INSTITUTE OF AGRICULTURAL AND FOOD ECONOMICS
NATIONAL RESEARCH INSTITUTE

Polish farms with cattle production in comparison to selected countries

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COMPETITIVENESS OF THE POLISH FOOD ECONOMY UNDER THE CONDITIONS OF GLOBALIZATION AND EUROPEAN INTEGRATION

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COMPETITIVENESS OF THE POLISH FOOD ECONOMY UNDER THE CONDITIONS OF GLOBALIZATION AND EUROPEAN INTEGRATION

Warsaw 2013

Study developed under the theme of **Competitiveness of Polish agricultural holdings and agricultural products at present and in a mid-term perspective**
in the task: *Opportunities to improve the efficiency of the different groups of farms in view of studies on similar holdings in selected countries*

The purpose is to determine the scope for improvement of the functioning of Polish farms with cattle production (dairy and non-dairy cattle breeding) in comparison to similar holdings in selected countries.

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Introduction

1.1. Setting the research problem

In Poland, the structure of agricultural production in recent years has been dominated by animal production. Its share in 2000 was over 62%. In subsequent years, despite the increase in value, its share fell to 53% in 2011. The structure of animal production was dominated by cattle, whose share in 2011 was 43.2%, and the share of milk alone was 32.1%. Dairy products are exported. Since 2003, Poland has achieved a positive balance in the foreign trade in dairy products; in 2011 it amounted to EUR 874 million, and in the next year it exceeded EUR 900 million. The share of dairy products in exports of agri-food products was also significant; in 2011 it was 9.5% [Handel Zagraniczny 34/2013]. In 2010, the rearing of cattle was conducted on 453.9 thousand farms [Powszechny Spis Rolny 2011], providing a source of livelihood for nearly 2 million residents of rural areas. The development potential of cattle production in Poland is high due to high labour resources in agriculture and a large area of permanent grassland which in 2010 was 3,283.53 thousand ha, and their participation in the agricultural area was 21.1% [Powszechny Spis Rolny, Użytkowanie gruntów 2011]. These resources allow for an increase in cattle numbers by at least 50%, from 5,500 thousand (in 2010) to 7,500 thousand. This was the population in 1995 and at its peak in 1975, the number of cattle population in Poland was 13,254 thousand. Potential for milk production far exceeds the current level of production, which is slightly more than 12 billion litres. In 1990, milk production in Poland exceeded 15 billion litres.

Given the current level of milk production and the existing production capacity, it is justified to conduct studies on the possibility of increasing the use of potential in cattle production, particularly dairy and beef cattle. These products are the raw material in the dairy and meat industries, and after processing, may constitute export items. Opportunities for development of milk and cattle production for the Polish market are hindered due to limited domestic demand. Development opportunities for this branch of animal production lie in the growth of exports of dairy and beef processing products. The main directions of these exports are the EU countries and third markets. On these markets, there is the strong competition among producers of milk and cattle from the EU. Therefore, it is necessary to study the efficiency of Polish farms producing milk and beef cattle and compare their results with producers from EU countries who are our competitors in these markets. Dairy and beef trade and processing enterprises directly compete on these markets. Their economic efficiency to a large extent determines the cost of the raw material, i.e. milk and beef produced on farms. According to A. Woś, the share of raw materials in total costs amounted to more

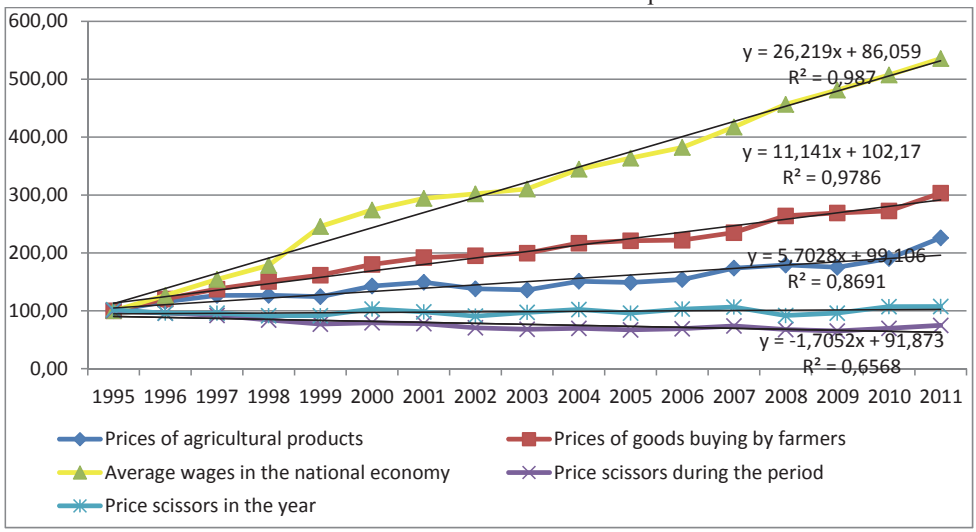
than 2/3 [Woś 2003]. Therefore, improving the efficiency of Polish cattle farms substantially affects the level of competitiveness of Polish dairy products and processed beef in foreign markets.

Regardless of these external premises, indicating the need for research, one should also pay their attention to internal reasons. They include permanent trends that exist between the costs of factors of production and the cost of agricultural products sold by farmers. Chart 1 shows the evolution of labour costs in national economy outside agriculture, the cost of inputs purchased by farmers and the prices of agricultural products in 1995-2011. The trends clearly show that the highest rate of growth occurs in the non-agricultural labour costs measured by the level of wages. In the analyzed period, wages in non-agricultural sectors increased more than fivefold. During the same period, the prices of agricultural means of production more than tripled, and the prices of agricultural products rose slightly more than twofold. These types of trends are persistent patterns and occur in all countries with a market economy. Faster growth in labour costs and the means of production than that of sales prices of agricultural products leads to a decrease in unit cost-effectiveness of agricultural products. In this situation, farmers wishing to achieve income from farm at the parity level[1] are forced to increase the scale of production. It can be achieved by an increase in the intensity of production or at a given level of intensity of production by increasing the area of the holding in relation to plant production, and in the case of animal production, by increasing the number of animals. One can also use both of these methods at the same time. Increasing production scale is possible only if there is a demand for agricultural products. As stated above, domestic demand for agricultural products is limited. The forecasting studies indicate that domestic demand for agricultural products may increase at a rate of 1% per year [Woś 1998].

In this situation, the main factor in the development of agricultural production, including the production of milk and beef cattle, is exports. Chart 1 also shows the indicators of "price scissors" over the years and in the entire period. The "price scissors" indicator was characterized by volatility, fluctuating around 100%. Values below 100% were observed in: 1996-1999, 2002-2003 and 2008-2009. In the remaining years, the economic situation was favourable. In contrast, throughout the period, the "price scissors" indicator stood at about 70%, which means that the prices of agricultural products in relation to the prices of the means of production grew slower by 30%.

[1] Income parity – income comparable to wages and salaries in the national economy outside agriculture.

Chart 1.1. Trends in the cost of factors of production



Source: [Ziętara W. 2013].

1.2. Purpose of research

The main objective of the study is to assess the economic and productive activities of holdings focused on cattle production, including milk and beef and milk production in Poland, and to determine their effectiveness in relation to the corresponding Hungarian, German, Danish and Dutch holdings in 2008-2010. The secondary objective is to determine directions of development of the surveyed Polish holdings in the medium term.

Implementation of this objective is to be done by performing the following research tasks:

- determining the place and role of milk production in Poland and in selected countries,
- assessment of: production potential of holdings with beef production, focused on the production of milk and milk and beef cattle, organization of production, costs and effects of these farms,
- identifying the main factors affecting the efficiency of the surveyed households,
- determining the directions of development of dairy farms and farms with cattle production in the medium term.

We also adopted the following research hypotheses:

1. The scale of milk production is the primary factor determining the efficiency of milk production on farms;
2. Polish dairy farms with more than 30 dairy cows are able to develop;
3. Farms specializing in milk production are more effective than bi-directional farms, conducting production of milk and beef cattle;
4. Polish dairy farms with over 50 dairy cows are capable of competing with their competitors in the surveyed countries.

1.3. Research methods

1.3.1. Methods for selecting subject of the study

Subjects of the study include farms focused on milk production (type 45) and milk and beef cattle production (type 49) covered by the European FADN in 2008-2010. Data from later years, 2011 and 2012, has not been yet available. The study covered holdings with these lines of production from Poland, Hungary, Germany, Denmark and the Netherlands.

Table 1.1. Size classes of holdings by Standard Output (SO)

Size classes of farms		Size in EUR
(1)	Very small	2 000 ≤ SO < 8 000
(2)	Small	8 000 ≤ SO < 25 000
(3)	Small to average	25 000 ≤ SO < 50 000
(4)	Average to large	50 000 ≤ SO < 100 000
(5)	Large	100 000 ≤ SO < 500 000
(6)	Very large	SO < 500 000

Source: [Goraj L. 2012].

In terms of the conditions of production and the structure of farms, such countries as Hungary and Germany are similar to Poland. In turn, Danish and Dutch holdings represent the types of farms with high technical efficiency. Surveyed holdings differ in economic size described by value of standard output (SO). Size classes of holdings determined using this criterion are given in Table 1.1. Table 1.2 shows the size of the surveyed holdings with regard to their economic size.

The figures in Tables 1 and 2 show that not all size classes are represented in the European FADN system. This system does not include holdings from the two smallest classes of up to EUR 25 thousand. Dairy farms (type 45) in Poland covered by the survey included classes 3, 4 and 5. The survey did not include

the largest holdings – class 6, due to insufficient population – less than 15 holdings. Dairy farms in Hungary and Germany are represented by classes 3-6, while in Denmark by classes 5 and 6 and in the Netherlands by classes 4 to 6.

Table 1.2. Number of surveyed holdings in 2008-2010

SO classes EUR thousand	Poland	Hungary	Germany	Denmark	Netherlands
Dairy farms (type 45)					
(3) 25 – 50	500 - 1000	15 - 40	40 - 100	-	-
(4) 50 – 100	500 - 1000	15 - 40	200 - 500	-	15 - 40
(5) 100 – 500	100 200	15 - 40	1000 - 2000	100 - 200	200 - 500
(6) 500 and more	-	15 - 40	200 - 500	200 - 500	40 - 100
Farms with dairy cattle and slaughter cattle (type 49)					
(3) 25 – 50	40 - 100	-	40 - 100	-	-
(4) 50 – 100	15 - 40	-	100 - 200	-	-
(5) 100 – 500	-	-	200 - 500	-	15 - 40
(6) 500 and more	-	-	15 - 40	-	15 - 40

Source: Polish and European FADN, IAFE-NRI.

Definitely less farms of type 49 were covered by the survey of the European FADN. Holdings from Germany of classes 3 to 6, from the Netherlands of classes 4 to 6, and from Denmark, only of class 5, are represented most comprehensively. Poland is represented only by the two smallest classes 3 and 4. There are no Hungarian holdings in the population. The number of holdings in each class is highly diverse. Holdings from Poland and Germany are most strongly represented in each class, and holdings from Hungary and the Netherlands are the least numerous. No representation of holdings of all size classes for dairy farms (type 45) and farms with cattle for slaughter (type 49) complicates the assessment of Polish farms. Therefore, caution is needed in the formulation of final conclusions.

1.3.2. Methods for the collection of research materials and data sources

The primary method of obtaining research materials was the documentary method, and research material was derived from data on individual farms under the European FADN in 2008-2010. The data included in the statistical yearbooks of Poland and surveyed countries, Eurostat and the literature, was an additional source of research material.

1.3.3. Methods for the development and presentation of research materials

The primary method of developing material was a descriptive method. The study covered a period of three years (2008-2010). Arithmetic means were calculated for this period and used in tabular and horizontal analysis. Indicators of change were calculated for individual characteristics, taking value of characteristics in 2008 as the basis for reference. The characteristics of the surveyed holdings included assessment of production potential of the organization of production, costs and outcomes, using the following indicators:

- Production potential of farms

1. Agricultural land area (ha),
2. Share of leased land (%),
3. Total labour input (AWU/farm),
4. Total labour input (AWU/100 ha of AL),
5. Share of own labour (%),
6. Value of assets (EUR thousands/ha),
7. Value of assets (EUR thousands/AWU),
8. Share of fixed assets in assets (%),
9. Share of equity in liabilities (%).

- Organisation of production

1. Share of cereals in AL (%),
2. Share of forage crops in AL (%),
3. Stocking density (LU/100 AL),
4. Stocking density of animals fed in a grazing system (LU/ha of forage area),
5. Number of cows (heads/farm),
6. Number of other cattle (LU/farm),
7. Share of animal production in total farm production (%),
8. Share of plant production in total farm production (%),
9. Share of other production (%),
10. Share of production transferred to the household (%).

- Costs

1. Total costs (EUR thousand/ha AL),
2. Direct costs (EUR thousands/ha AL),
3. Costs of purchased cattle feed (EUR/livestock unit),
4. Costs of own feed for cattle (EUR/livestock unit),
5. Other costs of animal production (EUR/livestock unit),
6. Cost of hired labour (EUR/ha AL),
7. Rent costs (EUR/ha AL),
8. Cost of interest (EUR/ha AL),
9. Depreciation costs (EUR/ha AL).

- Effects

1. Wheat yield (dt/ha),
2. Milk yield of cows (kg/cow),
3. Land productivity (EUR thousand/ha AL),
4. Productivity of assets (times),
5. Productivity of current assets (times),
6. Labour productivity (EUR thousand/AWU),
7. Profitability of land (EUR thousand/ha AL),
8. Profitability of assets (%),
9. Profitability of own work (EUR thousand/FWU),
10. Cost-effectiveness of production (%),
11. Viability of production (%),
12. Share of subsidies in income from holding (%),
13. Share of subsidies in revenues from holding (%),
14. Income from management[2] (EUR thousand/holding),
15. Income parity A[3] (%),
16. Income parity B[4] (%),
17. Net investment rate (%).

The adopted level of own cost of production factors necessary to calculate the income from the management is given in Table 1.3. The costs of using own land were set at the level of rent in given size classes of holdings in the surveyed countries. Costs of own labour were set at the level of wages for hired labour in the surveyed size classes of farms. The cost of labour in the national economy corresponds to the level of wages outside agriculture in given countries, and the cost of equity is set at the level of ten-year bond rates in surveyed countries and years.

The analysis of the efficiency of Polish cattle farms used the method of DEA (Data Envelopment Analysis), whose assumptions are presented in Chapter 6 "Efficiency of farms with cattle production by economic size, calculated using the DEA method".

[2] Income from management was calculated as the difference between income from farms and costs of using own factors of production – land, labour and capital. The cost of land is assumed at the level of lease in the given size class, the cost of own labour at the level of wages for hired labour in a given class of holdings, and the cost of equity at the level of interest rates on ten-year bonds.

[3] Income parity "A" – the ratio of income from the farm per unit of own labour (FWU) to wages for hired labour in the farms of a given size class in each of the surveyed countries.

[4] Income parity "B" – the ratio of income from the farm per unit of own labour (FWU) to the wages and salaries for hired labour in the national economy (outside agriculture) in the surveyed countries.

Table 1.3. Costs of using own production factors

Countries	Farm size in SO (EUR thousand) type 45			
	25 - 50	50 - 100	100 - 500	500 and over
	Cost of land (EUR/ha)			
Poland	52.3	57.9	47.3	-
Hungary	29.3	46.3	68.6	80.1
Germany	218.2	196.1	238.9	137.9
Denmark	-	-	494.5	666.7
Netherlands	-	674.2	626.3	819.6
Countries	Cost of labour in agriculture (EUR/h)			
Poland	1.86	1.93	2.72	-
Hungary	2.24	2.13	2.59	4.35
Germany	5.98	7.89	8.21	10.79
Denmark	-	-	16.85	18.04
Netherlands	-	10.56	12.34	13.89
Countries	Cost of labour in the national economy (EUR/h)		Cost of capital by 10-year bonds (%)	
Poland	4.36		5.91	
Hungary	4.53		8.53	
Germany	21.55		3.82	
Denmark	24.86		3.94	
Netherlands	21.95		3.92	

Source: Own calculations based on FADN, Eurostat.

In order to conduct a comprehensive evaluation of the effectiveness of cattle farms, by taking account of a larger number of variables, the analysis included the following indicators: productivity of land determined by the value of production per 1 ha of AL, in thousand EUR/ha, economic performance determined by the value of production per unit of labour, in thousand EUR/AWU; profitability of land determined by the income from a farm in thousand EUR/ha; profitability of own labour – determined by income from a farm per unit of own labour, in thousand EUR/FWU; profitability of assets determined by ratio of income from a farm to the value of assets; income from management in thousand EUR/holding; net investment rate determined by ratio of net investment to depreciation, as well as the share of subsidies in income from a farm. All of these indicators, except for the share of subsidies in income, are stimulants. This means that higher values of these indicators are assessed positively. A higher share of subsidies in income indicates greater dependence of holdings on external factors over which farmers have no effect. Therefore, a higher proportion of

subsidies in income from a farm is rated negatively. The selection of indicators is largely subjective. In order to reduce the degree of subjectivity, the selection of indicators was driven by the desire to make possibly comprehensive assessment of the effectiveness of management. Efforts were made to take into account both the production (productivity of production factors) and economic (profitability) effects, as well as the ability to grow.

In order to aggregate the indicators (variables), the study applies the method of indicator of relative goodness developed by R. Manteuffel [Manteuffel 1963]. Currently, this method is known under the name of "zeroed unitarisation" [Kukuła 2000]. It involves assigning each variable a number of points. A feature with the lowest value receives "0" points, while a feature with the highest value is given "100" points. The number of points for other characteristics is calculated by the following formula:

$$d = (a*100)/b$$

where:

d – number of points obtained by a given subject (farm) for a particular feature,
a – difference between the value of a feature in a given farm and the lowest value in a given set,
b – spread of given feature (difference between the peak value of the feature and the lowest value in a given set).

The objects covered by the comprehensive evaluation of farms included separately dairy farms (type 45) and beef cattle farms (type 49), grouped by economic size expressed in the SO.

2. Place and role of cattle production in Polish agriculture and in selected countries

2.1. Structure of agricultural production in Poland in 2000-2011

The role of agricultural production is determined by its level and structure. Table 2.1 gives the numbers characterising size and structure of commodity agricultural production in Poland in 2000-2011. It is worth emphasizing the dynamic growth of this category of production. The growth rate of commodity agricultural production in 2011 compared to 2000 was 212.7%. The rate of growth of crop production was higher, the growth rate in this period was 265%, and for animal production it was 181.4%. Diversified growth of plant and animal production was due to the higher cost-effectiveness of crop production in this period. There were also changes in the structure of production. 2000 was strongly dominated by animal production; its share was 62.6%.

Table 2.1. Structure of agricultural commodity production in 2000-2011

Specification	2000		2005		2011	
	PLN million	%	PLN million	%	PLN million	%
Commodity agricultural production	33491.4	100.0	42907.0	100.0	71263.1	100.0
Including: plant production	12541.0	37.4	16605.6	38.7	33239.7	46.6
Animal production	20950.4	62.6	26301.4	61.3	38023.4	53.4
Milk production	6725.4	32.1[a]	8475.3	32.2[a]	12205.9	32.1[a]
Production of beef cattle	2028.3	9.7[a]	2558.3	9.7[a]	4251.4	11.1[a]
Total cattle production	8753.7	41.8[a]	11033.6	41.9[a]	16457.3	43.2[a]

[a] share in animal production

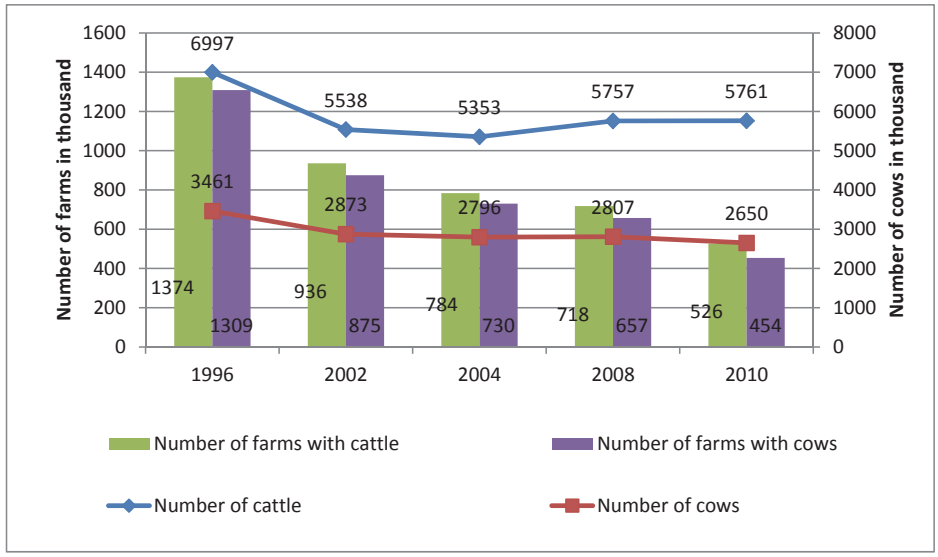
Source: [Rocznik Statystyczny Rolnictwa 2012].

After 11 years, animal production prevailed, though its share decreased to 53.4%. The commodity structure of animal production was dominated by the share of cattle production, which was quite stable and was in the range of 41.8--43.2%. The cattle production was dominated by milk production. Its share in commodity animal production was 32.1%, while in the cattle production approximately 75% during the period. These numbers indicate a significant role of cattle production and milk production in it and justify the need to study the viability of farms involved in this kind of production.

2.2. Changes in the number of farms and cattle population in Poland in 1996-2010

The analysed period 1996-2010 results from the availability of statistics from the Common Agricultural Census. The corresponding numbers are shown in Chart 2.1. The analyzed period saw a significant reduction in the number of holdings with cattle, including cows. The number of holdings with cattle decreased by 61.5%, and the number of holdings with cows by 65.4%. The structure of farms has also changed. In 1996, the share of holdings with cows in the total number of holdings with cattle was very high i.e. 95.2%, while in 2010 it dropped to 86.3%. These changes, although small, point to the increasing specialization of farms. There were also significant changes in the stock of cattle and cows. The number of cattle in this period decreased by 17.7% and of cows by 23.5%. The structure of the cattle population also changed. The share of cows in the cattle population in 1996 was 49.4%, while in 2010 it fell to 45.9%.

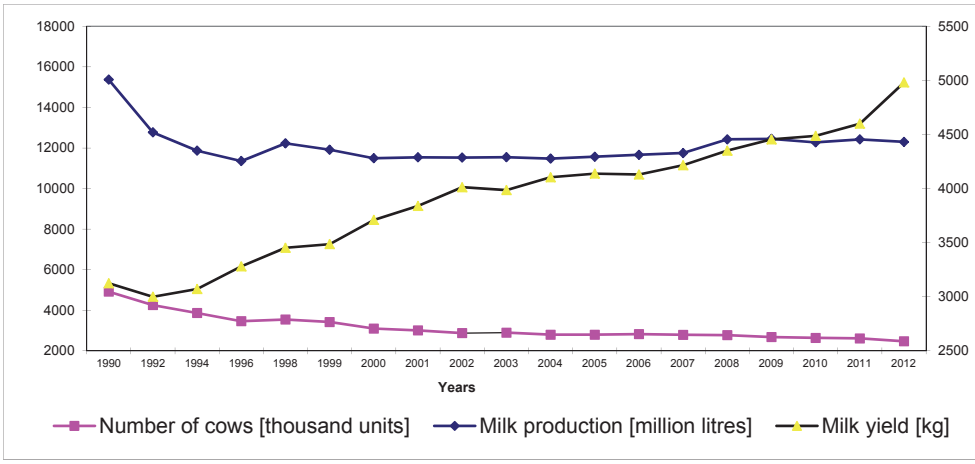
Chart 2.1. Changes in the number of holdings with cattle and in cattle population in 1996-2010



Source: [Adamski M. 2013].

These figures confirm the previous findings about the overlapping of specialization in the production of milk and beef cattle. These changes in the stock of cattle and cows in 1996-2010 were not too big, as a significant decrease in population occurred in 1990-1995, as shown by the numbers indicated in Chart 2.2.

Chart 2.2. Number of cattle, milk production and milk yield of cows in 1990-2012



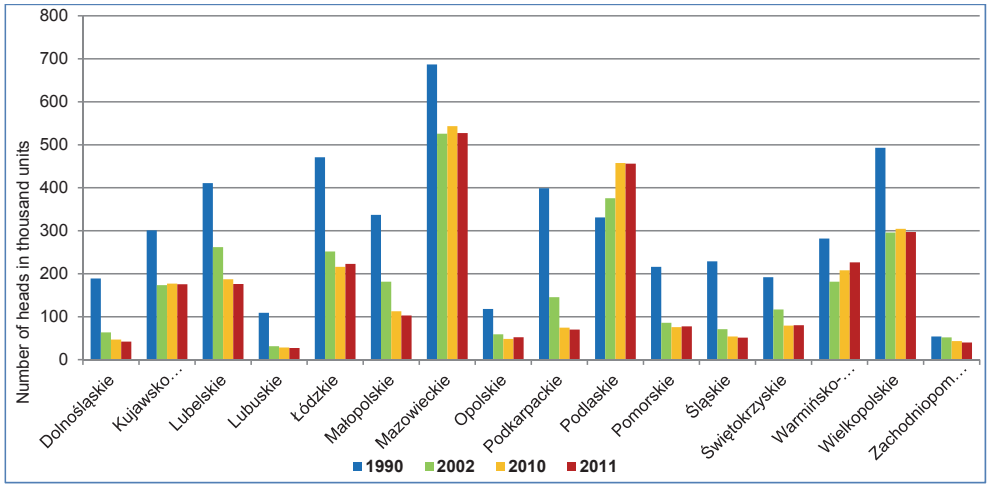
Source: [Ziętara W. 2013].

Trends shown in Chart 2.2. suggest that the strongest decline in the number of cows occurred in 1990-1996. The number of cows during this period decreased by 29.7% from 4919 thousand units in 1990 to 3461 thousand units in 1996; in the following years it decreased to 2469 thousand in 2012. The decrease in the period of 16 years was 28.7%, while compared to 1990 it was 50.1%. Milk production in 1990-1996 decreased by 26.2%, from 15,371 thousand tonnes to 11,355 thousand tonnes. In subsequent years, it underwent small changes with a slight increase, reaching in 2012 the level of 12,300 thousand tonnes. This level was lower than the volume of milk production in 1990 by 20%, despite the decrease in the number of cows by 50%. The difference between the rate of decline in the number of cows and milk production was a result of the increase in milk yield of cows, which in this period increased from 3125 kg of milk per cow per year to 4981 kg in 2012. The growth rate was 159.3%. This was a result not only of the selection of cows but also changes in the technology of milk production.

2.3. Changes in the stock of cows in spatial dimension between 1990 and 2011

In the period of 1990-2011 there were significant changes in the spatial distribution of cows. In 1990, 50.8% of cows were in the 5 following voivodeships: Mazowieckie (14.2%), Wielkopolskie (10.2%), Łódzkie (9.7%), Lubelskie (8.5%) and Podkarpackie (8.2). However, in 2011, 65.6% of cows were in the following provinces: Mazowieckie (20.0), Podlaskie (17.3), Wielkopolskie (11.1%), Warmińsko-Mazurskie (8.6) and Łódzkie (8.4%).

Chart 2.3. Changes in the number of cows in 1990, 2002, 2010 and 2011 in a spatial dimension



Source: [Adamski M. 2013].

The increased degree of diversification is also evidenced by the value of the Gini coefficient, which in 1990 was 0.153, while in 2011 it was 0.315. The value of "0" means no diversification, while the value of "1" means complete diversity, meaning that the entire population is in one province. It is worth emphasizing the growth in number of cows in Podlaskie Voivodeship, where the number of cows in the period increased by 37.7%. It is the only province where the number of cows increased. We must also emphasize the increase in the number of cows and its share in Warmińsko-Mazurskie Voivodeship, after a temporary decline. The largest decreases in the number of cows occurred in the following voivodeships: Podkarpackie (-82.5%), Dolnośląskie (-7.6%), Śląskie (-7%), Lubuskie (-75.2%) and Małopolskie (-69.5%).

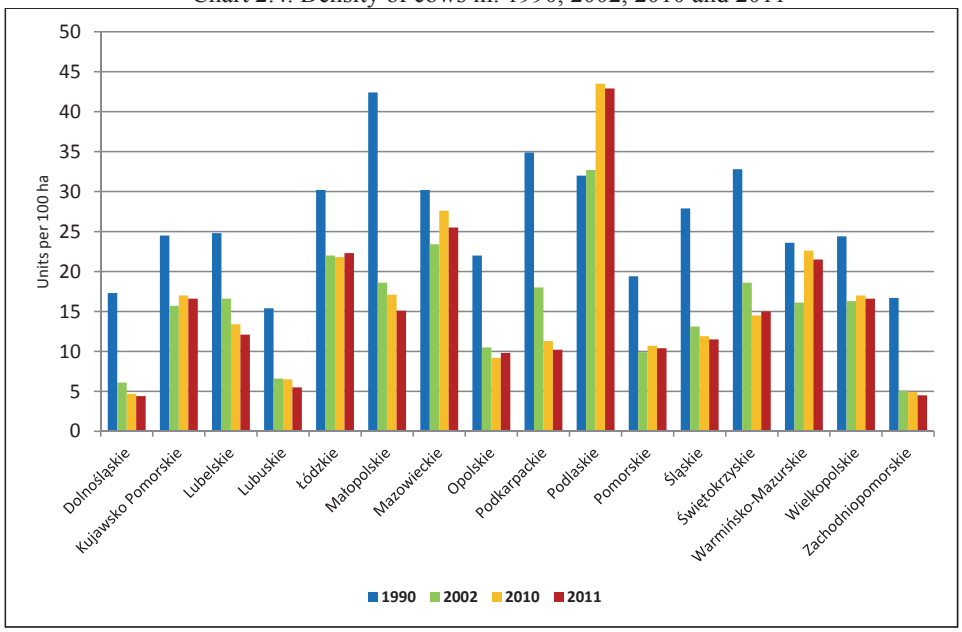
There were also significant changes in the density of cows per 100 hectares of AL, as shown in Chart 2.4. The average density of cows in 1990 was 26.3 cows/100 ha, while in 2011 only 17 cows. The decrease in density was 35.4%. In 1990, the highest density of cows, way above average, was in the following voivodeships: Małopolskie (42.4), Podkarpackie (34.9), Świętokrzyskie (32.8), Podlaskie (32) and Łódzkie 30.2 cows/100 AL. The lowest density of cows in that year was in the following voivodeships: Lubuskie (15.4), Zachodniopomorskie (16.7) and Dolnośląskie (17.3).

In 2011, by far the highest density of cows was in Podlaskie Voivodeship, where it stood at 42.9 cows/100 ha of AL. In the following regions it was significantly lower: Mazowieckie (25.5), Łódzkie (22.3) and Warmińsko-Mazurskie 21.5 cows/100 ha of AL. In the remaining voivodeships, the density of cows was lower than average. In the western voivodeships: Dolnośląskie, Zachodniopo-

morskie and Lubuskie, the density of cows ranged between: 4.4-5.5 units/100 ha of AL. The territorial distribution of cows and density show a clear concentration of milk production in the following voivodeships: Mazowieckie, Podlaskie and Warmińsko-Mazurskie. The processing of milk is also concentrated in these voivodeships.

The largest and most efficient dairy cooperatives, such as: "Mlekowita", "Mlekpol" and "Piątnica" are located in Podlaskie Voivodeship, while two of the largest private milk processing companies: "Danone" and "Bakoma" are located in Mazowieckie Voivodeship. In 2011 and 2012 the highest purchase prices of milk were in Podlaskie Voivodeship [Rynek Mleka 2013] and were as follows: 129 and 126 PLN/100 litres, while the lowest were in Małopolskie Voivodeship i.e. 105 and 107 PLN/100 litres.

Chart 2.4. Density of cows in: 1990, 2002, 2010 and 2011



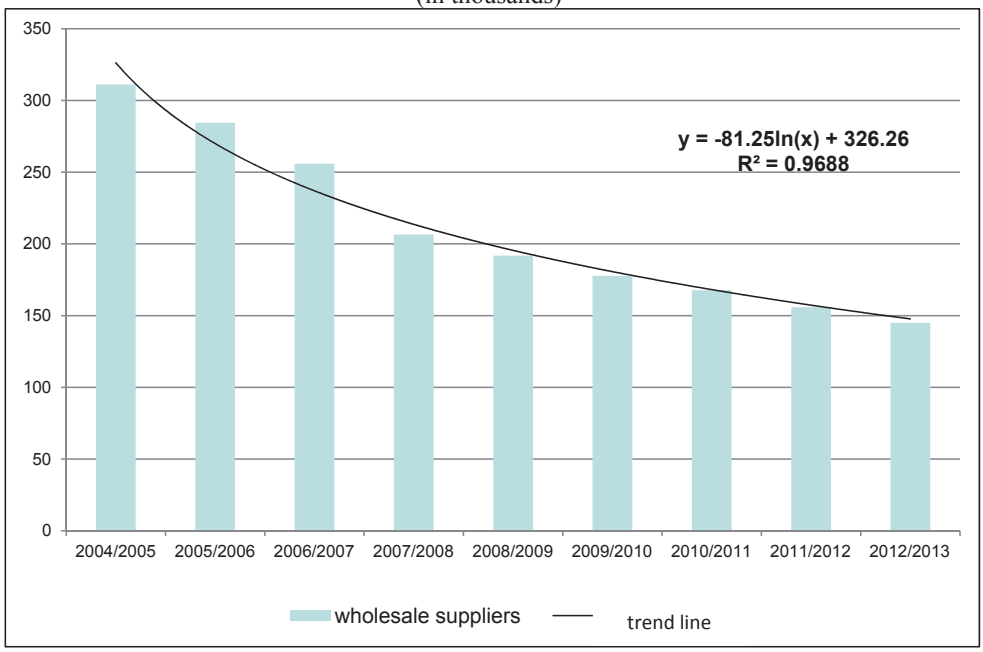
Source: [Biuletyn Informacyjny ARR No.1/2013; Ziętara W. 2012].

2.4. Changes in the number of milk suppliers in Poland

As shown in Section 2.1, in 1996-2010, the number of holdings with cattle, including cows, decreased respectively by 61.5 and 65.4%. In 2010, dairy cows were kept on 454 thousand farms. Some of these farms produced milk for their own needs. The actual role of milk is decided by the entities producing milk for sale to dairy plants. The milk quota system introduced in 2004 distinguished wholesale suppliers who were granted milk quotas for sales in dairy plants and so called direct suppliers who could sell milk through direct sales.

The number of wholesale suppliers and its changes in 2004-2012 are shown in Chart 2.5. In the quota year 2004/2005, the number of wholesale suppliers was 311 thousand, while in 2012/2013 the number of these suppliers has decreased to 145 thousand. The decline is 53.4%. Chart 2.5. shows that the reduction in the number of wholesale providers was best mapped by a logarithmic function. The coefficient of determination R^2 was 0.9688. The presented trend shows the actual process of concentration in milk production. Assuming that in subsequent years the rate of decline in the number of wholesale suppliers will be similar, by 2020 the number of these suppliers will be reduced to about 100 thousand. The planned elimination of milk quotas by 2015 may increase the rate of concentration.

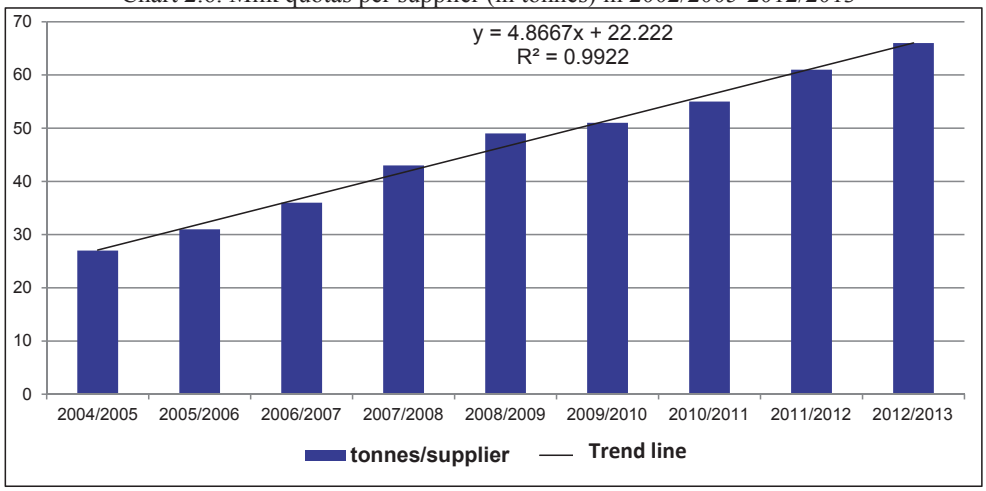
Chart 2.5. Number of wholesale suppliers in 2004/2005- 2012/2013
(in thousands)



Source: [Biuletyn Informacyjny ARR No.1/2013; Ziętara W. 2012].

The milk quota per supplier increased along with the decrease in the number of wholesale suppliers. In 2004/2005, there were 27 tonnes of milk per one wholesale supplier, while in 2012/2013, 60 tonnes of milk (Chart 2.6.). In this case, the changes were in accordance with the linear function, at the determination index of 0.9922.

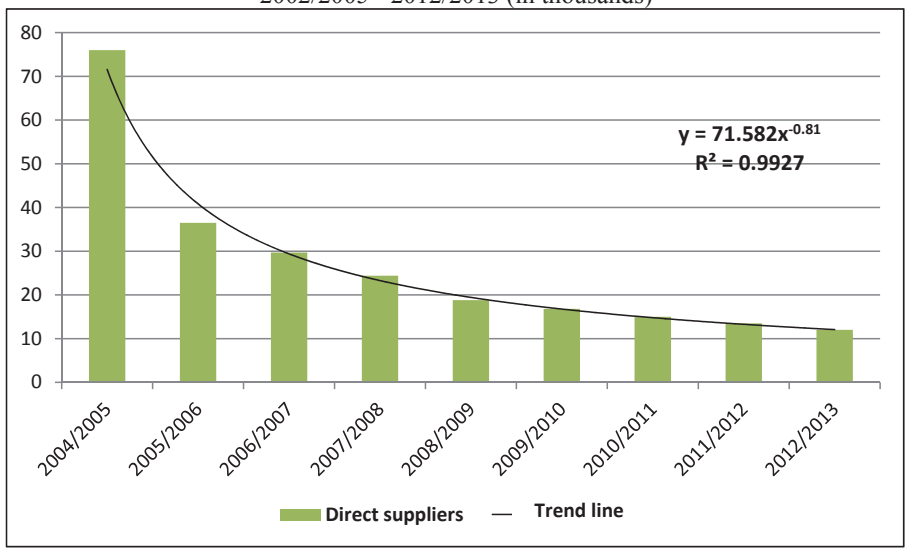
Chart 2.6. Milk quotas per supplier (in tonnes) in 2002/2005-2012/2013



Source: [Biuletyn Informacyjny ARR No.1/2013; Ziętara W. 2012].

Regardless of the wholesale suppliers, there are also direct suppliers. Changes in their numbers are shown in chart 2.7. They do not play a major role. Their numbers in the analysed period decreased from 76 thousand to 12 thousand. Changes were in accordance with the power function, at the determination index of 0.9927.

Chart 2.7. Changes in the number of direct suppliers in 2002/2005 - 2012/2013 (in thousands)



Source: [Biuletyn Informacyjny ARR No.1/2013; Ziętara W. 2012].

2.5. Milk economy in Poland and in the surveyed countries in 2010

There are striking differences in the organization of milk production between Poland and the surveyed countries. The corresponding numbers are shown in Table 2.2. These relate to 2010. Poland is clearly different in the number of farms. In 2010, Poland had 425.8 thousand farms with cattle. Germany had only 89.8 thousand farms with cattle, the Netherlands and Hungary considerably less, respectively 19.8 and 11.4 thousand. The smallest number of farms with cattle was in Denmark, only 4.3 thousand. Number of cows kept also varied. The largest number of cows was in Germany, 4,164.8 thousand units. In Poland, in the same year there were 2,505.6 thousand cows, while in Holland 1,487.6 thousand. The number of cows in Denmark stood at 568.2 thousand units, and the smallest number was in Hungary, only 245.1 thousand units.

There were also very large differences in the concentration level of raising cows. The largest herds of cows were in Denmark and the Netherlands, where the number of cows per farm was 132 and 75 cows respectively. In Germany, the average number of cows on a farm was ca. 46 units, and in Hungary about 22 cows. By far the lowest concentration of cows was on Polish farms, only 6 cows per farm. Other indicators illustrating the level of raising cows include: share of holdings with up to 9 cows and share of cows in herds up to 9 units. In Poland and in Hungary the share of holdings with up to 9 cows was respectively 82.2 and 81.5%, whereas in other countries this share was in the range of 3% (Netherlands) - 13% (Germany). In Poland in 2010, herds with up to 9 cows, kept 32.2% of the total number of cows, while in the Netherlands and Denmark those herds kept only 0.1% of cows. These facts point to a dramatically low level of concentration of cows on Polish farms.

Table 2.2. Number of farms and number of cows in the surveyed countries in 2010

Specification	Poland	Hungary	Germany	Denmark	Netherlands
Number of farms with cattle (thousand)	425.8	11.4	89.8	4.30	19.8
Number of cows (thousand)	2505.6	245.1	4164.8	568.2	1487.6
Number of cows on a farm (units)	5.9	21.5	46.4	132.2	74.7
Share of farms with 9 cows (%)	82.2	81.5	12.9	4.6	3.0
Share of cows in herds of up to 9 units	32.2	10.6	1.4	0.1	0.1

Source: [Statistisches Jahrbuch über Ernährung 2012].

Differences in the level of milk production were much smaller than in cow population (Table 2.3). The highest milk production was in Germany; in 2010 it was about 30 million tonnes of milk, almost three times higher than in Poland and the Netherlands, where it was respectively 12.4 and 11.9 million tonnes of milk. The lowest milk production was in Hungary, only 1.68 million tonnes. Smaller differences in milk production in the surveyed countries than in the total cow population were the result of differences in the level of milk yield of cows. In Denmark and the Netherlands, milk yield of cows exceeded 8 thousand kg of milk per cow per year, while in Poland it was about five thousand kg. In Hungary and Germany, milk yield was similar and was ca. 7 thousand kg.

There were also significant differences in the level of milk production marketability determined by the share of milk purchase in total milk production. In Poland and in Hungary the share of purchase was respectively: 72.3 and 69.6%, while in other countries it was around 98%. The low share of milk purchase in Poland and Hungary indicates higher consumption of milk on farms for the purpose of consumption in the household and feed.

Table 2.3. Role of milk production in the surveyed countries in 2010

Specification	Poland	Hungary	Germany	Denmark	Netherlands
Milk production (thousand tonnes)	12430	1685	29629	4910	11948
Milk yield of cows (kg/cow)	4960	6874	7144	8641	8031
Share of purchase (%)	72.3	69.6	98.1	98.1	97.2
Participation in milk production in the EU-27 (%)	8.3	1.1	19.6	3.2	8.0
Exceeding (+) or not (-) quotas in 2011/2012	-200.8	-534.7	+37.4	-9.8	+59.1

Source: [Statistisches Jahrbuch über Ernährung 2012].

The share of the surveyed countries in the EU milk production was also highly diverse. The highest participation was characteristic of Germany. Their share in milk production in the EU-27 in 2010 was about 20%. A similar level of participation was in Poland and the Netherlands, respectively: 8.3 and 8.0%. The share of Hungary was negligible, only 1.1%. It can therefore be assumed that Poland is a major producer of milk in the EU. Covering Poland and Hungary in 2004 with milk quotas was perceived as a barrier to development. It turned out, however, that both Poland and Hungary did not take full advantage of the allocated milk quota. This is evidenced by the figures given in Table 2.3. Germany and the Netherlands fully exploited production limits, and even exceeded them

in 2010. The planned abolition of milk quotas after 2015 will probably result in stronger variations in milk production between EU countries, but also in Poland between the voivodeships. One should expect a further increase in milk production in central and eastern Poland, in the following voivodeships: Mazowieckie, Podlaskie and Warmińsko-Mazurskie [Parzonko 2012].

3. Evaluation of production potential, organization of production, costs and effects on dairy farms (type 45) of the surveyed countries, depending on the economic size in 2008-2010

3.1. Assessment of dairy farms in different economic size classes

3.1.1. Assessment of dairy farms – small to average (class 3, SO of EUR 25-50 thousand) in the surveyed countries

3.1.1.1. Evaluation of production potential of dairy farms – small to average

In this class of economic size, the evaluation covers farms from Poland, Hungary and Germany. The figures characterizing the potential of this class size of dairy farms are shown in Table 3.1. The average size of dairy farms in Poland and Hungary was similar and amounted to EUR 35.9 and 37.7 thousand. German farms were about 15% higher. Polish and Hungarian farms increased slightly in size, respectively by 2 and 1.6%. German farms decreased in size by 6%.

The greater variation occurred in the area of agricultural land. Polish and German holdings had a similar area, which was: 26.8 and 20.6 ha. Hungarian farms were almost twice as large. Polish and Hungarian farms in the period decreased in area, respectively by 16.2 and 26.4%, while the German farms increased by about 2%.

The surveyed farms in addition to own land also used leased land. The lease was used to the greatest extent by Hungarian farms, where the share of leased land was approximately 50%. In Polish and German farms the share of leases was lower and stood at: 26.7 and 33.1%.

Total labour input determined by the number of AWU/farm were included in the range of 1.96 (Poland) to 1.22 (Germany). In Hungarian farms input amounted to 1.66 AWU. In terms of labour per 100 ha of AL, diversity was higher due to differences in the area of AL. The highest inputs were in Polish farms (7.37 AWU/100 ha) and the lowest in Hungarian farms, less than 4 AWU. In the studied period, Polish and Hungarian farms increased inputs per 100 ha of AL by 14 and 55% respectively, while German holdings decreased labour inputs by 5%. The share of own labour in total inputs was high, in the range of 78.5% (Hungary) to 99.1% (Germany). Polish and Hungarian farms recorded a decrease in the share of own labour by 15% and 32.7% respectively, while German holdings recorded growth of 2.6%. The increase in the share of own labour in labour inputs in German farms should be associated with high levels of labour costs in this country.

Table 3.1. Production potential of small to average dairy farms (type 45) according to size of SO (total volume of standard output in the range of EUR 25-50 thousand, class 3) in 2008-2010

Specification	Unit	Poland		Hungary		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Economic size	SO	**35.9**	102.0	**37.7**	101.6	**42.7**	94.0
Area of AL	ha	**26.8**	83.8	**43.8**	73.6	**20.6**	101.8
Share of leased land	%	**26.7**	88.6	**48.7**	96.2	**33.1**	110.7
Total labour input	AWU	**1.96**	95.5	**1.66**	114.2	**1.22**	96.8
Total labour input/ 100 ha of AL)	AWU	**7.37**	114.0	**3.92**	155.2	**5.94**	95.1
Share of own labour in total labour	%	**98.4**	85.0	**78.5**	67.3	**99.1**	102.6
Value of assets/ha of AL	thou-sand	**7.8**	144.4	**2.7**	103.5	**19.9**	93.1
Value of assets/AWU	thou-sand	**105.2**	126.6	**72.8**	66.7	**334.0**	97.9
Share of fixed assets in assets	%	**89.4**	104.6	**65.4**	103.9	**93.6**	100.3
Share of equity in lia-bilities	%	**92.1**	106.8	**89.7**	97.7	**95.6**	100.0

Source: European FADN.

Fixed assets in the surveyed farms were also highly diverse. In terms of 1 ha of AL, the value of fixed assets in German holdings in the surveyed period was about EUR 20 thousand and was nearly three times higher than on Polish farms and more than seven times higher than on Hungarian farms where the figure was only EUR 2.7 thousand/ha. Similar differences occurred in equipment for work, determined by a particular value of fixed assets per 1 AWU. There was a marked increase in the value of fixed assets on Polish farms, both per 1 ha and per 1 AWU, respectively, by 44 and 27%, with a decline in these values in German holdings by 3 and 2%. The assets of all farms were dominated by fixed assets. Their share in Polish and German holdings amounted to about 90%, while in Hungarian holdings it was lower and amounted to 65%. The liabilities were dominated by equity. Its share was 90% (Hungary) and more in other countries.

3.1.1.2. Assessment of production organization on dairy farms – small to average

Organization of production on dairy farms of this size class was varied. It was characterized using the structure of crops and production and stocking density. The corresponding numbers are given in Table 3.2. The share of cereals in the area of AL on Polish farms was the highest around 38%. On Hungarian and

German farms it was lower and amounted to: 30 and 16%. The share of cereals in AL was associated with participation of forage crops (pasture and forage crops on arable land). The highest was on German farms and stood at 83%, while on the remaining farms it was about 60%.

Table 3.2. Organisation of production in small to average dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 25-50 thousand, class 3) in 2008-2010

Specification	Unit	Poland		Hungary		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Share of cereals in AL	%	**37.6**	97.9	**29.9**	103.9	**16.3**	99.2
Area of forage crops	ha	**15.9**	84.7	**28.3**	71.6	**17.0**	100.9
Share of forage crops	%	**59.4**	101.1	**64.5**	97.4	**82.7**	99.1
Livestock density	LU/ 100 ha	**111.1**	103.7	**47.4**	126.3	**119.6**	77.5
Stocking density of animals fed in a grazing system per 1 ha of forage area	LU/ 1ha	**1.8**	102.8	**0.7**	127.0	**1.4**	78.3
Dairy cows	LU	**19.6**	85.2	**15.0**	93.1	**14.1**	77.8
Other cattle	LU	**9.4**	90.8	**4.7**	84.0	**10.3**	81.2
Share of crop production	%	**16.9**	100.7	**33.6**	98.7	**7.1**	125.8
Share of animal production	%	**82.3**	100.3	**65.9**	101.3	**82.9**	94.3
Share of other production	%	**0.8**	64.2	**0.5**	43.0	**10.0**	142.9
Including: share of transferred production	%	**1.1**	112.0	**0.6**	63.2	**0.9**	97.1

Source: as in Table 3.1.

The share of forage crops in the analysed period was stable. Stocking density determined by the number of livestock units (LU) per 100 ha of AL on Polish and German farms was similar and amounted to: 111 and 126 LU. It was significantly lower on Hungarian farms, only 47 LU/100 ha of AL. It can be assessed as very low, while in Polish and German holdings as average. Stocking density of cattle per 1 ha of main forage area (MFA) indicates the level of intensity of its use. In Polish and Hungarian holdings, this ratio was higher and amounted respectively to 1.8 and 1.4 LU/ha MFA. It should be assessed as average. However, on Hungarian farms it was much lower and stood at only 0.7 LU/ha MFA. This indicates extensive use of forage area. The number of cows on farms varied. The highest was on Polish farms with ca. 20 cows, while in Hungary and Germany, it was respectively: 15 and 14 cows. The size of herds of cows on all farms should be described as low. The total stock density of cattle was dominated by cows. The highest share of cows was on Hungarian farms

with 76%, while on Polish and German farms it was lower and amounted to 65 and 58% respectively.

The structure of total production on all farms was dominated by animal production. On Polish and German farms, its share exceeded 82%, while in Hungary it was lower and amounted to 66%. Polish and German farms should be considered more strongly specialized. One should emphasize a much higher share of the remaining production in German holdings, which was 10%, while on other farms it did not exceed 1%. The share of production transferred to the household on all farms was very low and stood at about 1%.

3.1.1.3. Assessment of the level and structure of costs on dairy farms – small to average

The level of total production costs per 1 ha of AL informs us about the level of intensity of farm production. The values characterizing the level and types of costs are shown in Table 3.3. The highest level of costs was on German farms where it was EUR 1,840/ha and was higher than on Polish and Hungarian farms respectively by 76 and 169%. Polish and German farms during the survey period saw a decrease in cost by about 15%, while on Hungarian farms costs increased by 3%. The level of direct costs on Polish and German farms was similar and amounted to 533 and 573 EUR/ha respectively, while on Hungarian farms it was about 40% lower i.e. EUR 340.

One should emphasize the differences in the structure of total costs, as defined by the share of direct costs in total costs. In the case of Polish and Hungarian farms this share was about 50%, while on German farms it stood at 31%. This was due to higher economy-wide cost, such as: depreciation, interest expense and lease. There were also differences in the cost of feed for cattle, both purchased and own feed. Cost of feed for cattle on Polish and German farms were similar: 448 and 384 EUR/LU, while on Hungarian farms they were significantly higher and amounted to 883 EUR/LU. Other costs of animal production on Polish and Hungarian farms were similar: 49 and 54 EUR/LU, while on German farms they were significantly higher and amounted to 119 EUR/LU. There were significant differences in the cost of hired labour. The highest was on Hungarian farms with 34 EUR/ha, while on Polish and German farms it was much lower and amounted to: 6 and 11.7 EUR/ha. Cost of interest, lease and depreciation was significantly higher in the case of German farms.

Table 3.3. Level and types of costs on small to average dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 25-50 thousand, class 3) in 2008-2010

Specification	Unit	Poland		Hungary		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Total costs/ha of AL	Euro	**1043.1**	84.7	**684.1**	103.1	**1839.9**	84.7
Direct costs /ha of AL),	Euro	**532.7**	75.8	**340.2**	116.3	**573.3**	71.8
Costs of purchased cattle feed/ LU	Euro	**286.4**	70.8	**560.1**	95.3	**270.3**	85.3
Cost of own feed for cattle/ LU	Euro	**161.9**	69.5	**322.7**	72.0	**111.2**	92.9
Other costs of animal production/LU	Euro	**48.5**	78.4	**53.9**	108.4	**119.2**	105.4
Cost of hired labour/ ha of AL	Euro	**6.0**	64.0	**33.6**	167.6	**11.7**	155.7
Cost of interest /ha of AL	Euro	**18.1**	91.9	**8.8**	655.3	**37.7**	91.4
Cost of lease /ha of AL	Euro	**14.0**	89.8	**14.3**	88.0	**71.6**	101.6
Depreciation costs /ha of AL	Euro	**224.6**	96.6	**69.3**	51.7	**388.8**	83.2

Source: as in Table 3.1.

3.1.1.4. Evaluation of economic and production effects on dairy farms – small to average

Production and economic effects of the surveyed holdings were assessed using indicators of productivity and profitability of land and other factors of production. The corresponding numbers are given in Table 3.4. The indicator of land use is wheat yield. Similar level of yield of this crop occurred in the case of Hungarian and German farms and amounted to: 51 and 55 dt/ha. A slightly lower level was recorded on Polish farms, 47 dt/ha. Milk yield of cows is characteristic of dairy farms. The highest yield was on German farms, almost 6 thousand kg of milk per cow per year.

Milk yield of cows on Polish farms was about 14% lower, while on Hungarian farms it was about 22% lower than in Germany. The highest productivity of land measured by the value of production per 1 ha of AL was on German farms, 1.94 thousand EUR/ha. Productivity of land on Polish and Hungarian farms was lower by 30% and 60% respectively. Different proportions occurred in the productivity of assets. The highest productivity of assets was on Hungarian farms where productivity ratio was 0.28, on Polish and German farms it was respectively 0.18 and 0.10. Low productivity of assets in German holdings was the result of high-value assets per 1 ha of AL. Definitely less variation was in productivity of current assets.

Table 3.4. Productivity and efficiency of small to average dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 25-50 thousand, class 3) in 2008-2010

Specification	Unit	Poland		Hungary		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Wheat yield	dt/ha	**47.0**	0.9	**50.6**	0.8	**54.7**	0.9
Milk yield of dairy cows	kg/ cow	**5008.4**	0.9	**4507.2**	0.9	**5797.2**	1.0
Productivity of land	thousand EUR/ha	**1.37**	0.86	**0.77**	0.97	**1.94**	0.83
Productivity of assets	times	**0.18**	0.60	**0.28**	0.94	**0.10**	0.90
Productivity of current assets	times	**1.69**	0.85	**0.81**	1.01	**1.52**	0.94
Labour productivity (P/1AWU)	EUR thousand	**18.73**	0.76	**20.56**	0.62	**32.67**	0.877
Profitability of land (D/ha)	EUR thousand	**0.58**	1.02	**0.30**	0.80	**0.61**	1.05
Profitability of assets (D/A)	%	**7.7**	70.9	**10.9**	77.1	**3.1**	112.3
Profitability of own labour (D/FWU)	EUR thousand	**8.1**	0.9	**9.8**	0.6	**10.4**	1.1
Cost-effectiveness of production (P/K)	%	**130.3**	102.0	**112.0**	94.0	**105.4**	98.5
Viability of production (D/P)	%	**42.1**	118.5	**38.9**	82.3	**31.6**	125.3
Income from management	EUR thousand	**-3.16**	-0.8	**-3.20**	1.9	**-21.16**	1.7
Income parity (A)	%	**195.8**	82.5	**195.3**	78.7	**89.6**	45.9
Income parity (B)	%	**77.5**	88.5	**90.4**	56.1	**20.2**	109.1
Net investment rate	%	**34.8**	57.2	**-37.1**	17.7	**-42.1**	656.0

Source: as in Table 3.1.

Productivity of these measures on Polish and Hungarian farms was similar and amounted to 1.69 and 1.52, while on Hungarian farms it was 0.81 and was about 52% lower than in Polish farms. Labour productivity measured by the value of production per 1 AWU was the highest on German holdings, it amounted to 32.6 thousand EUR/AWU and was higher than on Polish and Hungarian farms, respectively by 74 and 59%.

The profitability of land on Polish and German farms was similar and amounted to 0.58 and 0.61 thousand EUR/ha of AL. On Hungarian farms it was EUR 0.30 thousand and was about 50% lower. The profitability of assets was

the lowest on German farms, it was 3.1%, which was respectively two and three times lower than on Polish and Hungarian holdings.

The differences in profitability of own labour were not large. The highest profitability of own labour was on German farms, 10.4 thousand EUR/FWU and was higher than on Polish and Hungarian farms by 28 and 6%. Production was profitable and viable in all farms. The highest value of these indicators was on Polish farms.

Income from management, constituting the ultimate measure of effectiveness on all farms was negative. The highest negative value of this income was in German farms, -21.16 thousand EUR/farm. On Polish and Hungarian farms income from management was respectively: -3.16 and -3.20 thousand EUR. Income parity "A", being the relation of farm income per 1 FWU and wages of hired workers, on Polish and Hungarian farms was approximately 195%, while German farms did not reach this parity. The value of this ratio was approximately 90%. All surveyed farms did not reach income parity "B". The lowest value of this ratio was on German farms, it was 20%. The rate of net investment in Hungarian and German holdings was negative and amounted to -37 and -42% respectively. Net investment rate on Polish farms was 35%.

Generalizing the evaluation of small to medium dairy farms, one should note that holdings of this size class have no chance of development. This is evidenced by the negative income from management, not achieving income parity and negative investment rate (except for Polish farms). Polish farms, despite the positive net investment rate had a negative income from management and have not achieved income parity.

3.1.2. Assessment of dairy farms – average to large (class 4, SO of EUR 50-100 thousand) in the surveyed countries

3.1.2.1. Evaluation of production potential of dairy farms – average to large

In this size class, in addition to Polish, Hungarian and German farms, there are also dairy farms from the Netherlands. The numbers characterizing the production potential of this size class are given in Table 3.5. Diversity in terms of economic size is not large. SO value is contained in the range of EUR 66 (Poland) to 81 thousand (Netherlands). The greatest variation was in respect of the area of AL. The greatest area was on Hungarian farms (78 ha), and the smallest on Dutch farms (19.7 ha). Polish and German farms used respectively: 47.5 and 31.3 ha of AL. The area of AL on all farms in the surveyed period decreased slightly from 2% (Germany) to 16% (Poland).

Table 3.5. Production potential of average to large dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 50-100 thousand, class 4) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Economic size	SO	**66.2**	103.9	**77.9**	106.4	**73.1**	101.8	**81.0**	99.3
Area of AL	ha	**47.5**	84.2	**77.7**	98.8	**31.3**	98.1	**19.7**	92.2
Share of leased land	%	**33.4**	93.3	**41.3**	112.7	**46.0**	97.2	**43.3**	65.0
Total labour input	AWU	**2.3**	92.4	**2.3**	117.3	**1.4**	96.5	**1.2**	94.9
Total labour input/ 100 ha of AL)	AWU	**4.8**	109.8	**3.0**	118.7	**4.4**	98.4	**5.9**	102.9
Share of own labour in total labour	%	**91.2**	88.5	**69.5**	81.2	**97.1**	97.3	**95.8**	90.3
Value of assets/ ha of AL	thousand	**8.3**	146.3	**3.2**	90.8	**15.8**	101.2	**52.0**	160.5
Value of assets/ AWU	thousand	**171.4**	133.3	**108.2**	76.5	**355.2**	102.9	**883.8**	155.9
Share of fixed assets in assets	%	**89.7**	103.6	**71.5**	93.4	**92.4**	99.9	**84.3**	101.7
Share of equity in liabilities	%	**87.4**	111.5	**90.4**	102.8	**92.8**	101.6	**90.4**	102.8

Source: as in Table 3.1.

All farms, in addition to own land, also used leased land. Their share was in the range from 33% (Poland) to 46% (Germany). Labour inputs in AWU per farm were strongly differentiated. The highest were on Polish farms, 2.3 AWU, and the lowest on the Netherlands, 1.2 AWU, about 48% lower than on the Polish farms. Labour inputs per 100 ha of AL were less diverse. The highest were on Dutch farms, 5.9 AWU/100 ha of AL and the lowest on Hungarian farms, 3 AWU/100 ha of AL. The share of own labour in total inputs was varied. The lowest was on Hungarian farms, 69%, while the highest was on German farms where the rate was 97%. The share of own labour was also relatively high on Polish farms, where it stood at 91%. There was a very strong diversification of assets, both in terms of 1 ha of AL and 1 AWU. The highest occurred on Dutch holdings, where it amounted respectively to 52 thousand EUR/ha of AL and 884 thousand EUR/AWU. The lowest was on Hungarian farms, 3.2. EUR/ha of AL and 108 thousand EUR/AWU. Equipment in fixed assets on Polish farms was higher than on Hungarian farms respectively by 160% and

58% and lower than on German farms by 47% and 52%. The assets of all farms were dominated by fixed assets, whose share was in the range from 72% (Hungary) to 92% (Germany). The liabilities were dominated by equity, whose share exceeded 87%.

3.1.2.2. Assessment of production organization on dairy farms – average to large

The figures characterizing organization of production in average to large dairy farms is given in Table 3.6. The share of cereals in the agricultural area was varied. On Polish and Hungarian farms it was similar and amounted to about 33%. The lowest was on Dutch farms, only 0.1%. The share of cereals in area of AL was related to share of forage crops in the area of AL. On Polish and Hungarian farms it was similar and amounted to 64% and 61%; it was higher on German farms where it stood at 78%, and the highest on Dutch farms, 99%. Share of forage crops in the area of AL indicates a much higher level of specialization of German farms, and especially Dutch farms. Stocking density expressed as the number of livestock units per 100 ha of AL was highly diverse. The highest was on Dutch farms, 191 LU, and it was about 64% higher than on Polish farms and about 213% higher than on Hungary. It was higher than the density on German farms by 40%. Stocking density on Hungarian farms can be described as low, on Polish farms as average, and on German and Dutch farms respectively as high and very high. Stocking density is associated with the level of intensity of using the main forage area. On Polish, German and Dutch farms it similar and was in the range from 1.7 LU/ha to 1.9 LU/ha. It was significantly lower on Hungarian farms where it stood at 1 LU/ha. The number of cows in herds was varied. On Polish and Hungarian farms it was similar: 35 and 30 cows, while on German and Dutch farms it was about 24 cows. The share of cows in herds of cattle was similar, about 60%.

Production structure was not strongly diversified. On all farms it was dominated by animal production; its share in all farms, except for Hungarian farms, was over 80%, while in the latter it was 65%. These figures indicate a lower degree of specialization of Hungarian farms. In these farms, the share of crop production was 34%, while in the others it exceeded 14% (Poland). One should emphasize the share of other production in German and Dutch farms, which respectively amounted to: 7 and 14%, while in others it did not exceed 1%. Links between farms and households were very weak. The share of transferred production did not exceed 1%.

Table 3.6. Organisation of production in average to large dairy farms (type 45) according to the size of SO (total size of standard output in the range of EUR 50-100 thousand, class 4) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Share of cereals in AL	%	**32.8**	95.6	**32.5**	83.7	**19.7**	103.8	**0.1**	0.0
Area of forage crops	ha	**30.4**	85.9	**47.3**	97.8	**24.4**	97.1	**19.5**	94.2
Share of forage crops	%	**64.0**	102.0	**60.9**	99.0	**77.8**	99.0	**99.0**	102.2
Livestock density	LU/100 ha	**116.2**	108.3	**61.0**	114.4	**136.4**	93.6	**190.7**	104.5
Stocking density of animals fed in a grazing system per 1 ha of forage area	LU/ 1ha	**1.8**	105.8	**1.0**	114.4	**1.7**	94.4	**1.9**	103.1
Dairy cows	LU	**35.2**	89.0	**30.0**	97.2	**24.5**	91.2	**23.9**	94.9
Other cattle	LU	**18.8**	95.1	**15.5**	151.6	**17.6**	92.9	**13.3**	102.8
Share of crop production	%	**14.0**	91.3	**34.3**	106.0	**9.2**	108.5	**1.6**	89.1
Share of animal production	%	**85.3**	102.3	**64.9**	98.0	**83.7**	98.4	**84.4**	99.8
Share of other production	%	**0.7**	44.7	**0.8**	36.7	**7.1**	109.2	**14.0**	102.9
Including: share of transferred production	%	**0.5**	102.1	**0.5**	76.3	**0.5**	85.0	**0.1**	78.6

Source: as in Table 3.1.

3.1.2.3. Assessment of the level and structure of costs on dairy farms – average to large

Numbers characterising the level and structure of costs in surveyed farms are presented in Table 3.7. The surveyed farms of this class size differ in the intensity of production. By far, the most intensive farms in this regard were Dutch farms, where the level of total costs per 1 ha of AL was EUR 3719 and was more than three times higher than on Polish farms, almost 5 times higher than in Hungary and 1.7 times higher than on German farms.

Differences in the level of direct costs were lower. The highest were also on Dutch farms, 1331 EUR/ha, and were about 2 times higher than on Polish and German farms and 3.5 times higher than on Hungarian farms. One should emphasize the differences in the share of direct cost in total costs. On Polish and

Hungarian farms this share was similar and stood at about 50%, while on German and Dutch farms it was much lower and stood at 35%.

Table 3.7. Level and types of costs in average to large dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 50-100 thousand, class 4) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Total costs/ha of AL	Euro	**1200.7**	88.9	**751.2**	94.9	**2143.9**	96.5	**3719.3**	96.5
Direct costs /ha of AL),	Euro	**643.4**	81.7	**377.9**	95.0	**764.1**	94.9	**1330.8**	88.8
Costs of purchased cattle feed/ LU	Euro	**340.1**	72.1	**469.0**	93.2	**334.4**	97.5	**417.5**	82.2
Costs of own cattle feed/ LU	Euro	**144.3**	64.6	**304.1**	120.2	**117.7**	103.0	**21.0**	82.7
Other costs of animal production/LU	Euro	**56.9**	83.7	**52.4**	89.9	**112.8**	106.3	**190.2**	95.1
Cost of hired labour/ ha of AL	Euro	**18.4**	63.4	**42.9**	226.2	**20.0**	116.7	**59.0**	148.6
Cost of interest /ha of AL	Euro	**28.7**	86.2	**13.2**	89.9	**48.4**	76.9	**197.2**	80.5
Cost of lease /ha of AL	Euro	**19.4**	98.5	**19.0**	83.9	**90.3**	87.2	**288.4**	74.4
Depreciation costs /ha of AL	Euro	**232.3**	104.1	**90.2**	77.7	**429.2**	95.1	**505.3**	118.1

Source: as in Table 3.1.

Differences in the cost of purchased fodder were not large, from 334 EUR/LU (Germany) to 469 EUR/LU (Hungary). One should note the higher level of costs of external factors and depreciation on Dutch farms. Cost of hired labour in these farms were 59 EUR/ha and were twice as high as on Polish and German farms and 37% higher than on Hungarian farms. Much greater differences occurred in the cost of interest. On Dutch farms, these costs amounted to 197 EUR/ha and were respectively 6.0, 15 and 4 times higher than on Polish, Hungarian and German farms. Cost of lease on Dutch farms was 288 EUR/ha and was almost 15 times higher than on Polish and Hungarian farms and 3 times higher than on German farms. Variation in depreciation costs was lower. This cost on Dutch farms was 505 EUR/ha and was twice as high as on Polish farms

and more than 5 times higher than on Hungarian farms and 20% higher than on German farms.

3.1.2.4. Evaluation of economic and production effects on dairy farms – average to large

The numbers characterizing economic and production effects in average to large dairy farms are given in Table 3.8. Wheat, as a basic commodity plant was not grown on Dutch farms, where almost 100% of AL was allocated for the cultivation of fodder crops. Yields of wheat on Polish and German farms were respectively 51 and 64 dt/ha. On Hungarian farms they were only 36.8 dt/ha. Productivity of land measured by the value of production per 1 ha of AL was the highest on Dutch farms, 4 thousand EUR/ha. It was 5 times higher than on Hungarian farms and respectively 2.5 and 1.7 times higher than on Polish and German farms. Productivity of assets was the highest on Hungarian farms where the times ratio was 0.26, and the lowest on Dutch farms, where the corresponding ratio was only 0.08. On Polish and German farms, this ratio was respectively 0.20 and 0.15.

Productivity of current assets on Polish and German farms was similar and amounted respectively to 1.93 and 1.91. The lowest was on Hungarian farms where it amounted to 0.50. On Hungarian farms it was 0.93 and was about 52% lower than in Polish farms. The highest labour productivity was on Dutch farms where it amounted to EUR 67 thousand AWU and was 30% higher than on German farms and respectively 99% and 134% higher than on Polish and Hungarian farms. The profitability of land on Polish and German farms was similar and amounted respectively to 0.67 and 0.65 thousand EUR/ha of AL. On Dutch farms it was 0.52 thousand EUR/ha, and the lowest was on Hungarian farms, 0.38 thousand EUR/ha of AL. The profitability of assets was very strongly differentiated. The highest was on Hungarian farms where the times ratio was 11.9. This was due to the low value of the assets in these farms. On Polish and German farms the times ratio amounted respectively to 8.3 and 4.1. The lowest profitability of assets was on Dutch farms, where the corresponding figure was 1%. The profitability of own labour was less diverse. On Polish and German farms it was similar and amounted respectively to 15.41 and 15.1 thousand EUR/FWU. Higher profitability was on Hungarian farms, 18.44 thousand EUR/FWU, and the lowest on Dutch farms, 9.31 thousand EUR/FWU. Production was profitable and viable on all farms. The highest cost-effectiveness and viability ratios were on Polish and Hungarian farms and the lowest on Dutch farms. Income from management on Polish and Hungarian farms was positive and amounted respectively to 1,115 and 937 EUR/farm. On German and Dutch farms it was negative and amounted to -23.8 and -59.1 thousand EUR/farm.

Table 3.8. Productivity and efficiency of average to large dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 50-100 thousand, class 4) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Wheat yield	dt/ha	**50.8**	96.0	**36.8**	65.3	**63.6**	1.0	**-**	**-**
Milk yield of dairy cows	kg/ cow	**5943.2**	100.4	**3862.0**	88.7	**6198.3**	1.0	**7246.6**	1.0
Productivity of land	thousand EUR/ha	**1.6**	93.7	**0.8**	85.8	**2.3**	1.0	**4.0**	1.0
Productivity of assets	times	**0.20**	64.0	**0.26**	94.5	**0.15**	1.0	**0.08**	0.6
Productivity of current assets	times	**1.93**	84.9	**0.93**	80.5	**1.91**	1.0	**0.50**	0.7
Labour productivity (P/1AWU)	EUR thousand	**33.8**	85.3	**28.8**	72.3	**51.8**	1.0	**67.4**	1.0
Profitability of land (D/ha)	EUR thousand	**0.67**	113.6	**0.38**	103.0	**0.65**	1.2	**0.52**	1.6
Profitability of assets (D/A)	%	**8.3**	77.6	**11.9**	113.4	**4.1**	120.6	**1.0**	100.2
Profitability of own labour	EUR thousand	**15.41**	98.4	**18.44**	105.6	**15.15**	1.3	**9.31**	1.6
Cost-effectiveness of production (P/K)	%	**133.6**	105.3	**111.4**	90.4	**107.0**	104.5	**106.2**	102.9
Viability of production (D/P)	%	**41.1**	121.3	**44.8**	120.0	**28.3**	121.0	**13.0**	161.9
Income from management	EUR thousand	**1114.7**	29.0	**937.1**	160.2	**-23871.4**	0.7	**-59114.1**	1.2
Income parity (A)	%	**358.4**	105.4	**394.2**	88.7	**88.1**	145.8	**41.5**	174.7
Income parity (B)	%	**147.2**	98.4	**169.6**	105.6	**29.3**	125.1	**17.7**	159.6
Net investment rate	%	**78.1**	72.8	**1.1**	130.3	**-15.3**	-416.8	**0.5**	91.8

Source: as in Table 3.1.

Polish and Hungarian farms reached parity income both in relation to wages in the surveyed farms, as well as in the national economy. German and Dutch holdings did not reach either type of income parity. The rate of net investment on Polish farms reached 78%, and on Hungary only 1%. This rate on German farms was negative and amounted to -15%, while on the Netherlands it reached only 0.5%. Given the negative income from management, not achieving income parity and the negative or very low rate of net investment, it should be noted that average to large dairy farms on Germany and the Netherlands do not have a chance of development. Polish farms and to a lesser extent Hungarian farms have this chance.

3.1.3. Assessment of dairy farms – large (class 5, SO of EUR 100-500 thousand) in the surveyed countries

3.1.3.1. Evaluation of production potential of dairy farms – large

This size class included farms from all surveyed countries. The numbers characterizing the productive potential of this group are shown in Table 3.9. The surveyed farms differ in terms of economic size, although they are in the same size class as large holdings. The smallest were holdings from Poland (EUR 150 thousand) and the largest were farms from Denmark (EUR 315 thousand). The standard output in other farms ranged between EUR 201-249 thousand. Surveyed farms vary in size, which ranged from 47 hectares (Netherlands) to 160 ha of AL (Hungary). The area of Polish and Danish farms was similar respectively 108 and 93 ha. The share of leased land also varied. The greatest proportion of leased land was on German holdings (67%), while the smallest on Danish farms (24%). On other farms, the share of leased land was in the range of 38% (Netherlands) to 47% (Hungary). Total labour inputs were also diverse, from 1.67 AWU/farm (Netherlands) to 5.04 AWU/farm (Hungary). Labour inputs per 100 ha of AL were less diverse ranging from 1.88 (Denmark) to 3.55 AWU/100 ha (the Netherlands). A higher share of own labour inputs in total inputs were on Polish, German, Danish and Dutch holdings, respectively 68.5, 84.7, 70.2 and 92.2%. On Hungarian holdings the share of own labour was the lowest and amounted to 29.7%. Value of assets per 1 ha of AL was the highest on Dutch farms, EUR 52 thousand. On Danish farms it was about 46% lower. On Polish, Hungarian and German farms the value of assets was smaller than the value of assets on Dutch holdings, respectively by: 85, 93 and 79%. A similar level of differentiation occurred in technical infrastructure, expressed by the value of assets per 1 AWU. The highest value occurred on Dutch holdings, where the value of assets per 1 AWU was EUR 1,342 thousand, while the lowest was on Hungarian farms where it amounted to EUR 117 thousand. The assets in all sur-

veyed farms were dominated by fixed assets. Their proportion was in the range of 72% (Hungary) to 92% (the Netherlands). The share of equity in liabilities varied. On Polish, Hungarian and German farms it was about 80% on Dutch farms – about 70%, and the lowest was on Danish farms, 48%.

The low share of equity on Danish holdings results from legislation regarding the transfer of farms to descendants. Taking over farms in the family is done by way of purchase, using a bank loan.

3.1.3.2. Assessment of production organization on dairy farms – large

The figures characterizing the organization of production in the surveyed holdings are given in Table 3.10. The share of cereals in the area of AL on Polish and Hungarian farms was higher and amounted respectively to 30 and 33%. The share on German and Danish farms was lower and amounted respectively to 22 and 24%, and the share of cereals on Dutch holdings was the lowest, only 1.2%. The share of forage crops in AL also varied. On Polish and Hungarian farms it was about 60%, on German and Danish farms it exceeded 70%, and on Dutch holdings it was 97%.

The stocking density on Polish and Hungarian farms was lower and amounted respectively to 115 and 82 LU/100 ha of AL, on German and Danish farms it was high and amounted to 142 and 156 LU, while on Dutch farms it was very high and amounted to 242 LU/100 of AL. The level of stocking density was associated with the level of intensity of using main forage area.

On German, Danish and Dutch holdings, there were 2 LU and more per 1 ha of forage area. The number of cows was not strongly diversified. The number of cows was in the range of 63 (Germany) to 88 cows (Hungary and Denmark). Polish and Dutch farms kept about 77 cows. The herds of cattle were dominated by cows. Their proportion was in the range of 57% (Germany) to 70% (the Netherlands). The production structure was dominated by animal production. Its proportion was in the range of 70% (Hungary) to 91% (the Netherlands). Hungarian and Danish holdings had a relatively high proportion of crop production, respectively 29 and 24%. One should emphasize the share of other production on Dutch holdings, which was 7.2%, while in other farms it did not exceed 3%. The share of production transferred to households was very low and did not exceed 0.5%.

Table 3.9. Production potential of large dairy farms (type 45) according to size of SO (total volume of standard output in the range of EUR 100-500 thousand, class 5) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Economic size	SO	**151.1**	89.2	**225.8**	96.9	**201.5**	104.0	**315.1**	100.1	**248.8**	109.4
Area of AL	ha	**108.5**	73.0	**160.5**	107.3	**77.3**	99.3	**92.8**	91.7	**47.2**	101.1
Share of leased land	%	**42.5**	74.4	**47.6**	78.2	**67.0**	98.8	**24.3**	100.7	**38.0**	103.2
Total labour inputs	AWU	**3.64**	70.1	**5.04**	82.3	**1.90**	100.0	**1.74**	90.4	**1.67**	100.6
Total labour input/100 ha of AL	AWU	**3.35**	96.0	**3.15**	76.7	**2.45**	100.7	**1.88**	98.5	**3.55**	99.5
Share of own labour in total labour	%	**68.5**	114.2	**29.7**	135.6	**87.4**	100.6	**70.2**	95.0	**92.2**	99.9
Value of assets/ha of AL	thou-sand	**7.78**	146.2	**3.68**	88.2	**10.88**	104.7	**27.89**	100.4	**51.93**	118.0
Value of assets/AWU	thou-sand	**232.1**	152.2	**117.4**	115.0	**442.7**	103.9	**148.3**	101.9	**1462.6**	118.6
Share of fixed assets in assets	%	**88.1**	105.6	**71.6**	96.3	**88.4**	99.1	**91.0**	100.2	**92.1**	100.2
Share of equity in liabilities	%	**83.3**	109.8	**79.2**	113.8	**80.3**	100.2	**48.1**	101.3	**69.8**	101.3

Source: as in Table 3.1.

Table 3.10. Organisation of production in large dairy farms (type 45) according to the size of SO (total size of standard output in the range of EUR 100-500 thousand, class 5) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Share of cereals in AL	%	**30.5**	83.9	**33.4**	103.5	**22.4**	91.2	**24.5**	100.6	**1.2**	86.9
Area of forage crops	ha	**69.40**	78.9	**95.35**	105.6	**56.28**	102.5	**66.16**	92.2	**45.95**	102.9
Share of forage crops	%	**64.2**	108.2	**59.4**	98.4	**72.8**	103.2	**71.3**	100.5	**97.3**	101.7
Livestock density	LU/100ha	**115.1**	109.1	**82.2**	82.6	**146.4**	102.3	**152.4**	102.4	**241.7**	103.6
Stocking density of animals fed in a grazing system per 1 ha of forage area	LU/ 1ha	**1.76**	101.2	**1.32**	84.9	**1.96**	99.5	**2.08**	100.0	**2.40**	102.5
Dairy cows	LU	**76.8**	76.7	**88.5**	83.1	**63.2**	103.2	**88.2**	93.4	**77.1**	104.2
Other cattle	LU	**45.2**	85.9	**41.6**	102.6	**47.7**	100.3	**52.5**	96.5	**32.9**	108.8
Share of crop production	%	**12.7**	91.7	**28.6**	135.8	**11.9**	93.0	**23.7**	104.9	**1.3**	79.9
Share of animal production	%	**86.7**	101.9	**69.9**	90.2	**85.4**	101.1	**73.8**	98.3	**91.5**	101.4
Share of other production	%	**0.6**	49.0	**1.5**	35.7	**2.7**	98.9	**2.5**	104.1	**7.2**	86.5
Including: share of transferred production	%	**0.3**	110.5	**0.1**	125.6	**0.1**	77.6	**0.1**	115.8	**0.0**	80.2

Source: as in Table 3.1.

3.1.3.3. Assessment of the level and structure of costs on dairy farms – large

The level of intensity of production determined by total costs per 1 ha of AL was clearly diverse. On Polish and Hungarian farms it was similar and amounted to about 1380 EUR/ha of AL. It was lower twice than on German holdings and three and a half times lower than on Danish and Dutch holdings, where it was more than 4.5 thousand EUR/ha of AL. Similar correlations occurred in the level of direct costs. There were, however, differences in the cost structure. On Polish and Hungarian holdings the share of direct costs in total costs amounted to more than 50%, while on German and Danish holdings to approximately 40% and on Dutch holdings to 36%. The differences were caused by higher costs of external factors in the latter three countries. The costs of purchased feed per 1 LU were similar on Polish, German and Dutch holdings. They were in the range from 386 to 447 EUR/LU. On Hungarian holdings they were about 70% higher, while on Danish farms they were the highest and amounted to 1,026 EUR/LU. One should note the low level of costs of AL own feed on Dutch holdings, which is associated with the acquisition of own roughage from permanent grassland. Cost of hired labour on Polish, German and Dutch farms were similar and within the range of 70 to 81 EUR/ha. They were much higher on Hungarian farms, 134 EUR/ha, and the highest on Danish farms, 218 EUR/ha. Costs of interest on Polish and Hungarian farms were similar and were respectively 36 and 43 EUR/ha.

On German farms they were almost twice as high, but definitely the highest were on Danish farms, almost 800 EUR/ha. They were slightly lower on Dutch holdings, 669 EUR/ha. Costs of lease on Polish and Hungarian farms were very low and were respectively 20 and 30 EUR/ha. They were definitely the highest on Dutch farms, 239 EUR/ha. On German and Danish farms the costs of lease were significantly lower than in the Netherlands and were respectively 160 and 120 EUR/ha. Costs of depreciation also varied, the lowest were on Hungarian farms, 126 EUR/ha. On Polish farms they were almost twice as high. On German and Danish farms they were similar, around 420 EUR/ha. The highest were on Dutch farms; they amounted to 674 EUR/ha, which was associated with a high value of fixed assets.

Table 3.11. Level and types of costs in large dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 100-500 thousand, class 5) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008 =100%	Value	Change indicator 2008 =100%	Value	Change indicator 2008 =100%	Value	Change indicator 2008 =100%	Value	Change indicator 2008 =100%
Total costs/ha of AL	Euro	**1378.9**	80.3	**1379.4**	64.5	**2537.1**	106.0	**4537.4**	87.5	**4827.9**	100.0
Direct costs /ha of AL	Euro	**729.9**	79.3	**735.7**	62.4	**1025.0**	106.4	**2094.9**	88.1	**1748.9**	91.1
Purchased feed for cattle/LU	Euro	**386.0**	74.3	**670.1**	72.6	**404.1**	104.4	**1025.7**	85.3	**447.5**	85.1
Costs of own cattle feed/ LU	Euro	**131.5**	68.6	**328.8**	116.7	**97.1**	104.9	**525.4**	88.1	**11.0**	90.9
Other costs of animal production/LU	Euro	**74.8**	67.5	**80.0**	73.1	**130.7**	105.8	**186.5**	93.2	**182.6**	100.4
Cost of hired labour/ ha of AL	Euro	**81.3**	36.3	**133.8**	57.0	**69.4**	97.4	**217.9**	94.3	**74.7**	108.8
Cost of interest /ha of AL	Euro	**36.2**	80.0	**42.6**	54.1	**86.3**	99.6	**798.9**	65.6	**668.6**	96.4
Cost of lease /ha of AL	Euro	**20.1**	78.4	**33.0**	71.4	**160.1**	94.5	**120.1**	98.4	**238.4**	117.8
Depreciation costs /ha of AL	Euro	**218.5**	111.1	**126.5**	67.6	**420.3**	104.6	**422.6**	96.6	**763.7**	118.0

Source: as in Table 3.1.

3.1.3.4. Evaluation of economic and production effects on dairy farms – large

Table 3.12 shows the numbers characterizing economic and production effects of dairy farms – large. Land productivity measured by wheat yield was the lowest on Hungarian farms where the crop yields were about 40 dt/ha. These can be assessed as low. Yields on Polish farms were about 56 dt/ha and they can be assessed as average. On all other farms yields were in the range of 66 to 79 dt/ha. They can be assessed as fairly high. Milk yield of cows was in the range of 5,920 kg (Hungary) to 8,240 kg of milk per cow per year (Denmark). On Polish farms, milk yield was 6,643 kg, while on German and Dutch farms it was respectively 7,430 and 7,908 kg of milk. Land productivity measured by the value of production per 1 ha of AL on Polish and Hungarian farms was similar and amounted to 1.77 and 1.51 thousand EUR/ha. On German and Danish farms it was higher than the productivity of land on Polish farms by respectively 49 and 137%. It was significantly higher on Dutch holdings, 5.17 thousand EUR/ha and was nearly three times higher than on Polish farms. Productivity of assets was the highest on Hungarian farms where the times ratio was 0.4. On Polish and German farms it was similar and amounted to 0.24. On Danish and Dutch farms it was much lower and stood at 0.14 and 0.10 respectively. On all farms, except for German farms, the productivity of assets in the surveyed period decreased by 10% (Denmark) to 37% (Poland). Productivity of current assets was the highest on German farms where the times ratio was 2.09, than on Polish farms, 1.95, and Danish, 1.53. The lowest was on Dutch farms, 1.24. Labour productivity on Polish and Hungarian farms was similar and amounted to 52.7 and 47.3 thousand EUR/AWU respectively. By far the highest productivity was on Danish farms, EUR 210.5 thousand. On German and Dutch farms it respectively amounted to: 107.5 and 145.5 thousand EUR/AWU and was lower than productivity on Danish holdings by: 49 and 31%. The profitability of land, except for Danish farms, for which it was negative, was not strongly differentiated. It was in the range of 0.49 thousand EUR/ha (Hungary) to 0.80 thousand EUR/ha. Different relationships occurred in the profitability of assets. The highest value was reached by Hungarian farms (0.13%), the lowest by Danish farms (0.00). The profitability of own labour was strongly differentiated. The highest was on Hungarian farms, 59 thousand EUR/FWU, followed by Polish farms (EUR 31.8 thousand), German and Dutch, respectively, 28 and 25 thousand EUR/FWU. Profitability of own labour on Danish farms was negative. This was due to the negative income from farms.[5] Production on all farms, except for Danish farms, was profitable and viable. The highest values of these indicators

[5] In Danish holdings, labour of family members is treated as hired labour and is charged to the farm income.

were in Polish holdings. Income from management in Polish and Hungarian farms was positive and amounted respectively to 12.5 and 24.9 thousand EUR. In all other farms it was negative. The lowest value was in Danish farms, EUR -137.7 thousand, followed by Dutch farms, EUR -89.9 thousand, and German farms, EUR -15.8 thousand/ farm. Income parity "A" was reached by Polish, Hungarian and German holdings. Similar relationships occurred in parity income "B". The rate of net investment on Polish, Danish and Dutch farms exceeded 100% and was respectively: 124, 139 and 132%. Given the positive income from management, the parity income and rate of net investment, it should be noted that Polish farms, and slightly smaller Hungarian farms, despite a lower rate of net investment, have full development opportunities. German, Danish and Dutch farms have no development opportunities, in spite of a net investment rate of over 100% in the last two years.

Table 3.12. Productivity and efficiency of large dairy farms (type 45) according to the size of SO (total volume of standard output in the range of EUR 100-500 thousand, class 5) in 2008-2010

Specification	Unit	Poland		Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Wheat yield	dt/ha	**55.6**	87.7	**39.9**	67.8	**70.4**	101.3	**66.2**	88.3	**78.7**	88.1
Milk yield of dairy cows	kg/ cow	**6643.5**	99.4	**5921.7**	86.7	**7431.2**	102.4	**8241.1**	100.3	**7908.6**	103.2
Productivity of land	EUR thousand	**1.77**	91.7	**1.51**	68.1	**2.64**	117.1	**3.96**	89.8	**5.17**	101.2
Productivity of assets	times	**0.24**	62.7	**0.40**	77.3	**0.24**	111.9	**0.14**	89.5	**0.10**	85.7
Productivity of current assets	times	**1.95**	92.2	**1.43**	70.7	**2.09**	104.5	**1.58**	91.6	**1.26**	87.4
Labour productivity (P/1AWU)	EUR thousand	**52.7**	95.5	**47.3**	88.9	**107.5**	116.3	**210.5**	91.2	**145.5**	101.7
Profitability of land (D/ha)	EUR thousand	**0.64**	133.3	**0.49**	118.8	**0.58**	172.5	**-0.11**	1568.2	**0.80**	113.2
Profitability of assets (D/A)	%	**0.08**	91.2	**0.13**	134.7	**0.05**	164.9	**0.00**	1562.2	**0.02**	96.0
Profitability of own labour	EUR thousand	**31.82**	88.6	**58.79**	122.6	**28.09**	169.2	**-7.94**	1537.1	**24.29**	115.3
Cost-effectiveness of production (P/K)	%	**128.3**	114.1	**108.9**	105.6	**104.0**	110.4	**87.2**	102.6	**106.8**	101.1
Viability of production (D/P)	%	**36.0**	145.4	**33.1**	174.3	**21.8**	147.4	**-3.3**	1746.2	**14.7**	111.9
Income from management	EUR thousand	**12.5**	78.6	**24.9**	172.6	**-15.3**	3.1	**-137.7**	82.6	**-89.9**	107.4
Income parity (A)1	%	**527.4**	123.0	**1045.4**	152.3	**154.8**	163.7	**-21.7**	-1490.7	**92.1**	122.3
Income parity (B)2	%	**304.0**	88.6	**540.7**	122.6	**54.3**	169.2	**-13.3**	-1537.1	**46.1**	115.3
Net investment rate	%	**123.5**	92.1	**74.5**	131.5	**32.1**	89.2	**139.0**	-1.0	**131.8**	37.3

Source: as in Table 3.1.

3.1.4. Assessment of dairy farms – very large (class 6, SO of EUR 500 thousand and more) in the surveyed countries

3.1.4.1. Evaluation of production potential of dairy farms – very large

The numbers characterizing the productive potential of very large holdings are shown in Table 3.13. There are no Polish holdings in this size class. In terms of economic size, the largest farms are on Hungary and Germany; their value of SO is respectively: EUR 1070 and 895 thousand. Danish and Dutch holdings are much smaller, with a value of EUR 624 and 557 thousand.

Differences in the area of AL are definitely bigger. Hungarian farms use 823 hectares of land, over 8 times more than Dutch holdings, which use 99.3 hectares. In turn, German and Danish farms use respectively: 375 and 172 ha of AL. The share of leased land is also varied. In Hungarian and German farms, the share of leased land was about 80%, in Danish and Dutch it was about 30%. Total labour inputs varied just like the area of AL. Differences in labour input per 100 ha of AL were much smaller, in the range of 1.74 AWU (Germany) to 3.72 ha AWU/100 ha of AL (Hungary). The share of own labour was also highly diverse. Very low on Hungarian (3.2%) and German (9.8%) holdings, average on Danish holdings (33.7%) and high on Dutch holdings (74%). The value of assets, both per 1 ha of AL and 1 AWU was very strongly differentiated. Very low on Hungarian holdings and very high on Dutch holdings where it amounted to 52.4 thousand EUR/ha and was over 16 times higher than on Hungarian holdings and respectively 7 and 1.8 times higher than on German and Danish farms. Asset value per 1 AWU on Dutch and Danish farms was very high and amounted to: 1,896.1 thousand and 1,670.7 thousand EUR/AWU respectively, while on Hungarian and German farms, respectively, to 87.6 and 296.9 thousand EUR/AWU. On Dutch holdings it was 21 times higher than on Hungarian farms and 6.3 times higher than on German farms. The assets were dominated by fixed assets, ranging from 67% (Hungary) to 92.5% (the Netherlands). The liabilities of all farms, except for Danish (33.7%) farms, were dominated by equity.

Table 3.13. Production potential of very large dairy farms (type 45) according to size of SO (total volume of standard output over EUR 500 thousand, class 6) in 2008-2010

Specification	Unit	Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008=100%	**Value**	Change indicator 2008=100 %	**Value**	Change indicator 2008=100 %	**Value**	Change indicator 2008=100 %
Economic size	SO	**1070.5**	101.1	**895.4**	106.8	**624.3**	107.8	**557.0**	103.2
Area of AL	ha	**822.95**	79.7	**374.87**	132.9	**171.61**	96.0	**99.27**	96.7
Share of leased land	%	**80.6**	99.8	**77.5**	97.3	**27.3**	99.9	**32.9**	119.0
Total labour inputs	AWU	**32.96**	84.0	**8.72**	129.6	**2.92**	94.5	**2.64**	101.0
Total labour input/100 ha of AL	AWU	**3.72**	105.5	**2.38**	97.6	**1.74**	98.4	**2.84**	104.4
Share of own labour in total labour	%	**3.2**	-	**9.8**	93.4	**33.7**	96.2	**74.0**	92.4
Value of assets/ha of AL	Euro	**3180.3**	109.0	**7095.8**	110.8	**28878.8**	102.2	**52452.2**	110.7
Value of assets/AWU	Euro	**87634.5**	103.3	**296906.0**	113.6	**1670730.1**	103.8	**1896153.5**	106.0
Share of fixed assets in assets	%	**64.0**	103.9	**77.0**	98.6	**90.1**	101.3	**92.5**	99.2
Share of equity in liabilities	%	**72.2**	111.5	**69.8**	98.3	**33.7**	87.1	**62.3**	105.8

Source: as in Table 3.1.

3.1.4.2. Assessment of production organization on dairy farms – very large

Organization of production in the surveyed farms varied. The relevant data are given in Table 3.14. The share of cereals in the area of AL was the highest on Hungarian farms, 36.5%, and the lowest on Dutch farms, 1.9%. On German and Dutch farms it respectively amounted to 27.3 and 24.2%.

Table 3.14. Organisation of production in very large dairy farms (type 45) according to the size of SO (total size of standard output over EUR 500 thousand, class 6) in 2008-2010

Specification	Unit	Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008= 100%	**Value**	Change indicator 2008= 100%	**Value**	Change indicator 2008= 100%	**Value**	Change indicator 2008= 100%
Share of cereals in AL	%	**36.5**	101.5	**27.3**	98.4	**24.2**	99.7	**1.9**	41.9
Area of forage crops	ha	**416.9**	81.2	**220.1**	132.5	**122.3**	99.0	**92.8**	101.3
Share of forage crops	%	**53.3**	101.9	**62.7**	99.7	**71.6**	103.1	**94.3**	104.7
Livestock density	LU/ 100ha	**78.9**	119.2	**113.7**	101.9	**163.2**	104.4	**250.3**	101.2
Stocking density of animals fed in a grazing system per 1 ha of forage area	LU/ 1ha	**1.40**	122.1	**1.75**	101.9	**2.19**	99.1	**2.60**	98.9
Dairy cows	LU	**394.2**	93.3	**214.9**	137.1	**176.7**	100.5	**173.5**	98.9
Other cattle	LU	**241.0**	103.4	**153.2**	133.8	**99.9**	101.2	**70.0**	106.0
Share of crop production	%	**28.5**	90.6	**17.9**	91.5	**23.2**	98.8	**2.5**	100.4
Share of animal production	%	**66.5**	108.7	**77.8**	103.0	**74.0**	100.2	**90.6**	101.1
Share of other production	%	**5.0**	67.8	**4.1**	94.3	**2.8**	105.7	**6.9**	85.3
Including: share of transferred production	%	**0.1**	74.8	**0.1**	76.3	**0.0**	114.0	**0.0**	163.2

Source: as in Table 3.1.

The share of forage crops in the area of AL was similarly diverse, on Hungarian and German holdings it exceeded 50%, and was higher on Danish and Dutch farms, where it was respectively: 71,6 and 92,8%. These numbers correspond with stocking density in LU/100 ha of AL and LU/ha of main forage area. On Dutch farms, stocking density was very high, 250 LU/100 ha, while on Hungarian farms only 78.9 LU/100 ha. On German and Danish farms stocking density was higher and amounted respectively to 113.7 and 163.2 LU/100 ha of AL. The intensity of use of forage area on Dutch farms was very high, 2.6 LU

per 1 ha of this area, while on Hungarian and German farms, respectively 1.4 and 1.7 LU. On Danish farms, use of forage area was also high, 2.2 LU/ha.

Number of cows on farms differed significantly. The highest was on Hungarian farms, 394, lower in Germany, 215 cows, and the lowest on Danish and Dutch farms, where it was similar, about 175 cows. The production structure was dominated by animal production, the highest proportion was on Dutch farms, 91%. In other farms it was in the range of 66% (Hungary) to 78% (Germany). The share of crop production in all farms, except for Danish farms, was within the range from 18% (Germany) to 28% (Hungary). The share of other production was insignificant.

3.1.4.3. Assessment of the level and structure of costs on dairy farms – very large

The numbers characterizing the level and structure of costs in the surveyed dairy farms are given in Table 3.15. The highest level of intensity of production was on Danish and Dutch holdings, where total costs per 1 ha of AL were about EUR 5.2 thousand and were respectively 2.8 and 2 times higher than the costs on Hungarian and German holdings. The level of direct costs was the highest on Danish farms where it amounted to 2.2 thousand EUR/ha and was 22% higher than on Dutch farms. It was respectively 2.6 and 2.3 times higher than on Hungarian and German farms. There were also differences in the structure of total costs defined by the share of direct costs in total costs. This share on German and Dutch holdings was lower and amounted to 37% and 35% respectively, while the highest was on Hungarian farms, 47%. It was also relatively high on Danish farms, 43%. Costs of purchased feed on Hungarian and Danish holdings were higher and amounted to 825 and 1,030 EUR/LU respectively. On German and Dutch farms they were about 50% lower.

Table 3.15. Level and types of costs in very large dairy farms (type 45) according to the size of SO (total volume of standard output over EUR 500 thousand, class 6) in 2008-2010

Specification	Unit	Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008=100%	**Value**	Change indicator 2008=100%	**Value**	Change indicator 2008=100%	**Value**	Change indicator 2008=100%
Total costs/ha of AL	Euro	**1833.0**	99.8	**2539.5**	106.2	**5232.0**	90.6	**5173.0**	92.3
Direct costs/ha of AL	Euro	**862.5**	98.7	**955.9**	107.4	**2241.1**	93.8	**1827.8**	86.8
Costs of purchased cattle feed/LU	Euro	**823.8**	88.1	**472.4**	97.8	**1029.8**	88.8	**450.0**	80.6
Costs of own cattle feed/ LU	Euro	**355.8**	81.7	**115.4**	86.7	**494.7**	92.5	**9.2**	140.2
Other costs of animal production/LU	Euro	**83.6**	121.0	**154.9**	149.6	**192.5**	100.9	**173.8**	105.0
Cost of hired labour/ ha of AL	Euro	**307.5**	97.9	**350.0**	103.8	**352.8**	105.0	**167.9**	105.7
Cost of interest /ha of AL	Euro	**44.6**	61.7	**76.9**	115.7	**1092.3**	67.3	**810.1**	70.8
Cost of lease /ha of AL	Euro	**67.5**	125.1	**127.4**	108.0	**168.1**	93.9	**243.7**	124.4
Depreciation costs /ha of AL	Euro	**120.5**	116.2	**319.9**	102.4	**488.7**	110.4	**840.6**	115.4

7 Source: as in Table 3.1.

Costs of own feed for cattle in Hungarian and Danish holdings were higher and amounted to 356 and 472 EUR/LU respectively. In German farms they were much lower and amounted to 115 EUR/LU, and definitely the lowest were in Dutch holdings, only 9 EUR/LU. Low cost of own feed in Dutch and German holdings is to be associated with the acquisition of roughage from grassland. Cost of hired labour on Hungarian, German and Dutch farms were similar and within the range of 306 (Hungary) to 353 (Denmark) EUR/ha of AL. In Dutch holdings they were much lower, 168 EUR/ha of AL. Cost of interest were strongly differentiated, the highest were on Danish and Dutch farms, respectively 1,092 and 810 EUR/ha. By far the lowest were on Hungarian and German farms, respectively 45 and 77 EUR/ha of AL.

Differences in the cost of lease were lower than in the cost of interest. The highest level of lease was on Dutch farms, 244 EUR/ha, and the lowest on Hungarian farms, 67 EUR/ha. Differences in depreciation costs were very large. On Dutch farms, depreciation cost was 841 EUR/ha of AL and was almost 7 times higher than in Hungarian holdings and respectively: 2.6 and 1.7 times higher than in German and Danish holdings.

3.1.4.4. Evaluation of economic and production effects on dairy farms – very large

The numbers characterizing the production and economic effects of this class of farms are presented in Table 3.16. Yields of wheat inform about the direct productivity of land. On Hungarian farms they amounted to 37 dt/ha and they should be assessed as low. On all other farms they were in the range of 67 (Denmark) to 86 dt/ha (the Netherlands). The annual milk yield per cow was not strongly differentiated. It was in the range of 7,097 kg (Hungary) to 8,395 kg (Denmark). The difference in favour of Danish farms was 18%. Stronger differentiation occurred in the productivity of land. The highest value of production per 1 ha of AL was on Dutch farms, 5.5 thousand EUR/ha; more than three times higher than on Hungarian farms. It was respectively 2.3 and 1.2 times higher than productivity of land on German and Danish farms. Productivity of assets, just like in previous size classes, was the highest on Hungarian farms where the times ratio was 0.53, followed by German farms with times ratio of 0.37. Significantly lower productivity of assets was recorded on Danish and Dutch holdings; the value of times ratio was 0.15 and 0.11 respectively.

Table 3.16. Productivity and efficiency of very large dairy farms (type 45) according to the size of SO (total volume of standard output over EUR 500 thousand, class 6) in 2008-2010

Specification	Unit	Hungary		Germany		Denmark		Netherlands	
		Value	Change indicator 2008= 100%	**Value**	Change indicator 2008= 100%	**Value**	Change indicator 2008= 100%	**Value**	Change indicator 2008= 100%
Wheat yield	dt/ha	**37.0**	59.8	**68.1**	95.0	**67.3**	84.7	**86.4**	105.8
Milk yield of dairy cows	kg/ cow	**7097.7**	105.9	**8031.1**	105.6	**8395.2**	104.3	**7856.2**	96.5
Productivity of land	thousand EUR/ ha	**1.66**	97.9	**2.32**	107.0	**4.36**	95.5	**5.48**	100.3
Productivity of assets	times	**0.525**	89.8	**0.366**	96.6	**0.151**	93.5	**0.105**	90.7
Productivity of current assets	times	**1.448**	94.9	**1.660**	93.3	**1.524**	104.6	**1.397**	82.4
Labour productivity (P/1AWU)	EUR thousand	**44.22**	92.8	**97.99**	109.7	**254.09**	97.1	**202.62**	96.1
Profitability of land (D/ha)	EUR thousand	**0.24**	182.6	**0.23**	140.1	**-0.41**	41.5	**0.87**	152.2
Profitability of assets (D/A)	%	**7.6**	167.6	**2.8**	126.4	**-1.4**	40.6	**1.7**	137.6
Profitability of own labour	EUR thousand	*	*	**33.63**	204.3	**-54.26**	42.0	**46.86**	152.5
Cost-effectiveness of production (P/K)	%	**92.2**	98.0	**91.5**	100.8	**83.0**	105.5	**105.6**	108.8
Viability of production (D/P)	%	**16.5**	186.6	**9.7**	130.9	**-9.7**	43.4	**15.0**	151.7
Income from management	EUR thousand	**9.83**	-178.1	**-4.77**	94.3	**-254.3**	73.5	**-134.29**	68.3
Income parity (A)	%	*	*	**151.3**	201.3	**-139.6**	39.4	**154.7**	169.4
Income parity (B)	%	*	*	**65.0**	204.3	**-90.9**	42.0	**88.9**	152.5
Net investment rate	%	**63.0**	16.3	**52.0**	96.1	**303.0**	7.4	**162.0**	24.2

* lack of own labour

Source: as in Table 3.1.

Similar relationships occurred in productivity of current assets. The highest labour productivity was on Danish farms, it amounted to 254 thousand EUR/AWU. It was about 25% higher than on Dutch farms and almost 6 times higher than on Hungarian farms. Labour productivity on German farms was more than 2 times higher than in Hungarian farms, but 61% lower than on Danish farms. Profitability of land was the highest in Dutch holdings, and profitability of assets in Hungarian holdings. Profitability of land, assets and own labour on Danish farms was negative. On Dutch farms, profitability of own labour was 46.8 thousand EUR/FWU and was about 39% higher than on German farms. In all households, except for Dutch, production was unprofitable.

Profitability ratios were in the range of -9.7% (Denmark) to 16.5% (Hungary). Income from management on Hungarian and Dutch farms was positive, while on German and Danish farms it was negative. German and Dutch farms reached income parity "A" but did not reach income parity "B". In Danish holdings, income parity "A" and "B" was negative. Parity income was not calculated for Hungarian farms due to the disproportionately low own labour. The rate of net investments in Hungarian and German holdings was respectively 63 and 52%, it did not provide for simple reproduction of fixed assets. In other holdings, the net investment rate was high, particularly on Danish farms, where it amounted to 303%. On Dutch holdings it was much lower, 162%. Taking into account the income from management and not achieving income parity "B", it should be noted that dairy farms of this class size have limited development opportunities. Hungarian holdings were the closest to that opportunity, despite a low rate of net investment. Dutch holdings achieved positive income from management and the rate of net investment providing for expanded reproduction of fixed assets and income parity "B" in the amount of 89%; they also have a chance to develop.

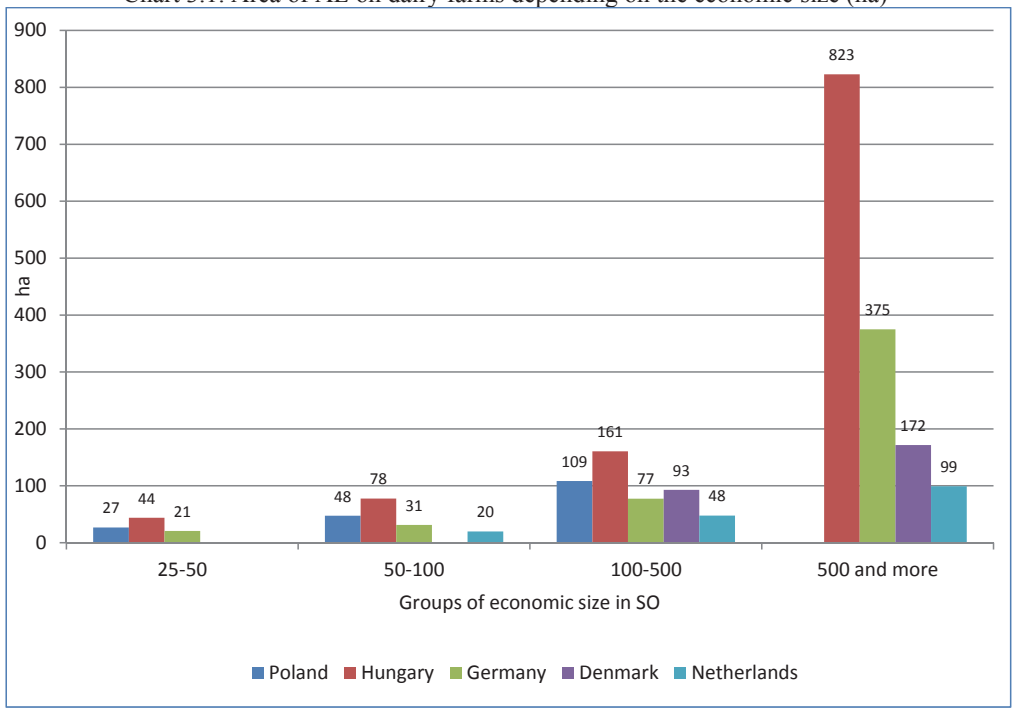
3.2. Assessment of surveyed dairy farms depending on the economic size

3.2.1. Assessment of production potential of dairy farms depending on the economic size

The production potential of dairy farms was characterized by the following features: area of AL, the share of leased land, total labour input expressed in AWU/farm labour participation in own labour, asset value per 1 ha of AL and share of equity in liabilities. Area of AL in surveyed dairy farms is shown in Chart 3.1. It confirms the relationship between the area of AL and economic size within individual countries. Polish dairy farms are present in three size classes: 3-5. Hungarian and German holdings are present in all analyzed size classes: 3-6, Dutch farms in classes 4-6, Danish farms only in classes 5 and 6. In terms of

farm size, German, Danish and Dutch farms were smaller than Polish and Hungarian holdings within given economic size classes. Area of Polish farms ranged between 27 and 109 ha of AL, areas of AL farms ranged from 44 to 823 ha of AL, German farms, from 21 to 375 ha of AL, Danish farms, from 93 to 175, and Dutch farms from 20 to 99 hectares.

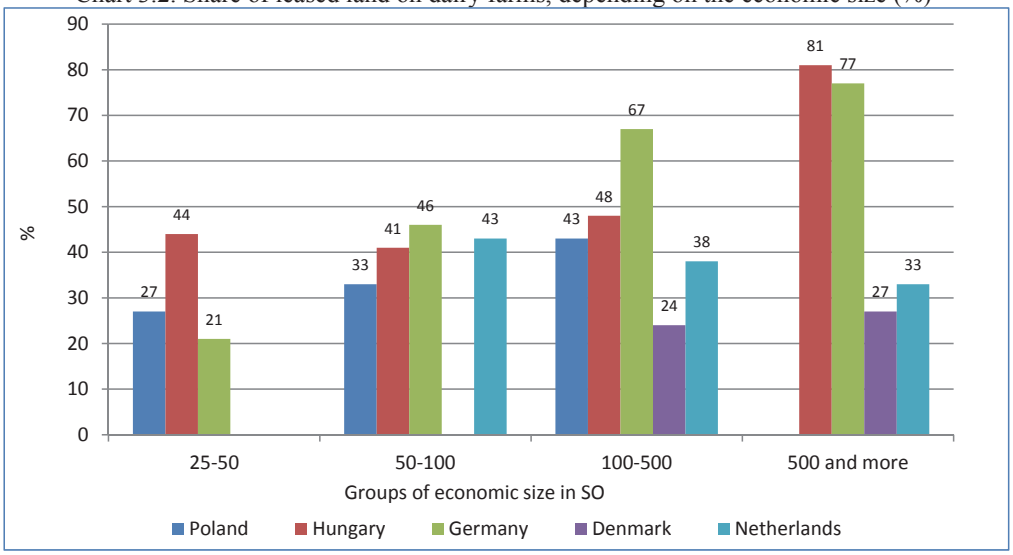
Chart 3.1. Area of AL on dairy farms depending on the economic size (ha)



Source: European FADN.

The surveyed farms benefited from the leased land in varying degrees. The relevant information is shown in Chart 3.2. The share of leased land increased with the increase in economic size, with the exception of Dutch holdings, where the share of leased land decreased. In Polish farms, the share of leased land was in the range of 27 to 43%, on Hungarian farms, from 44 to 81%, on German farms, from 21 to 77%, on Danish farms from 24 to 27%, while on Dutch farms it decreased from 43 to 33%. The low share of leased land on Danish farms is associated with different legal regulations for the transfer of farms to successors who take over the farm by way of purchase.

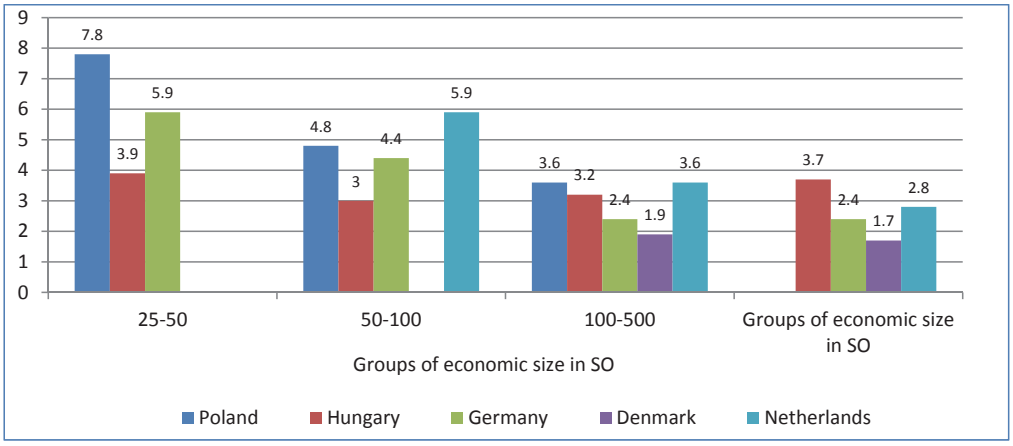
Chart 3.2. Share of leased land on dairy farms, depending on the economic size (%)



Source: European FADN.

Labour inputs per 100 ha of AL show a downward trend with an increase in economic size (Chart 3.3). The highest level of inputs occurred on Polish farms, between 7.8 and 3.6 AWU/100 ha of AL. On Hungarian farms it was in the range of 3.9 to 3.0 ha AWU/100 ha of AL, on German farms, from 5.9 to 2.4 ha AWU/100 ha of AL, on Dutch farms, from 5.9 to 2.8 AWU/100 ha of AL. On Danish holdings, the level of labour inputs was the lowest and was in the two highest classes respectively 1.9 and 1.7 AWU/100 ha of AL.

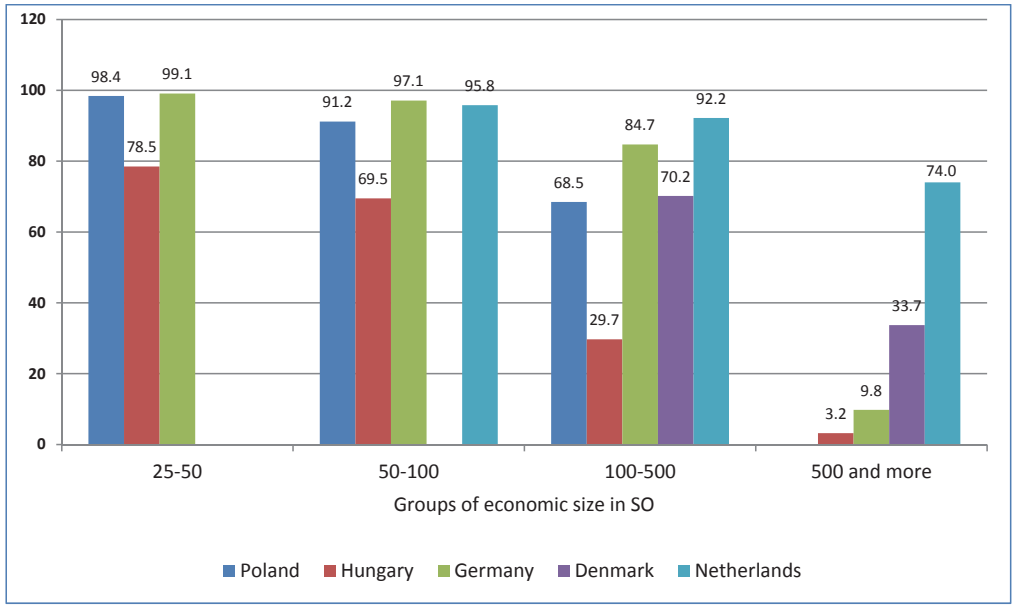
Chart 3.3. Labour inputs (AWU/100 ha of AL) on dairy farms depending on the economic size



Source: European FADN.

The share of own labour in total inputs varied between farms in the surveyed countries and economic size classes. The relevant data is shown in Chart 3.4. It showed a downward trend with increasing economic size. On Polish farms, the share of own labour decreased from 98.4 to 68.5%, on Hungarian farms from 78.5 to 3.2%, on German farms from 99.1 to 9.8, and on Dutch from 95.8 to 74%. In Danish holdings, the share of own labour was relatively low, between 70.2 and 33.7%. It results from the treatment of family members as hired workers.

Chart 3.4. Share of own labour in total labour input on dairy farms depending on the economic size



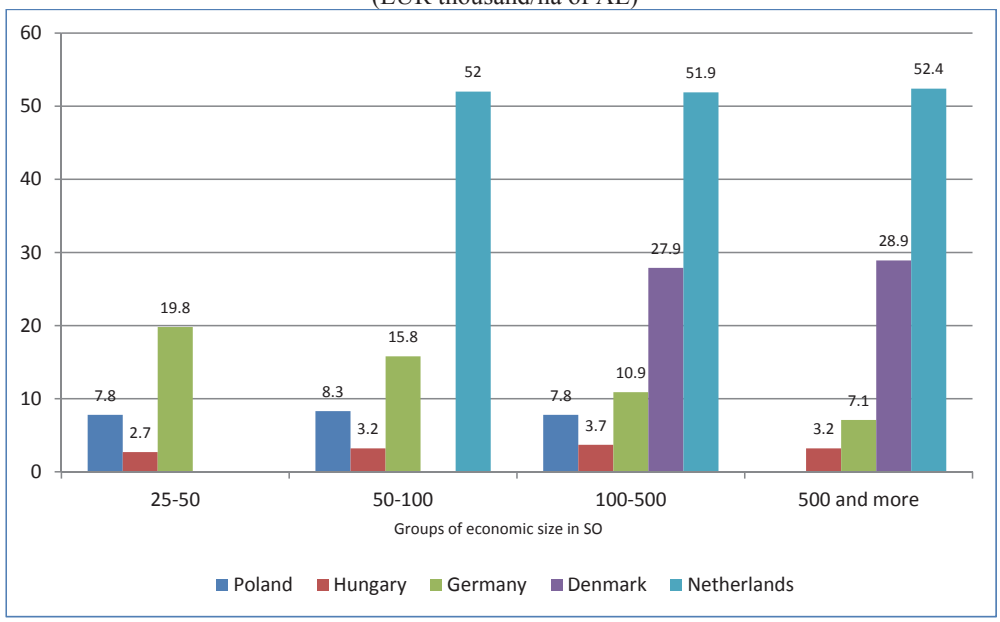
Source: European FADN.

Asset value per 1 ha of AL varied between farms of different countries, but remained at a similar level within different countries. The relevant information is shown in Chart 3.5. By far the lowest value of assets was on Hungarian farms where it ranged between 2.7 to 3.7 thousand EUR/ha of AL. On Polish farms, it was more than 2 times higher than on Hungarian farms, in the range of 7.8 to 8.3 thousand/ha of AL. On German holdings, the value of fixed assets showed a downward trend with increasing economic size, from 19.8 thousand EUR/ha of AL in Class 3 to 7.1 thousand EUR/ha in class 6 – the largest. Such tendency has been widely observed. In Danish and Dutch holdings, the value of fixed assets remained at a similar level, regardless of the economic size. On Danish farms, in the two largest classes, it was respectively 27.9 and 28.9 thou-

sand EUR/ha of AL, while on Dutch farms it ranged between 51.9-52.4 thousand EUR/ha of AL.

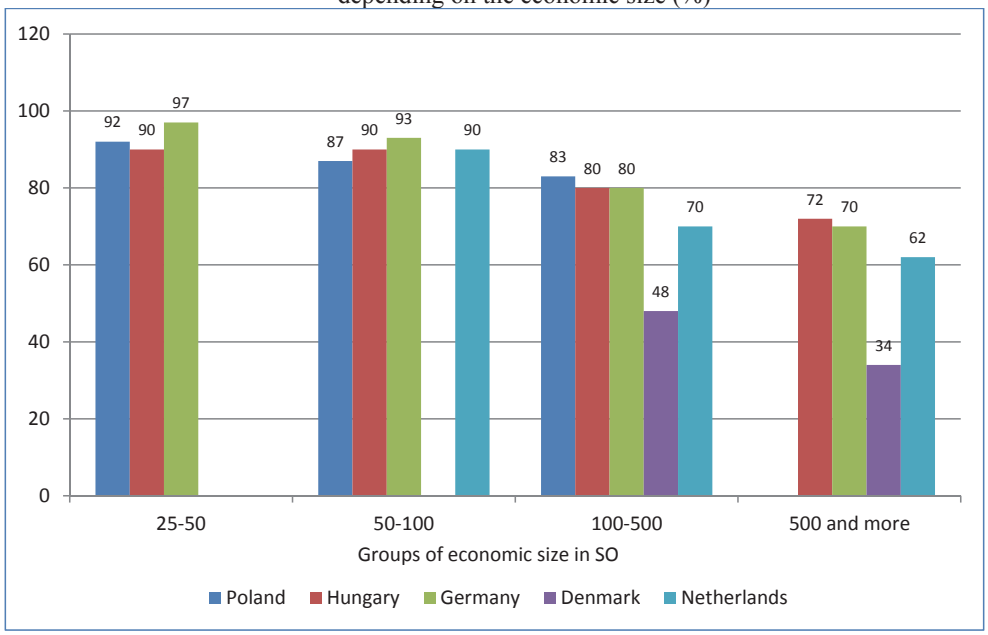
Structure of liabilities determined by the share of equity in total liabilities showed a downward trend. The share of equity declined with increasing economic size. In the third class with the value of SO of EUR 25-50 thousand, the share of equity in total liabilities was the highest, between 92 and 97%. In class 4 with the value SO of EUR 50-100 thousand, the share of equity ranged from 87 to 93%. In class 5 it was in the range of 48 to 83%, and in the highest class 6 in the range of 34 to 72%. The lowest share of equity was in Danish holdings, in the two highest classes it was respectively: 48 and 34%. One should emphasize the high share of equity on dairy farms, regardless of economic size. Danish farms were an exception, the share of equity was below 50%. These farms were supported to a great extent with loans. It is a specific feature of Danish holdings. One can also note that the highest production potential was in Dutch and Danish holdings, followed by German holdings. Production potential of Hungarian and Polish dairy farms was significantly lower.

Chart 3.5. Assets on dairy farms depending on the economic size
(EUR thousand/ha of AL)



Source: European FADN.

Chart 3.6. Share of equity in liabilities of AL dairy farms, depending on the economic size (%)



Source: European FADN.

3.2.2. Assessment of production organization on dairy farms, depending on the economic size

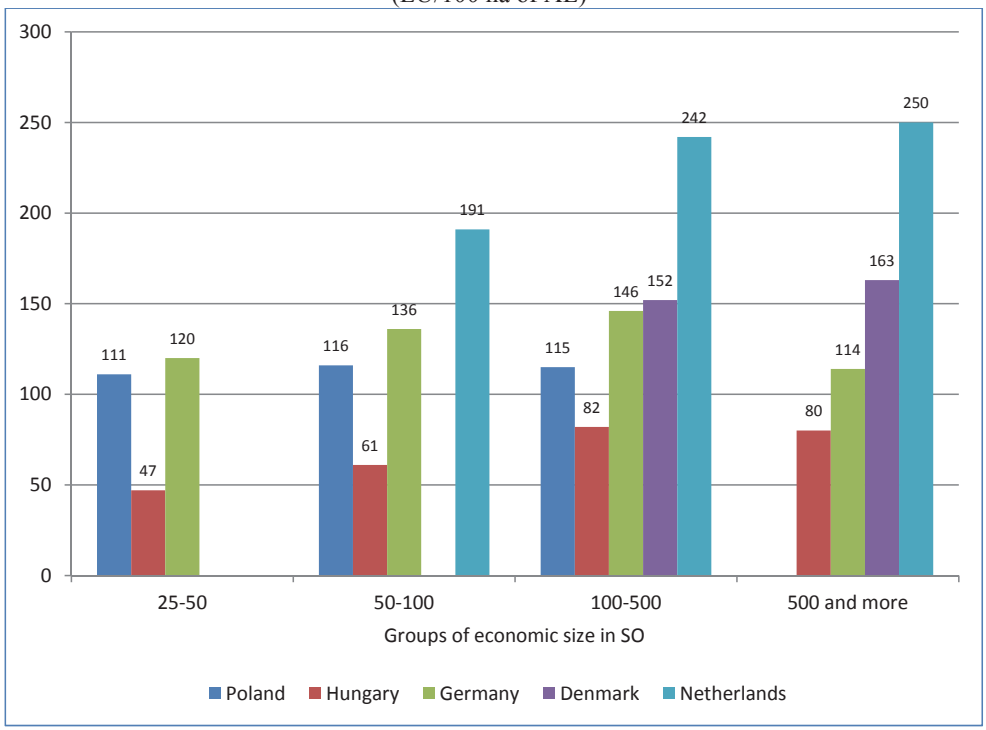
Organization of production on dairy farms was characterized by the following indicators: stocking density in LU/100 ha of AL, number of cows on the farm and share of animal production in total production. The relevant data are shown in charts 3.7-3.9.

Stocking density showed an increasing trend with increasing economic size in all surveyed farms. There were, however, differences in stocking density between countries. On Polish farms, stocking density increased from 111 LU/100 AL in Class 3 to 116 and 115 LU/100 ha of AL in class 4 and 5. Stocking density on Hungarian farms was the lowest, in the range of 47 LU/100 ha of AL to 63, 82 and 80 LU/100 ha of AL in subsequent size classes. Stocking density on German farms increased from 120 LU/100 ha in class 3 to 146 ha LU/100 ha of AL in class 5 and then decreased to 114 LU/100 ha of AL in class 6. Stocking density on Danish farms in the two highest classes was respectively 152 and 163 LU/100 ha of AL. The highest stocking density was in Dutch holdings in the last three classes and showed an upward trend from 191 to 250 LU/100 ha of AL. Stocking density on Danish farms, and especially on Dutch farms, can be described as very high.

Number of cows kept on farms shows a clear upward trend with the increase in economic size. In classes 3 to 5, the number of cows on farms of individual countries was similar. In Class 3 it was in the range of 14 to 19 cows, in class 4 from 24 to 35 cows, and in class 5 from 63 to 88 cows. In class 6, the number of cows was the largest, especially on Hungarian farms, it was 394, and in remaining farms it was in the range of 173 to 215 cows.

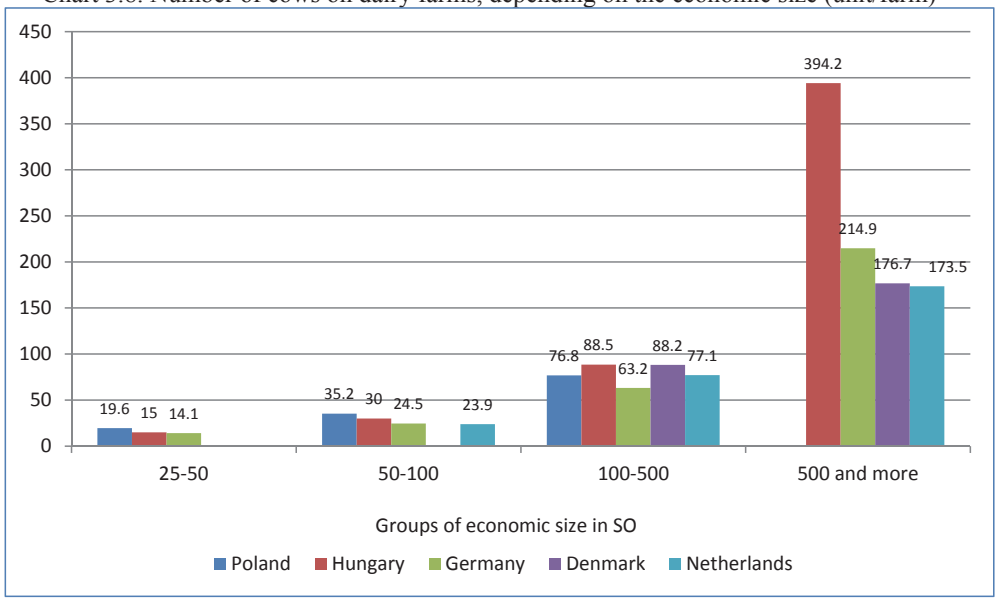
The structure of production in all classes was dominated by animal production, showing a slight upward trend with increasing economic size. Hungarian farms were least specialized in dairy production; the share of animal production in total production was in the range of 65-70%. On other farms the share of animal production exceeded 70% (Danish farms). The highest was on Dutch farms, more than 90% in the two highest classes.

Chart 3.7. Stocking density on dairy farms depending on the economic size (LU/100 ha of AL)



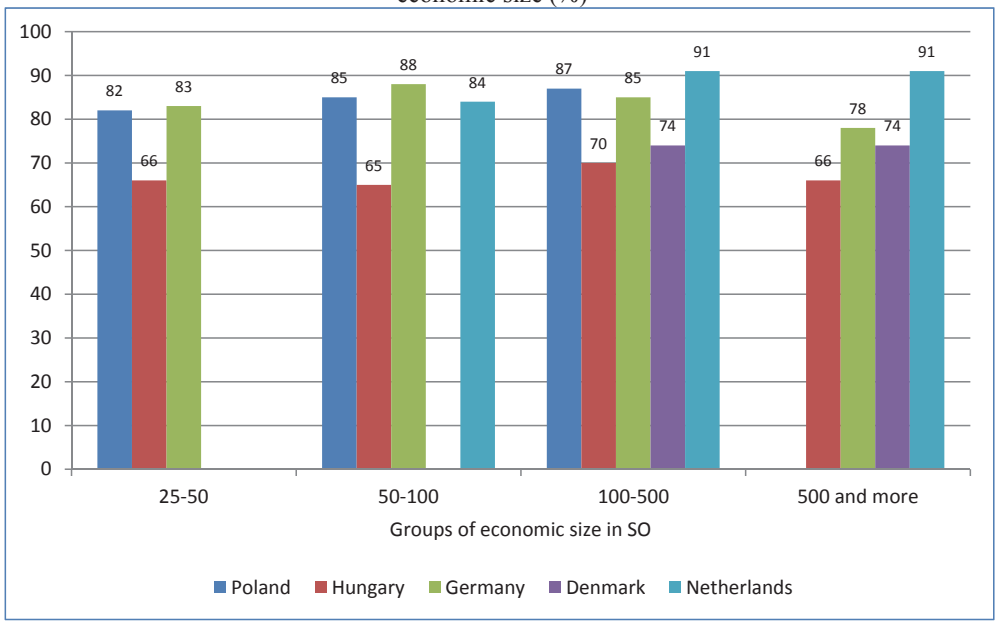
Source: European FADN.

Chart 3.8. Number of cows on dairy farms, depending on the economic size (unit/farm)



Source: European FADN.

Chart 3.9. Share of animal production in total production on dairy farms, depending on economic size (%)

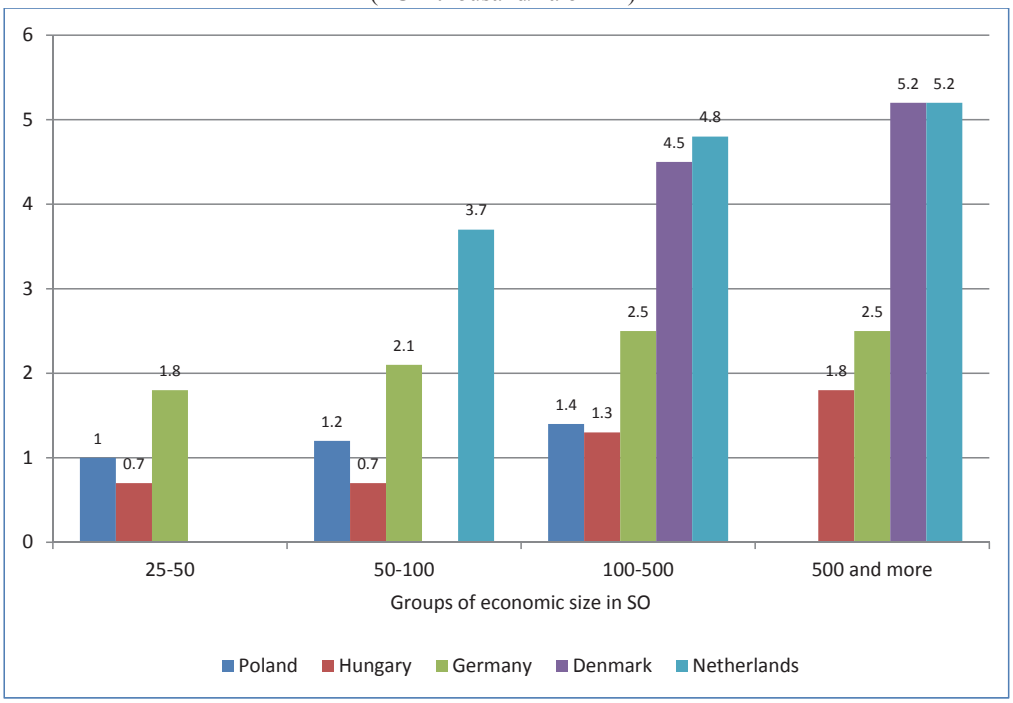


Source: European FADN.

3.2.3. Assessment of the level and structure of costs on dairy farms, depending on the economic size

The level and structure of costs are characterized by the following indicators: total and direct costs in thousand EUR/ha, costs of external factors (labour, capital and land) and depreciation costs per 1 ha of AL. The relevant data are presented in charts 3.10-3.15.

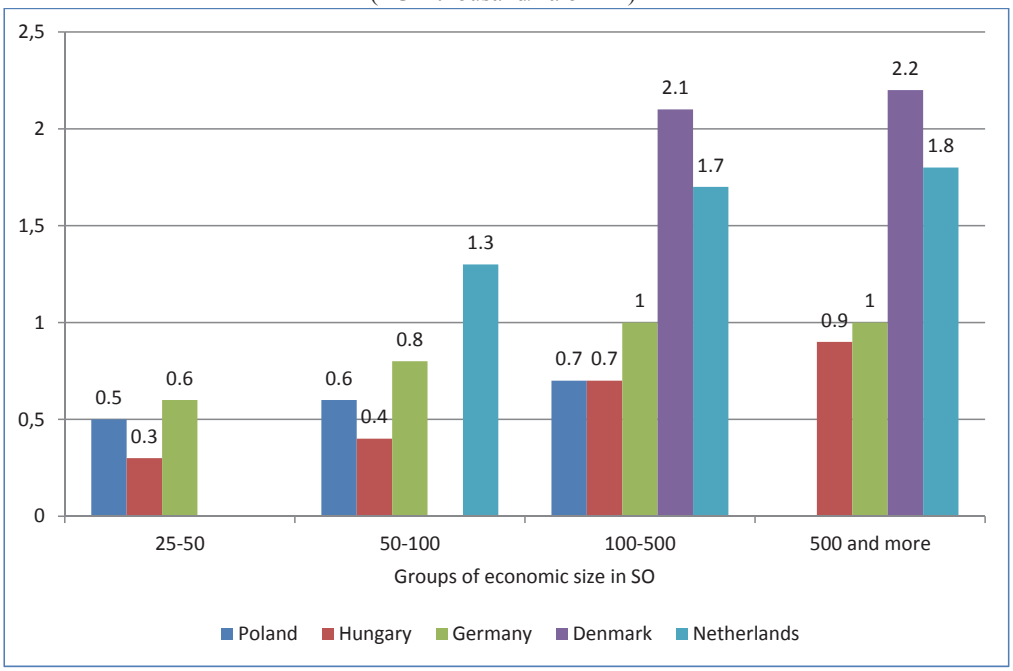
Chart 3.10. Total costs on dairy farms depending on the economic size (EUR thousand/ha of AL)



Source: European FADN.

Total costs per 1 ha of AL are an indicator of the intensity of production. Their level shows an increasing trend with increasing economic size. This trend is different from the previously occurring, according to which with the increase on farm size (area) there was a decline in the level of intensity of production. The limiting factors were labour and capital. The limiting factor in the surveyed dairy farms was land. Therefore, increasing the scale of production could be followed by an increase in the intensity of production. The lowest level of production intensity occurred in Hungarian and Polish holdings. In Hungarian farms it was in the range of 0.7 thousand EUR/ha (in class 3) to 1.8 thousand EUR/ha of AL (in class 6). In Polish farms it was slightly higher, between 1.0 thousand EUR/ha (in class 3) and 1.4 thousand EUR/ha of AL (in class 5).

Chart 3.11. Direct costs on dairy farms depending on the economic size
(EUR thousand/ha of AL)

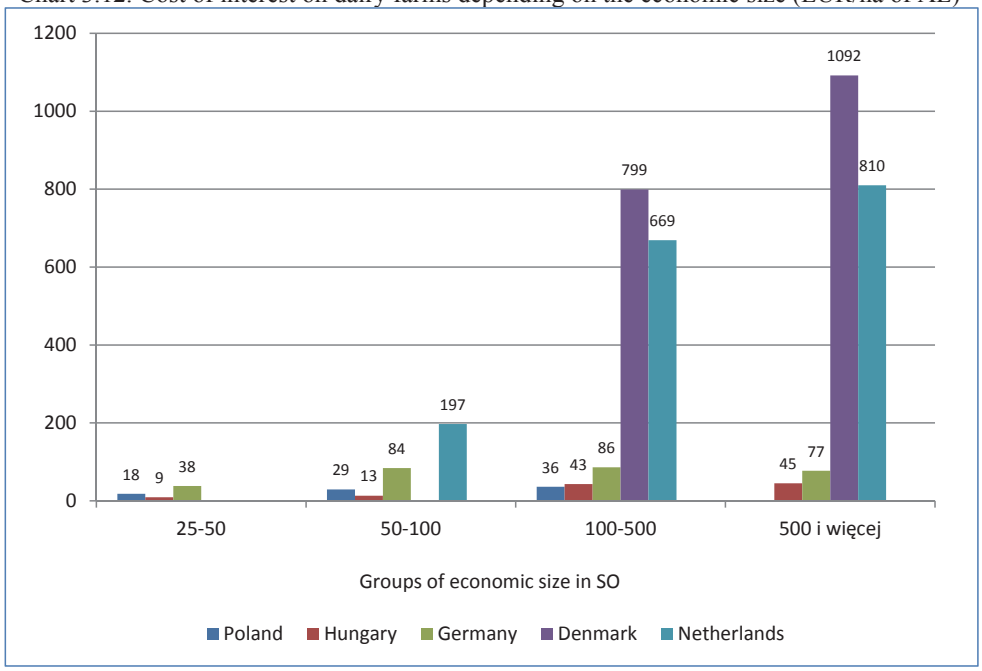


Source: European FADN.

On German farms they increased from 1.8 thousand EUR/ha (in class 3) to 2.5 thousand EUR/ha of AL (in class 5 and 6). In Danish and Dutch holdings the intensity level was the highest in class 6, 5.2 thousand EUR/ha of AL. In class 5 it was slightly lower and amounted to: 4.5 and 4.8 thousand EUR/ha of AL. Similar correlations occurred in direct costs. Their share in total costs in Polish and Hungarian farms was about 50%. The share of these costs in total costs in German, Danish and Dutch holdings was lower. In the case of German farms it was about 40%, while Danish and Dutch farms it was about 35%. This was due to higher cost of external factors on those farms.

The cost of interest which is a part of the costs of external factors is shown in Chart 3.12. It varied widely between the different size classes. It was very low on Polish and Hungarian farms, especially in Class 3 and 4. It was in the range from 9 to 29 EUR/ha of AL. On German farms it was not high either, between 38 and 86 EUR/ha of AL. The highest costs of interest were on Danish farms, respectively 799 and 1,092 EUR/ha of AL in the two highest classes. On Dutch farms they were slightly lower and amounted to 669 and 810 EUR/ha of AL respectively.

Chart 3.12. Cost of interest on dairy farms depending on the economic size (EUR/ha of AL)

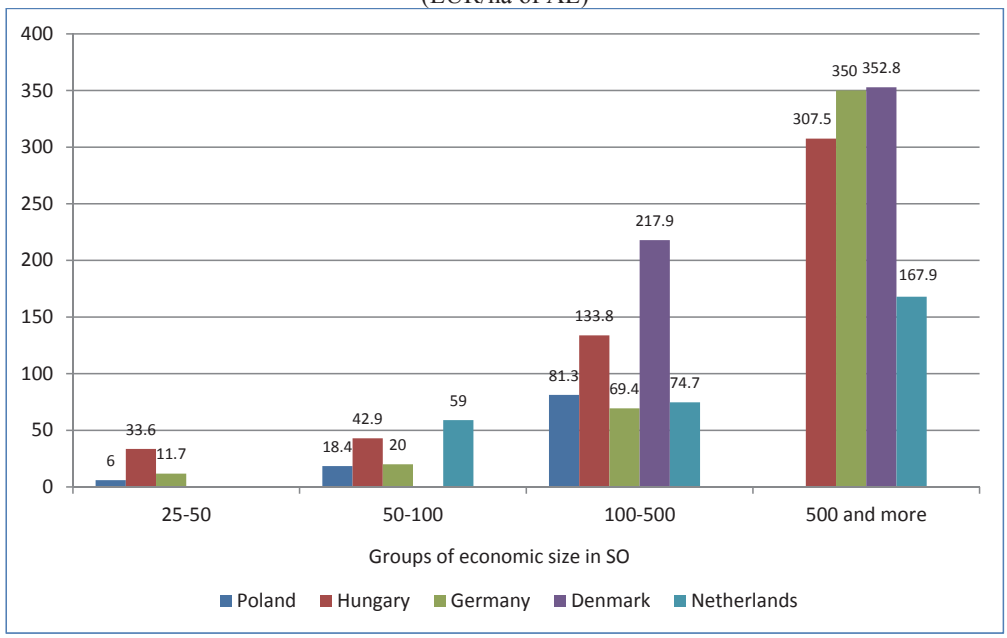


Source: European FADN.

Cost of hired labour was also strongly differentiated between classes of economic size. It also showed an increasing trend with increasing farm size. The lowest was in Polish and German holdings in classes 3 and 4, it was in the range of 6 EUR/ha to 20 EUR/ha of AL. On Hungarian farms it increases with increasing size of farms, from 33.6 EUR/ha in class 3 to 307.5 EUR/ha of AL in class 6. The highest cost of hired labour was on German and Danish farms in class 6, respectively 350 and 352.8 EUR/ha of AL. On Dutch farms, labour cost was much lower, in the last two size classes, 5 and 6, it was respectively: 74.7 and 167.9 EUR/ha of AL.

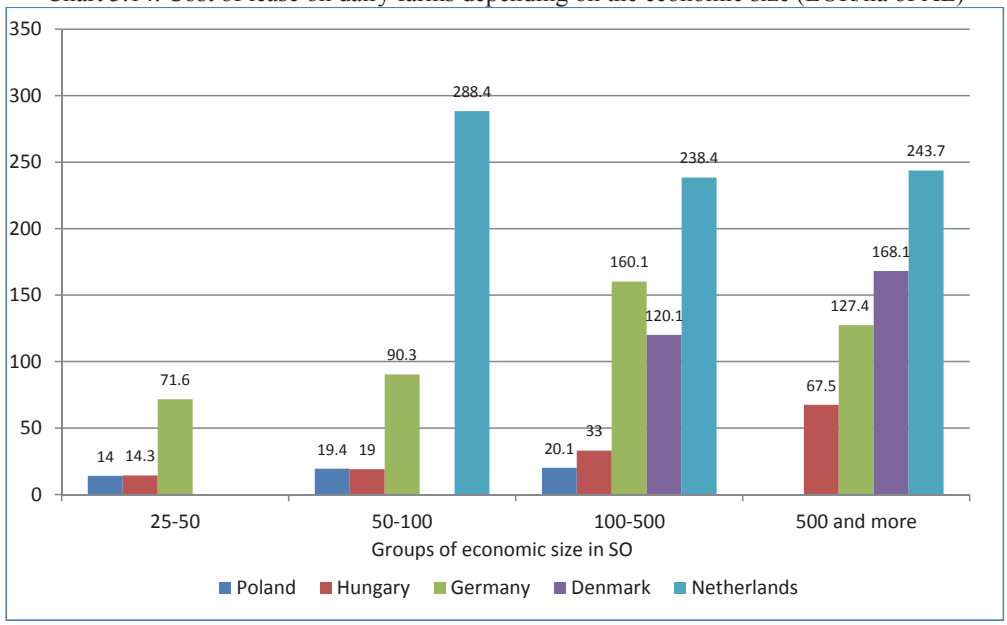
Lease cost was strongly differentiated, with a slight upward trend with the increase in economic size. On Polish farms it increased from 14 EUR/ha of AL in class 3 to 21 EUR/ha of AL in class 5. On Hungarian farms it grew from 14.3 EUR/ha in class 3 to 67.5 EUR/ha of AL in class 6.

Chart 3.13. Cost of hired labour on dairy farms depending on the economic size (EUR/ha of AL)



Source: European FADN.

Chart 3.14. Cost of lease on dairy farms depending on the economic size (EUR/ha of AL)

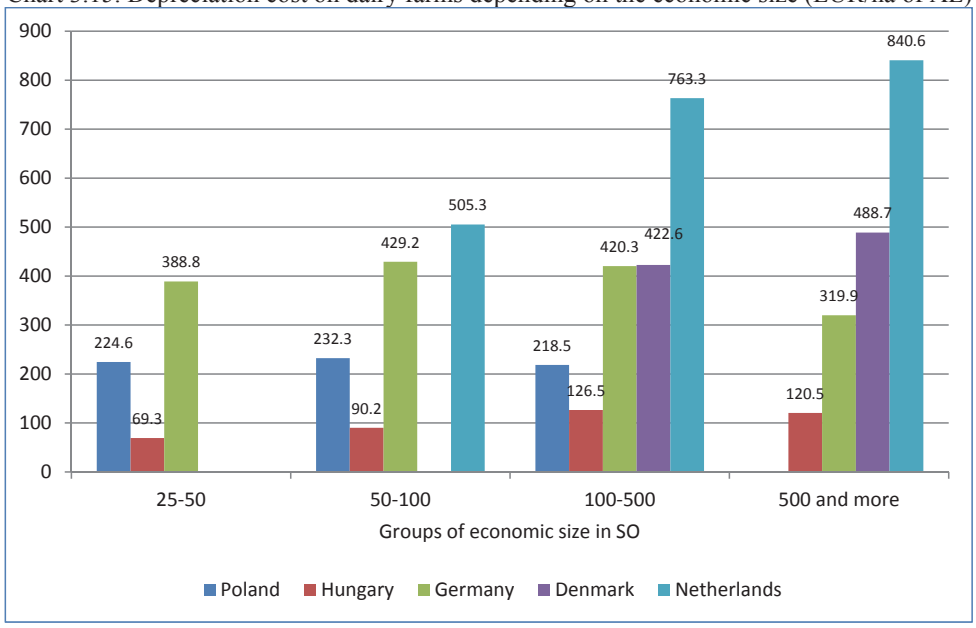


Source: European FADN.

On German farms, the cost of lease was in the range of 71.6 EUR/ha in class 3 to 160.1 EUR/ha of AL in class 5, while in class 6 it decreased to 127.4 EUR/ha of AL. The highest cost of lease – over 240 EUR/ha of AL – was on Dutch farms.

Depreciation cost is shown in Chart 3.15. There were differences between the holdings of individual countries within the economic size classes. The lowest cost of depreciation was on Hungarian farms, which showed a slight upward trend with increasing economic size of holdings, from 63.9 EUR/ha of AL to 126.5 and 120.5 EUR/ha of AL in classes 5 and 6. Depreciation costs on Polish farms were much higher than on Hungarian farms. They were at a similar level in subsequent classes of economic size and were in the range of 224.6 EUR/ha of AL in class 3 to 232.3 EUR/ha of AL in class 4, while in class 5 they decreased to 218.5 EUR/ha of AL. On German farms, in classes 3-5, they were around 400 EUR/ha of AL, while in class 6 they decreased to 320 EUR/ha of AL. Depreciation costs on Danish farms in classes 5 and 6 were respectively 422.6 and 488.7 EUR/ha of AL, showing a slight upward trend. The highest depreciation costs were on Dutch farms, showing an upward trend with increasing economic size of holdings, from 505.3 EUR in class 4 to 840.6 EUR/ha of AL in class 6.

Chart 3.15. Depreciation cost on dairy farms depending on the economic size (EUR/ha of AL)



Source: European FADN.

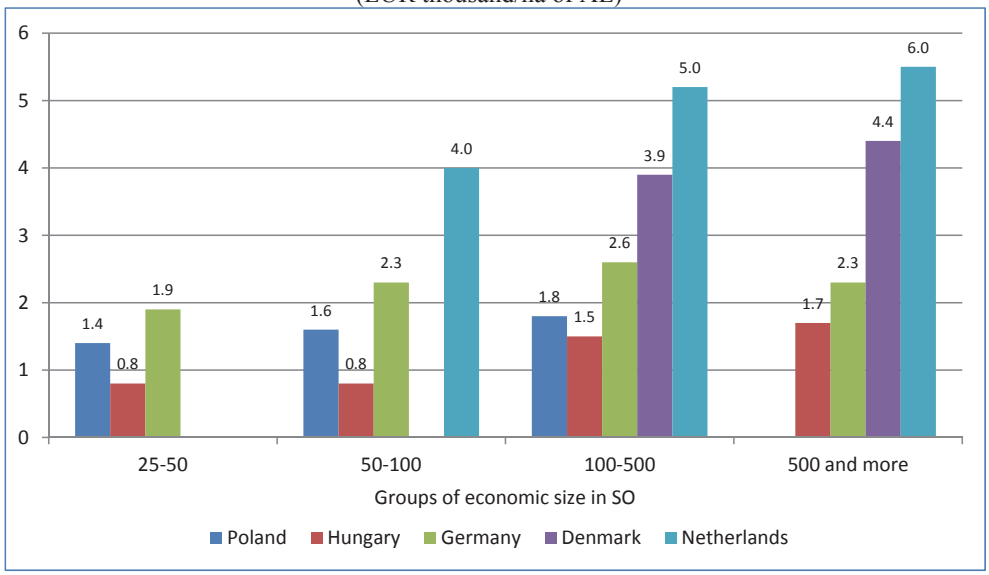
3.2.4. Assessment of production and economic effects on dairy farms, depending on the economic size

Assessment of production and economic effects was made using the indicators of productivity and profitability of production factors, the share of subsidies in revenues and income of farms, the profitability of own labour, parity income, income from management and the rate of net investment.

Productivity of land was highly variable between farms, within economic size classes and between classes. There was a relationship between productivity of land and the economic size of holdings, which increased with the increase in the size of holdings. The lowest productivity of land was on Hungarian farms. It was in the range of 0.8 thousand EUR/ha of AL in class 3 to 1.7 thousand EUR/ha of AL in class 6. On Polish farms land productivity was higher, in the range of 1.4 in class 3 to 1.8 thousand EUR/ha of AL in class 5. On German farms, land productivity was higher than on Polish and Hungarian farms, it was in the range of 1.9 thousand EUR/ha of AL in class 3 to 2.6 thousand EUR/ha of AL in class 5, and it decreased to 2.3 thousand EUR/ha of AL in class 6.

On Danish farms, land productivity was significantly higher than in the previously discussed farms and amounted respectively to 3.9 and 4.4 thousand EUR/ha of AL in class 5 and 6. The highest productivity of land was on Dutch farms, showing an increasing trend from 4.0 thousand EUR/ha of AL in class 4 to 6 thousand EUR/ha of AL in class 6.

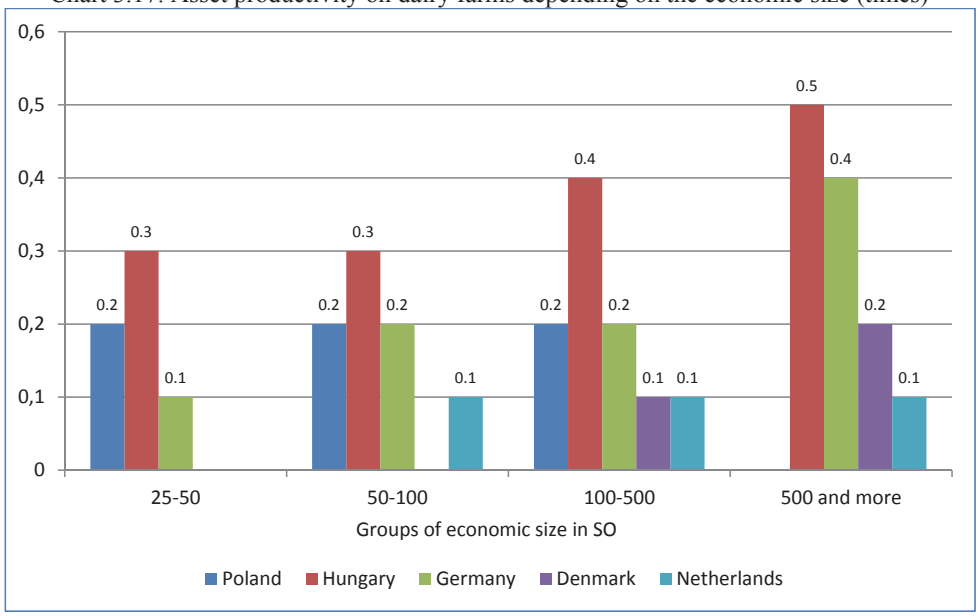
Chart 3.16. Land productivity on dairy farms depending on the economic size (EUR thousand/ha of AL)



Source: European FADN.

The numbers characterizing the productivity of assets are shown in Chart 3.17. The highest productivity of assets was on Hungarian farms in all economic size classes, showing an increasing trend of the times factor from 0.3 in class 3 to 0.5 in class 6. On Polish farms it was lower and stood at 0.2 in classes 3-5. On German farms, the value of the times factor in class 3 was low and stood at 0.1, in classes 4 and 5 it was 0.2, while in class 6 it increased to 0.4. On Danish and Dutch farms asset productivity was low, between 0.1 and 0.2.

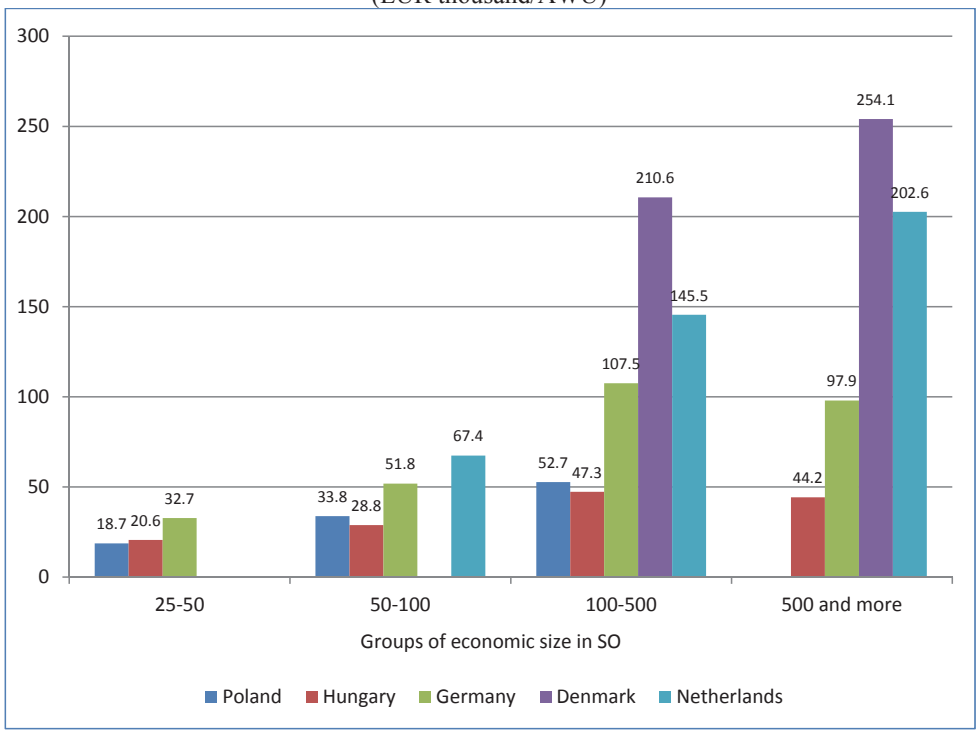
Chart 3.17. Asset productivity on dairy farms depending on the economic size (times)



Source: European FADN.

Labour productivity measured by the value of production in thousand EUR/AWU varied between classes of economic size, showing a rising trend. The lowest was in Polish and Hungarian holdings. On Polish farms it was in the range of 18.7 thousand EUR/AWU in class 3 to 52.7 thousand EUR/AWU in class 5. On Hungarian farms it was in the range of 20.6 thousand EUR/AWU in class 3 to 44.2 thousand EUR/AWU in class 6. Labour productivity in German holdings was higher than on Polish and Hungarian farms, it was in the range of 32.7 thousand EUR/AWU in class 3 to 107.5 thousand EUR/AWU in class 5 and 97.9 thousand EUR/AWU in class 6. On Dutch farms, labour productivity was higher than in German, it was in the range of 67.4 thousand EUR/AWU in class 4 to 202.6 thousand EUR/AWU in class 6. By far the highest productivity was on Danish farms, where in the last two classes it was respectively: 210.6 and 254.1 thousand EUR/AWU.

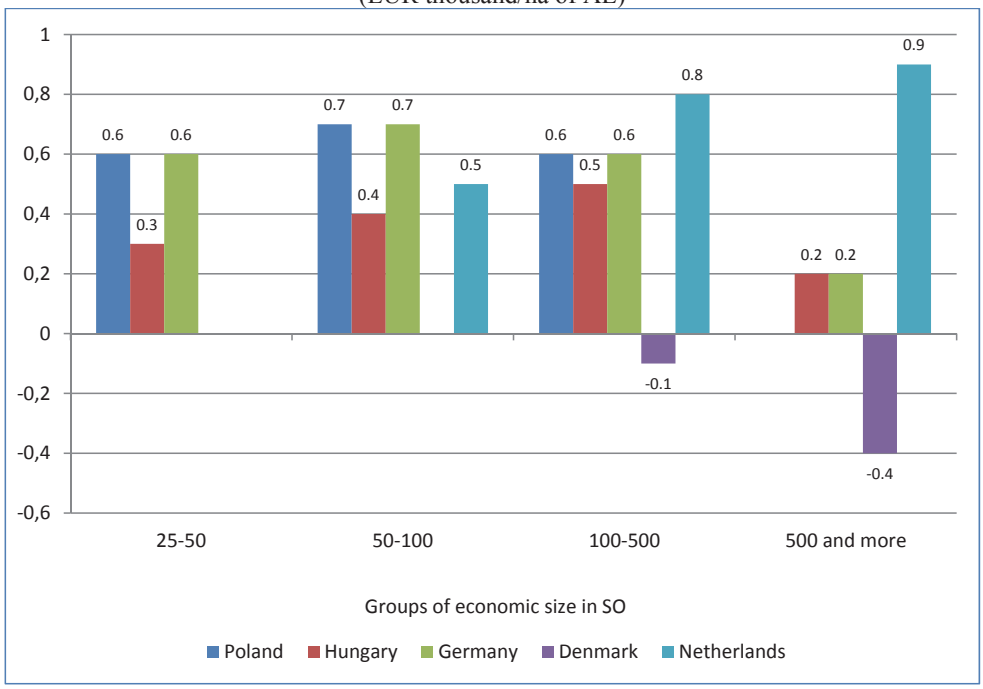
Chart 3.18. Labour productivity on dairy farms depending on the economic size (EUR thousand/AWU)



Source: European FADN.

Profitability of land (Chart 3.19) determined by income from a farm in thousand EUR/ha of AL in the surveyed farms was less diverse than the productivity of land. There is no clear relationship between the profitability of land and the size of farms, with the exception of Dutch farms where such relationship occurred. The lowest profitability of land was on Hungarian farms in all classes of economic size. It ranged between 0.3 and 0.5 thousand EUR/ha of AL in classes 3-5. In class 6 it decreased to 0.2 thousand EUR/ha of AL. On Polish farms it was almost twice as high. The profitability of land on German farms stood at a similar level in classes 3-5, it ranged between 0.6-0.7 thousand EUR/ha of AL. In class 6 it decreased to 0.2 thousand EUR/ha of AL. Profitability of land on Dutch farms was at the highest level, in the range of 0.5 thousand EUR/ha in class 4 to 0.9 thousand EUR/ha of AL in class 6. In Danish holdings, profitability of land was negative and amounted respectively to -0.1 and -0.4 thousand EUR/ha of AL in class 5 and 6.

Chart 3.19. Profitability of land on dairy farms depending on the economic size
(EUR thousand/ha of AL)



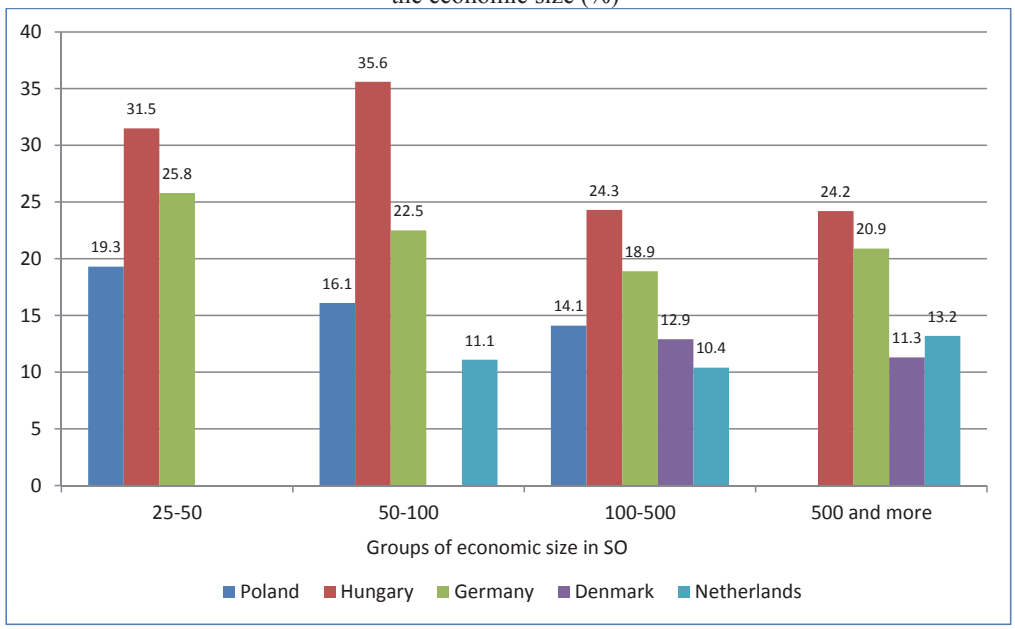
Source: European FADN.

Various kinds of subsidies to operations at farms, received by farmers under the Common Agricultural Policy of the European Union, had a significant effect on the level of income from farms. Data indicating the share of those subsidies in revenues and income of farms are shown in charts 3.20 and 3.21. The share of subsidies in revenues varied between countries and between classes of economic size. This proportion showed a downward trend with increasing economic size. On Polish farms it was in the range of 19.3% in class 3 to 14.1% in class 5. The highest share of subsidies in revenues was on Hungarian farms where it was in the range of 35.6% in class 4 to 24.2% in class 6. On German farms it was about 20%, with little differentiation. The lowest share of subsidies in revenues was in Danish and Dutch holdings, it was in the range of 10-13%.

The share of subsidies in income from the farm is much higher than the share in revenue. It varied between farms within a particular class of economic size, but also between classes. In classes 3 to 5 it showed a slight downward trend. The lowest share of subsidies in income occurred on Polish farms. In class 3 it was 50.7%, while in the two subsequent classes, 4 and 5, it was 40%. On Hungarian farms, in classes 3-5, it was in the range of 82.1% in class 3 to 75.1% in class 5. On German farms, in these classes, it was in the range from 86.2% in

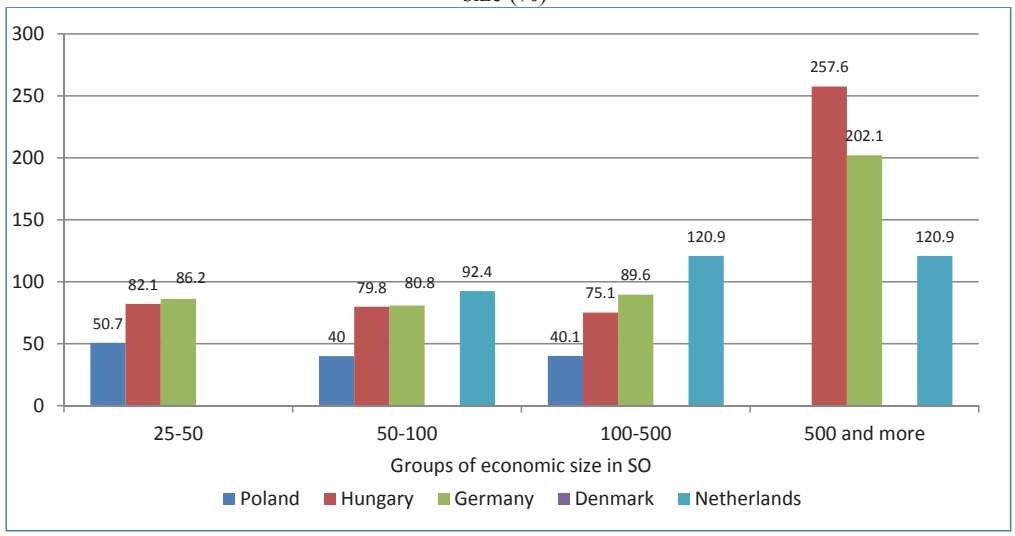
class 3 to 89.6% in class 5. On Dutch farms it was even higher and was respectively 92.4 and 120.9% in classes 4 and 5.

Chart 3.20. Share of operating subsidies in revenues of dairy farms, depending on the economic size (%)



Source: European FADN.

Chart 3.21. Share of operating subsidies in income of dairy farms, depending on the economic size (%)

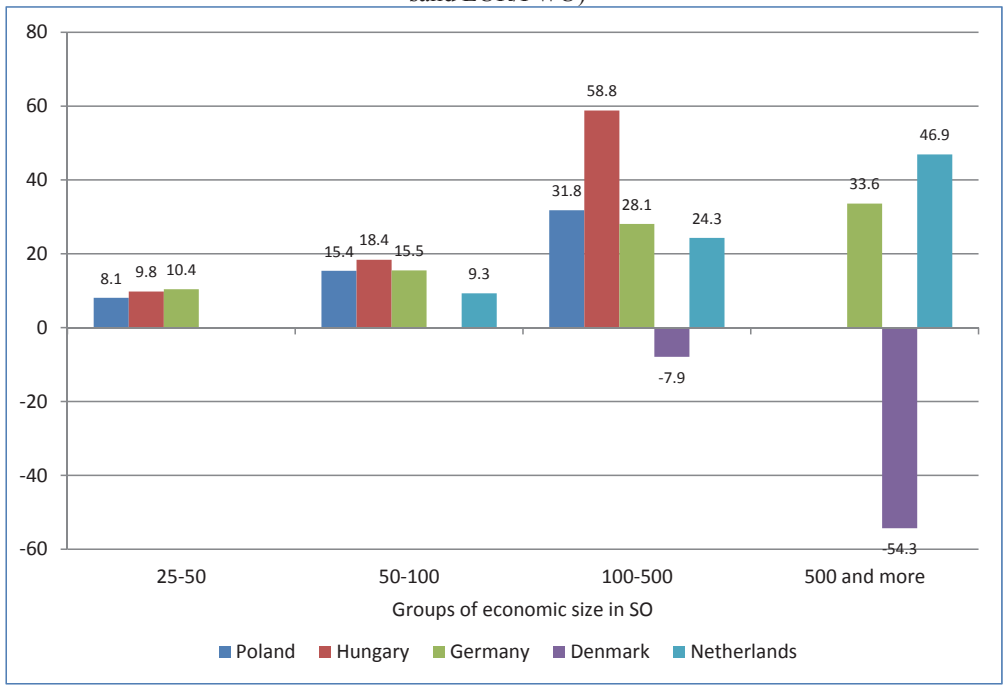


Source: European FADN.

The highest share of subsidies on farm income occurred in class 6; on Hungarian farms it was as much as 257.6%, on German 202.1% and on Dutch 120.9%. Apart from Polish farms in classes 4 and 5, we can conclude that the main factor affecting farm incomes were operating subsidies to farms. The share of subsidies was particularly high on Hungarian farms which had the largest area of AL. On Danish farms, farm income was negative. Therefore, we did not calculate the share of subsidies in income from the farm. Without these subsidies, the loss would be far greater.

The profitability of labour determined by the size of income from farm per FWU indicates the level of wages. Its level was closely correlated with economic size of farms (Chart 3.22). It showed an increasing trend with increasing economic size. In all farms, except for Danish farms, it showed a positive value. On Polish farms it was in the range of 8.1 thousand EUR/FWU in class 3 to 31.8 thousand EUR/FWU in class 5.

Chart 3.22. Profitability of own labour on dairy farms, depending on the economic size (thousand EUR/FWU)



Source: European FADN.

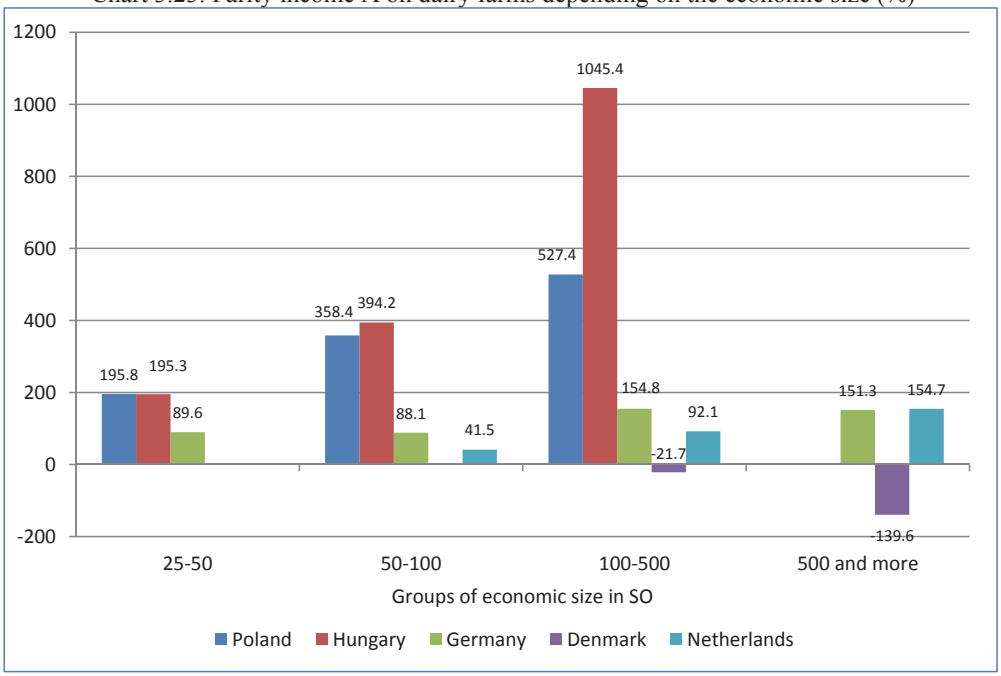
On Hungarian farms, in classes 3-5, income from labour was higher than on Polish farms. In classes 3 and 4 it was higher by an average of 20%, while in class 5 it was higher by 84%. On Hungarian farms, in class 6, that indicator of profitability of own labour was not calculated because there were no inputs of

own labour. On German farms it was in the range of 10.4 thousand EUR/FWU in class 3 to 33.6 thousand EUR/FWU in class 6. On Dutch farms it was in the range of 9.3 thousand EUR/FWU in class 4 to 46.9 thousand EUR/FWU in class 6. On Danish farms, profitability of own labour was negative, it was respectively -7.9 and -54.3 thousand EUR/FWU in class 5 and 6.

Income from own labour was the basis for determining the parity of income, both in relation to wages of hired workers in the surveyed farms (parity A) and in relation to wages in the national economy (parity B).

Income parity "A" was reached by all Polish and Hungarian farms and by German farms in classes 5 and 6, as well as by Dutch holdings in class 6 (Chart 2.23). Income parity "A" in Danish holdings was negative.

Chart 3.23. Parity income A on dairy farms depending on the economic size (%)

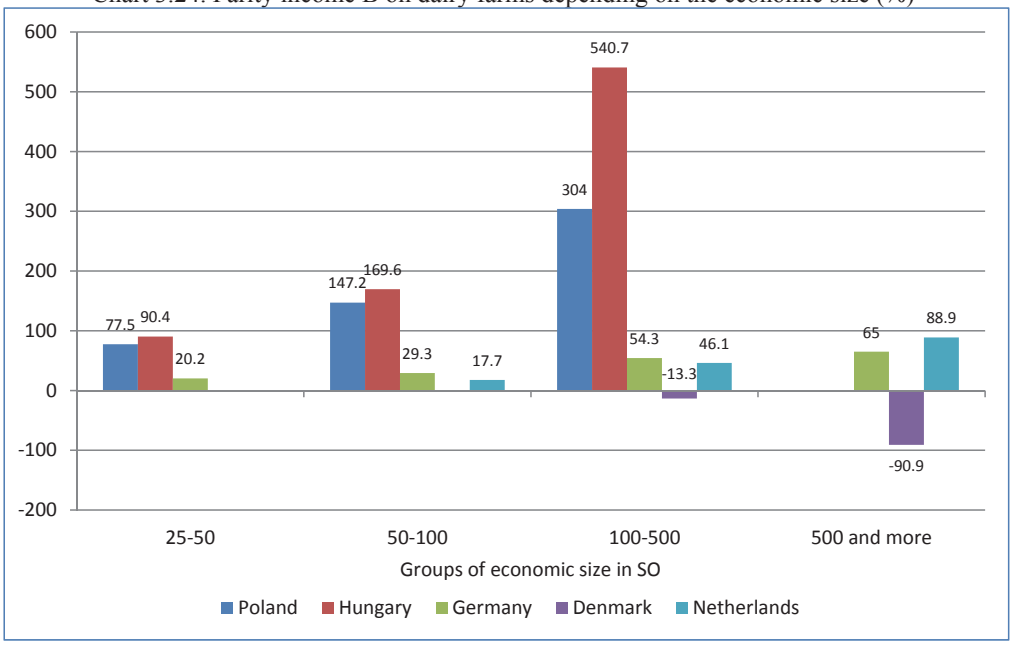


Source: European FADN.

Income parity "B", which is the relation of income from own labour on farm to the level of wages and salaries in the national economy, informs us about the actual income situation of farmers. On the surveyed dairy farms, the parity income and higher was reached only by Polish and Hungarian farms in classes 4 and 5. On other farms, especially on German and Dutch, indicators of income parity "B" were much lower than 100%. On German farms they were in the range of 20.2% in class 3 to 65% in class 6. On Dutch farms they were in the range of 17.7% in class 4 to 88.9% in class 6. Indicators of income parity "B" on

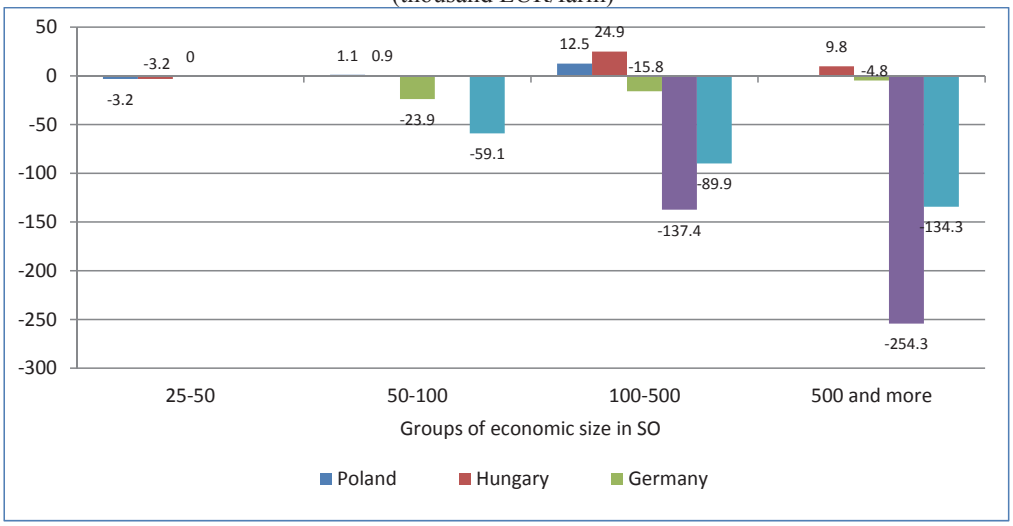
Danish farms were negative and amounted to -13.3% in class 5 and -90.9% in class 6.

Chart 3.24. Parity income B on dairy farms depending on the economic size (%)



Source: European FADN.

Chart 3.25. Income from management on dairy farms, depending on the economic size (thousand EUR/farm)

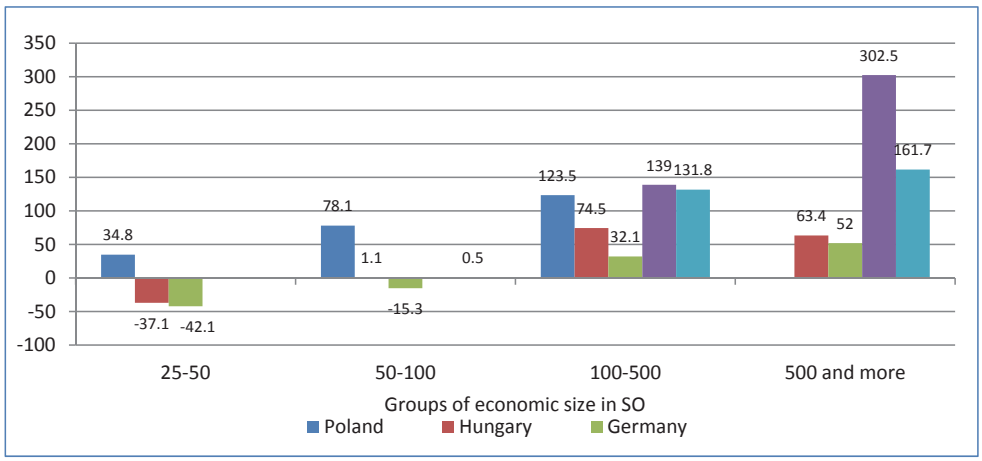


Source: European FADN.

Income from management, constituting the ultimate measure of management efficiency on Polish and Hungarian farms, was negative in class 3, and on German farms it had the value 0. In classes 4 and 5, Polish and Hungarian farms have obtained positive income from management. Hungarian holdings obtained a positive income from management also in class 6. German, Danish and Dutch holdings in classes 4-6 received a negative income from management. The lowest income was obtained by Danish farms, it amounted in classes 5 and 6 to respectively: -137.4 -254.3 thousand EUR/farm. On Dutch farms, income from management was in the range of -59.2 thousand EUR in class 4 to -134.3 thousand EUR/farm in class 6. Income from management in German farms was in the range of -23.9 thousand EUR in class 4 to -4.8 thousand EUR/farm in class 6.

Net investment rate was calculated as the ratio of net investment to depreciation and expressed as a percentage. The rate of net investment of over 100% indicates the increase in fixed assets, while below 100% indicates decrease in fixed assets. The figures presented in graph 3.26 show that net rates of over 100% were reached by Polish, Danish and Dutch holdings in class 5, as well as by Danish and Dutch holdings in class 6. Given the positive income from management, income parity "B" and the rate of net investment, it should be noted that holdings of class 3 from all countries have no development opportunities. In class 4 and 5 only Polish and Hungarian holdings have development opportunities. There are no such opportunities for German, Danish and Dutch holdings. In class 6, which includes very large holdings, Hungarian and some Dutch farms have development opportunities despite not achieving income parity "B", which was about 89%.

Chart 3.26. Net investment rate on dairy farms depending on the economic size (%)



Source: European FADN.

4. Assessment of production potential, organization of production, costs and effects on farms specializing in cattle (type 49) in the surveyed countries, depending on the economic size in 2008-2010

The ability to assess Polish farms specializing in cattle production (type 49) is very limited. There are no Hungarian and Danish farms in this group. In turn, Polish farms are represented only by two size classes: class 3, with the standard output (SO) EUR 25-50 thousand and class 4 with SO of EUR 50-100 thousand. Holdings from these classes could be compared only with the relevant holdings in Germany. Farms breeding cattle of class 5 and 6 covered by the FADN occurred only in Germany and the Netherlands. In addition, the population of these farms was small, in the range of 15-40 units.

4.1. Assessment of farms with cattle production in different classes of economic size

4.1.1. Assessment of farms with cattle production – small to average (class 3, SO of EUR 25-50 thousand) in the surveyed countries

4.1.1.1. Assessment of production potential of farms with cattle production – small to average

The numbers characterizing production potential of these holdings are shown in Table 4.1. Despite including Polish and German farms in the same class of economic size, they differed in this respect. The value of standard output (SO) in German holdings amounted to 41.1 thousand EUR and was 18.4% higher than on Polish farms. In the analyzed period, the value of production on Polish farms did not change, while on German farms it decreased by 15%.

The area of farms in both countries was similar and amounted to ca. 35 hectares. On Polish farms it decreased by 13%, while on German farms it increased by 14.5%. There were clear differences in the share of leased land. On Polish farms, the share of leased land was approximately 26%, while in Germany it was over twice as high and amounted to almost 57%.

Total labour inputs expressed in AWU in Polish farms, both per holding (1.88 AWU) and per 100 ha of AL (5.29), were significantly higher. The difference in both cases was approximately 70%. In the analyzed period, labour inputs in Polish holdings per farm decreased by 7%, while per 100 ha of AL increased by 7%. On German farms, labour inputs per farm were stable, while per 100 ha of AL they decreased by 12%. The share of own labour in total labour inputs was similar in both groups of holdings and stood at about 34%. It should be described as low in this size class of farms.

There were also significant differences in the value of assets, both per 1 ha and per work unit (AWU). In German holdings, the value of assets per 1 ha of AL was EUR 11.5 thousand and was about 88% higher than on Polish farms. Technical equipment expressed as the value of assets per 1 AWU on German farms amounted to EUR 369.3 thousand and was over three times higher than on Polish farms, where it was about 116 thousand/AWU. In the analyzed period, Polish holdings recorded an increase in assets, both per 1 ha of AL and per 1 AWU; it amounted respectively to: 148 and 139%. Increase in technical equipment on German farms was 12.5%, with stable equipment of land with technical facilities.

Table 4.1. Production potential of farms specializing in cattle production (type 49) described as average to small according to SO (total volume of standard output in the range of EUR 25-50 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Economic size	SO	**34.7**	100.6	**41.1**	85.3
Area of AL	ha	**35.7**	86.8	**35.1**	114.5
Share of leased land	%	**25.7**	129.5	**56.7**	104.6
Total labour inputs	AWU	**1.88**	92.9	**1.09**	100.9
Total labour input/100 ha of AL	AWU	**5.29**	107.1	**3.13**	88.1
Share of own labour in total labour	%	**34.1**	86.5	**34.1**	121.1
Value of assets/ha of AL	thousand	**6.1**	148.4	**11.5**	99.1
Value of assets/AWU	thousand	**115.8**	138.7	**369.2**	112.5
Share of fixed assets in assets	%	**86.5**	105.9	**90.2**	102.4
Share of equity in liabilities	%	**91.8**	108.0	**90.6**	102.0

Source: as in Table 3.1.

The structure of assets and liabilities and liabilities in both groups of farms was similar. The share of fixed assets in assets of Polish farms was 86.5 and on German farms it was 90.2%. It should be assessed as high. The share of equity in both groups of holdings was more than 90%. It should also be assessed as high, indicating low debt of these holdings.

In summary, it should be stated that production potential of German holdings in relation to land is similar to that of Polish farms. Labour inputs on Polish farms are higher, while the equipment of land and labour was significantly lower. In general, the production potential of German farms is higher than that of Polish farms.

4.1.1.2. Assessment of production organization on farms with cattle production – small to average

It is concluded that there are significant differences in the organization of production in the surveyed farms with cattle production. The relevant data are given in Table 4.2. The differences relate to the share of cereals and fodder crops in the area of agricultural land. The share of cereals in Polish holdings was 35.2%, while in German holdings it was 16.8%. In both groups the share of the area under cereals decreased. The decrease was greater on German farms where it stood at 29 percentage points, while on Polish farms it was about 8 percentage points.

Table 4.2. Organisation of production on farms specializing in cattle production (type 49) described as average to small according to SO (total volume of standard output in the range of EUR 25-50 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Share of cereals in AL	%	**35.2**	92.3	**16.8**	70.8
Area of forage crops	ha	**21.7**	89.5	**28.8**	124.0
Share of forage crops	%	**60.8**	103.1	**81.9**	108.3
Livestock density	LU/100 ha	**91.9**	104.8	**99.4**	68.4
Stocking density of animals fed in a grazing system per 1ha of forage area	LU/ 1 ha	**1.4**	99.3	**1.2**	64.0
Dairy cows	LU	**8.1**	56.8	**1.6**	82.7
Other cattle	LU	**22.7**	112.0	**31.8**	81.3
Share of crop production	%	**28.1**	113.4	**20.7**	141.9
Share of animal production	%	**69.7**	96.5	**64.4**	77.9
Share of other production	%	**2.2**	58.1	**14.9**	168.5
Including: share of transferred production	%	**1.1**	120.1	**0.6**	141.4

Source: as in Table 3.1.

The difference in the share of forage crops in AL was also important. The share of forage crops in Polish holdings was 61%, while in German holdings it was 82%. A higher proportion of forage crops on German farms indicates a higher degree of specialization. The differences in the stocking density specified by the number of livestock units per 100 ha of AL are not large. On Polish farms, stocking density was 92 LU, while in German farms it was 99 LU/100 ha of AL. On Polish farms density increased by 5%, while in Germany it decreased

by almost 32%. On Polish farms there were more dairy cows in the stock of cattle, 8.1 units, in German only 1.6 units. These figures also indicate a higher degree of specialization of German farms in the direction of beef cattle production. Both groups of farms recorded a decrease in the number of cows in the analyzed period. It was stronger on Polish farms, approximately 43%, and on German farms only 17%.

The structure of production in both farm groups was similar. It was dominated by animal production, whose share on Polish farms amounted to almost 70%, and on German farms to 64%. These figures indicate that the surveyed farms were not specialized in cattle production.

4.1.1.3. Assessment of the level and structure of costs on farms with cattle production – small to average

Costs incurred on the farm per 1 ha indicate the intensity of the level of production. In German holdings it was 1,389 EUR/ha, which was almost twice higher than in Polish holdings (Table 4.3). In both groups of holdings these costs decreased by approximately 20% in the surveyed period. The difference in direct costs was much smaller. Direct costs of German farms per 1 ha of AL amounted to EUR 380 and were only about 29% higher on Polish farms. The level of these costs in the analyzed period has also decreased. On Polish farms by about 30%, on German by as much as 55%. One should also note the differences in the cost structure. On Polish farms, the share of direct costs in total costs was significantly higher, it was 48%, while on German farms it was 27%. Polish farms had higher feed costs, both for own and purchased feed. Cost of own feed in Polish holdings amounted to 218 EUR/ha and was about 49% higher than in German holdings. In both groups of households in the analysed period there has been a decrease in costs of purchased feed. On Polish farms by 33%, on German by 12.5%. Cost of own feed in Polish holdings amounted to 152 EUR/ha, which was about 88% higher than in German holdings. The cost of own feed on Polish farms decreased by 30%, while on German farms it increased by 44.4%.

The costs of external factors were significantly higher on German farms. The costs of hired labour on German farms were 18.5 EUR/ha and were 115% higher than on Polish farms. One should note a strong decline in costs in German holdings, which amounted to about 73%, on Polish farms these costs increased by almost 9%. The cost of interest on German farms was 46.2 EUR/ha i.e. three times higher than on Polish farms. The costs of interest decreased during the analysed period. On Polish farms – by 27%, on German ones – by 7%.

Much greater differences occurred in the cost of lease. On German farms these costs amounted to 70.5 EUR/ha and were more than 7 times higher than on

Polish farms. The cost of lease on Polish farms during the analysed period increased by 18%, while on German farms it decreased by 21%.

Table 4.3. Level and types of costs on farms specializing in cattle production (type 49) described as average to small according to SO (total volume of standard output in the range of EUR 25-50 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Total costs/ha of AL	Euro	**709.9**	81.3	**1389.1**	77.1
Direct costs /ha of AL	Euro	**334.6**	71.4	**380.1**	44.9
Costs of purchased cattle feed/ LU	Euro	**218.0**	67.4	**146.4**	87.5
Costs of own cattle feed/ LU	Euro	**151.6**	69.1	**80.4**	144.4
Other costs of animal production/LU	Euro	**22.6**	69.4	**45.9**	77.6
Cost of hired labour/ ha of AL	Euro	**8.6**	108.6	**18.5**	12.7
Cost of interest /ha of AL	Euro	**15.0**	77.3	**46.2**	93.4
Cost of lease /ha of AL	Euro	**9.5**	118.4	**70.5**	78.6
Depreciation costs /ha of AL	Euro	**167.2**	93.0	**298.2**	111.6

Source: as in Table 3.1.

Depreciation costs of German farms were 298 EUR/ha and were about 78% higher than in Polish farms. Depreciation costs on Polish farms decreased by 7%, while on German farms they increased by almost 12%. This was due to an increase in the value of fixed assets.

In general, it should be noted that German farms operate at a higher level of intensity of production. They had significantly higher indirect costs, including costs of external factors and depreciation.

4.1.1.4. Assessment of productivity and efficiency of farms with cattle production – small to average

The numbers characterizing the productivity of factors of production on the surveyed farms are presented in Table 4.4. Direct productivity of land determined by yields of wheat as a major cereal was higher in German holdings. Wheat yields in these holdings amounted to 58.2 dt/ha and were 23.5% higher than on Polish farms. In both groups of farms, wheat yields decreased over the analysed period, on Polish farms by 12%, and on German farms by less than 7%. Milk yield of cows whose production in these farms was not the core business remained at a fairly low level. On Polish farms it was 4247 kg, and on

German farms it was about 15% higher and amounted to 4889 kg. On Polish farms milk yield decreased by 21%, while on German farms rose by less than 4%. Productivity of land, determined as the value of production per 1 ha of AL amounted to EUR 0.94 thousand on German farms and was 23.6% higher than on Polish farms. In both groups of holdings productivity of land in the analyzed period decreased by 21% and 29% respectively in Polish and German holdings.

Productivity of assets and current assets in Polish holdings was respectively 0.14 and 0.96 and was higher than in German ones by 75% and 16%. In both groups of holdings there was a decrease in productivity of assets and current assets, but it was much stronger on Polish farms. Productivity of assets in Polish holdings fell by 47%, while in German holdings by 28%. Declines in productivity of current assets were smaller. Decline on Polish farms was 25.5% and in German ones it was 9.5%.

Labour productivity on German farms amounted to 29.8 thousand EUR/AWU and was higher twice than in Polish farms. Labour productivity in both groups of farms has decreased. On Polish farms by 26% and on German by 19%.

The profitability of land, assets and own labour was significantly higher on Polish farms. The profitability of land on Polish farms was 0.33 thousand EUR/ha while in German holdings it was significantly lower and amounted to 0.01 thousand EUR/ha. The profitability of land in Polish and German farms increased by 3.8 and 650% respectively.

Productivity of assets in Polish holdings was 5.7%, while in German holdings it was 0.08%. Profitability of own labour in Polish holdings amounted to 6.6 thousand EUR/FWU and was more than seven times higher than in German farms.

Cost-effectiveness and viability of production in Polish farms was significantly higher than in German farms. Cost-effectiveness ratios were respectively 106.6 and 43.3%, whereas in German farms respectively 67 and 1%. Cost--effectiveness of production in Polish and German farms has slightly decreased by 2.6 and 7.6% respectively.

Income from management which is the ultimate measure of management efficiency in Polish and German farms was negative and amounted to -7.5 thousand and -33.4 thousand EUR/farm respectively. In Polish farms in increased by 90%, while in German farms it decreased by 4.2%.

Cost-effectiveness and viability of production on Polish farms was significantly higher than on German farms. Cost-effectiveness ratios were respectively 106.6 and 43.3%, whereas on German farms respectively 67 and 1%. Cost--effectiveness of production on Polish and German farms has slightly decreased by 2.6 and 7.6% respectively.

Table 4.4. Productivity and efficiency of farms specializing in cattle production (type 49) described as average to small according to SO (total volume of standard output in the range of EUR 25-50 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Wheat yield	dt/ha	**47.1**	87.8	**58.2**	93.6
Milk yield of dairy cows	kg/cow	**4247.4**	79.0	**4889.3**	103.6
Productivity of land	thousand EUR/ha	**0.76**	79.1	**0.94**	71.3
Productivity of assets	times	**0.14**	53.3	**0.08**	71.9
Productivity of current assets	times	**0.96**	74.5	**0.83**	90.5
Labour productivity (P/1AWU)	EUR thou-sand	**14.5**	73.9	**29.8**	80.9
Profitability of land (D/ha)	EUR thou-sand	**0.33**	103.8	**0.01**	750.5
Profitability of assets (D/A)	%	**5.7%**	69.9	**0.08**	757.5
Profitability of own labour	EUR thou-sand	**6.6**	97.3	**0.93**	805.4
Cost-effectiveness of produc-tion (P/K)	%	**106.6**	97.4	**67.0**	92.4
Viability of production (D/P)	%	**43.3**	131.2	**1.0**	1053.1
Income from management	EUR thou-sand	**-7.5**	190.0	**-33.4**	95.8
Income parity (A)	%	**174.2**	103.2	**5.0**	920.1
Income parity (B)	%	**62.7**	97.3	**1.9**	805.4
Net investment rate	%	**10.7**	-140.5	**-58.5**	89.2
Share of subsidies in income from holding	%	**252.7**	89.3	**2268.7**	14.1
Share of subsidies in reve-nues from holding	%	**39.4**	153.1	**55.3**	148.1

Source: as in Table 3.1.

Income from management which is the ultimate measure of management efficiency on Polish and German farms was negative and amounted to -7.5 thousand and -33.4 thousand EUR/farm respectively. On Polish farms it increased by 90%, while on German farms it decreased by 4.2%.

The income parity in relation to wages for hired labour on Polish farms amounted to 174.2%, while on German farms it was much lower and amounted to only 5%. Polish farms, despite achieving income parity in relation to wages and salaries for hired labour in agriculture, did not reach the parity income in

relation to the wages in the national economy. They reached only 62.7% of income parity B, while German farms reached only 1.9%.

The rate of net investment on Polish farms was positive and amounted to 10.7%, while on German farms it was highly negative and amounted to -58.5%.

The only source of income from farm in the two groups of farms were operating subsidies. Their share in income of Polish farms was 252.7%, while in German farms as much as 2268.7%.

The share of subsidies on farm revenue was lower. In Polish farms it was 39.4% and in German farms it was 55.3%. The share of subsidies in income in the analysed period declined, while the share in revenue rose by about 50%.

In general, it can be concluded that holdings of this size class have no chance of development. German farms definitely have no chance of development, their income from management was highly negative, they did not reach income parity and had a negative rate of net investment. Polish farms of this size class, despite demonstrating high viability and positive rate of net investment, did not reach income parity and had a negative income from management.

4.1.2. Assessment of farms with cattle production – average to large (class 4, SO of EUR 50-100 thousand) in the surveyed countries

4.1.2.1. Assessment of production potential of farms with cattle production – average to large

The numbers characterizing production potential of average to large farms with cattle production are shown in Table 4.5. The economic size of analyzed farms is similar. In both groups it is about EUR 72 thousand. However, they differ significantly in terms of area of AL. This area on Polish farms is 73 ha and is about 55% higher than on German farms. The area of AL on Polish farms decreased by 21.5%, while on German farms it increased by almost 15%. The share of leased land on German farms was about 60% and was 21 percentage points higher than on Polish farms. In addition, the share of leased land in these holdings decreased by 14%, while on German farms it increased by 8%. Labour inputs per farm on Polish farms were 2.19 AWU and were about 68% higher than on German farms. Labour inputs per 100 ha of AL in both groups were similar and were approximately 3 AWU. There were also differences in the share of own labour, it was higher on Polish farms, 65%, while on German farms it was 45%. There were also striking differences in the value of assets, both per 1 ha of AL, as well as per 1 AWU. In German holdings the value of assets per 1 ha of AL was EUR 11 thousand and was about 86% higher than in Polish farms. The value of assets per 1 AWU amounted respectively to EUR 409 and 192 thousand. On German farms it was over twice as high as in Polish

farms. The structure of assets and liabilities in both groups of farms was similar. The share of fixed assets amounted to about 87%, while the share of equity in liabilities was also approximately 87%.

Table 4.5. Production potential of farms specializing in cattle production (type 49) described as average to large according to SO (total volume of standard output in the range of EUR 50- 100 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Economic size	SO	**72.1**	103.7	**71.7**	95.9
Area of AL	ha	**73.0**	78.5	**47.1**	114.8
Share of leased land	%	**38.5**	85.8	**59.7**	108.0
Total labour inputs	AWU	**2.19**	94.3	**1.3**	105.0
Total labour input/ 100 ha of AL	AWU	**3.0**	120.0	**2.7**	91.4
Share of own labour in total labour	%	**64.9**	82.1	**45.4**	115.0
Value of assets/ha of AL	thousand	**5.9**	163.9	**11.0**	82.8
Value of assets/AWU	thousand	**192.5**	136.5	**408.9**	90.5
Share of fixed assets in assets	%	**85.9**	104.9	**88.5**	99.9
Share of equity in liabilities	%	**87.0**	106.6	**88.4**	94.2

Source: as in Table 3.1.

4.1.2.2. Assessment of production organization on farms with cattle production – average to large

The analyzed farms of this type differed in the organization of production. The intensity of the organization of production in Polish farms was lower than in German farms. This is evidenced by the higher share of cereals in the area of AL, which was 31%, while in German farms it was about 20% (Table 4.6). The share of fodder crops in Polish farms was 66% and was 10 percentage points lower than in German farms. In Polish farms, in the analysed period, both the area and the share of fodder crops in AL decreased, respectively by 25% and 4%, while in German farms they increased by 27% and 10%.

Another element that proves the lower level of intensity of production in Polish farms was the stocking density. In Polish farms it was 89 LU/100 ha of AL, while in German farms it was 108 LU and was higher by 20%. On Polish farms the stocking density increased by 22%, while on German farms it decreased by 15%. Polish farms had more dairy cows, 17 units, while in German

farms it was 5 cows. The share of crop production in total production in both groups was similar, approximately 22%. Polish farms had a higher share of animal production, 76%, which was about 10 percentage points higher than on German farms. Polish farms had a negligible share of other production. It was 0.8%, while on German farms it was much higher and amounted to 14%.

Table 4.6. Organisation of production on farms specializing in cattle production (type 49) described as average to large according to SO (total volume of standard output in the range of EUR 50-100 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Share of cereals in AL	%	**30.7**	105.8	**20.3**	74.2
Area of forage crops	ha	**48.6**	75.5	**36.3**	126.8
Share of forage crops	%	**66.3**	96.1	**76.8**	110.4
Livestock density	LU/100 ha	**89.5**	121.6	**107.7**	85.4
Stocking density of animals fed in a grazing system per 1 ha of forage area	LU/ 1ha	**1.3**	128.9	**1.4**	78.6
Dairy cows	LU	**17.1**	75.7	**5.5**	77.7
Other cattle	LU	**44.6**	108.5	**43.8**	101.9
Share of crop production	%	**22.9**	116.5	**20.1**	95.9
Share of animal production	%	**76.3**	96.8	**65.7**	96.2
Share of other production	%	**0.8**	32.7	**14.2**	127.8
including: share of transferred production	%	**0.6**	126.4	**0.3**	73.1

Source: as in Table 3.1.

In summary of the organization of production on the analysed farms it should be noted that Polish farms were less intensively organized. This is evidenced by the higher share of cereals and at the same time the lower proportion of forage crops in the area of AL and a lower stocking density. The structure of production had a higher share of animal production, which indicates a higher degree of specialization of Polish farms.

4.1.2.3. Assessment of the level and structure of costs on farms with cattle production – average to large

The numbers characterizing the level and structure of costs in average to large farms with cattle production are shown in Table 4.7. Total costs on German holdings were 1,545 EUR/ha of AL and were over twice higher than on Polish farms. These costs decreased in both groups of farms in the analysed period, in Polish holdings by 3%, and in German by 12%. Differences in the level of direct costs were definitely smaller. On German farms these costs amounted to 492 EUR/ha of AL and were 43% higher than on Polish farms. Direct costs decreased in both groups of farms in the analysed period, in Polish holdings by 9%, and in German by 17%. There were also differences in the structure of total costs. On Polish farms, the share of direct costs in total costs was almost 50% (48%), while on German farms it was 32%.

The cost of purchased feed for cattle in both groups were similar, on Polish farms it was 221/ha of AL, while on German farms it was 243 EUR/ha and was by 10% higher. On German farms, other costs of animal production were higher i.e. they were 64 EUR/LU and over twice higher than in Polish ones (2.17).

Table 4.7. Level and types of costs on farms specializing in cattle production (type 49) described as average to large according to SO (total volume of standard output in the range of EUR 50-100 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Total costs/ha of AL	Euro	**711.5**	97.3	**1545.1**	88.5
Direct costs /ha of AL	Euro	**344.5**	91.3	**492.5**	82.9
Costs of purchased cattle feed/LU	Euro	**221.2**	71.6	**242.8**	98.6
Costs of own cattle feed/ LU	Euro	**130.2**	86.1	**102.5**	101.7
Other costs of animal production/LU	Euro	**29.3**	66.7	**63.7**	99.4
Cost of hired labour/ ha of AL	Euro	**12.7**	94.4	**21.2**	64.2
Cost of interest /ha of AL	Euro	**17.1**	139.2	**52.6**	122.4
Cost of lease /ha of AL	Euro	**12.1**	67.2	**84.0**	104.2
Depreciation costs /ha of AL	Euro	**153.4**	105.5	**298.0**	90.9

Source: as in Table 3.1.

German farms had significantly higher costs of external factors. The costs of hired labour in German farms were 21 EUR/ha of AL and were 67% higher

than on Polish farms. They decreased in the analysed period, in Polish holdings by 6%, and much more on German farms, by 36%. Much greater differences occurred in the cost of interest. The cost of interest on German farms were 53 EUR/ha of AL and were over three times higher (3.07) than on Polish farms. The cost of interest increased in both groups in the analysed period. On Polish farms by 39%, on German by 22%. Even greater differences occurred in the cost of lease. On German farms these costs amounted to 84 EUR/ha of AL and were nearly 7 times (6.94) higher than on Polish farms.

There were also differences in the cost of depreciation. In German holdings it was 298 EUR/ha of AL and was almost twice (1.94) higher than in Polish holdings. Differences in depreciation costs were the result of differences in the value of fixed assets. On Polish farms, depreciation costs in the period increased by 5.5%, while on German farms they declined by 9%.

To summarize the assessment of the level and structure of costs in the analyzed farms, it should be noted that the level of intensity of production on German farms was higher over twice than on Polish farms. This was due to higher direct costs but also due to the costs of external factors, such as hired labour costs, interest and lease, and depreciation.

4.1.2.4. Assessment of productivity and efficiency on farms with cattle production – average to large

Direct productivity of land determined by yields of wheat in the analysed period was higher in German holdings. Wheat yields in these holdings amounted to 65 dt/ha and were 26% higher than on Polish farms. They were fairly stable. On Polish farms they increased by 9%, while on German farms they decreased by 3% (Table 4.8).

Milk yield of cows in both groups of farms was similar and amounted to approximately 5900 kg. It should be assessed as average. It was stable in the analyzed period. Fluctuations amounted to about 2%.

Productivity of land determined as the value of production per 1 ha of AL amounted to 1.26 thousand EUR/ha on German farms and was 43% higher than on Polish farms. During the analysed period it increased by almost 10% in these farms, while on German farms it decreased by 12%.

Productivity of assets and current assets in Polish holdings was slightly higher. Productivity of assets in Polish holdings was 0.16 and was 33% higher than in German farms. On Polish farms it decreased by 33%, which was associated with an increase in the value of assets, while on German farms it increased by 7%. Productivity of current assets in Polish holdings was 1.9 and was 8% higher than on German farms. In this case, also in the analysed period the

productivity of current assets on Polish farms decreased by 13%, while on German farms it increased by 6%.

Labour productivity measured by the value of production per 1 AWU in German holdings was EUR 47 thousand and was 62% higher than on Polish farms. Labour productivity decreased on Polish farms in the analysed period by 7%, while on German farms by 3%.

The profitability of land, assets and own labour on Polish farms was higher. The profitability of land determined by the level of income from a farm on Polish farms was 0.45 thousand EUR/ha of AL and was about 165% higher than on German farms, where it was 0.17 thousand EUR/ha of AL. The profitability of land increased in both groups of farms. On Polish farms by 36%, on German ones by 33%. Profitability of assets in Polish holdings was 7.8% and was higher than the profitability of assets in German holdings by 6.2 percentage points. Profitability of assets on Polish farms decreased by 17%, while on German farms it increased by 60%. Profitability of own labour in Polish holdings amounted to 16.5 thousand EUR/FWU and was 147% higher than on German farms. The profitability of own labour in both groups of households increased. On Polish farms by 8%, on German by 45%.

Cost-effectiveness and viability of production on Polish farms was significantly higher. Indicator of cost-effectiveness of production on Polish farms was 123%, while on German farms it was 82%, which indicates lack of profitability. Indicator of cost-effectiveness of production on Polish farms increased in the analysed period by 13%, while on German farms it remained at a constant level.

Indicator of viability specified by the ratio of income from farm to production on Polish farm was high, 51%, while in Germany it was 13.5%. This ratio in both groups of farms increased on Polish farms by 24% and on German farms by 50%.

Income from management which is the ultimate measure of management efficiency on Polish farms was positive and amounted to 1.6 thousand/farm, while in German holdings it was negative and amounted to -38.2 thousand EUR/farm. In the analyzed period, the income from management decreased in both groups of farms, on Polish farms it decreased by 68%, while on German ones by 27%.

Polish farms reached income parity, both in relation to the wages of hired workers on farms and relative to wages and salaries in the national economy. The respective ratios were 416 and 158%. German farms have not reached income parity, neither A nor B. The corresponding figures were 13 and -27%. These indicators in German farms have improved, but were insufficient.

The rate of net investment of Polish farms was positive and amounted to almost 41%, while in the case of German farms it was negative and amounted to

-27%. The main source of income in both groups of farms were subsidies. Their share in the income from farm of Polish holdings was 162%, while for German holdings it was 296%. The share of subsidies in revenues was lower, 34% in Polish farms and 39% in German farms.

Table 4.8. Productivity and efficiency of average to large dairy farms (type 49) according to the size of SO (total volume of standard output in the range of EUR 50-100 thousand) in 2008-2010

Specification	Unit	Poland		Germany	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Wheat yield	dt/ha	**51.3**	109.1	**64.8**	96.7
Milk yield of dairy cows	kg/cow	**5872.9**	102.3	**5898.6**	98.8
Productivity of land	thousand EUR/ha	**0.88**	109.6	**1.26**	88.4
Productivity of assets	times	**0.16**	66.9	**0.12**	106.9
Productivity of current assets	times	**1.09**	87.4	**1.01**	105.7
Labour productivity (P/1AWU)	EUR thousand	**29.1**	91.3	**47.2**	96.7
Profitability of land (D/ha)	EUR thousand	**0.45**	135.9	**0.17**	132.6
Profitability of assets (D/A)	%	**7.8**	82.9	**1.6**	160.2
Profitability of own labour	EUR thousand	**16.5**	108.4	**6.67**	144.7
Cost-effectiveness of production (P/K)	%	**123.0**	112.6	**81.8**	99.9
Viability of production (D/P)	%	**51.1**	124.0	**13.5**	149.9
Income from management	EUR thousand	**1.6**	31.9	**-38.2**	73.2
Income parity (A)1	%	**415.9**	89.9	**31.8**	196.3
Income parity (B)2	%	**158.5**	108.4	**12.8**	144.7
Net investment rate	%	**40.7**	-99.6	**-26.6**	1170.4
Share of subsidies in income from holding	%	**161.8**	68.9	**295.9**	74.5
Share of subsidies in revenues from holding	%	**34.3**	101.2	**39.3**	111.7

Source: as in Table 3.1.

In summary of the assessment of productivity and efficiency of surveyed groups of farms, it should be noted that German farms had higher productivity of land and labour. However, they had lower rates of profitability of land, assets and own labour, as well as cost-effectiveness and viability of production. They

did not achieve income parity and positive income from management. They also had a negative net investment rate. On this basis, it can be concluded that average to large German farms with cattle production, in contrast to Polish farms, have no capacity to develop.

4.1.3. Assessment of farms with cattle production - large (class 5, SO of EUR 100-500 thousand) in the surveyed countries

4.1.3.1. Assessment of production potential of farms with cattle production – large

The numbers characterizing production potential of large farms with cattle production are shown in Table 4.9. In this case, evaluation pertains to holdings of this economic size class from Germany and the Netherlands. The analysed farms, despite being in the same class of economic size vary in size. The standard value of production in German farms was EUR 201 thousand, while on Dutch farms it was 283 thousand EUR/farm. The difference was 40%. The farms also differed in the area of AL. The area of these land in German holdings was 91 ha, while in Dutch holdings only 44 hectares. German farms were more than twice as large. Both types of farms used leased land. The share of leased land was big. On German farms it was 68% and on Dutch farms it was 77%. The share of leased land increased in the analysed period by 5% and 9% respectively.

Total labour inputs per farm were higher in German farms, 1.83 AWU, while on Dutch farms it was 1.29 AWU. In terms of 100 ha of AL, labour inputs on Dutch farms were almost 3 AWU and were about 47% higher. The share of own labour on German farms was 74% and was by 32 percentage points higher than on Dutch farms. The share of own labour increased in both groups of farms by about 9%.

There were substantial differences in the values of assets, both per 1 ha of AL and 1 AWU. In Dutch holdings, the value of assets per 1 ha of AL was EUR 20 thousand and was about 114% higher than on German farms. The value of assets on German farms remained at the same level, while on Dutch farms it increased by 13%. Value of assets per 1 AWU on Dutch farms was EUR 686 thousand and was about 46% higher than on German farms. This value in Dutch holdings increased during the analysed period by almost 30%, while on German farms it remained at a similar level. The assets in both groups of farms were dominated by fixed assets, the share of which was similar and amounted to about 83%. The share of equity in German holdings was similar, while in Dutch holdings it was much lower at 60%. This means that Dutch holdings had more foreign capital.

In summary of the assessment of the production potential of German and Dutch farms of this size class, it should be noted that Dutch farms, despite

smaller area of AL, showed a higher standard output and higher proportion of leased land. They also had higher labour inputs per 100 ha of AL and a lower proportion of own labour in the total labour inputs. They were definitely better equipped with capital, as evidenced by the higher value of assets, both per 1 ha of AL and per work unit (AWU). They also benefited to a greater extent from foreign capital.

Table 4.9. Production potential of farms with cattle production (type 49) described as large according to SO (total volume of standard output in the range of EUR 100-500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands	
		Value	Change indicator 2008 =100%	Value	Change indicator 2008 =100%
Economic size	SO	**201.5**	97.7	**282.6**	97.5
Area of AL	ha	**91.31**	108.4	**43.78**	109.4
Share of leased land	%	**67.8**	105.3	**76.6**	109.5
Total labour inputs	AWU	**1.83**	104.5	**1.29**	95.4
Total labour input/100 ha of AL	AWU	**2.01**	96.4	**2.96**	87.2
Share of own labour in total labour	%	**74.2**	100.9	**42.1**	109.2
Value of assets/ha of AL	thou-sand	**9.43**	98.0	**20.18**	113.1
Value of assets/AWU	thou-sand	**469.49**	101.7	**685.62**	129.7
Share of fixed assets in assets	%	**83.2**	98.8	**82.9**	102.1
Share of equity in liabilities	%	**81.1**	97.9	**60.0**	108.4

Source: as in Table 3.1.

4.1.3.2. Assessment of organisation of production in large farms specializing in cattle production

Surveyed holdings differ in the organization of production. The corresponding numbers are shown in Table 4.10. Dutch holdings were much more intensely organized. Almost the entire area of AL (96%) was intended for the cultivation of fodder crops, while in German holdings it was 76%. The greatest differences were in stocking density, which in Dutch holdings was very high, 335.4 LU/100 ha of AL and was about 129% higher than on German farms. The high stocking density per area of AL was in line with the high stocking density of animals fed with roughage per 1 ha of forage area. On Dutch farms, it was 3.49 LU per 1 ha of this area, while on German farms it was 1.93 LU. The difference in favour of Dutch farms was 80%.

There were also differences in the structure of stocking density. On German farms, in addition to dairy cows, there was also other cattle, whose share was around 82%, while Dutch holdings kept only other cattle.

Table 4.10. Organization of production on farms specializing in cattle production (type 49) described as large according to size of SO (total volume of standard output within the range of EUR 100-500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands	
		Value	Change indicator 2008 =100%	Value	Change indicator 2008 =100%
Share of cereals in AL	%	**20.7**	95.9	**3.0**	103.7
Area of forage crops	ha	**69.3**	110.9	**42.0**	109.4
Share of forage crops	%	**75.9**	102.3	**96.0**	100.0
Livestock density	LU/100 ha	**146.5**	97.9	**335.4**	85.6
Stocking density of animals fed in a grazing system per 1 ha of forage area	LU/ha	**1.93**	102.1	**3.49**	84.1
Dairy cows	LU	**23.2**	95.2	**-**	**-**
Other cattle	LU	**106.1**	110.2	**146.9**	92.0
Share of crop production	%	**16.8**	101.9	**6.6**	109.0
Share of animal production	%	**79.2**	99.5	**79.7**	99.1
Share of other production	%	**4.0**	101.9	**13.7**	10.7
including: share of transferred production	%	**0.1**	87.2	**-**	**-**

Source: as in Table 3.1.

There were also certain changes in the structure of production. The share of animal production in total production in both groups of farms was similar, approximately 80%. The share of crop production, which was lower in Dutch holdings, amounted to 6.6%, while on German farms it was 16.8%. Dutch holdings had a higher share of other production, which amounted to 13.7%, while on German farms it was only 4%. Links between farm and household were negligible in both groups of farms. The share of transferred production on German farms was 0.1% and on Dutch farms it was not present.

4.1.3.3. Assessment of the level and structure of costs in large farms specializing in cattle production

The numbers characterizing the level and structure of costs in this size class of farms are shown in Table 4.11. The figures show that the level of intensity of production measured in terms of total cost per 1 ha of AL in Dutch hold-

ings was more than 3 thousand EUR/ha of AL and was about 56% higher than on German farms.

Table 4.11. Level and types of costs on farms specializing in cattle production (type 49) described as large according to SO (total volume of standard output in the range of EUR 100-500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Total costs/ha of AL	Euro	**1954.6**	103.5	**3044.8**	87.2
Direct costs /ha of AL	Euro	**799.8**	103.6	**1207.5**	84.5
Costs of purchased cattle feed/ LU	Euro	**314.9**	111.2	**203.1**	107.8
Costs of own cattle feed/ LU	Euro	**80.1**	114.5	**5.4**	23.2
Other costs of animal production/LU	Euro	**75.6**	93.2	**74.0**	68.2
Cost of hired labour/ ha of AL	Euro	**67.1**	140.7	**22.3**	109.2
Cost of interest /ha of AL	Euro	**71.1**	94.6	**318.8**	81.5
Cost of lease /ha of AL	Euro	**143.7**	98.3	**170.5**	106.8
Depreciation costs /ha of AL	Euro	**268.7**	101.8	**430.7**	86.7

Source: as in Table 3.1.

A similar difference was in the level of direct costs. The cost structure in both groups was similar. The share of direct costs in total costs was about 40%. In the analysed period in German farms there was a small increase in costs, both total and direct, by about 3%, while in Dutch farms they declined respectively by 13 and 15%. However, there was a fundamental difference in the cost of feed, both purchased and own feed. In German farms feed costs were much higher, by a total of 89%. Definitely greater difference was in relation to the cost of own feed. These costs in German farms amounted to 80 EUR/LU and were almost 15 times higher than in Dutch farms. It can be assumed that this situation was the result of higher yields of fodder crops. This is of course only a supposition, because there is no proof of it.

There are significant differences in the costs of external factors between the surveyed groups of farms. German farms had higher labour costs. They were 67 EUR/ha of AL and were 3 times higher than on Dutch farms. Both groups of farms recorded an increase in this group of costs, German farms by 40%, while Dutch farms by 9%. Dutch farms had significantly higher interest costs, which amounted to 319 EUR/ha of AL and were more than four times higher than on German farms. This was the result of greater involvement of foreign capital. In-

terest costs in the analysed period have been reduced. To a greater extent in Dutch holdings, by 19%, while on German farms by only 5%.

Cost of lease on Dutch farms was 170.5 EUR/ha and was 19% higher than on German farms. In the analyzed period it increased by 7%, while on German farms it decreased by 1.7%. There were also significant differences in the cost of depreciation. It was very high on Dutch farms, 431 EUR/ha, and was 60% higher. In the analyzed period it decreased by approximately 13%, while on German farms it remained at a similar level.

Generally it should be noted that Dutch farms specializing in cattle production had a much higher level of intensity of production. Costs of interest, lease and depreciation were significantly higher.

4.1.3.4. Assessment of productivity and efficiency of large farms specializing in cattle production

The differences in the level of intensity of production resulted in production and economic outcomes given in Table 4.12. Productivity of land was determined, as in the previously discussed groups of farms, by the value of production per 1 ha of AL. Wheat was produced only by German farms. The resulting yield in these farms was 74.3 dt/ha. It should be described as fairly high. Milk yield per cow per year in German holdings amounted to 7280 kg. It should be described as average. Milk production in these farms was not a priority activity. Dutch farms have not kept dairy cows. They were clearly focused on breeding other cattle.

Productivity of land on Dutch farms was 2.65 thousand EUR/ha and was about 46% higher than on German farms. Productivity of assets and current assets in German holdings was respectively 0.19 and 1.14 and was higher than on Dutch farms by respectively 46% and 50%. In the analyzed period it improved slightly (by 5 and 7%), while on Dutch farms it dropped by 17 and 8% respectively. Higher productivity of assets, including current assets, in German holdings was the result of lower asset values. Labour productivity in both farm groups was similar and amounted to about 90 thousand EUR/AWU. In the analyzed period it increased by 9% on German farms and by 8% on Dutch farms.

The profitability of land, assets and own labour on German farms was respectively: 0.34 thousand EUR/ha, 3.6% and 20.7 thousand EUR/FWU and was higher than on Dutch farms respectively by 30, 200 and 127%. In the analyzed period, the profitability of these factors of production increased by 15, 17 and 28%. In Dutch holdings this growth was much higher and amounted to 158, 128, 197%.

Table 4.12. Productivity and efficiency of farms specializing in cattle production (type 49) described as large according to SO (total volume of standard output in the range of EUR 100-500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2008 =100%
Wheat yield	dt/ha	**74.3**	98.5	**-**	**-**
Milk yield of dairy cows	kg/ cow	**7280.4**	99.2	**-**	**-**
Productivity of land	EUR thousand	**1.81**	105.3	**2.65**	94.2
Productivity of assets	times	**0.19**	107.4	**0.13**	83.3
Productivity of current assets	times	**1.14**	101.0	**0.76**	91.9
Labour productivity (P/1AWU)	EUR thousand	**90.27**	109.2	**89.54**	108.0
Profitability of land (D/ha)	EUR thousand	**0.34**	115.2	**0.25**	258.4
Profitability of assets (D/A)	%	**3.6**	117.5	**1.2**	228.5
Profitability of own labour	EUR thousand	**20.69**	128.2	**9.13**	297.1
Cost-effectiveness of production (P/K)	%	**92.6**	101.7	**87.3**	108.0
Viability of production (D/P)	%	**18.6**	109.4	**9.8**	274.4
Income from management	EUR thousand	**-28.7**	80.5	**-36.2**	97.7
Income parity (A)1	%	**115.6**	121.5	**45.6**	248.6
Income parity (B)2	%	**40.0**	128.2	**17.3**	297.1
Net investment rate	%	**47.2**	256.8	**-14.0**	-22.3
Share of subsidies in income from the farm	%	**152.1**	89.4	**94.5**	89.7
Share of subsidies in revenue from the farm	%	**28.2**	97.7	**26.4**	100.4

Source: as in Table 3.1.

Production profitability indicators determined by the ratio of production to costs in both groups of farms were lower than 100%. On German farms they amounted to 93% and on Dutch farms to 87%. They indicate that production was unprofitable. The profitability rate of production on German farms amounted to about 19% and was almost 90% higher than on Dutch farms.

Income from management which is the ultimate measure of management efficiency was negative in both groups of farms. In German holdings it amounted to EUR -28.7 thousand, while on Dutch farms to EUR -36.2 thousand.

German holdings of this class size reached income parity "A". Income parity indicator was approximately 116%, while the corresponding rate in Dutch holdings was only 46%. Both groups of farms did not reach income parity "B". The value of this indicator for German farms was 40%, while for Dutch farms only 17%.

The rate of net investment on German farms was positive. It was 47%, while on Dutch farms it was negative and amounted to -14%. This rate on German farms has increased by 157%, while on Dutch farms it decreased by 22%.

The main source of income in both groups of farms were subsidies. Their share in the income from farm in German holdings was very high and amounted to 152%, while in Dutch holdings it was 94.5%. The share of subsidies in revenues was similar in both groups of farms and amounted to 28% on German farms and 26% on Dutch farms.

Taking into account the negative income from management, income parity "B" and the rate of net investment it should be noted that the chances of development of this size class holdings in Germany and the Netherlands are very limited, especially in the latter.

4.1.4. Assessment of farms with cattle production – very large (class 5, SO of over 500 thousand EUR) in the surveyed countries

4.1.4.1. Assessment of production potential of farms with cattle production – very large

In terms of economic size, farms specializing in cattle production described as very large were similar. The value of standard output (SO) in German holdings was 1,019 thousand and was 19% higher than in the Dutch holdings (Table 4.13). In the analysed period, the size of German holdings decreased by 48%, while the size of Dutch farms increased by 4%. The period of analysis of these farms was shorter and covered the years 2009 and 2010.

Analyzed holdings substantially differed in the size of AL. The area of AL on German farms was 477 ha and was 21 times greater than on Dutch farms, where it was only 22.24 ha. In the analyzed period it decreased on German farms by 45%, while on Dutch farms by 4%. Leased land dominated in both groups of farms. Its share varied and amounted to 88 and 54% respectively. In the analysed period it decreased slightly, by 12 and 2%.

Total labour inputs per farm were strongly differentiated. On German farms they amounted to 7,42 AWU and on Dutch farms to 1,81 AWU. In terms of 100 ha of AL, the situation was reversed. On Dutch farms, it was 8.13 AWU per 100 ha of AL, while on German only 1.57 AWU and it was 5 times smaller than on Dutch farms. In the analysed period, the labour inputs per 100 ha of AL increased by 6% in German holdings and by 9% in Dutch holdings. There were

also differences in own labour. Its share in the total labour inputs on German farms was approximately 80%, while on Dutch farms it was about 20%.

Table 4.13. Production potential of farms specializing in cattle production (type 49) described as very large according to SO (total volume of standard output over EUR 500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands*	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2009 =100%
Economic size	ESU	**1019.4**	52.2	**853.5**	104.0
Area of AL	ha	**477.2**	55.5	**22.24**	96.1
Share of leased land	%	**82.3**	88.1	**53.5**	97.9
Total labour inputs	AWU	**7.42**	58.8	**1.81**	104.5
Total labour input/100 ha of AL	AWU	**1.57**	105.9	**8.13**	108.7
Share of own labour in total labour	%	**79.8**	114.5	**19.8**	97.2
Value of assets/ha of AL	thou-sand	**4.47**	183.6	**66.79**	122.2
Value of assets/AWU	thou-sand	**283.28**	173.3	**819.73**	112.5
Share of fixed assets in assets	%	**67.8**	112.9	**86.4**	102.0
Share of equity in liabilities	%	**66.3**	87.1	**39.1**	122.5

* Values apply only to the period 2009-2010.
Source: as in Table 3.1.

There were also very large differences in the value of assets per 1 ha of AL. On Dutch farms, this figure was almost 67 thousand EUR/ha and was almost 15-fold higher than in German holdings. In both groups, this value rose by 84% and 22% respectively. The value of assets per 1 AWU on Dutch farms was very high. It amounted to EUR 820 thousand and was nearly three times higher than on German farms. In this case, the working equipment in the analyzed farms also increased. It was stronger on German farms, 73%, and in Dutch holdings by 13%.

The assets in the two groups of farms were dominated by fixed assets. Their proportion on German farms was lower. It was 68%, while on Dutch farms it was 86%. In both groups there was an increase in the share of fixed assets, respectively by 13% and 2%. The share of equity in liabilities varied. On German farms it was 66%, while on Dutch farms only 39%. In the analyzed period it decreased on German farms by 13%, while on Dutch farms it increased by 22%.

Generally, it should be noted that despite similar economic size of holdings, the production capacity of German farms was higher. This was determined

by: larger area of AL, higher labour inputs, higher the value of the assets and higher equity value.

4.1.4.2. Assessment of production organization on farms with cattle production – very large

The organization of production on farms of this class size specializing in cattle production differed greatly, both in terms of crop production and livestock production. The corresponding data are shown in table 4.14. The differences in the organization of crop production can be regarded as irrelevant. The share of cereals in the area of AL on German farms was 21%, while on Dutch farms it was about 8%. In the latter it was marginal. The difference in area under fodder crops was the result of different area of AL in the analyzed farms. The share of fodder crops was less diverse. On German farms it was 71%, while on Dutch farms it was 87%. The main difference was in the organization of animal production. This refers to the structure of the animals and their density per 100 ha of AL. German farms kept dairy cows and other cattle, while Dutch farms kept only other cattle. The difference in density is very large. On Dutch farms it was 1,981 LU/100 of AL and was more than 15 times higher than on German farms where it was 126 LU/100 ha of AL. Very high density of animals on Dutch farms was the result of small area. In addition, rearing cattle on those farms was based on purchased feed. Density increased in both groups of farms in the analysed period. On German farms by 64%, while on Dutch farms by 8%. The differences in stocking density per 1 ha of forage area were smaller.

On Dutch farms, it was 22 LU per 1 ha of this area, while on German farms it was 1.62 LU. The structure of production in the two groups of farms was dominated by livestock production, which on German farms was approximately 80%, while in Dutch ones it was 90%.

Table 4.14. Organisation of production on farms specializing in cattle production (type 49) described as very large according to SO (total volume of standard output of over EUR 500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands*	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2009 =100%
Share of cereals in AL	%	**21.3**	68.2	**8.3**	49.5
Area of forage crops	ha	**329.6**	66.5	**19.7**	102.9
Share of forage crops	%	**70.8**	119.8	**88.6**	107.1
Livestock density	LU/100ha	**126.3**	164.4	**1981.3**	108.3
Stocking density of animals fed in a grazing system per 1 ha of forage area	LU/ 1ha	**1.62***	129.6	**0.15***	106.7
Dairy cows	LU	**117.81**	98.4	**-**	**-**
Other cattle	LU	**406.27**	83.7	**438.72**	104.3
Share of crop production	%	**16.1**	56.4	**5.1**	143.5
Share of animal production	%	**79.5**	113.7	**90.5**	98.6
Share of other production	%	**4.4**	103.2	**4.4**	84.7
including: share of transferred production	%	**0.0**	173.0	**-**	**-**

* Values apply only to the period 2009-2010.
**this figure does not include the calves for fattening.
Source: as in Table 3.1.

4.1.4.3. Assessment of the level and structure of costs in very large farms specializing in cattle production

The effects of differences in production and organization potential of the analyzed farms are very large differences in the level of intensity of production. On Dutch farms, total costs per 1 ha of AL amounted to almost EUR 14 thousand and were 7.5 times higher than on German farms (Table 4.15). In the latter, during the analysed period, costs increased by 43%, while on Dutch farms they decreased approximately by 2%. Differences in direct costs were similar. The costs structure was also similar. The share of direct costs in total costs in both groups of farms was approximately 38%. There was a big difference in the cost of purchased cattle feed. On German farms with more area under forage crops, the costs of purchased feed amounted to 311 EUR/LU, while in Dutch holdings they amounted to 190 EUR/LU. The difference was 39% in favour of German farms. It may be supposed that the structure of purchased feed was different. German farms also kept dairy cows, and for this reason bought expensive feed with higher protein content. The cost of own feed per 1 LU on German farms was 73 EUR/LU and was 87 times higher than on Dutch farms. These differences were due to a small area of Dutch farms. Raising beef cattle on those farms was conducted on the basis of purchased feed.

Table 4.15. Level and types of costs on farms specializing in cattle production (type 49) described as very large according to SO (total volume of standard output in the range of EUR 100-500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands*	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2009 =100%
Total costs/ha of AL	Euro	**1851.3**	143.1	**13975.93**	98.4
Direct costs /ha of AL	Euro	**702.9**	161.0	**5428.42**	84.4
Costs of purchased cattle feed/ LU	Euro	**311.0**	94.7	**190.6104**	73.6
Costs of own cattle feed/ LU	Euro	**72.7**	66.4	**0.83**	0.0
Other costs of animal production/LU	Euro	**93.9**	161.6	**74.1**	83.3
Cost of hired labour/ ha of AL	Euro	**278.8**	96.5	**380.6**	107.7
Cost of interest /ha of AL	Euro	**63.8**	261.2	**1862.1**	95.2
Cost of lease /ha of AL	Euro	**105.5**	135.2	**253.0**	195.0
Depreciation costs /ha of AL	Euro	**171.8**	146.4	**2946.5**	108.6

*Values apply only to the period 2009-2010.
Source: as in Table 3.1.

Differences in hired labour costs were not large. On Dutch farms they were 381 EUR/ha and were 36% higher than on German farms. Much greater differences occurred in the cost of interest. On Dutch farms they were 1862 EUR/ha of AL and were 29 times higher than on German farms. In the analyzed period, interest costs in German holdings increased by 161%, while in Dutch holdings they decreased by 5%. There were also differences in the costs of other external factors: lease and depreciation. Cost of lease on Dutch farms was 253 EUR/ha and was by 139% higher than on German farms. In both groups, these costs increased. On German farms by 35%, while on Dutch farms by 95%. Depreciation cost on Dutch farms amounted to 2496 EUR/ha and was more than 17 times higher than on German farms.

Generally, it can be said that the level of production intensity measured by total costs per 1 ha of AL was much higher in Dutch holdings. Especially interest cost was higher, indicating the use of foreign capital to a greater extent by Dutch holdings.

4.1.4.4. Assessment of productivity and efficiency of very large farms specializing in cattle production

In holdings of this class size, especially Dutch ones, organization of crop production was subordinated to the needs of animal production. German farms cultivated wheat, whose yields were about 56 dt/ha (Table 4.16). The yield was average. One should similarly evaluate the performance of dairy cows that were kept only on German farms. It was 7200 kg of milk per cow per year. It should also be evaluated as average. Milk production in these farms was a basic activity. It complemented the production of beef cattle. Dutch farms were focused solely on breeding other cattle for fattening.

Land productivity measured by the value of production per 1 ha of AL holdings on Dutch farms was about EUR 14 thousand and was 9 times higher than on German farms. This was the effect of a definitely higher level of production intensity. There were no significant changes in the productivity of land in the two groups of farms in the period considered.

Productivity of assets in German holdings was 0.35 and was by 75% higher than on Dutch farms. In the analyzed period, the productivity of assets in German holdings increased by 61%, while in Dutch holdings it decreased by 23%. Productivity of current assets in Dutch holdings was 1.51 and was 40% higher than on German farms. In both groups of farms, in the analysed period, the productivity of current assets decreased – on average by 12%.

Labour productivity on Dutch farms was 169 thousand EUR/AWU and was 75% higher than on German farms. In the analyzed period, labour produc-

tivity in German holdings increased by 12%, while in Dutch holdings it decreased by 13%.

The profitability of land and assets was higher on Dutch farms. Income from farm per 1 ha of AL on Dutch farms was EUR 2.71 thousand and was more than 24 times higher than on German farms. The profitability of land increased in both groups of farms in the analysed period. On German farms by 52%, while on Dutch farms by 9%. The differences in profitability of assets were smaller. On Dutch farms, profitability of assets was 4.1% and was about 64% higher than on German farms. In the analyzed period, the profitability of assets in German holdings increased by 172%, while in Dutch holdings it decreased by 11%.

The profitability of own labour measured by income from farm per FWU was similar in both groups of farms and was about 38 thousand EUR/FWU. In the analyzed period, on German farms it increased by 48%, while on Dutch farms it decreased slightly, by 1.1%.

Production was unprofitable in both groups of farms. Indicators of cost--effectiveness of production in both groups of farms were lower than 100%. On German farms it was 81%, while on Dutch farms 98%. In the analyzed period, the cost-effectiveness of production on German farms increased by 25%, while on Dutch farms it decreased by 4%. In spite of unprofitable production, in both groups of farms production was viable. The viability rate of production on Dutch farms was 19.8% and was 175% higher than on German farms where it stood at 7.2%. In both groups of farms the viability ratios increased, on German farms by 13%, while on Dutch farms by 15%.

Income from management, which is the ultimate measure of management efficiency, was negative in both groups of farms at a similar level of around -38 thousand EUR/holding. In the analyzed period it improved by 69% in German holdings and by 65% in Dutch holdings.

In terms of income parity, situation of surveyed farms varied. German farms reached income greatly exceeding the wages in agriculture. Index of parity "A" was 179%. On Dutch farms this index stood at 81%. This means that the resulting income from farm per unit of own labour on Dutch farms was lower than wages for hired labour in agriculture. The income situation worsened in both groups of farms in the analysed period. To a greater extent in German holdings, by almost 40%, while on Dutch farms by 9%. Both groups of farms have not reached parity income relative to wages and salaries in the national economy. Index of income parity “B” was approximately 76%, while in Dutch holdings it was 71%. In the analyzed period, this index improved on German farms by 20%, while in Dutch holdings it remained at a similar level.

Table 4.16. Productivity and efficiency of farms specializing in cattle production (type 49) described as very large according to SO (total volume of standard output over EUR 500 thousand) in 2008-2010

Specification	Unit	Germany		Netherlands*	
		Value	Change indicator 2008 =100%	**Value**	Change indicator 2009 =100%
Wheat yield	dt/ha	**55.7**	100.0	**-**	**-**
Milk yield of dairy cows	kg/ cow	**7197.9**	171.2	**-**	**-**
Productivity of land	EUR thou-sand	**1.51**	101.2	**13.7**	94.6
Productivity of assets	times	**0.35**	161.1	**0.20**	77.4
Productivity of current assets	times	**1.08**	87.7	**1.51**	88.1
Labour productivity (P/1AWU)	EUR thou-sand	**96.43**	112.0	**168.7**	87.1
Profitability of land (D/ha)	EUR thou-sand	**0.11**	152.0	**2.71**	108.8
Profitability of assets (D/A)	%	**2.5**	272.4	**4.1**	89.0
Profitability of own labour	EUR thou-sand	**39.11**	148.3	**37.40**	98.9
Cost-effectiveness of produc-tion (P/K)	%	**81.4**	124.7	**97.9**	96.2
Viability of production (D/P)	%	**7.2**	112.6	**19.8**	114.9
Income from management	EUR thou-sand	**-38.4**	169.1	**-37.1**	164.5
Income parity (A)1	%	**178.9**	59.6	**87.0**	90.8
Income parity (B)2	%	**75.6**	120.0	**71.0**	98.9
Net investment rate	%	**52.7**	124.7	**-8.2**	103.4
Share of subsidies in income from farm	%	**473.8**	41.7	**178.7**	111.0
Share of subsidies in revenues from farm	%	**31.6**	70.6	**22.6**	135.1

*Values apply only to the period 2009-2010.
Source: as in Table 3.1.

In terms of income parity, situation of surveyed farms varied. German farms reached income greatly exceeding the wages in agriculture. Index of parity "A" was 179%. In Dutch farms this index stood at 81%. This means that the resulting income from farm per unit of own labour on Dutch farms was lower than wages for hired labour in agriculture. The income situation worsened in

both groups of households in the analysed period. To a greater extent in German holdings, by almost 40%, while on Dutch farms by 9%. Both groups of farms have not reached parity income relative to wages and salaries in the national economy. Index of income parity "B" was approximately 76%, while in Dutch holdings it was 71%. In the analyzed period, this index improved on German farms by 20%, while in Dutch holdings it remained at a similar level.

The rate of net investment on German farms was positive and amounted to ca. 53%, while on Dutch farms it was negative and amounted to -8.2%.

The main sources of income from farm in both groups of farms were subsidies. Subsidies on German farms were almost 5 times higher than the income received, and on Dutch farms they were 79% higher.

In general, assessment of productivity and efficiency of this group of farms should verify that Dutch holdings, in relation to German holdings, were characterized by: higher productivity of land and current assets, higher profitability of land and assets, and higher viability of production. In both groups of farms there was a negative income from management. They did not reach the level of income at the parity level in relation to wages and salaries in the national economy. The main sources of income from farm in both groups of farms were various subsidies.

Taking into account the negative income from management and not achieving income parity, it should be noted that farms of this class size have no development opportunities. Their functioning was totally dependent on payments under the CAP.

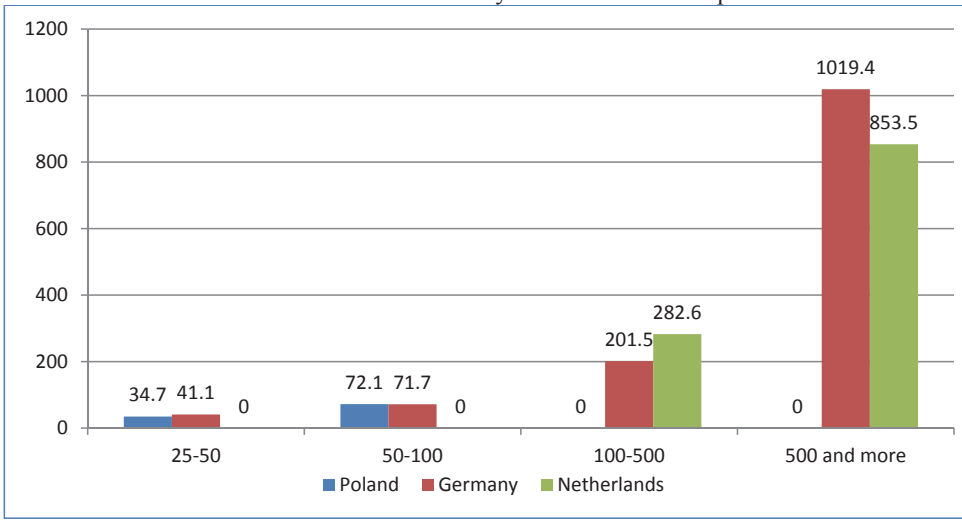
4.2. Assessment of surveyed farms with cattle production depending on the economic size

4.2.1. Assessment of production potential of farms with cattle production depending on the economic size

Chart 4.1 shows the classes of surveyed farms by economic size specified by value of Standard Output (SO). The economic size of each class was similar to the average values of individual classes. The class of very large farms, with the value of production of over EUR 500 thousand, included only German and Dutch holdings. The value of standard output in German holdings amounted to EUR 1019 thousand and was 19% higher than on Dutch farms.

The production potential of the analyzed farms was characterized by the following indicators: agricultural area, share of leased land, labour inputs and their structure, level and structure of assets and liabilities.

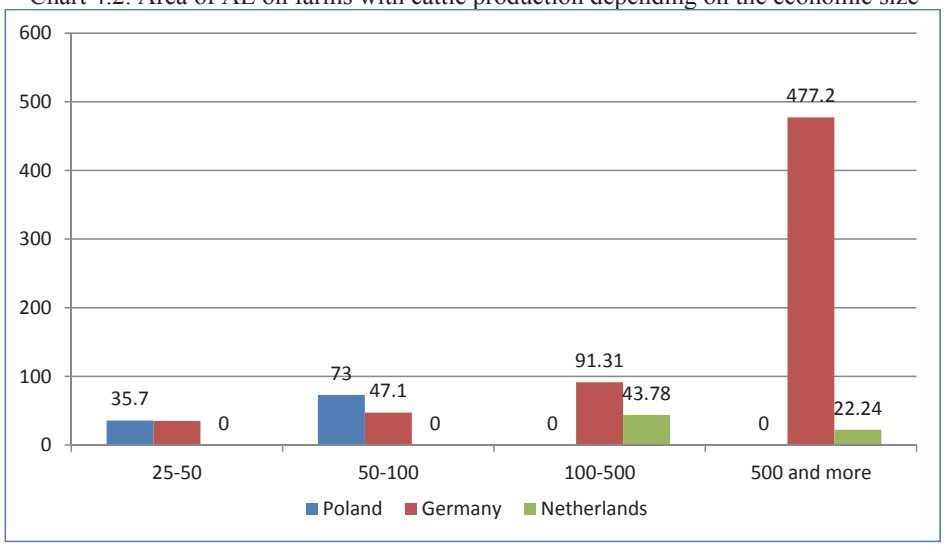
Chart 4.1. Economic size of surveyed farms with cattle production



Source: European FADN.

Agricultural land on farms was correlated with economic size (Chart 4.2). Polish farms were only in class 3 (EUR 25-50 thousand) and 4 (EUR 50-100 thousand). The area of AL in these classes amounted respectively to 35.7 ha and 73 ha of AL. German holdings were present in classes 3, 4, 5 and 6. Their size ranged between 35.1 ha in class 3 to 477.2 ha in class 6.

Chart 4.2. Area of AL on farms with cattle production depending on the economic size

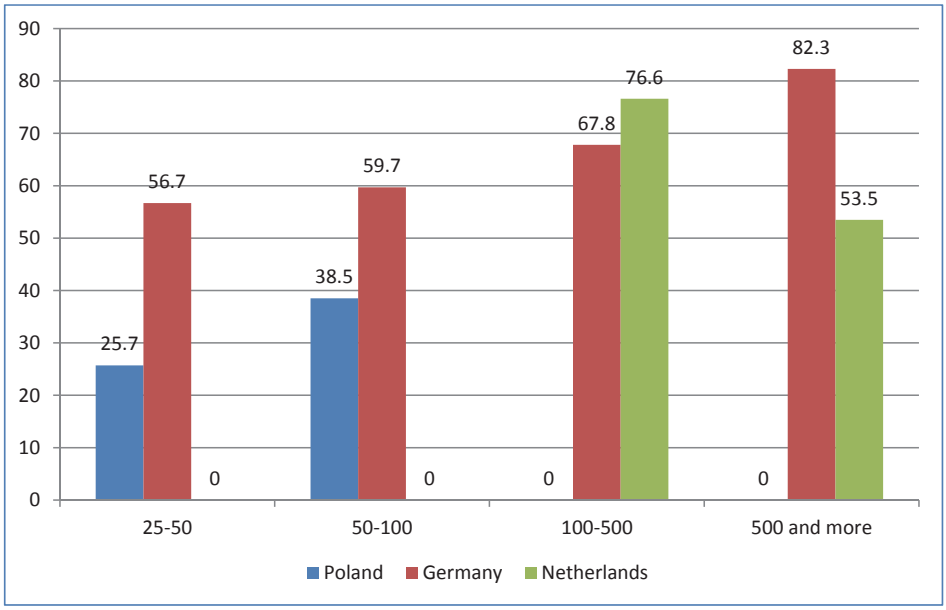


Source: European FADN.

Dutch holdings were present in class 5 and 6. In this case, there was no association between the area of AL and economic size. The area of AL in class 6 with the standard output of EUR 853 thousand was only 22.24 ha. It was 50% less than the corresponding area in class 5. The area of German farms in the corresponding classes was smaller than area of Polish farms, while Dutch holdings had a smaller area of AL than German farms.

The surveyed farms differed in the share of leased land. The share of leased land increased with increasing economic size. On Polish farms the share of leased land was in the range from 26% to 38% and was lower than on German holdings, where it was in the range from 57% in class 3 to 82% in class 4 (Chart 4.3). Among Dutch farms, the above-mentioned regularity was not found. The share of leases in class 6 with the standard output of over EUR 500 thousand was 54% and was 24 pp lower than in class 5. This fact should be associated with a smaller area of AL in class 6.

Chart 4.3. Share of leased land on farms with cattle production depending on the economic size

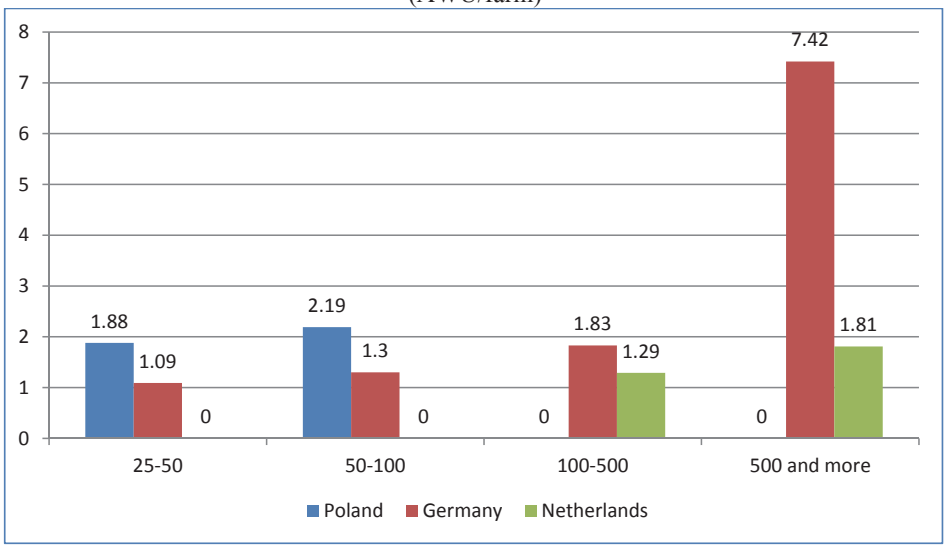


Source: European FADN.

Total labour inputs expressed in AWU per farm increased with the increase in economic size (Chart 4.4). This pattern occurred in all farms. Labour inputs on Polish farms were higher than in German farms, and these in turn were higher than on Dutch farms. Labour inputs in Polish farms were in the range of 1.88 AWU/farm in class 3 to 2.19 AWU/farm in class 4. The range of labour inputs on German farms was greater, in the range of 1.09 AWU/farm in class 3

to 7.14 AWU/farm in class 6. The range of labour inputs on Dutch farms was smaller, in the range of 1.29 AWU/farm in class 5 to 1.81 AWU/farm in class 6.

Chart 4.4. Total labour inputs on farms with cattle production depending on the economic size (AWU/farm)

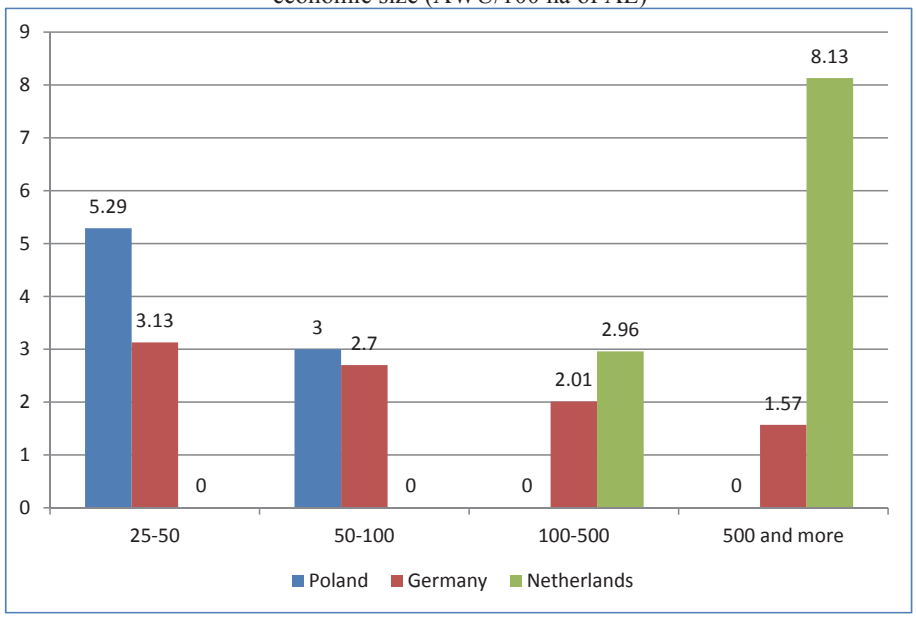


Source: European FADN.

The level of total labour input per 100 ha of AL decreased with increasing economic size of farms. The exception were Dutch farms where labour inputs on farms of class 6 were significantly greater than on farms of class 5 (Chart 4.5). Labour inputs on Polish farms were in the range of 5.3 AWU/100 AL in class 3 to 3 AWU/100 ha of AL in class 4. The range of labour inputs on German farms was greater, in the range of 3.13 ha AWU/100 ha of AL in class 3 to 1.57 AWU/100 of AL in class 6. The level of labour inputs on Dutch farms was significantly higher than in German holdings in the corresponding size classes. It was in the range of 2.96 ha AWU/100 ha of AL in class 5 to 8.13 AWU/100 ha of AL in class 6. Greater labour inputs on Dutch farms were the result of a smaller area of AL.

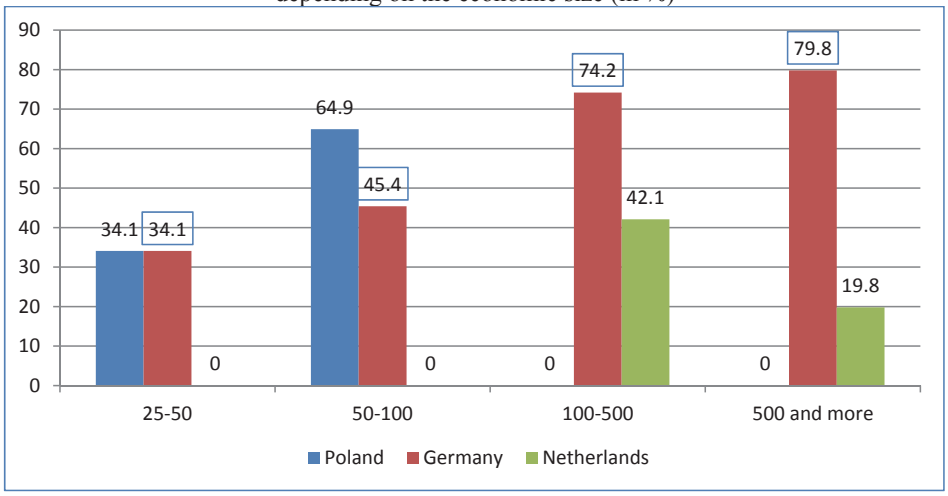
There were also differences in the share of own labour in total labour inputs. Its share increased with the increase in economic size (Chart 4.6). The exception were Dutch holdings, where the share of own labour in class 6 was lower than in Class 5. The share of own labour in total labour inputs on Polish farms was in the range from 34% in class 3 to 65% in Class 4. On German farms the range was greater, from 34% in class 3 to 80% in class 6. On Dutch farms the share of own labour in total labour inputs was lower. It was 42% in class 5 and 20% in class 6.

Chart 4.5. Total labour inputs per 100 AL on farms with cattle production depending on the economic size (AWU/100 ha of AL)



Source: European FADN.

Chart 4.6. Share of own labour in total labour inputs on farms with cattle production depending on the economic size (in %)

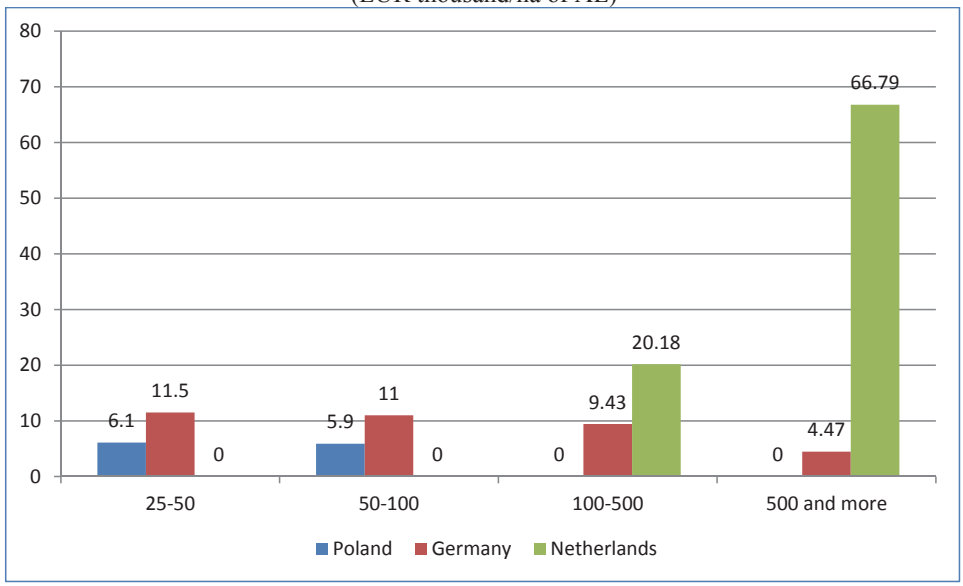


Source: European FADN.

Asset value per 1 ha of AL varied in the studied farms and decreased with increasing economic size. The exception were Dutch farms where asset value in class 6 was significantly higher than in class 5. Diversification of assets between classes 3 and 4 was smaller on Polish farms. The value of assets in class 4

amounted to 5.9 thousand EUR/ha of AL and was only about 3% lower than in class 3. The range of asset value on German farms was between 11.5 thousand EUR/ha of AL in class 3 and 4.47 thousand EUR/ha of AL in class 6. A significant decrease occurred between class 5 and 6. It was almost 53%. The value of assets on Dutch farms in class 6 amounted to 66.8 thousand EUR/ha of AL and was more than three times higher than on farms of class 5. This was due to a smaller area of farms in Class 6.

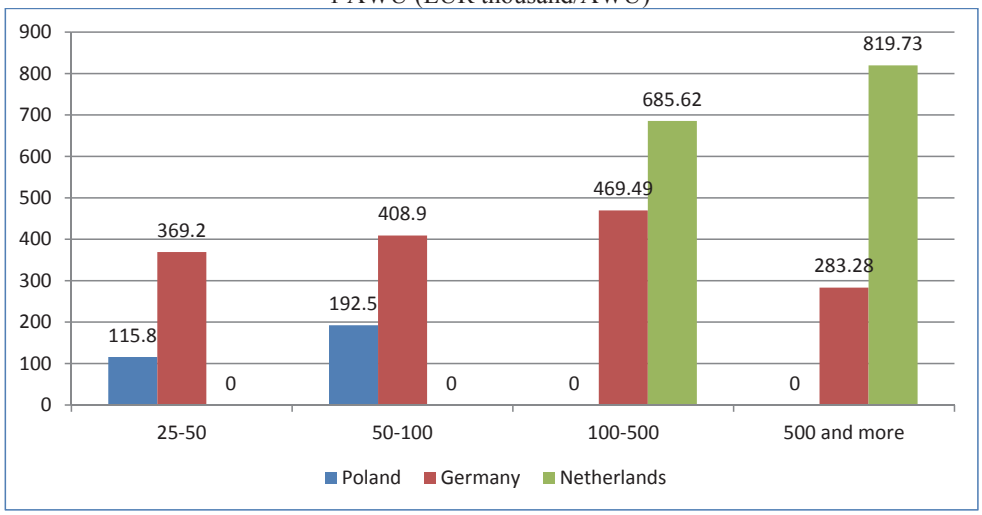
Chart 4.7. Asset value on farms with cattle production depending on the economic size (EUR thousand/ha of AL)



Source: European FADN.

Trends in equipment of labour specified by asset value per 1 AWU developed differently in relation to equipment of land. Asset value per 1 AWU increased with the increase in economic size. The exceptions were German holdings of class 6, where the value of assets was lower than in class 5 (Chart 4.8). Asset value on Polish farms per 1 AWU was in the range from 116 thousand EUR/AWU in class 3 to 192 thousand EUR/AWU in class 4. Equipment of labour in German holdings was higher than on Polish farms, it was in the range from 369 thousand EUR/AWU in class 3 to 469 thousand EUR/AWU in class 5. In class 6, as already mentioned, there was a reduction in the value of assets by about 40% compared to class 5. The highest level of equipment of labour was on Dutch farms, where it was in the range from 686 thousand EUR/AWU in class 5 to 829 thousand EUR/AWU in class 6.

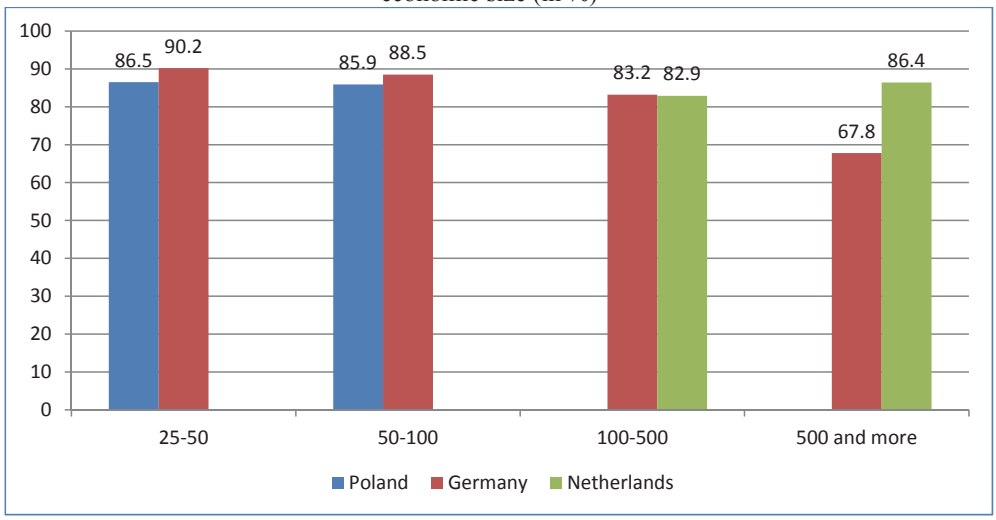
Chart 4.8. Asset value on farms with cattle production depending on the economic size per 1 AWU (EUR thousand/AWU)



Source: European FADN.

The structure of assets in the analyzed farms was similar, regardless of the economic size (Chart 4.9). Fixed assets dominated in all farms. Their share was in the range from 83 to 90%. The exceptions were German holdings of class 6, where the share of fixed assets in total assets was approximately 68%.

Chart 4.9. Share of fixed assets in assets of farms with cattle production depending on the economic size (in %)

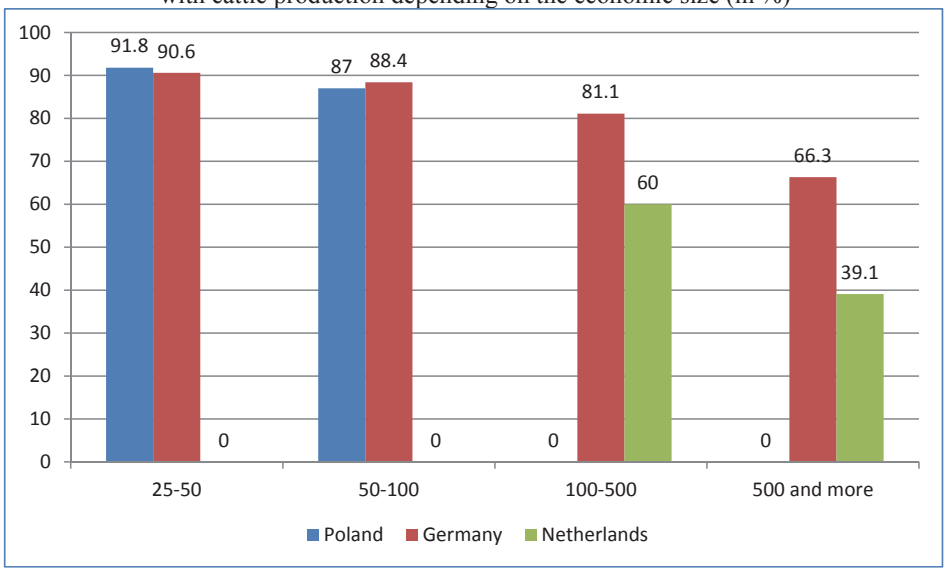


Source: European FADN.

The structure of liabilities in the analyzed farms was different (Chart 4.10). Liabilities of Polish and German holdings in classes 3-5 were dominated

by equity, whose share was in the range from 81% to 92%. In German holdings in class 6 and Dutch holdings in class 5, the share of equity in total liabilities was lower and amounted respectively to 66% and 60%. The share of equity in liabilities in the largest Dutch farms was significantly lower, 39%.

Chart 4.10. Share of equity in liabilities of farms
with cattle production depending on the economic size (in %)



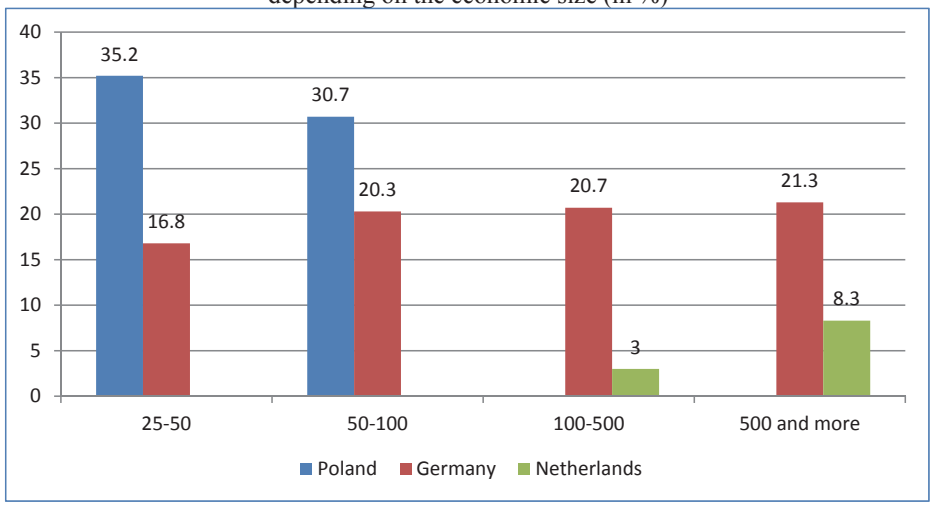
Source: European FADN.

4.2.2. Assessment of production organization on farms with cattle production depending on the economic size

Assessment of the organization of production in the analyzed farms with cattle production was made taking into account the following indicators: the share of cereals and fodder crops in the agricultural area, stocking density LU/100 of AL, stocking of cattle in LU/ha of forage area, the number of cows and other cattle and the production structure.

The share of cereals was not highly differentiated, and was not associated with the economic size of farms. The highest share of cereals was on Polish farms, respectively 35 and 31% in classes 3 and 4. On German farms it was in the range of 17-21%. The lowest share of cereals was on Dutch farms, respectively 3 and 8% in classes 5 and 6.

Chart 4.11. Share of cereals in the area of agricultural land on farms with cattle production depending on the economic size (in %)

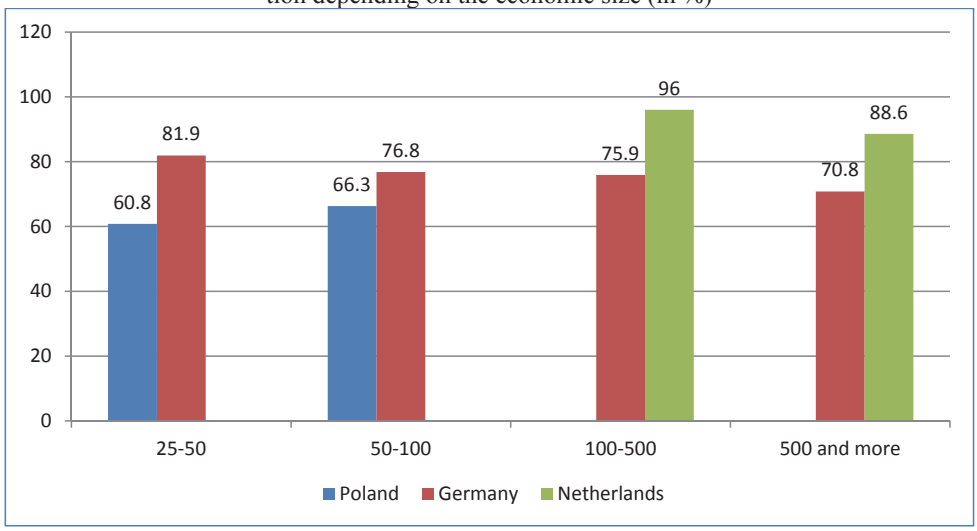


Source: European FADN.

The proportion of cereals in the agricultural area is related to the share of fodder crops (Chart 4.12). On Polish farms the share of fodder crops in the area of AL was lower than on German and Dutch farms. It was 61 and 66% respectively in classes 3 and 4. In German holdings, in the corresponding classes, the share of these crops was higher and amounted to 82 and 77%. In the next two classes, the share of fodder crops on German farms was slightly lower and amounted to 76 and 71%. On Dutch farms, the share of forage crops in AL was higher and amounted to 96 and 89% respectively in classes 5 and 6. The high share of forage crops in the area of AL on German farms, and especially on Dutch farms, indicates a much higher level of specialization of these farms. Organization of plant production was subordinated to animal production.

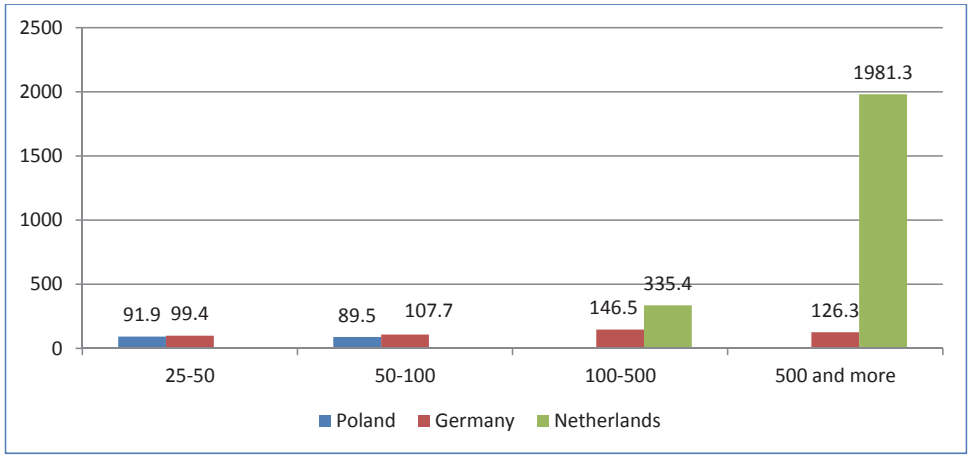
Another element of the organization of production on farms with cattle production was density of cattle in LU/100 ha of AL. The relevant data is shown in Chart 4.13. On Polish and German farms livestock density ranged between 90 LU/100 ha of AL and 146 LU/100 ha of AL. It can be described as high. On Polish farms it was lower and amounted to about 90 LU/100 ha of AL in both classes of economic size. The density on German holdings was higher, in the range of 99 LU/100 ha of AL in class 3 and 146 LU/100 ha of AL in class 5. In this range of economic size it showed a rising tendency. In class 6 density was lower at 126 LU/100 ha of AL. On Dutch farms, livestock density was significantly higher at 335 LU/100 ha of AL and 1981 LU/100 ha of AL respectively in class 5 and 6. Livestock density on Dutch farms indicates a high degree of specialization of these farms.

Chart 4.12. Share of fodder crops in the area of agricultural land on farms with cattle production depending on the economic size (in %)



Source: European FADN.

Chart 4.13. Livestock density on farms with cattle production depending on the economic size in LU/100 ha of AL

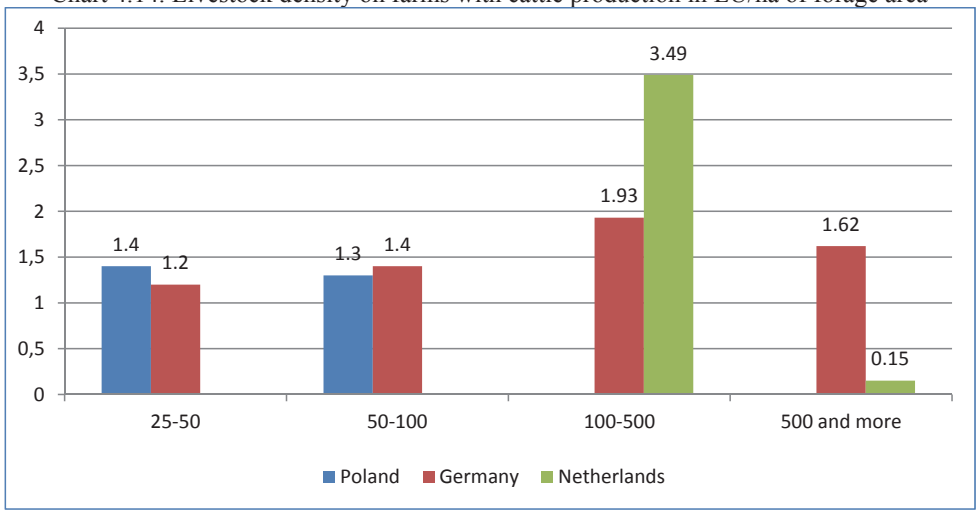


Source: European FADN.

Density of animals fed in a grazing system (cattle) in LU/ha of forage area indicates the level of intensity of its use. On Polish and German holdings of classes 3 and 4 it was similar, in the range from 1.2 LU/ha to 1.4 LU/ha regardless of the economic size of farms. It should be described as average. On farms of economic size belonging to class 5 and 6, density was significantly higher, especially on Dutch farms, where it was 3.49 LU/ha and 22.3 LU/ha, respectively in classes 5 and 6. On German farms, livestock density per hectare of forage area was lower. It was 1.93 LU/ha and 1.62 LU/ha respectively in classes

5 and 6. It is worth mentioning that livestock density in relation to the forage area was very high.

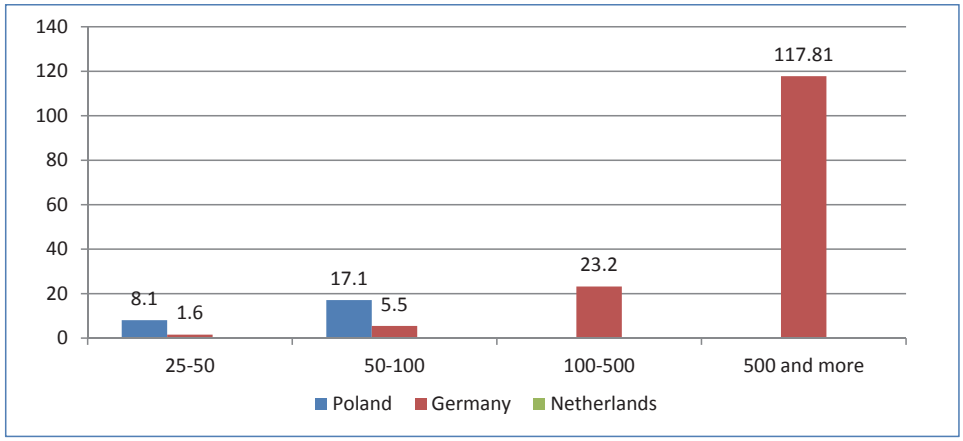
Chart 4.14. Livestock density on farms with cattle production in LU/ha of forage area



Source: European FADN.

The number of dairy cows in Polish and German varied, in the range from 1.6 units to 118 units on the farm (Chart 4.15). On Polish farms in classes 3 and 4, it was respectively 8.1 and 17.1 cows and was higher than the number of cows on the corresponding German farms where the number was respectively 1.6 and 5.5 cows. In the next two classes of economic size, the number of cows was higher at 23.2 units in class 5 and 117.8 units in class 6. Dutch farms have not kept dairy cows.

Chart 4.15 Number of dairy cows on farms with cattle production depending on the economic size

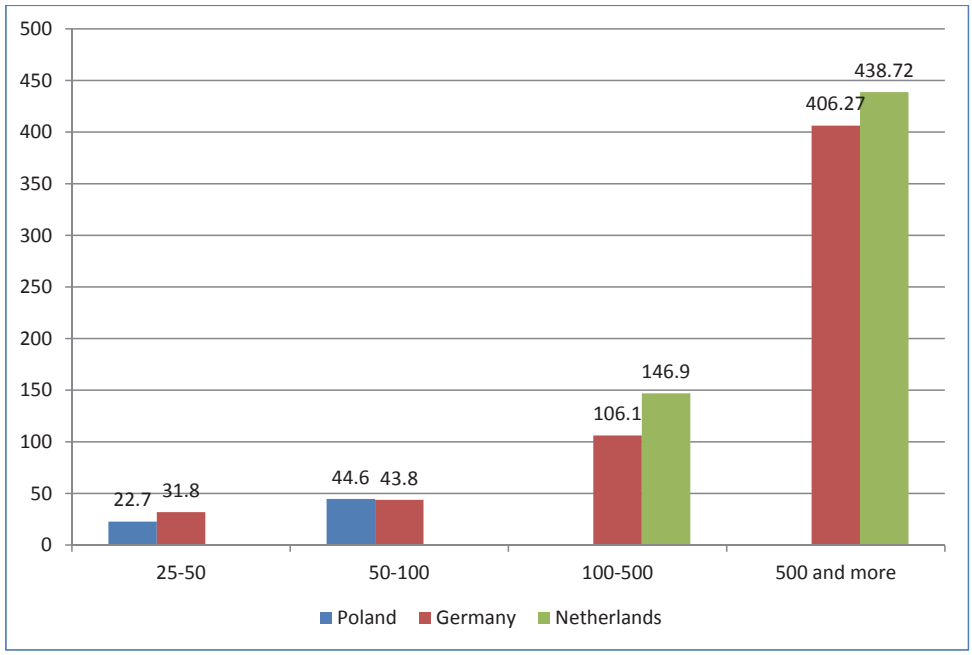


Source: European FADN.

Number of other cattle on farms with cattle production varied in the analyzed farms and was associated with the economic size of farms (Chart 4.16). It ranged between 23 LU/farm in class 3 and 439 LU/farm in class 6.

The scale of breeding other cattle, which formed the basis of the activities of these farms, should be described as small, except for German and Dutch farms in class 6.

Chart 4.16. Number of other cattle on farms with cattle production depending on the economic size in LU/farm

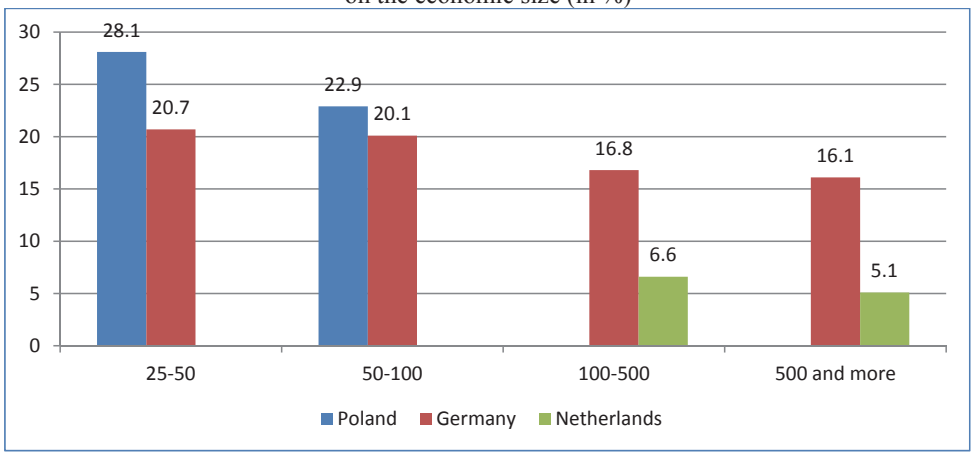


Source: European FADN.

The structure of production in analyzed farms varied. It was characterized by the share of plant and animal production in total production. The relevant data are presented in graphs 4.17 and 4.18. The share of crop production was negatively correlated with economic size of farms.

As the economic size increased, the share of crop production decreased, and at the same time the share of livestock production increased. The share of plant production in total production on Polish farms was in the range of 28% and 23% respectively in classes 3 and 4. On German farms it was in the range from 21% in class 3 to 16% in class 6. The share of plant production on Dutch farms was significantly lower, 6.6% and 5.1% respectively in classes 5 and 6.

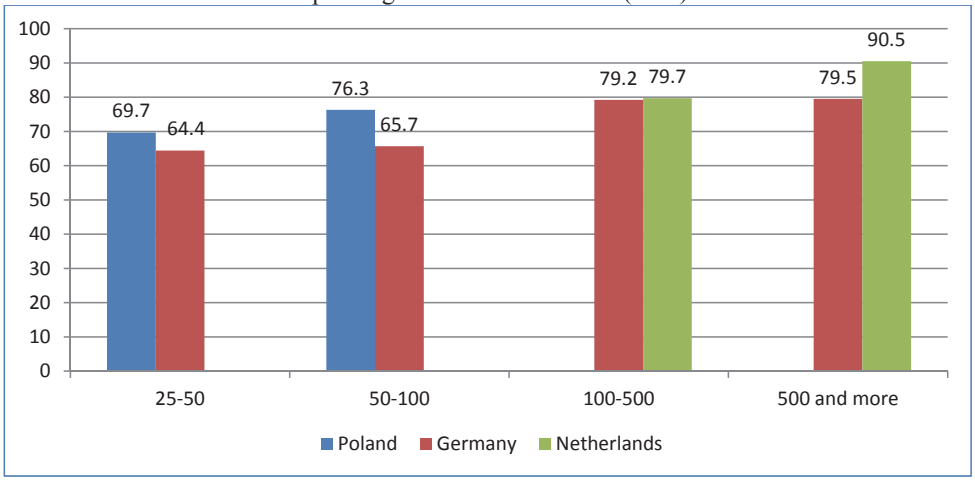
Chart 4.17. Share of plant production on farms with cattle production depending on the economic size (in %)



Source: European FADN.

The share of animal production in total production, however, was positively correlated with the economic size of farms. It increased with the increase in economic size. On Polish farms it was in the range from 70 to 76% respectively in classes 3 and 4. On German farms it was in the range from 64% in class 3 to 80% in class 6. On Dutch farms it was even higher at 80 and 90% respectively in classes 5 and 6. The share of other production on Polish farms was negligible, about 1-2%. In German holdings in classes 3 and 4 and in Dutch holdings in class 5, the share of other production was approximately 14%. The share of other production in other classes of these farms was about 4%.

Chart 4.18 Share of animal production in total production on farms with cattle production depending on the economic size (in %)



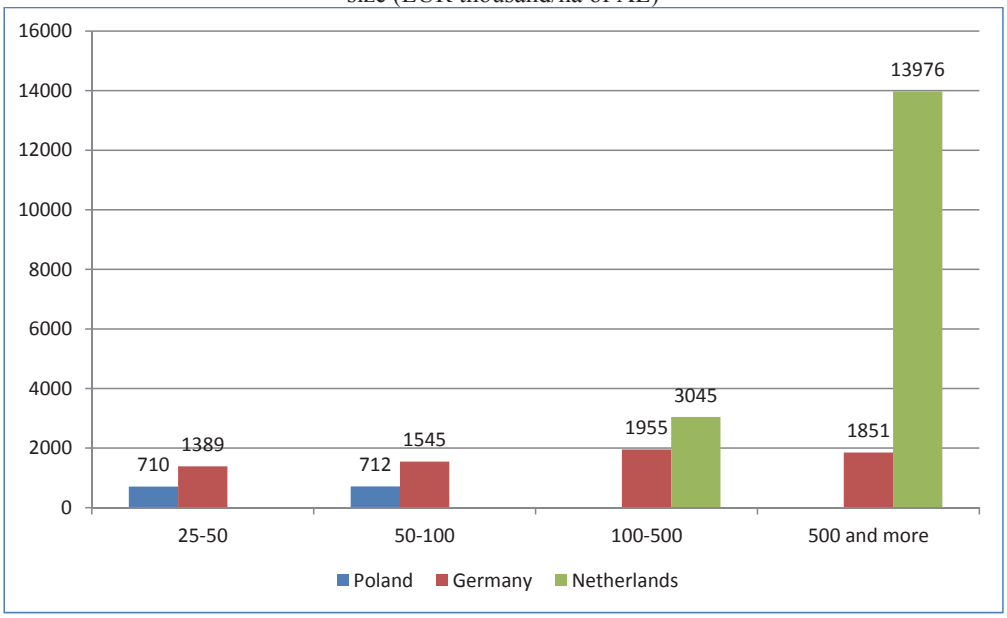
Source: European FADN.

4.2.3. Assessment of the level and structure of costs on farms with cattle production depending on the economic size

Analysis of total costs per 1 ha of AL indicates the existence of a positive relationship between the level of costs and the economic size (Chart 4.19). This pattern occurs in all farms, but with various intensity. On Polish farms in class 3 and 4, the difference in the level of costs was small. Costs on farms in class 4 amounted to 712 EUR/ha and were only 0.2% higher than in class 3. The total costs on German farms showed an upward trend from class 3 to class 5, where they amounted to 1,955 EUR/ha and were about 41% higher than in class 3. In class 6 these costs in relation to class 5 declined by about 5%. The highest costs per 1 ha of AL occurred on Dutch farms in classes 5 and 6, respectively 3045 and 13,976 EUR/ha of AL. This was due to the smaller area of these farms in relation to German farms.

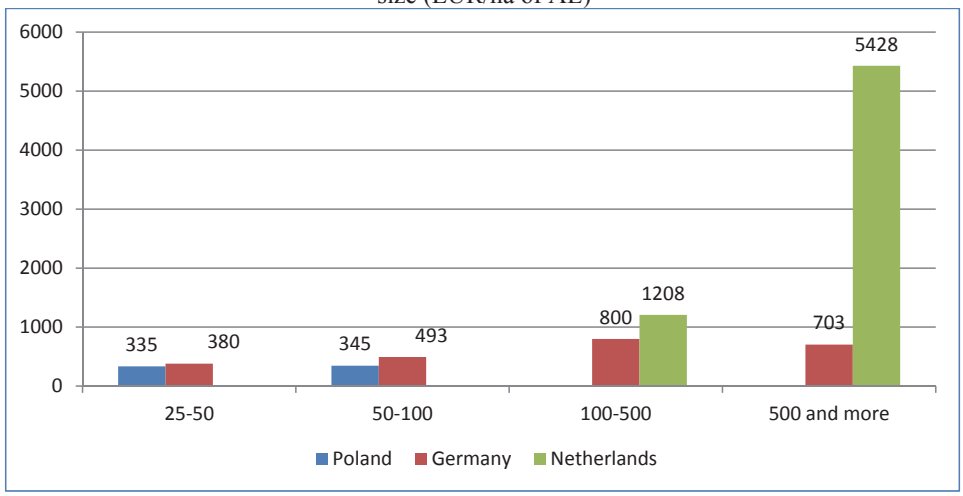
Similar trends have occurred in direct costs per 1 ha of AL (Chart 4.20). The cost structure was similar in German and Dutch holdings. The share of direct costs in total costs was about 40%. On Polish farms, the share of direct costs in total costs was higher – 48%.

Chart 4.19. Level of total costs on farms with cattle production depending on the economic size (EUR thousand/ha of AL)



Source: European FADN.

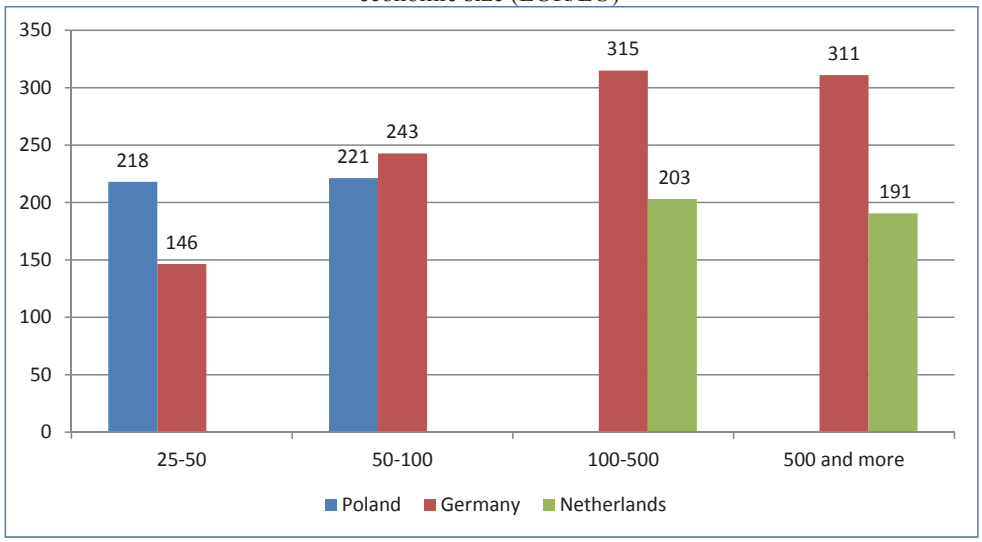
Chart 4.20. Level of direct costs on farms with cattle production depending on the economic size (EUR/ha of AL)



Source: European FADN.

There were differences in the evolution of the costs of purchased feed per 1 LU (Chart 4.21). On Polish farms in class 3 and 4 they were similar. They were respectively 218 and 211 euro/LU. On German farms they demonstrated an increasing trend with increasing economic size, from class 3 to 5, where they amounted to 315 EUR/LU and were 116% higher than in class 3. In class 6 they amounted to 311 EUR/LU and were 1.3% lower than in class 5.

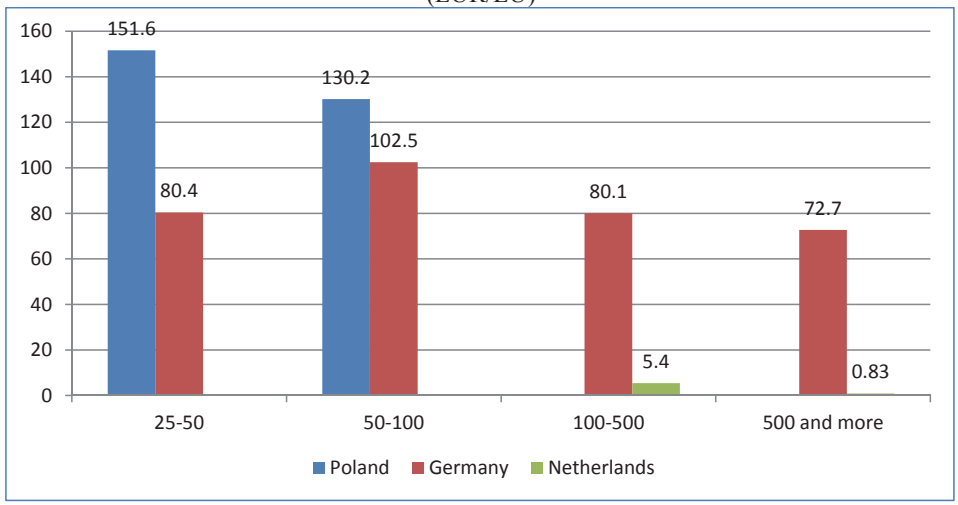
Chart 4.21. Cost of purchased feed on farms with cattle production depending on the economic size (EUR/LU)



Source: European FADN.

On Dutch farms, the costs of purchased feed were significantly lower than in German holdings in classes 5 and 6 and remained at a similar level. In class 6 they amounted to 192 EUR/LU and were 6% lower than in class 5.

Chart 4.22. Cost of own feed on farms with cattle production depending on the economic size (EUR/LU)



Source: European FADN.

The costs of own feed in the analyzed farms varied (Chart 4.22), with no clear trend. They were the highest in Polish farms. In class 3 and 4 they were respectively 152 and 130 EUR/LU. The differences in costs in German farms were small. In classes 3 and 5 they amounted to 80 EUR/LU, and in class 6 to 73 EUR/LU. In class 4 they were about 28% higher than in classes 3 and 4.

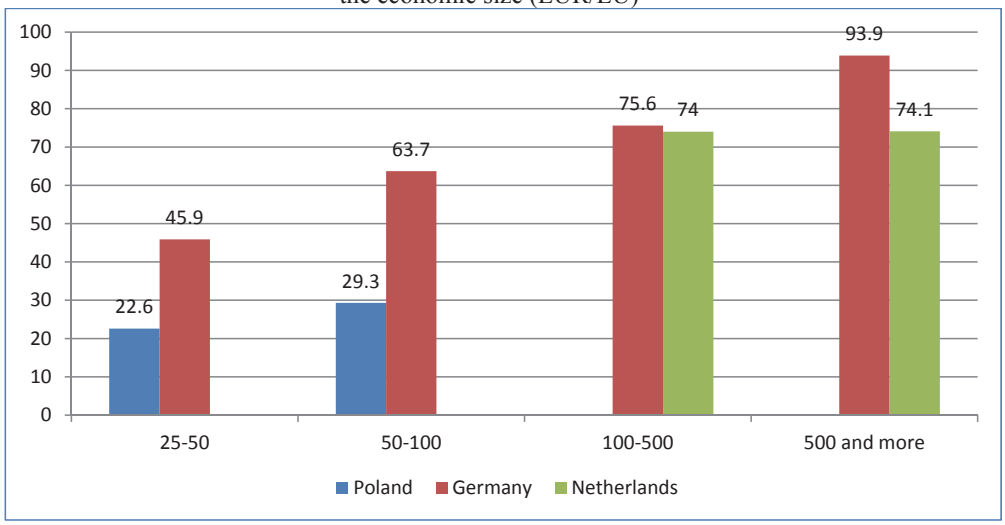
The level of the remaining costs of animal production was positively correlated with the economic size of farms. They increased with the increase in economic size (Chart 4.23). On Polish farms in class 3 and 4 they were respectively 23 and 29 EUR/LU. In class 4 they were about 26% higher than in class 3.

On German farms, differentiation between classes was greater. In class 6 they amounted to 94 EUR/LU and were 104% higher than in class 3. On Dutch farms, other expenses in class 5 and 6 were almost identical, they were respectively 74 and 74.1 EUR/LU.

Costs of hired labour in the analyzed farms were highly diversified among countries and classes, and positively correlated with the size of farms (Chart 4.24). They were the lowest in Polish farms in class 3 and 4, respectively 8.6 and 12.7 EUR/ha of AL. In German farms, the costs of hired labour varied greatly, within the range of 18.5 EUR/ha in class 3 to 279 EUR/ha in class 6. Diversification of costs of hired labour in Dutch farms was also very large. In class 5 and 6 they were respectively 22 and 381 EUR/ha of AL. The costs of

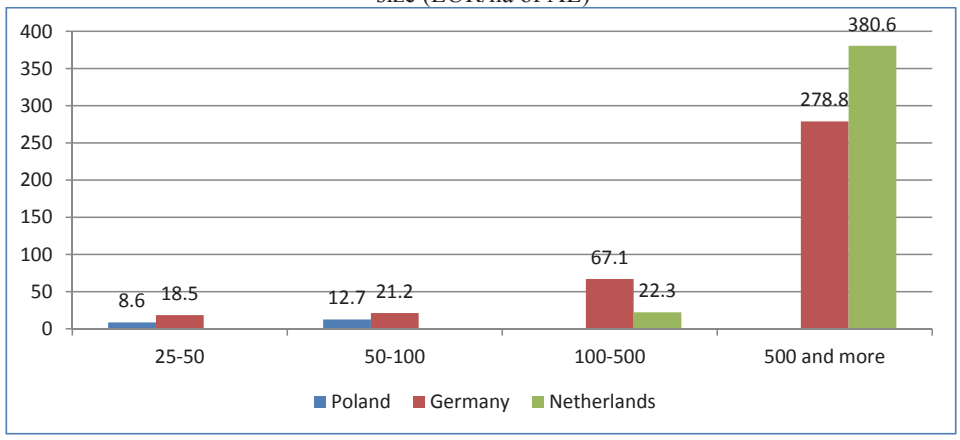
hired labour in class 6 in German and Dutch holdings were very high. They were respectively 279 and 381 EUR/ha of AL.

Chart 4.24. Other costs of animal production on farms with cattle production depending on the economic size (EUR/LU)



Source: European FADN.

Chart 4.24 Costs of hired labour on farms with cattle production depending on the economic size (EUR/ha of AL)

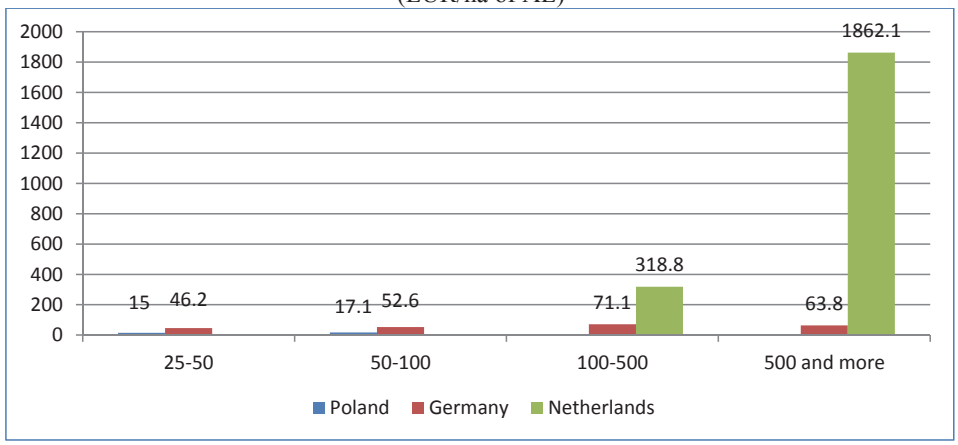


Source: European FADN.

Costs of interest were strongly differentiated not only between farms of the analyzed countries but also between economic size classes (Chart 4.25). On Polish farms of class 3 and 4 they were very low and not very diverse. They were respectively 15 and 17 EUR/ha. On German farms, differentiation between the classes from 3 to 6 was small, within the range from 53 to 71 EUR/ha. The highest costs of interest occurred on Dutch farms where in classes 5 and 6 they

were respectively 319 and 1862 EUR/ha of AL. Very high costs of interest in class 6 were due to a small area of farms in this class of economic size.

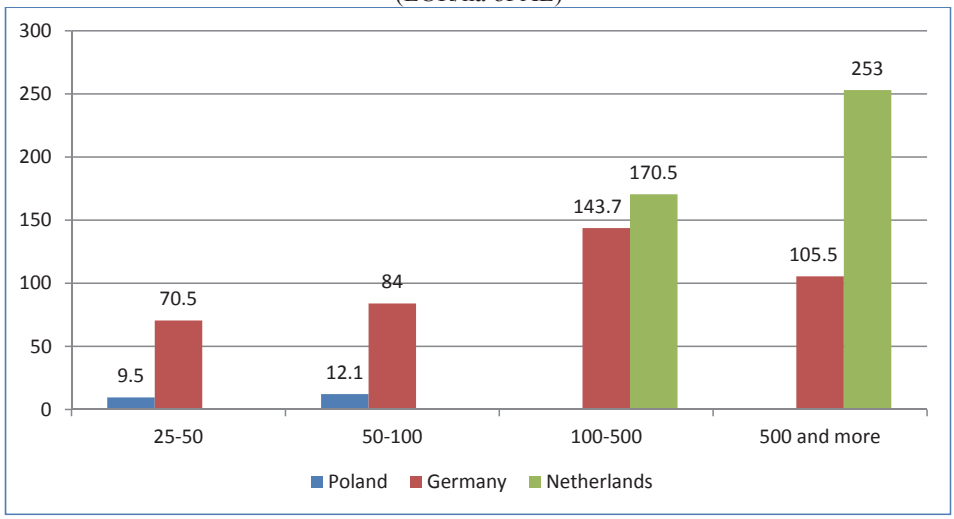
Chart 4.25. Costs of interest on farms with cattle production depending on the economic size (EUR/ha of AL)



Source: European FADN.

Lease costs increased with the increase of economic size (Chart 4.26). They very low on Polish farms in class 3 and 4, respectively 9 and 12 EUR/ha of AL. They were significantly higher in German holdings, where in classes 3 to 5 they showed an upward trend from 71 to 144 EUR/ha. In class 6 they decreased to 106 EUR/ha. They were definitely higher on Dutch farms. In classes 5 and 6 they were respectively 171 and 253 EUR/ha of AL.

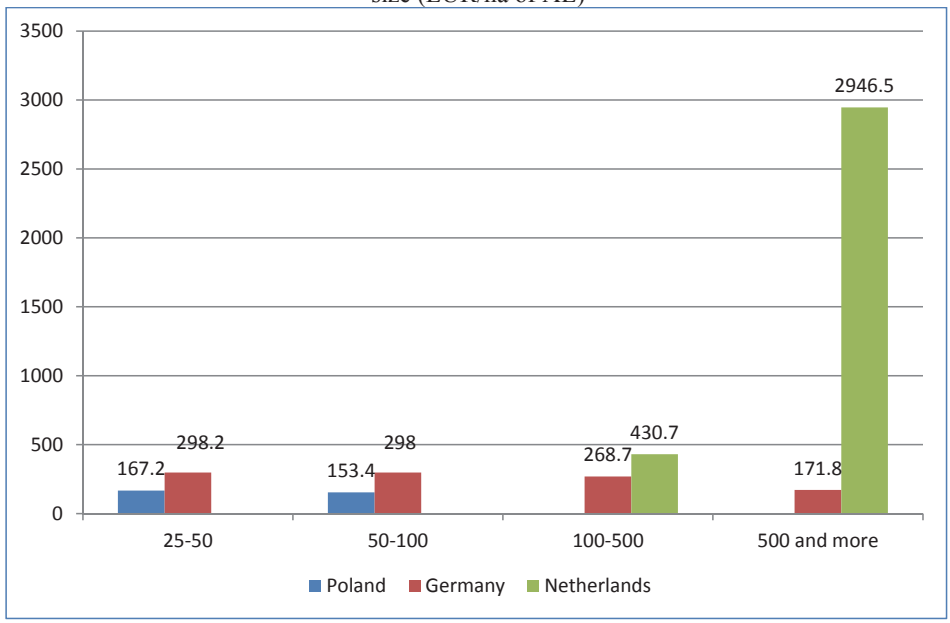
Chart 4.26. Costs of lease on farms with cattle production depending on the economic size (EUR/ha of AL)



Source: European FADN.

Different trends occurred in depreciation costs (Chart 4.27). They were the lowest on Polish farms, respectively 167 and 153 EUR/ha of AL. They were higher and less variable on German farms. In classes 3 and 4 they were similar and amounted to 298 EUR/ha. In subsequent classes 5 and 6, they decreased respectively to 269 and 172 EUR/ha of AL. They were significantly higher on Dutch farms and amounted to 431 and 2947 EUR/ha respectively in classes 5 and 6.

Chart 4.27. Costs of depreciation on farms with cattle production depending on the economic size (EUR/ha of AL)



Source: European FADN.

4.2.4. Assessment of productivity and efficiency on farms with cattle production depending on the economic size

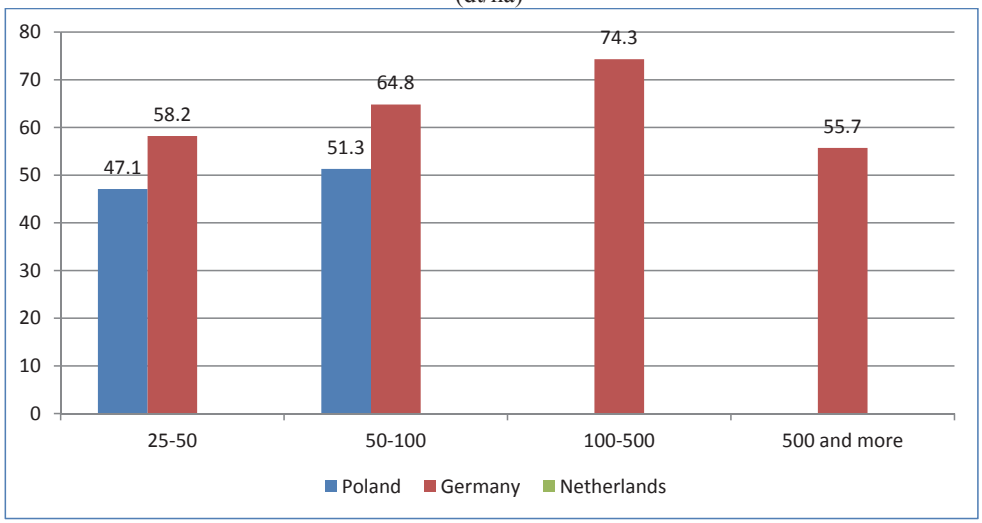
Assessment of productivity and efficiency was made using selected groups of indicators, such as: unit productivity (yield, milk yield of cows), productivity and efficiency of production factors.

Chart 4.28 shows the evolution of wheat crop, which informs directly about the productivity of land. This crop was cultivated only on Polish and German farms. There was a relationship between the level of yields and the economic size of farms in classes 3 to 5.

On Polish farms, wheat yields in classes 3 and 4 were respectively 47 and 51 dt/ha and were significantly lower than on German farms where they were in

the range from 58 to 74 dt/ha in classes 3 to 5. They were much lower in class 6 of German farms, 56 dt/ha.

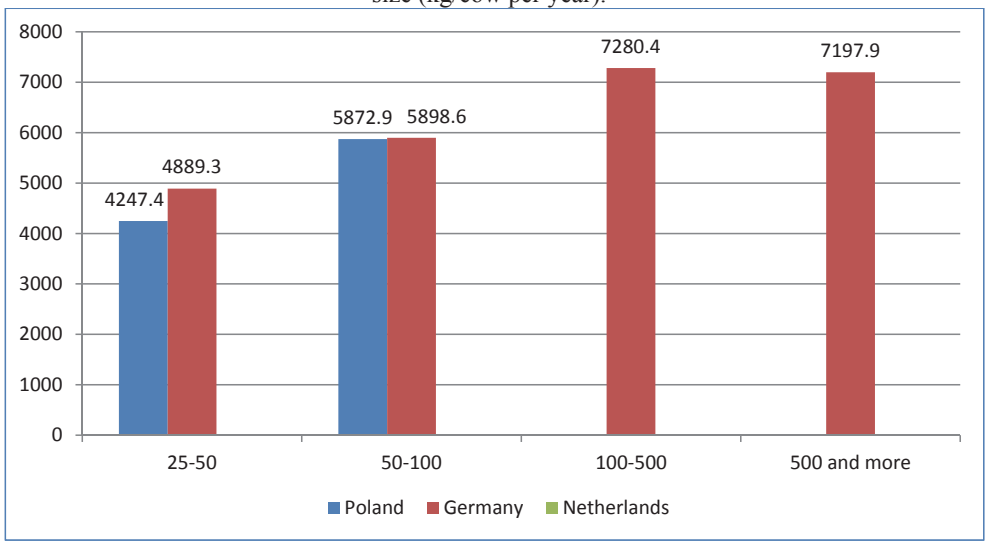
Chart 4.28. Wheat yield on farms with cattle production depending on the economic size (dt/ha)



Source: European FADN.

Milk yield of cows in the surveyed farms showed an increasing trend with increasing economic size (Chart 4.29).

Chart 4.29. Milk yield of cows on farms with cattle production depending on the economic size (kg/cow per year).

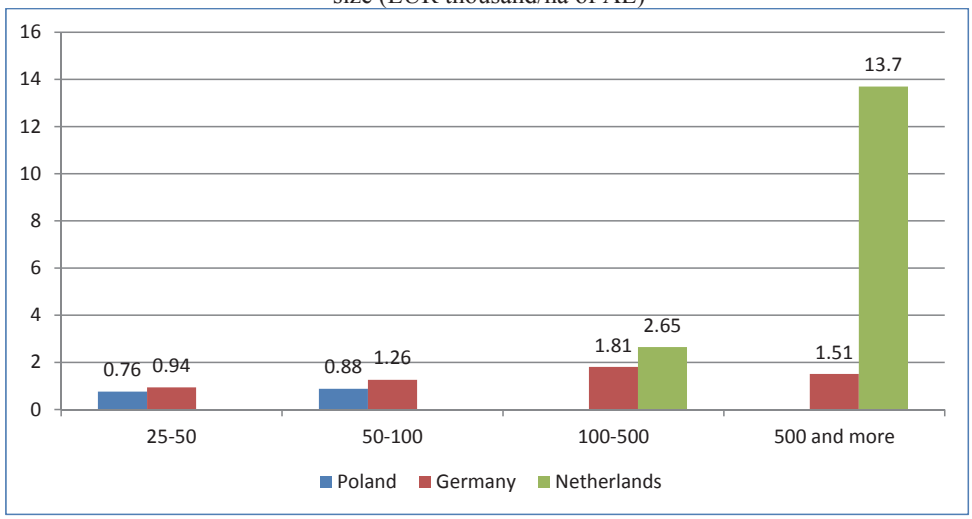


Source: European FADN.

Dairy cows were kept only on Polish and German farms. On Polish farms, milk yield of cows in classes 3 and 4 amounted respectively to 4247 and 5873 kg of milk per cow per year. It should be assessed as low and average. It was higher on German farms, in the range from 4889 kg in class 3 to 728 kg in class 5. In class 6 it was only 1.2% lower than in class 5. Milk yield of cows on German farms should be assessed as average. It should be noted that breeding of dairy cows in this type of farms was an additional activity.

Productivity of land in the surveyed farms was determined by the value of production in thousand EUR per 1 ha of AL. On Polish farms in classes 3 and 4, on German farms in classes 3 to 5 and on Dutch farms in classes 5 and 6, productivity of land showed an increasing trend with increasing economic size (Chart 4.30). The lowest productivity of land was on Polish farms in classes 3 and 4, respectively 0.76 and 0.88 thousand EUR/ha of AL. On German farms it was higher, in the range from 0.94 thousand EUR/ha in class 3 to 1.81 thousand EUR/ha in class 5. In class 6 it decreased to 1.51 thousand EUR/ha. Productivity of land was significantly higher on Dutch farms, respectively 2.65 and 13.7 thousand EUR/ha of AL in classes 5 and 6.

Chart 4.30. Land productivity on farms with cattle production depending on the economic size (EUR thousand/ha of AL)

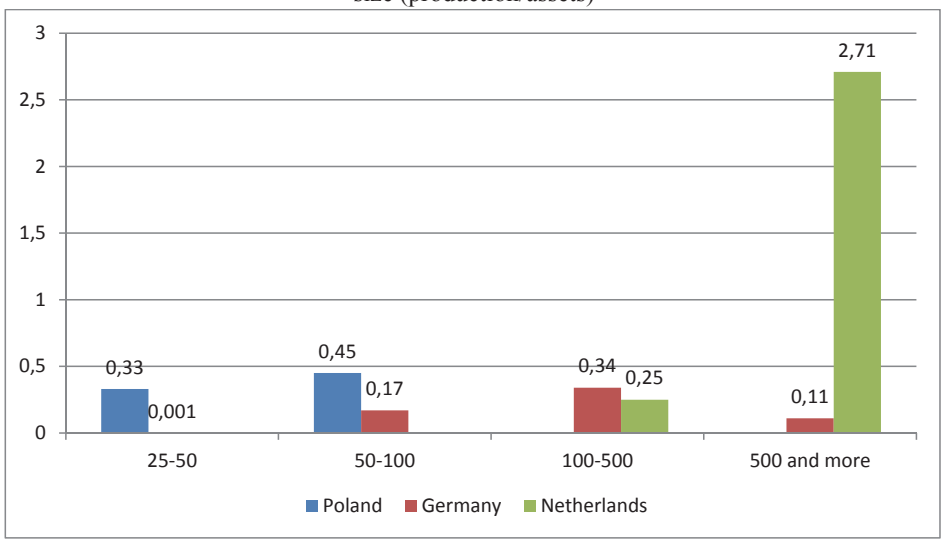


Source: European FADN.

Similar trends occurred in the productivity of assets (Chart 4.31). Asset productivity in all surveyed farms increased with increasing economic size. In Polish farms in classes 3 and 4 it was 0.14 and 0.16 respectively, whereas in German farms it ranged between 0.08 in class 3 and 0.35 in class 6. In Dutch farms in classes 5 and 6 it was lower than in the corresponding classes of German farms and amounted to 0.13 and 0.2.

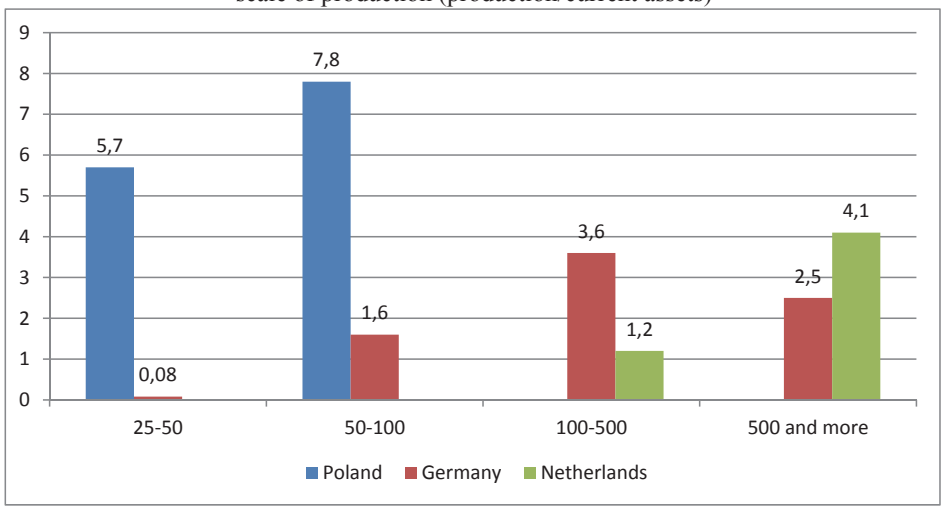
Similar trends occurred in the productivity of current assets (Chart 4.32). The exceptions were German holdings in class 6, where the productivity of current assets was 1.08 and was 5.3% lower than in class 5.

Chart 4.31. Land productivity on farms with cattle production depending on the economic size (production/assets)



Source: European FADN.

Chart 4.32. Productivity of current assets on farms with cattle production depending on the scale of production (production/current assets)

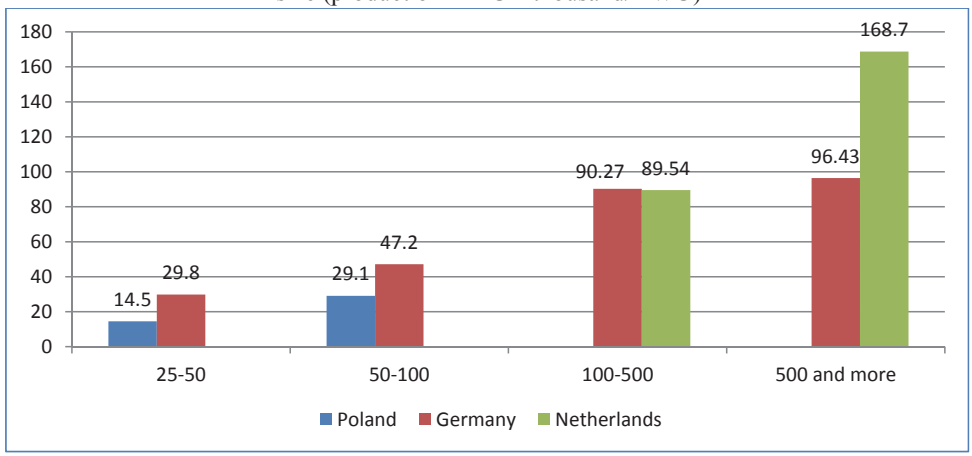


Source: European FADN.

Labour productivity determined by the value of production per unit of work (AWU) in the surveyed farms with cattle production was correlated with

economic size of farms (Chart 4.33). This trend occurred in all farms regardless of the country. On Polish farms it was in the range from 14 to 29 thousand EUR/AWU, respectively in classes 3 and 4. In German holdings, in the corresponding classes, it was higher by 100% and 62% respectively. In German holdings in classes 5 and 6, it was 90 and 96 thousand EUR/AWU. It was the highest in Dutch farms in class 6 where it amounted to 169 thousand EUR/AWU.

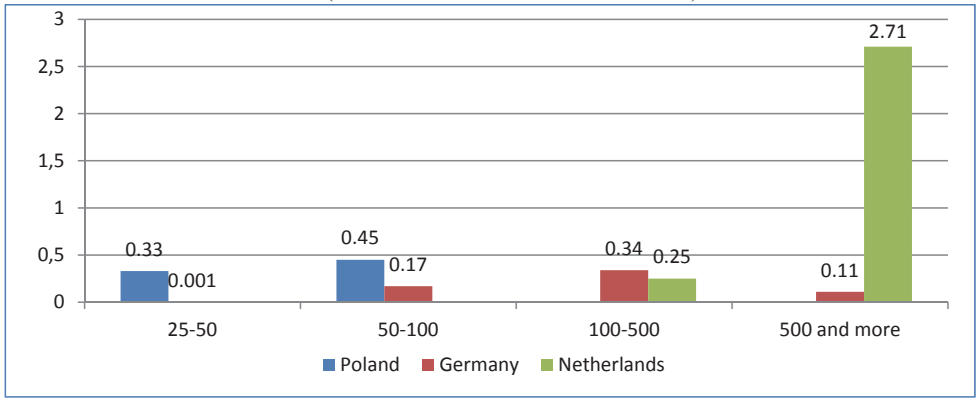
Chart 4.33. Labour productivity on farms with cattle production depending on the economic size (production in EUR thousand/AWU)



Source: European FADN.

The profitability of land was determined by the value of income in EUR thousand from the farm per 1 ha of AL. There was also the relationship between the profitability of land and economic size (Chart 4.34).

Chart 4.34. Profitability of land on farms with cattle production depending on the economic size (income in EUR thousand/ha of AL)

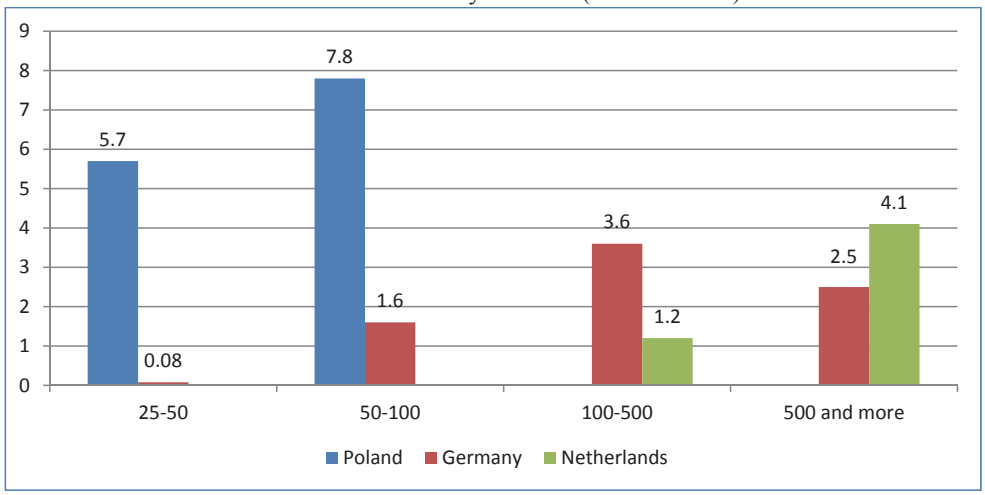


Source: European FADN.

The highest profitability of land was on Polish farms where in classes 3 and 4, respectively, it was 0.33 and 0.45 thousand EUR/ha. On German farms in corresponding classes it was significantly lower and amounted to 0.001 and 0.17 thousand EUR/ha. In class 5 it was significantly higher and amounted to 0.34 thousand EUR/ha, while in class 6 it was significantly reduced to 0.11 thousand EUR/ha, i.e. by 68%. This was due to the large area of these farms. Profitability of land was the highest in the case of Dutch farms in class 6, it amounted to 2.71 thousand EUR/ha. This was the result of a small area of these farms.

Similar trends as in the profitability of land occurred in the profitability of assets. There was also a positive relationship between the profitability of assets and the economic size of farms, except for German farms in class 6, in which there was a decrease in relation to class 5 (Chart 4.35).

Chart 4.35. Profitability of assets (income/assets)



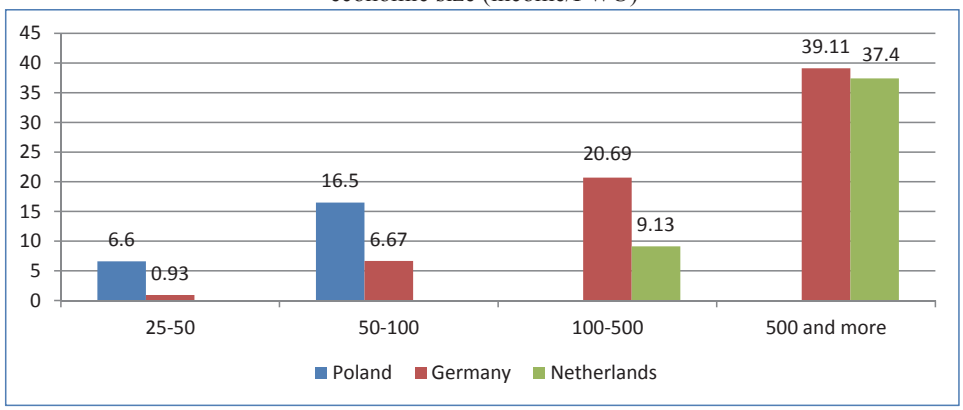
Source: European FADN.

The highest profitability of assets was in Polish farms in classes 3 and 4, respectively 5.7 and 7.8. On German farms it was significantly lower, in the range from 0.08 (class 3) to 3.6 (class 5). In class 6 there was a decrease to 2.5, i.e. by 31%. The profitability of assets on Dutch farms in classes 5 and 6 was respectively 1.2 and 4.1.

The profitability of own labour was closely associated with economic size, showing an increasing trend with increasing economic size (Chart 4.36). On Polish farms in classes 3 and 4 it was respectively 6.6 and 16.5 EUR/FWU. In German holdings, in the corresponding classes, it was lower by 91% and 60% respectively. In the other two classes, 5 and 6, profitability was higher and amounted to 21 and 39 thousand EUR/FWU respectively. Similar trends oc-

curred on Dutch farms in classes 5 and 6, where income per FWU was respectively 9 and 37 thousand EUR.

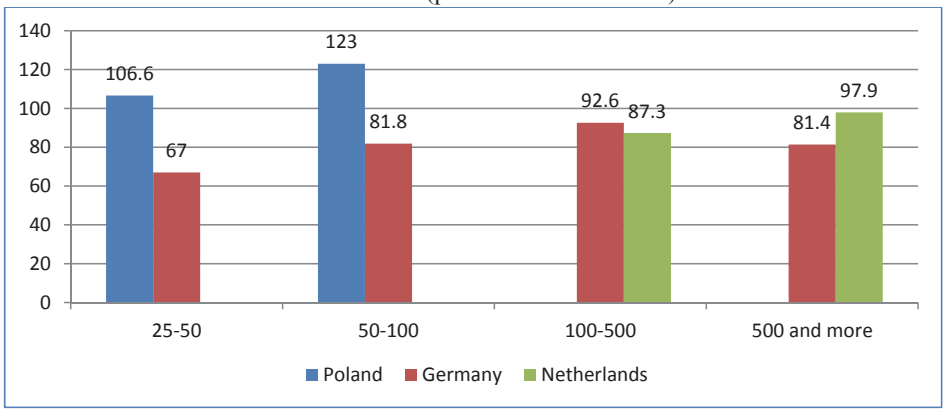
Chart 4.36. Profitability of own labour on farms with cattle production depending on the economic size (income/FWU)



Source: European FADN.

Profitability of production determined by the ratio of production to costs varied in the studied farms. The indicator of profitability was over 100% only on Polish farms, in classes 3 and 4 it was respectively 107 and 123% (Chart 4.37). On other farms, regardless of their size class, it was lower than 100%. The lowest indicator was in German holdings in class 3, it was 60%, and the highest one on Dutch farms in class 6, it was 98%.

Chart 4.37. Cost-effectiveness of production on farms with cattle production depending on the economic size (production/costs x 100)

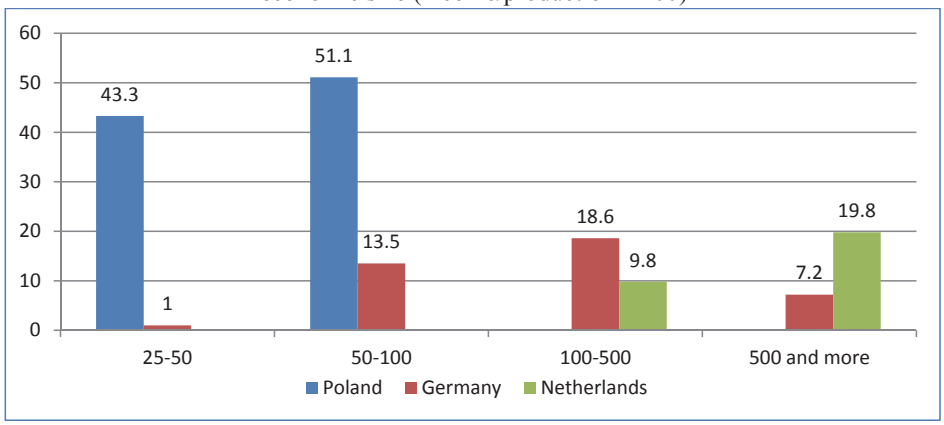


Source: European FADN.

The profitability of production determined by the ratio of income from the farm to the production was strongly differentiated in the surveyed farms (Chart 4.38). Profitability ratios increased with the increase in economic size, with the

exception of German farms in class 6. The viability of production was the highest on Polish farms, in classes 3 and 4 it was respectively 33 and 51%.

Chart 4.38. Viability of production on farms with cattle production depending on the economic size (income/production x 100)

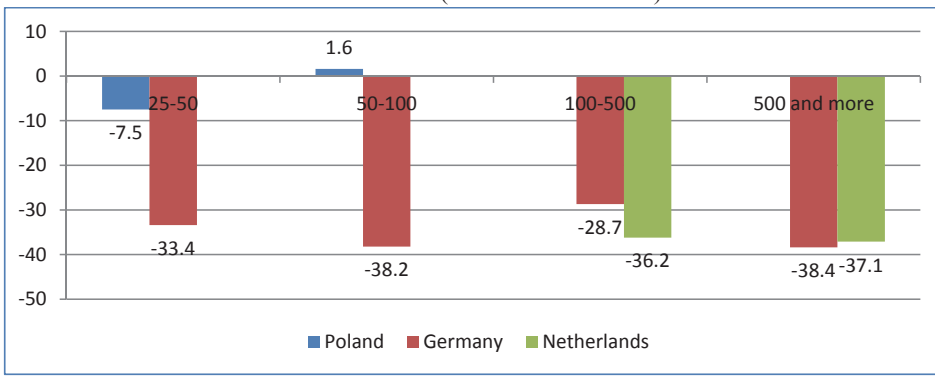


Source: European FADN.

On German farms it was in the range from 1% in class 3 to 19% in class 5. In class 6 it was 7.2% and was 61% lower than on farms in class 5. Viability indicators of Dutch farms in classes 5 and 6 were respectively 10 and 20%.

Income from management which is the ultimate measure of the efficiency of management in the surveyed farms was negative, except for the Polish farms in class 4, where it amounted to EUR 1.6 thousand (Chart 4.39). On German farms it was in the range from EUR -38.2 thousand (in class 4) to EUR -29 thousand (class 5). The Dutch farms in class 5 and 6 had the income from management amounting respectively to -36 and -37 thousand EUR/farm. There has been no relationship between the economic size and profit from management.

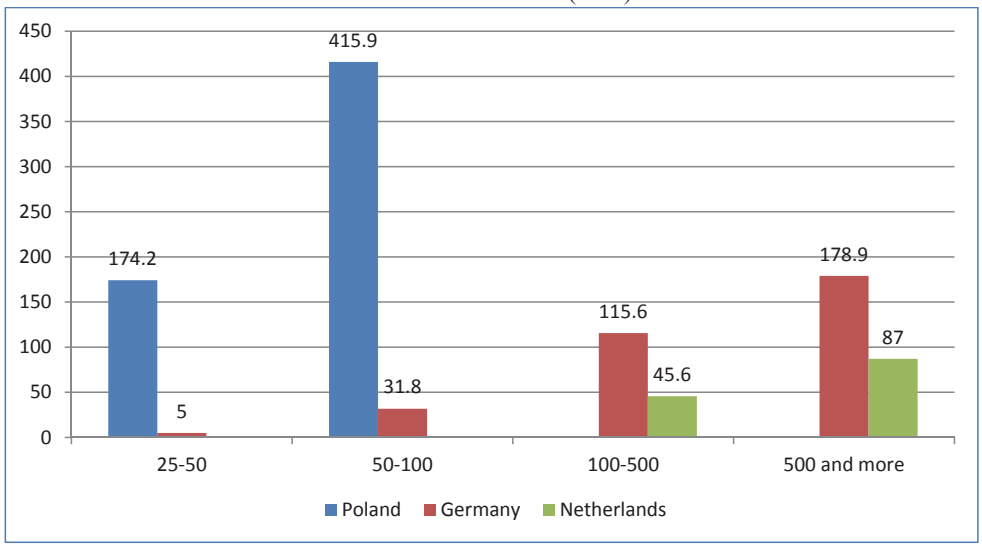
Chart 4.39. Income from management on farms with cattle production depending on the economic size (thousand EUR/farm)



Source: European FADN.

Income parity "A" specified by the ratio of income from the farm per unit of own labour (FWU) to the wages for hired labour in the surveyed farms was achieved on Polish and German farms in classes 5 and 6 (Chart 4.40).

Chart 4.40. Income parity "A" on farms with cattle production depending on the economic size (in %)



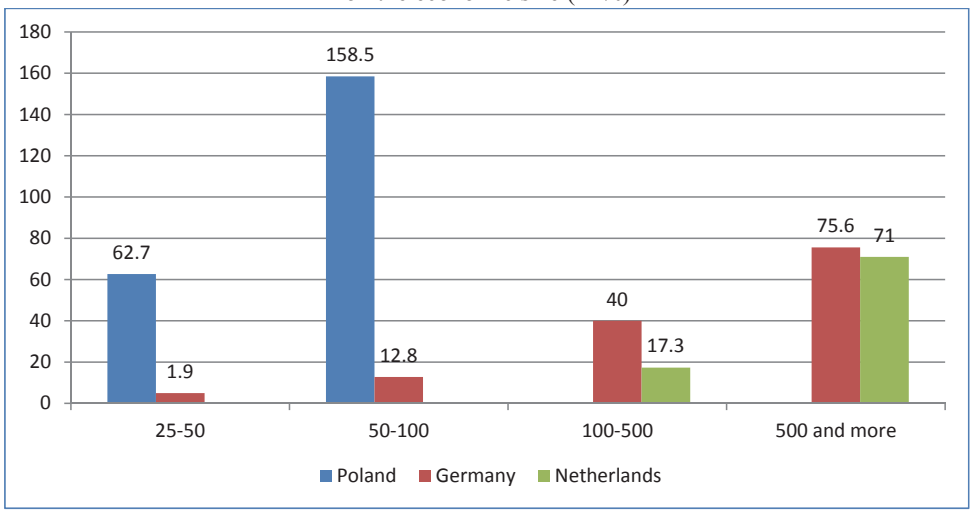
Source: European FADN.

On other farms it was negative. In Polish farms in classes 3 and 4, the respective indicators of income amounted to 174 and 416%. On German farms in classes 5 and 6 they amounted to 116 and 179%. The lowest value of the income parity "A" indicator was in German holdings in class 3. On Dutch farms in classes 5 and 6, the value of this indicator was 46 and 87% respectively.

In general, it should be noted that German farms in classes 3 and 4, as well as Dutch farms in classes 5 and 6, did not reach income parity "A".

Income parity "B", which is the ratio of income from the farm per 1 FWU to the average wages and salaries in the national economy was reached only by Polish farms in class 4 (Chart 4.41). Other farms did not reach income parity "B". A relatively favourable result was achieved by Polish farms in class 3, where the value of the indicator "B" was 63%, and by German and Dutch holdings in class 6, where the value of the indicator amounted to 77 and 71%. Not achieving income parity "B" deprives German and Dutch holdings of development opportunities regardless of their economic size. Polish farms in class 3 were in a similar situation.

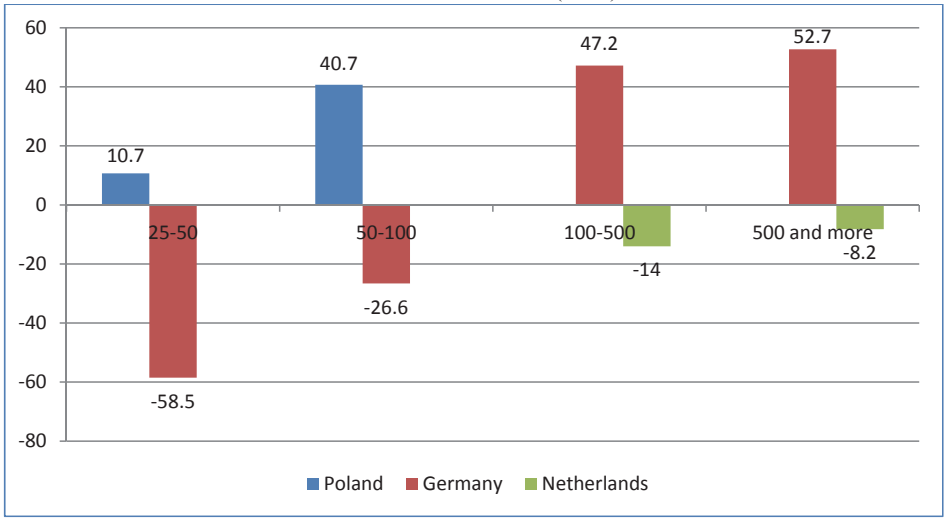
Chart 4.41. Income parity "B" on farms with cattle production depending on the economic size (in %)



Source: European FADN.

Net investment rate specified by the ratio of net investment to depreciation reached positive values only on Polish and German holdings in classes 5 and 6 (Chart 4.42).

Chart 4.42. Net investment rate on farms with cattle production depending on the economic size (in %)



Source: European FADN.

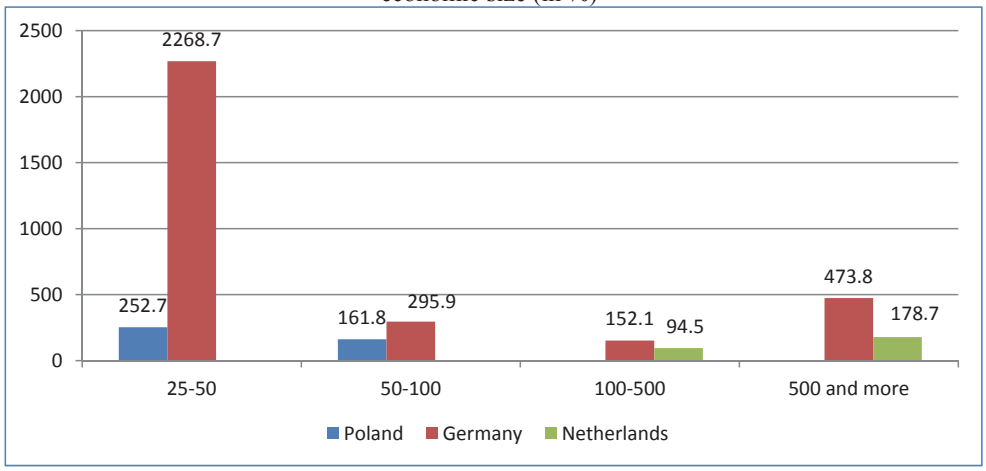
On Polish farms in classes 3 and 4, the corresponding values were 11 and 41%, while in German holdings in classes 5 and 6, they were 47 and 53%. These

groups of farms increased their production potential, which indicates their developmental abilities. Investment rates in other holdings were negative. On German farms in classes 3 and 4, they amounted respectively to 58 and -27%. On Dutch farms, the values of investment rates were more favourable. In classes 5 and 6, they were respectively -14 and -8%.

Analysis of the data in chart 4.43 shows that the primary and basically the only source of income in the surveyed farms were all kinds of subsidies they receive in the framework of the Common Agricultural Policy. On Polish farms in classes 3 and 4, the proportions of subsidies in income amounted to 253 and 162%. In the corresponding classes of German holdings these indices were higher and amounted respectively to 229 and 296%. In the other two classes, 5 and 6, these rates were respectively 152 and 474%. In Dutch holdings, the share of subsidies in income from the farm in classes 5 and 6 were lower than on the corresponding German farms and were respectively 95 and 179%.

The share of subsidies in income from the farm confirms the previous finding that subsidies are a major source of income from the farm.

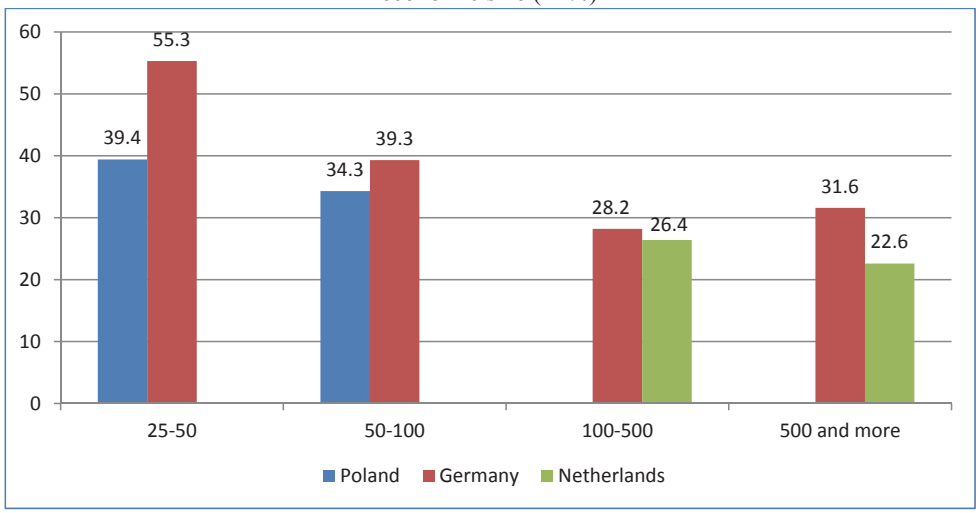
Chart 4.43. Share of subsidies in income on farms with cattle production depending on the economic size (in %)



Source: European FADN.

The share of subsidies in income of farms is shown in Chart 4.44. It showed a downward trend with increasing economic size. On Polish farms in classes 3 and 4, it was respectively 39 and 34%. In German holdings, in the corresponding classes, it was higher by 40 and 14% respectively. In classes 5 and 6, the share was lower and amounted to 28 and 32% respectively. On Dutch farms in classes 5 and 6, the share of subsidies in revenues was 26 and 23% respectively.

Chart 4.44. Share of subsidies in revenues on farms with cattle production depending on the economic size (in %)



Source: European FADN.

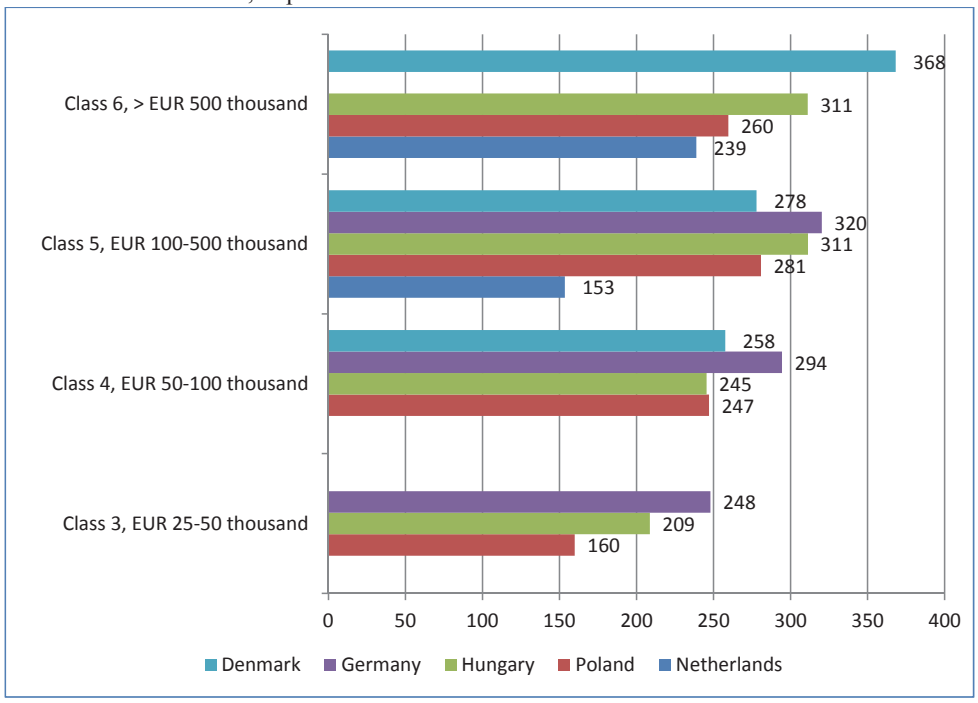
In general, it should be noted that subsidies are an important component of farm revenue and are also the main source of farm income. Without subsidies, the functioning of farms with cattle production would be more difficult. Moreover, taking into account income from management, income parity "B" and the rate of net investment, it should be noted that, among the surveyed farms, only Polish farms with cattle production of the economic size class 4 (EUR 50-100 thousand of Standard Output) demonstrate development capacity.

5. Comprehensive assessment of the efficiency of farms with cattle production in the surveyed countries

5.1. Comprehensive assessment of dairy farms

The analysis shows that the highest values of the point indicator of relative goodness (PIRG) were acquired by farms in classes 5 and 6 (Chart 5.1). Thus, the holdings with the highest scale of production were in the best economic situation. Within these classes, however, the results varied considerably, the highest value of the indicator was in Dutch holdings in class 6, 368 points, while the lowest in Danish holdings in class 5, only 153 points, and it was the lowest score among all classes.

Chart 5.1. Cumulative indication of the relative goodness of dairy farms in the surveyed countries, in particular economic size classes of SO in 2008-2010



Source: Own calculations.

The results of Polish dairy farms should be assessed positively in relation to all farms. Polish farms reached the highest values of PIRG in all classes according to which they were classified (classes 3 to 5). In the lower size classes, the greatest weakness were shown by German farm (160 points in class 3), and Polish farms were the strongest. Point indicator of relative goodness for Hungar-

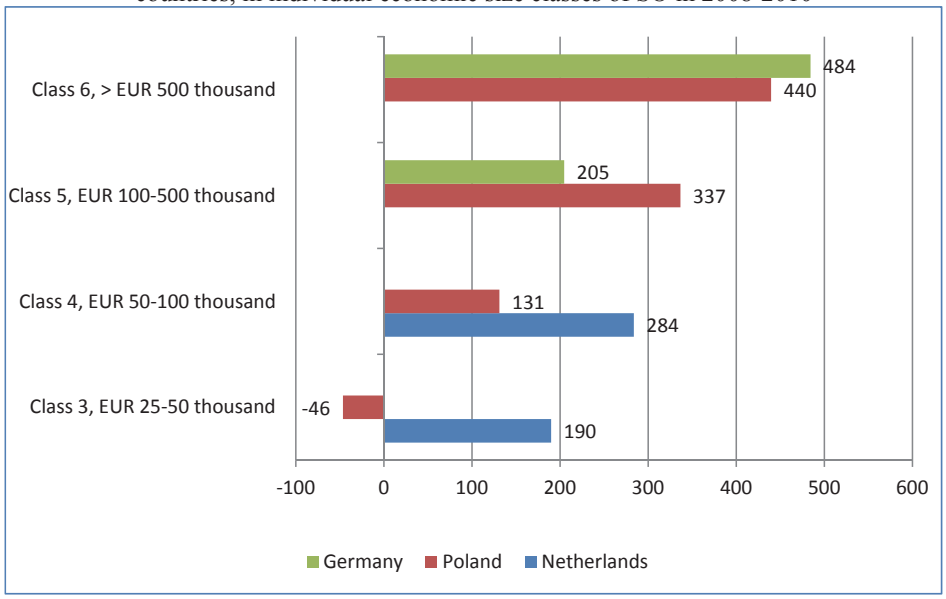
ian holdings ranked them generally close to the average value of the class, with the exception of class 4, where these farms have achieved the worst result.

5.2. Comprehensive assessment of holdings with the production of other cattle

Among the farms specialized in cattle production, the highest values of PIRG were achieved by the largest size classes (Chart 5.2). It is evident that the disparities between the various classes are considerably larger than in the case of dairy farms. It can, therefore, be concluded that the orientation in cattle production is much more cost effective at very large scale.

The highest value of the indicator, as in the case of dairy farms, was achieved by Dutch holdings in class 6, 484 points. The lowest value of PIRG – 46 points, was achieved by German farms in class 3. It should be noted also that the highest rates in the lower classes were achieved by Polish farms (class 3 and 4), significantly outpacing German farms.

Chart 5.2. Cumulative indication of the relative goodness of cattle farms in the surveyed countries, in individual economic size classes of SO in 2008-2010



Source: Own calculations

6. Efficiency of farms with cattle production by economic size, calculated using the DEA method

An important issue in assessing the economic performance of the farm is to assess its effectiveness. This part of the study evaluates efficiency of farms specializing in milk production (type 45) and farms specializing in cattle production (type 49). The technical efficiency of farms was measured using the nonparametric DEA method (Data Envelopment Analysis), also referred to as data envelope analysis or data limit analysis. This method, unlike the parametric method, does not require a priori assumption of the form of searched efficiency limit, and it is determined during the analysis.

Assumptions of the DEA method can be illustrated by the following formula:

$$F(\mu, v) = \frac{\sum_{r=1}^{s} \mu_r E_r}{\sum_{i=1}^{m} v_i N_i} \rightarrow \max$$

where:

s – number of effects achieved by the object,
m – number of inputs incurred by the object,
μr – weights of individual effects,
vi – weights relating to individual inputs,
E – effect,
N – inputs.

In this equation the coefficients μr and vi, which are weights of empirical values of effects and costs, are optimized. Thus, the equation sets the opportunity of maximum reduction of real inputs or identifying them on such level as to receive designated effects [Coelli 2005]. This method is often used to evaluate the efficiency in agriculture. It was used, among others, in the assessment of farms in Saxony, determining technical efficiency of small farms in central Ethiopia, the productivity of cereal farms in Mongolia, the evaluation of the effectiveness of different groups of farms in Brandenburg [Ziółkowska 2008]. This method has also been widely used to assess the effectiveness of agricultural holdings established on the basis of the Agricultural Property Stock of the State Treasury [Kulawik 2008].

The analysis used the model oriented on inputs called BCC[6], which described a possibility of reducing spending without reducing the effect, while taking into account the variable effects of scale. The VRS rate, which represented the variable effects of scale of operations, was used to classify the farms. The technical efficiency of analyzed units was determined using the CCR model[7], which, unlike the previous one, allowed for estimating the extent to which the farms could reduce inputs while reaching the same amount of effect under constant influence of the scale of operations.

Fully effective units, i.e. the ones that had the optimal ratio of inputs to effects, created benchmarks assuming the value of unity. However, for the purposes of this analysis, we created wider intervals that allowed (due to the sufficient number of farms) a comparison between them. Effective farms were those with the VRS coefficient between 0.85 and 1, farms with low efficiency were those in the range of 0.5-0.85. Ineffective farms were those with VRS coefficient lower than or equal to 0.5.

Variables for the construction of models are defined as follows:

Effect – value of production (PLN).

Variables for the construction of models are defined as follows:

Inputs:

x1` – agricultural land area (ha),

x2` – total labour inputs (AWU),

x3` – value of assets expressed by depreciation costs (PLN),

x4` – total costs less the cost of salaries and depreciation (PLN).

6.1. Evaluation of the effectiveness of farms specializing in milk production (type 45)

The first assessed group were that of very small dairy farms with the economic size of up to EUR 8 thousand (Table 6.1). Farms with less land (about 7 ha) but larger animal herds have proven to be more efficient in this population. This group is also characterised by lower labour inputs (1.34 AWU). The very small farms were specialized to a minimum extent, the share of animal production ranged from 50 to 61%. With this economic size, even among the most efficient farms with income of PLN 20 thousand, the income from management has not been achieved. In order to pay for own labour at the level of wages for hired

[6] BCC – abbreviation of the names of the authors of the second application of DEA (Banker, Charnes, Cooper).

[7] CCR – abbreviation of the names of the authors of the first application of DEA (Charnes, Cooper, Rhodes).

labour and to pay the cost of employed capital, they would have to achieve the income twice as high. Despite the low profitability, this group recorded no debt, but the sale of assets progressed in the group of inefficient farms and farms with low efficiency. This situation permits us to conclude that dairy farms of this size have virtually no chance of survival and development.

Table 6.1. Value of selected indicators, depending on the technical efficiency of dairy farms with size of up to EUR 8 thousand (class 1, very small farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	1.74	1.46	1.32
Total labour inputs	AWU	1.74	1.46	1.34
Area of AL	ha	10.13	8.14	6.95
Share of forage crops in AL	%	4.31	3.86	3.74
Animals in total	LU	4.24	5.44	5.13
Cattle population	LU	4.24	5.26	4.71
Milk yield of dairy cows	kg/cow	3646	3449	3630
Share of animal production in total production	%	50.1	61.2	52.4
Value of assets	PLN thousand/ha	13.89	19.94	19.44
Debt ratio	%	0	0	1.2
Gross investment rate	%	-66.5	-11.5	17.1
Income from the farm	PLN	5028	12992	19658
Income from management	PLN	-28627	-21580	-18574

Source: Own compilation based on Polish FADN data.

Dairy farms classified according to FADN as small (class 2) stood out in comparison to the previous group with a slightly higher degree of specialization, as evidenced by the share of animal production in total production and the number of livestock in relation to the farm area (Table 6.2). The differences between farms assessed as effective and less efficient are much more prominent in this group. They are visible primarily in the number of cattle population (average of 12 to 18 units) and milk yield of cows (from 3.5 thousand to less than 5 thousand litres of milk). Effective farms with higher numbers of livestock had smaller area of forage crops and higher value of assets.

Table 6.2. Value of selected indicators, depending on the technical efficiency of dairy farms with size of EUR 8-25 thousand (class 2, small farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	1.73	1.82	1.73
Total labour inputs	AWU	1.74	1.84	1.74
Area of AL	ha	17.47	17.04	15.76
Share of forage crops in AL	%	9.78	8.94	8.90
Animals in total	LU	12.82	16.81	18.66
Cattle population	LU	12.49	16.34	18.50
Milk yield of dairy cows	kg/cow	3427	4268	4873
Share of animal production in total production	%	68.3	71.7	73.7
Value of assets	PLN thou-sand/ha	18.92	23.26	27.72
Debt ratio	%	4.0	4.7	5.5
Gross investment rate	%	18.3	85.1	189.8
Income from the farm	PLN	22853	51120	76299
Income from management	PLN	-24946	-3422	18426

Source: Own compilation based on Polish FADN data.

The whole group of small dairy farms showed a relatively low debt ratio. Although it was slightly higher on farms with the highest efficiency, it should be noted that enhanced rate of reproduction of the assets and the positive income from management was observed only in this population. One could say that probably only the most efficient dairy farms in this size group are able to compete in the market. However, it is likely that in order to maintain this ability, they will be forced to continue to invest and expand the scale of production.

Analysis of indicators of groups of small to average dairy farms again showed that the highest efficiency was achieved by farms with the highest level of specialization (share of animal production in total production). The most efficient farms on average had 27 ha of agricultural land and were about 6 hectares smaller compared to farms with the lowest efficiency (Table 6.3). The number of cattle was on average 36 large units compared to 29 units in the ineffective group. Dairy farms described as inefficient also had a 35% lower milk yield per cow and the interest debt higher by 3.2 percentage points. The group of inefficient farms in this size class, as the only one, was characterized by a limited reproduction of assets. However, it seems that the economic situation of dairy

farms at this level of production is not threatened. The positive income from management is even reached by farms from a group of farms with low efficiency, thereby having a significant potential to improve profitability.

Table 6.3. Value of selected indicators, depending on the technical efficiency of dairy farms with size of EUR 25-50 thousand (class 3, small to average farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	2.00	1.95	1.82
Total labour inputs	AWU	2.05	2.00	1.87
Area of AL	ha	33.62	28.60	27.25
Share of forage crops in AL	%	19.77	17.15	17.14
Animals in total	LU	29.50	33.47	37.19
Cattle population	LU	28.82	32.74	36.49
Milk yield of dairy cows	kg/cow	4143.89	5159.69	6394.75
Share of animal production in total production	%	72.8	77.9	82.9
Value of assets	PLN thousand/ha	20.65	26.70	28.85
Debt ratio	%	9.3	8.9	6.1
Gross investment rate	%	53.9	153.7	178.3
Income from the farm	PLN	56046.24	106280.50	165454.74
Income from management	PLN	-13152.44	28879.56	86960.03

Source: Own compilation based on Polish FADN data.

Average to large dairy farms proved to be the group in which the scale of production guaranteed to get positive income from management, even at very low technical efficiency (Table 6.4).

The average effective farm of class 4 had 41 ha of land (16 ha less than inefficient one), total labour input was 2.08 AWU (15% less than in inefficient one) and kept less than 64 units of large cattle (16% more than in ineffective one). As a result of these differences, according to the average indicators, the efficient farms obtained almost ten times higher income from farm management than farms with the lowest efficiency.

Table 6.4. Value of selected indicators, depending on the technical efficiency of dairy farms with size of EUR 50-100 thousand (class 4, average to large farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	2.20	2.07	1.97
Total labour inputs	AWU	2.45	2.32	2.08
Area of AL	ha	56.93	50.63	41.08
Share of forage crops in AL	%	36.20	32.03	30.50
Animals in total	LU	56.72	61.74	65.01
Cattle population	LU	55.24	61.16	63.91
Milk yield of dairy cows	kg/cow	5368	6327	6617
Share of animal production in total production	%	80.0	81.3	84.6
Value of assets	PLN thou-sand/ha	24.02	28.65	34.70
Debt ratio	%	18.6	13.8	10.4
Gross investment rate	%	142.0	218.2	236.6
Income from the farm	PLN	128975	215239	281466
Income from management	PLN	17499	90698	167795

Source: Own compilation based on Polish FADN data.

This economic class also saw a clearly increased capital commitment. The value of assets was PLN 24 to 35 thousand per ha and was higher in the group of highly effective farms. In addition to the capital intensity, it should be noted that this group of farms was much more inclined to maintain higher debt. This tendency, however, was inversely proportional to the rate of efficiency. Quite good level of profitability of the group prompted farms to make investments. It was observed that their amount also increased with increasing levels of efficiency in the group.

Dairy farms with economic size in the range of EUR 100-500 thousand proved to be the biggest in terms of scale of production for which, due to the size of the group in the Polish FADN database, it was possible to publish summary tables (Table 6.5). The highly-efficient farms in this group have an area of 105 ha, 16% less than in the group of inefficient farms (Table 6.5). Total labour inputs are at a level of 3.59 AWU and are lower by 10% than in the group of inefficient farms. Highly-efficient farms at the same time have about 46% larger herd of cattle with an average number of 160 livestock units. In this group of economic size, there was also the highest level of milk yield of cows. That yield

in efficient farms was 7.5 kg litres and was higher by 26% than in the group of farms with the lowest efficiency.

Table 6.5. Value of selected indicators, depending on the technical efficiency of dairy farms with size of EUR 100-500 thousand (class 5, large farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	2.54	2.33	1.96
Total labour inputs	AWU	4.00	4.13	3.59
Area of AL	ha	125.29	116,50	105.52
Share of forage crops in AL	%	78.97	75.98	68.61
Animals in total	LU	110.53	144.48	160.32
Cattle population	LU	108.72	143.34	159.88
Milk yield of dairy cows	kg/cow	5926.10	7405.43	7452.74
Share of animal production in total production	%	76.6	83.0	85.0
Value of assets	PLN thousand/ha	19.56	30.35	32.62
Debt ratio	%	15.9	16.3	19.2
Gross investment rate	%	95.9	161.0	177.9
Income from the farm	PLN	346957	517450	562557
Income from management	PLN	129193	220056	247418

Source: Own compilation based on Polish FADN data.

Debt ratio was relatively high in the studied group. Farms with higher efficiency showed a greater tendency to go into debt. Although all farms in this group achieved positive income from management, the indicated differences allowed farms with high efficiency to obtain a 62% higher income from the farm and about 91% higher income from management.

Table 6.6 is used to further illustrate the structure of farms in terms of technical efficiency in different size classes. Red colour marks the groups of farms which did not obtain income from management, while green marks those which obtained it.

With the exception of the group of very large farms, it can be seen that most farms were in the range of low efficiency. Its improvement in the case of holdings in group 2 would certainly have resulted in obtaining income from management and, in the case of higher groups, it would significantly improve viability of operations. This specification shows very clearly that a significant proportion of dairy farms have great potential for improving economic performance.

Table 6.6. Share of groups of holdings by economic size, technical efficiency and income from management

Economic size class in SO (ES6) and ranges of values	Group's share in the whole population (%)	Inefficient farms VRS<0.5 (%)	Farms with low efficiency VRS in range 0.5-0.85 (%)	Farms with high efficiency and fully effective, VRS in range 0.85-1 (%)
(1)	3.0	4.4	60.3	35.3
(2)	32.5	9.1	69.1	21.8
(3)	40.0	18.4	73.0	8.6
(4)	19.8	22.3	63.3	14.4
(5)	4.7	39.0	33.3	27.7
Total	100	16.7	67.5	15.8

Negative income from management Positive income from management

Source: Own elaboration.

In conclusion, it can be said that dairy farms allowing for earnings close to parity were already farms with standard output of EUR 8-25 thousand, but only in the case of having the maximum efficiency. The positive income from management, regardless of the efficiency, was guaranteed only from the farm size in the range of EUR 50-100 thousand of standard output.

6.2. Evaluation of the effectiveness of farms specializing in cattle (type 49)

Table 6.7 gives the values of selected indicators in each group of technical efficiency of the smallest farms with cattle production, in terms of production volume. The analysis of the indicators shows that although these farms have an average of 8 to 10 ha of agricultural land, they can be considered to be social. Even among the most effective farms, the income from the farm made it impossible to pay for own labour at the level of wages for hired workers. These farms kept small herds of cattle (3 to 5 units) and represented a low degree of specialization in cattle production. This group did not recreate its assets and in the case of farms with low efficiency and the ineffective ones a sale of owned fixed assets was observed. The situation of these farms proves that obtaining income even close to parity in the direction of specialization was not possible at such a small scale of production.

Table 6.7. Value of selected indicators, depending on the technical efficiency of farms with cattle production with size of up to EUR 8 thousand (class 1, very small farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	1.30	1.43	1.09
Total labour inputs	AWU	1.30	1.43	1.10
Area of AL	ha	10.42	9.78	7.93
Share of forage crops in AL	%	6.85	5.27	4.06
Animals in total	LU	5.05	5.86	6.09
Cattle population	LU	3.01	5.37	5.38
Share of animal production in total production	%	26.1	46.9	51.2
Value of assets	PLN thousand/ha	16.52	16.90	17.73
Debt ratio	%	0.3	2.3	2.2
Gross investment rate	%	-18.5	-8.3	4.7
Income from the farm	PLN	3471	10132	14455
Income from management	PLN	-51639	-35649	-17901

Source: Own compilation based on Polish FADN data.

Another group of analyzed farms specializing in cattle production, despite the scale of production which was twice as high, also did not obtain income from management (Table 6.8). These farms were characterized by higher than Polish average (10.38 ha) area of farm, from 16 ha in highly-efficient farms to 25 ha on farms with the least favourable ration of inputs to outcomes. They also had much larger herds of cattle, from 13 to 10 livestock units. Still, one cannot talk about a significant specialization in cattle production in this case. The share of livestock production in total production did not exceed 57%, so these farms were not greatly specialized, probably the second, only slightly less important orientation, was the crop production. Only farms with the highest efficiency in this group were characterized by the expanded reproduction of assets. However, they probably financed investments mostly with credit, as they were characterized by the highest rate of debt.

In summary of the results of the analyzed group of farms, it should be noted that despite the significant volume of production, their situation is not the best. The most profitable farms are those with the best relationship between inputs and outcomes, but even they will be forced to change direction or intensify the scale of cattle production to survive.

Table 6.8. Value of selected indicators, depending on the technical efficiency of farms with cattle production with size of EUR 8-25 thousand (class 2, small farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	1.60	1.63	1.51
Total labour inputs	AWU	1.64	1.65	1.60
Area of AL	ha	24.86	20.62	15.90
Share of forage crops in AL	%	16.99	10.29	8.94
Animals in total	LU	14.35	16.45	16.06
Cattle population	LU	10.88	14.47	13.19
Share of animal production in total production	%	54.4	57.2	57.3
Value of assets	PLN thousand/ha	13.83	16.59	19.36
Debt ratio	%	5.0	7.1	12.3
Gross investment rate	%	26.7	81.0	184.9
Income from the farm	PLN	15135	31719	40589
Income from management	PLN	-21917	-13371	-9324

Source: Own compilation based on Polish FADN data.

Farms with cattle production described as small to average (class 3) were the population where the effective group achieved income allowing farmers to pay fairly for own labour and achieve return on equity (Table 6.9). The analyzed holdings had an area from 30 to 42 ha and herds of cattle from 32 to 36 livestock units. These groups of farms already showed significantly greater specialization in cattle production, it can be seen both in the ratio of heads to the area, as well as in the proportion of animal production in total production.

It is worth noting that cattle farms of class 3 mostly modernized their assets (except for the group with low efficiency). Although the particularly high rate of reproduction of assets was characteristic of the ineffective group, it should be noted that these farms still represented the lowest level of capital employed. Without a doubt, it can be concluded that the operation of a farm oriented to cattle production with this scale of production, while maintaining optimal inputs, was profitable and allowed further development.

Table 6.9. Value of selected indicators, depending on the technical efficiency of farms with cattle production with size of EUR 25-50 thousand (class 3, small to average farms)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	1.96	1.92	1.88
Total labour inputs	AWU	2.08	1.99	2.01
Area of AL	ha	42.03	36.86	30.20
Share of forage crops in AL	%	28.20	21.22	17.26
Animals in total	LU	32.45	35.92	35.52
Cattle population	LU	24.21	32.86	31.24
Share of animal production in total production	%	62.0	70.8	72.6
Value of assets	PLN thousand/ha	12.62	17.14	21.52
Debt ratio	%	15.3	9.0	7.9
Gross investment rate	%	255.1	79.5	165.0
Income from the farm	PLN	2969	62158	97953
Income from management	PLN	-22042	-2302	32307

Source: Own compilation based on Polish FADN data.

In the analyzed type, the largest farms, in terms of volume of production in the population of Polish FADN, were average to large farms (Table 6.10). Similar to dairy farms, the farms with high production scale achieved satisfactory profitability regardless of the level of efficiency. It should be noted, however, that groups with higher efficiency achieved much better results.

An average farm in the analyzed groups had between 65 and 71 ha, of which 48 to 42% were forage crops. The average size of the cattle population ranged from 52 to 71 livestock units, and it was more than 95% of all animals kept, depending on the group. Inefficient farms, compared to other farms, were characterized by high debt and a limited reproduction rate of assets. Their results enabled the achievement of income from management, however, it was at a low level, less than PLN 1 thousand, compared to PLN 23 thousand in the group with low efficiency and PLN 117 thousand on farms with the highest VRS. It is thus evident that maintaining optimal relationships of inputs to production effects, even with the benefits offered by the scale of production, is crucial for the performance of farms.

Table 6.10. Values of selected indicators, depending on the technical efficiency of farms with cattle production with size of EUR 50-100 thousand (average to large)

Specification	Unit	Inefficient farms	Farms with low efficiency	Farms with high efficiency and fully effective
Own labour inputs	FWU	2.33	2.02	1.93
Total labour inputs	AWU	2.34	2.57	2.04
Area of AL	ha	71.39	64.84	67.35
Share of forage crops in AL	%	41.79	41.78	47.51
Animals in total	LU	54.85	70.68	66.72
Cattle population	LU	52.14	68.80	63.25
Share of animal production in total production	%	64.0	78.0	82.9
Value of assets	PLN thousand/ha	12.90	20.42	17.50
Debt ratio	%	35.9	16.6	12.9
Gross investment rate	%	47.8	140.1	292.4
Income from the farm	PLN	75208	149963	224285
Income from management	PLN	905	23174	117248

Source: Own compilation based on Polish FADN data.

The summary of the analysis of the effectiveness of cattle farms used, as in the previous section, the share of groups in the population and the income from management (Table 6.11). The table shows that almost every fourth farm oriented on breeding cattle is inefficient, and every second farm shows significant weaknesses in this area. Therefore, there are visible gaps in this group of farms as regards the efficiency of production, and limiting them would significantly improve economic performance.

The analysis also showed that farms with cattle production of first and second class sizes were not able to generate income from management. The limit for the achievement of income from managing the farm was in the 3rd size class and concerned only farms with high efficiency. Given these results, it seems that cattle production should be chosen to the greatest extent primarily on farms with considerable area of agricultural land for maintaining large herds. It seems that only this group in this specialization has a chance of development.

In conclusion, it must first be emphasized that in both types of farms, specializing in milk production, as well as specializing in cattle production, there was the area of production volume, in which its scale and level of specialization made it virtually impossible to achieve income from farm management regardless of the achieved degree of efficiency. In the case of dairy farms, this regu-

larity concerned farms of up to EUR 8 thousand, while in the type of cattle farms, this phenomenon was observed in groups to the size of EUR 25 thousand.

Table 6.11. Share of groups of holdings by economic size, technical efficiency and income from management.

Economic size class in SO (ES6) and ranges of values	Group's share in the whole population (%)	Inefficient farms VRS<0.5 (%)	Farms with low efficiency VRS in range 0.5-0.85 (%)	Farms with high efficiency and fully effective, VRS in range 0.85-1 (%)
(1)	13.4	14.5	51.6	33.9
(2)	48.9	33.2	46.9	19.9
(3)	26.6	18.7	56.9	24.4
(4)	11.0	9.8	52.9	37.3
Total	100.0	24.2	50.9	24.9

- Negative income from management - Positive income from management

Source: Own elaboration.

The analysis of technical efficiency using DEA has also enabled an indication of the size classes in both study types, where the economic results, depending on the degree of optimization of production inputs conditioned the development opportunities of the farm. In the case of dairy farms, these were the groups with sizes ranging from EUR 8 to 50 thousand, and in the type of cattle farms, groups from EUR 25 to 50 thousand of production volume. In the indicated ranges, taking into account the income from management and investment, it should be noted that only those farms that achieve high efficiency showed chances of development.

There was also a third area of particular classes of farm size. It included the population, which, due to the scale of production, was in the most favourable economic situation. The analysis showed that the areas, both in the type of milk and cattle, have been identified on farms with production of over EUR 50 thousand. These were the classes 4 and 5 in the case of dairy farms and class 4 in the case of cattle farms. It should be noted, however, that the increase in efficiency between the two groups resulted in significant disparities in income. For example, on dairy farms in class 5, the difference in income from management between the group of inefficient farms and those with the highest efficiency was as much as 91%.

In conclusion, it should be emphasized that the surveyed size classes of farms specializing in milk and cattle showed significant differences in the average values of the analyzed indicators between the effectiveness groups. It follows that they have significant opportunities to optimize production, and thereby improve profitability. It was also observed that these relationships increase with the scale of production, and therefore the average-large and large farms should be most interested in identifying inefficient areas.

7. Factors significantly determining the change in income from agricultural activities on Polish dairy farms and cattle farms

The most important indicator, which reflects the situation on farms, is their income. This part of the study analyzes statistically significant factors that affect the change in income from agricultural activities and the development of Polish farms specializing in milk production (type 45) and farms specializing in cattle (type 49).

This analysis was done on a specially separated group of farms providing accounting for the Polish FADN in 2010. This group included 1,932 dairy farms and 365 cattle farms. In either case, the assessment used the econometric modelling. All calculations whose results are presented in this chapter were done in GRETL (version 1.9.13).

7.1. Evaluation of the impact of factors that significantly determine the change in income from agricultural activities

The econometric model was prepared before making the analysis. The dependent variable was the income from farm (Y) and independent variables (X_i) were individual indicators analyzed in the first part of this study.

The choice of variables for models was done by rejecting the quasi-constant variables, followed by the analysis of the correlation matrix and reduction of non-relevant independent variables using the Hellwig method. We also examined the possibility of an apparent correlation between the independent variables. This way, both types of farms were assigned variables that most influenced the dependent variable, but they were not significantly correlated with each other. In the case of dairy farms, dependent variables describing income were own labour input, area of own land, milk yield of cows, stocking density and proportion of forage crops. Construction of the model for cattle farms used identical variables as in the case of dairy farms, except for the milk yield of cows, which proved to be strongly correlated with labour inputs in this population. Both models abandoned variables for capital value due to the high correlation with the area of agricultural land and lower explanation of model dependence.

The economic and agricultural research commonly uses linear function, a polynomial of the second degree or a power function, to present input-effect relationship. Thus, very often, there is also a non-linear dependence between variables in such studies. Investigating the nature of these relationships was the first step in the analysis. This objective was achieved using White's non-linearity test, based on Lagrange multipliers. This test was carried out by adding

logarithms of the variables to the model for the remainders. Finally, the equation is:

$$Y = \alpha_0 + \alpha_1 x_{1i} + ...\alpha_k x_{ki} + \gamma_1 \ln x_{1i} + \gamma_n \ln x_{ki} + \upsilon_i.$$

The models obtained had to reject the linear form as indicated by the product of T x R^2, which was higher than the critical value χ^2, and the non-linear form of the model was used for further analysis. In this case, the best fit was a power function[8] of the form:

$$Y = b_0 x^{b_1}{}_{1i} \times .... \times x^{b_k}{}_{ki}.$$

Parameters of power function were evaluated by taking the logarithm, bringing the power function to the linear form and applying: the method of ordinary least squares (OLS). Thus, at the outset, the linear model for the analyzed data was estimated in the form:

$$\ln Y = \ln b_0 + b_1 \ln x_1 + ...b_k \ln x_k.$$

The first step in the evaluation of constructed econometric models was to evaluate the significance of the impact of each independent variable X_i on the dependent variable Y. It was made by "backwards" stepwise regression. For this purpose the t-Student test for the significance of the parameter α_i was used. The null hypothesis for this test is: H_o: $\alpha_i = 0$, with alternative hypothesis H_1:α_i different from 0. Statistic value is determined from the formula $t_j = a_j/S(a_j)$. The estimated model parameters differing significantly from zero were marked with * symbol in Table 6.1. This means that the variable is significantly different from zero at a significance level of 10%. In turn, the F-Snedecor test enabled a comprehensive assessment of the suitability of the model. This test is to verify the hypothesis H_0: $\alpha_1 = \alpha_2 = ... = \alpha_k = 0$, using F statistics[9].

Finally, the result of the F test for groups of farms allowed the rejection of the null hypothesis. In other words, the models included significant variables.

Multicollinearity was tested by VIF (Variance Inflation Factors). If VIF value is 1, it means that the variable X_i is not correlated with other independent variables. According to Gruszczyński and Podgórska (2003), VIF value > 10 is a sign of multicollinearity, which interferes with the quality of the model.

[8] The highest degree of fit of R^2.

[9] with critical values of statistics $F_{\alpha, s1, s2}$, where α – level of significance, s1 = k, and s2 = n-k-1.

Finally, variables with significant p value at significance level greater than 10% have been eliminated. The variables that were highly correlated with each other have been also rejected. Final models included only important variables (Table 6.1) which means that they were suitable for practical use.

White's test was used in order to investigate homoscedasticity, which verifies the H_o hypothesis, that the variance of the random component ε_i is constant for all i ($\sigma_1^2=\sigma^2$, for each i=1,2,…,n) with respect to hypothesis H_1 that the variance of ε_i random component is not constant for all. In the analyzed model of farms, homoscedasticity was achieved as evidenced by the value of the White's test (67.959 in the case of dairy farms and 22,936 for cattle farms).

The criterion for explanation of variation of the dependent variable by the model was the determination coefficient R^2. In the estimated model of dairy farms, the value of determination coefficient R^2 was 0.72, while in the case of cattle farms it was $R^2 = 0.59$. It can therefore be concluded that both models achieved a satisfactory level of explanation of the dependent variable.

7.2. Evaluation of the impact of factors that significantly determine the change in income of dairy farms

Finally, the resulting model for dairy farms, after meeting the objectives of the OLS method, has been transformed into a power form and subjected to substantive analysis. It has the form:

$$Y = 3{,}34\, x_1^{\,0{,}155} \,..... \times x_5^{\,0{,}512}.$$

A set of independent variables used in the analysis concerning the dairy farms is shown in Table 7.1.

Table 7.1. List of independent variables used in the analysis of dairy farms

Specification	Markings	Coefficients	Standard error	t-Student	P value	*	VIF
Constant	X_0	3.34845	0.253	13.23	<0.00001	*	-
Own labour input	X_1	0.155205	0.035	4.46	<0.00002	*	1.08
Area of own land	X_2	0.849086	0.017	48.51	<0.00001	*	1.42
Milk yield	X_3	0.430971	0.029	14.58	<0.00001	*	1.45
Livestock density	X_4	0.580619	0.032	18.28	<0.00001	*	1.35
Share of forage crops	X_5	0.512872	0.023	22.02	<0.00001	*	1.69

Source: Own calculations.

The marginal analysis was made for the theoretical dairy farm with values of studied variables equal to the average in the sample. Theoretical income (from the model) for the farm in 2010 amounted to PLN 82.9 thousand (Table 7.2). It follows from the relationships described by the model that by increasing own labour inputs by 1 man-hour, the income will increase by PLN 3.09. From this point of view, increasing labour inputs on dairy farms seems not very attractive. Given the fact that the level of wages for hired labour, depending on farm size, ranged from PLN 7 to 11 for man-hour[10], it appears that these farms should continue to invest in labour-saving technologies.

The situation is different in the case of increase in the area of AL of farms. The marginal analysis showed that the increase in the area by another 1 ha should theoretically result in the increase of income by PLN 2,458. The increase in AL, at a cost of lease of land not exceeding PLN 250 (not including area payments) seems to be highly preferred direction of development for this type of farms. It can be assumed that this relationship, with continuing prosperity in milk, can cause intense competition between these farms on agricultural land market now and in the future.

Table 7.2. Marginal analysis for statistically significant factors affecting the increase or decrease in income of dairy farm

Specification	Unit	Increase/decrease in income of:
Increase in own labour input by unit	1 man-hour	PLN 3.09
Increase in area of agricultural land	1 ha	PLN 2.458
Increase in the share of fodder plants in land	1%	PLN 622
Increase in stocking density	0.01LU/ha	PLN 224.9
Increase in the average productivity in the barn	1 kg	PLN 9.71

Source: Own calculations.

As in the case of enlarging the area of AL, the increase in the share of forage crops has a positive effect on the theoretical income. Although the share of forage crops in Polish dairy farms is more than 60%, further increase (by 1%) should result in an increase in income for a farm by about PLN 600.

The calculations also show that the income would be positively affected by increase in stocking density. The analysis showed that an increase in density by 0.01 LU/ha will result in an increase in income of PLN 224.9.

[10] Labour costs in Poland on the basis of Table 1.3.

The increase on farm income was also possible in the case of the improvement in milk yield of cows. Marginal analysis for the model indicates that increasing the average milk yield in the barn by 1 kg will result in the increase in income of PLN 9.71. Assuming that the average size of herds in the sample qualified for modelling was approximately 23 cows, it can be said that each additional kg of milk increased income by PLN 0.42.

7.3. Evaluation of the impact of factors that significantly determine the change in income of farms specializing in cattle

Finally, the resulting model for cattle farms, after meeting the objectives of the OLS method, has been transformed into a power form and subjected to substantive analysis. It has the form:

$$Y = 7{,}75 x_1^{0{,}268} ..... \times x_4^{0{,}443}.$$

A set of independent variables used in the analysis concerning the cattle farms is shown in Table 7.3.

Table 7.3. List of independent variables used in the analysis of cattle farms

Specification	Markings	Coefficients	Standard error	t-Student	P value	*	VIF
Constant	X_0	7.75223	0.163	47.283	<0.00001	*	–
Own labour input	X_1	0.268601	0.105	2.5462	0.01130	*	1.27
Area of own land	X_2	0.904671	0.049	18.375	<0.00001	*	1.16
Livestock density	X_4	0.411359	0.052	7.8314	<0.00001	*	1.59
Share of forage crops	X_5	0.442668	0.094	4.6968	<0.00001	*	1.47

Source: Own calculations

Marginal analysis, conducted in the same manner as in the case of dairy farms, showed that the average theoretical income in the study group in 2010 amounted to PLN 34.3 thousand (Table 7.4). The relationships explained by the model show that by increasing own labour inputs by 1 man-hour, the income will increase by PLN 2.60. Therefore, as in the case of dairy farms, cattle farms were not able to generate rates comparable to the wages for hired labour (PLN 7 to 11 for man-hour). In order to increase their competitiveness, cattle farms should also invest in the development of labour-saving production techniques.

The results show that in the case of increase in the area of a farm with cattle production, there will be an increase in income. In the case of increase by 1 ha, the expected growth of income is PLN 1,294. While this is probably more than the average lease, the cattle farms will not be able to compete with dairy farms for the purchase of land.

The lower theoretical profitability of land is also reflected in the case of the estimated increase in the share of fodder plants in the crops of cattle farms. The increase in the share of forage crops in the crop structure (by 1%) is PLN 285 more income from the farm. Although the proportion of forage crops in cattle farm is not lower than on dairy farms (approximately 60% depending on the economic size), and increase in that proportion is profitable, the result is a much lower increase in income.

Similar relations are shown in the analysis of stocking density. Although the stocking density positively affects the value estimated in the model (increase in density by 0.01 LU/ha results in an increase in income of PLN 105.6), this impact is about a half that in the case of dairy farms.

Table 7.4. Marginal analysis for statistically significant factors affecting the increase or decrease in income from cattle farm

Specification	Unit	Increase/decrease in income of:
Increase in own labour inputs	1 man-hour	PLN 2.60
Increase in area of agricultural land	1 ha	PLN 1294
Increase in the share of fodder plants in land	1%	PLN 285
Increase in stocking density	0.01LU/ha	PLN 105.6

Source: Own calculations.

The analysis of factors significantly determining the change in income from agricultural activities allowed for identifying and assessing the factors that influence the agricultural income of farms in the study groups of farms specializing in milk production (type 45) and farms specializing in cattle production (type 49).

The size of owned agricultural land had by far the strongest impact on the income in both groups. On dairy farms, the expected increase in income as a result of increase land area was almost twice as high. It can therefore be concluded that these farms are stronger pressured to expand the area and are able to offer much higher prices for land due to much higher profitability of this factor of production.

Stocking density and the share of fodder crop area also had an important impact on the achieved income. In both groups of farms, the increase in these indicators resulted in the improvement of income. However, similarly as in the case of land, the profitability of dairy farms was twice as high.

The milk yield in a herd proved to be a very influential variable in the case of the estimated income on dairy farms. This factor is important as it is known that Polish farms have still great potential in terms of the average performance. Using the average theoretical values to illustrate it, one can conclude that the increase in the average performance of a herd by 100 litres of milk is a rise on farm income by 1%.

In the case of own labour inputs, in both agricultural types of analyzed farms, the analysis showed a positive impact on income of farms (PLN 3.09 and 2.60 for man-hour). However, taking into account the level of wages for hired labour, it would be totally unacceptable to farm owners. It seems that this high rates should therefore lead to further substitution of labour by capital.

8. Status and trends in beef production in Poland

8.1. Introduction

Despite large body mass, and therefore a high demand for animal feed, cattle are the most numerous species of farm animals in the world. Their population is estimated at about 1.3 billion units. Physiological properties and an emotional bond in the past, make that there are no climatic, geographic, cultural and religious boundaries for cattle. Cattle are wherever there are people and green land or land unsuited to cultivation. In the poor countries of Africa and Asia, with extremely extensive conditions of keeping, nutrition based almost exclusively on grass in land unsuited to cultivation, they are the main source of tractive force in agriculture and a small amount of beef and milk produced on the basis of feed unsuitable to man. In developed countries, they are the major source of highly nutritious milk and a whole range of tasty and nutritious dairy products as well as tasty, nutritious and expensive beef containing less cholesterol than red muscles of poultry [Carnevale de Almeida 2006]. In ancient times, they were respected, honoured and worshiped. Paintings and sculptures of cattle were placed in the most exposed places of cultural activity. Human existence largely depended on cattle long before their domestication when they were hunted as valuable source of meat. Other cattle products were used to manufacture clothing, shoes, equipment, tents, threads, ropes, chords, arcs, needles, water containers, etc. After domestication, they were used in the first place as a pulling force in agriculture and transport (in poor countries this is still common), and then to produce small amounts of milk. Meat direction in the present understanding started late, only about 250 years ago, as cattle were too valuable to kill them, except for old and ill at risk of dying.

I am writing this in the present study on use of bovine meat to remind you of a strong emotional bond between man and cattle in the past, of their multidirectional importance in human life in past times, and indicate that the use of domesticated cattle for meat within the meaning similar to the present has a short history compared with the period of about 10 thousand years of raising domesticated animals.

In view of the topic, one must ask what factors determine the production of beef. The most important of these include:

- animal population,
- proportion of individual breeds (commercial types) in the population,
- feed base and natural conditions,
- profitability,
- market,
- producers.

8.2. Cattle population

The number of cattle in Poland in 2012 was 5,520 million units, including 2,469 thousand cows (Table 1) [Zwierzęta gospodarskie 2013]. Despite the drastic decline in the population: 1975 – cattle 13.2 million units; cows – 6.1 million [Statistical Yearbook, 1991; Rolnictwo..., 2012], we still have a significant number of them in Europe.

Table 8.1. Number and density of cattle in Poland

Years	Population (in thousands)		Share of cows in the herd (%)	Density per 100 ha of agricultural land	
	total cattle	cows		total cattle	cows
1975	13 254	6 146	46.4	69.0	32.0
1980	12 649	5 956	47.1	66.8	31.4
1985	11 055	5 528	50.0	58.7	29.3
1990	8 320	4 362	52.4	53.7	26.3
1995	7 306	3 579	49.0	39.2	19.2
2000	5 723	3 047	51.0	32.5	17.0
2005	5 385	2 801	51.0	33.0	17.0
2008	5 560	2 770 (60 ms)	50.7	35.0	16.9
2010	5 560	2 636 (107 ms)	47.0	35.0	17.0
2011	5 500	2 568 (122 ms)	47.0	35.0	17.0
2012	5 520	2 469 (123 ms)	45.0	36.0	16.0

ms – meat cows

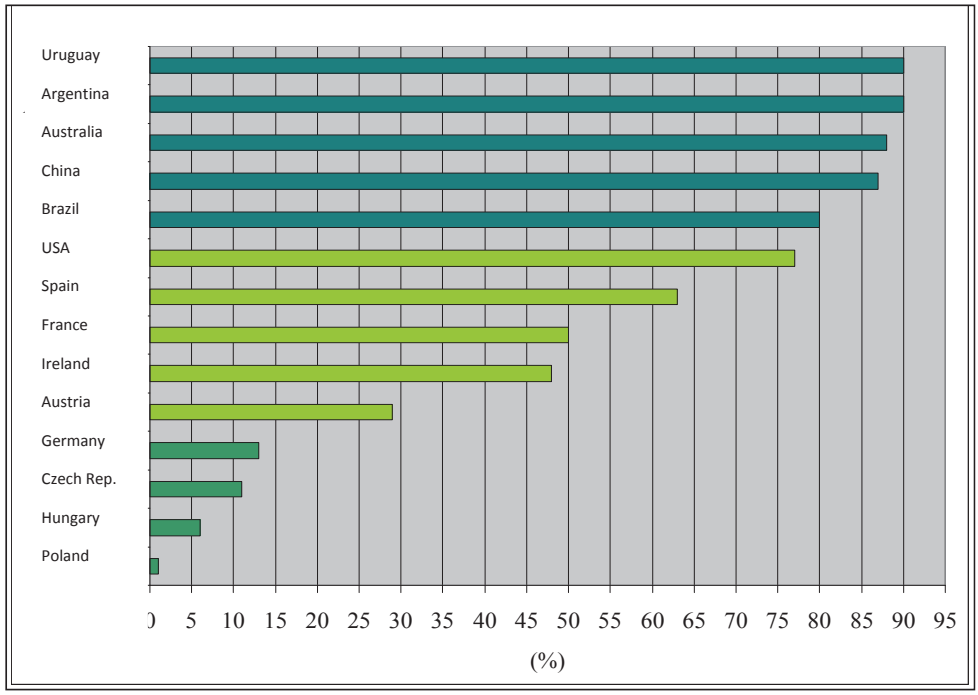
Source: [Rocznik Statystyczny 1991; Rolnictwo… 2012; Zwierzęta… 2013].

This population consists of:

- meat breeds and their half-breeds,
- dairy breeds,
- half-breeds derived from cross-breeding meat and dairy breeds.

From the point of view of efficiency of fattening and meat quality, meat breeds and their half-breeds show the greatest usefulness for the production of beef, followed by half-breeds derived from cross-breeding of breeds of dairy cows with meat bulls. The proportion of the number of cows in these three groups in various countries and regions of the world is very diverse. This is reflected in Chart 8.1. showing the share of meat cows in the entire population of cows in selected countries leading production of beef in the world – the United States, Brazil, Argentina, Uruguay, where meat cows constitute 75-90% of the population of cows. In the European countries most advanced in meat cattle rearing – France, Great Britain, Italy, Spain, Ireland, meat cows account for about 50% of the herd of cows. In other European countries few to several percent.

Chart 8.1. Share of meat cows in the entire population of cows in selected countries



Source: [Rocznik Statystyczny Rolnictwa 2012].

In Poland, meat cows covered by the assessment of usefulness for meat, account for only 1% of the number of cows [Ocena wartości użytkowej... 2012] and the entire stock of cows not used for milk is 5% [Rolnictwo... 2012].

This clearly indicates that the production of beef in Poland cannot be based on meat breeds. Despite this finding, the analysis of the problems of beef production cannot ignore the issue of meat cattle breeding, if only because of its economic importance in the world.

Breeding meat cattle has been practiced in our country for a very short period of time, only 20 years long. The drastic decline in cattle numbers particularly evident in the 1990s (only dairy cattle at that time) resulted in non-utilization of many grassland and buildings. In addition, the acreage of fallow land significantly increased. This space had to be developed, preferably by introducing meat cattle.

This was recognized and used by the careful analyst of the situation in agriculture – professor Henryk Jasiorowski. Involvement of the Professor, his authority and organizational skills led to the creation in 1994 of the Polish Association of Beef Cattle Breeders and Producers, which represented first breeders [Jasiorowski 1995]. The creation of the Association gave formal and organizational basis to conduct organized breeding of beef cattle. Its first members were

few novice breeders of beef cattle. Their number has now grown to nearly one thousand.

Tables 8.2 and 8.3 show the numbers and breed composition covered by the evaluation of the value in use of the female population, and since 2007, of beef cattle in Poland. They are the following breeds: Black Angus (AN), Red Angus (AR), Blonde d'Aquitaine (BD), Charolais (CH), Galloway (GA), Hereford (HH), Highland (HI), Limousine (LM), Piemontese (PI), Simmental (SM), Salers (SL), Wagyu (WY), Welsh Black (WB). They come primarily from imports, and then on this basis domestic breeding is developed with imported bulls.

Although there is no ideal meat breed, a partial answer to the question "what breed to choose?" has been already given by breeders, who operate in this direction of production. Data from the Polish Association of Beef Cattle Breeders and Producers show that Limousine breed accounts for 70% of headage, followed by Charolaise – 14.4% and Hereford – 4.7%. In total, French breeds, Limousine and Charolaise, and British Hereford represent almost 90% of the female population of meat cow breeds of cattle in our country (Table 8.2, Chart 8.2).

Absolute domination of Limousine breed is seen in the female population of half-breeds, where it accounts for nearly 90% (Table 8.3, Chart 8.3).

Changes in the preferences of our breeders on the choice of breed are more vividly seen in the accompanying charts. There is a growing interest in the Limousine breed in pure breed population and a slow decline in the number of Charolais and Hereford cows.

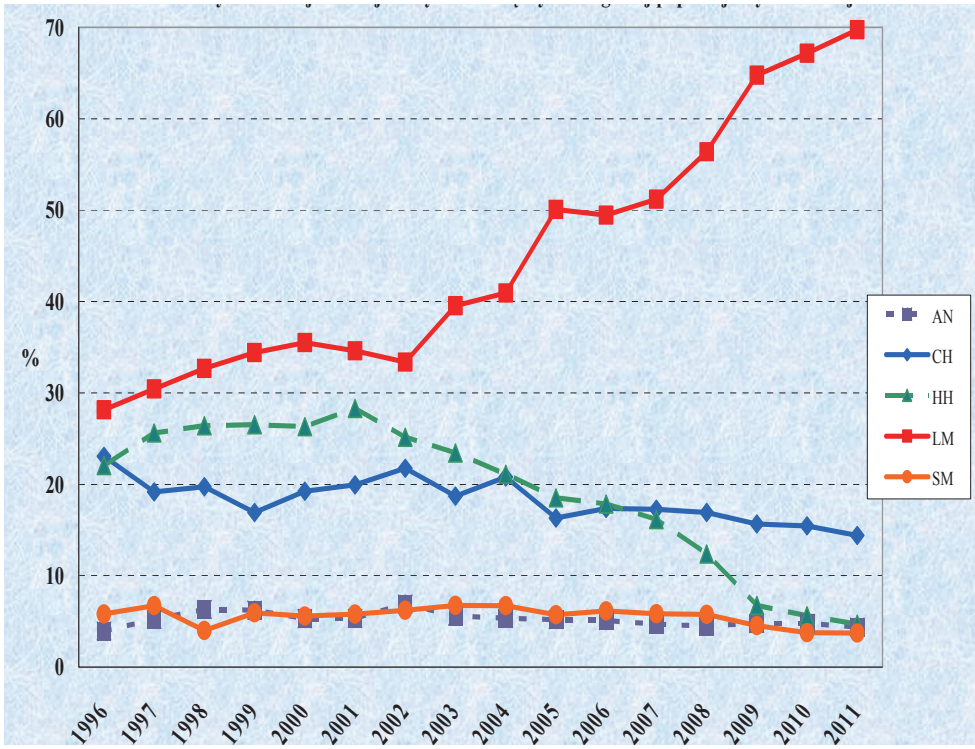
Table 8.2. Population of cows of meat breeds covered by the evaluation of the value in use in Poland (in thousand heads)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	**Total**
	Black Angus	Red Angus	Blonde d'Aquitaine	Charolaise	Galloway	Hereford	Highland	Limousine	Marchigiana	Piemontese	Simentaler	Salers	Wagyu	Welsh Black	
	AN	AR	BD	CH	GA	HH	HI	LM	MR	PI	SM	SL	WY	WB	
1996	156		-	908	-	869	-	1109	-	147	229	521	-	-	**3939**
1997	316		-	1162	-	1554	-	1846	-	160	408	617	-	-	**6063**
1998	455		-	1427	-	1909	-	2362	-	140	290	644	-	-	**7227**
1999	523		-	1417	-	2222	-	2882	-	184	497	650	-	-	**8375**
2000	483		-	1749	-	2391	-	3226	-	141	507	588	-	-	**9085**
2001	487		-	1821	-	2583	-	3159	-	175	530	367	-	7	**9129**
2002	673		-	2119	-	2449	-	3248	-	193	606	431	-	16	**9735**
2003	657		-	2201	-	2758	-	4653	-	184	793	501	-	21	**11768**
2004	742		-	2890	-	2930	-	5684	-	117	935	577	-	9	**13884**
2005	888		1	2793	-	3174	-	8578	-	113	980	587	-	18	**17130**
2006	1001		45	3400	-	3500	7	9689	-	122	1206	601	-	26	**19597**
2007*	314	371	109	2512	17	2350	50	7443	-	66	851	434	-	24	**14541**
2008	351	436	114	2956	18	2165	90	9856	-	5	1008	457	-	25	**17481**
2009	328	412	8	2417	3	1042	137	9995	-	2	701	355	-	35	**15435**
2010	380	407	15	2538	3	925	156	11037	-	8	618	300	1	48	**16436**
2011	291	417	32	2335	2	762	171	11310	-	15	605	214	1	61	**16216**

* since 2007 the list includes only cows

Source: [Ocena wartości użytkowej bydła ras mięsnych. PABCBP, Warsaw 2012].

Chart 8.2. Percentage of cows of the most numerous meat breeds in the total population of cows



Source: [Ocena wartości użytkowej bydła ras mięsnych. PABCBP, Warsaw 2012].

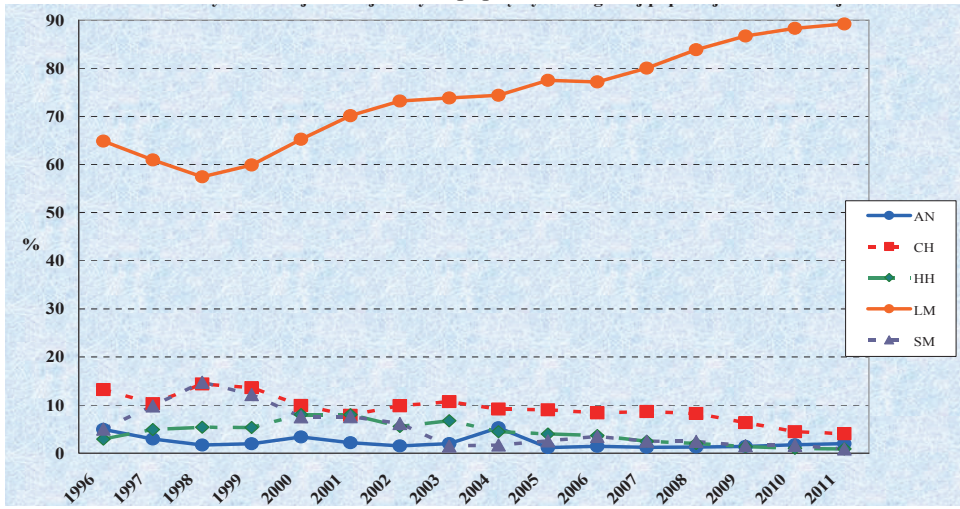
Table 8.3. Population of cow cross-breeds with cattle meat breeds covered by the evaluation of the value in use in Poland (in thousand heads)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	**Total**
	Black Angus	Red Angus	Blonde d'Aquitaine	Charolaise	Galloway	Hereford	Highland	Limousine	Marchigiana	Piemontese	Simentaler	Salers	Wagyu	Welsh Black	
	AN	AR	BD	CH	GA	HH	HI	LM	MR	PI	SM	SL	WY	WB	
1996	245		98	655	-	145	-	3211	-	271	248	-	-	79	**4952**
1997	162		146	565	-	271	-	3344	-	381	539	-	-	79	**5772**
1998	129		159	1082	-	407	-	4314	-	226	1108	-	-	87	**7601**
1999	161		196	1118	-	438	-	4919	-	266	1000	-	-	114	**8243**
2000	320		184	939	-	761	-	6176	-	261	715	-	-	112	**9468**
2001	214		151	770	-	781	-	6837	-	141	741	-	-	113	**9748**
2002	136		158	885	-	499	-	6564	-	59	555	-	-	112	**8968**
2003	188		233	1007	-	634	-	6925	-	136	140	-	-	119	**9382**
2004	579		134	1002	-	488	-	8125	-	260	187	-	-	150	**10925**
2005	137		161	1057	-	470	-	9073	-	373	302	1	-	136	**11710**
2006	189		201	1098	-	482	-	10108	-	398	456	23	-	145	**13100**
2007*	113	27	111	983	-	280	3	9070	-	369	283	36	-	58	**11676**
2008	121	34	112	998	-	245	4	10142	-	46	296	38	-	61	**12097**
2009	94	15	77	490	-	105	5	6682	-	41	123	22	-	54	**7711**
2010	126	8	83	340	-	77	4	6684	1	46	124	22	-	56	**7576**
2011	140	9	95	302	-	67	7	6653	-	42	67	18	4	55	**7459**

* since 2007 the list includes only cows

Source: [Ocena…, 2012].

Chart 8.3. Percentage of cows of the most numerous cross-breeds with meat breeds in their total population



Source: [Ocena wartości użytkowej bydła ras mięsnych. PABCBP, Warsaw 2012].

Given the small population of beef cattle in Poland, the number of breeds can be seen as impressive. The scale of production is not determined by the number of breeds, but the headage and technology of fattening. From this point of view, such a rich breed variety is not necessary. One should keep in mind that breed is selected by the breeder assisted by knowledge of selectors. It is advantageous that these breeds are dominated by those appreciated in the world: limousine, charolaise, hereford, simental, angus. These are breeds with different use characteristics, carcass quality, environmental requirements and temperament. According to the author, it would be beneficial to increase the share of Simmental breed and halt the decline, and even better increase the share of Hereford, which in addition to excessive fatness has many advantages – good growth rate, early maturing, moderate environmental requirements, easy calving, good parent qualities, calm temperament. The latter characteristics make it highly recommended especially for beginners and less experienced breeders.

Looking outside of the breeding point of view, it can be concluded that such a large number of breeds allows for meeting the ambitions and passions of breeders, sometimes hobbyists, and now the much valued biodiversity of flora and fauna. Looking from a breeding point of view, this theoretically is not conducive to the effective implementation of breeding work, the accuracy of the assessment of the breeding value. But if we realize that breeders of 7 least numerous breeds keep together only 500 cows, I am convinced that if it were Limousine cows, it would not significantly improve the efficiency of selection in

this breed, depriving hobby breeders of their passions and Polish fauna of 7 breeds.

According to the environmental requirements (pastures), beef cattle breeding thrives in North-Eastern Poland (Warmińsko–Mazurskie and Podlaskie Voivodeships) – 33% of active population and Western Poland (Zachodniopomorskie and Lubuskie Voivodeships) – 22% of the population. By far the least number of these cows is in 5 voivodeships of Southern Poland (Opolskie, Śląskie, Małopolskie, Świętokrzyskie and Podkarpackie Voivodeships) – only 5%.

Due to the short period of existence and small population of about 120 thousand cows, of which only 24 thousand are covered by the evaluation of the value in use, beef cattle now plays a minor role in the production of beef. If all reared meat calves other than those intended for herd replacement were fattened to the body weight of about 600 kg, we could get 25 thousand tonnes of beef, which is only 6% of its global production. Unfortunately, the vast majority of these calves are exported, which significantly reduces the amount of beef produced.

Despite recent high interest in quality beef on the EU market and in the Middle East, one should not expect a significant increase in beef cattle population in Poland. If within 20 years of breeding this cattle we reach the previously mentioned population of 120 thousand cows, then with similar, and maybe even worse economic conditions, there is no basis for a radical change. The planned abolition of the milk quota will not encourage interest in bovine meat. The high prices of grain and fodder and very low domestic consumption of beef is not conducive to the production of beef. Moreover, the production of beef on the basis of meat breeds with a limited area of grassland in Europe is expensive.

In theoretical considerations, the reserve of grassland for grazing beef cattle is in the foothill areas of Bieszczady and Sudety Mountains, as well as fallow land, which covers an area of 450 thousand ha [Rolnictwo... 2012]. However, in addition to economic conditions, the big obstacle in the use of these foothill pastures is a short period of grazing. Given the fact that so far these areas have not been used, it is difficult to assume that in the coming years it will change. In turn, a large part of land not suitable for cultivation and fallow land have sandy soil, and should be afforested.

Breeding cattle, from the feed and economic point of view, is an inefficient way of processing vegetable protein to very tasty beef and animal protein, vitamins and minerals valuable to the human body. According to old but valid data [Reid 1979], one MJ of digestible energy of feed can produce the following amount of protein: in production of broilers – 3.9 g, in milk – 3 g, in beef – 1 g. Not counting the manure, the only products obtained from meat cows are calves, because a small amount of milk drank within 6-9 months of keeping them with mothers is not an additional value of goods. This causes the value of the annual

production of meat obtained from meat cows to be 2-2.5 times smaller compared to milk cows. The lower production is accompanied by a much lower cost of keeping them.

The annual production value of one cow

- milk cow:
  Milk 6,000 kg x PLN 1.2 = PLN 7,200
  Calf 40 kg x PLN 12.0 = PLN 480
  Total PLN 7,680
- meat cow:
  Weaned calf 250 kg x PLN 12 = PLN 3,000

In order to have a calf, and more specifically, on average a seven-month old weaned calf ideal for fattening with a weight of approximately 250 kg (depending on the breed and gender 200-300 kg), we have to keep a cow all year, and to be precise – at least 1.2 cows. Given the inter-calving period often exceeding one year, the efficacy of breeding and deaths of calves, it is difficult to obtain a better result than 80 weaned calves received during the year from a herd of 100 cows. Thus, the cost of keeping cows is a great burden on the costs of beef production, which occurs in an incomparably lesser extent in dairy cattle, where, without much trouble, a cow, in addition to the calf, also gives 6000 kg of milk.

This causes that production of beef in beef cattle herds is economically justified where there are large resources of pasture and land not suitable for cultivation, which often cannot be otherwise used as for inexpensive grazing of cows and meat heifers, and their calves, especially bulls, are given for fattening.

8.2.1. Dairy cattle

Until the late 1970s, Poland almost exclusively bred commercial milk-meat cattle. The dominant breed was black and white, complemented by the red-white, Simmental and Poland red breeds. With the exception of the last one, others were characterized by good fattening and slaughter value.

The population of dairy cattle consists of 12 breeds [Ocena... 2012]. But in reality, the production of milk and beef is decided by phf breed constituting about 90% of population. The second most numerous breed is Simmental, particularly valuable for meat use, it is only about 1% of the population.

Holstein cows achieve the highest milk yield among all breeds in use around the world. According to the model of dairy breeds resulting from physiological conditions, cattle are poorly muscled. However, they show great potential for growth, which predisposes them to "heavy" fattening to the body weight of about 700 kg. Such well-fed bulls have decent, but clearly worse than other

meat breeds, musculature and good quality meat. The current popular belief about poor usefulness of phf breed for meat use is exaggerated, just like the resulting convictions on low consumption of beef due to poor quality of meat because it comes from phf fattening. The poor quality, to a much greater extent, is caused by the fact that meat in stores often comes from meat cows than young bulls and post-slaughter procedures, not subjecting carcasses to maturation and culinary preparation appropriate to the type of slaughter, very diversified fattening technology, than the genetic origin from phf cattle [Matuszewska 1996]. The best proof of this is the fact that in Europe, with the exception of Poland, almost all healthy calves of Holstein breed are used for fattening, while in our country, until 2011, over 30% of the new-born calves were slaughtered or exported. In France – a country with a larger population of meat breeds than of dairy breeds, great culinary culture and a high consumption of beef – as much as 40% of the amount comes from the dairy breeds, including, the most numerous Holstein breed [Fitaman 2011].

8.2.2. Commercial cross-breeding

As previously mentioned, in the coming years, it is difficult to expect a significant increase in the population of meat cattle to the size which could play a significant part in the production of beef. Therefore, in addition to improving technology for fattening young cattle, a reasonable solution to improve the efficiency of fattening and improve the quality of beef is the use of commercial cross-breeding of dairy cows with meat bulls. This method has been used in Poland for 50 years [Grodzki 1977]. It allows the use of additive effect of crossed genes of different breeds and heterosis effect and rapid improvement of quantitative and qualitative characteristics of the offspring at no additional cost. The rapidly progressive intensification of animal husbandry and shortening period of use, unfortunately, are not conducive to commercial cross-breeding. However, this apply mainly to only 150 thousand suppliers of milk to dairy cooperatives [Broś 2013]. The remaining 300 thousand owners who keep 1-3 cows (Table 8.4.) applies extensive breeding system in which cows are used for many years (5-7), as in small-scale herds of 5 to 9 cows [Agricultural Census 2012]. Farmers (producers) with small herds (1-10 cows), applying extensive breeding and long-term use are a potential base of cows for cross-breeding. Assuming an average of 5-6 years of use only in those herds, one could allocate about 500 thousand cows for cross-breeding. In addition, in the remaining herds with a higher, but not the highest level of breeding, one could allocate up to 20% of cows with the lowest productivity, from which breeders do not intend to leave heifers for herd replacement, to cross-breeding. This would double the current

scope of cross-breeding according to the scheme shown in Chart 8.4. Belgian white and blue, Limousine, Charolaise and Simmental bulls are particularly suitable for cross-breeding, and Hereford bulls are suitable for insemination of heifers. It should be added that in 2005, cross-breeding covered 413 thousand cows, in 2010, only 325 thousand, without using existing capabilities.

In view of the expensive concentrate feeds and high production costs of farm feed, the previously mentioned small herds of cattle and cows are first predisposed for on-farm fattening and beef production.

Photo 8.1. Half-breed bulls on pasture

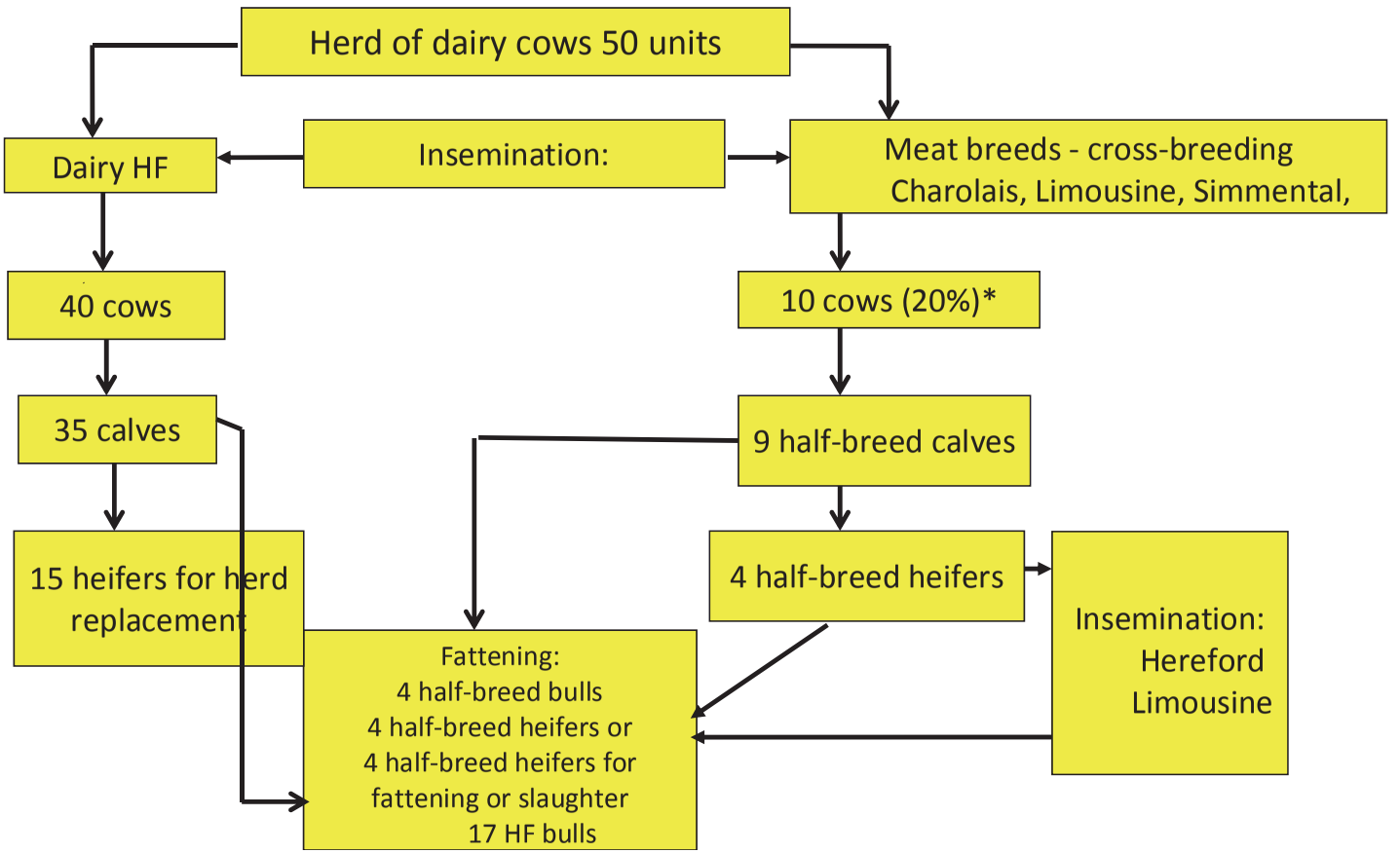
Table 8.4. Structure of herds of cows

Size of a herd of cows	Cows		Breeders	
	Number	%	Number	%
1	192 428	7.3	193 858	42.7
2	155 524	5.9	78 542	17.3
3-4	176 612	6.7	52 664	11.6
5-9	329 500	12.5	49 940	11.0
10-29	1 099 212	41.7	65 830	14.5
30-49	361 132	13.7	9 988	2.2
50-100	158 160	6.0	2 724	0.6
>100	163 432	6.2	454	0.1
Total	**2 636 000**	**100.0**	**454 000**	**100.0**

Source: [Ocena… 2012].

In general, these farms have enough (often physically less efficient) workforce to fatten one or several half-breed in a traditional system – on a fenced pasture in summer (Photo 8.1), or even by staking. In winter, depending on the possibility of preparing animal feed – haylage, corn silage, beet pulp. If it is not possible to prepare feed for 1-2 fatteners, it can be relatively inexpensive, even hand-dug potatoes supplemented with concentrated feed and hay. Another alternative is summer pasture rearing and sale of 250-300 kg of fatteners to other farms specializing in fattening.

Chart 8.4. Cross-breeding in a herd of dairy cattle



* In herds with low efficiency, cross-breeding may apply to a much larger percentage of cows.
Source: [Grodzki 1977]

I realize that these are marginal and short-term, ad hoc solutions, rather than future-oriented, but they allow for using small farms, which cannot meet the criteria for milk production, to produce beef or breed weaned calves to be sold for fattening. This would allow for fattening 200-300 thousand units per year, i.e. the production of 60-100 thousand tonnes.

8.2.3. Number of calves

In the European Union, the primary factor limiting the production of beef is the insufficient number of calves. Milk quotas and increasing milk yield cause progressive decline in dairy herds cows from 24,480 thousand in 2005 to 22,863 thousand in 2011 [Rynek Mleka No. 32 and 43, 2007 and 2012]. Previously, the decrease in the number of dairy cows was accompanied by increase in the number of meat cows. After replacing subsidies to cow herds and age of fatteners with area subsidies, the number of meat cows is also reducing. As a result of the above, in 2005-2013, the number of new born calves will decrease by about 2 million units, and the negative balance in trade in beef will increase to approximately 500 thousand tonnes. This is the hardest biological barrier in Europe from the point of view of beef production. In contrast to crop yields, there is progress in this area, but regress is caused by lengthening the inter-calving period and shortening period of using cows. Scientific achievements in the field of reproductive biotechnology – obtaining many embryos from a single cow in a year, change little in this respect, because one needs hosts for these embryos. With the number of born calves as the most important, next to the fodder base, biological determinant of beef production, Poland is in a good situation. With the number of cows owned, in recent years, we get about 2 million calves (Table 8.5). Although the dominant number of these are poorly muscled Holstein calves, but still, compared with a deficit of calves in the European Union it is our asset, which is little used. Of this number, in 2011, as many as 572 thousand units, which represents 29% of births, were exported or slaughtered with low body weight of only 82 kg. The export, and even more so, the slaughter, are the worst of all possible solutions from the economic point of view. The aforementioned average body weight of 82 kg is made up of the mass of about 250 kg weaned calves and mostly around 55 kg nurslings which, with the exception of ill and undeveloped units, should be fattened to about 700 kg. Complaining of such a solution, one should note an optimistic tendency, as in 2000, we exported and slaughtered as many as 1040 thousand calves, which accounted for 45% of their numbers. From that year on, in each subsequent year, we lose tens of thousands of calves less.

The question arises in light of the presented situation on the calves market: why get rid of such large quantities? If not the only, then certainly one of

the main reasons for years has been low profitability, and even unprofitable fattening, accompanied by a relatively high price of calves caused by the previously mentioned deficit in Europe. With a low body weight of calves, this decent price gives little income from the sale of a few or a dozen pieces from the farm.

Table 8.5 Births, slaughter and sale of calves

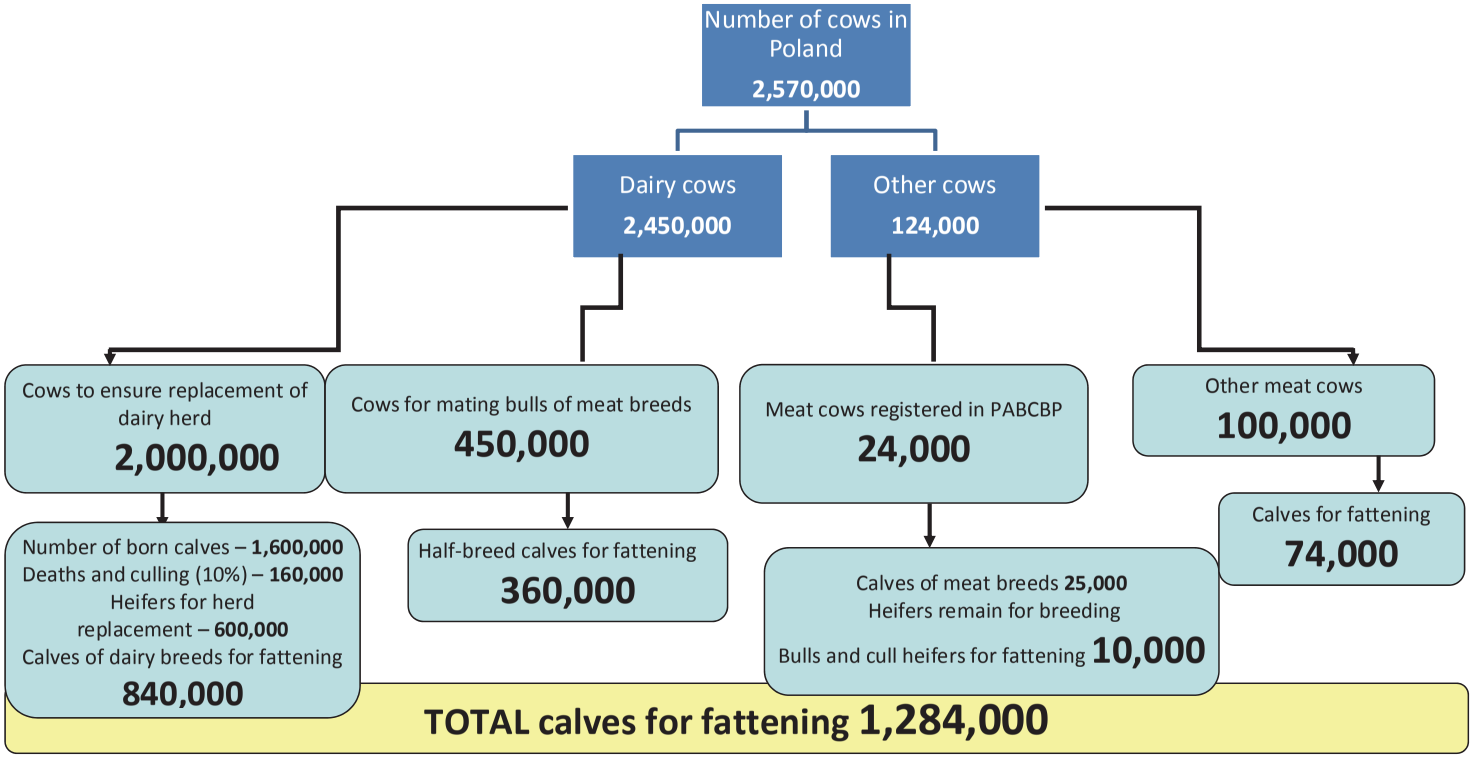
Years	Births of calves (thousand units)	Slaughter and export of calves		Average weight (kg)	Production of veal (thousand tonnes)
		in relation to births (%)	thousand units		
2000	2304	45	1041	79	51
2003	2287	43	987	77	47
2005	2198	33	735	83	38
2007	2316	31	735	82	37
2009	2187	33	713	86	38
2010	2056	32	663	85	33
2011	1967	29	572	82	28
2012	1879	24	454	90	25

Source: [Rynek Mięsa No. 42 and 44, 2012 and 2013].

In summary of this issue, it must be noted that a significant number of calves and current very poor utilization for fattening are a strong advantage in predicting the growth of beef production.

Figure 8.5. presents an analysis of the calves in Poland in 2011. With the stabilization of the cattle population in recent years, with slightly marked downward trend, it can be assumed that a similar number will be in the current year. If all born and reared calves, bulls for the most part (except those left for herd replacement), i.e. 1200 thousand head, were to be used for fattening to a body weight of about 600 kg, we would get 400 thousand tonnes of "young" beef plus nearly 200 thousand tonnes of beef from culled cows. This would give the production 50% higher than the current level and similar to that of 1975 (Table 8.6.). Of course, these are theoretical considerations that usually are not fully confirmed in practice, but point to our capacity to produce beef from the point of view of maximum use of cattle population.

Chart 8.5. Estimated number of calves in Poland according to data from 2011



* assuming simple reproduction and average 4-year use of cows in the herd
Source: [Grodzki 1977].

Expected production of beef based on data from Chart 8.5:

284,000 x 0.6 t = 770,400 tonnes of livestock
770,400 x 0.54 = 416,000 tonnes of beef

600,000 cows x 0.6 t = 360,000 tonnes of livestock
360,000 x 0.52 = 190,000 tonnes of cow carcasses

Sum of beef production = 606,000 tonnes

Table 8.6. Production of beef in Poland

Years	Slaughter of cattle (thousand units)*	Average body weight (kg)	Beef production (thousand tonnes)
1975	3150	405	700
1990	3492	409	780
1993	2486	310	432
1997	1963	393	423
2000	1529	415	350
2002	1229	425	287
2005	1149	518	329
2007	1336	528	388
2008	1348	536	397
2010	1331	558	409
2011	1372	547	413
2012	1294	555	394

* Slaughter of cattle including exports of fatteners
Source: [Rynek Mięsa No. 10/1996, 42/2012, 44/ 2013].

8.3. Feed base

In addition to the population of cattle and calves, this is the second major factor which indicates the scope of development of each direction of animal production, especially cattle, whose breeding, in contrast for example to the poultry, is strongly associated with the acreage of feed crops, as silage imports, not to mention the green fodder, is impossible. A thorough analysis of this issue is beyond the scope of this study, which presents the most important figures showing the feed area and yield.

Specification	1990	2011
Agricultural land area (thousand ha)	18720	15442
Meadows (thousand ha)	2475	2589
Pastures (thousand ha)	1585	702
Meadows + pastures (thousand ha)	4060	3291
Cereal production (thousand tonnes)	28014	26767
Cattle population (thousand units)	8320	5500
Beef production (thousand tonnes)	780	413

Source: [Rocznik statystyczny 1991; Rolnictwo… 2012].

Since in 1990 we were able to feed 8.3 million heads of cattle and produce 780 thousand tonnes of beef with the incomparably more difficult economic conditions of importing the missing concentrate feed components, why do not do this now. Although agricultural area has been reduced by 3.3 million ha, but the increase in cereal yields has meant that in 2011 we produced 1.2 million tonnes less than in 1990 [Agricultural Census 2012, Rolnictwo ... 2012]. The acreage of corn definitely increased – it is the main feed crop for cattle in the form of silage and grain. In addition, technology of harvesting crops for silage and haylage and their preparation and storage is simply incomparable. This results in significant improvement in the quality and nutritive value of silage. Silage from the 1990s and the present day are practically two completely different feeds. Haylage is mass produced and crushed corn silage is becoming more common. These briefly presented selected facts indicate that the possibilities of producing feed, as opposed to the costs, are not a factor limiting livestock production in Poland, and the more so the production of beef.

8.4. Cost-effectiveness

Cost-effectiveness, a very important issue in every field of activity, similar to feed resources, is a subject of studies by specialists in agricultural economics. Detailed analysis of the production of cattle for slaughter – production costs and prices of fatteners in the world is presented by the "agri benchmark beef" network involving 24 farms on all continents. Results of these analyses indicate that production costs grew faster in 2005-2009 than the prices of fatteners.

Of course, with different production conditions on individual continents, it is done in very different degrees. In Europe at that time, the lowest production costs were in Poland, 200$/100 kg of body weight in 2009, in France and Italy, 290 and 320$ respectively [Analiza efektywności... 2009, 2012]. Unfortunately for Polish producers, these lower costs were accompanied by the lowest price 170$/100 kg of body weight, in France and in Italy it was respectively 302 and 314$. This indicates that our beef producers were in the worst economic situa-

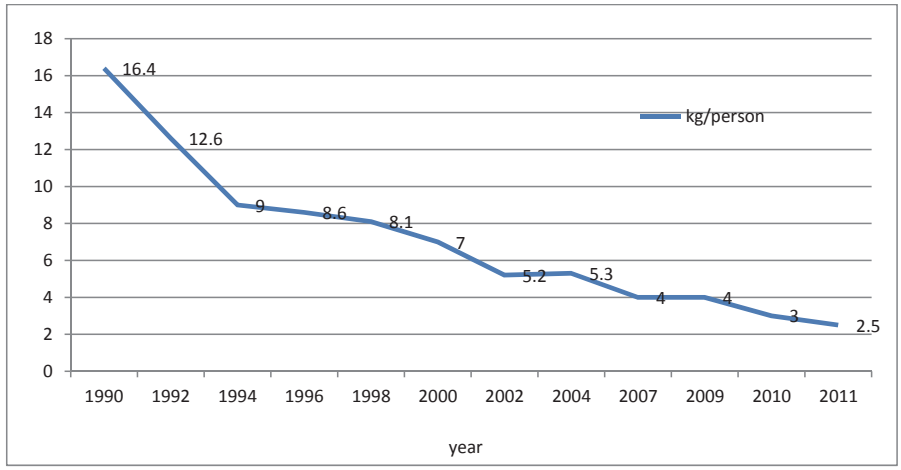
tion in Europe. This fully explains the drastic decline in beef production in Poland in this period, and even worse in the period before it. Since 2011, there is an increase in prices of cattle for slaughter. It amounted to 22% compared to the previous two years and continued in 2012. It should be noted, however, that it is accompanied by a rise in production costs, particularly of concentrated feed and energy. Despite that, the optimistic fact was the 40% lower exports of calves in the first quarter of 2012, as compared to the previous year.

8.5. Market

In developed countries with high competition for most products, the greater problem than cost-effective production is cost-effective sale, which is determined to a greater extent by the consumer than the producer.

Therefore, it is extremely important to have the sales market. In the case of beef, there is a large difference between the domestic and foreign market. Fortunately for Poland, beef is scarce in the European Union. The drastic decline in beef consumption in Poland with more than 16 kg/person per year to just 2.5 (Chart 8.6.) significantly confirms that the domestic market absorption is negligible - 100 thousand tonnes. If we were to count only on ourselves, the small beef production would have to be reduced 4-fold. Fortunately for our beef producers, there is a ready market abroad.

Chart 8.6. Beef consumption in Poland



Source: [Rynek Mięsa No. 10/1996, 42/2012, 44/ 2013].

Note, however, that in contrast to a stable domestic market, foreign market is capricious. Political disagreements, disease, existing or invented by competitors are enough to reduce this market, or even close it. And then what our producer will do with fatteners? In addition, beef deficit in the European Union is accompanied by overproduction in South America and Australia. Just "loosening" customs barriers is enough to fill the deficit by these countries within 1 month. I do not know any other product as beef, whose export is more than three times higher than sales in the domestic market (Table 8.7).

The strongest advantage in the production of beef, as well as milk, are our breeders responsive to market conditions. They repeatedly demonstrated that under favourable economic conditions they are able to overcome many difficulties, meet high quality criteria and significantly increase production.

Table 8.7. Exports and imports of beef in carcasses equivalent (thousand tonnes)

Years	Exports	Imports	Balance	
			thousand tonnes	EUR million
2000	58	2	56	
2005	174	13	161	
2010	340	23	317	850
2011	333	22	311	908
2012	321	21	300	920

Source: [Rynek mięsa No. 42, 2012].

8.6. Summary

- When considering the status and trends of beef production in Poland one should keep in mind the current state of cattle and situation on the beef market in Poland, the European Union and in the world. After a period of drastic decline in cattle population, in recent years it is relative stable with a small downward trend. In contrast to the domestic market, foreign markets, particularly in Middle East, Russia, Turkey and EU have a high demand for beef. To ensure greater stability of sales, it is necessary to increase the consumption of beef in Poland, which, unfortunately, on a significant scale is not possible.
- The population of cattle in Poland is dominated by phf breed representing approximately 90% of the population. Beef cattle are only a few percent of the population. In terms of breed composition, one should not expect major changes except for a slight increase in headage of beef cattle, and this means that beef will continue to be produced on the basis of dairy cattle of phf breed, which, contrary to popular belief, gives good results in fattening.
- To make better use of the large growth potential of this breed and to increase beef production, one should fatten bulls of this breed to a high body weight – about 700 kg.

- To get more calves, heifers unsuitable for breeding and used for fattening should be impregnated, milked for about 3 months and after this period fattened and sent to slaughter.
- Important breeding activity is cross-breeding, causing an increase in the volume and an improvement of beef quality, particularly in small-scale farms engaged in extensive breeding. Without interfering with reproduction, cross-breeding can cover at least 500 thousand cows.
- A large reserve of beef production is in small herds with 1-4 cows (about 500 thousand units). One can successfully use on-farm fattening with summer grazing in the pasture.
- Export of calves should be kept to a minimum, and only units that are not suitable for fattening should be slaughtered.
- In turn, exports of heavy fatteners should be substituted with the export of meat carcasses and minced meat.
- Cattle population is capable of producing about 600 thousand tonnes of beef per year. The main factors limiting the scale of production are:

– low cost-effectiveness of beef production, despite improvement in 2012 and drastically low consumption,

– no integration of cattle producers and the meat industry,

– poor organization of buying by intermediaries and not by the meat industry, few agreements with manufacturers, small activity of producers in the creation of producer groups.

9. Summary

After the system changes that took place in Poland in 1989, which resulted in the introduction of a market economy, Polish agriculture, including milk production, underwent significant changes.

The global production of milk decreased from more than 15 billion kg in 1990 to 12 billion kg in 2012. This was due to the drop in number of cows from 5 million (1990) to around 2.6 million (2012) and the increase in milk yield of cows during this period from about 3.5 thousand kg/cow to about 5 thousand kg/cow. The number of holdings with cows significantly decreased, from 1309 thousand in 1996 to 454 thousand in 2010. At the same time there was an increase in concentration. This is evidenced by the decrease in the number of wholesale suppliers, from 311 thousand in the quota year 2004/2005 to 145 thousand in 2012/2013. During this period, milk production has doubled per one supplier and in the last quota year it was about 60 tonnes of milk. There were also changes in the number of cows in the spatial distribution. In 1990, 50.8% of cows were in five voivodeships: Mazowieckie (14.2%), Wielkopolskie (10.2%), Łódzkie (9.7%), Lubelskie (8.5%) and Podkarpackie (8.2). However, in 2011, 65.6% of cows were in the following voivodeships: Mazowieckie (20.0), Podlaskie (17.3), Wielkopolskie (11.1%), Warmińsko-Mazurskie (8.6) and Łódzkie (8.4%). The value of the Gini coefficient increased from 0.153 in 1990 to 0.315 in 2011.

The concentration level of breeding cows on Polish farms was significantly lower than in the holdings of the analyzed countries: Hungary, Germany, Denmark and the Netherlands. In Poland in 2010, the average number of cows kept on the farm was 6 units, while in Hungarian, German, Danish and Dutch holdings, respectively: 22, 46, 132 and 75 units. Marketability level of milk production on Polish and Hungarian farms amounted respectively to: 72 and 70%, while in other countries it was in the range of 97-98%.

Comparative analysis of Polish dairy farms was made in similar economic size classes. In class 3 with the value of standard output (SO) of EUR 25-50 thousand, the analysis covered the Polish, Hungarian and German holdings. The results are the following statements:

- the analysed holdings differed in the value of standard output (SO). Polish and Hungarian farms were characterized by similar values, which were respectively EUR 36 and 38 thousand, while for German farms SO was EUR 43 thousand;
- greater differences occurred in the agricultural land (AL), on Polish and German farms it was similar and amounted to 27 and 21 hectares, while on Hungarian farms it was significantly higher, 44 ha;

- Polish farms had the highest labour inputs (1.96 AWU/farm) and German farms had the lowest (1.22 AWU/farm), also per 100 ha of AL, labour inputs on Polish farms were the highest (7.37 AWU), while the lowest were on Hungarian farms, 3.93 AWU/100 ha;
- the share of own labour in total labour inputs varied, on Polish and German farms it was similar and amounted to 74 and 80%, while on Hungarian farms it was 64%;
- striking differences occurred in the value of assets, both in terms of 1 ha and 1 AWU, on German farms the corresponding values were EUR 20 and 334 thousand and were three times higher than on Polish and Hungarian farms;
- assets were dominated by fixed assets whose share was in the range of 65-94%, the lowest was in Hungarian holdings and the highest in German holdings;
- liabilities in all farms were dominated by equity (90-96%);
- the analysed holdings of this size class differed in the organization of production, they were dominated by animal production, its share on Polish and German farms was similar and amounted to 82 and 83% respectively, on Hungarian farms it was lower and amounted to 64%, the proportion of forage crops in the structure of AL was the highest on German farms, 83%, while on Polish and Hungarian farms it was respectively 60% and 64%, stocking density in livestock units per 100 ha of AL on Polish and German farms was similar and amounted to 111 and 120 LU/100 ha of AL, on Hungarian farms it was much lower and amounted to 47 LU/100 ha, the highest number of cows was on Polish farms, 20 units, and on Hungarian and German farms it was respectively 15 and 14 units;
- the highest intensity of production was in German holdings, 1,840 EUR/ha and was two and three times higher than on Polish and Hungarian farms, the differences in the level of direct costs were much lower. On Polish and German farms they were similar and amounted respectively to 533 and 573 EUR/ha of AL, while on Hungarian farms they amounted to 340 EUR/ha of AL, the highest costs of hired labour were on Hungarian farms, 34 EUR/ha of AL, costs of interest, lease and depreciation were the highest on German farms. Cost of lease in these farms was 72 EUR/ha of AL and was more than 5 times higher than on Polish and Hungarian farms, where it stood at 14 EUR/ha;
- the highest productivity of land was on German farms, 1.94 thousand EUR/ha of AL, and was respectively: 40 and 152% higher than on Polish and Hungarian farms, while the highest productivity of assets was on Hungarian and Polish farms, while that of current assets was the highest on

Polish farms, labour productivity measured by the value of production in thousand EUR/AWU on Polish and Hungarian farms was similar and amounted respectively to 19 and 21 thousand EUR/AWU, while on German farms it amounted to 34 thousand EUR/AWU and was about 70% higher than on other farms, the profitability of assets was the highest on Hungarian farms, while that of own labour was the highest on German farms, cost-effectiveness and viability of production were the highest on Polish farms. Income from management which is the ultimate measure of management efficiency on all analysed farms was negative, the least favourable was on German farms, EUR -21 thousand, while on Polish and Hungarian farms it amounted respectively to EUR -3.1 and -3.2 thousand. Polish and Hungarian farms achieved income parity in relation to wages paid for hired labour on dairy farms, while all analysed farms have not achieved parity in relation to the wages and salaries in the national economy. The lowest level of this kind of parity was on German farms where it was only 20%, while on Polish and Hungarian farms it was respectively 77 and 90%. Hungarian and German holdings had a negative net investment rate, respectively 37 and 42%, in Polish farms it was positive and amounted to 35%;

- taking into account the negative income from management, not achieving income parity with respect to wages in the national economy and the negative net investment rate (except for Polish farms), it should be noted that the chances of development of farms in this class size are very limited, particularly that of Hungarian and German holdings.

Analysis of the 4 class size of dairy farms (type 45) with a value of production of EUR 50-100 thousand covered Polish, Hungarian, German and Dutch holdings. It allows for formulating the following statements:

- farms were characterized by a similar value of standard output (SO), which ranged between EUR 73-81 thousand, on Polish farms this value was EUR 66 thousand. The smallest area of AL was on Dutch farms, 20 ha of AL, on German farms it was higher, 31 ha of AL, and the highest was on Hungarian farms, nearly 78 ha of AL, holdings in this class benefited from leased land. The share of leased land was uneven, between 33% (Poland) and 46% (Germany), labour inputs per farm were similar in Polish and Hungarian holdings, 2.3 AWU/farm, and were almost twice as high as on German and Dutch farms, where it stood at 1.4 and 1.2 AWU. However, they were different per 100 ha of AL. The highest were on Dutch farms, 5.9 AWU/100 ha of AL, while in other farms they were in the range from 3 AWU to 4.8 AWU/100 of AL (Poland). The share of own labour in total labour inputs varied, the highest was in Dutch holdings, 81%, and the lowest in Hungarian

holdings, 46%, on Polish and German farms it was similar and amounted respectively to 57 and 69%. The value of assets, both in terms of 1 ha and 1 AWU was very much different, the highest was in Dutch holdings, respectively 52 thousand EUR/ha of AL and 884 thousand EUR/AWU, and the lowest was on Hungarian farms, respectively 3.2 thousand EUR/ha of AL and 108 thousand EUR/AWU. On Polish farms it was 8 thousand EUR/ha of AL and 171 thousand EUR/AWU and was lower twice than on German farms. Assets of all holdings were dominated by fixed assets, over 70%, and liabilities were dominated by equity, whose share exceeded 87% (Poland), in other countries it was higher;

- organization of production varied in the surveyed farms. Dutch farms practically did not grow cereals and the proportion of forage crops in AL was 99%, in other farms it was in the range of 61-79%. The highest livestock density was on Dutch and German farms, 191 and 136 LU/100 ha of AL, on Polish and Hungarian farms it was respectively 116 and 61 LU/100 ha of AL. The highest number of cows was on Polish farms, 35 units, in other farms it ranged between 24-30 units. Production structure was dominated by animal production, whose share exceeded 80%, except for the Hungarian farms where it was 65%;
- by far the highest level of production intensity was on Dutch farms, where the cost per 1 ha of AL amounted to EUR 3,700 and were almost higher twice than on German farms, over three times higher than on Polish farms and nearly five times higher than on Hungarian farms, slightly smaller differences occurred in direct costs, the costs of hired labour, interest, lease and depreciation were the highest in Dutch holdings, and cost of interest, lease and depreciation were the lowest in Hungarian holdings;
- productivity of land varied considerably, the highest was on Dutch farms, EUR 4 thousand per ha of AL, it was almost higher twice than on German farms, 2.5 times higher than on Polish farms and 5 times higher than on Hungarian farms. There were also differences in milk yield of cows, the highest was in Dutch holdings, 7200 kg, and the lowest on Hungarian farms, 3860 kg, on Polish and German farms it was similar, about 6 thousand kg of milk per cow per year. Productivity of assets was the lowest on Dutch farms, 0.08, and the highest on Hungarian farms, 0.26, while on Polish and German farms it was similar and amounted to 0.2 and 0.15. Productivity of current assets was the highest on Polish and German farms, respectively 1.93 and 1.91, while the lowest on Dutch farms, 0.5. The highest labour productivity was on Dutch farms, 67 thousand EUR/AWU, it was 30% higher than on German farms, 99% higher than on Polish farms and 134% higher than on Hungarian farms. The profitability of land on Polish and German farms was

similar and amounted respectively to 0.67 and 0.65 thousand EUR/ha of AL, slightly lower was on Dutch farms, 0.52 thousand EUR/ha of AL, and the lowest on Hungarian farms where it was 0.38 thousand EUR/ha of AL, the profitability of assets also varied, the highest was on Hungarian farms, 11.9%, slightly lower was on Polish farms – 8.3%, and much lower on German and Dutch farms, respectively 4.1 and 1.0%. Income from management on German and Dutch farms was strongly negative, respectively EUR -23.9 and -59.1 thousand. On Polish and Hungarian farms it was positive and amounted respectively to EUR 1.1 and 0.9 thousand. Polish and Hungarian farms achieved income parity, both in relation to wages paid for hired labour on dairy farms, as well as in relation to the wages and salaries in the national economy, while German and Dutch holdings did not achieve the two types of income parity. They also had a negative (Germany) and very low (Netherlands) net investment rate;

- given the negative income from management, not achieving income parity and the negative and very low rate of net investment, it should be noted that German and Dutch dairy farms of this size class do not have a chance of development. Polish and Hungarian farms have such opportunities.

Analysis of the 5 class size of dairy farms (type 45) with a value of production of EUR 100-500 thousand covered dairy farms from Poland, Hungary, Germany and the Netherlands. This allows for making the following statements:

- value of standard output SO in Hungarian, German and Dutch holdings was similar, in the range from EUR 201 thousand (Germany) to EUR 248 thousand (Netherlands). The lowest value of output was on Polish farms, EUR 151 thousand, and the highest on Danish farms, EUR 315 thousand. The smallest area of AL was on Dutch farms (47 ha), and the highest on Hungarian farms, 160 ha of AL. The share of leased land was uneven, the highest was on German farms, 67%, and the lowest on Danish farms, 24%. Labour inputs were the highest on Hungarian and Polish farms, respectively 5 and 3.6 AWU/farm, in other farms they were in the range from 1.67 (Netherlands) to 1.90 AWU (Germany). Minor variations occurred in inputs per 100 ha of AL, which were in the range from 1.88 (Denmark) to 3.55 AWU (Netherlands). The share of own labour in total inputs was in the range 44--65%. Similar to previous size classes, there was a very strong diversification of assets, both in terms of 1 ha of AL and 1 AWU. The highest occurred in Dutch holdings, where it amounted respectively to 52 thousand EUR/ha of AL and 1463 thousand EUR/AWU. It was significantly lower in Polish and Hungarian holdings. The assets were dominated by fixed assets, their share

exceeded 70%, and liabilities were dominated by equity, the share exceeded 70%, with the exception of Denmark, where it stood at 48%;

- the share of fodder crops in AL was in the range from 60% (Hungary) to 97% (Netherlands), on German and Danish farms it was similar and stood at 73 71%. Stocking density varied, the highest was in Dutch holdings, 242 LU/100 ha of AL, and the lowest on Hungarian farms, 82 LU/100 ha of AL. On other farms it ranged between 115 LU/100 ha of AL (Poland) and 152 LU/100 ha of AL (Denmark). Number of cows varied slightly, it ranged between 63 units (Germany) and 88 units (Hungary and Denmark). Production structure was dominated by animal production, its share exceeded 70%. The highest was in Dutch farms, 91%;
- the highest level of production intensity was on Dutch and Danish farms, where the costs per 1 ha of AL were respectively: EUR 4828 and 4537, they were almost 50% lower in German holdings and 70% lower in Polish and Hungarian holdings. The differences in direct costs were slightly smaller, in the range from 730 EUR/ha (Poland, Hungary) to EUR 2095 (Denmark). Cost of hired labour and cost of interest were the highest on Danish farms, respectively 218 and 799 EUR/ha of AL, while the costs of lease and depreciation were the highest in Dutch holdings. The lowest costs of hired labour were on German farms, 70 EUR/ha of AL;
- there was a strong differentiation in the productivity of land. The value of production in thousand EUR/ha of AL ranged between 1.51 thousand (Hungary) and 5.17 thousand EUR (Netherlands). On German and Danish farms it amounted respectively to 2.64 and 3.96 thousand EUR/ha of AL, on Polish ones it amounted to 1.77 thousand EUR/ha of AL. Milk yield of cows was in the range from 5922 kg (Hungary) to 8241 kg (Denmark). On Polish farms, it was 6643 kg of milk per cow per year. Productivity of assets was the highest on Hungarian farms, 0.04, and the lowest on Dutch farms, 0.1, Productivity of current assets was the highest on German and Polish farms, respectively 2.09 and 1.95 The lowest was on Dutch farms, 1.26. By far the highest labour productivity was on Danish farms, 210 thousand EUR/AWU, followed by Dutch and German farms, respectively EUR 145 and 107 thousand, while the lowest was on Hungarian and Polish farms, respectively 47 and 52 thousand EUR/AWU. Profitability of land and own labour, as well as viability of production on Danish farms were negative. Income from management on German, Danish and Dutch farms was negative, reaching the lowest value on Danish farms, EUR -137.7 thousand. Polish, Hungarian and German holdings achieved income parity in relation to the wages on dairy farms, but this kind of parity was not reached on Danish and Dutch farms. Income parity in relation to wages and salaries in the national economy was achieved only by

Polish and Hungarian holdings. Net investment rate was positive in all farms, the highest in Danish and Dutch holdings, respectively 1.39 and 1.32%. The lowest was on German farms only 0.32%;

- taking into account the negative income from management, not achieving the income parity and a low rate of net investments, it should be noted that the development opportunities of German, Danish and Dutch dairy farms are limited. Polish and Hungarian farms have greater development opportunities.

Analysis of the 6 size class of dairy farms (type 45) with a value of output of over EUR 500 thousand covered farms from Hungary, Germany, Denmark and the Netherlands, there were no farms from Poland. On this basis, one can formulate the following statements:

- the highest value of standard output was on Hungarian and German farms, respectively EUR 1070 and 895 thousand, significantly lower value was in Danish and Dutch farms, EUR 624 and 557 thousand. The area of AL varied greatly, by far the largest was on Hungarian farms 823 ha of AL, and on German, Danish and Dutch farms it was respectively 375, 172 and 99 ha of AL. The share of leased land was also strongly diversified, the highest was on Hungarian farms, 81%, on German farms it was also high, 77%, significantly lower was on Dutch and Danish farms, respectively 33 and 23%. Total labour inputs were also much diversified, the highest on Hungarian farms, 33 AWU and the lowest on Dutch farms, 2.64 AWU. Diversity was far smaller in terms of 100 ha of AL. Labour inputs were in the range from 1.74 (Denmark) to 3.72 (Hungary) AWU/100 ha of AL. The share of own labour in total labour inputs was the lowest on Hungarian farms, 17%, while in other farms it was in the range from 62% (Germany) to 75% (Netherlands). The value of assets per 1 ha of AL and 1 AWU was very strongly differentiated. The highest was in Dutch holdings, where the respective values were 52,4 thousand EUR/ha of AL and 1896 thousand EUR/AWU. The corresponding values in Hungarian holdings where 3.2 thousand EUR/ha and 87.6 thousand EUR/AWU. The value of assets in Danish holdings was also high, 28.9 thousand EUR/ha and 1,760 thousand EUR/AWU. The assets were dominated by fixed assets (over 60%) and liabilities were dominated by equity, with the exception of Danish farms, where the share of equity was only 34%;
- the share of forage crops in AL varied, the lowest was in Hungarian holdings, 53%, and the highest in Dutch holdings, 94%, on German and Danish farms it amounted respectively to 63 and 72%. Stocking density was also highly diverse. The highest was in Dutch holdings, 250 LU/100 ha of AL, and the lowest on Hungarian farms, 79 LU/100 ha of AL. On German and

Dutch farms it was quite high, respectively 114 and 163 LU/100 ha of AL. Number of cows was less diverse, the largest was on Hungarian farms, 394 units, and the smallest on Dutch farms, 173 units, on German and Danish farms it was respectively 215 and 177 cows. The production structure was dominated by animal production, whose share was in the range from 66% (Hungary) to 91% (Netherlands);

- by far the highest level of intensity of production was in Danish and Dutch holdings, where total costs per 1 ha of AL were similar and stood at 5.2 thousand EUR/ha, in Hungarian and German holdings they were respectively lower by: 65 and 51%. Cost of hired labour on Hungarian, German and Danish farms was similar and within the range from 307 (Hungary) to 353 (Denmark) EUR/ha of AL. Cost of interest was significantly higher on Danish and Dutch farms, respectively 1092 and 810 EUR/ha of AL. On Hungarian and German farms it was respectively 45 and 77 EUR/ha of AL. Similar variations occurred in the cost of lease on Danish and Dutch farms, it was respectively 168 and 244 EUR/ha of AL, while in Hungarian and German holdings it was respectively 67 and 127 EUR/ha of AL. By far the lowest cost of depreciation occurred on Hungarian farms, 120 EUR/ha of AL, while on German, Danish and Dutch farms it was respectively 320, 489 and 840 EUR/ha of AL;
- there was a strong variation in the productivity of land, the highest land productivity was on Dutch and Danish farms, respectively 5.5 and 4.4 thousand EUR/ha of AL, on Hungarian farms it was only 1.7 thousand EUR/ha of AL and about 62% lower than on Danish farms and 70% lower than on Dutch farms. Productivity of land on German farms was 2.32 thousand EUR/ha of AL and was lower than the productivity of Danish and Dutch farms, respectively: by 47% and 58%. There were significant differences in the productivity of assets. The highest was on Hungarian farms, 0.52, and the lowest on Dutch farms, 0.1. Productivity of current assets significantly less varied, in the range from 1.39 (Netherlands) to 1.66 (Germany). The highest profitability of land and own labour was on Dutch farms, while the lowest and negative on Danish farms. Income from management on German, Danish and Dutch farms was negative; by far the lowest was on Danish farms: EUR -254 thousand. German and Dutch farms achieved income parity in relation to wages on dairy farms, but did not achieve income parity with respect to wages and salaries in the national economy. Danish farms were in the most difficult situation. Net investment rate was positive in all farms, the highest in Danish holdings. Taking into account the negative income from management and not achieving income parity, it should be noted that ana-

lysed farms of this size class, despite a positive net investment rate, have no development opportunities.

Analysis of dairy farms of different economic size classes allows to formulate the following statements:

- there was a positive relationship between the area of agricultural land on farms and their economic size within individual countries, also the share of leased land increased, except for Dutch farms, where the share of leased land decreased in the higher size classes. There was a negative relationship between labour inputs per 100 ha of AL and the share of own labour in total labour inputs and the economic size of farms. There was no clear relationship between the value of assets per 1 ha of agricultural and the economic size. The share of equity decreased with the increase in economic size;
- stocking density in LU/100 ha of AL and the number of cows on the farm showed an increasing trend with increasing economic size. In all groups of farms, regardless of economic size, production structure was dominated by animal production, its share was in the range from 65% (Hungary) to 91% (Netherlands);
- total costs and direct costs per 1 ha of AL showed an increasing trend with increasing economic size of farms. Costs of hired labour, lease and interest showed similar trends;
- land productivity also increased with increasing economic size. Productivity of assets increased with increasing economic size only in Hungarian holdings, in other farms there was no clear regularity, but there was a clear positive relationship between labour productivity and the economic size of farms;
- profitability of land varied, there was no relationship between the profitability of land and the economic size of farms, such positive relationship occurred only in Dutch holdings;
- the main sources of income for dairy farms, outside Poland, were all kinds of subsidies for operating activity, on Polish farms, the share of subsidies in income was in the range from 40 to 50%, while on other farms in the range from 75 (Hungary) to 258% (also Hungary);
- profitability of own labour showed a positive relationship with the economic size, except for Danish farms, where it was negative, income parity "B" was achieved only by Polish and Hungarian holdings in 4 and 5 class of economic size with the standard output of EUR 50-100 thousand and EUR 100-500 thousand, holdings in these economic size classes achieved positive income from management and showed development opportunities, dairy farms of other classes had no such development opportunities.

Farms specializing in cattle production (type 49) were represented by Polish farms only in 3 and 4 economic size class, while German holdings of this type were present in classes 3 to 6, and Dutch farms only in class 5 and 6. The analysis of this group of farms allows for making the following statements:

- farms specializing in cattle production were characterized by a similar size in the different classes of economic size. The area of agricultural land was correlated with the economic size within individual countries. This area was greater than on dairy farms with corresponding economic size. The exceptions were Dutch holdings, where the area of AL was lower, especially in class 5 and 6; it amounted to 43.8 and 22.2 ha. The share of leased land was also positively correlated with economic size. The lowest was on Polish farms, from 26% in class 3 to 68% in class 5. On German farms it was much higher, from 57% in class 3 to 82% in class 6. On Dutch farms in class 6 it was 54% and was significantly lower than in class 5 where it stood at 77%. Total labour inputs were positively correlated with economic size of farms, negatively correlated per 1 ha of AL on Polish and German farms. In Dutch holdings this relationship was reversed. This was the result of a smaller area of these farms. The share of own labour in total labour inputs increased with increasing economic size. Dutch farms were the exception in this regard. The value of assets, both in terms of 1 ha of AL and 1 AWU was positively correlated with economic size of holdings, with the exception of German farms in class 6. The assets on farms of all classes, regardless of the country, were dominated by fixed assets, which exceeded 67%, while liabilities were dominated by equity, whose share exceeded 60%, with the exception of Dutch farms in class 6;
- organization of production was similar in the analyzed farms. The structure of crops was dominated by fodder crops, whose share in the area of AL was in the range from 61% (Polish holdings in class 3) to 96% (Dutch holdings in class 5). Livestock density on Polish and German farms in classes 3 and 4 was similar, in the range from 90 to 108 LU/100 ha of AL. On German and Dutch farms in class 5 it was respectively 146 and 335 LU/100 ha of AL. By far the highest was in Dutch holdings in class 6, 1981 LU/100 ha of AL, which was the result of a small area of these farms. Livestock density was dominated by other cattle. The structure of production was dominated by animal production, whose share was in the range from 64% to 91%. The lowest was on Polish farms and the highest in Dutch holdings;
- the level of intensity of production determined by the total cost per 1 ha of AL was positively correlated with the economic size of farms. The lowest costs were on Polish farms, 710 EUR/ha of AL in class 3 and 4. On German farms they were more than twice as high. However, on Dutch farms they were the

highest, 3045 and 13976 EUR/ha of AL respectively in classes 5 and 6. Similar trends occurred in the level of direct costs. Costs of hired labour, interest, lease and depreciation were the highest on Dutch farms;

- productivity of land determined by the value of production per 1 ha of AL was positively correlated with economic size of farms, except for German farms in class 6, where it amounted to 1.51 thousand EUR/ha of AL and was 17% lower than in class 5 farms. The lowest productivity of land was on Polish farms in classes 3 and 4, respectively 0.76 and 0.88 thousand EUR/ha of AL. However, on Dutch farms it was the highest in class 5 and 6, respectively in 2.65 and 13.7 EUR/ha of AL. Productivity of assets and current assets was positively correlated with the economic size of farms within countries. On Polish farms in classes 3 and 4 it was higher than on the corresponding German farms. Labour productivity was positively correlated with economic size. On Polish farms it was the lowest in classes 3 and 4, it amounted to 14.4 and 29.1 thousand EUR/AWU, while the highest occurred in German and Dutch holdings in class 6, where it was respectively 96.4 and 168.7 thousand EUR/ AWU. The profitability of land and assets was positively correlated with economic size of farms, except for German farms in class 6, where it was lower than in class 5. The profitability of own labour was also positively correlated with the economic size of farms. The lowest was in German holdings in class 3 and 4, respectively 0.93 and 6.67 thousand EUR/FWFU. On Polish farms in the corresponding classes it was higher and amounted to 6.6 and 16.5 thousand EUR/FWU. The highest profitability of own labour occurred on German and Dutch farms in class 6, where it amounted respectively to 39.11 and 37.40 EUR/FWU. The cost-effectiveness and viability of production was the highest on Polish farms in classes 3 and 4, respectively: cost-effectiveness indicators 103 and 121%, viability indicators 43.3 and 51.1%. The lowest indicators of viability were on Dutch farms in class 5, where viability indicator was 9.7%, and in German holdings in class 6, 7.2%. Income from management in all farms except for Polish farms in class 4 was negative. These farms only achieved income parity "B". Given the positive income from management and the level of income parity "B", it must be noted that from among the analyzed farms with cattle production, only Polish farms in class 4 had development capacities. Similar to dairy farms, in this type of farms direct payments for operating activities were also the main and mostly the only source of income.

A comprehensive assessment of farms using the point indicator of relative goodness showed that Polish dairy farms in classes 3 to 5 had the higher effi-

ciency than the corresponding group of Hungarian, German, Danish and Dutch farms. However, the development potential was demonstrated only by farms in classes 4 and 5. Also Polish farms with production of other cattle in class 3 and 4 showed higher efficiency than the corresponding German farms. Development capacity was shown only in Polish holdings in class 4.

Assessment of the economic efficiency of farms made using the DEA method showed that the inference of capacity development of dairy farms on the basis of averages is insufficient. The analysis of medium-size classes showed the economic development potential of holdings in class 4 and higher. However, the analysis using the DEA method showed that even among 2 class of economic size there are holdings with high efficiency with VRS values in the range 0.85-1.0, which achieve the positive income from management and are able to grow. In the 3 class of economic size, development potential was seen also in holdings with low efficiency, with VRS values in the range of 0.50-0.85. On farms with cattle production (type 49), holdings of 3 economic size class showing high efficiency with VER values in the range of 0.85-1.0 obtained positive income from management and were characterized by their ability to grow. As mentioned above, full developmental capacity was characteristic of holdings in 4 economic size class.

The analysis of factors affecting the income from dairy farms showed that the most important of them include increase in: own labour inputs, agricultural area, the share of fodder crops in the agricultural area and the milk yield of cows. The significant factors in cattle production include increase in: own labour inputs, own land area, stocking density and proportion of forage crops in the agricultural area.

Analysis of the status and development trends of beef production in Poland indicated the following actions:

- due to the dominance of phf, in order to better exploit its huge potential for the production of beef, one should fatten bulls of that breed to a body weight of about 700 kg;
- to get more calves, heifers unsuitable for breeding and used for fattening should be impregnated, milked for about 3 months and after this period fattened and sent to slaughter;
- cross-breeding is an important breeding activity that causes an increase in the number and improvement of beef quality, particularly in small-scale farms engaged in extensive breeding. Without interfering with reproduction, cross-breeding can cover at least 500 thousand cows;

■ large reserves of beef production are in small herds with 1-4 cows (about 500 thousand units) One can successfully use on-farm fattening with summer grazing in the pasture;
■ export of calves should be kept to a minimum, and only units that are not suitable for fattening should be slaughtered;
■ in turn, exports of heavy fatteners should be substituted with the export of meat carcasses and minced meat;
■ cattle population is capable of producing about 600 thousand tonnes of beef per year. The main factors limiting this scale of production are: low domestic demand, lack of integration between producers of cattle and the meat industry, buying organization run by intermediaries and not by the meat industry, few agreements with producers and small activity of producers in the creation of producer groups.

The analysis allowed for the positive verification of the adopted hypotheses. The studies have confirmed that the scale of milk production is the primary factor determining the efficiency of milk production on farms and that Polish dairy farms with more than 30 dairy cows are capable of development. It was also confirmed that farms specialized in milk production are more effective than bi-directional farms, focusing on the production of milk and beef cattle. It was not confirmed that Polish dairy farms with over 50 dairy cows are capable of competing with the relevant holdings in the surveyed countries. Research has shown Polish dairy farms with over 35 dairy cows and milk yield of about 6 thousand kg of milk per cow per year are capable to compete with farms in the surveyed countries.

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