012[a]

Specification		Maize for grain			Edible potatoes			Live animals			Dairy cows (milk)		
		2-8	**10-25**	**30-80**	**1-3**	**5-10**	**13-30**	**4-16**	**20-40**	**50-260**	**5-10**	**15-45**	**50-130**
Average	(%)	125.4	140.3	135.8	143.6	117.4	146.2	80.1	88.0	99.6	118.6	135.9	136.9
Percentile 5%	(%)	80.8	83.6	85.6	73.0	69.4	90.1	55.2	62.7	67.6	87.1	99.4	96.2
Median	(%)	131.5	132.7	128.1	151.5	121.8	134.9	79.4	91.1	93.2	116.3	135.0	135.4
Percentile 95%	(%)	194.8	210.1	214.7	277.4	177.2	187.0	132.7	153.4	176.7	191.6	199.6	205.8
Quadratic deviation	(pp)	29.8	16.9	18.8	33.3	23.8	22.4	10.9	15.1	14.9	24.0	16.8	20.9
Positional coefficient of variation	(%)	22.7	12.7	14.7	22.0	19.6	16.6	13.8	16.6	15.9	20.7	12.5	15.4
Rate of farms with the profitability indicator below 100	(%)	14	18	13	14	18	13	77	74	68	33	6	8

[a] Selection criterion of the scale of production as in Tables 1 to 4.

Table 7

Selected descriptive statistical data concerning the profitability indicator of milk production in chosen organic farms in 2012 against the background of previous years

Specification		**2006**	**2007**	**2008**	**2009**	**2011**	**2012**
Average	(%)	195.2	135.8	124.8	131.3	113.3	128.4
Percentile 5%	(%)	87.2	88.5	79.2	79.8	76.7	91.0
Median	(%)	163.7	124.0	128.0	125.9	125.6	127.2
Percentile 95%	(%)	310.3	207.9	184.1	199.7	168.9	201.7
Quadratic deviation	(pp)	50.8	27.4	31.7	19.4	22.6	28.9
Positional coefficient of variation	(%)	31.0	22.1	24.8	15.4	18.0	22.7
Rate of farms with the profitability indicator below 100	(%)	14	16	38	25	28	20