Effectiveness, production costs and competitiveness of Polish agricultural holdings at present and in the medium- and long-term perspective

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

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This study was prepared under the theme: **Competitiveness of Polish agricultural holdings and agricultural products at present and in a mid-term perspective**, within the framework of the research tasks:

The possibility of improving the effectiveness of functioning of individual groups of Polish agricultural holdings at the background of analogous achievements of groups of holdings from selected EU countries

The development possibilities of different groups of agricultural holdings and their competitive skills in a mid-term perspective

Economic surpluses of selected agricultural products, their current analysis and assessment of the scale and scope of the changes expected in a mid-term perspective

The main part of the paper includes: estimates of the number of competitive national agricultural holdings, analysis of their situation at the background of similar holdings in some selected European Union countries, and analysis of production costs and profitability for selected products in 2005-2012. This was used as a basis to project a change in the number of competitive national agricultural holdings in a 2020 perspective, and the futurological literature – to develop a vision of evolution of the phenomenon in the next two decades.

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FROM THE AUTHORS

Many authors set much store by analyses related to the past, thinking that they will help them predict the future conditions of the economic situation of national agricultural holdings. However, their environment is more and more complex, thus, drawing conclusions about the future on this basis starts raising doubts. Therefore, in this small book we have made an attempt to draw attention to the selected issues which had and may have a specific impact on the future of these holdings.

Since 2003, Poland has been an increasingly larger net exporter of agri-food products, thus, this future will be co-determined by the events related not only to the national economic policy and membership in the European Union, but also to the determinants of global nature, which include climate change and change in the age structure of food consumers, increased GDP amount *per capita*, progress in techniques to obtain agricultural products, etc. This also refers to the influence which may be exerted on agricultural holdings by a potential scientific and technical revolution in the national economy.

The sustainability of agricultural holdings in the longer term is determined by their ability to compete with other similar entities in the market: local, national or the EU. Competitive holdings are larger, invest a lot of funds, take in innovations, gain not only income but also profits from their own capital invested and even from management. Besides, more often than any other entities, they undertake both group activities strengthening their market position and policy-stimulated undertakings protecting the widely understood natural environment. So, in fact, they are all businesses, although those owned by natural persons are not covered by the Act on economic activity in our country.

In the chapters making up this book, competitive holdings owned by both natural and legal persons are, therefore, called interchangeably agricultural holdings or businesses.

The book consists of three substantive chapters. The first contains estimates determining the changes in the number of national agricultural holdings distinguished by their competitiveness in 2004-2012, and also indicates the factors which will have a positive and a negative impact on their number in 2020 and in the next few decades. The second chapter identifies national agricultural holdings existing in 2006-2011, and presents them against a background of similarly chosen entities in the selected

European Union countries. The third chapter deals with production costs of selected products of agricultural origin, the cost-effectiveness of this production and its effectiveness in 2006-2011 and in the medium term.

The predictions regarding the future of agricultural holdings (businesses) were based on analyses concerning past events, which use mostly figures taken from the results of the EU-wide and Polish FADN monitoring but also other empirical materials gathered by the authors. Moreover, the literature on the subject was also used for this purpose and in the description of long-term perspective ideas the literature on the subject was the only source. In the anticipatory thinking, attention was paid mainly to the medium-term perspective.

However, the actual condition of the national agricultural holdings in the long term may differ from the one presented in this book. The point is that the book does not take into account another scenario which may be called Scenario B. This scenario is underlain by two reasons.

The first reason is the effects of the rapid rate of changes taking place in the surroundings of individual people, as neither our psychology, physiology nor social structures are adapted to this. Each subsequent change makes more or less people stressed and frustrated and, consequently, aggressive or apathetic as the effects of the previous change have not been assessed yet and there was no time to adapt to them. Modern means of communication allow people with such attitudes to form groups, sometimes very large, which are able to exert influence on the direction of further social and economic transformations.

The second reason, triggering the existence of Scenario B, may be the diversification of the economic development of the countries around the world. Some states have experienced the effects of not only the industrial but also scientific and technical revolution, others start implementing the latter or – like Poland – are facing such a prospect. Still others, inhabited by the majority of the global population, experience various phases of the industrial revolution. The experience of the European and Japanese history, not too distant in time, shows us that not necessarily this must be accompanied by aiming only at improving the standard of life of societies. The diversification of the development level of the countries experiencing the industrial revolution is, in fact, conducive to the intensification of the phenomenon of terrorism, but also of political forces seeking the revision of the borders of neighbouring states of lower development level, which, in consequence, may end the contemporary phase of

the peaceful development of the world. Observation of the political scene shows that such phenomena manifest themselves in the majority of countries in Asia and Africa, even in Eastern Europe, or find their inspiration there. Thus, potential armed conflicts can be wide-ranging. However, a comforting fact is that during wars people also need to eat, and this will create an opportunity for agriculture of the countries which will not be affected by armed conflicts.

DETERMINANTS OF AN INCREASE IN THE COMPETITIVENESS OF POLISH AGRICULTURAL HOLDINGS

Introduction

For a long time, Polish agriculture has had its specific nature distinguishing it at the background of the majority of other European countries. Starting from the sixties of the last century, this specific nature was expressed mainly in a large percentage of small holdings owned by natural persons with limited or no contact with the market and in the fact that owners of these holdings gained their income, in part or in majority, from other sources, mostly from gainful employment.

The change in the socio-economic system, at the turn of the 1980s and 1990s, destroyed this mechanism. Growing unemployment was a reason for which small family holdings could not go bankrupt and remained in poverty and deprivation, and this, in turn, was accompanied by the depreciation of fixed assets. However, there were exceptions. Agricultural accounting kept at the Institute of Agricultural and Food Economics (*Polish*: *Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej, IERiGŻ*) in 1999 in holdings owned by natural persons showed that the extended reproduction of fixed assets was characteristic of, *inter alia*, holdings of 16-100 ESU specialising in cereals and with the mixed plant and animal production.

It was a preview of the fact that in case of an improvement in management conditions, there will be an increase in the share of national agricultural holdings owned by natural persons increasing their assets and, at the same time, the level of income gained. Indeed, the significant improvement in management conditions, initiated in 2004, led to the emergence of such a phenomenon. On the basis of assets of some production cooperatives and former state-owned agricultural holdings new, mostly private, entities were established, also those organised as companies. For this reason, the population of holdings owned by legal persons was changing.

Theoretical introduction

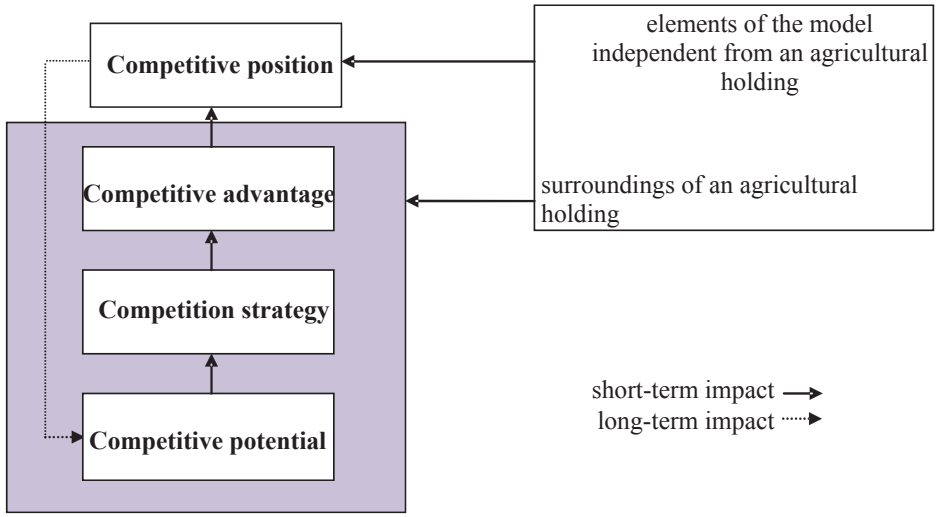
Competitiveness of an agricultural holding may be defined as its attribute, resulting both from its internal characteristics and associated with the ability to adapt to changes in the surroundings, which allows this holding to achieve more

effectively the objectives of the major group of stakeholders (owners), also in the long term, when compared to other agricultural producers or participants in the economic process [Kagan 2013].

In systemic terms, as part of the competitiveness, we may distinguish subsystems forming an integrated whole and allowing to make a model assessment of this phenomenon with a breakdown into various spheres [Stankiewicz 2002]. One of them, is the competitive potential understood as owned production resources as well as skills and opportunities to access and use resources in the surroundings of an agricultural holding (Diagram 1). The competitive potential is, thus, a configuration of abilities, competence, skills, powers or performance and efficiency of all tangible and intangible resources of a given entity which may be launched during the process of use [Lichtarski 1999].

Diagram 1

Integrated competitiveness model of an agricultural holding



Source: own elaboration based on: [Flak and Głód 2012].

Nevertheless, the competitive potential does not consist of all resources, but mainly of those, which are or may be used by an agricultural holding to build, strengthen and maintain the competitive advantage. The highest position in the hierarchy of the production potential, due to the possibility of deciding on the competitiveness of an agricultural holding, is occupied by resources deemed strategic. They include these which meet the following criteria [Woś 2006]:

- are rare due to their quantity or quality and thus difficult to acquire;
- are unique and thus difficult to substitute or imitate;
- are valuable and thus necessary to perform basic functions of an agricultural holding.

In agriculture, we may apply the following classification of resources:

– natural, including natural capital and its components: utilised agricultural area and its quality, and other features determining its productivity (lay of the land, water conditions, agroclimatic conditions), owned breeds – production lines – varieties of animals, species – varieties of plants, etc.;
– human factor-related: knowledge, skills, level of involvement and motivation of agricultural holding owners and employed household members and staff, values followed by them and their families as well as objectives to be achieved;
– financial resources and related possession of specific equipment, machinery, buildings and structures, which are directly related to the possibility of using certain unique production techniques and technologies;
– organisational resources related to the structure of an organisation, management system, but also with a network of connections with suppliers and customers of products or other participants in the economic process, or resulting from access to infrastructure;
– financial resources and business financing structure.

The prerequisite for the skilful use of the production potential is often the development and implementation of an appropriate action strategy enabling the achievement of the competitive advantage. In holdings owned by natural persons, it may be informal and in small entities it may come down even to a provisional plan of building and maintaining the competitive potential [Odening and Bockelmann 2012].

In large holdings, a competition strategy is a long-term and comprehensive plan of actions to maximise the use of the potential (resources) for achieving objectives adopted. Typically, it specifies the area where competition is to take place, according to what rules and to what extent [Porter 2000; Seinmann 2001].

The result of the skilful use of the competitive potential using a competition strategy is to obtain the competitive advantage understood as the unique competence of a holding to achieve an objective against a background of other agricultural producers [Flak and Głód 2012]. Sometimes, achieving the competitive advantage may result from a favourable coincidence in the sector or in the general market or from state intervention. An example of such a situation

is, *inter alia*, obtaining the competitive advantage of agricultural holdings and agri-food businesses from Belarus in 2014, due to the introduction of an embargo on food from the countries which had imposed economic sanctions on Russia. Political decisions of the so-called further surroundings of an agricultural holding were decisive as it comes to obtaining the advantage resulting from the location of this holding within a given country.

However, this does not mean that an agricultural holding with the competitive advantage automatically shows high economic efficiency. The advantage itself means having effective instruments to compete within one of many dimensions of the functioning of an agricultural holding [Flak and Głód 2012].

On the other hand, the competitive position is a measure of achieving the competitive advantage and thus it is placed on the top of the hierarchy of competitiveness subsystems. It provides an indication – measure of the success of the economic process implemented in relation to competitors.

At the same time, it affects the competitive potential of a holding in subsequent periods of its functioning. It is easier for holdings achieving the high economic efficiency to acquire new or to keep strategic resources they already have.

The process of measuring the competitiveness of an agricultural holding is often simplified and reduced to determining its competitive position, by comparing obtained economic results under specific external conditions against a background of a selected group of agricultural producers. Taking into account the chain of causality and feedback in a form of a long-term impact of the competitive position on the future competitive potential, such simplification is reasonable.

In case of corporations, operating in the non-agricultural sector, determining the competitive position of an entity takes place through determining its market power (the most commonly used indicator is the change in the market share) and financial situation [Pierścionek 2011]. Due to the large number of entities operating in this link of the food economy chain, in microeconomic terms, the measurement of the share of a single agricultural holding in the market of sold products is not reasonable. Only in case of an analysis of data aggregated at the meso- and macro-economic level, the change in the share of a given group of agricultural holdings either in the structure of managing utilized agricultural area as a specific production factor, or in the flow of products supplied to the market, may indicate the change in its competitive position. Thus, when analysing agricultural holdings at the micro-economic level, we limited ourselves mainly to a financial analysis of obtained results, while disregarding the determination of its market power.

Diagram 2

Main financial aspects of the functioning of agricultural holdings and areas of their measurement

Main aspects	Time factor:	
	short term	longer term
Financial security	**Analysis of financial liquidity** Allows to determine the ability to pay the most urgent (current) financial obligations	**Analysis of long-term solvency** Allows to assess the ability of an entity to pay obligations over a long period of time
Benefits for owners	**Analysis of profitability** Allows to assess financial benefits from running agricultural activity and from owned production factors	**Analysis of investments** Allows to determine whether the production potential of an agricultural holding will be maintained, extended or limited in the future

Source: [Kagan 2013].

The measurement of the financial effectiveness of an agricultural holding usually comes down to an assessment of two main aspects of its functioning, namely, the level of providing security of activity and the amount of benefits achieved by owners – the group of the closest stakeholders [Nowak 2008]. Both areas are most frequently considered concurrently but separately. The inclusion of the time factor allows to broaden the areas of analysis both in terms of financial security and benefits for owners (Diagram 2).

The availability of financial resources and, at the same time, the choice of a source for financing current economic activities and a development strategy for the amount of maintained current assets in relation to the demand of working capital are an important aspect of the functioning of an agricultural holding. This aspect, in fact, determines this holding's security with regard to the current financial solvency and in the long term – the level of debt and the level of financial leverage. In case of small and medium-sized agricultural holdings of natural persons there is, however, a problem with the typical measurement of liquidity as it is not possible to separate the financial sphere of an agricultural holding (financial proceeds and current liabilities) from finances of a household [Tomczak 2006].

Determining the entity's security only on the basis of the situation of an agricultural holding (the structure of balance sheet assets and liabilities) is, thus, seriously encumbered. Taking into account an aversion of small and

medium-sized holdings owned by natural persons to the credit risk and the extent of using the so-called trade credit, it must be stated that this group of entities is not affected by the problem of the suboptimal selection of capital structure in order to achieve greater benefits from an agricultural holding. An improvement in the financial result at the expense of security of its functioning (increased financial risk) can take place only in entities having the properties of a medium-sized or large business, thus, in large holdings of natural persons and agricultural holdings of legal persons [Kagan 2011].

Thus, the analysis of competitiveness disregarded the area of financial security while focusing on benefits achieved by owners of agricultural holdings. When segmenting entities, both an assessment of current benefits for an owner from an agricultural holding (the profitability of activities) and the ability of a holding to reproduce production assets – its ability to shape future benefits for owners – have been used. Investments may, in fact, be connected with the fact that owners of a holding resign from consumption (reinvesting a financial surplus) and restrict liquidity (the amount of current assets is reduced), but usually additional financial costs are generated, e.g. costs of service of acquired foreign capital to finance an investment or an additional cost of depreciation. These costs encumber current activity but are often a prerequisite to achieve financial profit in the future. So, they are a measure of developing the future competitive potential of a holding. While assuming the stability of other factors, profits of holdings in subsequent years (competitive position) are determined by the scale of the competitive potential and the amount of property investments.

Using both these parameters, i.e. the profitability of business activity and the scope of the reproduction of the holding's assets (the difference between the gross investment value and depreciation amount), the population of agricultural holdings has been divided into four groups (Diagram 3).

The first group are holdings which are in the most favourable situation and are referred to as "holdings with the competitive capacity". They obtain the positive financial result (net profit) and are also characterised by the positive reproduction of fixed assets. Owners of such a holding gain necessary current benefits from its functioning and are able to pay for all production factors, including, in holdings of natural persons, they may provide necessary payment for own labour, but also they do not reduce their assets (competitive potential) for the next period of functioning.

The worst situation, in terms of competitiveness, applies to holdings with the net financial loss and negative reproduction of assets. In their case, the absence of the competitive capacity results not only from the reduction in production assets (competitive potential) expected in the future, but from the further reduction in the amount of the generated financial surplus.

Diagram 3

Diagram of segmentation of agricultural holdings depending on their competitive capacity

Segmentation criteria	Financial result	Reproduction of assets:	
		positive	negative
Profitability of activity	Net financial profit (positive financial result)	Holdings with the competitive capacity	Holdings potentially able to achieve the competitive capacity
	Net financial loss (negative financial result)	Holdings potentially able to achieve the competitive capacity	Holdings without the competitive capacity

Source: based on the study by W. Józwiak [2003].

The third group are holdings which, over the analysed period, achieved the net financial profit, but are characterised by the negative reproduction of assets. In their case, we should expect the reduction in the production potential in subsequent periods for various reasons. As a consequence, financial benefits obtained from owning a holding will deteriorate. Possibilities and thus opportunities to reverse the negative phenomenon in this regard result from having current funds to change the scale of the production potential in the future. Thus, the group of such holdings is potentially able to achieve the competitive capacity.

When holdings show financial losses, and, at the same time, are characterised by the extended reproduction of fixed assets, they have also been included in the group potentially able to achieve the competitive capacity. However, in this case the production potential is increased despite the lack of full payment for all production factors.

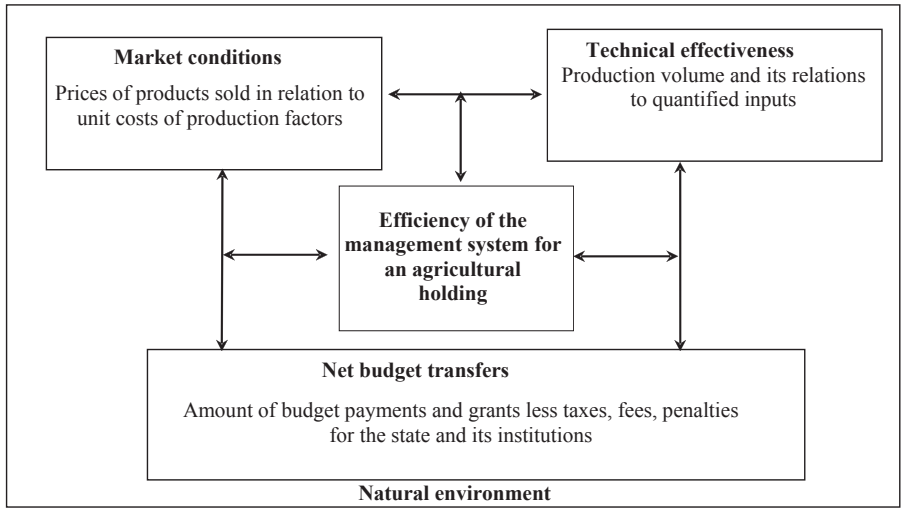
One of the reasons for such a phenomenon is a positive assessment of the future prospect for the functioning of an entity and thus waiting for an improvement in financial results of a holding, to an extent which in the future will provide full payment for all production factors and will also compensate for current financial losses. Such a procedure leads to reducing the current consumption in holdings of natural persons for the benefit of the development of an entity, and in companies – to reducing the value of equity of an entity.

The very financial condition (competitiveness) of a holding is determined by many factors whose characteristics and impact are diversified and often difficult to distinguish. In the model study, these factors can be grouped which results in simplification, and, simultaneously, facilitates the measurement of their impact. In the analysis conducted, three groups of factors have been distinguished, which focus on the impact of a very large number of other elements affecting the competitiveness of agricultural holdings (Diagram 4):

- market conditions, understood as relations of prices of products sold by agricultural holdings to unit costs of purchased production factors;
- technical efficiency, and taking into account the time factor, also an increase in the productivity of inputs in an agricultural holding; progress in this regard is most often measured by relations of the production volume to quantified inputs;
- net budget transfers, especially from the period of the integration of our country with the EU, these include single area payments, production grants, as well as targeted payments provided in a form of direct state aid for agricultural holdings.

Diagram 4

Simplified diagram of factors determining the financial condition (competitiveness) of an agricultural holding



Source:[Kulawik et al. 2012].

All three aggregated factors should be considered as stimulants for the competitiveness of agricultural holdings only when considering their direct impact on financial results. However, it should be stressed that there are also interactions between them and thus their indirect impact may have a different direction than the direct impact on the competitiveness. Therefore, through their negative impact on other factors, they may indirectly deteriorate the competitive position both in the short and long term.

An example of the negative impact is the indirect impact of direct payments on the market conditions (price relations) and technical efficiency. It is assumed that budget transfers in a form of direct payments, on the one hand, prevent a rise in prices of agricultural raw materials, on the other – by improving the financial situation of agricultural holdings, they stimulate a rise in prices of agricultural inputs [Kukuła and Czyżewski 2011].

An important issue, from the point of view of the long-term competitiveness, remains the impact of budget subsidies and grants on the technical use of production resources of market origin in agriculture and on natural capital. The results of existing studies show that state aid, particularly in a form of direct payments, including decoupled payments, has a negative impact on the technical use of resources and the productivity of agriculture [Kagan 2012]. On the other hand, it has a positive impact on the resource of natural capital and the environmental impact of agricultural holdings [Kulawik et al. 2013].

However, the final impact of budget transfers is dependent not only on the support instrument itself (for which measures budget funds are allocated), conditions for receiving public aid and the amount of funds supplying a given agricultural holding. The effects of the impact of this factor, as well as of others, are also determined by the very financial situation of an agricultural holding, adopted management system and the sensitivity to a change in external conditions as well as by the flexibility and abilities to undertake adaptation processes, particularly under the conditions of changes in the environment [Kagan 2012].

Change in the number of agricultural holdings with the competitive capacity after 2004

The analysis and estimate prepared on a basis of empirical materials, derived from the results of the Polish FADN monitoring with regard to agricultural holdings of natural persons [Józwiak 2012], showed that in 2006--2008 there were about 90 thousand holdings of natural persons conducting agricultural activity and having an area of utilized agricultural area exceeding 1 ha, which had the features of holdings with the competitive capacity. The

analysis also showed that among other, usually smaller, holdings there were some which had the potential to be able to achieve that capacity. This evaluation used the VRS (variable return to scale) indices established using the DEA method under a variant focused on inputs and profits from management, which were calculated as a difference between agricultural income and payment for own labour and own land and capital, calculated, in turn, according to market rates applicable in agriculture. It was estimated in total that in Poland in 2006--2008 there were about 290 thousand holdings of natural persons which were characterised by the competitive capacity or had the potential to be able to achieve that capacity in the near future.

It was decided to verify the above figures using the more convincing method and, at the same time, to assess the changes, which have taken place during the post-accession period, in the number of holdings with the competitive capacity and those which are able to achieve that capacity soon. To this end, 5,387 holdings, which in 2005-2012 kept agricultural accounting on a continuous basis, have been selected from among holdings under the Polish FADN monitoring. Each of these holdings has been characterised according to the amounts of profits gained from own assets and to the net investment value. Profit from own assets has been calculated as differences between income from a family holding and payment for own labour in a holding, calculated according to market rates applicable in agriculture. Payment for one person employed full--time in a holding (delivery and administrative work in total) was an exception as it was calculated according to parity rates.

Relevant calculations allowing to segment the population of agricultural holdings have been drawn up from the data for 2005-2007 and 2010-2012. The figures characteristic of the structure of holdings from the analysed panel in 2005-2007 and the corresponding numbers of holdings in the country are included in Table 1. It results from the Table that the previous estimate overrated the number of holdings which had the potential to be able to achieve the competitive capacity. In 2005-2007, the number of holdings with the competitive capacity amounted to, in fact, about 91 thousand, while of those potentially able to achieve that capacity – only about 84 thousand. The latter group was dominated by holdings achieving the net financial profit and the negative reproduction of assets – 68.5 thousand entities (82% of the group), while those with the net financial loss, and, at the same time, the positive reproduction of assets were represented by 15 thousand entities (18% of the

group). Therefore, in the years directly after accession there were, in total, about 174 thousand holdings with the competitive capacity and those which were able to achieve that capacity.

Table 1

Structure of holdings from the analysed panel and corresponding number of holdings of natural persons in Poland in 2005-2007

Groups of holdings	Structure of holdings from the analysed panel (%)	Number of holdings in the country corresponding to the structure (thousand)
Holdings with the competitive capacity	41.4	90.7
Holdings potentially able to achieve the competitive capacity, including:	40.0	83.8
– with profit and negative reproduction of assets	33.0	68.5
– with financial loss and positive reproduction of assets	7.0	15.3
Holdings without the competitive capacity	20.3	1,567.1
Total	100.0	1,741.6[a]

[a] Average area of utilised agricultural area of agricultural holdings in the analysed panel was 31.4 ha. That number corresponded to 219.2 thousand of the largest holdings of natural persons, which was established on a basis of the study entitled *Charakterystyka gospodarstw rolnych w 2007 r.*, [2008].

Source: calculations by J. Sobierajewska and W. Józwiak prepared based on the results of the Polish FADN monitoring and figures published by the GUS[1].

Similar findings, drawn up using the figures taken from the results of the Polish FADN monitoring covering 2010-2012 period as well as the compiled results from the Agricultural Census carried out in 2010 [GUS 2012], showed that the number of holdings with the competitive capacity remained almost at the same level as in 2005-2007, but there has been an increase in their share in the general population (Table 2) as, although their share in the population of holdings of natural persons in 2007 was a bit more than 5%, in 2010 it increased to more than 7%.

[1] *GUS – Główny Urząd Statystyczny;* CSO – Central Statistical Office.

An increase in the number of holdings and in their share in the structure of the entire population took place in the case of the group "potentially able to achieve the competitive capacity". In 2010-2012, there were more than 119 thousand of such holdings (an increase by more than 42% when compared to 2005-2007), and their share in the population increased to 8%. This resulted from an increase in the number of holdings which gained the net financial profit, but were characterised by negative reproduction of assets.

In total, the number of holdings with the competitive capacity and of those which could be able to achieve that capacity soon amounted to about 209 thousand in 2010-2012. Therefore, it increased by 1/5 when compared to the situation in 2005-2007.

Table 2

Number of holdings of natural persons with the competitive capacity and of those with the potential to be able to achieve it in 2005-2007 and 2010-2012 and their specification

Groups of holdings	Years			
	2005-2007		2010-2012	
	number (thousand)	share (%)[a]	number (thousand)	share (%)[b]
Holdings with the competitive capacity	90.7	5.2	90.3	7.1
Holdings potentially able to achieve the competitive capacity, including:	83.8	4.8	119.1	8.0
– with profit and negative reproduction of assets	68.5	4.0	110.1	7.4
– with financial loss and positive reproduction of assets	15.3	0.8	9.0	0.6
Holdings without the competitive capacity	1,567.1	90.0	1,270.8	84.9

[a] Share in the national population of holdings with more than 1 ha of utilised agricultural area according to the data of 2007.
[b] Share in the national population of holdings with more than 1 ha of utilised agricultural area according to the data of 2010.
Source: as in Table 1.

It has been estimated that in 2010 holdings with the competitive capacity and potentially able to achieve it utilised about 52.5% of utilised agricultural area owned by agricultural holdings of natural persons, but their share in the national agricultural commodity production was probably higher. Against the background of holdings without the competitive capacity, they were distinguished by much larger average area of utilised agricultural area per entity and thus – by the scale of activity (Table 3).

Table 3

Structure of ownership of utilised agricultural area by individual groups of holdings of natural persons in 2010

Groups of holdings	Area (thousand ha)	Share (%)[a]	Average area of a holding (ha)
Holdings with the competitive capacity	3,187	24.1	35.3
Holdings potentially able to achieve the competitive capacity, including:	3,757	28.5	31.5
– with profit and negative reproduction of assets	3,589	27.2	32.6
– with financial loss and positive reproduction of assets	168	1.3	18.7
Holdings without the competitive capacity	6,250	47.4	4.9
Total/on average	13,194	100.0	9.4

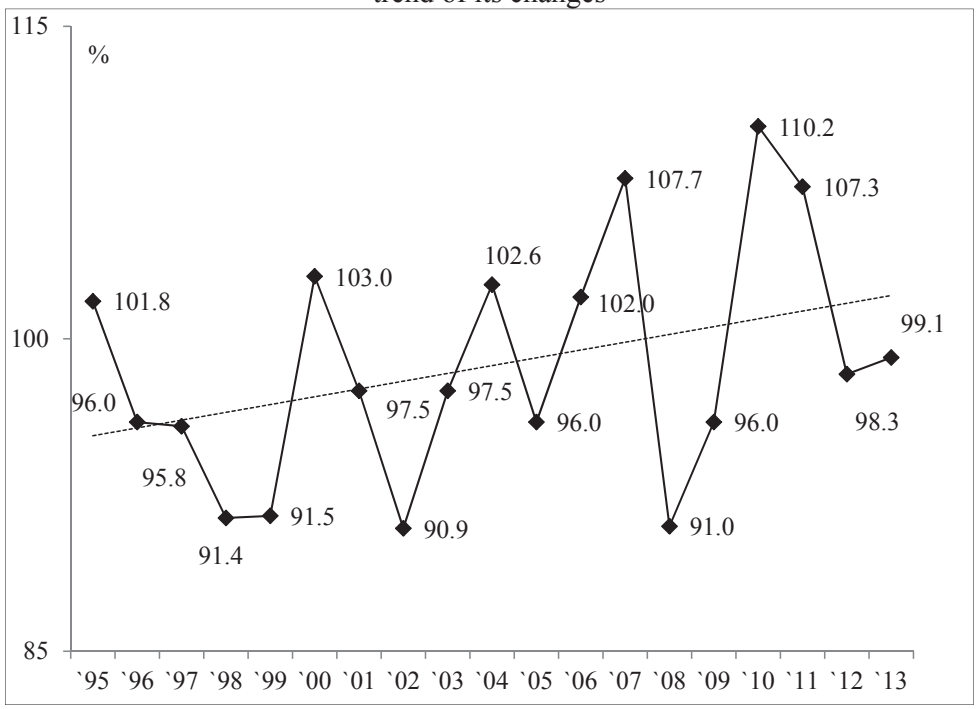
Source: as in Table 1.

It should be added that the conditions which took place in 2010-2012 differed from those of previous years. Direct payment rates in 2011 and 2012, expressed in EUR, stopped growing, but remained at the level of 2010, and a rise in prices of agricultural products was no longer ahead of a rise in prices of means of production (the cumulative indicator of "price scissors" in 2012-2013 remained significantly below 100). This economic downturn could discourage some households with the competitive capacity from implementing investments on a scale ensuring the extended reproduction and as a result they joined the group of holdings with the potential to regain that capacity in case of an economic upswing (Chart 1).

Such a presumption is supported mainly by the fact that the reproduction rate of fixed assets decreased in holdings with the competitive capacity by about 5.0 percentage points, from 7.3% in 2005-2007 to 2.3% in 2010-2012.

Chart 1

Evolution of the price relation indicator (price scissors) for 1995-2013 and the trend of its changes



Source: own elaboration based on the CSO data.

In 2010, at the other extreme there were about 1,687 thousand holdings conducting agricultural activity[2], but with the features indicating the absence of the competitive capacity. The majority of them conducted the agricultural production[3], but their number decreased in 2002-2010 by as much as 29%. For about 7% of holdings from that group, it was not possible to determine the type of the agricultural production they conducted. Some of them probably did not conduct production, but only kept land ready for production.

[2] Together with those with the area of up to 1 ha of utilised agricultural area.

[3] Apart from holdings characterised by the competitive capacity, the records covered holdings which were able to achieve that capacity soon and other holdings running agricultural activity, and in 2010, 383 thousand holdings, which did not run any agricultural activity.

On the basis of the above it may be concluded that subsidies, used by holdings with the features indicating the absence of the competitive capacity, were not allocated for increasing the value of assets and developing the production, but mainly for improving the living conditions of holding owners and their families or for other purposes not related to the agricultural activity. The same conclusion follows also from the monograph by B. Chmielewska [2013]. A similar segmentation method has been used to analyse holdings of legal persons, i.e. mainly of private corporations, agricultural production co-operatives and agricultural holdings from the public sector.

The results of this segmentation (Table 4) inform about the situation differing from that of holdings of natural persons. In 2007-2009, the share of holdings with the competitive capacity and those which were able to achieve that capacity soon was by far higher (93-94%), and the former accounted for about a half of that value. From this it results that the share of holdings without the competitive capacity was about 6-7% only. The reason was the privatisation carried out after changing the socio-economic system in the last decade of the 20th century.

Table 4

Structure of ownership of utilised agricultural area by individual groups of holdings of legal persons in 2007-2012

Groups of holdings	Years					
	2007-2009			2010-2012		
	number	share (%)[a]	area (thousand ha)	number	share (%)[a]	area (thousand ha)
Holdings with the competitive capacity	1,939	47.7	878.7	1,845	50.9	684.5
Holdings potentially able to achieve the competitive capacity, including:	1,862	45.8	844.0	1,606	44.4	596.1
– with profit and negative reproduction of assets	1,475	36.3	668.8	1,488	41.1	552.2
– with financial loss and positive reproduction of assets	387	9.5	175.2	118	3.3	43.9
Holdings without the competitive capacity	264	6.5	119.8	169	4.7	62.7

Source: calculations by A. Kagan prepared based on the results of the monitoring of large--scale agricultural holdings and on the figures published by the CSO.

The changes have affected mainly entities with the negative financial result and the positive reproduction of assets. However, this phenomenon may not be directly identified with the competitiveness itself and its change. This process has resulted from the continuing privatisation process of holdings from the public sector, including, in particular, subsidiary holdings, operating at agricultural schools, after entrusting their management to voivodeship offices. In the ownership transformation process, mostly holdings of natural persons were established, thus, the legal situation of holdings changed or their assets, divided as a result of the privatisation, were purchased by local individual farmers.

We need to stress the adaptation activity of larger Polish agricultural holdings since Poland's integration with the EU, when compared to, for example, Hungarian holdings. Table 5 contains the indicators characterising the profitability of equity and the level of the reproduction of fixed assets in holdings of 16 and more ESU in 2004-2006.

Table 5

Equity profitability indices[a] and reproduction rate of fixed assets[b] in Polish and Hungarian agricultural holdings of natural persons with 16 and more ESU (average sizes in 2004-2006)

Production types of holdings	Equity profitability indices[a] (%) in holdings		Reproduction rate of fixed assets[b] (%) in holdings	
	Polish	Hungarian	Polish	Hungarian
Cereal	6.8	9.1	3.7	1.5
Milk	9.1	9.0	5.3	-0.3
With pig and/or poultry	7.0	4.7	4.0	-0.2
With various plant and animal production	11.4	6.5	16.8	2.5
Arithmetic mean	8.6	7.3	7.4	0.9

[a] Difference between agricultural business income (agricultural income of holdings of natural persons and profits of holdings of legal persons) and the estimated, at the market level, payment for own, executive and administrative work, referred to the value of equity.
[b] Net investment value (gross investment value minus the amount of depreciation) in relation to the value of fixed assets.
Source: [Józwiak et al. 2013].

The positive value of the former indicator informs that income gained by holdings allowed to pay, at the market level, for labour of agricultural families in a holding and the surplus, being in fact profit, informs about gained payment

of equity (in total, of land and resources of other means of production). This profit, referred to the value of equity, allows to assess the level of this payment. The positive reproduction rate of fixed assets informs about the extended reproduction, equal to zero – about the simple reproduction, and negative – about the depreciation of owned fixed assets.

The figures from Table 5 show that larger Polish and Hungarian holdings with all four analysed types of production were profitable over the entire analysed period (2004-2006). Therefore, they were able to pay for labour input at the market level and were left with profit to pay for own means involved in production processes. The average equity profitability index in Polish holdings was slightly higher (by 1.3 percentage point) than in Hungarian holdings, but the average rate of the extended reproduction of fixed assets was higher by as much as 6.5 percentage points. It is probable that this phenomenon was caused by the pressure put on agricultural holdings by the businesses and companies from the Polish food industry. Thanks to that, there has been a significant change in production structures of agriculture and an improvement in the quality of produced goods, with the fairly stable agrarian structure [Urban 2010]. However, this required the intensification of investment processes.

Table 6

Changes in the effectiveness of intermediate consumption costs in Polish agriculture in 1998-2010 (fixed prices of 2003)

Specification	Average annual values in		Values in 1998-2002 = 100
	1998-2002	2006-2010	
Revenue at base prices[a] (PLN million)	52,852	59,751	113.0
Intermediate consumption costs (PLN million)[b]	34,685	35,482	102.3
Gross value added[c] (PLN million)	18,167	24,269	133.6
Amount of revenues in PLN per PLN 100 of the amount of intermediate consumption	152.4	168.4	110.5

[a] Production value and payments to specific types of products.
[b] Costs of means of production and production services (without costs of taxes and foreign production factors).
[c] Difference between revenues and intermediate consumption costs.
Source: [Józwiak 2012a].

Agricultural holdings responded to the changing conditions also in a different way. They specialised their production and took in all sorts of innovation, as well as abandoned the cultivation of less-favoured utilised agricultural area and small-scale animal rearing (usually inefficient). From the figures in Table 6, in

fixed prices, it results that intermediate consumption costs in 2006-2010 were by 2.3% higher than in 1998-2002, but that phenomenon was accompanied by several times faster income growth.

This means that over the analysed period there has been an increase in the efficiency of incurred production costs. The volume of revenues gained in 2006--2010 from the amount of intermediate consumption costs was by 10.5% higher than in 1998-2002.

Specialisation has been one of the more important factors reducing unit production costs in small-scale holdings, thus, in the majority of Polish agricultural holdings. It has reduced unit costs of acquiring information to facilitate effective management, as well as transaction costs associated with sale of finished products, purchase of means of production, applying for loans and subsidies, etc. In addition, holdings with the specialised production did not require such large quantities of machinery and equipment as holdings with the multilateral, thus, non-specialised production. In holdings with the specialised production, costs of depreciation and operation of those means were lower. The role of specialisation is supported by the following numbers. In 2002-2010, the total number of agricultural holdings decreased by 24.3%, but the decrease in the number of specialised holdings amounted to only 6.5%, while the number of holdings with the non-specialised production (with various types of crops, with rearing of various species of animals and mixed plant and animal production) decreased by 47.3%. Probably, some non-specialised holdings disappeared, while others limited the scope of their production and joined holdings specialising in the production of specific goods.

Holdings took in innovations bringing technical, biological, marketing and management progress. Despite the fact that those innovations were applied most probably only in 18-19% of all holdings, those holdings still had more than half of the national agricultural area [Józwiak et al. 2013].

As from 2008, economic effects of agriculture were limited by the growing burdens (incurred production costs and reduction in the production volume), resulting from the implementation of the cross-compliance principle consisting in observing the rules of good agricultural practices [Niewęgłowska 2011]. Burdens related to the implementation of the rules governing animal welfare, which started to apply in 2012 [Józwiak et al. 2013b], were also growing. Benefits from the compliance with those rules appeared with delay and compensated for previously incurred costs only partially. After all, the trend expressed by the growth of agricultural income continued.

What raises concern is the level of the sustainability of agricultural holdings which determines the sustainability of holdings in a longer term. This refers to an overall assessment of the economic situation and the environmental impact of the agricultural production. The analysis showed [Wrzaszcz 2013] that in 2008 only 13% of holdings owned by natural persons and of 2 and more ESU could be regarded as sustainable. On that basis and on the basis of the CSO data, specifying the number and size of holdings conducting agricultural activity, it is possible to estimate that it was 5% of all holdings with the area of 1 ha or more of utilised agricultural area.

Most of them were of the size within the range of 16-40 ESU. The sustainable production does not pose any bigger threats to the natural environment and gained income gives – according to the cited author – a possibility of modernising holdings and supporting farmers and their families at the level not lower than that of families of employees with the average salary in the whole national economy. Therefore, it may not be ruled out that the share of holdings characterised by the sustainability would be larger, if in assessing that phenomenon "payment" for own labour was adopted at the level assumed in the above calculation which had been used to determine the number of holdings with the competitive capacity.

Naturally, the share of holdings, which implement only the selected activities forming the overall sustainability, is higher. The analysis showed [Zieliński 2014], e.g., that 74.0% of holdings specialised in the production of cereals and technologically similar plants and plants covered by the Polish FADN monitoring in 2005-2010 were characterised by the positive balance of carbon dioxide storage (sequestration) in the soil. Thus, persons managing those holdings reduced the negative impact of the agricultural production on the climate.

This means that some Polish agricultural holdings may pose a threat to the environment which is expressed, *inter alia*, in: progressive mineralisation of soil organic matter, pollution of surface waters and confined groundwaters, succession of wild and undesirable vegetation in areas so far used extensively for agricultural purposes, etc.

Similar phenomena take place, to an even smaller extent, in agricultural holdings in areas covered by nature protection. In total, they cover 32.5% of the country, which is a reason why our country is perceived as a "green island" of the EU grouping, and this facilitates and will facilitate, in the future, our foreign trade in agri-food products. Available descriptions of holdings under the European Ecological Network Natura 2000 inform that utilised agricultural area

covers here about 2.5 million ha and it is utilised by less than 303 thousand holdings. Because of a large number of regulations and prohibitions, costs of meeting the cross-compliance requirements with respect to the environmental protection and limited resources of free funds most of the holdings continue the traditional way of conducting the agricultural production.

They are also characterised by the lack of interest in the implementation of the agri-environmental programme. All in all, this limits the income growth and thus interest of the younger generation in taking holdings over from the parental generation.

Income of a small part of other, usually larger, holdings is supplemented by income from agro- and ecotourism, producing regional products or providing various types of services, but practice shows that there is also another solution. So far, few larger agricultural holdings start increasing the utilised area and intensity of their production and become fully market-oriented holdings. These larger holdings from areas covered by nature protection become the main beneficiaries of the agri-environmental programme.

Reasons for an increase in the number of holdings with the competitive capacity

Years 2004-2013

Opening up access to the European Union market was of incredible importance for Polish food producers, as so far that market had been protected by customs and non-tariff systems. As production costs and prices of most foodstuffs in the economically developed countries of the former EU-15 were higher than in Poland, Polish comparative advantages have been revealed. Therefore, the development of the export from Poland was faster than expected, while a threat of the import was less serious [Urban 2010].

It was also important that the status of adaptations of the national food industry to the integration was larger than expected before. As a result of the transformation and modernisation of the food industry, the following took place: inclusion of that industry in the globalisation processes coming before the introduction of regulation systems for major agricultural markets (similar to the EU ones) and gradual adaptation to the EU standards, mostly regarding the quality of manufactured food.

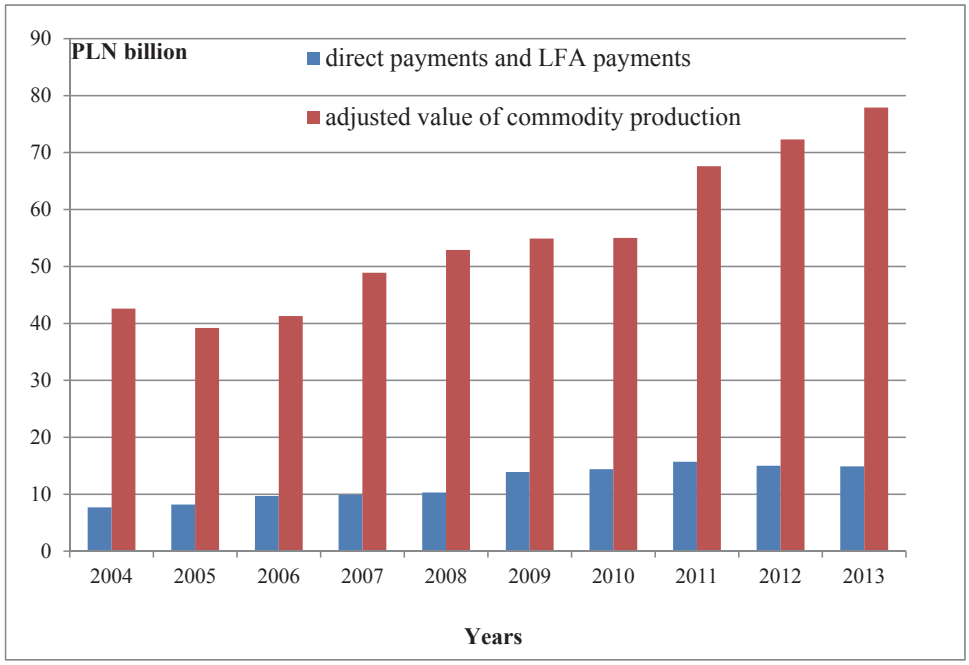
Accession-related financial support for agricultural producers was of conditional nature. The EU administrative authorities imposed the conditions of conducting the agricultural production in such a way so as to bring the private

optimum (understood as an adequate level of economic benefits gained by agricultural producers) close to the social optimum, which takes into account the interests of future generations, by protecting existing ecosystems [Zegar 2012] and other elements of the environment, as well as animal welfare.

In accordance with the expectations, covering Polish agriculture with the Common Agricultural Policy has brought a significant growth in grants (subsidies) which increase income of agricultural holdings (Chart 2). Those grants, calculated at fixed prices, were in 2004 by about eight times higher than the annual average in 1998-2003, and in 2005, and in five subsequent years they still rose. They affected, *inter alia*, the share of grants in agricultural business income (agricultural income of holdings of natural persons and profits of agricultural companies). This share amounted to nearly 10% in 2003, a year later it increased to about 23% and in 2011 it achieved the level of 49.4%.

Chart 2

Value of the commodity production[a] of Polish agriculture, of direct budget support and LFA support in 2004-2013 (current prices)



[a] Commodity production has been adjusted by subsidies and grants directly related to the given type of activity.

Source: own elaboration based on the CSO, ARMA and AMA reports.

Subsidies were not the only external factor increasing income of agricultural producers. The changes in relations of agricultural product prices to prices of means of production purchased by agricultural holdings were also beneficial. This is evidenced by the cumulative indicator of the so-called price scissors, which in 2011 amounted to 108.3 when compared to 2003, adopted as 100.

The most important conditions which in 2004-2013 favoured the establishment of Polish holdings with the competitive capacity and of those which were able to achieve that capacity soon, included, therefore, the income growth. This was enabled by an increase in subsidies for agricultural holdings and those subsidies increased their income and supported investment activities. Another important condition was the development of the food industry and the low wage level which led to an increase in the export of food products, which, in turn, affected a relatively rapid rise in prices of products of agricultural origin. However, we may formulate an opinion that similar conditions, on such a scale and to such an extent, will surely not repeat in the next years.

The establishment of holdings with the competitive capacity and of those which are able to achieve it soon – as pointed out above – was also contributed to by the active attitude of some agricultural producers, which consisted in seeking and implementing various efficiency-oriented activities. Some of them took the form of "simple rationalities" consisting in reducing expenses which did not generate sufficient income. Therefore, the resource of those "simple rationalities" has decreased and only to a limited extent it may contribute to improving the situation of holdings in the next years.

Years 2014-2020

Without fear of making a great error, it may be assumed that in order to improve their own holdings, some Polish agricultural producers will continue to make use of the progress resulting from: implementing various innovations, specialisation of the production and increase in its scale and other efficiency--oriented solutions. We also know that subsidies will be of lesser importance in the income growth than they were in the previous years.

However, there will be the final phase of the current global economic recession, combined with an increase in the demand for products of agricultural origin in the developing countries as a result of the globalisation of the world economy, with the limited possibilities of increasing the supply of these goods due to climate change. In addition, the experiences of the past few years show that there will probably be an increase in the demand for organic

food, although its share in the domestic production of food will be small in the last year of the described period [Drewnowska 2014]. All this will translate into a boom in agricultural products and foodstuffs, and because Poland has participated since 2003 in the global division of labour in this regard, Polish agricultural producers will also benefit from that.

However, we may not completely rule out the development of the situation according to the pessimistic scenario, mainly due to the prolonged economic recession, as indicated by the economic situation of the European Union southern countries – Greece, Portugal, Spain and Italy [Stańczuk 2014]. The prolonged recession may also be contributed to by the tensions which have occurred in Eastern Europe and in some Muslim countries of the Middle East. All this may have a negative impact on the economic situation of the EU countries for several subsequent years. This will reduce a boom in agri-food products. In Poland, other phenomena will coincide with this. As a result of the parliamentary elections, there may be a change in the distribution of political forces, which will lead to the long-time postponed national reform of social security for the agricultural population and of the taxation system for agricultural holdings. Specific effects on income of some agricultural holdings will also be exerted by the liquidation of milk quotas and a potential ban on the import of feedstuffs made of the so-called GMO plants. Of course, we may hope for the adaptation abilities of the national food industry and national agricultural holdings. Nevertheless, in such a situation, it is probable that there will be a reduction in the growth rate of the number of holdings with the competitive capacity, and we may not rule out a reduction in this number as a result of joining the group of holdings with the potential to be able to regain this capacity in case of an economic upswing.

After 2020

Some issues regarding the beginning of the period specified in the title of the subchapter do not require any forecasts as they are already a subject of political arrangements. The more important issues include a reduction in greenhouse gas emissions within the framework of the European Union by 2030. Poland is a significant emitter of these gases in relation to the generated GDP, so both the absence of investment aimed at reducing these emissions (paying contractual penalties), as well as taking such investments using public funds may slow down the Polish economy for some time, and this will have a negative impact on the domestic demand for agri-food products and, as a consequence, on

the number of national agricultural holdings with the competitive capacity and of those which will be able to achieve it.

The need to make new modernisation transformations in the nearest quarter-century in the Polish economy and in the level of life of Polish citizens is more and more frequently and seriously discussed, as the effects of the transformations which have occurred in the last two decades are at an end [Józwiak 2014b]. These future transformations are to be composed of, *inter alia*, the emergence of the creative society and building an economy based on constantly growing level of knowledge gained using scientific methods. The success in the implementation of these transformations, and in fact, in the modernisation leap will facilitate the resolution of problems stemming from: climate change, ageing of the society and potentially others. Therefore, salaries in the national economy will rise, which will result in giving up running small agricultural holdings. As a result, agriculture will be dominated by holdings with the medium and large concentration of production and the majority of them will be characterised by the competitive capacity or will have the features showing that they could achieve this capacity.

Finally, we may try to identify even the more distant time perspective. After all, futurologists do formulate forecasts to indicate future potential threats and opportunities for the further development.

In the media, we are often attacked by disastrous images relating to the nutrition of the global population and the agricultural development in the future, but there are assumptions indicating their falseness. About 2/3 of owners of agricultural holdings on a global scale have very small agricultural holdings, which are cultivated using hand-held tools. Income from these holdings barely provides a minimum standard of living for owners and their families and is not sufficient to purchase means to intensify the production. However, this situation is changing. Globalisation increases the urbanisation processes, which leads to the concentration of land in a decreasing number of holdings, increased intensification of the production and income growth for the farming population, just as it was before in the countries which are currently economically well--developed. Urbanisation has another important aspect for this reasoning. It leads to a decline in the total fertility rate of women, and thus to the slower increase in the demand for food.

Processes of the concentration of land in a decreasing number of holdings in the economically developed countries are becoming less important and there is nothing strange about it. The population here does not grow almost at all and

the comfort of life grows in importance. Therefore, the environmental protection is becoming essential, with an emphasis on procedures aimed at reducing greenhouse gas emissions. Technicised agriculture has a negative impact on the environment, also on its most important aspect – climate. A change in the economic policy objectives in these countries does not necessarily lead to a decrease in the supply of goods of agricultural origin. To a certain extent, procedures associated with sequestration of some greenhouse gases (mainly carbon dioxide) in the soil are complementary, in terms of the effects, to agricultural income [Zieliński 2014], and this income is, after all, positively correlated with the volume of agricultural production. For the above reasons, the eminent futurologist – Jonger Randers [2014] – is convinced that in the middle of the current century (i.e. in about 35 years), there will be enough food for everyone on a global scale. However, access to it is a different issue as not every potential consumer will have funds to buy it. Thus, agriculture may experience the effects of an economic downturn. But in Poland, as in many other developed countries in the world, this will be agriculture characterised by the low employment rate and with holdings whose scale of production is much larger than it is now. There are also indications showing that this will be agriculture implementing environmental targets to an extent larger than it is now.

Summary

An increase in the competitiveness of Polish agricultural holdings is a process consisting in the growing share of holdings characterised by the competitive capacity, thus achieving income meeting the aspirations of owners regarding the standard of living and investing in an agricultural holding. In 2004 and in the following years, Polish agriculture continued adaptation processes initiated before, but new ones have been initiated as a result of a significant increase in subsidies and the impact of the relatively well-developed national food industry. Currently (2010-2012), a dozen or so percent of national agricultural holdings of natural persons are characterised by the competitive capacity or have the potential to be able to achieve this capacity in case of an improvement in the management conditions. It is estimated that they provide about half of the value of the national agricultural production.

A comparison with the situation in Hungary shows that larger Polish agricultural holdings of natural persons adapted more actively to changes in the conditions which occurred in 2004-2012.

From analyses and estimates based thereon it results that the deterioration in the economic conditions limits the growth rate in the number of holdings characterised by the competitive capacity for the benefit of the growth in the number of those which have the potential to be able to achieve this capacity in case of an economic upswing.

The further growth in the number of agricultural holdings with the competitive capacity and of those which could achieve this capacity soon will be determined by conditions other than those that existed in 2004-2012. However, everytime the point will be whether or not these conditions will be conducive to a boom in products of agricultural origin.

Nominal amounts of funds granted within the framework of the Common Agricultural Policy in the new financial perspective (2020) do not differ much from those that existed in 2010-2013. A threat to the further development of Polish agriculture is associated with the possibly prolonged period of the global recession. A threat may also result from the national policy. Limited proceeds to the state budget may, in fact, lead to the revision of the social security system for persons working in their agricultural holdings and to taxation of agricultural holdings with income tax. The specific negative impact will also be exerted on some national agricultural holdings by the liquidation of the so-called milk quota, imposed on the European Union Member States and a potential internal ban on the import of feedstuffs made of GMO plants. All this may limit the favourable trend, which appeared after 2004 in Polish agriculture and consists in the growth in the number of agricultural holdings with the competitive capacity and of those which could achieve this capacity soon.

Around 2030, costs of energy carriers in Poland will probably increase, which will result from the European Union's policy aimed at reducing greenhouse gas emissions. Probably, there will also be a process of the emergence of the creative society and building an economy based on the scientific and technical revolution (constantly growing level of knowledge gained using scientific methods). Both these phenomena will lead to an increase in costs of energy carriers and salaries in the national economy. As a result, the selection of smaller and inefficiently functioning agricultural holdings will be intensified, which will create the conditions for the strengthening of agricultural holdings with the competitive capacity and of those with the potential allowing them to achieve this capacity. It is possible that they will have to face a recession in the demand for products of agricultural origin and this situation may last until the middle of the current century.

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COMPETITIVE POSITION OF AGRICULTURAL HOLDINGS[4] IN POLAND AND OTHER EU COUNTRIES

Introduction

The integration of Poland with the European Union (EU) and covering agriculture with the rules of the Common Agricultural Policy (CAP) have significantly changed the conditions of the functioning, of not only processing and agricultural trade companies, but also agricultural holdings. In principle, possibilities of trade in agri-food products, especially with the old EU countries (EU-15), have increased. This is evidenced by an increase in the export of agri--food products, which in 2004-2012 increased from EUR 5 billion to EUR 17.7 billion, mainly to the EU countries. In 2012, the share of the export to those countries accounted for 76.3% [Łopaciuk 2013]. The production potential of Polish agriculture is significant when compared to other EU countries. This is evidenced by the area of utilised agricultural area (UAA) *per capita*, which in 2010 amounted to 0.38 ha and was significantly higher than in Germany and the Netherlands, where it amounted to, respectively: 0.20 and 0.11 ha, as well as the high share of persons employed in agriculture, which in the recent years amounted to about 14%. The similar index in the EU-15 was included in the range of 2-5%. Opening of the EU market to agri-food products led Polish producers to the competition with similar products from other countries. Farmers were seriously afraid of that kind of competition. As many as 70% of them stated that in 2003 Polish agriculture would not be ready to function within the EU structures and standards [Wilkin 2000]. The dynamic growth in the export of agri-food products, mainly to the EU countries, showed that those products were able to compete in that demanding market. The basic sources of the competitive advantage were the quality and price of those products [Szczepaniak 2007]. It is not primary agricultural producers, i.e. farmers, but trade and agricultural processing companies which compete directly in foreign markets, as the subject of trade are mostly processed products. Their quality and

[4] Production operators in agriculture are commonly called agricultural holdings which conduct the commodity production. They are businesses of various legal forms. This issue is seen in a similar way by F. Tomczak [2003]. The subject of studies are agricultural commodity holdings. Family commodity holdings function as businesses of natural persons, although they are not included in the Act on economic activity. Regardless of this form, there are agricultural businesses in a form of partnerships and corporations as well as cooperatives. The subject of studies are agricultural businesses run by natural persons. In the study, in order to simplify the analysis, we use the terms business and holding interchangeably.

price are to a significant extent determined by raw materials derived from agricultural holdings. The importance of raw materials for agri-food processing is determined by their high share in total costs of finished products. It amounts to about 2/3 [Woś 2003].

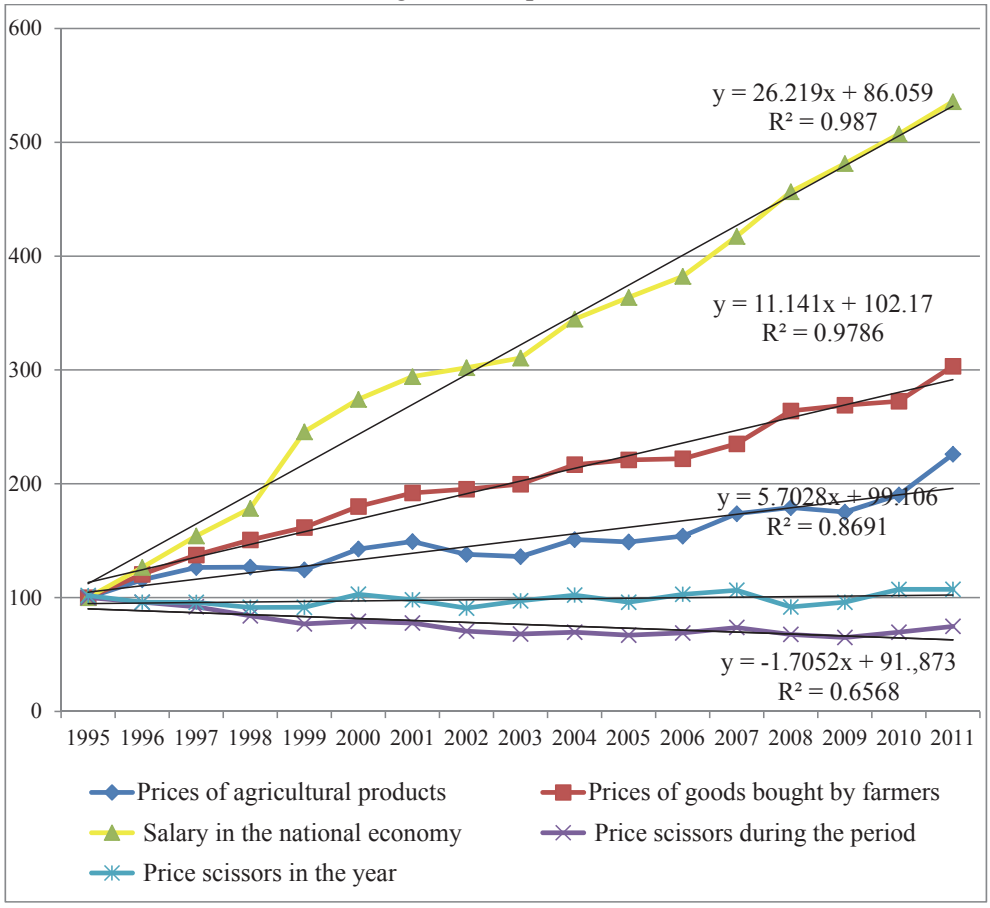
Agricultural holdings function in an environment which is made of various types of institutions, legal regulations and supply and outlet markets. They affect the functioning of holdings which need to adapt to the ever--changing conditions. A significant impact on the functioning of holdings is exerted by trends pertaining to the formation of prices of production factors and agricultural products. Chart 1 shows the trends of changes in costs of production factors and prices of agricultural products in Poland in 1995-2012. These trends are timeless regularities which occur in all countries with market economy. From the Chart presented it results that over the analysed period the highest growth rate was shown by salaries of those employed in the national economy outside of agriculture, which are a primary component of labour costs. Over that period, salaries in the national economy rose by more than five times. Prices of means of production purchased by farmers rose by more than three times, while prices of agricultural products sold by farmers rose by slightly more than twice. The growth rate in salaries outside of agriculture and means of production purchased by farmers which was definitely faster than the growth rate in selling prices of agricultural products leads to a decrease in the cost-effectiveness of the agricultural production.

A farmer wishing to get holding income comparable to salaries of those employed outside agriculture (parity income) must produce an increasing number of products, i.e. increase the labour productivity. He may accomplish this in two ways. The first consists in increasing the level of the production intensity at the given area of a holding, the other in increasing the area of this holding. The first way is possible to be applied on a small scale, due to the existing barrier to demand for agricultural products. It applies to fruit-growing holdings and those involved in the animal production loosely related to land (poultry). The second way, to increase the labour productivity, consists in increasing the area of a holding with the existing level of the production intensity. The use of this way is also limited due to the low supply of land. If some farmers are to be able to increase their holdings, others should give up agricultural production. They will do so if they have an opportunity to work outside of agriculture. The rate of desirable transformations in the agrarian structure is determined by "…the macroeconomic situation prompting decisions on choosing to conduct the non-agricultural activity only" [Sikorska 2013, p. 17]. Therefore, it may be assumed that transformations in the agrarian

structure will be evolutionary, depending on the rate of the national economic development. As mentioned before, the production potential of Polish agriculture is high when compared to other EU countries. However, it is not fully used. The fuller use of this potential is dependent on the growth in the export of agri-food products, because the internal market opportunities are limited. The following thesis should be assumed as reasonable: prerequisite for the development of Polish agriculture is the growth in the export of agri-food products. For this reason, we should carry out studies on the competitive position of Polish commodity holdings which determine the competitiveness of Polish agri-food products in foreign markets.

Chart 1

Trends of changes in costs of production factors and prices of agricultural products



Source: CSO Statistical Yearbooks 1996-2014.

Objective of studies, sources and methods

The objective of the studies is to evaluate the activities and determine the competitive position of Polish agricultural holdings in relation to holdings of selected countries, e.g. selected agricultural types, according to the FADN classification[5]. The studies covered the following basic agricultural types of holdings:

- plant holdings – cereals, oilseed and protein crops (Type 13),
- general fieldcropping holdings (Type 14),
- fruit-growing holdings (Type 32),
- vegetable-growing holdings (Type 20),
- dairy holdings (Type 45),
- holdings rearing other commercial groups of cattle (Type 49),
- pig holdings (Type 51),
- poultry holdings (Type 52).

The primary selection criterion for these agricultural types was their importance in agriculture. The share of plant holdings in 2010 amounted to 37.1% of all holdings, the share of cereals and rapeseed in the cropping structure in that year amounted to, respectively: 72.4% and 9%.

The needed for the studies is "supported" by the risks related to the one--sided use of land, because these are most often holdings without the animal production, which leads to a decrease in soil organic matter and, consequently, to a reduction in its production potential [Kuś 2011; Kuś, Jończyk 2005; Ziętara, Zieliński 2011].

Fruit-growing holdings in 2010 accounted for 20.6% of the total number of holdings. Their share in utilised agricultural area (UAA) was 3.9%, and in the total agricultural production – 12.6%. In these holdings, the land productivity measured by the production value per 1 ha of UAA was by 3.23 times higher than the land productivity in the entire agricultural sector. In addition, strong concentration processes took place in these holdings. A decrease in the number of fruit-growing holdings in 2010, when compared to 2002, was 11%, and in the number of vegetable-growing holdings – 50%. The fruit-growing production is of notably export-oriented nature [Świetlik 2012].

Cattle holdings played an important role in the commodity production. The share of milk and bovine livestock in the animal commodity production in 2010 amounted to 43.2%. The number of dairy holdings decreased by 51.8%

[5] FADN – Farm Accountancy Data Network.

in 2000-2010, while the positive foreign trade balance for dairy products amounted to EUR 913 million. The production in these holdings is also of export-oriented nature [Ziętara, Adamski 2013].

In the recent years, alarming trends have been observed in the production of pig livestock. The share of livestock in the animal commodity production decreased from 37.6% in 2000 to 25.5% in 2012, while the share of poultry livestock increased from 12% to 22%. In 2002-2010, the number of pig holdings decreased by 66% to 260 thousand in 2010. There was also the negative foreign trade balance for products obtained by processing pig livestock, mainly due to the growth in the import of live animals, mainly piglets and weaners, to 5,126.3 thousand heads in 2013.

The consequences of the decrease in the production of pig livestock are numerous, they restrict employment in agriculture (increased unemployment), result in the decreased demand for concentrated feed and consequently restrict the activity of the feed industry and consumption of own cereals for feed. The poultry production in 2000-2012 showed a strong upward trend and clear export-oriented nature, hence the justification for the need to conduct the studies of production growth factors in poultry holdings [Ziętara, Mirkowska, Blicharski, Adamski 2014].

The subject of studies were holdings under the FADN system, selected according to their economic size expressed in ESU[6] and SO[7]. The studies covered the following size classes of holdings: 4-8; 8-16; 16-40; 40-100 and more than 100 ESU, and according to the SO production value, from 2 to more than 500, from: Poland, Hungary, Germany, Denmark and the Netherlands. The studies applied to 2006-2010. Plant holdings (Type 13 and 14) were assessed in 2006-2008, fruit-growing holdings (Type 32 and 20) in 2007-2009, cattle holdings (Type 45 and 49) in 2008-2010, and pig holdings (Type 51) and poultry holdings (Type 52) in 2009-2011. The economic size of plant and fruit--growing holdings was expressed in ESU, while that of dairy, cattle, pig and poultry holdings in SO. This resulted from the availability of the FADN data.

Primary source materials were the accounting data collected under the FADN system and containing the information which allowed to describe the analysed holdings in terms of their production potential, organisation of

[6] ESU – European Size Unit – European measure of the economic size of holdings, corresponding to the equivalent of EUR 1,200 of the standard gross margin.
[7] SO – Standard Output – European measure of the economic size of holdings introduced instead of ESU. It is the five-year average sum of standard production values from individual production activities.

production, costs and effects. The complementary sources were the statistical data from statistical yearbooks and literature.

The descriptive method was the basic method to develop the materials. The studies covered the periods of 3 years. For each period, arithmetic means of individual features were calculated and used in tabular reports and a horizontal analysis. For individual features, change indicators were also calculated, where the value of the feature in the initial year was adopted as a reference basis. The scope of the changes in those periods was limited. Therefore, the calculated averages properly reflect the level of features. The description of analysed holdings assessed the production potential, organisation of production, costs and effects, using the following indicators:

- Production potential of holdings

1. Area of utilised agricultural area (ha),
2. Share of leased land (%),
3. Total labour input (AWU/holding),
4. Total labour input (AWU/100 ha of UAA),
5. Share of own labour in total labour input (%),
6. Value of assets (EUR thousand/ha),
7. Value of assets (EUR thousand/AWU),
8. Share of fixed assets in assets (%),
9. Share of equity in liabilities (%).

- Organisation of production

1. Share of cereals in the area of utilised agricultural area – UAA (%),
2. Stocking density (LU[8]/100 of UAA),
3. Stocking density of pigs (LU/holding and per 100 ha of UAA),
4. Share of the animal production in the total production of a holding (%),
5. Share of the plant production in the total production of a holding (%),
6. Share of other production (%),
7. Share of the production transferred to a household (%).

- Costs

1. Total costs (EUR thousand/ha of UAA),
2. Direct costs (EUR thousand/ha of UAA),
3. Costs of feed for pigs from purchase (EUR/LU),
4. Costs of own feed for pigs (EUR/LU),
5. Other animal production costs (EUR/LU),

[8] LU – Livestock Units, conversion unit of livestock used in studies of the EU-wide FADN. To some extent, it corresponds to the manure unit used (rarely) in Poland.

6. Costs of contract work (EUR/ha of UAA),
7. Land tenure costs (EUR/ha of UAA),
8. Costs of interest (EUR/ha of UAA),
9. Costs of depreciation (EUR/ha of UAA).

- Effects

1. Land productivity[9] (EUR thousand/ha of UAA),
2. Asset productivity (times),
3. Current asset productivity (times),
4. Labour productivity[10] (EUR thousand/AWU),
5. Land profitability[11] (EUR thousand/ha of UAA),
6. Asset profitability (%),
7. Own labour profitability (EUR thousand/FWU),
8. Cost-effectiveness of production – P/C (%),
9. Production profitability – I/P (%),
10. Share of subsidies in holding income (%),
11. Share of subsidies in holding revenues (%),
12. Management income[12] (EUR thousand/holding),
13. Income parity A[13] (%),
14. Income parity B[14] (%),
15. Net investment rate (%).

[9] Land productivity has been defined by the ratio of the production value to the area of UAA, asset productivity has been defined by the ratio of production to assets, and current asset productivity – by the ratio of production to current assets.

[10] Labour productivity has been defined by the ratio of the production value to total labour input expressed in AWU (Annual Work Unit).

[11] Land, asset and own labour profitability (Family Work Unit – FWU) has been defined by the ratio of holding income to the listed production factors.

[12] Management income is the difference between holding income from the farm and costs of use of own production factors – land, labour and capital. The cost of land has been adopted at the level of land tenure within the given size class of holdings, cost of own labour – at the level of payment for contract work within the given class of holdings while the cost of equity – at the level of the interest rate of 10-year bonds.

[13] Income parity "A" is the ratio of holding income per family work unit (FWU) to payment for contract work in holdings from the given size class in each analysed country.

[14] Income parity "B" is the ratio of holding income per family work unit (FWU) to payment for contract work in the national economy (outside agriculture) in the analysed countries.

Efficiency and competitiveness of holdings in theory and practice

The economic efficiency is generally understood as the ratio of obtained outputs to incurred inputs. Economic efficiency can be discussed on the macro- and micro-scale, i.e. with respect to holdings and businesses. This study analyses agricultural holdings. As outputs, the production and agricultural holding income have been adopted. Inputs cover, total costs and direct costs incurred in agricultural holdings as well as involved resources: land, labour and capital[15]. Depending on the adopted reference basis, the efficiency of the use of land, labour and funds has been assessed, using selected indicators. The land use efficiency has been determined by the agricultural production value per 1 ha of UAA (land productivity). The labour use has been assessed using the economic labour productivity indicator understood as the ratio of the production value to labour input expressed in AWU[16].

The efficiency of the use of means of production has been defined by the asset productivity (production value/assets). On the other hand, using the category of agricultural holding income, the profitability of individual production factors has been determined. These indicators, as measures of the economic efficiency of agricultural businesses, are commonly used by many authors [Józwiak 2008; Goraj, Mańko 2011].

The competitiveness is a basic concept appearing in economic sciences. It is a complex concept and includes many features of businesses. According to Świtalski, "the competitiveness of a single company is the ability to meet customer needs more efficiently than competitors" [Świtalski 2005, pp. 163-170]. On the other hand, M.J. Stankiewicz [2003, pp. 184-201] considers the competitiveness of businesses as a system consisting of four elements: competitive potential, competitive advantage, competition instruments and competitive position. The competitive potential is defined by Stankiewicz as complete resources of a business along with its competence and abilities. The competitive advantage is a result of the efficient use of the production potential allowing to generate an attractive market offer and efficient competition instruments. He defines management instruments as tools and methods used knowingly and deliberately to build capital of customers and to create goodwill. Whereas he understands the competitive position as a result achieved by a business in competing in a given sector, against the background of results achieved by competitors.

[15] Capital has been expressed by the value of assets of a holding.
[16] AWU (Annual Work Unit) – unit of labour input equivalent to 1 person fully employed (2,120 working hours/year) in agriculture.

Agricultural businesses from different countries do not compete among themselves directly, but indirectly. According to A. Woś [2003, pp. 7-19]: "We deal with the competitiveness also when individual entities (holdings) are not parties to the agricultural market but their production costs have an essential impact on the competitive capacity of final products". A similar view is expressed by J. Gołębiewski [2001, pp. 318-335], who states: "We cannot talk about the competitive cereal industry without the proper raw materials background, as well as about flexible and efficient agriculture without the efficient sphere of marketing, storage and processing".

The production potential of analysed holdings has been defined by the economic size expressed in ESU and SO and the area of UAA[17], the efficiency has been defined by land, labour and asset productivity indicators, while their competitive position has been defined, for the purpose of the studies, as their development ability determined by the following specific indicators:

– positive management income (businessman's profit),
– parity income,
– net investment rate,
– share of grants in holding income.

The last indicator informs about the impact of the CAP on the profitability of agricultural holdings.

Table 1, for illustrative purposes, provides costs of use of own production factors in analysed plant and fruit-growing holdings, depending on the economic size expressed in ESU. In other types of agricultural holdings, those costs were higher.

[17] The chapter applies the abbrevation UAA instead of the phrase "utilised agricultural area".

Table 1

Costs of own production factors in plant and fruit-growing holdings

Countries	Economic size of holdings (ESU) a/a				
	4-8	8-16	16-40	40-100	>100
	Costs of land (EUR/ha)				
Poland	55.0/-	44.0/85.9	51.3/122.3	103.1/250	57.1/700
Hungary	49.1/-	60.0/67.5	58.4/90.0	71.0/120.0	/96.0/-
Germany	-/-	-/-	147.5/500.0	154.5/585.5	150.2/467.0
Labour costs in agriculture (EUR/h)					
Poland	1.69/-	1.64/1.83	1.69/1.83	2.10/2.15	3.84/2.02
Hungary	2.40/-	2.34/2.24	2.31/2.24	2.70/2.11	4.07/-
Germany	-/-	-/-	6.50/9.10	7.17/7.35	10.57/7.42
Countries	Labour costs in national economy (EUR/h)			Capital costs by 10-year bonds (%)	
Poland	2.62			5.59	
Hungary	4.54			4.26	
Germany	19.23			3.98	

a/a – plant holdings/fruit-growing holdings.
Source: [Ziętara, Zieliński 2011; Ziętara, Sobierajewska 2012].

Production potential, efficiency and competitive position of holdings

Typically plant holdings

Table 2 provides the figures characteristic of the potential, efficiency and competitive position of Polish plant holdings (Type 13 and 14) against the background of relevant Hungarian and German holdings. The production potential has been determined by the economic size of holdings, area of UAA and the production intensity level. The efficiency has been determined by land, labour and asset productivity indicators, while the competitive position has been determined by management income, parity income, net investment rate and the share of grants in holding income. Table 2 and subsequent tables contain the figures characteristic of the potential, efficiency and competitive position of holdings able to develop, i.e. those which achieve positive management income and earn income at the parity level. Through this, they are able to compete. The analysis disregards smaller holdings which did not meet these requirements.

Table 2

Potential and competitive position of Polish plant holdings

Specification	Plant holdings: cereals, oilseed, legumes (Type 13)			Holdings with other fieldcrops (Type 14)		
	Poland	Hungary	Germany	Poland	Hungary	Germany
Economic size (ESU)	8-16	8-16	>100	8-16	8-16	40-100
Area of UAA (ha)	42.5	44.8	552.4	24.7	28.0	77.6
Total costs (EUR thousand/ha)	0.58	0.60	1.269	1.08	0.97	2.01
Land productivity (EUR thousand/ha)	0.69	0.66	1.60	1.40	1.10	2.10
Labour productivity (EUR thousand/ AWU)	19.71	37.53	133.60	15.40	20.30	118.80
Asset productivity (times)	0.24	0.30	0.36	0.30	0.40	0.30
Management income (EUR thousand/ holding)	2.12	3.12	45.38	3.91	2.01	4.81
Income parity (%)	152.8	159.3	159.1	157.8	114.6	70.0
Net investment rate (%)	38.5	-33.6	44.6	14.2	-15.5	58.7
Share of grants in income %	79.6	89.4	185.4	41.8	70.2	74.6

Source: [Ziętara, Zieliński 2011].

From the figures in Table 2 it results that Polish and Hungarian plant holdings had a similar area of UAA within the economic size class of 8-16 ESU.

In Type 13 that area amounted to, respectively, 42.5 and 44.8 ha of UAA, while in Type 14, it amounted to, respectively: 24.5 and 28 ha of UAA. Definitely, the larger area of UAA was held by German holdings of Type 13, where it was 552.4 ha of UAA and was by more than 10 times larger than for Polish and Hungarian holdings, while in Type 14 – it was 77.6 ha of UAA and was by about three times larger than in other holdings. In both types, German holdings were within the class of more than 100 ESU.

The production intensity level for Polish and Hungarian holdings was similar. In Type 13, it was, respectively, EUR 0.58 and 60 thousand per ha, while in Type 14, it was by 1.8 and 1.6 times higher. In German holdings of both types, it was by about 100% higher than in Polish and Hungarian holdings.

Taking into account the value of the indicators in question, it should be stated that the production potential of Polish and Hungarian plant holdings was similar, while that of German holdings was by more than twice higher.

The land productivity for Polish and Hungarian holdings of Type 13 was similar and amounted to, respectively, EUR 0.69 and 0.66 thousand per ha of UAA, while that of German holdings was by more than twice higher. In Type 14, the land productivity in Polish and Hungarian holdings was by about twice higher than in Type 13. In German holdings, the land productivity was EUR 2.10 thousand per ha of UAA and was by, respectively, 50% and 91% higher than in Polish and Hungarian holdings. Definitely, greater differences between analysed holdings took place in case of the labour productivity. In Polish holdings of Type 13, the production value per AWU amounted to EUR 19.7 thousand, while in Hungarian and German holdings it was by 1.9 and 6.8 times higher, respectively. In Type 14, the labour productivity was lower when compared to Type 13 – by 22% in Polish holdings, by 46% in Hungarian holdings and by 11% in German holdings. Definitely smaller differences occurred in the asset productivity, which was within the range from 0.24 in Polish holdings (Type 13) to 0.40 in Hungarian holdings of Type 14.

In conclusion, it may be stated that the efficiency determined by the land, labour and asset productivity in Polish plant holdings was lower than in Hungarian and German holdings.

All analysed holdings gained positive management income. In German holdings, it was definitely higher, especially in those of Type 13, where it amounted to EUR 45.38 thousand, while in Polish and Hungarian holdings it

amounted to, respectively, EUR 2.12 and 3.12 thousand per holding. In Type 14, in Polish holdings it amounted to EUR 3.91 thousand and was by about 95% higher than that of Hungarian holdings and by 19% lower than that of German holdings. All agricultural holdings gained income at the parity level apart from the largest German holdings of Type 14, where it was 70%. The net investment rate in Polish and German holdings was positive, and in Hungarian holdings it was negative. Income in all analysed holdings was dependent on the level of grants. Their share was the highest in German holdings of Type 13 with the economic size of more than 100 ESU, where it amounted to 185.4%. The lowest dependence on grants was demonstrated by Polish holdings of Type 14 and with the economic size of 8-16 ESU in which the share of grants in holding income accounted for 41.8%.

In general, it should be stated that the minimum size of Polish and Hungarian plant holdings with the competitive capacity was within the range of 8-16 ESU and had the area of AL, respectively: 42.5 ha and 24.7 ha in Polish holdings and 44.8 ha and 28.0 ha in Hungarian holdings. The minimum economic size of German holdings amounted to more than 100 ESU and the minimum area of UAA was 552 ha in Type 13 and 77.6 ha in Type 14.

Fruit-growing holdings

The figures characterising the potential, efficiency and competitive position of fruit-growing holdings (Type 32) are provided in Table 3. The minimum economic size of Polish fruit-growing holdings was within the range of 8-16 ESU, while that of Hungarian and German holdings – within the range of 40-100 ESU, and of Dutch holdings – more than 100 ESU. The area of Polish and German holdings amounted to, respectively: 12.9 and 13.6 ha of UAA and of Hungarian and Dutch holdings, respectively: 60.16 ha and 22.73 ha. Among analysed holdings, there were large differences in the level of production intensity, determined by total costs per 1 ha of UAA. The lowest differences were in Hungarian holdings, where those costs amounted to EUR 1.6 thousand per ha, in Polish agricultural holdings they were by about 40% higher. Higher costs were incurred in German holdings – EUR 5.76 thousand per ha.

They were by about 156% higher than in Polish holdings, while in Dutch holdings they amounted to EUR 17.36 thousand per ha and were by almost 8 times higher than in Polish holdings. Taking into account the area and the production intensity level, it should be stated that Dutch holdings had the highest production potential, and Polish holdings – the lowest.

The land productivity level in fruit-growing holdings was diversified to a similar extent as the production intensity. The lowest was in Hungarian holdings – EUR 1.62 thousand per ha, while the highest in Dutch holdings, where it was EUR 19.5 thousand per ha and was by 6.4 times higher than in Polish holdings. Smaller differences occurred in the labour productivity.

In Polish and Hungarian holdings, the production value per 1 AWU was similar and amounted to, respectively: EUR 13.17 and 13.22 thousand. In German and Dutch holdings, it was higher by, respectively, 2.4 and 6.4 times. The asset productivity was similar – from 0.19 (Hungary) to 0.24 (Germany and the Netherlands). Taking into account the productivity of production factors, it should be stated that the efficiency of Dutch and German holdings was higher than that of Polish and Hungarian holdings.

Management income in Polish, Hungarian and Dutch holdings was negative, within the range from EUR -1.77 thousand (Polish) to EUR -12.24 thousand (Dutch). In German holdings, it was positive, but very low, it amounted to EUR 0.08 thousand per holding. Polish and Hungarian holdings gained income close to parity income, while that of German and Dutch holdings was definitely lower, at the level of 36.7% and 49.8%. The net investment rate in Polish and German holdings was positive, while in other holdings – negative.

The share of grants in holding income in Polish, German and Dutch holdings was relatively low, within the range from 17.5% (Germany) to 23.9% (the Netherlands). In Hungarian holdings it was very high, as in fact it amounted to 219.2%. This resulted from the large area of those holdings.

Taking into account management income, parity income and net investment rate, it should be stressed that the competitive position of Polish and Hungarian fruit-growing holdings was higher than that of German and Dutch holdings. The minimum size of Polish and German fruit-growing holdings amounted to about 13 ha, while that of Dutch and Hungarian, respectively: 22.73 ha and 60.16 ha of UAA.

Table 3

Potential and competitive position of Polish fruit-growing holdings

Specification	Fruit-growing holdings (Type 32)			
	Poland	Hungary	Germany	Netherlands
Economic size (ESU)	8-16	40-100	40-100	>100
Area of UAA (ha)	12.90	60.16	13.60	22.73
Total costs (EUR thousand/ha)	2.25	1.60	5.76	17.36
Land productivity (EUR thousand/ha)	3.05	1.62	7.46	19.56
Labour productivity (EUR thousand/AWU)	13.17	13.22	38.55	85.13
Asset productivity (times)	0.20	0.19	0.24	0.24
Management income (EUR thousand/ holding)	-1.77	-9.2	0.08	-12.24
Income parity (%)	114.30	93.70	36.70	49.80
Net investment rate (%)	3.60	-15.60	36.80	-35.20
Share of grants in income (%)	22.90	219.20	17.50	23.60

Source: [Ziętara, Sobierajewska 2012].

Vegetable-growing holdings

The minimum size of Polish and Hungarian vegetable-growing holdings was included within the range of 16-40 ESU, and their area was, respectively, 5.9 and 9.0 ha of UAA, while that of German and Dutch holdings was within the range of 40-100 ESU and their area was, respectively: 2.2 and 6.11 ha of UAA (Table 4). The definitely smaller area of German vegetable-growing holdings resulted from the fact that some of them dealt with the protected production. The production intensity level in analysed holdings was strongly diversified. It was lower in Polish and Hungarian holdings, in which total costs per 1 ha of UAA were, respectively: EUR 10.4 and 14.73 thousand. In German and Dutch holdings, it was higher than that of Polish holdings by, respectively: 7 and 4 times.

Taking into account the area of holdings and the production intensity level, it should be stated that Dutch and German holdings had the greatest production potential, while Polish holdings – the lowest.

The production intensity level was associated with the land productivity, which was the highest in German holdings – about EUR 80 thousand per ha. In Dutch holdings, it was by about 45% lower. The land productivity was definitely lower in Polish and Hungarian holdings, and it was respectively: EUR 13.29 and 18.17 thousand per ha and represented only 16.6% and 22.7% of the land productivity in German holdings.

The diversification degree of the labour productivity was lower than that of the land productivity. The highest labour productivity was achieved by Dutch holdings, where the production value per 1 AWU was EUR 77.17 thousand, i.e. it was by more than three times higher than in Polish and Hungarian holdings and by about 50% higher than in German holdings. The diversification in the asset productivity was lower. The higher asset productivity was achieved by Hungarian and German holdings, where it amounted to about 0.80 and was by about 74% higher than in Polish and Hungarian holdings – 0.49 and 0.43, respectively. Taking into account the above productivity indicators for production factors, it should be stated that from this point of view, German and Dutch vegetable-growing holdings were more efficient than Polish and Hungarian holdings.

All analysed vegetable-growing holdings, except for Dutch holdings, had positive management income. Parity income was gained by Polish and Hungarian holdings, while German and Dutch holdings gained it at the level of, respectively: 37% and 36%. The positive investment rate was achieved by Hungarian and German holdings while Polish and Dutch holdings had the negative one, which was respectively: -3.6% and -109.0%.

Taking into account management income, it may be concluded that the development ability was demonstrated by Polish and Hungarian holdings with the economic size of 16-40 ESU and German holdings within the range of 40--100 ESU. Limited development abilities in this economic size were held by Dutch holdings. Analysed vegetable-growing holdings made use of grants to a minimum extent. Their share in holding income did not exceed 7%.

Table 4

Potential and competitive position of Polish vegetable-growing holdings

Specification	Vegetable-growing holdings Type 20			
	Poland	Hungary	Germany	Netherlands
Economic size (ESU)	16-40	16-40	40-100	40-100
Area of UAA (ha)	5.90	9.00	2.20	6.11
Total costs (EUR thousand/ha)	10.04	14.73	69.27	38.25
Land productivity (EUR thousand/ha)	13.29	18.17	79.98	44.20
Labour productivity (EUR thousand/AWU)	21.69	23.63	51.07	77.18
Asset productivity (times)	0.49	0.80	0.85	0.43
Management income (EUR thousand/holding)	4.75	18.44	5.04	-16.50
Income parity (%)	175.0	455.1	37.0	36.10
Net investment rate (%)	-3.60	94.55	5.30	-109.00
Share of grants in income (%)	6.70	5.70	4.60	5.40

Source: [Ziętara, Sobierajewska 2012].

Dairy and other cattle holdings

The minimum size of Polish and Hungarian dairy holdings was within the range of 50-100 thousand SO and with the area of 48 and 78 ha of UAA, respectively. These holdings kept, respectively, 35 and 30 dairy cows. The minimum size of German and Danish holdings was larger and within the range of EUR 100-500 thousand SO, and of Dutch holdings – more than EUR 500 thousand SO and they had the area of, respectively: 77; 92.80 and 99.27 ha of UAA in which 63; 88 and 178 cows were kept, respectively (Table 5).

In German, Danish and Dutch holdings, the production intensity level was higher than in Polish and Hungarian holdings. The highest total costs per 1 ha of UAA were in Dutch holdings, where they amounted to EUR 5.17 thousand while in Polish holdings they were, respectively: EUR 1.2 and 0.7 thousand.

Taking into account the area of holdings and the intensity level, it should be stated that German, Danish and Dutch holdings had much greater production potential than Polish and Hungarian holdings.

Table 5

Potential and competitive position of Polish dairy holdings

Specification	Dairy holdings (Type 45)				
	Poland	Hungary	Germany	Denmark	Netherlands
Economic size (SO)	50-100	50-100	100-500	100-500	>500
Area of UAA (ha)	48.00	78.00	77.00	92.80	99.27
Total costs (EUR thousand/ha)	1.20	0.70	2.50	4.54	5.17
Number of cows (head)	35	30	63	88	173
Land productivity (EUR thousand/ha)	1.60	0.80	2.64	3.96	5.48
Labour productivity (EUR thousand/AWU)	33.80	28.80	107.50	210.50	202.62
Asset productivity (times)	0.20	0.26	0.24	0.14	0.11
Management income (EUR thousand/holding)	1.11	0.94	-15.30	-137.70	134.29
Income parity (%)	147.2	169.6	54.3	-13.30	88.90
Net investment rate (%)	78.10	1.10	32.10	139.00	162.00
Share of grants in income (%)	40.0	79.8	89.6	-	120.9

Source: [Ziętara, Adamski, Grodzki 2013].

The land productivity in analysed holdings was closely connected to the intensity level. The highest was in Dutch holdings, where it amounted to EUR 5.48 thousand per ha, while the lowest in Hungarian holdings – EUR 0.80 thousand per ha. Similar relationships were noted in the labour productivity. In Dutch holdings, the production value per 1 AWU was EUR 202.62 thousand, in Danish holdings it was slightly higher – EUR 210.5 thousand. The lowest was in Hungarian holdings, where it amounted to EUR 28.80 thousand only.

The asset productivity in Polish, Hungarian and German holdings was similar, ranging from 0.20 (Poland) to 0.26 (Hungary). In Danish and Dutch holdings, it was definitely lower and amounted to, respectively: 0.14 and 0.11. Taking into account the values of the above productivity indicators of production factors, it should be stated that German, Danish and Dutch holdings utilised land and labour more productively, while holdings in Denmark and the Netherlands differed from other holdings in terms of the productivity of other (except land) asset components.

Polish, Hungarian and Dutch holdings gained positive management income, as well as parity income, and positive net investment rate and they demonstrated development abilities. German and Danish holdings, although being definitely bigger than Polish and Hungarian holdings demonstrated negative management income, which was EUR -15.3 thousand and EUR -137.70 thousand per holding. They did not gain parity income either. Their development abilities should be considered limited. Dairy holdings made use of grants to a significant extent. Polish holdings made use of those grants to the lowest extent. The share of grants in holding income accounted for 40% in their case, while in Hungarian and German holdings it was, respectively: 79.8% and 89.6% and in Dutch holdings – 120.9%.

Cattle holdings were found in Poland and Germany only. The minimum size of such holdings in Poland was within the range of EUR 50-100 thousand SO and they had the area of 73.4 ha of UAA. The production intensity level was lower there than in dairy holdings. Total costs per 1 ha of UAA in them were EUR 0.71 thousand. They gained positive income management and parity income thus demonstrating development abilities. German holdings were definitely bigger. Their economic size was within the range of EUR 100-500 thousand SO and their area was 91.31 ha of UAA. They did not gain positive management income and income at the parity level (40%). Their development abilities should be considered limited. Cattle holdings were strongly dependent on grants. The share of grants in holding income in both groups was above 150%. Without grants, cattle holdings could not function.

Pig and poultry holdings[18]

The minimum size of Polish and Hungarian pig holdings was within the range of EUR 50-100 thousand SO and they had the area of, respectively, 30 and 32.4 ha of UAA and pig stocking density of 74 and 88 LU per holding (Table 6). The production intensity level in both types of holdings was the same, it amounted to EUR 2.1 thousand per ha of UAA. The land productivity and labour productivity in these holdings were similar. Hungarian holdings achieved higher asset productivity, which amounted to 0.44 and was by 76% higher than for Polish holdings. Management income for Polish holdings was slightly negative, it amounted to EUR -0.9 thousand. Both groups of the holdings gained parity income and positive net investment rate. It may be concluded that Polish pig holdings with the size of EUR 50-100 thousand SO demonstrate development abilities. German, Dutch and Danish pig holdings with the economic size of EUR 100-500 thousand, despite the high pig stocking density of more than 200 LU per holding, high productivity and labour productivity, do not demonstrate development abilities (Table 6).

Management income was negative for them, ranging from EUR -31.95 (Germany) to EUR -129.37 (Denmark) thousand per holding. Relatively the best situation applied to German holdings, as they achieved parity income and high net investment rate (109.13%). The most difficult situation applied to Danish holdings where holding income was negative. All analysed pig holdings made use of support under the CAP. The share of grants in income was within the range from 36% (Poland) to 62% (Germany).

The minimum economic size of Polish, Hungarian and German poultry holdings was within the range of EUR 50-100 thousand SO per holding. The area of Hungarian and Polish holdings was, respectively, 12 and 16 ha of UAA, while that of German holdings was higher and amounted to 19 ha of UAA. The production intensity level was little diversified, within the range from EUR 6.4 thousand per ha (Germany) to EUR 7.5 thousand per ha of UAA (Poland). Poultry holdings of the analysed size have development abilities, despite the fact that Hungarian and German holdings gain income slightly below the parity level, of respectively 90% and 85%. Dutch and Danish poultry holdings did not demonstrate development abilities, regardless of their economic size.

[18] This applies to holdings specialising in rearing pigs or poultry.

Table 6

Potential and competitive position of Polish pig holdings

Specification	Pig holdings (Type 51)				
	Poland	Hungary	Germany	Denmark	Netherlands
Economic size (SO)	50-100	50-100	100-500	100-500	100-500
Area of UAA (ha)	30.00	32.40	54.38	72.60	6.39
Total costs (EUR thousand/ha)	2.10	2.10	4.90	5.61	46.50
Pig stocking density/ holding	74.40	87.85	212.40	297.75	283.80
Land productivity (EUR thousand/ha)	2.55	2.56	5.09	5.17	47.55
Labour productivity (EUR thousand/AWU)	40.40	42.56	165.65	281.39	274.81
Asset productivity (times)	0.25	0.44	0.32	0.17	0.30
Management income (EUR thousand/ holding)	-0.90	2.20	-31.95	-129.37	-55.89
Income parity (%)	142.00	276.00	112.45	-31.02	16.19
Net investment rate (%)	140.18	91.55	109.13	34.76	84.22
Share of grants in income (%)	36.00	44.00	62.00	-	41.25

Source: [Ziętara, Adamski, Blicharski, Mirkowska 2014].

Summary

When assessing the competitiveness of Polish holdings against the background of the selected countries, it should be stated that they do not compete directly only indirectly with similar holdings from other countries. The competitiveness of analysed agricultural holdings has been defined by determining their development abilities under the conditions of a given country.

The following were adopted as criteria of development abilities and competitiveness:

– positive management income,
– holding income at the parity level,
– positive net investment rate.

The minimum size of Polish and Hungarian cereal holdings (Type 13) with development abilities was 8-16 ESU and their minimum area was 42 and 45 ha of UAA, while the minimum size of German holdings of Type 13 was more than 100 ESU and 552 ha of UAA. The minimum size of Polish and Hungarian holdings with mixed fieldcrops (Type 14) was 8-16 ESU and, respectively, 25 and 28 ha of UAA, while that of German holdings – 40-100 ESU and 78 ha of UAA.

The minimum size and area of Polish fruit-growing holdings was 8-16 ESU and 13 ha of UAA, while in case of Hungarian and German holdings it was 40-100 ESU and, respectively, 60 and 14 ha of UAA, and the minimum size of Dutch fruit-growing holdings was more than 100 ESU and 22.73 ha of UAA.

The minimum size and area of Polish and Hungarian vegetable-growing holdings was 16-40 ESU and, respectively, 6 and 9 ha, and that of German and Dutch holdings: 40-100 ESU and 2.2 and 6.11 ha of UAA.

The minimum size and area of Polish and Hungarian dairy holdings was within the range of EUR 50-100 thousand SO, and 48 and 78 ha of UAA and the number of kept cows was 35 and 30 heads. On the other hand, the minimum size of German and Danish holdings was within the range of EUR 100-500 thousand SO, and of Dutch holdings – more than EUR 500 thousand SO and their area respectively: 77; 92.80 and 99.27 ha of UAA. The number of cows in those holdings amounted to, respectively: 63, 88 and 173 heads.

The minimum economic size of Polish cattle holdings was within the range of EUR 50-100 thousand SO and their area was 73.4 ha of UAA, while the size of German holdings was within the range of EUR 100-500 thousand SO and their area was 91.31 ha of UAA. Polish cattle holdings of the given economic size demonstrated development abilities, while German holdings,

despite the greater production potential, did not have such abilities. The main source of income for these holdings were grants whose share in income exceeded 150%.

The minimum economic size and area of Polish and Hungarian pig holdings was within the range of EUR 50-100 thousand SO and their area, respectively, 30 and 32 ha of UAA, and 74 and 78 LU per holding, while in case of German, Danish and Dutch holdings – within the range of EUR 100-500 thousand SO and their area respectively: 54.38; 72.60 and 6.39 ha of UAA and the population of pigs of more than 212 LU per holding. Development abilities of German, Danish and Dutch pig holdings were limited, as they did not gain management profit.

The minimum size and area of Polish, Hungarian and German poultry holdings was within the range of EUR 50-100 thousand per SO and, respectively, 12, 16 and 19 ha of UAA, and 63, 58 and 45 LU per holding. Danish and Dutch poultry holdings did not demonstrate development abilities regardless of their economic size.

The provided minimum economic sizes of holdings and their area in terms of their development abilities, and thus of holdings able to compete indirectly with similar holdings from other countries are significantly different from the average sizes of holdings which are definitely lower. This means that the vast majority of Polish holdings do not have development abilities and are unable to compete. They do not provide farmers, running this type of holdings, with income at the parity level. The prerequisite for the functioning of these holdings is to gain income from non-agricultural activities.

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ANNEX I

1. Assessment of the production potential, organisation of production, costs and effects in cereal holdings and holdings with other fieldcrops, depending on their economic size, in Poland and in the selected countries in 2006-2008

Table AI.1.1

Area of utilised agricultural area and ownership relations in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Area of UAA in Polish holdings	ha	22.1	42.5	93.3	223.9	793.5
Area of UAA in Hungarian holdings	ha	21.3	44.8	97.7	229.8	1012.2
Area of UAA in German holdings	ha	-	-	57.3	133.5	552.4
Share of leased land in Polish holdings	%	23.1	32.1	42.1	50.2	62.6
Share of leased land in Hungarian holdings	%	28.2	41.0	49.9	62.3	92.3
Share of leased land in German holdings	%	-	-	60.8	68.4	80.4

Source: own calculations based on the FADN data.

Table AI.1.2

Total labour input (AWU) per 100 ha of UAA and share of own labour in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Labour input in Polish holdings	AWU/ 100 ha	5.62	3.50	1.96	1.33	1.28
Labour input in Hungarian holdings	AWU/ 100 ha	2.45	1.77	1.35	1.14	1.65
Labour input in German holdings	AWU/ 100 ha	-	-	2.14	1.16	0.87
Share of own labour in Polish holdings	%	98.70	94.40	85.27	56.77	7.53
Share of own labour in Hungarian holdings	%	91.72	84.97	71.00	40.26	2.61
Share of own labour in German holdings	%	-	-	95.68	87.53	27.28

Source: own calculations based on the FADN.

Table AI.1.3

Value of assets in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Value of assets in Polish holdings	EUR thousand/ ha	3.24	3.10	2.47	2.10	2.12
Value of assets in Hungarian holdings	EUR thousand/ ha	2.51	2.15	1.97	1.90	1.44
Value of assets in German holdings	EUR thousand/ ha	-	-	11.56	6.48	3.20
Value of assets in Polish holdings	EUR thousand/ AWU	57.53	88.00	126.42	159.41	165.07
Value of assets in Hungarian holdings	EUR thousand/ AWU	101.15	123.16	146.50	165.23	88.54
Value of assets in German holdings	EUR thousand/ AWU	-	-	537.93	558.61	368.46

Source: own calculations based on the FADN data.

Table AI.1.4

Share of fixed assets in assets and of equity in liabilities in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Share of fixed assets in Polish holdings	84.13	82.70	80.30	76.95	63.66
Share of fixed assets in Hungarian holdings	65.17	65.10	69.20	68.70	50.36
Share of fixed assets in German holdings	-	-	93.17	90.80	78.00
Share of equity in Polish holdings	92.10	85.70	78.61	73.35	69.43
Share of equity in Hungarian holdings	85.44	84.24	75.15	72.37	67.71
Share of equity in German holdings	-	-	90.33	84.43	70.84

Source: own calculations based on the FADN data.

Table AI.1.5

Organisation of production in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Share of cereals in Polish holdings	%	76.90	74.30	74.10	73.73	67.50
Share of cereals in Hungarian holdings	%	72.70	69.10	66.67	65.43	66.23
Share of cereals in German holdings	%	-	-	61.80	62.53	60.37
Stocking density in Polish holdings	LU/ 100 ha	5.50	5.40	4.90	3.07	3.43
Stocking density in German holdings	LU/ 100 ha	11.30	7.80	4.36	3.13	3.00
Stocking density in German holdings	LU/ 100 ha	-	-	11.03	11.63	10.73

Source: own calculations based on the FADN data.

Table AI.1.6

Structure of production in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Share of plant production in Polish holdings	89.50	90.60	91.60	92.07	94.63
Share of plant production in Hungarian holdings	85.20	89.90	90.50	88.50	83.16
Share of plant production in German holdings	-	-	71.27	78.20	82.50
Share of animal production in Polish holdings	7.30	7.30	6.50	6.13	2.77
Share of animal production in Hungarian holdings	10.70	7.20	4.43	3.50	3.00
Share of animal production in German holdings	-	-	9.57	10.36	7.90

Source: own calculations based on the FADN data.

Table AI.1.7

Total costs and direct costs in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008
(EUR thousand/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Total costs in Polish holdings	0.580	0.580	0.582	0.609	0.835
Total costs in Hungarian holdings	0.630	0.600	0.630	0.705	0.886
Total costs in German holdings	-	-	1.255	1.215	1.269
Direct costs in Polish holdings	0.240	0.260	0.294	0.307	0.369
Direct costs in Hungarian holdings	0.240	0.230	0.232	0.241	0.269
Direct costs in German holdings	-	-	0.373	0.438	0.441

Source: own calculations based on the FADN data.

Table AI.1.8

Costs of plant protection products and of seeds in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008
(EUR thousand/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Costs of plant protection products in Polish holdings	0.050	0.050	0.067	0.072	0.104
Costs of plant protection products in Hungarian holdings	0.040	0.040	0.050	0.057	0.075
Costs of plant protection products in German holdings	-	-	0.097	0.122	0.132
Costs of seeds in Polish holdings	0.040	0.050	0.046	0.049	0.061
Costs of seeds in Hungarian holdings	0.070	0.060	0.066	0.065	0.062
Costs of seeds in German holdings	-	-	0.059	0.065	0.067

Source: own calculations based on the FADN data.

Table AI.1.9

Costs of contract work and of interest in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (EUR thousand/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Costs of contract work in Polish holdings	0.009	0.007	0.011	0.027	0.097
Costs of contract work in Hungarian holdings	0.010	0.013	0.022	0.029	0.033
Costs of contract work in German holdings	-	-	0.016	0.028	0.159
Costs of interest in Polish holdings	0.004	0.013	0.015	0.016	0.017
Costs of interest in Hungarian holdings	0.006	0.013	0.022	0.029	0.033
Costs of interest in German holdings	-	-	0.037	0.038	0.040

Source: own calculations based on the FADN data.

Table AI.1.10

Land tenure costs and costs of depreciation in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (EUR thousand/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Land tenure costs in Polish holdings	0.010	0.012	0.016	0.022	0.036
Land tenure costs in Hungarian holdings	0.013	0.023	0.030	0.045	0.078
Land tenure costs in German holdings	-	-	0.109	0.128	0.155
Costs of depreciation in Polish holdings	0.140	0.130	0.106	0.093	0.075
Costs of depreciation in Hungarian holdings	0.096	0.090	0.104	0.120	0.091
Costs of depreciation in German holdings	-	-	0.220	0.192	0.145

Source: own calculations based on the FADN data.

Table AI.1.11

Level of yields of wheat and corn in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (dt/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Yield of wheat in Polish holdings	47.6	48.4	49.4	48.6	53.1
Yield of wheat in Hungarian holdings	38.8	41.4	41.4	42.2	42.3
Yield of wheat in German holdings	-	-	67.6	69.9	70.1
Yield of corn in Polish holdings	63.8	69.5	67.0	63.7	63.4
Yield of corn in Hungarian holdings	64.1	65.0	65.1	65.6	63.3
Yield of corn in German holdings	-	-	88.4	93.4	93.1

Source: own calculations based on the FADN data.

Table AI.1.12

Land productivity and labour productivity in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Land productivity in Polish holdings	EUR thousand/ ha	0.685	0.687	0.711	0.739	0.824
Land productivity in Hungarian holdings	EUR thousand/ ha	0.673	0.659	0.678	0.720	0.836
Land productivity in German holdings	EUR thousand/ ha	-	-	1.088	1.156	1.160
Labour productivity in Polish holdings	EUR thousand/ AWU	12.214	19.710	36.340	56.000	63.340
Labour productivity in Hungarian holdings	EUR thousand/ AWU	27.170	37.530	50.580	62.900	51.200
Labour productivity in German holdings	EUR thousand/ AWU	-	-	50.730	99.800	133.600

Source: own calculations based on the FADN data.

Table AI.1.13

Asset productivity and current asset productivity in cereal holdings (Type 13) in Poland, Germany and Hungary, depending on the economic size, in 2006-2008 (times)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Asset productivity in Polish holdings	0.21	0.243	0.29	0.35	0.42
Asset productivity in Hungarian holdings	0.27	0.303	0.34	0.38	0.58
Asset productivity in German holdings	-	-	0.09	0.18	0.36
Current asset productivity in Polish holdings	2.90	2.64	2.48	2.41	2.24
Current asset productivity in Hungarian holdings	2.79	2.87	2.92	2.98	3.09
Current asset productivity in German holdings	-	-	2.94	2.65	2.63

Source: own calculations based on the FADN data.

Table AI.1.14

Land and asset profitability in cereal holdings (Type 13) in Poland, Germany and Hungary, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Land profitability in Polish holdings	EUR thousand/ ha	0.302	0.286	0.313	0.314	0.148
Land profitability in Hungarian holdings	EUR thousand/ ha	0.208	0.238	0.257	0.233	0.167
Land profitability in German holdings	EUR thousand/ ha	-	-	0.137	0.258	0.209
Asset profitability in Polish holdings	%	9.30	10.10	12.70	15.00	8.00
Asset profitability in Hungarian holdings	%	8.200	10.90	13.10	12.10	10.80
Asset profitability in German holdings	%	-	-	3.50	4.00	6.50

Source: own calculations based on the FADN data.

Table AI.1.15

Own labour profitability, management income and share of subsidies in holding income in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Own labour profitability in Polish holdings	EUR thousand/ FWU	5.45	8.73	18.84	41.56	73.93
Own labour profitability in Hungarian holdings	EUR thousand/ FWU	9.13	15.81	27.19	51.180	385.60
Own labour profitability in German holdings	EUR thousand/ FWU	-	-	6.72	25.47	88.10
Management income in Polish holdings	EUR thousand/ holding	-4.80	2.12	8.44	16.52	43.51
Management income in Hungarian holdings	EUR thousand/ holding	0.11	3.12	13.57	32.40	113.07
Management income in German holdings	EUR thousand/ holding	-	-	-22.96	-10.30	45.38
Share of subsidies in holding income in Polish holdings	%	80.0	79.6	71.4	73.1	244.6
Share of subsidies in holding income in Hungarian holdings	%	91.5	89.4	87.4	104.5	141.9
Share of subsidies in holding income in German holdings	%	-	-	277.7	137.5	185.4

Source: own calculations based on the FADN data.

Table AI.1.16

Income parity in relation to payment for contract work in agriculture and in the national economy in cereal holdings (Type 13) in Poland, Germany and Hungary, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Income parity in relation to payment for work in agriculture in Polish holdings (A)	148.40	237.60	457.70	811.00	908.20
Income parity in relation to payment for work in agriculture in Hungarian holdings (A)	172.8	269.1	488.50	871.30	4143.50
Income parity in relation to payment for work in agriculture in German holdings (A)	-	-	40.50	136.20	351.20
Income parity in relation to payment for work in the national economy in Polish holdings (B)	94.2	152.80	329.80	723.10	1317.40
Income parity in relation to payment for work in the national economy in Hungarian holdings (B)	92.00	159.30	274.00	515.80	3886.30
Income parity in relation to payment for work in the national economy in German holdings (B)	-	-	15.90	60.20	159.10

Source: own calculations based on the FADN data.

Table AI.1.17

Net investment rate in cereal holdings (Type 13) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Net investment rate in Polish holdings	- 47.8	38.5	83.3	108.6	151.9
Net investment rate in Hungarian holdings	- 67.8	- 33.6	19.3	28.0	32.1
Net investment rate in German holdings	-	-	- 8.2	65.8	44.4

Source: own calculations based on the FADN data.

Table AI.1.18

Area of utilised agricultural area and ownership relations in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Area of utilised agricultural area in Polish holdings	ha	13.3	24.7	50.1	114.9	555.2
Area of utilised agricultural area in Hungarian holdings	ha	-	28.0	37.9	156.3	881.4
Area of utilised agricultural area in German holdings	ha	-	-	39.1	77.6	246.4
Share of leased land in Polish holdings	%	19.0	25.1	32.5	36.7	71.6
Share of leased land in Hungarian holdings	%	-	33.1	39.9	59.0	95.9
Share of leased land in German holdings	%	-	-	54.6	58.0	77.5

Source: own calculations based on the FADN data.

Table AI.1.19

Total labour input (AWU) per 100 ha of UAA and share of own labour in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Total labour input in Polish holdings	AWU/100 ha	15.10	9.10	5.40	2.70	2.20
Total labour input in Hungarian holdings	AWU/100 ha	-	5.60	2.70	2.20	2.20
Total labour input in German holdings	AWU/100 ha	-	-	3.40	2.30	1.70
Share of own labour in Polish holdings	%	79.80	74.10	65.90	55.70	9.20
Share of own labour in Hungarian holdings	%	-	60.20	52.10	26.90	1.90
Share of own labour in German holdings	%	-	-	88.20	73.60	31.10

Source: own calculations based on the FADN data.

Table AI.1.20

Value of assets in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Value of assets in Polish holdings	EUR thousand/ ha	5.50	4.50	3.90	3.20	2.40
Value of assets in Hungarian holdings	EUR thousand/ ha	-	3.10	2.60	2.40	1.90
Value of assets in German holdings	EUR thousand/ ha	-	-	15.00	13.40	6.30
Value of assets in Polish holdings	EUR thousand/ AWU	37.10	50.00	72.50	119.00	109.50
Value of assets in Hungarian holdings	EUR thousand/ AWU	-	56.80	97.30	110.50	88.40
Value of assets in German holdings	EUR thousand/ AWU	-	-	442.40	590.80	360.50

Source: own calculations based on the FADN data.

Table AI.1.21

Share of fixed assets in assets and of equity in liabilities in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Share of fixed assets in Polish holdings	81.30	80.80	80.10	78.90	62.10
Share of fixed assets in Hungarian holdings	-	65.90	68.30	71.10	53.30
Share of fixed assets in German holdings	-	-	92.50	91.90	81.50
Share of equity in Polish holdings	93.70	90.40	85.00	83.10	68.60
Share of equity in Hungarian holdings	-	85.70	81.50	71.50	60.10
Share of equity in German holdings	-	-	90.50	91.30	75.30

Source: own calculations based on the FADN data.

Table AI.1.22

Organisation of production in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Share of cereals in Polish holdings	%	51.20	52.90	54.60	56.40	54.00
Share of cereals in Hungarian holdings	%	-	46.70	43.70	50.00	51.00
Share of cereals in German holdings	%	-	-	52.10	54.20	48.10
Stocking density in Polish holdings	LU/ 100 ha	11.70	13.40	14.50	8.70	12.20
Stocking density in Hungarian holdings	LU/ 100 ha	-	19.80	12.50	11.40	8.70
Stocking density in German holdings	LU/ 100 ha	-	-	16.50	19.50	26.60

Source: own calculations based on the FADN data.

Table AI.1.23

Structure of production in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Share of plant production in Polish holdings	93.80	92.20	90.40	93.30	86.20
Share of plant production in Hungarian holdings	-	88.60	88.50	83.70	79.40
Share of plant production in German holdings	-	-	69.10	78.10	78.90
Share of animal production in Polish holdings	5.00	6.70	8.40	5.60	11.60
Share of animal production in Hungarian holdings	-	9.90	8.30	8.30	8.40
Share of animal production in German holdings	-	-	8.60	9.50	13.10

Source: own calculations based on the FADN data.

Table AI.1.24

Total costs and direct costs in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (EUR thousand/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Total costs in Polish holdings	1.20	1.08	0.92	0.86	1.12
Total costs in Hungarian holdings	-	0.97	0.78	0.88	1.15
Total costs in German holdings	-	-	1.74	1.83	2.01
Direct costs in Polish holdings	0.45	0.42	0.44	0.43	0.48
Direct costs in Hungarian holdings	-	0.37	0.28	0.31	0.34
Direct costs in German holdings	-	-	0.49	0.62	0.70

Source: own calculations based on the FADN data.

Table AI.1.25

Costs of plant protection products and of seeds in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (EUR thousand/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Costs of plant protection products in Polish holdings	0.07	0.08	0.09	0.11	0.12
Costs of plant protection products in Hungarian holdings	-	0.05	0.05	0.07	0.09
Costs of plant protection products in German holdings	-	-	0.11	0.16	0.15
Costs of seeds in Polish holdings	0.10	0.10	0.09	0.09	0.10
Costs of seeds in Hungarian holdings	-	0.14	0.09	0.09	0.09
Costs of seeds in German holdings	-	-	0.12	0.12	0.16

Source: own calculations based on the FADN data.

Table AI.1.26

Costs of contract work and of interest in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (EUR thousand/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Costs of contract work in Polish holdings	0.11	0.08	0.06	0.05	0.17
Costs of contract work in Hungarian holdings	-	0.08	0.07	0.09	0.19
Costs of contract work in German holdings	-	-	0.05	0.08	0.26
Costs of interest in Polish holdings	0.01	0.01	0.02	0.01	0.02
Costs of interest in Hungarian holdings	-	0.00	0.02	0.03	0.04
Costs of interest in German holdings	-	-	0.06	0.04	0.05

Source: own calculations based on the FADN data.

Table AI.1.27

Land tenure costs and costs of depreciation in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (EUR thousand/ha)

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Land tenure costs in Polish holdings	EUR thousand/ ha	0.01	0.01	0.02	0.02	0.04
Land tenure costs in Hungarian holdings	EUR thousand/ ha	-	0.02	0.02	0.04	0.11
Land tenure costs in German holdings	EUR thousand/ ha	-	-	0.14	0.18	0.20
Costs of depreciation in Polish holdings	EUR thousand/ ha	0.30	0.24	0.17	0.14	0.11
Costs of depreciation in Hungarian holdings	EUR thousand/ ha	-	0.18	0.13	0.13	0.12
Costs of depreciation in German holdings	EUR thousand/ ha	-	-	0.27	0.28	0.24

Source: own calculations based on the FADN data.

Table AI.1.28

Level of yields of wheat and corn in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (dt/ha)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Yield of wheat in Polish holdings	44.6	46.9	51.0	55.2	57.3
Yield of wheat in Hungarian holdings	-	35.8	39.6	43.0	44.9
Yield of wheat in German holdings	-	-	73.9	77.9	72.3
Yield of corn in Polish holdings	62.9	70.8	69.9	63.7	63.8
Yield of corn in Hungarian holdings	-	61.3	68.7	69.0	70.7
Yield of corn in German holdings	-	-	80.4	82.2	81.1

Source: own calculations based on the FADN data.

Table AI.1.29

Land productivity and labour productivity in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Land productivity in Polish holdings	EUR thousand/ ha	1.70	1.40	1.30	1.10	1.10
Land productivity in Hungarian holdings	EUR thousand/ ha	-	1.10	0.90	0.90	1.10
Land productivity in German holdings	EUR thousand/ ha	-	-	1.80	2.00	2.10
Labour productivity in Polish holdings	EUR thousand/ AWU	11.30	15.40	23.10	41.60	49.70
Labour productivity in Hungarian holdings	EUR thousand/ AWU	-	20.30	32.60	42.10	48.60
Labour productivity in German holdings	EUR thousand/ AWU	-	-	53.70	88.90	118.80

Source: own calculations based on the FADN data.

Table AI.1.30

Asset productivity and current asset productivity in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (times)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Asset productivity in Polish holdings	0.30	0.30	0.30	0.40	0.50
Asset productivity in Hungarian holdings	-	0.40	0.30	0.40	0.60
Asset productivity in German holdings	-	-	0.10	0.20	0.30
Current asset productivity in Polish holdings	3.80	3.40	2.90	2.60	2.60
Current asset productivity in Hungarian holdings	-	3.00	3.20	2.90	3.10
Current asset productivity in German holdings	-	-	3.70	1.30	3.00

Source: own calculations based on the FADN data.

Table AI.1.31

Land and asset profitability in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Land profitability in Polish holdings	EUR thousand/ ha	0.70	0.60	0.60	0.50	0.20
Land profitability in Hungarian holdings	EUR thousand/ ha	-	0.40	0.30	0.40	0.20
Land profitability in German holdings	EUR thousand/ ha	-	-	0.50	0.60	0.40
Asset profitability in Polish holdings	%	12.70	13.60	14.00	15.00	5.30
Asset profitability in Hungarian holdings	%	-	12.00	12.00	15.30	7.30
Asset profitability in German holdings	%	-	-	3.00	4.00	6.30

Source: own calculations based on the FADN data.

Table AI.1.32

Own labour profitability, management income and share of subsidies in holding income in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008

Specification	Unit	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Own labour profitability in Polish holdings	EUR thousand/ FWU	5.80	9.10	15.00	31.40	71.90
Own labour profitability in Hungarian holdings	EUR thousand/ FWU	-	11.40	23.40	63.60	359.30
Own labour profitability in German holdings	EUR thousand/ FWU	-	-	14.30	33.10	75.70
Management income in Polish holdings	EUR thousand/ holding	-1.86	3.911	11.65	30.41	19.97
Management income in Hungarian holdings	EUR thousand/ holding	-	2.01	9.13	27.87	77.48
Management income in German holdings	EUR thousand/ holding	-	-	-7.88	4.813	40.31
Share of subsidies in income in Polish holdings	%	37.30	41.80	45.90	52.40	148.90
Share of subsidies in income in Hungarian holdings	%	54.70	70.20	69.90	94.90	169.20
Share of subsidies in income in German holdings	%	-	-	106.80	74.60	83.20

Source: own calculations based on the FADN data.

Table AI.1.33

Income parity in relation to payment for contract work in agriculture and in the national economy in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Income parity A in Polish holdings	162.3	271.0	445.0	749.0	833.0
Income parity A in Hungarian holdings	-	259.0	503.0	1082.0	4172.0
Income parity A in German holdings	-	-	116.0	257.0	354.0
Income parity B in Polish holdings	100.2	157.8	258.6	543.9	1243.1
Income parity B in Hungarian holdings	-	114.6	235.1	640.5	3685.5
Income parity B in German holdings	-	-	33.2	77.0	176.1

Source: own calculations based on the FADN data.

Table AI.1.34

Net investment rate in holdings with other fieldcrops (Type 14) in Poland, Hungary and Germany, depending on the economic size, in 2006-2008 (%)

Specification	4-8 ESU	8-16 ESU	16-40 ESU	40-100 ESU	>100 ESU
Net investment rate in Polish holdings	-29.0	14.2	77.3	120.3	40.1
Net investment rate in Hungarian holdings	-	-15.5	-17.6	13.3	37.0
Net investment rate in German holdings	-	-	39.5	62.2	58.7

Source: own calculations based on the FADN data.

2. Assessment of the production potential, organisation of production, costs and effects in fruit- and vegetable-growing holdings, depending on the economic size, in Poland and in the selected countries in 2007-2009

Table AI.2.1

Production potential of fruit-growing holdings (Type 32) in 2007-2009, depending on the economic size

Specification	Measurement unit	8-16 ESU	16-40 ESU	40-100 ESU	≥ 100 ESU
Economic size					
Poland	ESU	10.7	22.2	-	-
Hungary	ESU	10.8	26.6	62.2	-
Germany	ESU	-	-	69.8	250.1
Netherlands	ESU	-	-	-	193.6
Area of utilised agricultural area in the holding					
Poland	ha	12.96	26.74	-	-
Hungary	ha	9.44	23.45	60.16	-
Germany	ha	-	-	13.65	43.46
Netherlands	ha	-	-	-	22.73
Share of leased land					
Poland	%	6.2	14.0	-	-
Hungary	%	30.3	19.8	29.2	-
Germany	%	-	-	47.7	67.7
Netherlands	%	-	-	-	29.9
Total labour input					
Poland	AWU	3.01	5.21	-	-
Hungary	AWU	1.24	2.84	4.95	-
Germany	AWU	-	-	2.56	6.48
Netherlands	AWU	-	-	-	5.25
Share of own labour in total labour input					
Poland	%	57.6	32.5	-	-
Hungary	%	45.4	26.1	20.0	-
Germany	%	-	-	56.4	25.0
Netherlands	%	-	-	-	32.2
Value of assets per 1 ha of UAA					
Poland	EUR thousand/ha	15.51	14.6	-	-
Hungary	EUR thousand/ha	8.50	8.6	5.80	-
Germany	EUR thousand/ha	-	-	30.73	22.27
Netherlands	EUR thousand/ha	-	-	-	80.95
Value of assets per 1 employed person					
Poland	EUR thousand/AWU	67.01	75.11	-	-
Hungary	EUR thousand/AWU	68.26	74.15	71.85	-
Germany	EUR thousand/AWU	-	-	161.45	148.8
Netherlands	EUR thousand/AWU	-	-	-	350.2
Share of fixed assets in assets					
Poland	%	87.0	85.6	-	-
Hungary	%	83.2	85.8	92.1	-

cont. Table AI.2.1

Germany	%	-	-	89.8	86.8
Netherlands	%	-	-	-	81.9
Share of equity in liabilities					
Poland	%	89.2	86.4	-	-
Hungary	%	79.3	75.7	65.3	-
Germany	%	-	-	86.7	77.0
Netherlands	%	-	-	-	64.9

Source: own calculations based on the FADN data.

Table AI.2.2

Organisation of production in fruit-growing holdings (Type 32) in 2007-2009, depending on the economic size

Specification	Measurement unit	8-16 ESU	16-40 ESU	40-100 ESU	≥ 100 ESU
Share of orchards in the area of UAA					
Poland	%	80.0	83.2	-	-
Hungary	%	68.7	66.8	62.4	-
Germany	%	-	-	63.3	71.7
Netherlands	%	-	-	-	89.6
Share of other crops in the area of UAA					
Poland	%	20.0	16.8	-	-
Hungary	%	31.3	33.2	37.6	-
Germany	%	-	-	36.7	28.3
Netherlands	%	-	-	-	10.4
Share of plant production in total production					
Poland	%	98.4	96.9	-	-
Hungary	%	90.2	96.3	96.0	-
Germany	%	-	-	86.8	90.4
Netherlands	%	-	-	-	87.7
Share of animal production in total production					
Poland	%	0.4	1.6	-	-
Hungary	%	0.7	0.4	0.4	-
Germany	%	-	-	0.7	2.6
Netherlands	%	-	-	-	3.7
Share of other production in total production					
Poland	%	1.2	1.5	-	-
Hungary	%	9.1	3.4	3.6	-
Germany	%	-	-	12.5	7.0
Netherlands	%	-	-	-	8.6
Share of production transferred to the household					
Poland	%	0.5	0.2	-	-
Hungary	%	0.6	0.1	0.13	-
Germany	%	-	-	0.12	0.01
Netherlands	%	-	-	-	0

Source: own calculations based on the FADN data.

Table AI.2.3

Level and types of costs in fruit-growing holdings (Type 32) in 2007-2009, depending on the economic size

Specification	Measurement unit	8-16 ESU	16-40 ESU	40-100 ESU	≥ 100 ESU
Total costs					
Poland	EUR thousand/ha	2.25	2.38	-	-
Hungary	EUR thousand/ha	1.77	1.95	1.60	-
Germany	EUR thousand/ha	-	-	5.76	6.65
Netherlands	EUR thousand/ha	-	-	-	17.36
Direct costs					
Poland	EUR thousand/ha	0.53	0.58	-	-
Hungary	EUR thousand/ha	0.38	0.33	0.36	-
Germany	EUR thousand/ha	-	-	1.07	1.21
Netherlands	EUR thousand/ha	-	-	-	4.86
Costs of plant protection products					
Poland	EUR thousand/ha	0.29	0.32	-	-
Hungary	EUR thousand/ha	0.26	0.36	0.25	-
Germany	EUR thousand/ha	-	-	0.48	0.53
Netherlands	EUR thousand/ha	-	-	-	1.34
Cost of contract work					
Poland	EUR thousand/ha	0.38	0.54	-	-
Hungary	EUR thousand/ha	0.28	0.40	0.31	-
Germany	EUR thousand/ha	-	-	1.14	1.72
Netherlands	EUR thousand/ha	-	-	-	3.62
Cost of interest					
Poland	EUR thousand/ha	0.04	0.045	-	-
Hungary	EUR thousand/ha	0.05	0.054	0.06	-
Germany	EUR thousand/ha	-	-	0.17	0.2
Netherlands	EUR thousand/ha	-	-	-	1.29
Land tenure cost					
Poland	EUR thousand/ha	0.005	0.013	-	-
Hungary	EUR thousand/ha	0.014	0.011	0.03	-
Germany	EUR thousand/ha	-	-	0.15	0.2
Netherlands	EUR thousand/ha	-	-	-	0.25
Cost of depreciation					
Poland	EUR thousand/ha	0.87	0.77	-	-
Hungary	EUR thousand/ha	0.57	0.55	0.38	-
Germany	EUR thousand/ha	-	-	1.14	1.20
Netherlands	EUR thousand/ha	-	-	-	3.37

Source: own calculations based on the FADN data.

Table AI.2.4

Productivity and efficiency of fruit-growing holdings (Type 32) in 2007-2009, depending on the economic size

Specification	Measurement unit	8-16 ESU	16-40 ESU	40-100 ESU	≥ 100 ESU
Land productivity					
Poland	EUR thousand/ha	3.05	4.66	-	-
Hungary	EUR thousand/ha	1.58	1.62	1.40	-
Germany	EUR thousand/ha	-	-	7.46	8.0
Netherlands	EUR thousand/ha	-	-	-	19.56
Asset productivity					

cont. Table AI.2.4

Poland	times	0.20	0.23	-	-
Hungary	times	0.19	0.19	0.25	-
Germany	times	-	-	0.24	0.36
Netherlands	times	-	-	-	0.24
Current asset productivity					
Poland	times	1.54	1.60	-	-
Hungary	times	1.13	1.32	2.18	-
Germany	times	-	-	2.35	2.77
Netherlands	times	-	-	-	1.36
Labour productivity					
Poland	EUR thousand/AWU	13.17	17.23	-	-
Hungary	EUR thousand/AWU	12.11	13.22	16.94	-
Germany	EUR thousand/AWU	-	-	38.55	52.96
Netherlands	EUR thousand/AWU	-	-	-	85.13
Land profitability					
Poland	EUR thousand/ha	0.92	1.22	-	-
Hungary	EUR thousand/ha	0.17	-0.11	0.09	-
Germany	EUR thousand/ha	-	-	1.94	1.62
Netherlands	EUR thousand/ha	-	-	-	2.36
Asset profitability					
Poland	%	6.3	8.13	-	-
Hungary	%	2.2	-0.03	1.9	-
Germany	%	-	-	6.1	6.7
Netherlands	%	-	-	-	3.0
Cost-effectiveness of production					
Poland	%	135.7	143.0	-	-
Hungary	%	89.5	81.7	87.5	-
Germany	%	-	-	128.0	119.1
Netherlands	%	-	-	-	113.3
Own labour profitability					
Poland	EUR thousand/ FWU	6.84	17.79	-	-
Hungary	EUR thousand/ FWU	2.55	-1.13	6.0	-
Germany	EUR thousand/ FWU	-	-	17.08	38.74
Netherlands	EUR thousand/ FWU	-	-	-	32.0
Production profitability					
Poland	%	28.8	31.6	-	-
Hungary	%	8.9	-4.0	5.5	-
Germany	%	-	-	24.0	18.4
Netherlands	%	-	-	-	-12.1
Management income					
Poland	EUR thousand	-1.77	10.55	-	-
Hungary	EUR thousand	-3.25	-8.48	-9.20	-
Germany	EUR thousand	-	-	0.08	26.91
Netherlands	EUR thousand	-	-	-	-12.24
Share of subsidies in holding income					
Poland	%	22.9	25.8	-	-
Hungary	%	760.2	206.5	219.2	-

cont. Table AI.2.4

Germany	%	-	-	17.5	29.5
Netherlands	%	-	-	-	23.6
Holding income parity in relation to payment for contract work in fruit-growing holdings					
Poland	%	187.4	484.7	-	-
Hungary	%	78.2	-25.3	129.2	-
Germany	%	-	-	125.4	252.6
Netherlands	%	-	-	-	122.85
Holding income parity in relation to payment in the national economy					
Poland	%	114.3	297.3	-	-
Hungary	%	39.8	-17.6	93.7	-
Germany	%	-	-	36.7	83.3
Netherlands	%	-	-	-	49.3
Net investment rate					
Poland	%	3.6	13.8	-	-
Hungary	%	-17.7	-15.6	21.1	-
Germany	%	-	-	36.8	26.9
Netherlands	%	-	-	-	-35.2

Source: own calculations based on the FADN data.

Table AI.2.5

Production potential in vegetable-growing holdings (Type 20) in 2007-2009

Specification	Measurement unit	16-40 ESU	40-100 ESU	≥ 100 ESU
Economic size				
Poland	ESU	26.43	59.87	166.33
Hungary	ESU	26.80	-	-
Germany	ESU	28.93	67.07	330.63
Netherlands	ESU	-	73.33	516.93
Area of utilised agricultural area in the holding				
Poland	ha	5.98	7.30	10.47
Hungary	ha	9.0	-	-
Germany	ha	1.88	2.20	12.63
Netherlands	ha	-	6.11	9.89
Share of leased land				
Poland	%	9.3	13.2	0.87
Hungary	%	39.6	-	-
Germany	%	62.2	46.9	69.67
Netherlands	%	-	40.4	50.80
Total labour input				
Poland	AWU	3.65	6.31	17.1
Hungary	AWU	5.91	-	-
Germany	AWU	2.33	3.38	7.66
Netherlands	AWU	-	3.34	9.7
Share of own labour in total labour input				
Poland	%	51.4	32.5	11.7
Hungary	%	18.6	-	-
Germany	%	50.7	42.2	22.7
Netherlands	%	-	45.1	18.9
Value of assets in EUR thousand per 1 ha of UAA				
Poland	EUR thousand/ha	27.13	49.93	132.11
Hungary	EUR thousand/ha	22.64	-	-
Germany	EUR thousand/ha	103.05	93.52	41.04
Netherlands	EUR thousand/ha	-	104.64	292.60

cont. Table AI.2.5

Value of assets in EUR thousand per 1 employed person				
Poland	EUR thousand/AWU	44.39	57.75	80.78
Hungary	EUR thousand/AWU	34.29	-	-
Germany	EUR thousand/AWU	70.25	60.18	67.47
Netherlands	EUR thousand/AWU	-	189.77	297.97
Share of fixed assets in assets				
Poland	%	90.4	91.0	91.3
Hungary	%	71.7	-	-
Germany	%	80.8	78.1	78.5
Netherlands	%	-	78.0	79.8
Share of equity in liabilities				
Poland	%	79.6	67.6	40.6
Hungary	%	48.1	-	-
Germany	%	51.0	53.5	52.4
Netherlands	%	-	64.9	35.3

Source: own calculations based on the FADN data.

Table AI.2.6

Organisation of production in vegetable-growing holdings (Type 20) in 2007-2009

Specification	Measurement unit	16-40 ESU	40-100 ESU	≥ 100 ESU
Share of vegetables acreage in the area of UAA				
Poland	%	20.7	18.1	29.3
Hungary	%	57.1	-	-
Germany	%	35.0	68.9	64.9
Netherlands	%	-	57.2	78.0
Share of other crops in the area of UAA				
Poland	%	79.3	81.9	70.7
Hungary	%	42.9	-	-
Germany	%	65.0	31.1	35.1
Netherlands	%	-	42.8	22.0
Share of plant production in total production				
Poland	%	99.0	99.7	99.87
Hungary	%	99.2	-	-
Germany	%	87.9	86.9	94.5
Netherlands	%	-	90.0	89.1
Share of animal production in total production				
Poland	%	0.8	0.17	0.05
Hungary	%	0	-	-
Germany	%	0.20	0.04	0.07
Netherlands	%	-	0.47	0.07
Share of other production in total production				
Poland	%	0.2	0.13	0.08
Hungary	%	0.8	-	-
Germany	%	11.9	13.02	5.40
Netherlands	%	-	9.57	10.80
Share of production transferred to the household				
Poland	%	0.3	0.08	0.02
Hungary	%	0.06	-	-
Germany	%	0.04	0.05	0.02
Netherlands	%	-	0	0

Source: own calculations based on the FADN data.

Table AI.2.7

Level and types of costs in vegetable-growing holdings (Type 20) in 2007-2009

Specification	Measurement unit	16-40 ESU	40-100 ESU	≥ 100 ESU
Total costs				
Poland	EUR thousand/ha	10.04	18.96	44.99
Hungary	EUR thousand/ha	14.73	-	-
Germany	EUR thousand/ha	63.80	69.27	32.53
Netherlands	EUR thousand/ha	-	38.25	134.23
Direct costs				
Poland	EUR thousand/ha	3.80	7.08	13.92
Hungary	EUR thousand/ha	5.64	-	-
Germany	EUR thousand/ha	17.0	18.42	9.58
Netherlands	EUR thousand/ha	-	14.21	34.07
Costs of plant protection products				
Poland	EUR thousand/ha	0.31	0.44	0.81
Hungary	EUR thousand/ha	0.87	-	-
Germany	EUR thousand/ha	0.29	0.46	0.54
Netherlands	EUR thousand/ha	-	0.73	2.29
Total costs of seeds				
Poland	EUR thousand/ha	1.23	2.10	3.06
Hungary	EUR thousand/ha	2.05	-	-
Germany	EUR thousand/ha	12.76	12.97	6.14
Netherlands	EUR thousand/ha	-	6.52	18.72
Costs of own seeds				
Poland	EUR thousand/ha	0.01	0.07	0.01
Hungary	EUR thousand/ha	0	-	-
Germany	EUR thousand/ha	0	0	0.01
Netherlands	EUR thousand/ha	-	0.78	0.08
Cost of contract work				
Poland	EUR thousand/ha	1.18	2.86	6.44
Hungary	EUR thousand/ha	2.92	-	-
Germany	EUR thousand/ha	14.28	16.76	5.56
Netherlands	EUR thousand/ha	-	7.91	24.16
Cost of interest				
Poland	EUR thousand/ha	0.18	0.38	0.96
Hungary	EUR thousand/ha	1.01	-	-
Germany	EUR thousand/ha	1.81	1.88	0.85
Netherlands	EUR thousand/ha	-	1.56	7.42
Land tenure costs				
Poland	EUR thousand/ha	0.02	0.98	0.05
Hungary	EUR thousand/ha	0.05	-	-
Germany	EUR thousand/ha	0.64	0.39	0.43
Netherlands	EUR thousand/ha	-	0.67	1.63
Cost of depreciation				
Poland	EUR thousand/ha	1.41	2.53	7.08
Hungary	EUR thousand/ha	1.10	-	-
Germany	EUR thousand/ha	5.34	5.72	3.19
Netherlands	EUR thousand/ha	-	4.03	17.89

Source: own calculations based on the FADN data.

Table AI.2.8

Productivity and efficiency in vegetable-growing holdings (Type 20) in 2007-2009

Specification	Measurement unit	16-40 ESU	40-100 ESU	≥ 100 ESU
Land productivity				
Poland	EUR thousand/ha	13.29	24.88	55.57
Hungary	EUR thousand/ha	18.17	-	-
Germany	EUR thousand/ha	71.38	79.98	36.76
Netherlands	EUR thousand/ha	-	44.20	134.13
Asset productivity				
Poland	times	0.49	0.50	0.42
Hungary	times	0.80	-	-
Germany	times	0.72	0.85	0.90
Netherlands	times	-	0.43	0.46
Current asset productivity				
Poland	times	5.17	5.64	4.87
Hungary	times	2.84	-	-
Germany	times	3.75	3.89	4.23
Netherlands	times	-	1.33	2.27
Labour productivity				
Poland	EUR thousand/AWU	21.69	28.48	33.98
Hungary	EUR thousand/AWU	23.63	-	-
Germany	EUR thousand/AWU	50.63	51.07	60.49
Netherlands	EUR thousand/AWU	-	77.18	136.63
Land profitability				
Poland	EUR thousand/ha	3.28	6.02	10.70
Hungary	EUR thousand/ha	3.54	-	-
Germany	EUR thousand/ha	8.32	11.36	4.90
Netherlands	EUR thousand/ha	-	5.81	-0.001
Asset profitability				
Poland	%	9.1	12.0	8.30
Hungary	%	10.5	-	-
Germany	%	6.9	12.0	11.93
Netherlands	%	-	5.6	-0.03
Cost-effectiveness of production				
Poland	%	91.1	132.0	124.07
Hungary	%	84.2	-	-
Germany	%	43.2	115.2	112.90
Netherlands	%	-	115.4	100.07
Own labour profitability				
Poland	EUR thousand/FWU	10.47	21.34	56.10
Hungary	EUR thousand/FWU	29.14	-	-
Germany	EUR thousand/FWU	12.77	17.19	35.27
Netherlands	EUR thousand/FWU	-	23.45	-1.51
Production profitability				
Poland	%	24.9	24.4	19.47
Hungary	%	20.0	-	-
Germany	%	11.9	13.9	13.23
Netherlands	%	-	13.0	-0.11
Management income				
Poland	EUR thousand	4.75	18.85	21.13

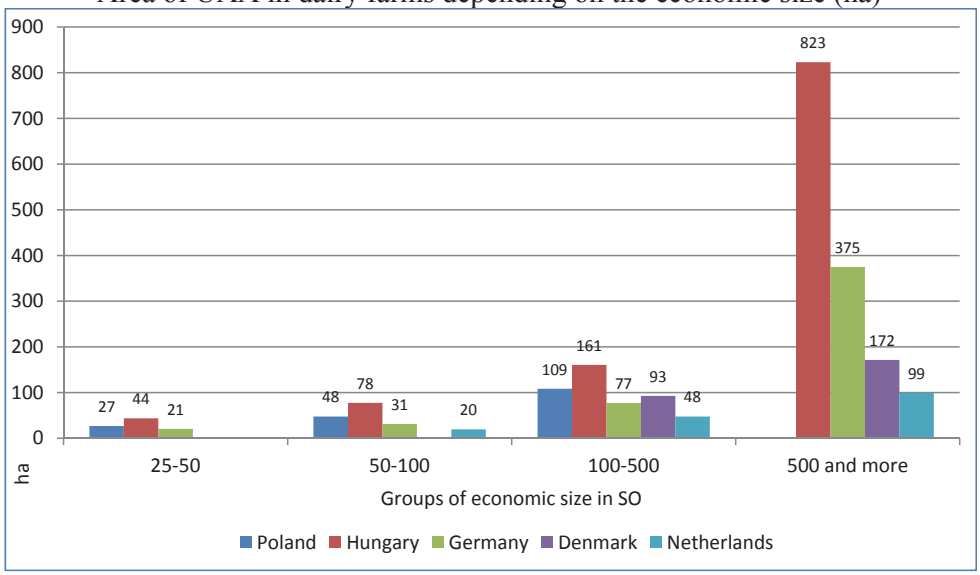
				cont. Table AI.2.8
Hungary	EUR thousand	18.44	-	-
Germany	EUR thousand	-9.61	5.04	25.27
Netherlands	EUR thousand	-	-16.56	-110.79
Share of subsidies in holding income				
Poland	%	6.7	2.9	2.0
Hungary	%	5.7	-	-
Germany	%	9.0	4.6	9.1
Netherlands	%	-	5.4	26.4
Holding income parity in relation to payment for contract work in agriculture				
Poland	%	264.3	444.9	1262.3
Hungary	%	540.6	-	-
Germany	%	663.8	91.9	203.7
Netherlands	%	-	88.80	-4.9
Holding income parity in relation to payment in the national economy				
Poland	%	175.0	356.6	937.5
Hungary	%	455.1	-	-
Germany	%	27.5	37.0	75.8
Netherlands	%	-	36.1	-1.8
Net investment rate				
Poland	%	-3.6	132.1	78.43
Hungary	%	94.5	-	-
Germany	%	-7.6	5.30	-25.70
Netherlands	%	-	-109.0	22.93

Source: own calculations based on the FADN data.

3. Assessment of the production potential, organisation of production, costs and effects on dairy farms depending on the economic size, in Poland and in the selected countries in 2009-2011

Chart AI.3.1

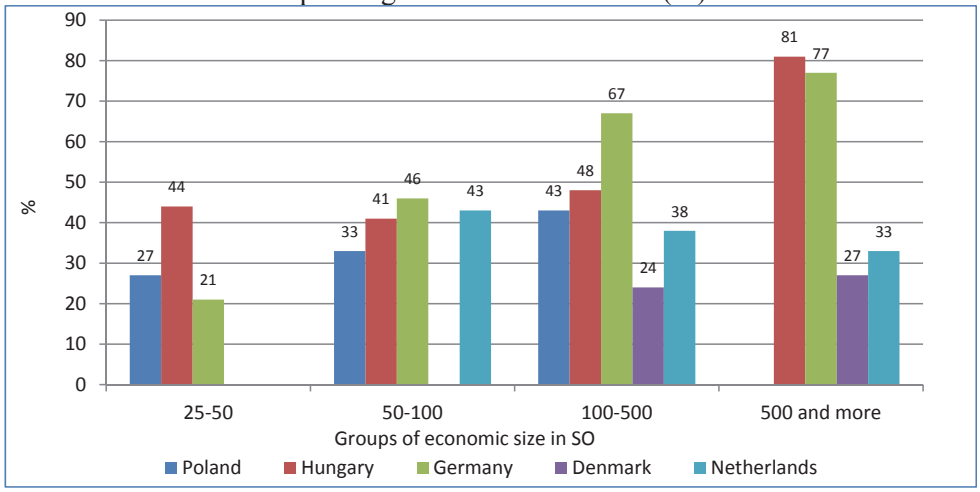
Area of UAA in dairy farms depending on the economic size (ha)



Source: European FADN.

Chart AI.3.2

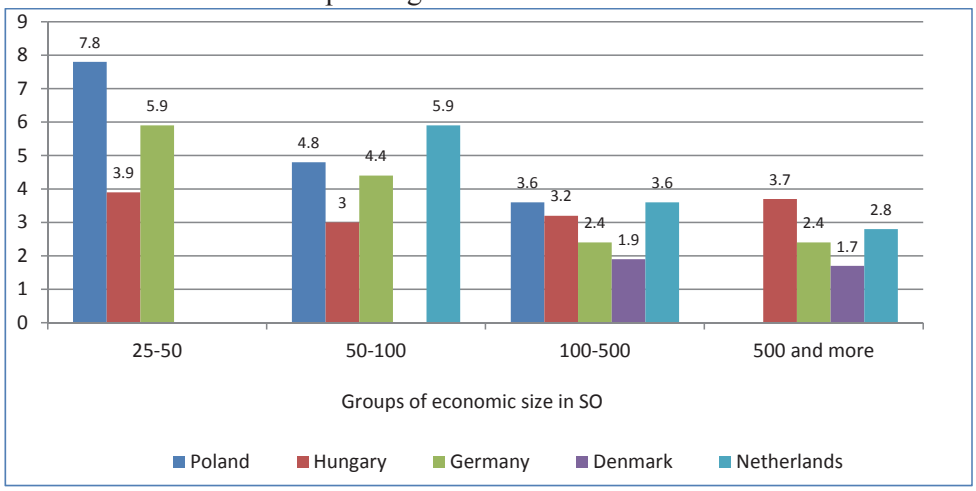
Share of leased land in dairy farms. depending on the economic size (%)



Source: European FADN.

Chart AI.3.3

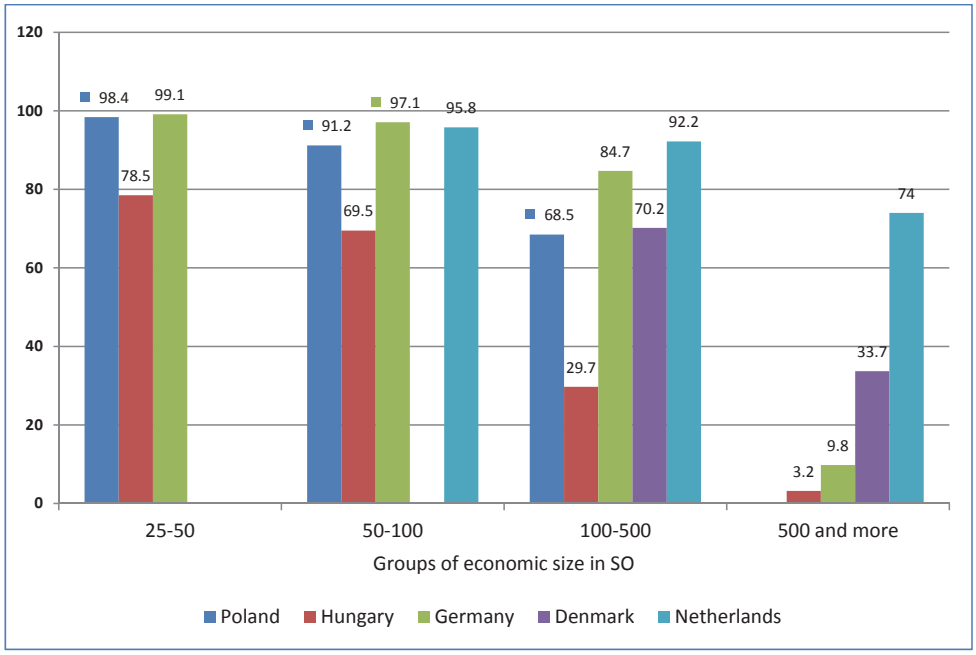
Labour input (AWU/100 ha of UAA) in dairy farms depending on the economic size



Source: European FADN.

Chart AI.3.4

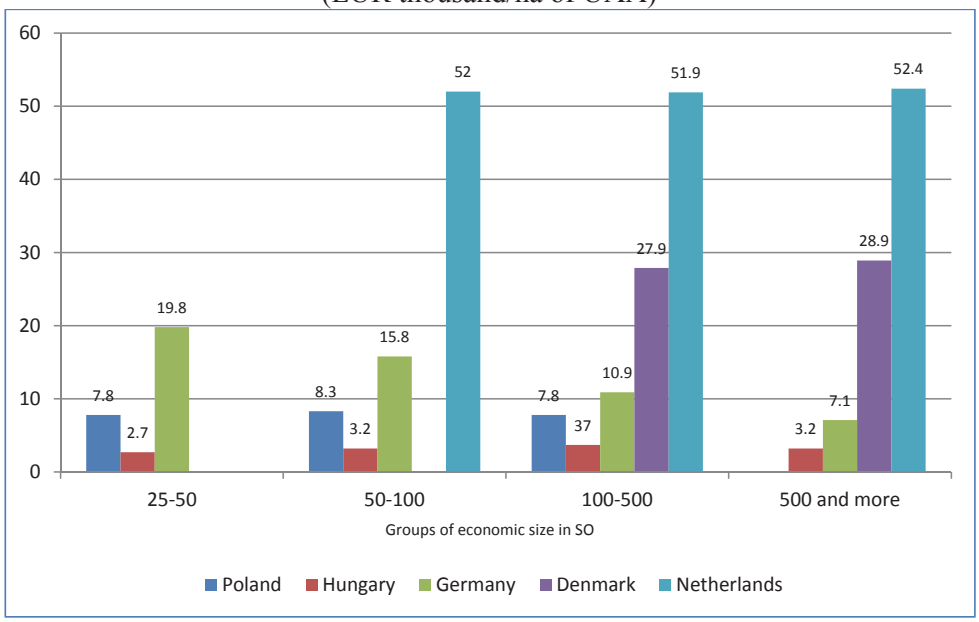
Share of own labour in total labour input in dairy farms depending on the economic size



Source: European FADN.

Chart AI.3.5

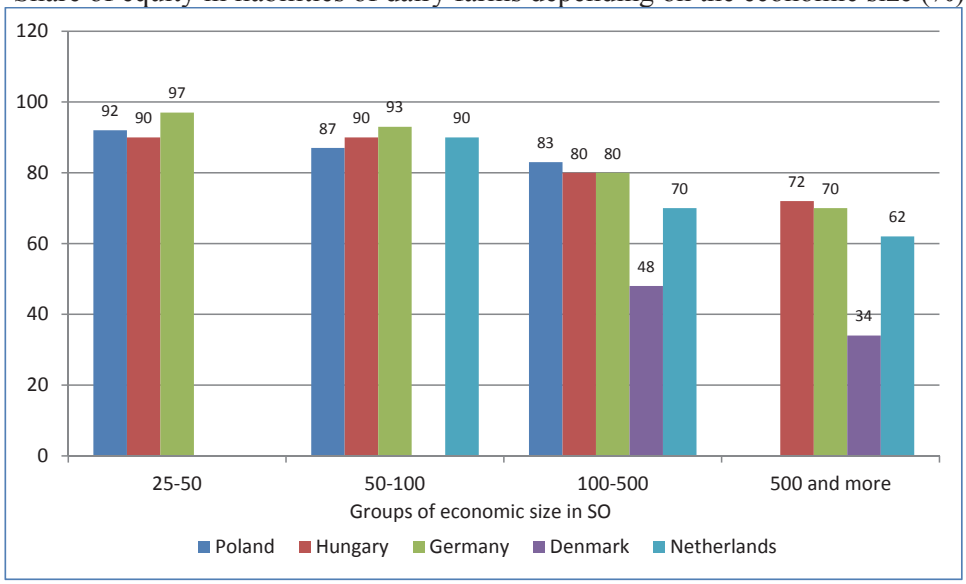
Assets in dairy farms depending on the economic size
(EUR thousand/ha of UAA)



Source: European FADN.

Chart AI.3.6

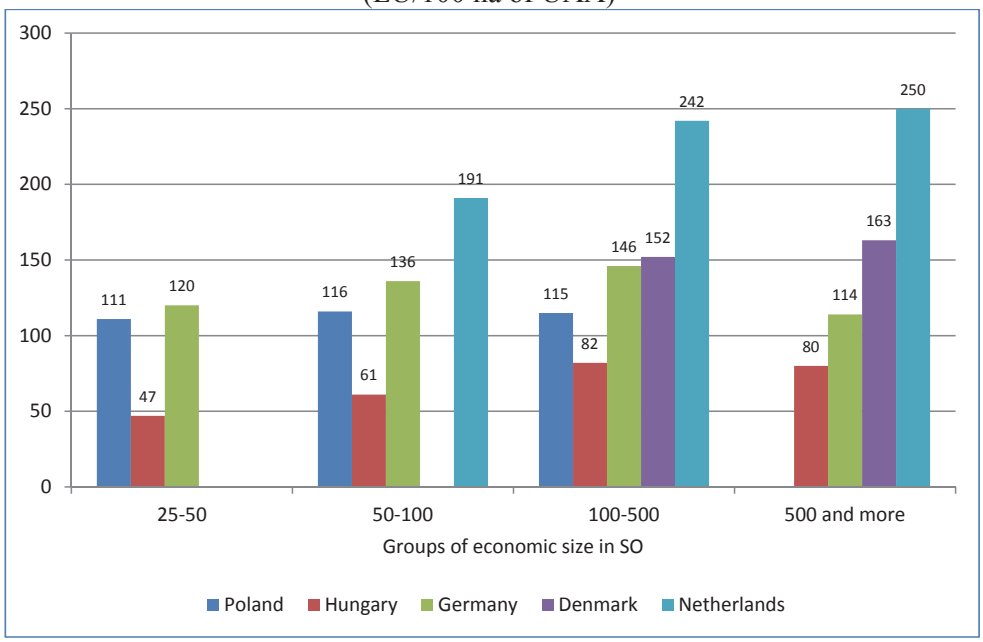
Share of equity in liabilities of dairy farms depending on the economic size (%)



Source: European FADN.

Chart AI.3.7

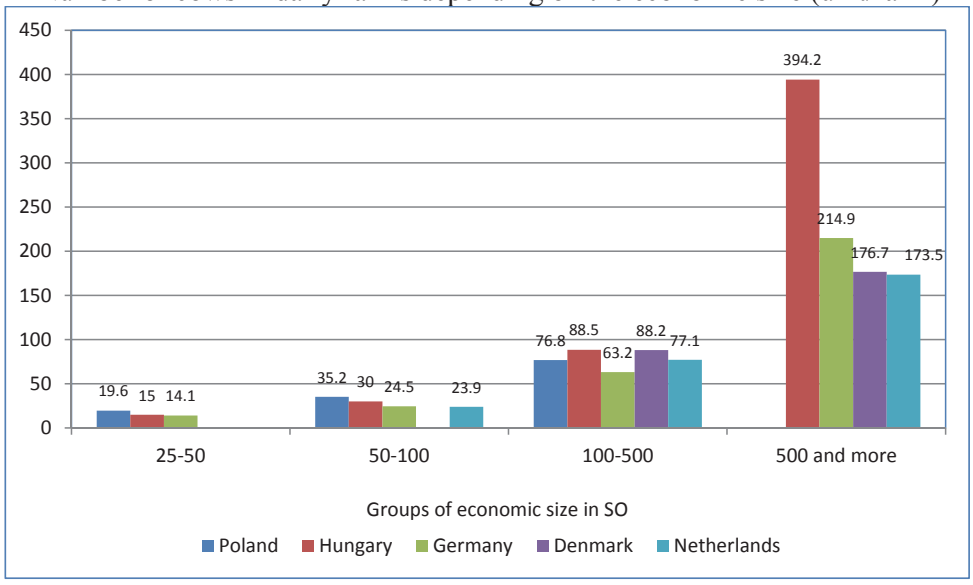
Stocking density in dairy farms depending on the economic size (LU/100 ha of UAA)



Source: European FADN.

Chart AI.3.8

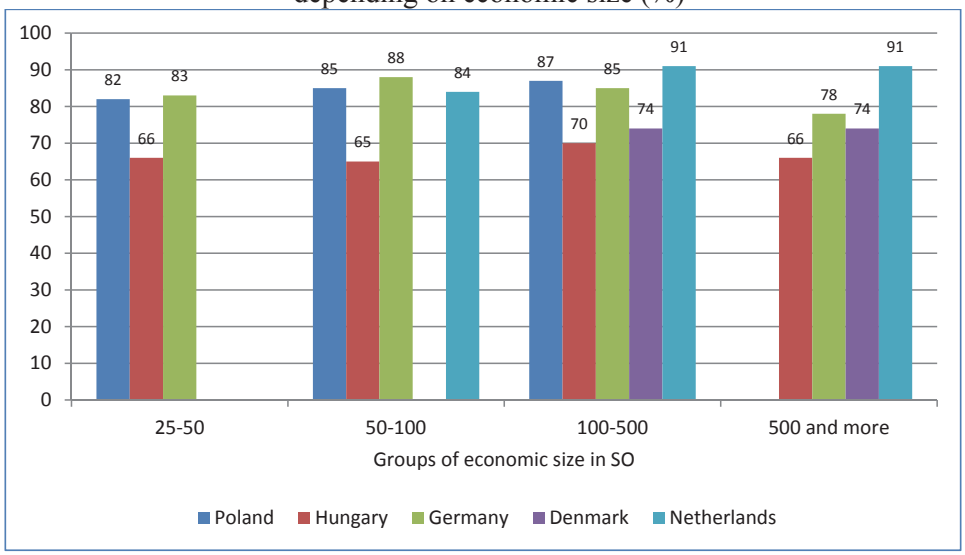
Number of cows in dairy farms depending on the economic size (unit/farm)



Source: European FADN.

Chart AI.3.9

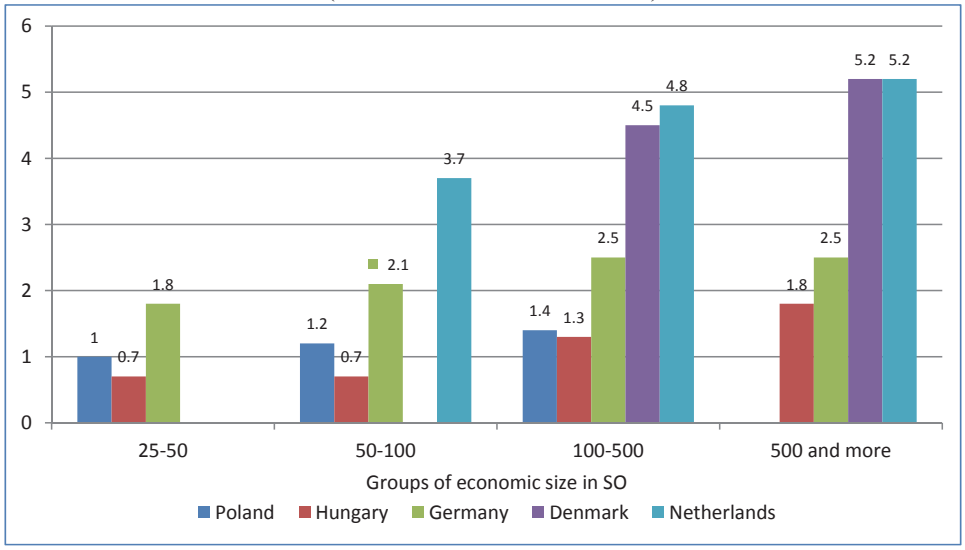
Share of animal production in total production in dairy farms depending on economic size (%)



Source: European FADN.

Chart AI.3.10

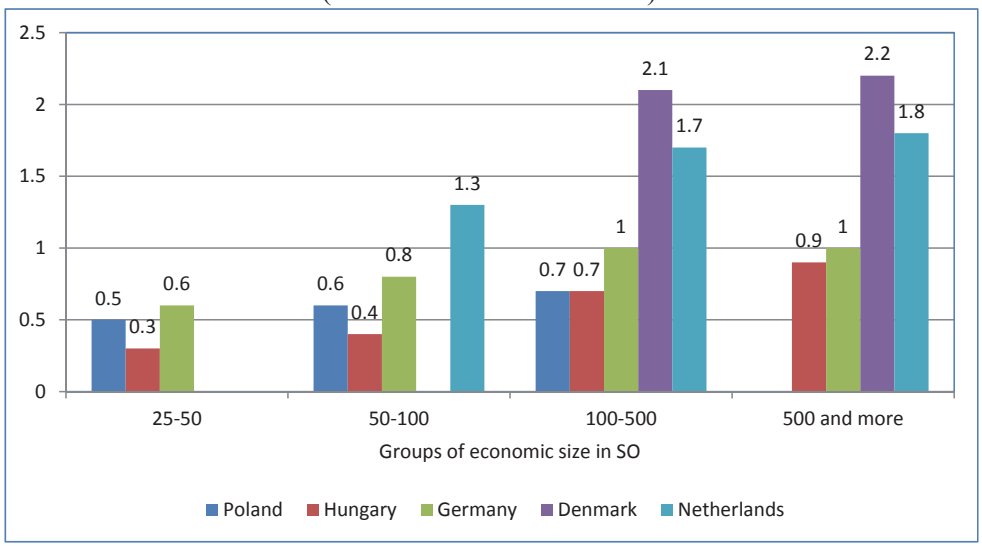
Total costs in dairy farms depending on the economic size (EUR thousand/ha of UAA)



Source: European FADN.

Chart AI.3.11

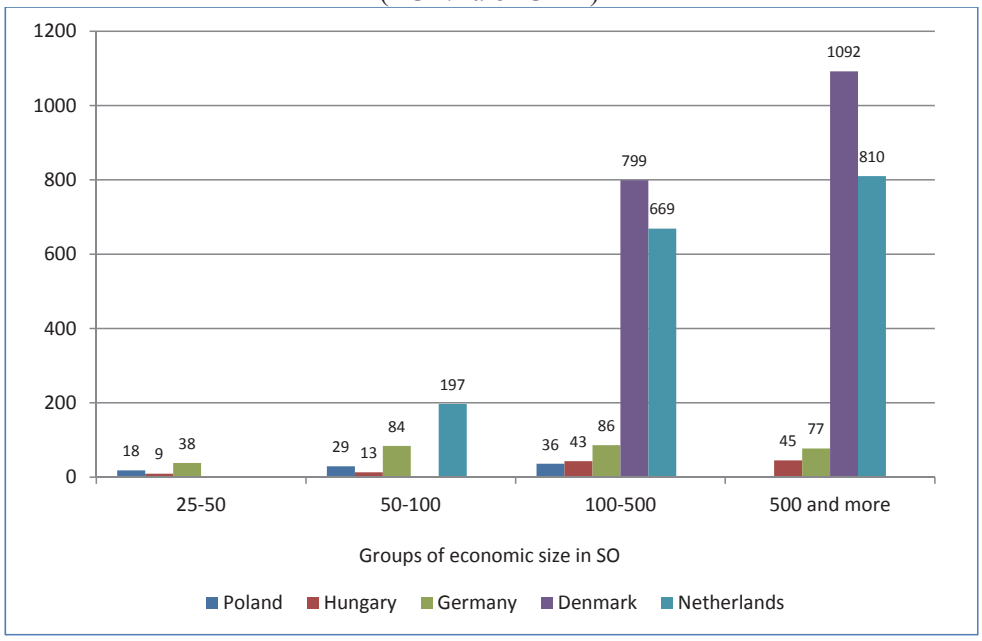
Direct costs in dairy farms depending on the economic size
(EUR thousand/ha of UAA)



Source: European FADN.

Chart AI.3.12

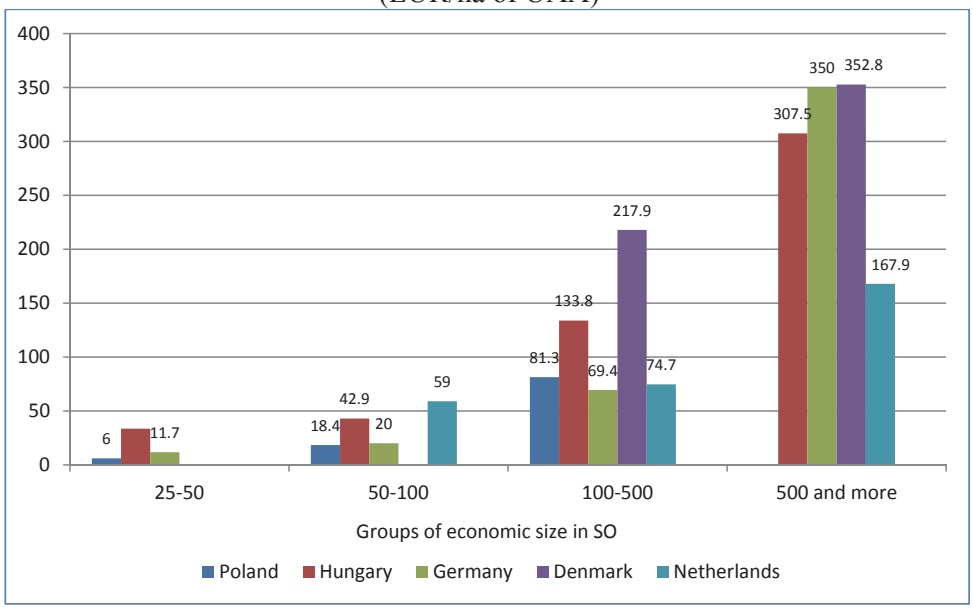
Cost of interest in dairy farms depending on the economic size
(EUR/ha of UAA)



Source: European FADN.

Chart AI.3.13

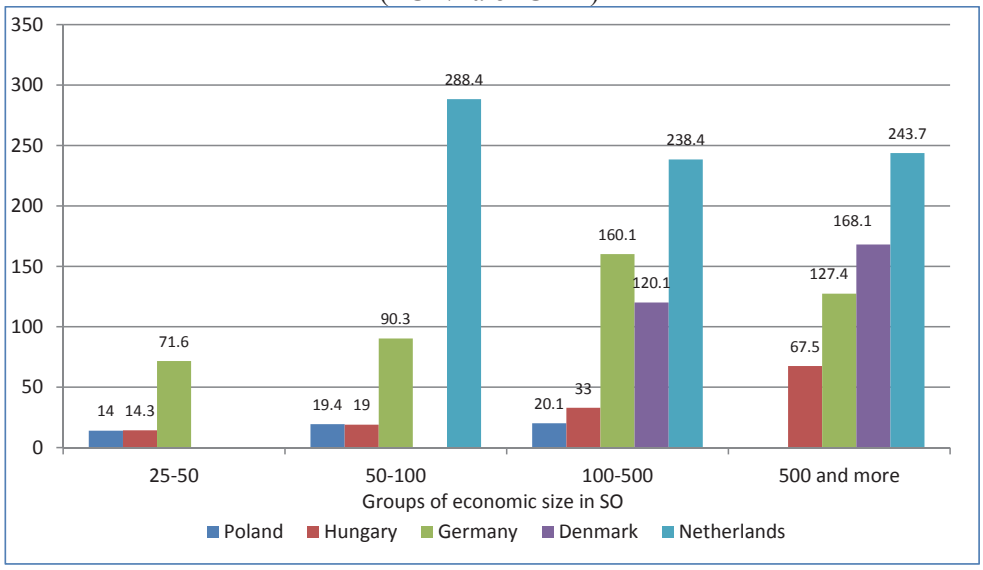
Cost of hired labour in dairy farms depending on the economic size
(EUR/ha of UAA)



Source: European FADN.

Chart AI.3.14

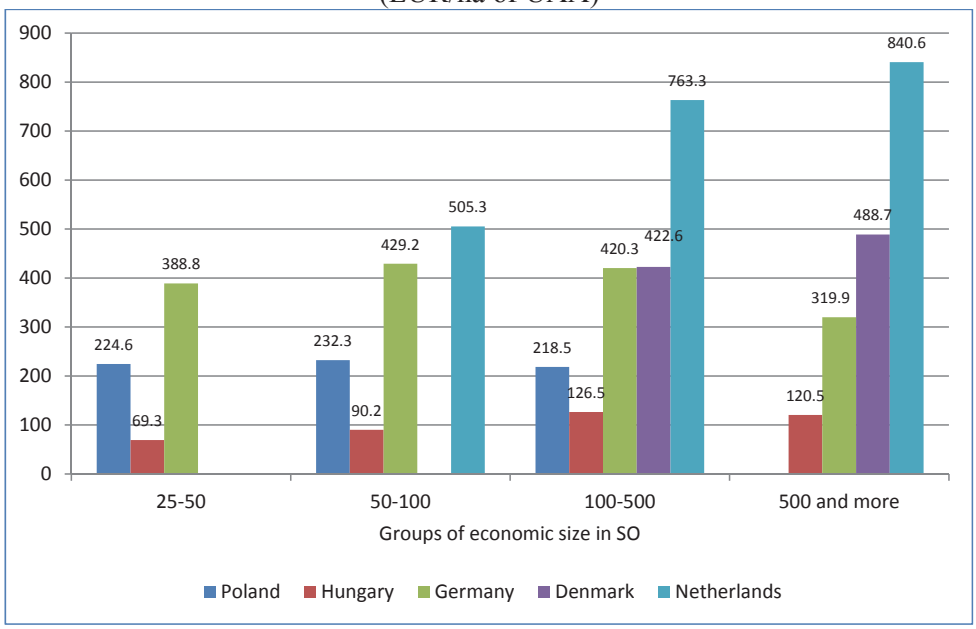
Cost of lease in dairy farms depending on the economic size
(EUR/ha of UAA)



Source: European FADN.

Chart AI.3.15

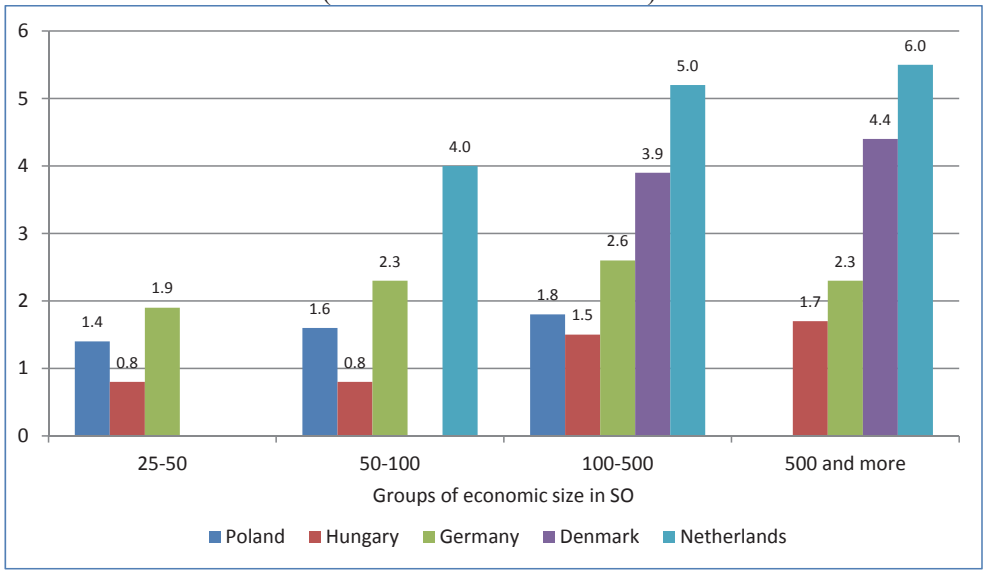
Depreciation cost in dairy farms depending on the economic size
(EUR/ha of UAA)



Source: European FADN.

Chart AI.3.16

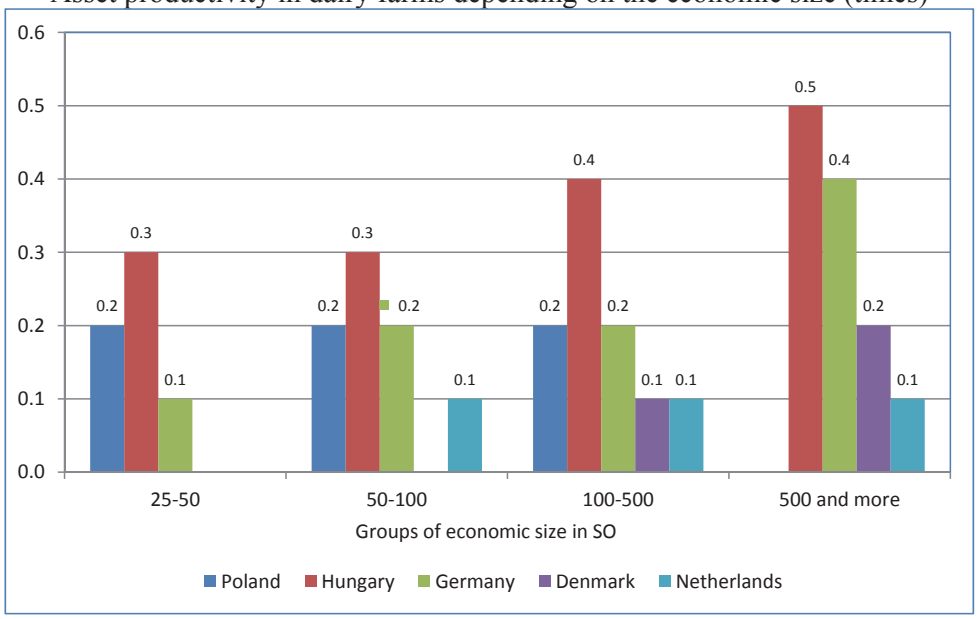
Land productivity in dairy farms depending on the economic size
(EUR thousand/ha of UAA)



Source: European FADN.

Chart AI.3.17

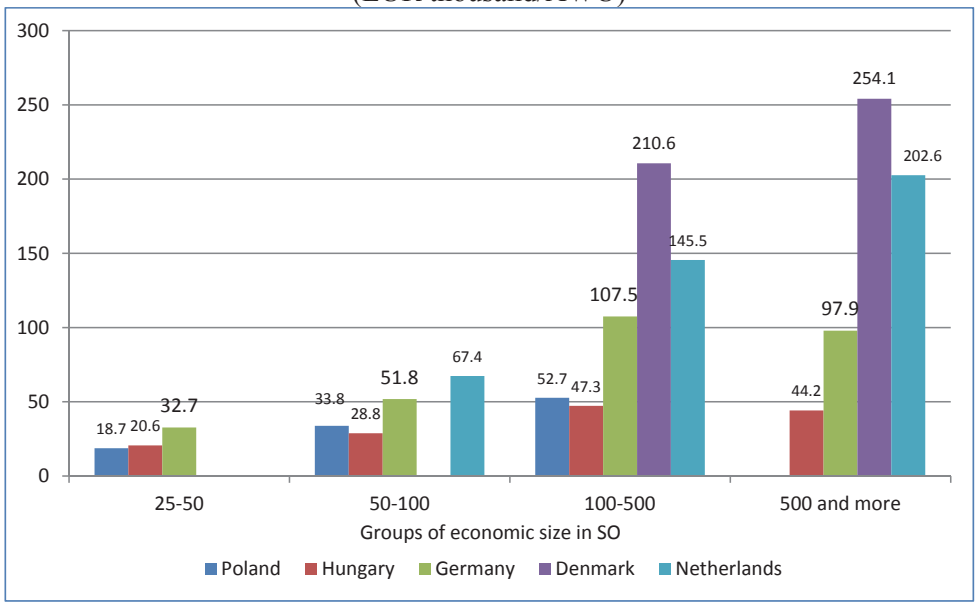
Asset productivity in dairy farms depending on the economic size (times)



Source: European FADN.

Chart AI.3.18

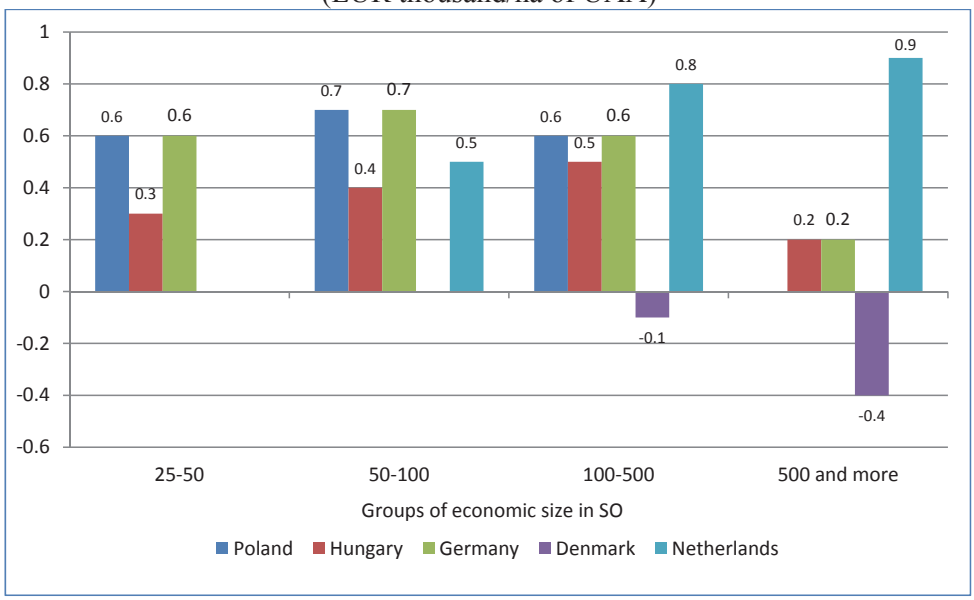
Labour productivity in dairy farms depending on the economic size (EUR thousand/AWU)



Source: European FADN.

Chart AI.3.19

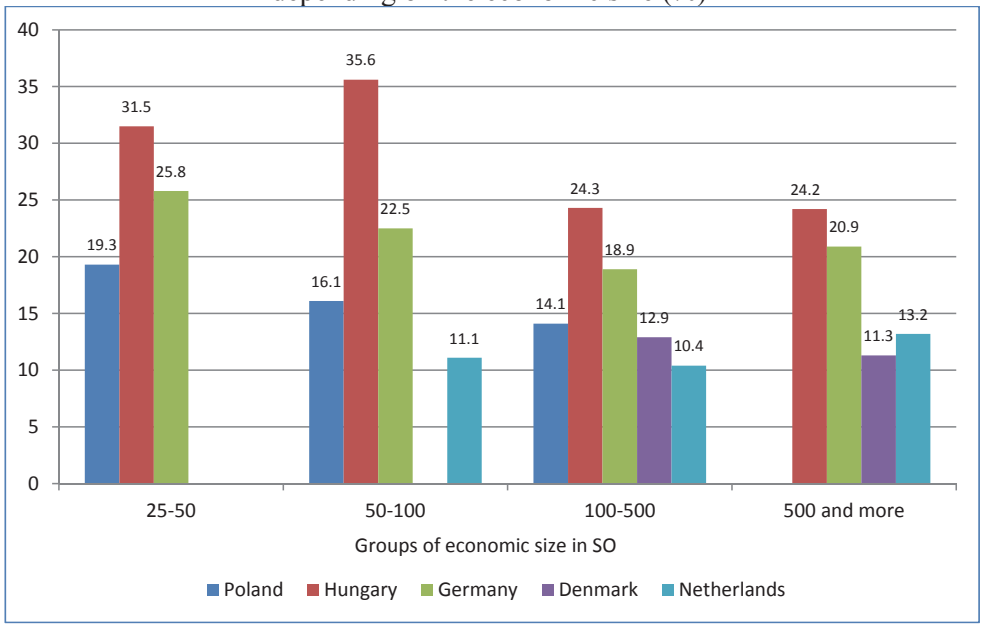
Profitability of land in dairy farms depending on the economic size (EUR thousand/ha of UAA)



Source: European FADN.

Chart AI.3.20

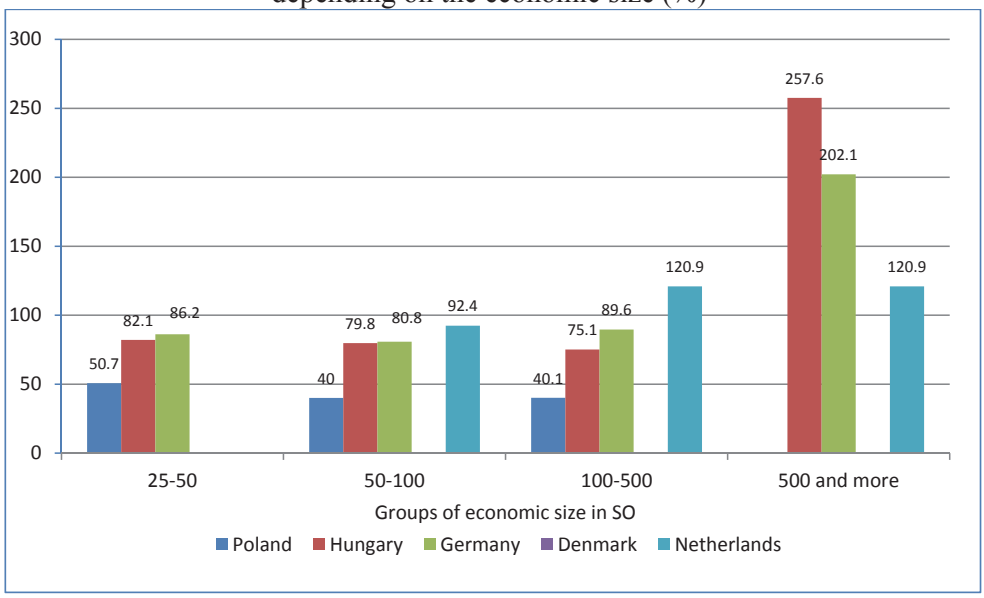
Share of operating subsidies in revenues of dairy farms depending on the economic size (%)



Source: European FADN.

Chart AI.3.21

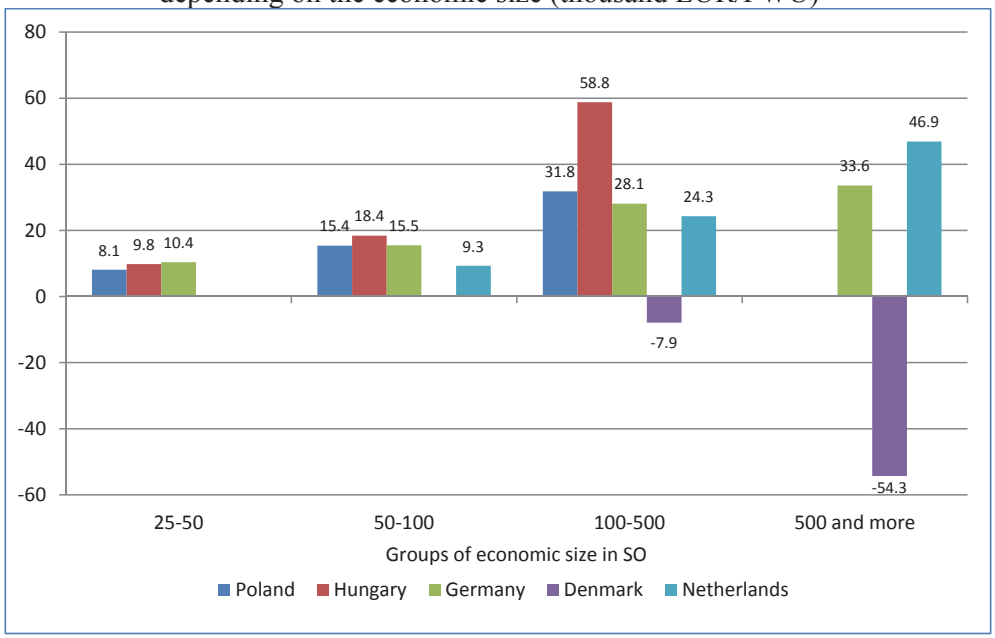
Share of operating subsidies in income of dairy farms depending on the economic size (%)



Source: European FADN.

Chart AI.3.22

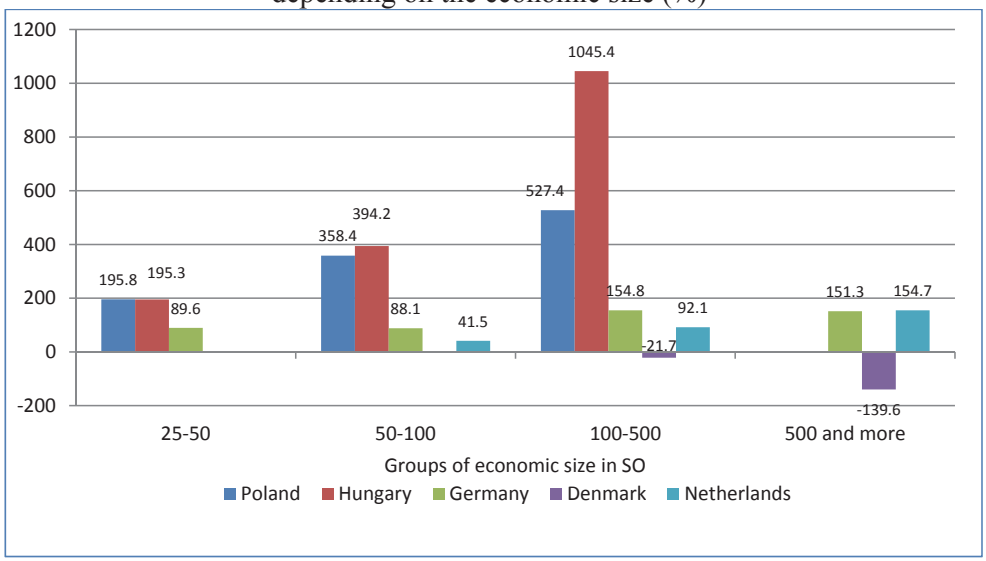
Profitability of own labour in dairy farms depending on the economic size (thousand EUR/FWU)



Source: European FADN.

Chart AI.3.23

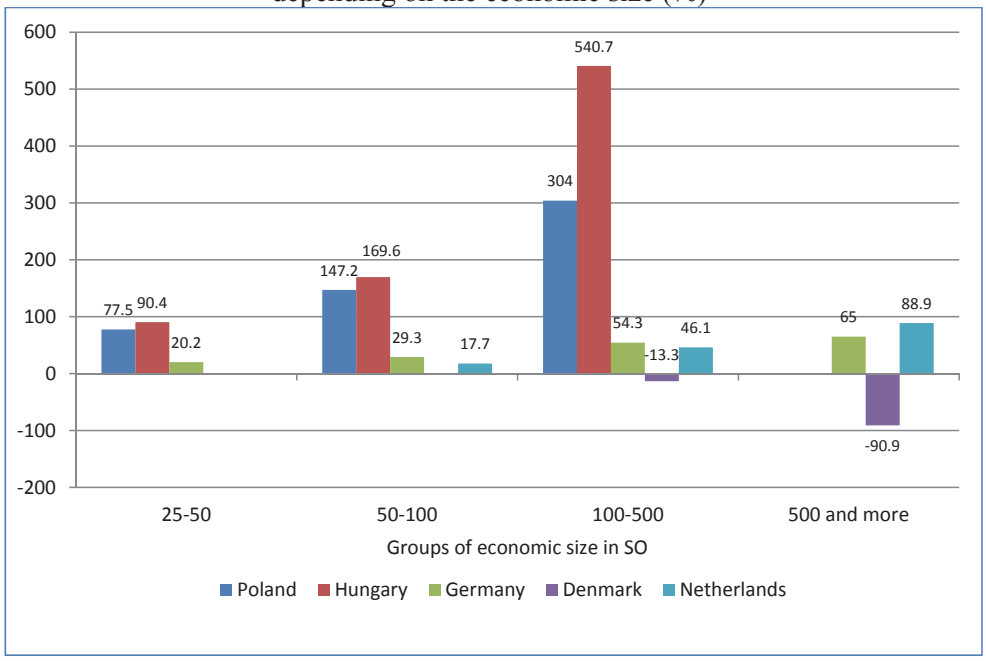
Parity income A in dairy farms
depending on the economic size (%)



Source: European FADN.

Chart AI.3.24

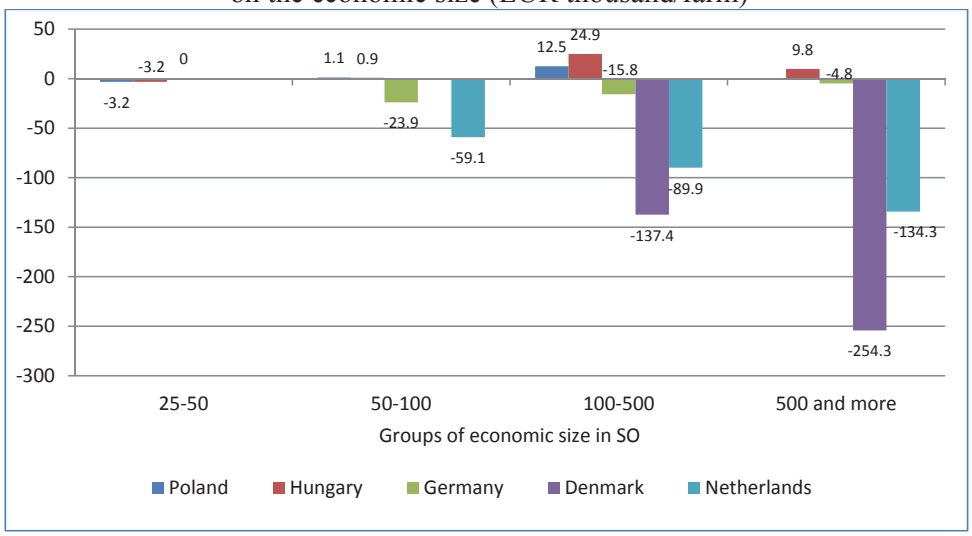
Parity income B in dairy farms
depending on the economic size (%)



Source: European FADN.

Chart AI.3.25

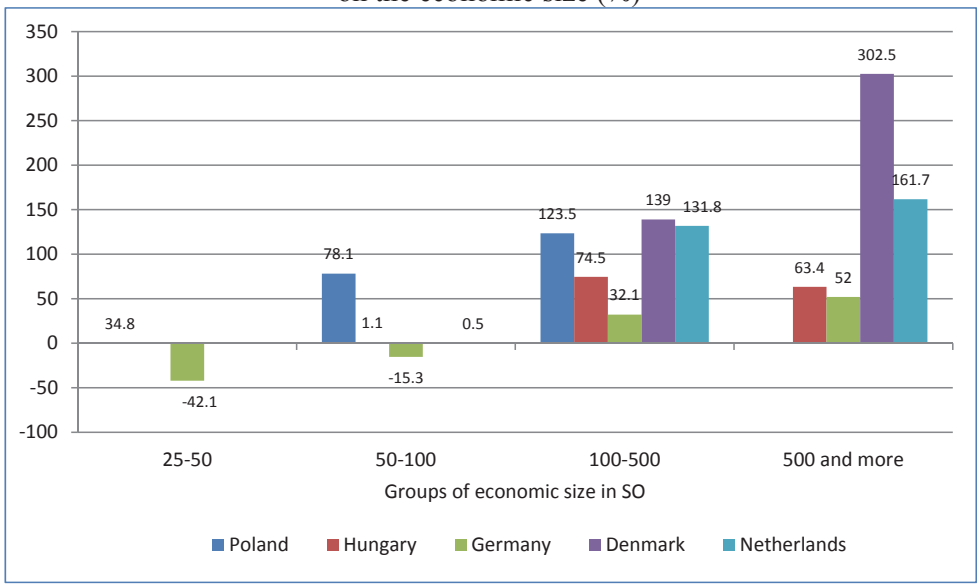
Income from management in dairy farms depending on the economic size (EUR thousand/farm)



Source: European FADN.

Chart AI.3.26

Net investment rate in dairy farms depending on the economic size (%)

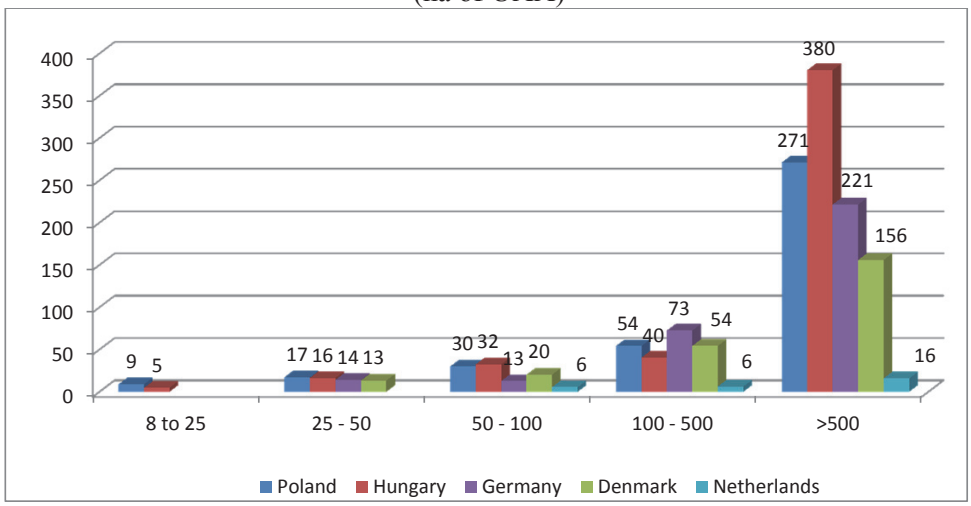


Source: European FADN.

4. Assessment of the production potential, organisation of production, costs and effects in pig holdings, depending on the economic size, in Poland and in the selected countries in 2009-2011

Chart AI.4.1

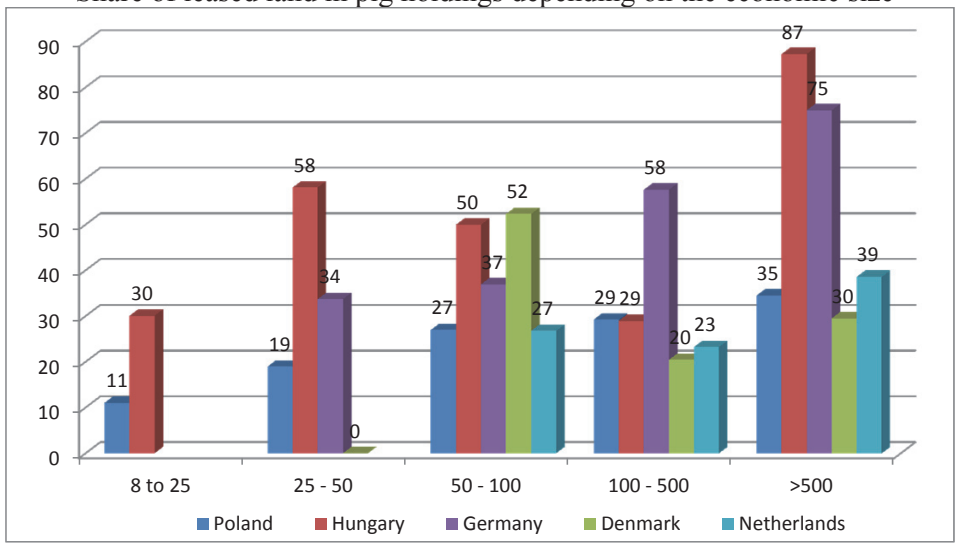
Area of utilised agricultural area in pig holdings depending on the economic size (ha of UAA)



Source: based on the FADN data.

Chart AI.4.2

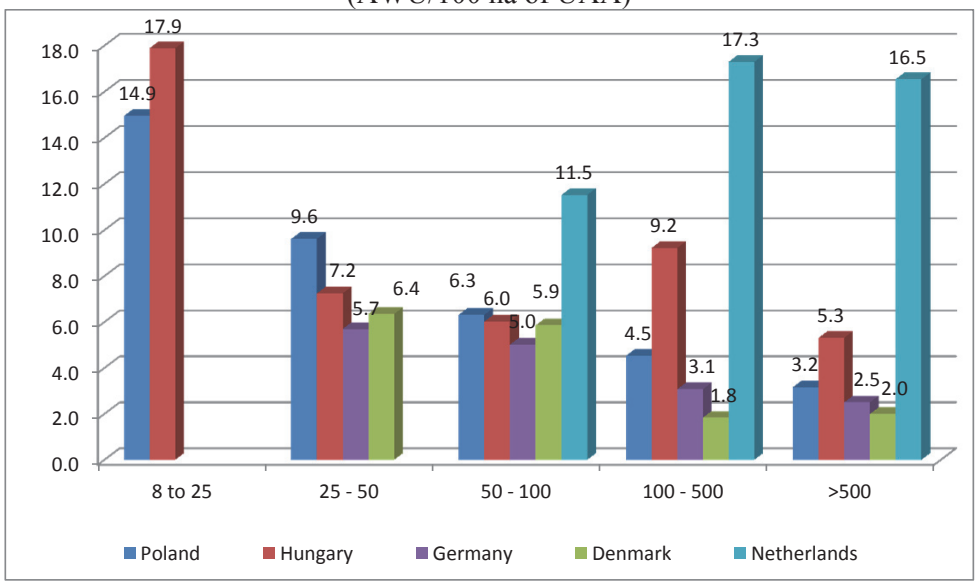
Share of leased land in pig holdings depending on the economic size



Source: based on the FADN data.

Chart AI.4.3

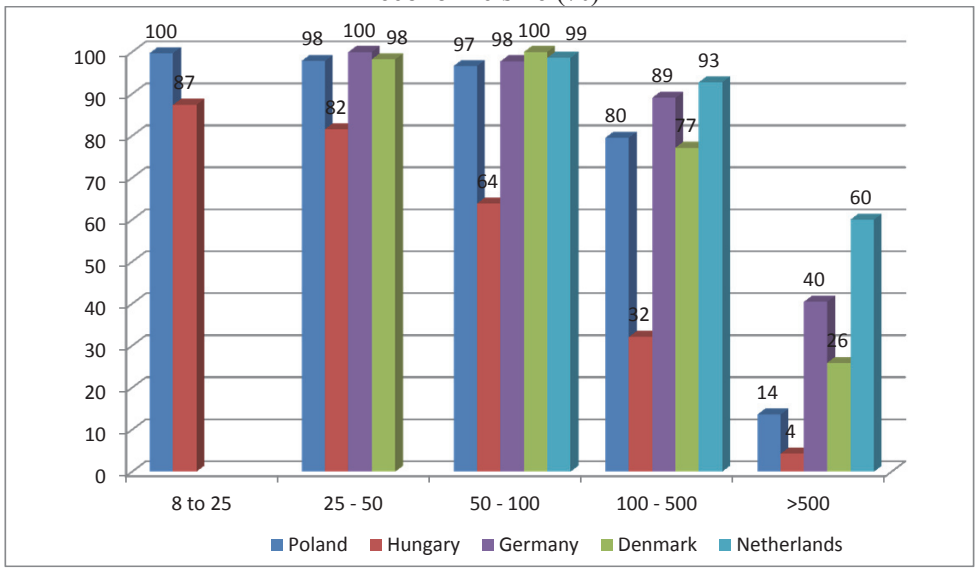
Total labour input in pig holdings depending on the economic size (AWU/100 ha of UAA)



Source: based on the FADN data.

Chart AI.4.4

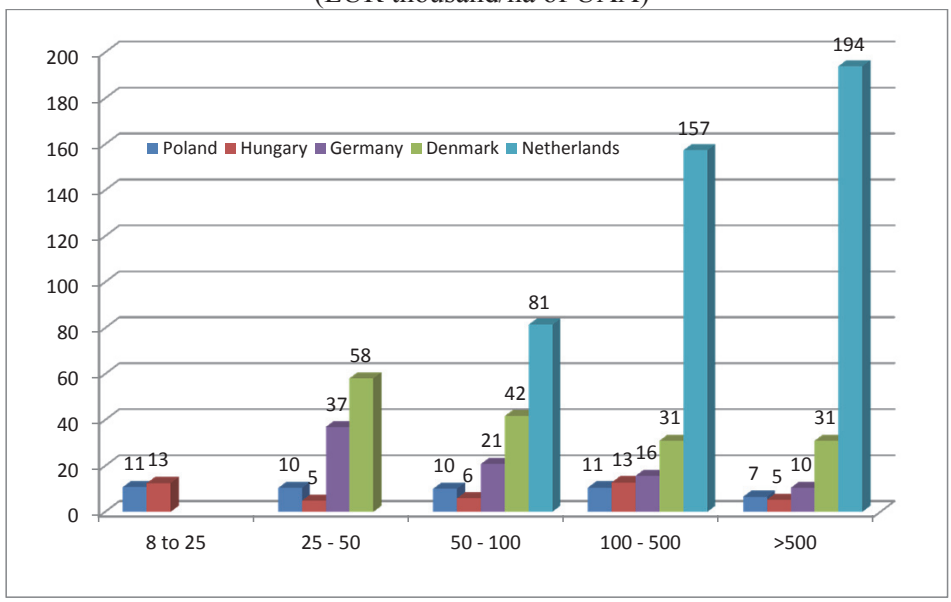
Share of own labour in total labour input in pig holdings depending on the economic size (%)



Source: based on the FADN data.

Chart AI.4.5

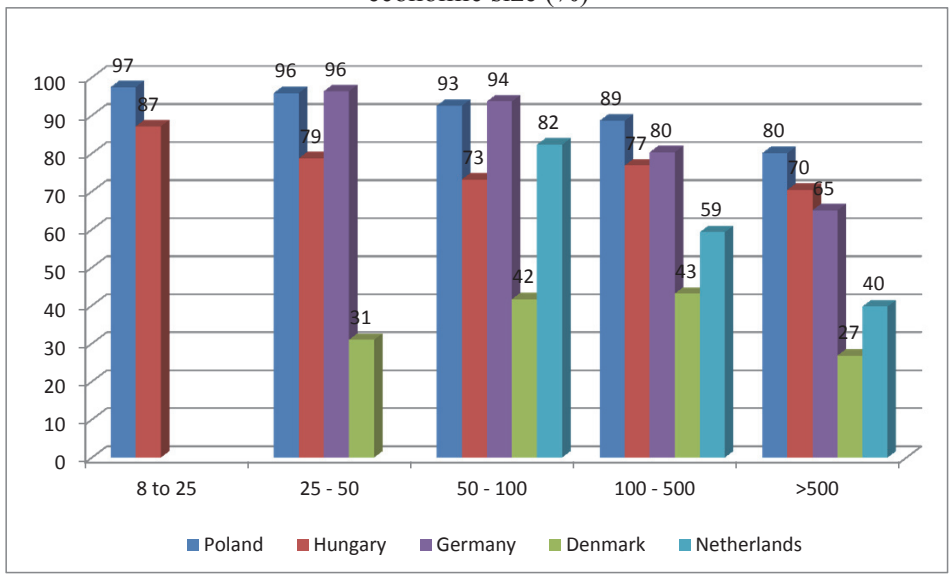
Value of assets in pig holdings depending on the economic size (EUR thousand/ha of UAA)



Source: based on the FADN data.

Chart AI.4.6

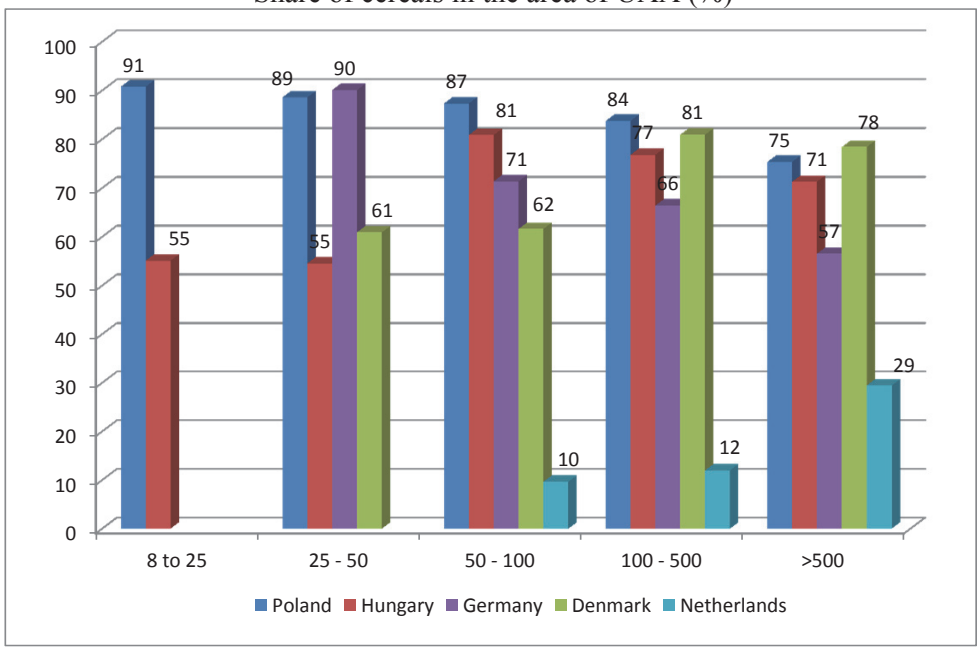
Share of equity in liabilities in pig holdings depending on the economic size (%)



Source: based on the FADN data.

Chart AI.4.7

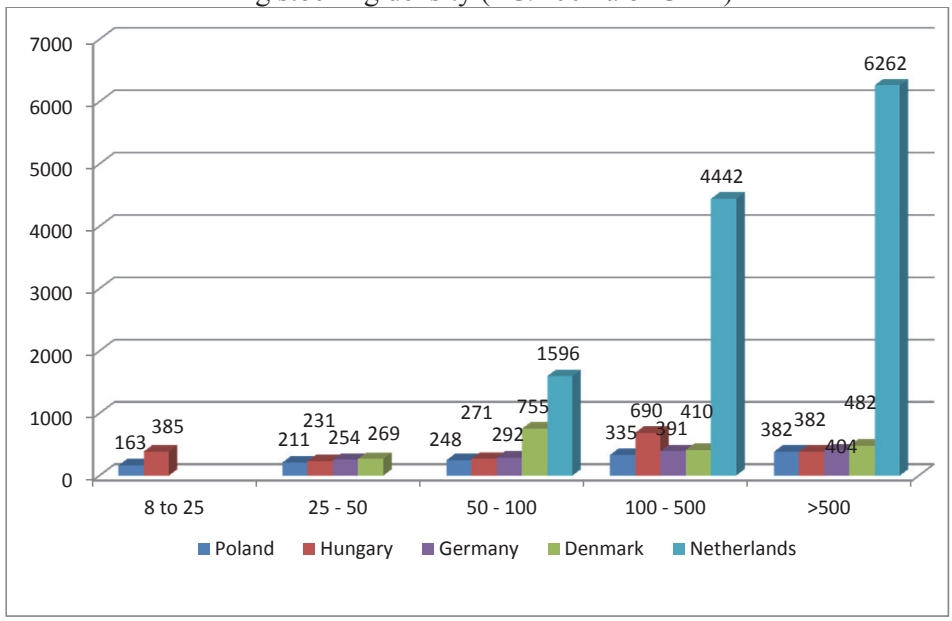
Share of cereals in the area of UAA (%)



Source: based on the FADN data.

Chart AI.4.8

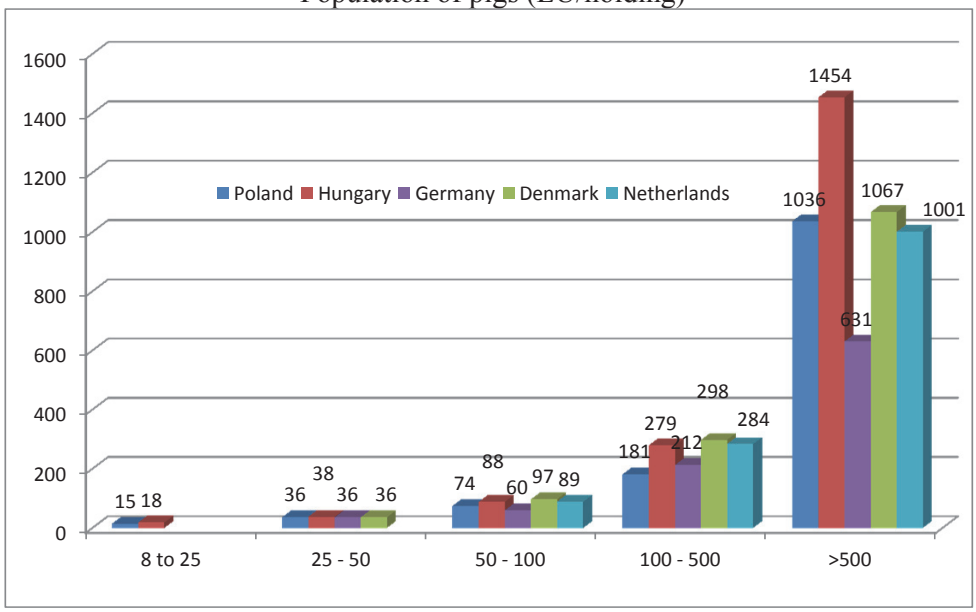
Pig stocking density (LU/100 ha of UAA)



Source: based on the FADN data.

Chart AI.4.9

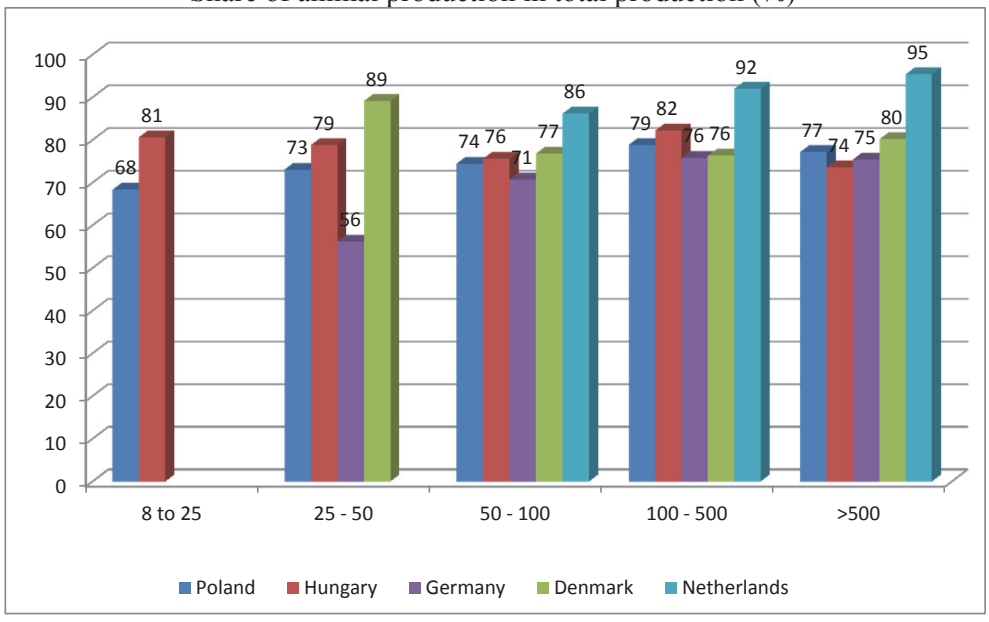
Population of pigs (LU/holding)



Source: based on the FADN data.

Chart AI.4.10

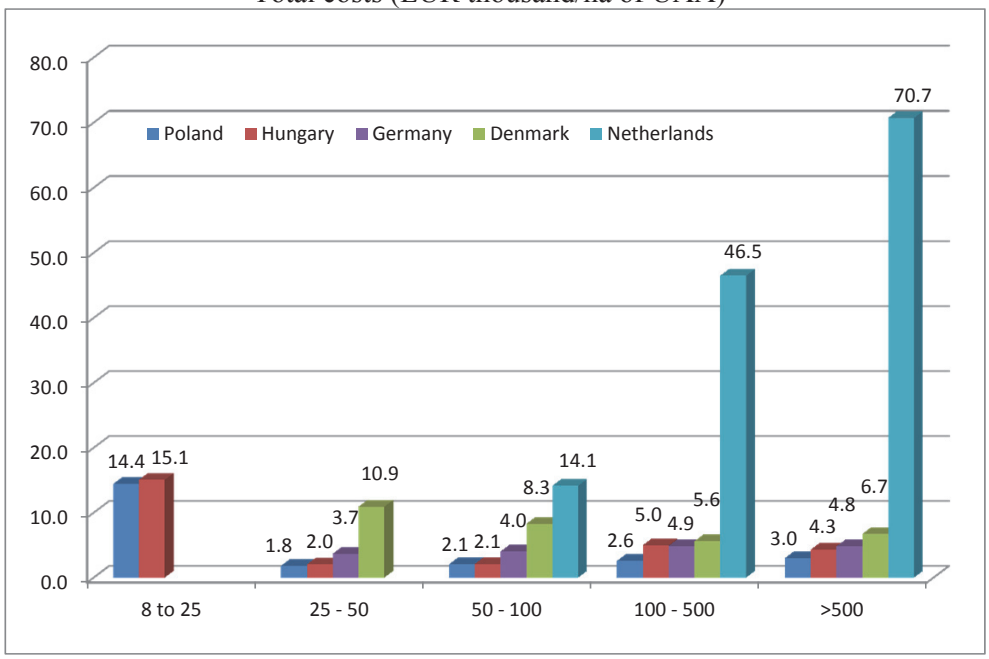
Share of animal production in total production (%)



Source: based on the FADN data.

Chart AI.4.11

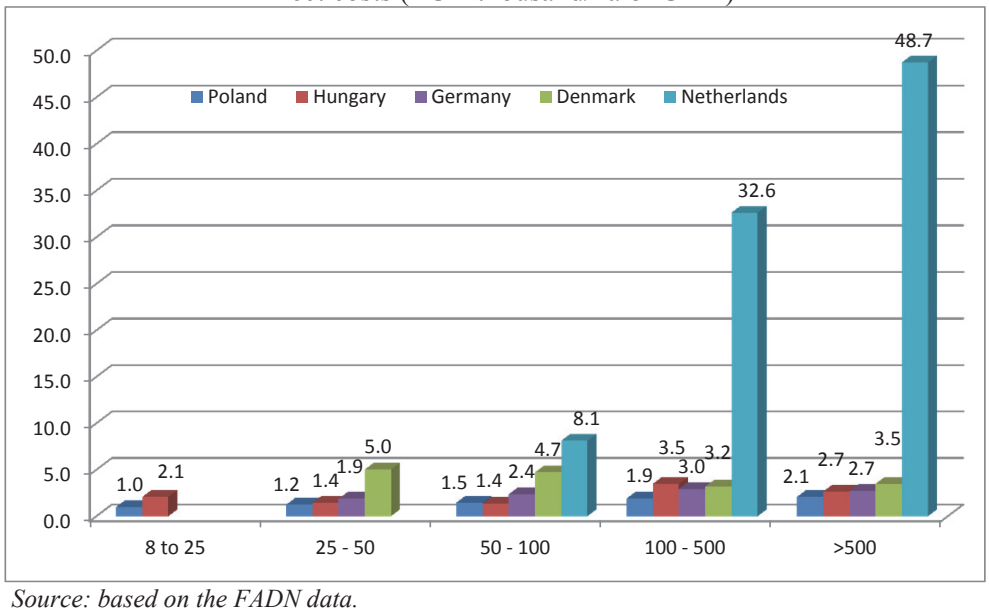
Total costs (EUR thousand/ha of UAA)



Source: based on the FADN data.

Chart AI.4.12

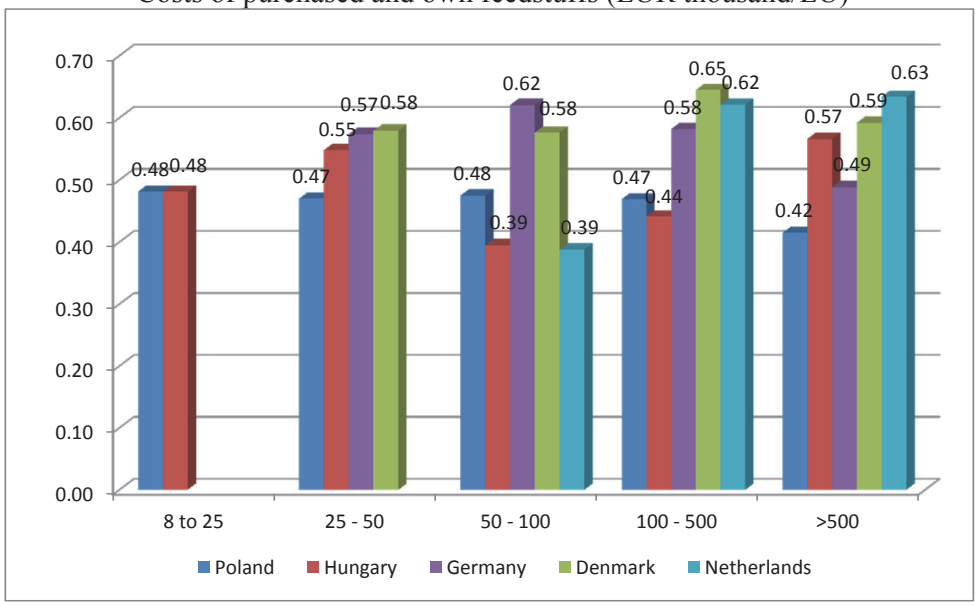
Direct costs (EUR thousand/ha of UAA)



Source: based on the FADN data.

Chart AI.4.13

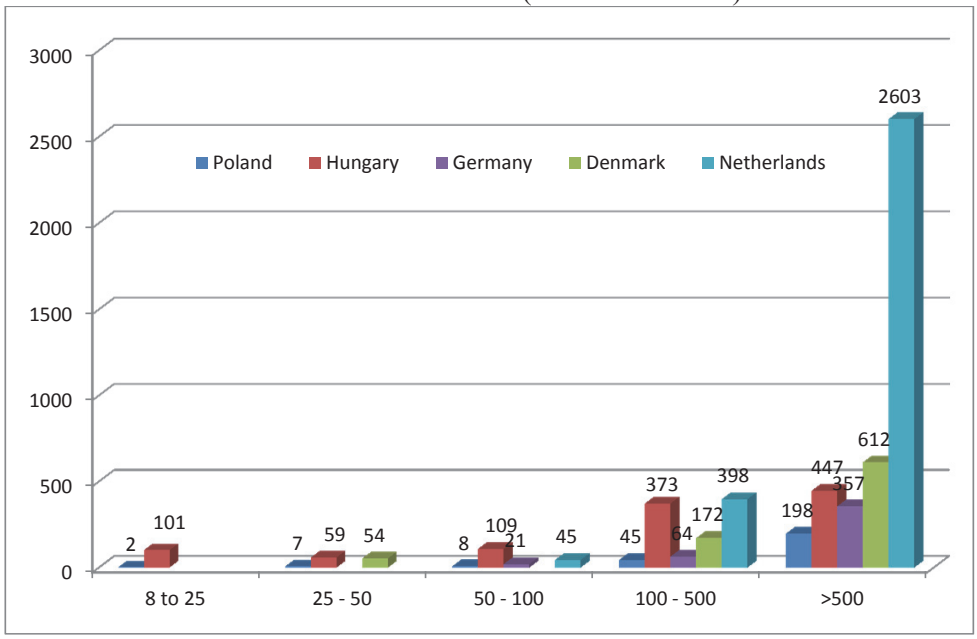
Costs of purchased and own feedstuffs (EUR thousand/LU)



Source: based on the FADN data.

Chart AI.4.14

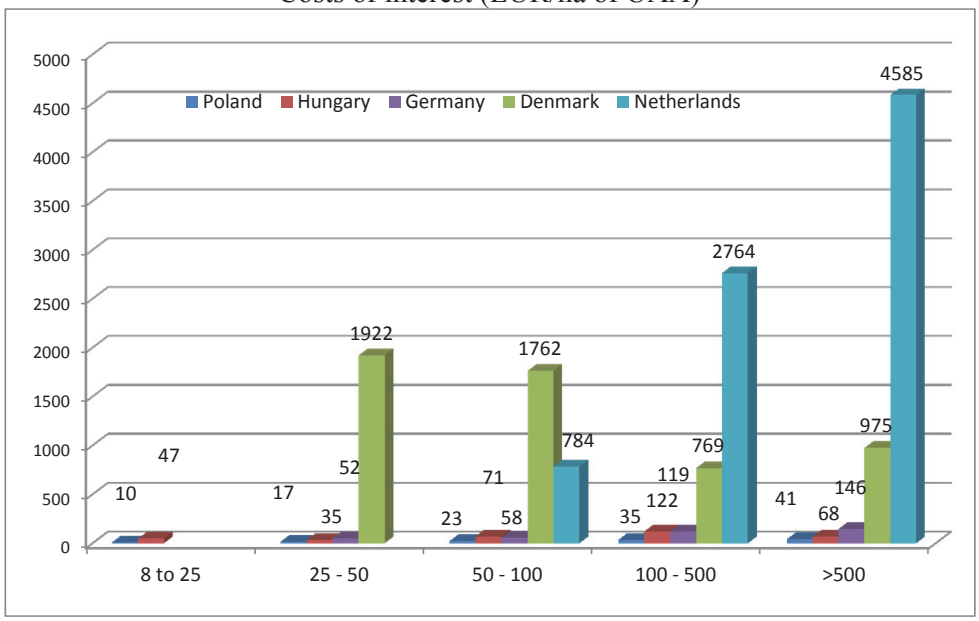
Costs of contract work (EUR/ha of UAA)



Source: based on the FADN data.

Chart AI.4.15

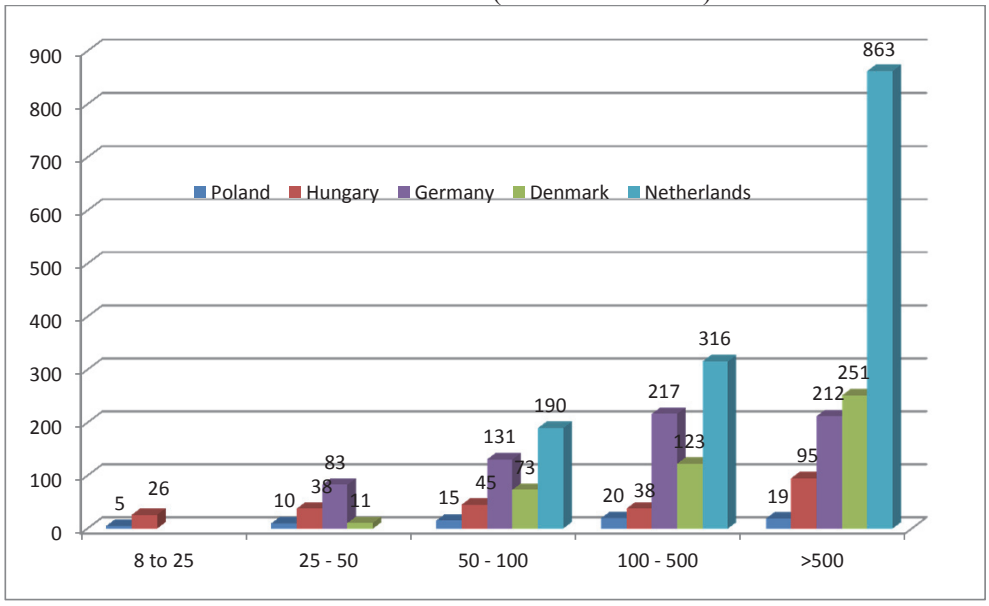
Costs of interest (EUR/ha of UAA)



Source: based on the FADN data.

Chart AI.4.16

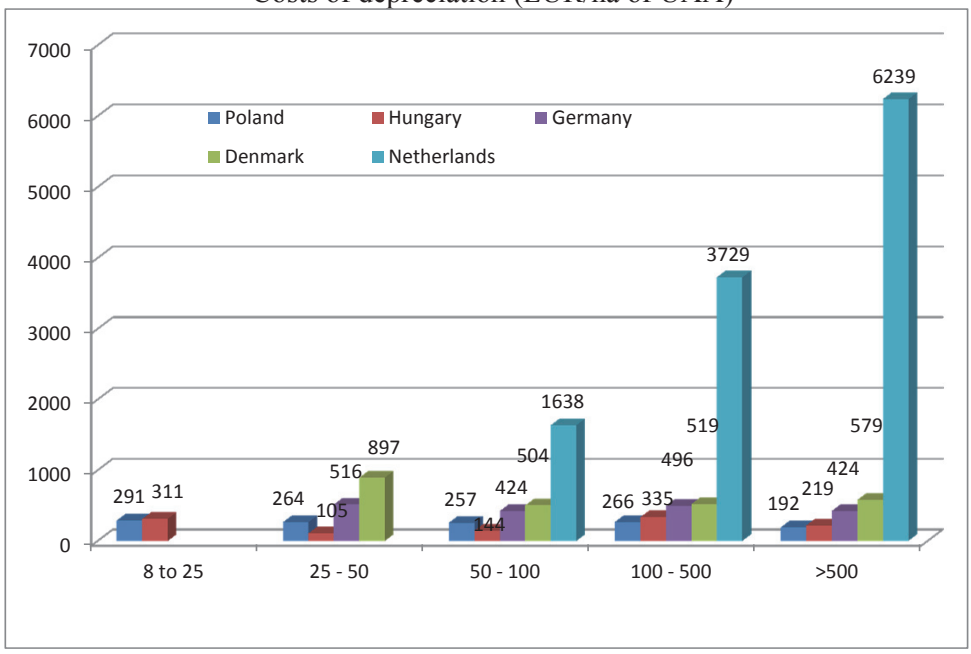
Land tenure costs (EUR/ha of UAA)



Source: based on the FADN data.

Chart AI.4.17

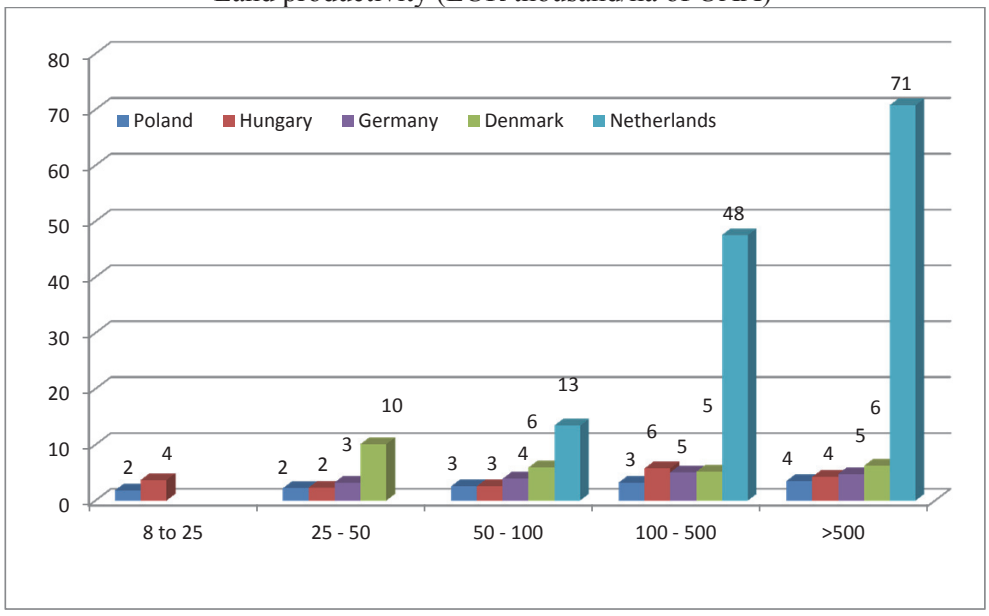
Costs of depreciation (EUR/ha of UAA)



Source: based on the FADN data.

Chart AI.4.18

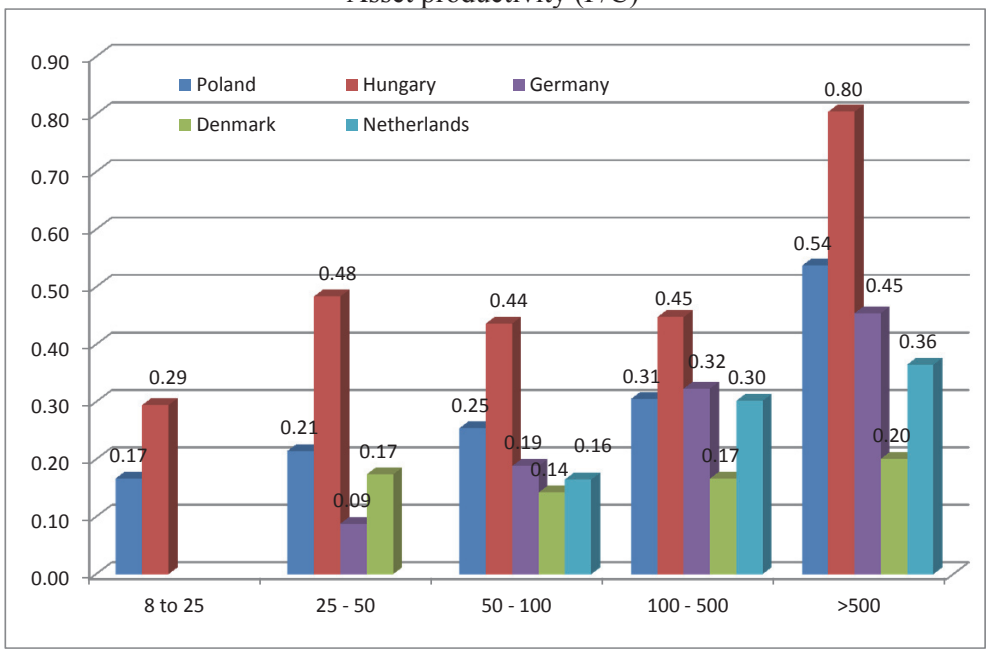
Land productivity (EUR thousand/ha of UAA)



Source: based on the FADN data.

Chart AI.4.19

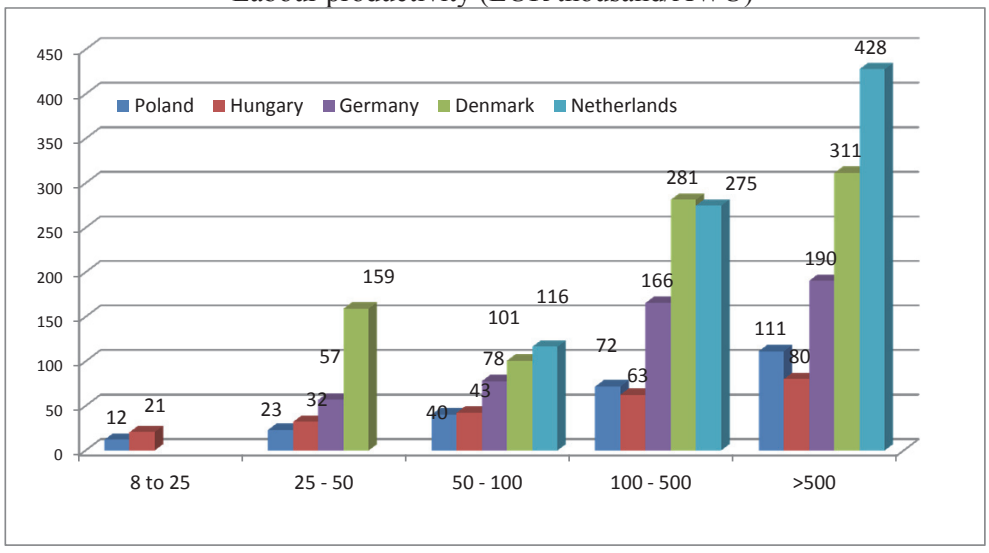
Asset productivity (P/C)



Source: based on the FADN data.

Chart AI.4.20

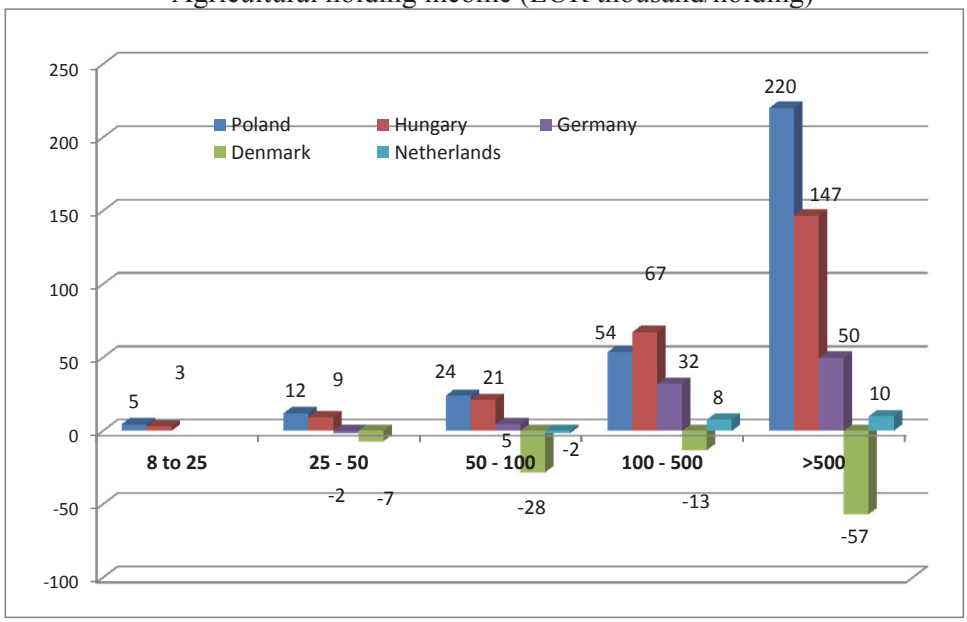
Labour productivity (EUR thousand/AWU)



Source: based on the FADN data.

Chart AI.4.21

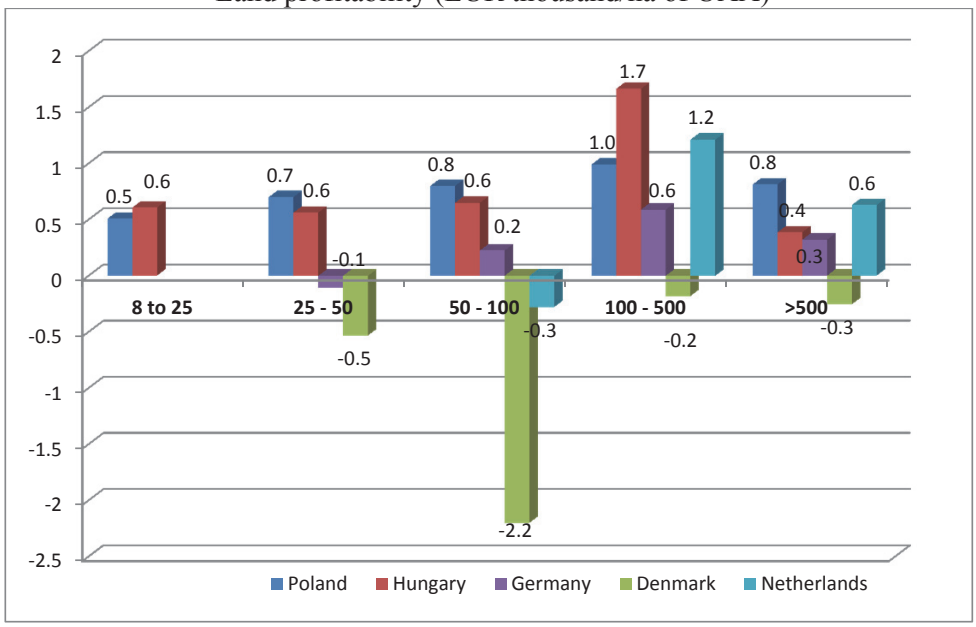
Agricultural holding income (EUR thousand/holding)



Source: based on the FADN data.

Chart AI.4.22

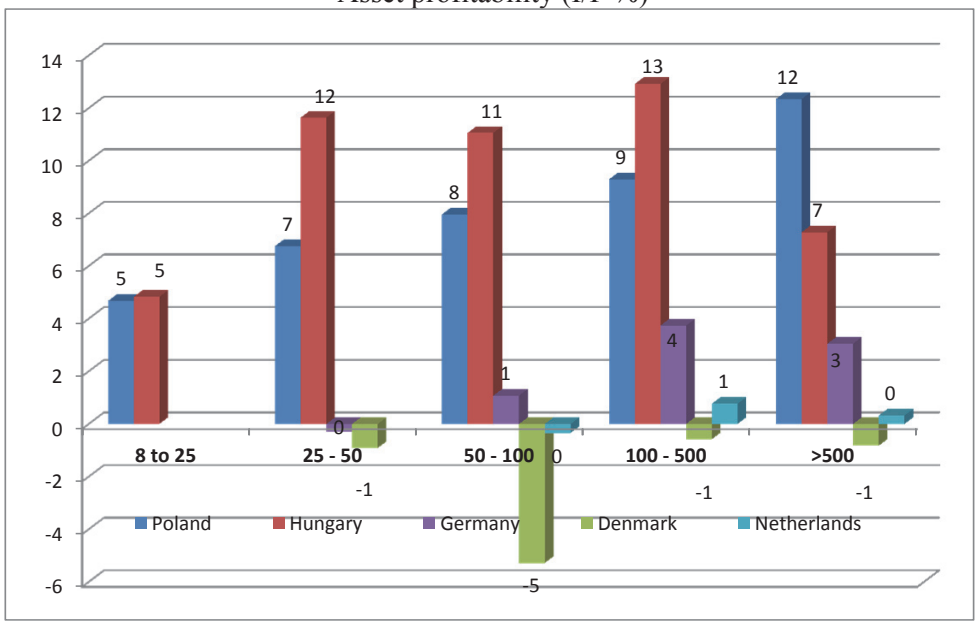
Land profitability (EUR thousand/ha of UAA)



Source: based on the FADN data.

Chart AI.4.23

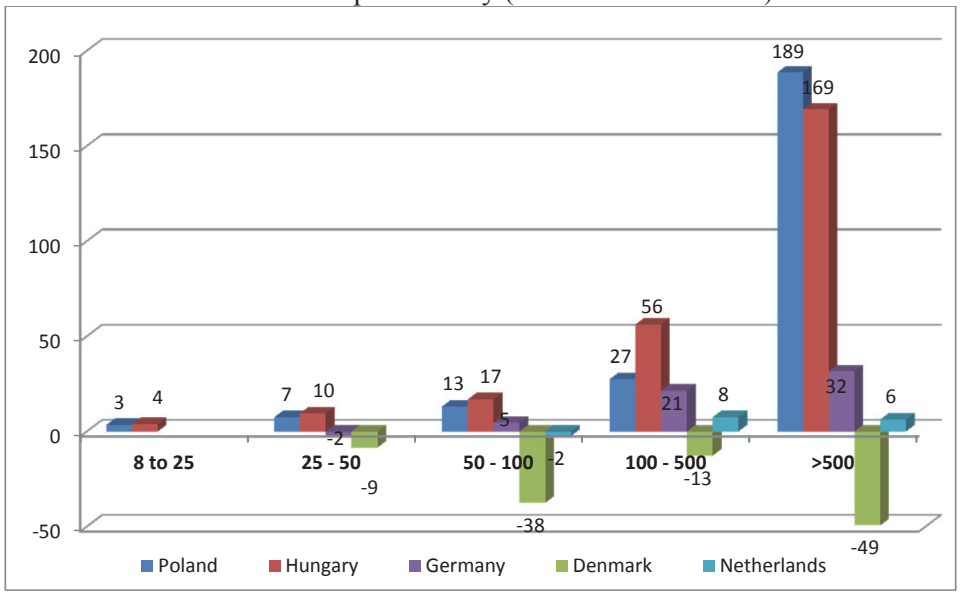
Asset profitability (I/P %)



Source: based on the FADN data.

Chart AI.4.24

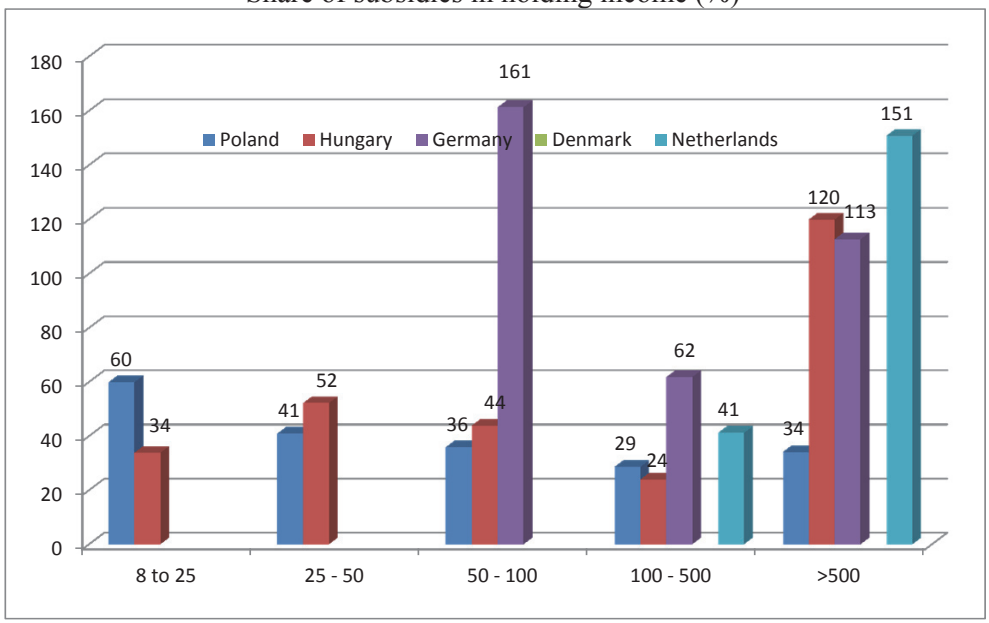
Own labour profitability (EUR thousand/FWU)



Source: based on the FADN data.

Chart AI.4.25

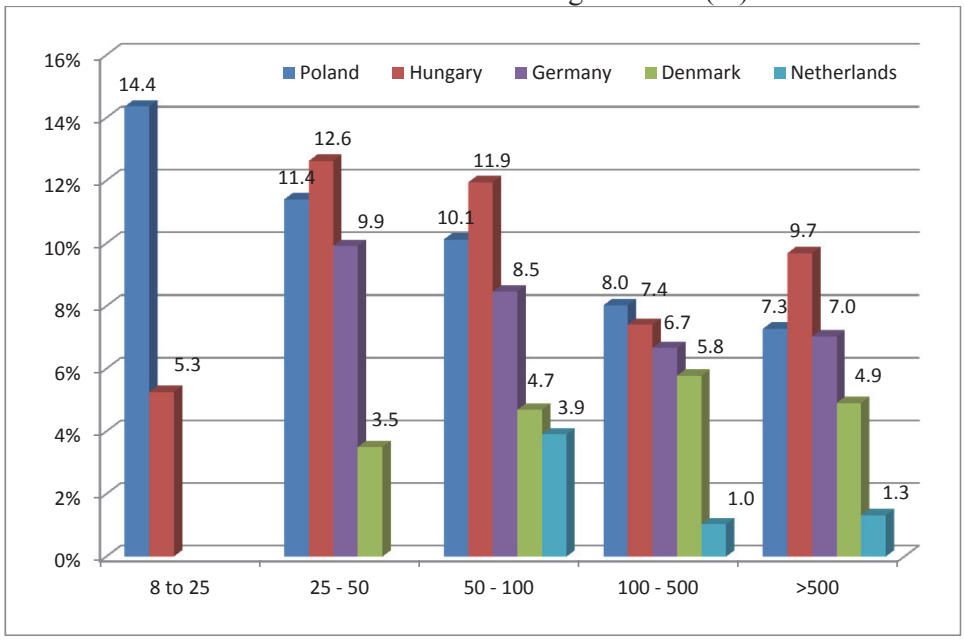
Share of subsidies in holding income (%)



Source: based on the FADN data.

Chart AI.4.26

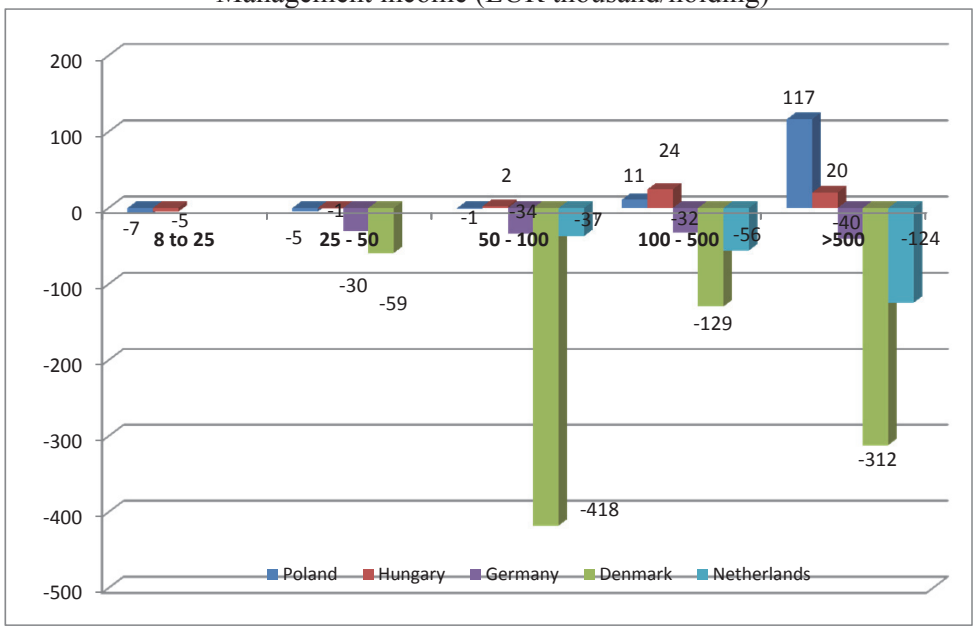
Share of subsidies in holding revenues (%)



Source: based on the FADN data.

Chart AI.4.27

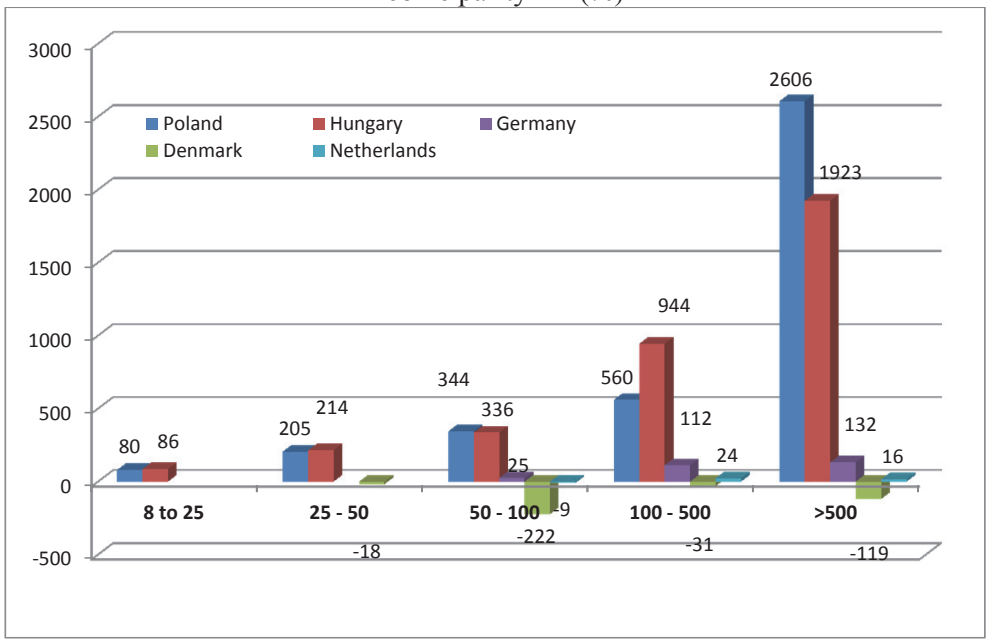
Management income (EUR thousand/holding)



Source: based on the FADN data.

Chart AI.4.28

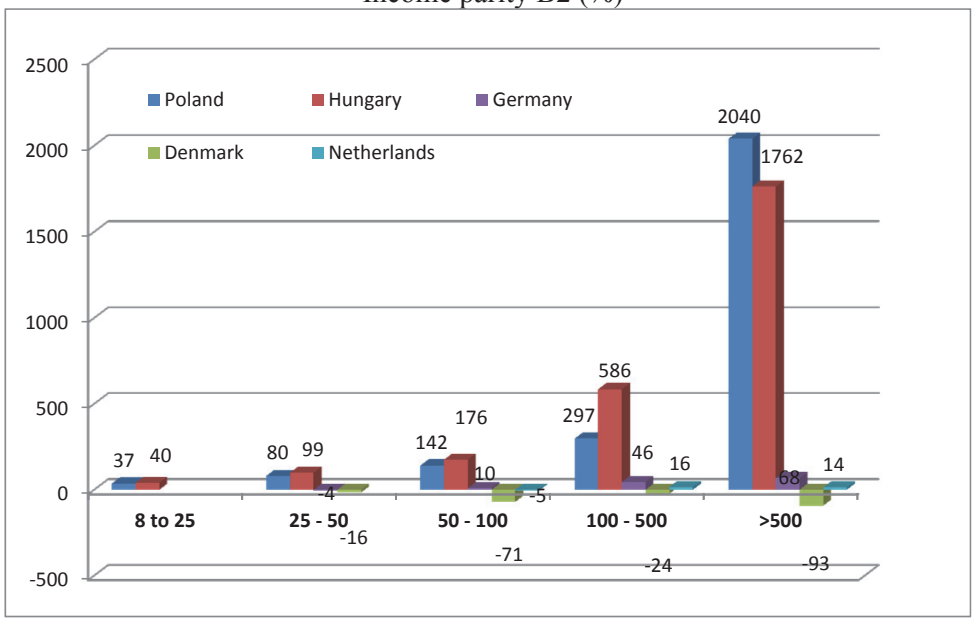
Income parity A1 (%)



Source: based on the FADN data.

Chart AI.4.29

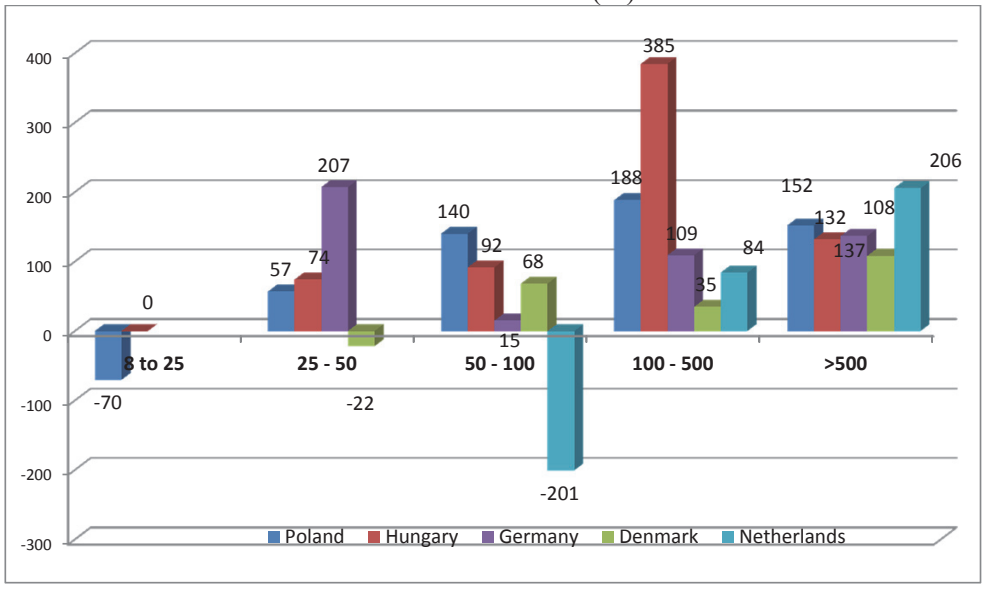
Income parity B2 (%)



Source: based on the FADN data.

Chart AI.4.30

Net investment rate (%)



Source: based on the FADN data.

COSTS, INCOME AND COST-EFFECTIVENESS OF OBTAINING SELECTED AGRICULTURAL PRODUCTS IN 2006-2011 AND IN THE MEDIUM TERM

Introduction

Making the right choice is a difficult, but important aspect of any decision-making process. In the recent years, this phenomenon has been taking on particular importance, and this is related to, *inter alia*, the fact that many areas of economic life are subject to very dynamic changes, which results in an increase in uncertainty and risk. In case of the agricultural production, due to its biological and technical nature and in the light of changes in the Common Agricultural Policy and in the conditions of global competition, this issue is particularly important. Therefore, when making decisions, agricultural holdings often use tools supporting this process, while allowing to justify choices made in a rational manner. One of such tools is forecasting which allows to diagnose future conditions under which the actions taken will be implemented. Thus, it may be stated that in case of agriculture forecasting is an essential element of effective and efficient running of a holding. It also plays an important role in determining the consequences of decisions made, i.e. expected benefits and costs to be incurred. The more information a farmer is going to have about possible effects of decisions made, the more rational his decisions are.

Forecasts play an important information and warning role. They should inspire, above all, persons using study results to take measures aimed at reinforcing the direction of development deemed beneficial or to prevent the direction of development deemed undesirable [Zeliaś 2005].

A similar position is taken by Sobczak [2008]. In his opinion, even if forecasts are not accurate, they make people aware of phenomena and trends which may shape the forecast phenomenon in the nearest years. Thanks to this, it is possible to take measures aimed at eliminating negative events. Accurate forecasting is a skill held by few and it is a combination of knowledge and art.

According to Zeliaś [2005], despite enormous progress which has taken place in future prediction methods, and, in particular, the development of theory of econometric forecasting (assisted by modern computer techniques), a forecast used by an economist is still encumbered with a bigger or smaller error. In the complex realities of economic life, flawless forecasts do not exist. This is due to the fact that economic phenomena are more complex than physical ones and

affected by so many explanatory variables that the identification of the role and importance of each variable is virtually impossible. Besides, these variables may not be subject to any experiment, i.e. may not be watched under artificial conditions, in which only selected variables operate. Thus, a question arises on how to use a forecast. First of all, we should not apply a strategy, in which decisions are made as if a forecast was flawless. Economic forecasts should inspire people using study results to take measures aimed at reinforcing the direction of development deemed beneficial or to prevent the direction of development deemed undesirable.

The chapter focuses on: (1) direct costs of cultivating cereals and rapeseed and the cost-effectiveness of this cultivation in 2015, (2) cost-effectiveness of the milk production in the same year, and (3) projection on the cost--effectiveness of production of selected agricultural products in 2020.

Costs of cultivating cereals and rapeseed and the projection on the cost-effectiveness of their cultivation in 2015

In Poland, agriculture is one of the basic branches of the national economy determining the production of food, population nutrition level and food security of the country. It has the significant production potential, but also poses environmental risks. In the recent years, the results of the intensification of agriculture have been increasingly visible, both in Poland and in other countries. More and more common is also the awareness of negative consequences of excessive mineral fertilisation or of using large quantities of chemical plant protection products [Dincer 2000, Runowski 2002].

Thus, agriculture is faced with a dilemma. On the one hand, it is necessary to increase the efficiency of management and, on the other – to improve the quality of products. This is a problem noticed by many researchers. Attention is paid to ensuring a specific level of yield while minimising the negative environmental impact.

Inputs contributing directly to the growth in the agricultural production (mineral fertilisers, plant protection products) are subject to the law of diminishing returns. This means that an increase in the level of use of these inputs brings diminishing unit revenues [Samuelson 1995]. On the other hand, two types of effects appear: an increase in the volume of inputs is more and more harmful to the environment, and diminishing revenue per input unit deteriorates economic relations, especially when input unit prices – due to their limited supply – start rising [Zegar 2009].

In Poland, the consumption of mineral fertilisers is quite high, for several years it has exceeded 100 kg of NPK per 1 ha of utilised agricultural area, just like in some EU countries (e.g. Germany, the Netherlands, Belgium and Luxembourg). Despite this, it is estimated that agriculture in our country infringes the balance of ecosystems to a lesser extent than that in the countries with highly intensive agriculture. In Poland, family holdings dominate where industrialisation and modernisation of agriculture are not advanced. However, recently, a group of holdings has been established which are already or will soon be competitive in relation to intensive Western European agriculture – this phenomenon is visible especially in the group of large-scale commodity holdings [Wielicki, Baum 2008].

With the lower consumption of chemical yield-creating products, we often deal with a decline in yields. This decline, however, may occur after exceeding the optimum fertilisation threshold. Sometimes, the increased consumption of chemical products is economically unreasonable because there are other environmental factors limiting yielding of plants, e.g. shortage of water.

This is an important issue, because in recent years the weather has been significantly different from the one considered "normal" for decades. Losses of yields due to adverse weather events, such as: thermal conditions, precipitation, frequency and intensityof extreme events, become one of the main problems [Popp, Hantos 2011]. Together with climate change, we also observe the greater environmental impact of agriculture such as, e.g. increased erosion [Olesen et al. 2011].

Forecasts for the future predict global warming for at least several decades, although deviations from the trend within short periods of time may happen. The production in agriculture depends on climatic conditions, but also affects climate. Climate is getting warmer now, mainly due to a human-induced increase in the concentration of greenhouse gases in the atmosphere. Therefore, in the context of climate change, agriculture plays various roles of: victim, beneficiary, accomplice of change and ally in preventing changes [Kundzewicz, Kozyra 2011]. Due to the increased frequency of the occurrence of years with adverse climatic conditions and thus the stronger variation of yielding of individual crops, a major challenge is to run agricultural holdings while maintaining their financial stability.

Bearing in mind the adverse environmental impact of intensive agriculture, the primary objective assumed in this study was to determine the relationship between the plant production intensity level and its efficiency.

The production intensity diversification scale has been shown on an example of four plant production activities of a relatively large economic importance in Poland, i.e. winter wheat, winter rye, spring barley and winter rapeseed. It should be added that in Poland cereals are the most significant group of crops. This is a result of changes which have taken place in Polish agriculture in recent decades, *inter alia*, related to a decrease in the importance of potatoes as feed for pigs. Also the growth in the area of rapeseed is observed in national sown crops. The impact of the production intensity for the crops on their production and economic results has been analysed. An additional aspect was the projection of income and, therefore, defining the direction of change in the medium term. The impact of the projected rate of changes in prices of means of agricultural production and obtained yields on the amount of income has been shown.

Methodology of studies

Data for four plant production activities, which were covered by studies in 2006-2011, i.e. for winter wheat, winter rye, spring barley and winter rapeseed, were collected in individual agricultural holdings located throughout Poland. The number of holdings in the study sample was within the range from 118 to 275, depending on the activity and year of study.

Holdings have been selected for studies deliberately from a representative sample of holdings, which was monitored by the Polish FADN system. The selection of holdings for each year has been made independently. Studies on agricultural production activities were conducted in accordance with the methodology of the AGROKOSZTY system.

According to the literature, the intensity in agriculture is evidenced by the amount of inputs per area unit. The approach to this problem has changed over the years, mainly in the context of the selection of the most appropriate parametres for assessing the intensity [Manteuffel 1984; Hernandez-Rivera, Mann 2008].

In studies conducted the actual amount of inputs of the means of production, which in terms of value are expressed by the level of direct costs, was adopted as a measure of the production intensity. Direct costs of the plant production include: the cost of seed material, of mineral fertilisers, of plant protection products and growth regulators as well as specialist costs, which are directly related to the specific activity: the cost of irrigation water, soil analysis, etc.

To assess the production intensity, holdings from the study sample have been organised according to the amount of direct costs incurred per 1 ha of the studied activities. Data were formulated according to quartiles, however, in order to show

the diversification scale, the results for the individual activities were presented for two marginal quartiles, i.e. groups of holdings with the low (A) and high (B) level of direct costs incurred per 1 ha of crops. The results were presented as three-year moving averages (in the period covering the years 2006-2011). Such a formulation reduces the effect of accidental fluctuations possible when analysing yearly averages (e.g., effects of sudden changes in market or weather conditions) and allows to determine the direction of changes with greater certainty.

A horizontal analysis was used by comparing the parameters characterising the analysed activities in holdings with the low (A) and high (B) intensity of their crops. To show the diversification scale, the data were expressed as an A/B ratio in percentage terms, assuming that the data for the activities in holdings from group B = 100.

The studies covered income, i.e. the value of the potentially commercial production from 1 ha of crops, inputs and costs as well as economic effects. As a basic measure for assessing the effects obtained, the level of direct surplus and of income from activity without subsidies has been assumed. The method for calculating those categories has been presented below:

– direct surplus = production value – direct costs,
– income from activities without subsidies = production value – total costs (direct + indirect[19]).

The adopted study methods allowed to assess the economic efficiency of production of the analysed activities. The focus was on the analysis of the level of the production value and incurred costs. Two levels of the economic account were separated taking into account the purpose, which the generated information is to serve. An expression of the relation between the production value and the costs is the production cost-effectiveness index which, accordingly to the cost

[19] The calculations leading to the calculation of business income include both direct and indirect costs. The level of indirect costs has been determined on the basis of the data from the Polish FADN. Indirect costs, which may be defined as costs of production readiness, are incurred due to the functioning or just the existence of a holding. They may be divided into actual and estimated costs. Actual indirect costs include: (1) general costs – electricity, heating fuel, motor fuel, current repairs, maintenance and inspections, services, insurance of buildings, property and vehicles, other costs, for example, charge for water, telephone; (2) taxes – agricultural, forestry, on special sections of agricultural production, on real estate and others, e.g. on means of transport; (3) cost of external factors – contract work, land tenure and interest on loans. On the other hand, estimated indirect costs include: depreciation of buildings and structures, machinery and technical equipment, means of transport, land improvement, orchards and perennial plantations, intangible assets and completed investments in foreign fixed assets.

group included in the denominator, was marked as I, II. The cost-effectiveness index I means a surplus of the production value over direct costs, and the indicator II – a surplus of the production value over total costs (direct+indirect). This index informs about the percentage in which the production value expressed in current prices covers costs incurred for its generation.

The next aspect of studies is the projection for 2015 of income from the cultivation of winter wheat, winter rye, spring barley and winter rapeseed. A basis for preparing that projection were the actual data characterising the activities in holdings from Group A and B, on average, in 2006-2011. Such an approach reduced random fluctuations in individual variables. The development of the projection was based on the time series method [Mirer 2002].

Using the public statistical data for the variables describing revenues and production costs of the analysed activities, time series have been built, they covered 17 years, i.e. the period from 1995 to 2011. Time series allowed to extrapolate the analysed phenomena into the future. For their modelling and preparing the projection of results, classic development trend models have been used. The development trend has been separated using an analytical method, i.e. by finding a trend function *f(t)* (*t* means time), which best describes changes in the phenomenon over time [Wasilewska 2011]. The analytical form of this function has been selected using a heuristic method. It consists in finding several forms of the trend function and then in choosing one of them according to the applied criterion [Stańko 1999].

Two function selection criteria have been distinguished: the value of the determination coefficient R^2, and knowledge about the evolution of the analysed phenomenon over time. It has also been assumed that the function parameters should be statistically significant. Five functions have been analysed: linear, quadratic polynomial, exponential, power and logarithmic. For each series, models of the development trend in the following form have been prepared:

$Y_t = \beta_0 + \beta_1 t + \varepsilon_t$ – linear trend model,

$Y_t = \beta_0 + \beta_1 t + \beta_2 t^2 + \varepsilon_t$ – quadratic trend model,

$Y_t = \beta_0 e^{-\beta_1 t + \varepsilon_t}$ – exponential trend model,

$Y_t = \beta_0 t^{\beta_1} e^{\varepsilon_t}$ – power trend model,

$Y_t = \beta_0 + \beta_1 \ln(t) + \varepsilon_t$ – logarithmic trend model,

where:

Y_t – value of the variable explained in point *t*,

t – explanatory variable (time) assumes total values from 1 to ∞,

β_0 – absolute term,

$\beta_1.\beta_2$ – function parameters,

ε_t – random element.

For each of the analysed time series one of the trend functions was selected and used to extrapolate the given phenomenon into 2015, i.e. variables characterising the activities. The projection has been prepared with average production results of the analysed activities and with the results worse (pessimistic version) and better (optimistic version) than the average level. The yield has been adjusted on the basis of the average deviations from its average amount in 1995-2011.

Results in 2006-2011

The studies show the diversification of economic results of the crop production activity, depending on the intensity of their cultivation. Direct costs incurred per 1 ha were a measure of the intensity. Attention is drawn by the positive correlation between the amount of those costs and the area under cultivation. In low-intensity holdings (A), the area of analysed activities was within the range of 5.9-16.8 ha, while in high-intensity holdings (B) it was within the range from 9.6 to 38.0 ha. It is estimated that in case of the larger cultivation scale, the higher inputs of yield-creating factors have been applied deliberately, farmers expected better production and economic results. The more that those holdings (B) mostly had better quality soils. Their value in use expressed in points was within the range of 0.81-1.28 points, while in case of low-intensity holdings (A) it was from 0.59 to 1.13 points.

A farmer can largely control the level of direct costs, but despite this fact, the plant production is encumbered with a great risk and uncertainty due to variable climatic factors, on which a farmer has no impact.

The diversification of cost, production and income categories of the analysed activities has been expressed in a form of a relation, by comparing their level per 1 ha in holdings with the low (A) to high (B) intensity of technology of their cultivation. As a result, it was determined that direct costs in group A accounted for from 29.6% to 46.2% of the level incurred in group B. This means that in low-intensity cultivation entities (A) – when compared to high-intensity entities (B) – they were lower, depending on the activity, by 53.8% to 70.4%.

The structure of direct costs is dominated by two components – the cost of mineral fertilisers and of plant protection products, and their general share ranged from 61.9% to 85.8%. The cost of mineral fertilisers in Group A holdings was from 25.6% to 49.3% of the level incurred by Group B farmers, while the cost of plant protection products was from 13.6% to 53.1%.

The reason for the diversification could be, to a small extent, the divergence in the purchase price of those products, however, it is estimated that the decisive impact in case of plant protection products was exerted by the number of conducted protection procedures which was related to the quantity of consumed active substance. On the other hand, the diversification of the cost of mineral fertilisers resulted mainly from the difference in the amount of the applied dose of NPK. In Group A holdings, it was smaller than in Group B holdings, from 39.2% to 74.3% (see Table 1).

The fertilisation level is an important aspect of each conducted production, and its quantitative dimension is closely related to the fertilisation efficiency. Actions aimed at improving the efficiency of the use of nutrients are important and desirable, they relate to the reduction in costs and an improvement in the quality of products. A major difficulty in this area is. However, the fact that farmers rarely carry out soil analyses for the content of nutrients, and, consequently, the soil is often irrationally fertilised.

In order to assess the effectiveness of applied mineral fertilisation (NPK), the average gross productivity, i.e. yield expressed in kg per 1 kg of NPK input has been calculated. This indicator was higher in Group A holdings. In case of rapeseed, the difference was 30%, but in case of barley it was even 220%. The figures in Table 1 also indicate a significant convergence of this assessment with the efficiency of direct costs incurred.

The analysis also took account of the efficiency of total costs incurred. The results of the calculations indicate the type of their relations similar to those of direct costs. In low-intensity holdings (A), total costs were smaller by 42.1--54.9%, depending on the type of crops, than in Group B holdings. It was largely determined by the share of direct costs, since their share in Group A holdings was 33.6-38.9% and 51.3-55.5% in Group B.

Table 1

Results of selected cereals and rapeseed in the sample of holdings from the lowest (A) and the highest (B) quartile of direct costs of their cultivation, on average, in the years of studies*

Activity	Groups of holdings	Yield dt/ha	Selling price PLN/dt	Average efficiency of fertilisation kg	Data per 1 ha expressed as A/B ratio, in %							
					Dose of NPK	Value of production (VP)	Direct costs (DC)	Total costs (TC)	Direct surplus	Income from activities without subsidies	Cost--effectiveness index	
											I VP/DC	II VP/TC
Winter wheat	A	42.0	56.81	35.05	37.8	68.9	43.0	57.9	86.2	105.1	160.4	119.0
	B	58.7	59.90	18.24								
Winter rye	A	22.3	48.67	41.79	25.7	57.6	29.6	45.1	81.1	156.4	194.6	127.8
	B	36.5	49.71	17.08								
Spring barley	A	36.7	55.13	57.58	29.0	82.1	41.9	57.1	110.9	194.9	195.8	143.8
	B	42.3	58.69	18.00								
Winter rapeseed	A	23.9	132.09	9.62	60.8	78.6	46.2	57.7	109.4	239.1	170.3	136.2
	B	29.8	135.93	7.27								

* Years of studies: winter wheat, winter rye and winter rapeseed – 2006, 2008, 2011; spring barley – 2007, 2009, 2011. Groups of holdings include: A – 25% of holdings from the study sample with the lowest level of direct costs incurred for the given production activity, low level of intensity; B – 25% of holdings with the highest level of direct costs, high level of intensity. The average productivity of fertilisation – yield expressed in kg per 1 kg of NPK.

Source: elaboration based on own studies.

In the light of large differences in terms of direct costs incurred, which have been adopted as a measure of the cultivation intensity, it is interesting to get to know the impact of its low and high level on the production results of activity. The calculations have demonstrated that in low-intensity holdings (A), plant yields were by 13.2-38.9% lower than in high-intensity holdings (B).

When it comes to the selling price, there was no large diversification between the groups of holdings and this is the proof that the price, to a small extent, is dependent on a farmer. A derivative of the yield and price is the realised production value. Its amount from 1 ha in Group A holdings was 57.6--82.1% of the level obtained in those of Group B. Smaller yielding of analysed crops was the main determinant of this situation.

As a measure for assessing economic effects, direct surplus and income from activities without subsidies (Table 1) have been adopted. When it comes to the direct surplus, in case of spring barley and winter rapeseed, the higher one was obtained by farmers in low-intensity holdings (A) – advantage when compared to high-intensity holdings (B) was, respectively, 10.9% and 9.4%. But then the direct surplus obtained from the cultivation of 1 ha of winter wheat and winter rye in Group A holdings was lower by, respectively, 13.8% and 18.9%.

Income from activities without subsidies determined for analysed agricultural products indicates the unambiguous advantage of Group A holdings. This advantage, compared to those in Group B, ranged from 5.1% in case of winter wheat to 139.1% for winter rapeseed.

The direct surplus is one of the two important categories of income in the economic account. It enables a simplified assessment of the economic efficiency of the agricultural production, depending on the level of obtained yields and change in the level of inputs, as well as the fluctuations of prices of both. Income from activities without subsidies is the surplus created after deducting direct and indirect costs from the production value. This income category is, thus, suitable for assessing the results in the longer term, because it allows either to indicate the possibilities of developing productive forces of agricultural holdings, maintaining them at the unchanged level or to warn that both are impossible without the more or less deep restructuring.

To assess the economic efficiency of the production of analysed activities in the selected groups of holdings, the cost-effectiveness index has been used, which is understood as the percentage ratio of the production value to costs. The calculation results show that the economic efficiency of production, measured by the cost-effectiveness index I and II, has always been higher in holdings A, i.e. those with lower direct costs.

In Group A holdings, the cost-effectiveness index I (ratio of the production value to direct costs) was higher by 60.4-95.8% when compared to the index calculated for Group B holdings. The cost-effectiveness index II, calculated in a similar manner (ratio of the production value to total costs) was higher by 19.0-43.8%.

Projection of income for 2015

The results of the projection of income drawn up for cereals – winter wheat, winter rye and spring barley as well as winter rapeseed – show the higher average growth rate in costs than in the value of their production (within the range from 2.9 to 7.9 percentage points) in the perspective of 2015. Taking this observation into account, the impact of the anticipated growth in costs on economic results of the cultivation of the above-mentioned crops has been analysed, in holdings with the low (Group A) and high (Group B) intensity of their cultivation, while the measure of the intensity were direct costs per 1 ha of the area of cultivation.

The projection assumed the identical rate of change in individual cost components in both groups of holdings, but due to their different share in the cost structure, the overall rate of changes in costs – in relation to the base year – was different in those groups. The calculations included in Table 2 show that the rate of changes in costs was slightly higher in Group B holdings, with the exception of winter rye.

The results presented in Table 1 proved that the high production intensity did not always mean the high cost-effectiveness. This results from the fact that the former is shaped at a holding and the latter during the market exchange. Economic results of the analysed species of cereals and rapeseed were better in holdings with lower direct costs, i.e. in group A.

From Table 2 it results that in the perspective of 2015, in Group A holdings we should expect the greater growth rate in income from their cultivation, and the difference to the detriment of Group B holdings may be from 1.8 to 10.4 percentage points (pp). The same direction of change is visible in case of income calculated per 1 dt of the product.

Moreover, the projection shows that in 2015 the results for intensively cultivated spring barley (B) may be particularly poor. It is expected that income from 1 ha of crops will decrease below the level of the base year by 8.4%, while in low-intensity holdings (A) this income may increase by 2.0%.

A measure of the assessment of the effectiveness is the cost of generating an activity income unit. In the perspective of 2015, in both groups of holdings its growth is expected, however, in Group A holdings the growth rate will be weaker, from 2.1 to 13.6 pp. These results indicate a more rational way of conducting the production in holdings from this group. In Group A holdings, the share of income in the production value will also be higher, from 1.8 to 9.6 pp.

Table 2

Projection for 2015 – indices of the rate of changes (%) for the results of cereals and rapeseed in holdings from the lowest (A) and the highest (B) quartile of direct costs of their cultivation, in relation to the base year*

Specification		Winter wheat		Winter rye		Spring barley		Winter rapeseed	
		A	B	A	B	A	B	A	B
Yield, dt/ha		104.7		101.2		100.7		100.6	
Selling price, PLN/dt		107.6		111.6		108.4		113.1	
Production value, PLN/ha		112.5	112.7	113.3	113.1	109.1	109.0	113.8	113.8
Total costs, PLN/ha		116.0	116.4	117.4	117.2	116.3	116.9	116.7	117.1
Income from activity without subsidies	PLN/ha	108.7	106.9	108.9	103.1	102.0	91.6	111.1	107.6
	PLN/1 dt	103.9	102.2	107.5	101.9	101.3	91.0	110.4	106.9
Total costs per PLN 1 of income from activity without subsidies, PLN		106.7	108.8	107.9	113.6	113.9	127.5	105.0	108.9
Share of income from activity without subsidies in the production value, %		96.7	94.9	96.1	91.2	93.6	84.0	97.7	94.5

* Estimate for 2011; data for 2006-2011 have been adjusted using indices of changes designated based on the trend function, and then averaged. Groups of holdings A and B – see Table 1.
Source: elaboration based on own studies.

The study results determine a potential direction of changes under average, i.e. similar as in the recent years, conditions of the functioning of holdings, both market and climate. Agriculture, however, is a special branch, which results from the largely biological nature of the production. So, it faces fortuitous events, such as droughts, floods, but also conditions conducive to the agricultural production. They have a big influence on yields of crops but cannot be predicted.

In moderate climate of Europe, yielding of plants is determined basically by two meteorological components: temperature and precipitation, while in northern Europe – from the point of view of agriculture – there is a shortage of heat energy while in southern Europe, in turn, there is a shortage of rainfall [Flohn, Fantechi 1984]. A specific feature of Polish climate is the possibility of the occurrence of both these factors, both in shortage and in excess, and optimal thermal and rainfall conditions occur in, approximately, one-third of the years [Banaszkiewicz 2003].

In order to determine the scope of the changes in economic results of analysed species of cereals and rapeseed – depending on the yield – the projection has been prepared in two versions, pessimistic (adverse production results) and optimistic (positive production results). For the relevant calculations, the yield variability was used (*in plus* and *in minus*), when compared to the calculation prepared for average conditions of the functioning of holdings in the base year.

Table 3 shows the projection results assuming the pessimistic production conditions. In this way, it was possible to determine changes in the income level, which may be expected, if climatic conditions are particularly adverse and will result in a strong decrease in the yield. The findings show that the activity which will respond to the deterioration of conditions in the weakest way will be winter wheat while for spring barley their impact will be the strongest.

Table 3

Projection for 2015, assuming adverse production results – indices of the rate of changes (%) for the results of cereals and rapeseed in holdings from the lowest (A) and the highest (B) quartile of direct costs of their cultivation, in relation to the base year*

Specification		Winter wheat		Winter rye		Spring barley		Winter rapeseed	
		A	B	A	B	A	B	A	B
Yield, dt/ha		93.4		82.6		80.5		85.2	
Selling price, PLN/dt		107.6		111.6		108.4		113.1	
Production value, PLN/ha		100.4	100.6	92.5	92.3	87.3	87.3	96.3	96.3
Total costs, PLN/ha		116.0	116.4	117.4	117.2	116.3	116.9	116.7	117.1
Income from activity without subsidies	PLN/ha	84.0	75.8	66.3	32.3	59.0	21.4	77.7	57.8
	PLN/1 dt	90.0	81.1	80.3	39.1	73.3	26.6	91.2	67.9
Total costs per PLN 1 of income from activity without subsidies, PLN		138.1	153.6	177.0	362.9	197.0	545.8	150.3	202.6
Share of income from activity without subsidies in the production value, %		83.7	75.3	71.7	35.0	67.6	24.5	80.6	60.0

* Estimate for 2011; data for 2006-2011 have been adjusted using indices of changes designated based on the trend function, and then averaged. Groups of holdings A and B – see Table 1.

Source: elaboration based on own studies.

The decrease in the yield will result in the deterioration of the income situation of the activity, but the impact of this decrease will be weaker in Group A holdings. The advantage of Group A holdings over those of group B is clear. Taking into account the income decrease rate – in relation to the base year – the difference in favour of Group A holdings may amount to, depending on the type of crops, from 8.2 to 37.6 pp. A consequence will be the significantly lower growth rate in the cost of generating an income unit in Group A holdings and the greater share of income from activity without subsidies in the production value, from 8.4 to 43.1 pp.

The optimistic version of the projection assumes that production results of the analysed activities will be more favourable than average. The results of calculations (Table 4) show that winter rapeseed will respond to these conditions in the strongest way and as a result, an improvement in the income situation may be significant. On the other hand, relatively the weakest income growth rate is anticipated for spring barley.

Table 4

Projection for 2015, assuming beneficial production results – indices of the rate of changes (%) for the results of cereals and rapeseed in holdings from the lowest (A) and the highest (B) quartile of direct costs of their cultivation, in relation to the base year*

Specification		Winter wheat		Winter rye		Spring barley		Winter rapeseed	
		A	B	A	B	A	B	A	B
Yield, dt/ha		113.8		112.7		107.3		124.2	
Selling price, PLN/dt		107.6		111.6		108.4		113.1	
Production value, PLN/ha		122.3	122.5	126.0	125.8	116.2	116.2	140.5	140.5
Total costs, PLN/ha		116.0	116.4	117.4	117.2	116.3	116.9	116.7	117.1
Income from activity without subsidies	PLN/ha	128.8	132.2	135.0	146.7	116.2	114.7	162.2	183.6
	PLN/1 dt	113.1	116.2	119.8	130.1	108.2	106.8	130.6	147.8
Total costs per PLN 1 of income from activity without subsidies, PLN		90.1	88.0	87.0	79.9	100.1	101.9	71.9	63.8
Share of income from activity without subsidies in the production value, %		105.3	107.9	107.1	116.6	99.9	98.7	115.5	130.7

* Estimate for 2011; data for 2006-2011 have been adjusted using indices of changes designated based on the trend function, and then averaged. Groups of holdings A and B – see Table 1.

Source: elaboration based on own studies.

The projection results presented in Table 4 show that in conditions of very large yields, the growth rate in income from 1 ha of winter plants – wheat, rye and rapeseed, will be stronger in high-intensity holdings (B). When compared to low--intensity holdings (A), the difference may be, depending on the type of crops, from 3.4 to 21.4 pp. As a consequence, the cost decrease rate will be higher in Group B holdings – from 2.1 to 8.1 pp. In case of spring barley, the projection results indicate a similar growth rate in income from 1 ha of crops in both groups of holdings, although there is the small advantage in favour of Group A holdings (by 1.5 pp). These circumstances are reflected in the share of income in the production value, which in case of spring barley is higher in Group A holdings (by 1.2 pp), while for wheat, rye and rapeseed it is higher in Group B holdings by 2.6 to 15.2 pp than in the reference group.

In the optimistic version, it is expected that the growth rate in income from the cultivation of winter wheat, winter rye and winter rapeseed will be stronger in high-intensity holdings (Group B). However, bearing in mind the lower – when compared to Group A holdings – income level from their cultivation (see Table 1), it is estimated that the income situation of these activities under highly intensive cultivation (B) will still be worse than in low intensity holdings (A).

The results of the projection show the direction and rate of changes in revenues (production value), costs, and income from the cultivation of wheat, rye, barley and rapeseed in the perspective of 2015 under specific production and price conditions. Thus, they show the anticipated limits of variability of obtained effects. Recognising them is advisable to get the proper picture of changes which may take place in the cost-effectiveness of individual activities and, at the same time, to get the proper response to these changes of holding owners and other interested persons or institutions.

In this context, it is worth quoting the results of studies of the American researchers on the impact of climate change on yields of cereals in 1980-2008 in the main regions of their cultivation in the world [*Wpływ zmian klimatu*… 2014]. The assessment covered changes in temperature, duration of the vegetation season, precipitation, changes in the concentration of carbon dioxide in the air and fertilisation. Studies show that the impact of adverse climate change in the majority of the regions dominated over the positive effect of changes in the cultivation technology. Over the analysed period, in 65% of the world regions, the average temperature increased by 1 degree. As a consequence, the net yield of corn decreased by 3.8% (as a result, the yield on a global scale is smaller by an amount

equal to the annual production of corn in Mexico). The decrease in the yield of wheat is estimated at 2.5%. The increased concentration of carbon dioxide in the air positively affected the volume of the yield, because otherwise the decrease in the yield would be about 5.5%. In the analysed years, the yields of rice and soy slightly increased but without taking into account the positive impact of the higher carbon dioxide concentration, yields of those plants would decrease by 0.1% and 1.7%. respectively. The biggest losses in yields were reported in Russia (15%), while in the USA no impact of climate change on the volume of yields was found.

Summing up, it may be concluded that decisions made by farmers always entail a risk as to results obtained. This stems from the difference between the time, when decisions are made and the time when their effects appear. Thus, the presented results contribute to recognising the effects of management under specific production and economic conditions. Probably, this will allow – at least to some extent – to prevent possible negative phenomena.

The findings, which aimed at projecting income from cereals and rapeseed in the perspective of 2015, demonstrated a significant advantage of crops with the low level of direct costs. The intensive cultivation, with the high level of these costs, was characterised by the stronger growth rate than the revenue growth rate which had a negative impact on the level of income. The more favourable ratio of income to production costs may be expected only in case of extremely high yields. Only then, will the revenue growth rate be higher than in case of the low-intensity cultivation.

This is an important issue due to the production efficiency, but also with a view to the environmental protection. In the recent years, risks posed by intensive agriculture have been noticed more and more clearly. Thus, reducing these risks is one of the tasks of modern agriculture. Various measures are taken for this purpose. The cultivation technology is improved, to take into account not only production and economic effects, but also the environmental safety. Thus, the concept of the quantitative development is being redefined into qualitative solutions.

In the 20th century, the use of the achievements of genetics in improving cultivars was of great significance for the growth of crops. For example, N. Borlaug introduced into the cultivation and nutrition in India and Pakistan dwarf wheats grown in Mexico, which led to a doubling of yields and self-sufficiency in the cereal production. That achievement was called the Green Revolution, and its author was awarded the Nobel Peace Prize in 1970, for "victory in man's war against hunger". Of crucial importance to the further increase in the productivity of plants is the so-called Gene Revolution.

Thanks to recognising the function of organisms at the molecular level, it become possible to analyse, understand and manipulate DNA. Creating new cultivars, more fertile and of better quality, is the best way to develop the plant production, both in quantity and quality terms. New, improved cultivars are a factor intensifying the agricultural production which is environmentally friendly and is of definitely ecological nature. The above-mentioned "Green Revolution" is an example of the importance of biological progress in human nutrition. Biological progress – its size and speed of implementation – is determined by many factors, the most important of which are the knowledge about the genetic fundamentals of processes and phenomena related to improving crops and using in their cultivation methods and technologies based on the latest biological and genetic knowledge, particularly, molecular biology and genomics [Greene et al. 2011].

In European conditions, the model of intensive agriculture loses its importance, and the additional role to play is designated by the perception of agriculture other than just production perception. Care for human health, environmental protection and preservation of the landscape designate a different direction for the development of agriculture [Zilberman et al. 1999].

In recent years, more and more attention has been paid to nitrogen and phosphorus management in the context of risks associated with their dispersion in the environment. This dispersion is proportional to the consumption of mineral fertilisers and the animal population. National measures in this regard are compliant with the Council Directive [1991], which is one of the first EU legal acts aimed at controlling pollution and improving the quality of waters.

The world's population is likely to keep on increasing for several decades. The further increase in the agricultural production is, therefore, necessary for the global political and social stability. Maintaining the adequate level of the food production is a great challenge. But doing this in a way that does not violate the balance of the environment and public health is even a greater challenge.

Cost-effectiveness of the milk production in the medium term

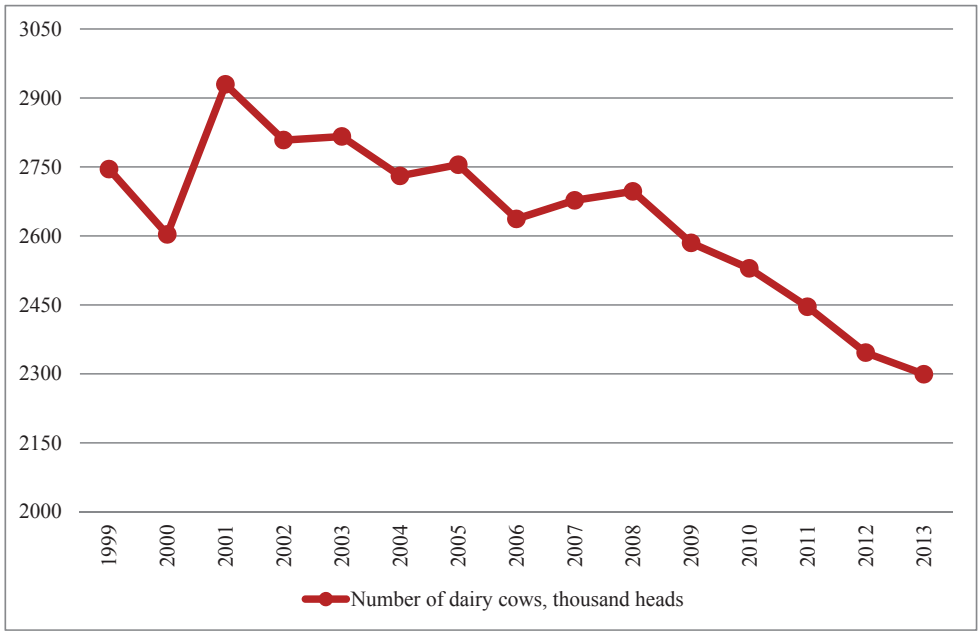
The commodity production of Polish agriculture is dominated by the animal production, and in 2004-2012 its share amounted to 53.4-62.6%. Whereas in the animal commodity production, the share of rearing dairy cattle

and milk production ranged from 29.1% to 33.5%[20]. This proves the great importance of the milk production for Polish agriculture. On the other hand, in the European Union our country is ranked sixth in terms of buying-in of milk.

In Poland, the dairy sector is also of great social significance. About 160 thousand producers place milk on the market and this is the main source of living for their agricultural holdings. The market of milk and milk products is a dynamically developing branch of Polish agriculture. The concentration of production and processing of milk and the better and better quality of raw materials and products make the dairy sector more and more specialised.

Chart 1

Total population of dairy cows in 1998-2013 in the country



Source: own elaboration based on the CSO data.

At the same time, an important issue is the sensitivity of the dairy sector to ever-changing market conditions. The milk production is becoming more and more demanding and expensive. This results from continually changing climatic conditions, agri-environmental requirements with regard to the sustainable agricultural production, instability of the financial markets, rise in prices of

[20] *Rocznik Statystyczny RP 2004*, CSO, Warszawa 2005; *Rocznik Statystyczny RP 2007*, CSO, Warszawa 2008; *Rocznik Statystyczny RP 2011*, CSO, Warszawa 2012; *Rocznik Statystyczny RP 2013*, CSO, Warszawa 2014.

means of production and growing requirements of consumers who expect products which are increasingly more diverse and of better quality [*Kwotowanie produkcji mleka* 2012].

The public statistics indicate that in Poland the population of dairy cows has been decreasing for a dozen or so years. In 2001, the total number of dairy cows in the country amounted to just over 2,900 thousand heads, while in 2013 it decreased to 2,299 thousand heads, i.e. by 20.7% (Chart 1).

There is a reduction in the population of cows, there is also a reduction in the number of milk producers, especially the smallest ones, i.e. keeping up to 9 dairy cows. In 2010 – when compared to 2009 – the number of holdings with no more than 9 dairy cows decreased by as much as 1/3. In the same period, the number of holdings keeping large herds of cows, i.e. 30-99 heads, increased by about 3%. The number of the largest holdings, keeping more than 200 cows, increased by 56.0%. The progressive concentration of rearing dairy cows is also evidenced by an increase in the concentration of these animals in a holding, from 3.3 heads in 2002 to 5.9 heads in 2010[21].

According to many milk producers, possibilities of increasing the concentration of manufacturing this product in Polish holdings are limited, and the problem is access to land. A rise in prices of this production factor is a reason for which organising a feed base becomes more and more expensive. In this situation, holdings which will not cope with a reduction in costs, will have to give up the milk production in the future.

Problem of access to land occurs also in other countries, e.g. in Germany, where many farmers compete for land with owners of biogas plants. As a result, 1 hectare of land costs EUR 30-40 thousand and the annual lease of 1 ha costs EUR 400-600[22].

Although a big problem of the dairy industry in Poland is the fragmentation of the production of dairy raw material, changes which occur are beneficial, which can be exemplified by the increased marketability of the milk production. In 2009-2010, 80% of produced milk were allocated to sale, of which 73% were delivered to dairies.

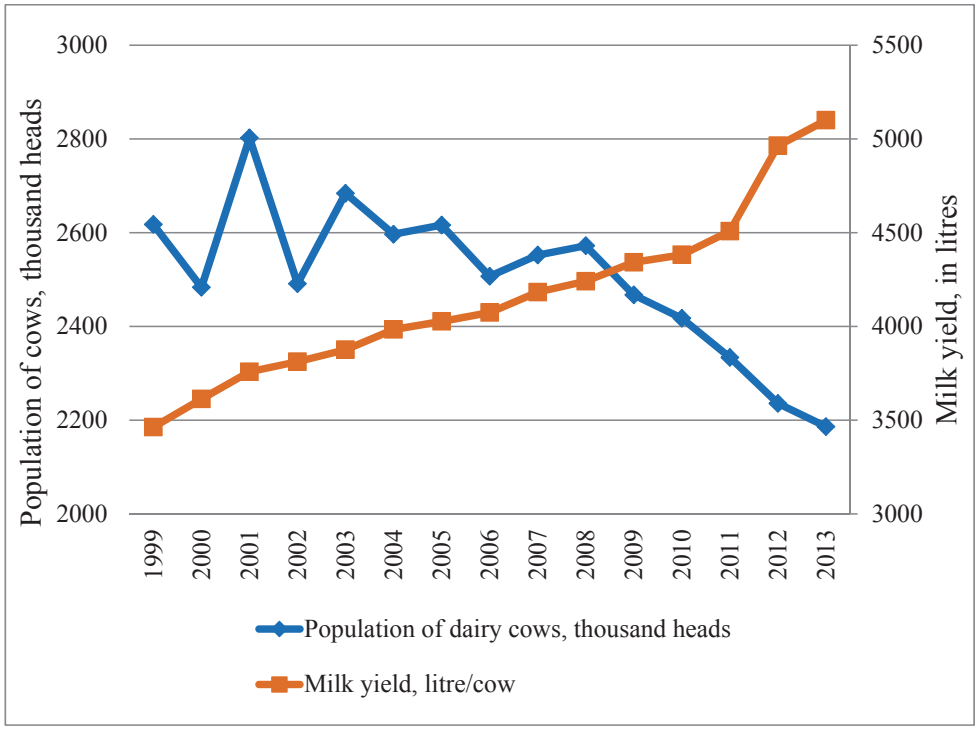
Thus, the changes are significant, as before Poland's accession to the EU. the dairy industry bought only 60% of produced milk [Seremak-Bulge 2011].

[21] *Rocznik Statystyczny RP 2011*, CSO, Warszawa 2012.
[22] *Rynek mleka po zniesieniu kwot*, http://www.topagrar.pl/articles/top-bydlo/rynek-mleka-po-zniesieniu-kwot/ [access: April 2014].

Along with the progressive concentration of the production and the decreasing population of dairy cows another trend appears, namely – a systematic increase in the milk yield of cows (Chart 2).

Chart 2

Population of dairy cows and milk yield in individual holdings in 1998-2013



Source: own elaboration based on the CSO data.

In 1998-2013, in individual holdings in Poland the population of dairy cows decreased by 22.4% (from 2,818.4 to 2,186.3 thousand heads). At the same time, in the same period, an increase in the milk yield by 48.1% was recorded (from 3,443 to 5,100 litres per cow)[23].

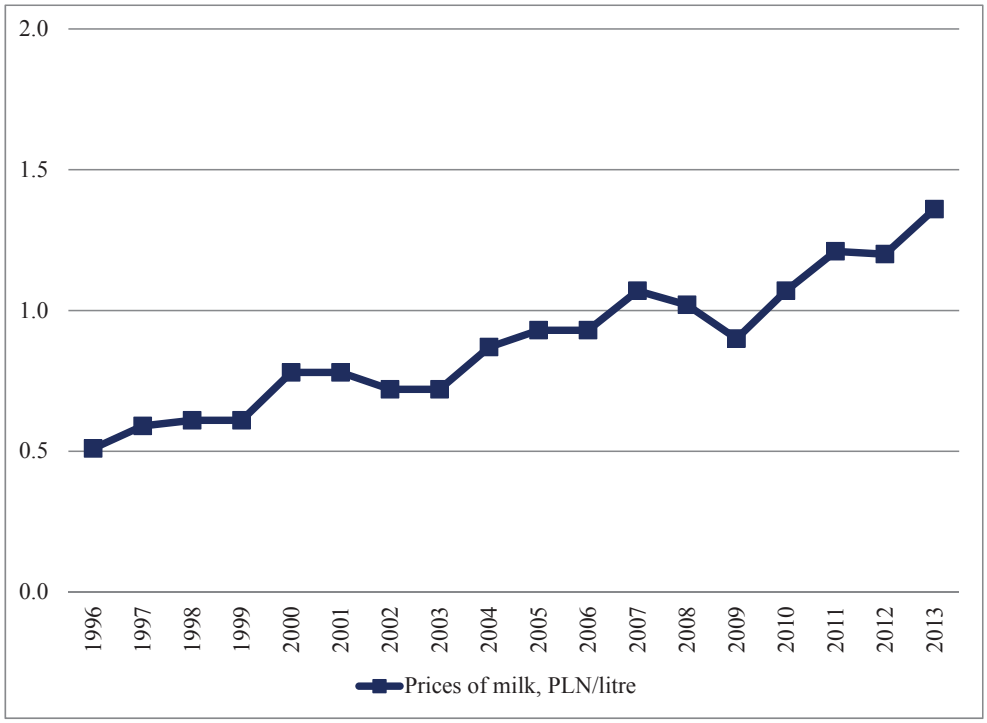
The milk selling price also was subject to changes. Chart 3 shows the changes in its level in 1995-2013. In general, we may observe an upward trend, with slight price decreases in 2001-2003, before Poland's accession to the European Union, and in the early years (2008-2009) of the crisis.

[23] *Rolnictwo 2006*, CSO, Warszawa 2007; *Rocznik Statystyczny Rolnictwa 2012*, CSO, Warszawa 2012; *Zwierzęta gospodarskie w 2013 r.,* CSO, Warszawa 2014; *Rynek mleka. Stan i perspektywy*, No 46, Analizy Rynkowe, IERiGŻ-PIB, ARR, MRiRW, Warszawa 2014.

The average milk buying-in price in 2012 also slightly decreased (by 1.2%), and since the conditions were more favourable in the following years, the milk price increased during the year by as much as 13.2%.

Chart 3

Milk selling price in 1995-2013



Source: own elaboration based on the CSO data.

Methodical assumptions of the account

The projection of economic results of the milk production for 2015 has been prepared, on average, for the entire sample of analysed holdings and for groups differing in terms of the population of cows. In 2006-2011, these studies (conducted within the framework of the so-called AGROKOSZTY system) covered, on average, 163 holdings with an average of 21.5 heads of cows.

The number of cows in a herd can be considered as a measure of the milk production scale, so, in order to show the differences in the cost-effectiveness of the milk production and milk yield of cows, the entire sample has been divided into quartiles according to the number of animals in a holding. The results of this grouping have been presented for the marginal quartiles only, i.e. for:

- 1st quartile, i.e. 25% of holdings with the smallest number of cows (5.9 heads, on average),
- 4th quartile, i.e. 25% of holdings with the biggest number of cows (44.1 heads, on average).

The calculations for 2011 reflect the results from the years 2006--2011, which have been adjusted by indices of changes designated based on the trend function, and then averaged. The objective of that approach was to create a starting point for building the projection model for 2015.

The results describing income from the milk production in the base year (2011) were used to build the projection (based on time series) of production and economic results in 2015. The procedure of projection for holdings classified into the 1st and 4th quartile was the same as in the case of average results for the entire study sample. The projection used the same time series and the previously selected trend functions, and the differences in the projection results stemmed only from the adopted output data, which were different for each group of holdings.

Results of the projection for the cost-effectiveness of the milk production in 2015

In 2011, i.e. the base year for the projection model, the average status of cows in analysed holdings was 21.5 heads, their milk yield – 5,815 litres and the milk selling price was PLN 1.21 per litre. In these production and price conditions, the direct surplus (without subsidies) per 1 cow was PLN 5,317 and income from this activity without subsidies amounted to PLN 2,958.

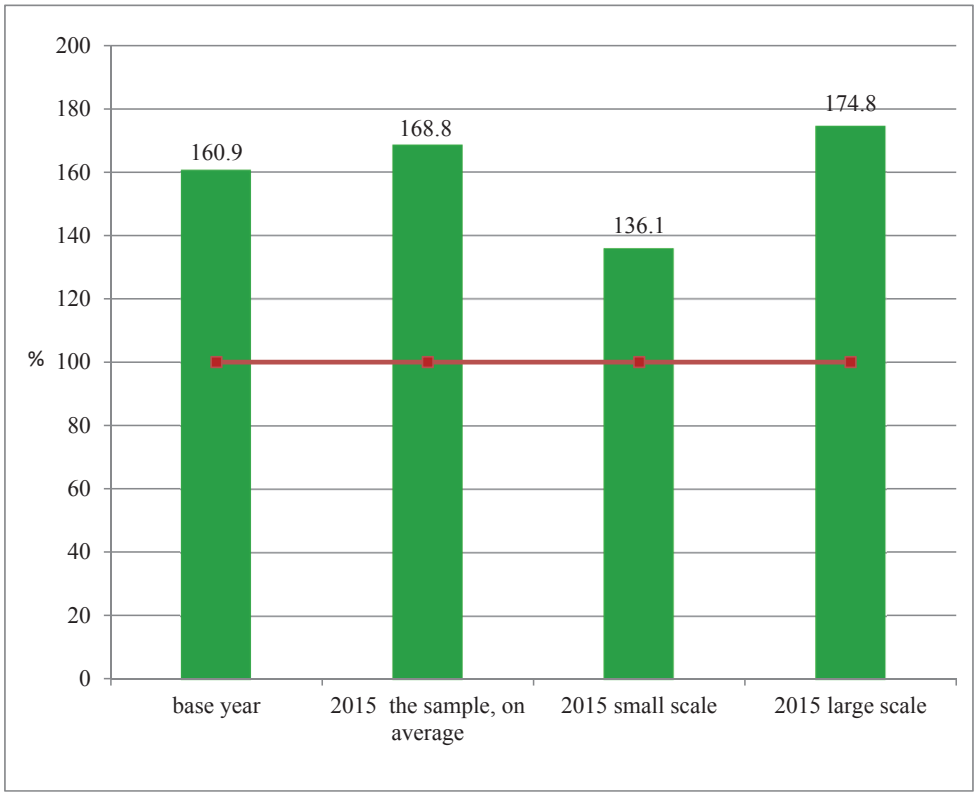
Therefore, the milk production was cost-effective. A measure was the cost-effectiveness index (ratio of the production value to total costs), which was 160.9% (Chart 4).

A comparative analysis of production and economic results indicates the clear advantage of holdings with the large number of cows (the average number of cows – 44.1 heads). They achieved the milk yield higher by 56.2% and the price of sold milk higher by 22.1%. However, costs of keeping cows were higher: direct by 19.4% and total (i.e. direct and indirect in total) by 33.6%.

Nevertheless, the economic surplus remaining at the disposal of a farmer and the economic efficiency of the production were also higher. Income without subsidies per 1 cow was higher by 199.5% and the milk production cost--effectiveness index – by 36.9 pp.

Chart 4

Milk production cost-effectiveness in the base year (2011) and the projection for 2015, on average in the analysed sample, and depending on the production scale



Source: own findings.

Based on the projection, it is envisaged that in the perspective of 2015, the milk yield of cows will increase by 4.9% against the figures of 2011, and the milk selling price – by 14.4%. From the trend function of a dozen or so years it results that the milk yield of cows will be increasing at the annual rate of 1.1-1.3%, and the milk price – by 3.3-3.6% [Skarżyńska 2013]. With such rate of changes, the average production value per 1 dairy cow in the analysed group of holdings will be higher by 19.6% in 2015. However, it is estimated that in 2015 direct costs of keeping 1 cow may also be higher, by 13.1%.

The particularly strong growth is predicted for the cost of own feedstuffs from non-commodity products and of purchased feedstuffs, respectively, by 15.1% and 14.9%. This is determined by an expected rise in prices, in the first case of mainly mineral fertilisers, and in the second – of individual types of feedstuffs. In the structure of indirect costs, an important position shall be

occupied by actual indirect costs, including fuel, electricity, repairs and agricultural services. It is anticipated that costs will increase by 14.8%, while total costs, i.e. direct and indirect in total, will be higher by 14.0% (Table 5).

Table 5

Indices of the rate of change (%) for the results of the milk production – per 1 dairy cow – in 2015, in relation to the base year 2011*, on average in the study sample and in groups of holdings

Specification	On average in the study sample	Depending on the production scale [number of cows/ holding]**	
		small	large
Milk yield of cows	104.9		
Milk selling price	114.4		
Total production value	119.6	119.3	119.7
Direct costs	113.1	112.7	113.2
Direct surplus without subsidies	122.7	124.5	122.5
Total costs (direct + indirect)	114.0	113.7	114.1
Income from activity without subsidies	128.9	138.4	128.2

* Estimate for 2011; data for 2006-2011 have been adjusted using indices of changes designated based on the trend function, and then averaged.

** Scale selection criterion was the number of cows in a holding, small concentration – 25% of holdings (1st quartile) from the sample with the lower population of cows, and large concentration – 25% of holdings (4th quartile) from the sample with the upper population of cows.
Source: own elaboration.

It is estimated that their average growth will not exceed 3.5% per year. On the other hand, in groups of holdings differing in terms of the number of cows, the total cost growth rate is different, and this results from the different cost structure. It is estimated that in 2015, when compared to the base year (2011), on average in the analysed sample of holdings, milk production income – calculated without subsidised – per 1 cow, will increase by 28.9%. Whereas in holdings with the smallest and the largest number of cows it will be higher by 38.4% and 28.2%, respectively. The level of this income will be higher in holdings keeping large herds of cows, but the growth rate will be stronger in entities with the small population of cows. This will be contributed to by the weaker growth rate in costs, both direct (by 12.7% to 13.2% at the large scale) and total (by 13.7% to 14.1%). This will be a consequence of the different cost structure and also the different growth rate in individual cost components (Table 5).

The study results show that, in the perspective of 2015, the production value growth rate per 1 cow will be stronger than the increase in costs of keeping it by 5.6 pp. As a result, when compared to 2011, the milk production cost-effectiveness, captured as a percentage ratio of the production value to total costs – on average in the sample – will improve by 7.9 pp (Chart 4). But in holdings keeping small herds of cows (5.9 heads, on average) it will be higher by 6.4 pp, and in case of bigger herds (44.1 heads, on average) – by 8.2 pp.

It is estimated that the main factor diversifying the income level is the milk yield of cows. For this reason, in 2015 in holdings with large herds of cows, the cost of producing 1 litre of milk will probably decrease by 14.3%. These holdings will also obtain the higher milk price due to the better quality of manufactured raw material and a stronger negotiating position of farmers resulting from the possibility of delivering larger batches of the commodity.

Anticipating future, possible events is very reasonable. When making specific management decisions, a farmer should be prepared for various circumstances, both good and bad, and having the specific knowledge will allow to reduce – at least to some extent – the effects of the latter.

Improving the milk production cost-effectiveness in 2015 against 2011 may not, however, be a basis for the answer to the question about the situation in the next few years, because milk quotas will be liquidated as from 1 April 2015.

So far, the presence of Poland in the EU has created development opportunities for holdings specialising in the milk production. The introduction of milk quotas and limiting the supply of milk led to the relative stability of prices, which affected the improvement in the production cost-effectiveness and subsidies to investments facilitated the restructuring.

The Common Agricultural Policy funds allocated to dairy holdings, improved their competitiveness against the background of agricultural holdings in other Member States.

The strength of dairy holdings in Poland, conducive to their further development, is: experience of farmers, high quality of milk and relatively low production costs, low price of raw milk when compared to other EU countries, relatively good economic results of holdings producing milk on a large scale, modern dairy industry and wide range of dairy products in retail, and natural conditions in the country favourable for the development of this type of production. However, dairy holdings in Poland have also weaknesses – fragmentation of the milk production, relatively low performance of cows, outdated cow rearing technologies in holdings with small herds, unused production capacity, etc.

Holdings keeping small herds of cows are, not without reasons, most afraid of the liquidation of milk quotas. Under new conditions, they will have an alternative – either to accept the less favourable economic conditions or to give up the milk production and, consequently, to change production profile.

The surrounding also entails other risks. Milk producers strongly experience the upward trend in prices of the means of production. A big problem is also the lack of flexibility in organising the production, if not milk, than what? Livestock buildings and machinery significantly limit the number of possible scenarios. In this situation, even favourable natural conditions will not allow a holding to shift immediately to another type of production.

However, large dairy holdings have a chance to develop further. Farmers become more and more aware of the importance of economies of scale in production. With a view to it, investments are made in new machinery and buildings, unfortunately, high debt service costs are often overlooked, which sometimes may cause serious problems.

The liquidation of milk quotas is perceived as a chance by producers involved in the milk production on a larger scale, who want to continue to deal with rearing of dairy cattle. In the opinion of experts, the lack of restrictions in the production will, however, probably result in an increase in the amount of milk in the market and a reduction in its prices.

According to a report by the European Commission[24], an increase in the production of milk and milk products, resulting from the liquidation of milk quotas, may be expected in particular in these Member States which so far have been restricted by the amounts, i.e. in Ireland, Germany, the Netherlands, Denmark, Austria, Poland and France. However, the authors of the report make a reservation that the volume of production will depend on the consumption growth rate both in the EU and in the world, as well as on other factors, e.g. environmental restrictions.

According to the European Commission forecasts[25], the liquidation of milk quotas in 2015 will translate into the strong growth of buying-in in ten Member States, which will result in exceeding the growth rate by 10%. To the greatest extent, this change will be beneficial for Ireland, where the market milk supply may increase by more than 20%, and for Germany and the Netherlands – an

[24] *Raport KE: Zniesienie kwot mlecznych to wzrost produkcji mleka,* http://finanse.wp.pl/kat,1034079,title,Raport-KE-zniesienie-kwot-mleczny-to-wzrost-produkcji-mleka,wid,16680187,wiadomosc.html?ticaid=112e7e [access: June 2014].

[25] *KE optymistycznie o przyszłości europejskiego mleczarstwa*, http://mlecznaferma.pl/ke-optymistycznie-o-przyszlosci-europejskiego-mleczarstwa/ [access: April 2014].

increase of 16%. In case of Poland, the Commission estimates the production growth by about 10%. In turn, a decrease in supplies is anticipated in Greece, Finland, the Czech Republic, Sweden, Romania, Bulgaria, Croatia and Hungary.

The above projections are in line with the forecasts made by national analysts[26], except that for Poland the predicted increase in the milk production is only by 3% (to 2020). By 2020, all "actors" important in the world market of milk are planning to increase their production.

Another aspect are the ambitious plans of the countries in Asia and South America. For example, the Chinese, in order to fully meet the internal market's needs, by 2020 are planning to increase their milk production by 40%, and New Zealand, producing milk at the lowest costs in the world – by a little less, i.e. about 17%.

The European Commission forecasts a reduction in milk prices by 10%, but other Western institutions anticipate the decrease by as much as 15-20%. A prolonged period of lower prices of milk will be survived by holdings, which will have low production costs. In Europe, there are regions where climatic conditions and the economic situation allow for relatively low milk production costs. According to opinions of experts, Poland is not among these regions. The technical and economic results of Polish dairy holdings are much weaker than those of holdings in the "old" Union. Lower costs of labour, services, fuels are eliminated by keeping too small herds, poor reproduction, high costs of veterinary services, high culling rate and mortality of calves.

Despite many concerns, experts predict that by 2022 the economic situation in the world market should not be assessed so pessimistically, mainly due to an expected increase in the demand for dairy products in developing countries.

[26] *Zachód Europy szykuje ekspansję, czy wytrzymamy zniesienie kwot mlecznych?* http://mlecznaferma.pl/zachod-europy-szykuje-ekspansje-czy-wytrzymamy-zniesienie-kwot-mlecznych/ [access: April 2014].

Projection of the cost-effectiveness of manufacture of selected agricultural products in 2020

A farmer, running a holding, may not focus only on solving current problems. He should also think ahead, specifying, e.g. directions and scope of investing. In order to survive in the market, the information, which, to a smaller or greater extent, would present the future conditions, is required. Preparing forecasts and predicting the development of various phenomena is becoming necessary for the functioning of holdings, the more that the recent directions of changes in the Common Agricultural Policy, consist in limiting the market regulation. This means that a holding is subject to a much greater impact of the supply and demand rights and competition rules. Under these conditions, the need for producers to respond to signals sent by the market is increasing. It is to result in:

- making agriculture able to meet the market demands by adjusting the production to demand;
- avoiding the distortion of the competition in international trade;
- strengthening the competitiveness and innovation in the agricultural sector, so that it is able to face the challenges of the global market.

As a result of these changes to the agricultural policy, we should expect the greater demand for the information about future market conditions dictated by prices of agricultural products [Stańko 2009] and acquired means of production, changes with regard to subsidies and taxation, etc.

Therefore, the results presented in this chapter show the impact of the rate of changes in yields, prices of products and prices of means of agricultural production (e.g., seed material, fertilisers, plant production products) on the level of revenues, costs and income of five crop production activities – winter wheat, winter rye, spring barley, winter rapeseed and sugar beet, in the perspective of 2020. It is to help to determine changes expected in this year when compared to the base year, i.e. 2013, and, in fact, average values from 2011-2013.

The study results show what we may expect under average market and climatic conditions and, thus, similar to those from the last several years. When running a holding, we should bear in mind that obtained results are also dependent on the weather conditions occurring in subsequent years.

However, these are adverse fortuitous events, e.g. droughts and floods, but also conditions conducive to the agricultural production, e.g. desirable amount of rainfall and their distribution over time matching plant development stages. We may not predict the occurrence of these events in individual years, but they often have a big impact on the volume of yields.

Fluctuations may also cover prices of products and cost components and the rate of these changes does not need to reflect a trend observed in the last dozen or so years. Deviations from average values may be significant, which, as a consequence, also has an impact on the income level in individual years. In agriculture, it is thus not possible to develop a fully accurate forecast of economic phenomena, but it is possible to anticipate the limits of variability of features of our interest, which characterise the future reality (yields, prices, etc.), and to observe the direction of their changes.

For a detailed analysis of this issue, a projection model has been built, which allowed to determine the effect of individual changes in the yield, price and cost of analysed crops on the change in economic results in 2020, while individual changes mean deviations from projection results arising from the trend. The scale of deviations, of income from activity without subsidies, from projection results for 2020 has also been analysed, due to the variability of yields and prices recorded over a period of 19 years (1995-2013) within the framework of public statistics.

The presented results reflect the average level of analysed features in groups of holdings in which the studies were conducted and therefore they should not be directly translated into the average results for the country. They show, however, specific phenomena and dependencies and the direction of their changes (e.g. the evolution of the cost-effectiveness of production), and in this regard they provide a basis for the formulation of conclusions relating not only to the analysed sample.

Methodology of studies

In order to anticipate future events, quantitative methods based on classical trend models have been used. For this purpose, empirical data from the AGROKOSZTY system and the Polish FADN have been applied. Empirical material describing the activities selected for the studies came from the years 2011-2013. The model projection assumed the invariability of the structure and amount of inputs incurred on individual activities in the production process. This means that the inputs reflect the average level in the base years, i.e. 2011-2013. The information necessary to determine the trend line and to build the projection model came mainly from public statistics studies. Time series for individual variables, i.e. components of the structure of the production value and costs, included a period of 19 years, i.e. from 1995 to 2013.

The projection results follow from the long-term trend, and thus they indicate, what we may expect in the not-too-distant future under average production and market conditions. The production in agriculture, however, is subject to the impact of factors that make the scope of the change in some variables significantly different from the designated trend. In order to show the impact of these changes on the income level, the projection results for 2020 have been presented in terms of variants.

The analysis covered the deviations from income (*in plus* and *in minus*) from individual activities due to individual changes in the yield (+/-1 dt for most crops, for sugar beet +/-10 dt), prices (+/-1 PLN/dt) and production costs (+/-100 EUR/ha). In addition, the variability of the yield and prices in the last 19 years (1995-2013) has been determined. The assumption was to investigate random fluctuations, not related to the long-term trend [Skarżyńska 2014]. The variability of the yield and prices has been calculated as the quotient of the root from the sum of squares of residuals from the models to the arithmetic mean of the following variables:

$$V = \frac{\sqrt{\sum(Y - \hat{Y})^2}}{\bar{Y}}$$

where:

V – variability of the analysed variable,

Y – empirical values of the variable,

$\hat{Y}$ – theoretical values of the variable resulting from the model,

$\bar{Y}$ – arithmetic mean of the variable.

Taking into account the variability of the yield and prices observed in 1995-2013, the possible amount of deviations of the yield and prices from the level anticipated for 2020 under average conditions has been calculated. For each activity, the strength of the impact of each factor on income has been analysed independently. This was possible because the analysis of the correlation between the yield and price showed no significant relationship between them. Correlations have been calculated using for each variable the differences of logarithms between subsequent observations ($\ln [Y_t] - \ln [Y_{t-1}]$). In this way, the effect of long-term changes arising from the development trend and likely to have a significant impact on the results of correlation has been eliminated.

The variant-based expression of the projection results may be an instruction as to the scope of changes in the income situation of analysed production activities in the perspective of 2020 (the projection model does not show dependencies, e.g. how the change in the supply of products may affect prices in the next year).

Obtained results

The findings showed that in the recent years the income situation of **winter wheat** was favourable. On average, in 2011-2013 (in the calculations, this period is represented by the year 2013), in holdings growing wheat (on average area of 23.84 ha), income from this activity calculated without subsidies amounted to EUR 1,372 per ha. But the production cost-effectiveness index, i.e. percentage ratio of the production value to direct and indirect costs in total, was 144.1% (Table 6).

What can we expect in 2020? An attempt to answer this question is provided by the projection using the direction of change observed in the past, after referring this change to the average values from the years 2011-2013 compared to the situation in 2013, as the base year.

The results of this projection and the rate of changes in relation to the base year for the projection (2013) have been shown in Table 6. It is anticipated that in the nearest years, the yield of winter wheat may increase by about 1.2% a year, reaching in 2020 – in the analysed sample of holdings – the level of 61.1 dt per ha. This means that when compared to 2013, it will be higher by 8.4%. The grain selling price will rise at the rate of 2.2-2.6% a year and in the perspective of 2020 it will rise by 18.1% (it will amount to PLN 93.42 per dt when compared to PLN 79.13 per dt in 2013). Such growth rate in the yield and grain price will allow, to achieve revenues higher by 27.8% in 2020.

The applied projection method also allows to determine the growth rate in production costs. Assuming the invariability – in relation to the base year – of incurred inputs and taking direct costs together, it is estimated that their annual increase will be within the range from 3.8% to 4.8%. The fastest growth rate is anticipated for the cost of seed material, by 4.4-5.7% a year, the cost of mineral fertilisers will be increasing within the range of 4.2-5.5% a year and the cost of plant protection products – by 2.0-2.3%.

As a result, the increase of direct costs accumulated within seven years (2014-2020) and will amount to 33.8%. Consequently, in 2020 in analysed holdings they will be at the level of PLN 1,900 per ha, while in 2013 they amounted to PLN 1,420 per ha.

In case of total costs (direct and indirect in total), it is anticipated that their average increase will not exceed 4.2% a year. As a result in 2020 – in relation to 2013 – these costs will be higher by 30.0%. The projection results show that in 2020 in holdings growing almost 24 ha of winter wheat, income without subsidies per 1 ha may be at the level of PLN 1,686 per ha. Thus, it will exceed the level from 2013 by 22.9%.

However, the economic efficiency of the production of wheat will deteriorate and this is shown by the rate of changes in the production value and costs (in total). The growth in costs will, in fact, be stronger than the growth rate in the production value by 2.2 pp. As a consequence, the cost-effectiveness index will decrease to the level of 141.7%, while in 2013 it was 144.1%.

Summing up the considerations regarding the results of the cultivation of winter wheat, it should be stated that in 2011-2013 it was a profitable activity. The projection showed that it will remain like that also in 2020. However, the projection results indicate disturbing changes. First of all, in the years of studies, there will be a gradual decrease in the economic efficiency of the winter wheat production and cost-effectiveness index expressed by the degree of coverage with the production value of costs incurred for its manufacture, by 2020 it will decrease by 2.4 pp in relation to 2013. This means that incurred inputs will not bring the expected effects and despite an improvement in the production results the unit cost of grain production will increase.

It should be stressed that the completed projection should be treated with a certain degree of caution. Admittedly, it specifies the possible course of processes, however, the agricultural production is subject to the laws of nature, which no one is able to predict. It is also necessary to note the fact that the output data for developing the projection came from holdings growing winter wheat on a larger scale (about 24 ha). The production results of wheat were significantly better than the average results in the country.

These observations suggest that when using the projection results we should use visible trends or the anticipated annual rate of changes in specific variables (and not in the specific values presented in the tables and assigned to the specific years). In this sense, the presented results provide a basis for the formulation of conclusions relating not only to the analysed sample. This way of perceiving the projection results relates not only to winter wheat, but also to other discussed products.

Winter rapeseed is considered a plant competitive against wheat due to the similar soil requirements. In the opinion of experts, the price of rape seeds, higher by more than twice than the wheat price, indicates that the cultivation of rapeseed is competitive when compared to wheat. This price relation has continued since 2008, and in 2011-2013 in holdings covered by the studies there was an advantage of the rapeseed price of 2.2 times.

In recent years, winter rapeseed was a cost-effective activity, when adopting, as a measure, both the economic surplus which a farmer may use and the cost-effectiveness index. On average, in 2011-2013 income from activity without subsidies gained from rapeseed was, on average, at the level of PLN 1,125/ha, in case of cultivating rapeseed in the area of 16.29 ha, while the cost--effectiveness index (percentage ratio of the production value to the amount of costs) amounted to 133.4% (Table 6).

The projection results for 2020 show that in the nearest years the cultivation of winter rapeseed will also be cost-effective. However, we should not expect any significant improvement in the production results. It is estimated that the annual yield growth increase will be within the range from 1.0% to 1.2% and as a result, in the seven years the yield might be higher by 7.8%. In the analysed sample of holdings this means an increase by 2 dt per ha.

The price of rape seeds – in relation to the base year for the projection, i.e. 2013 (the average for 2011-2013) – will probably rise by 24.7%, and annual rises will be from 2.9% to 3.5%. As a result of these changes, revenues from 1 ha of rapeseed will increase annually by 3.9% to 4.8% and in 2020 will reach the level higher by 34.5%.

Table 6

Results of the cultivation of winter wheat and winter rapeseed in the base year 2013 and the projection for 2020 (at current prices)

Specification		Winter wheat			Winter rapeseed		
		Level for 2013*	Projection for 2020	Index of changes 2013 = 100	Level for 2013*	Projection for 2020	Index of changes 2013 = 100
Number of analysed holdings		161		-	149		-
Area of cultivation	[ha]	23.84		-	16.29		-
Yield of seed	[dt/ha]	56.3	61.1	108.4	25.9	27.9	107.8
Seed selling price	[PLN/dt]	79.13	93.42	118.1	173.99	217.05	124.7
		Per 1 ha, in PLN			**Per 1 ha, in PLN**		
Total production value		4482	5731	127.8	4499	6053	134.5
Total direct costs		1420	1900	133.8	1711	2278	133.1
including: seed material		231	325	140.5	161	226	140.0
mineral fertilisers in total		845	1176	139.1	1086	1511	139.1
plant protection products		303	352	116.1	388	451	116.1
Direct surplus without subsidies		3062	3830	125.1	2788	3775	135.4
Total indirect costs		1690	2144	126.8	1662	2103	126.5
Income from activity without subsidies		1372	1686	122.9	1125	1672	148.6
TOTAL COSTS		3111	4044	130.0	3374	4380	129.8
Indices of the economic efficiency							
Cost-effectiveness index	[%]	144.1	141.7	98.3	133.4	138.2	103.6
Total costs per1 dt	[PLN]	55.23	66.23	119.9	130.47	157.08	120.4
Income from activity without subsidies per 1 dt	[PLN]	24.36	27.61	113.4	43.52	59.97	137.8
Total costs per PLN 1 of income from activity without subsidies	[PLN]	2.27	2.40	105.8	3.00	2.62	87.4

* 2013 – base year for the projection model, the results reflect the average data for 2011-2013.
Source: elaboration based on own studies.

The annual growth rate in direct costs is expected to be within the range from 3.7% to 4.7%, due to which in 2020 they will exceed the level from 2013 by 33.1%. The fastest growth rate will be for the cost of seed material (4.3--5.7%), and the cumulative increase in seven years (2014-2020) will probably amount to 40.0%. The next position is occupied by mineral fertilisers, whose cost may be higher in the target year by 39.1%, with the annual growth rate from

4.2% to 5.5%. Then total costs (direct and indirect in total) of the cultivation of 1 ha of winter rapeseed will increase annually by 3.4-4.2%. As a consequence, in 2020 – when compared to the base year for the projection, i.e. 2013 – they may be higher by 29.8%.

As a result, income from the cultivation of winter rapeseed calculated without subsidies, which may be gained by farmers in 2020, will increase by 48.6% when compared to 2013. Its level will be similar to income from the cultivation of winter wheat – PLN 1.67 per ha when compared to PLN 1,686 per ha in case of wheat.

The projection results indicate that in the perspective of 2020 we should expect the growth rate in the rapeseed production value stronger by 4.7 pp than costs associated with its cultivation. As a consequence. the cost-effectiveness of its production will be higher by 3.6%.

It is estimated that in 2020 the cost of producing 1 dt of rapeseed will increase by 20.4% when compared to the situation in 2013. However, given the rise in the price of seeds by 24.7%, it is expected that income from activity without subsidies calculated per 1 dt will be higher by 37.8%.

Based on the above findings, we may therefore conclude that in 2011--2013 the cultivation of rapeseed was cost-effective and will remain like that in the adopted projection horizon, i.e. by 2020 (Table 6).

In 2011-2013, **winter rye** was, on average, cultivated in the area of 9.39 ha and provided income without subsidies at the level of PLN 376 per ha (Table 7). Thus, farmers have not suffered any losses from the cultivation of this species of cereals, but it is difficult to call this situation favourable.

The projection results show that in 2020 income without subsidies from the cultivation of rye may be by 61.8% higher when compared to its level in the base year. Despite such strong increase, this income still remains fairly low, as it amounts only to PLN 608 per ha. When compared to winter wheat, it will be lower by 2.8 times and to spring barley – by 1.9 times. The income growth anticipated for 2020 is a result of the production value of described cereal which is higher by 35.9%. This will be determined mainly by the grain selling price, according to the projection higher by 22.1% (PLN 71.17 per dt in 2020 when compared to PLN 58.31 per dt in 2013), because the yield growth is estimated at 11.6%. In the analysed holdings, the yield will be at the level of 35.9 dt, which means that within a period of seven years (2014-2020) it will increase by 3.7 dt.

From the projection it results that the annual yield growth rate will not exceed 1.6%. Much faster growth rate – from 2.6% to 3.2% – is anticipated for the grain price. Under these conditions. annual increases in the production value will be within the range from 4.2% to 4.8%.

The projection method assumes the invariability of the structure and amount of inputs incurred in the rye production process. Thus, the assumed growth in costs results only from predicted (based on the trends observed in the past and extrapolated into the future) changes in prices of means of production.

From the calculations it results that by 2020 direct costs will increase by 33.7% (thus, their annual growth rate will be 3.8%-4.8%). The particularly strong increase is predicted for the cost of mineral fertilisers (by 39.1%) and seed material (by 32.2%).

It is estimated that the annual increase in total direct and indirect costs (total costs) will be within the range of 3.4-4.2% and, as a result, in 2020 they may be higher by 29.5% when compared to 2013.

The projection results demonstrate the weaker growth rate in costs rather than that in the production value. It will be beneficial for farmers because it will improve the economic efficiency of the production of the described good. The cost-effectiveness index will probably reach the level of 131.0%, i.e. it will be higher than in the base year for the projection by 6.2 pp (Table 7).

From an analysis of the projection results it also results that in order to improve the economic effects of the cultivation of rye, farmers' efforts should be focused mainly on obtaining better production results.

Spring barley was also a profitable crop in the analysed years. The results of the studies show that in 2011-2013 in holdings growing barley, in the average area of 11.09 ha, the surplus of the production value over costs (direct and indirect in total) amounted to PLN 1,043 per ha, while the production cost--effectiveness index amounted to 151.3% (Table 7).

According to the projection, in the nearest years we should expect a small increase in the yields of spring barley. The anticipated annual growth rate may be only 0.5%, which means that in 2020 the yield may be higher by 3.5%, and thus it may be at the level of 44.8 dt per ha – the increase will be just 1.5 dt.

It is anticipated that the grain price will rise at the rate of 2.3-2.7% a year and in 2020 it may be PLN 84.15 per dt, and this means an increase by 18.9% when compared to the base year for the projection (2013). Such rate of increase in the yield and barley selling price in 2020 will allow to gain income from 1 ha

in the amount of PLN 3,784, i.e. higher by 22.9% than in 2013. This means their annual growth rate within the range of 2.8-3.2%.

The projection results for 2020 show also the much faster – when compared to 2013 – growth in costs than that in the production value (by 7.4 pp). The upward trend will apply both to direct and indirect costs.

The expected direct cost growth amounts to 33.6%. with the annual rate of their changes of 3.8-4.8%. The largest growth is expected for the cost of mineral fertilisers (by 39.1%) and seed material (by 30.7%). But then the indirect cost growth will probably be 27.3%. As a consequence, total costs of the cultivation of 1 ha of spring barley (direct and indirect costs in total) will be higher by 30.3% (with annual increments from 3.5% to 4.3%) and in analysed holdings it will reach the level of PLN 2,652 per ha.

As the growth rate in costs will be stronger than that in revenues, income from activity without subsidies in 2020 will amount to 108.5% of the level obtained in 2013 (PLN 1,132 per ha when compared to PLN 1,043 per ha in 2013). However, the economic efficiency of production will deteriorate. The cost-effectiveness index, i.e. percentage ratio of the production value to total costs will decrease by 8.6 pp. Nevertheless, barley will still have a chance to be the cost-effective activity and farmers will have at their disposal the surplus in a form of income without subsidies.

In order to improve the production cost-effectiveness, the growth in costs must be smaller or, at most, equal to the increase in the production value. What is, thus, important is the yield level at which the marginal cost becomes equal to the price. Explaining this issue is of fundamental importance in the context of answering the question about the volume of yield, which brings the maximum production cost-effectiveness, understood as the ratio of the production value to costs and as the difference between them.

It is assessed that in 2020 – when compared to 2013 – the cumulative growth in production costs of 1 dt of barley grain may reach 25.9%. For this reason, we may expect higher, by 20.1%, production cost of PLN 1 of income from the described activity, without subsidies. As a result, the level of this income per 1 dt of grain may increase by only 4.9% (Table 7).

Table 7

Results of the cultivation of winter rye and spring barley in the base year 2013 and the projection for 2020 (at current prices)

Specification		Winter rye			Spring barley		
		Level for 2013*	Projection for 2020	Index of changes 2013 = 100	Level for 2013*	Projection for 2020	Index of changes 2013 = 100
Number of analysed holdings		118		-	142		-
Area of cultivation	[ha]	9.39		-	11.09		-
Yield of grain	[dt/ha]	32.2	35.9	111.6	43.3	44.8	103.5
Grain selling price	[PLN/dt]	58.31	71.17	122.1	70.79	84.15	118.9
		Per 1 ha, in PLN			**Per 1 ha, in PLN**		
Total production value		1 890	2 569	135.9	3 079	3 784	122.9
Total direct costs		665	889	133.7	954	1 275	133.6
including: seed material		159	210	132.2	167	219	130.7
mineral fertilisers in total		396	551	139.1	620	862	139.1
plant protection products		103	119	116.1	146	169	116.1
Direct surplus without subsidies		1 225	1 680	137.1	2 124	2 509	118.1
Total indirect costs		850	1 072	126.2	1 081	1 377	127.3
Income from activity without subsidies		376	608	161.8	1 043	1 132	108.5
TOTAL COSTS		1 515	1 961	129.5	2 035	2 652	130.3
Indices of the economic efficiency							
Cost-effectiveness index	[%]	124.8	131.0	105.0	151.3	142.7	94.3
Total costs per 1 dt	[PLN]	47.10	54.65	116.0	47.01	59.19	125.9
Income from activity without subsidies per 1 dt	[PLN]	11.68	16.94	145.0	24.10	25.27	104.9
Total costs per PLN 1 of income from activity without subsidies	[PLN]	4.03	3.23	80.0	1.95	2.3	120.1

* 2013 – base year for the projection model, the results reflect the average data for 2011-2013.

Source: elaboration based on own studies.

Summing up the considerations regarding the income situation of spring barley, it should be stated that in the nearest years farmers will not suffer any loss from its cultivation, although they should not also hope for too high income from the production alone, i.e. without support in a form of subsidies. With the expected slower rate of changes in the production value rather than that in costs, the cost-effectiveness of cultivating spring barley will be gradually decreasing.

The increase in the productivity of barley gives hope to improve economic results, because the higher yields may compensate for the growth in cultivation costs. At the current rate of their increase, the production cost of 1 dt of grain is also increasing – by 2020 at the annual rate of 3.0-3.8%. On the other hand, the grain price will rise at the rate of 2.3-2.7%. The stronger growth rate in production costs of 1 dt of grain than that in its selling price will be a main reason for the decrease in the cost-effectiveness of cultivating spring barley in 2020 when compared to 2013.

In the recent years, **sugar beets** have been a very profitable crop, not only against the background of winter rye or spring barley, but also against the background of income gained from winter wheat and winter rapeseed. On average, in 2011-2013, with the average area of cultivation of 8.91 ha, the surplus of the production value over direct and indirect costs was PLN 2,564 per ha. But the production cost-effectiveness in quotient terms reached the level of 141.4% (Table 8).

What can we expect in the nearest years? This is a difficult question in the context of the reform of the sugar market and the "great unknown", i.e. the sugar beet selling price. In accordance with the agreement reached by the European Commission, the EU Council of Agriculture Ministers and the European Parliament, the quota system for sugar and isoglucose is to be liquidated on 30 September 2017, so is the application of minimum sugar beet prices.

The rules of the functioning of the EU sugar market after the liquidation of production quotas have not been specified yet. We may expect that the increased sugar production may result in reducing both the sugar price and the sugar beet price. Many EU Member States, fearing for the market, opt for maintaining the quota system until at least 2020. The main threat in case of the liquidation of quotas is the significant price variability [Bolisęga 2012].

Quantitative methods (also called mathematical and statistical methods), based on classic trend models, were applied for designing the level of income from the cultivation of sugar beets in 2020. Trend models, also known as development trend models, describe the evolution of phenomena over time. Forecasting on the basis of these models takes place by means of the projection (extrapolation) of the trend observed in the past into the future. In the studies, the average for 2011-2013 has been adopted as a "starting point" for the projection and in the calculations it is represented by the year 2013.

Table 8

Results of the cultivation of sugar beets in the base year 2013 and the projection for 2020 (at current prices)

Specification			Sugar beets		
			Level for 2013*	Projection for 2020	Index of changes 2013 = 100
Number of analysed holdings			140		-
Area of cultivation		[ha]	8.91		-
Yield of roots		[dt/ha]	611	710	116.1
Root selling price		[PLN/dt]	14.30	16.16	112.9
			Per 1 ha, in PLN		
Total production value			8754	11475	131.1
Total direct costs			2600	3477	133.8
including:	seed material		740	1056	142.6
	mineral fertilisers in total		1133	1576	139.1
	plant protection products		668	776	116.1
Direct surplus without subsidies			6154	7997	130.0
Total indirect costs			3590	4593	128.0
Income from activity without subsidies			2564	3404	132.8
TOTAL COSTS			6189	8070	130.4
Indices of the economic efficiency					
Cost-effectiveness index		[%]	141.4	142.2	100.5
Total costs per1 dt		[PLN]	10.12	11.37	112.3
Income from activity without subsidies per 1 dt		[PLN]	4.19	4.80	114.4
Total costs per PLN 1 of income from activity without subsidies		[PLN]	2.41	2.37	98.22

* 2013 – base year for the projection model, the results reflect the averages for 2011-2013.

Source: elaboration based on own studies.

On the above basis, the sugar beet selling price expected in 2020 has been determined. From the projection it results (Table 8) that the beet price will rise, but the annual rate of this rise is not going to be high. It will probably oscillate around 1.8%. As a result, in 2020 the price may be higher by 12.9% when compared to the price from 2013. The annual increases in the yield of sugar beets will range from 2.0% to 2.3%, which in the target year of the projection will ensure the yield higher by 16.1%. At this rate of changes in the price and

yield, we may expect that revenues from the unit of the sugar beet cultivation area will be higher by 31.1% (the annual rate of change will be within the range of 3.7-4.2%).

It is expected that direct costs will increase at the rate of 4.0% to 4.5% a year and as a result, in 2020, when compared to 2013, their level may be higher by 33.8%. The cost of mineral fertilisers will increase within the range of 4.2-5.5%, while the cost of seed material is expected to increase by 5.2%, and of plant protection products – from 2.0% to 2.3%.

The expected annual increase in total costs (direct and indirect in total) is estimated at 3.6-4.2% and, as a consequence, in 2020 they may exceed the level from 2013 by 30.4%. With the constant level of inputs of means of production, average total costs of cultivating 1 ha of sugar beets in holdings from the analysed sample may then amount to PLN 8,070, while in 2013 this amount was PLN 6,189 (Table 8).

The anticipated growth rate in the production value and sugar beet cultivation costs indicates an improvement in the income situation. It is estimated that income from activity without subsidies gained from 1 ha in the target year will be by 32.8% higher than in 2013. The projection account indicates also that the economic efficiency of the beet production in 2020 will be higher, but only insignificantly. The cost-effectiveness index will increase by 0.8 pp and the growth rate in the production value stronger by 0.7 pp than that in costs incurred will be the determining factor.

It is estimated that in 2020 – when compared to 2013 – production costs of 1 dt of sugar beet roots will be higher by 12.3%, while the expected price rise will be 12.9%. The rise in the root price stronger than that in the unit cost of their production will stimulate the income growth. As a result, income from activity without subsidies calculated per 1 dt will be higher than in 2013 by 14.4%. In this situation the cost of generating the income unit will slightly decrease (by 1.8%).

A positive manifestation of the changes which have recently taken place in the cultivation of sugar beets was the yield increase which may evidence changes in the cultivation technology. Therefore, there is nothing surprising in the fact that the projection results indicate its further increase. This situation will stimulate an improvement in the input-output relation and lead to the decrease in unit costs of the sugar beet production.

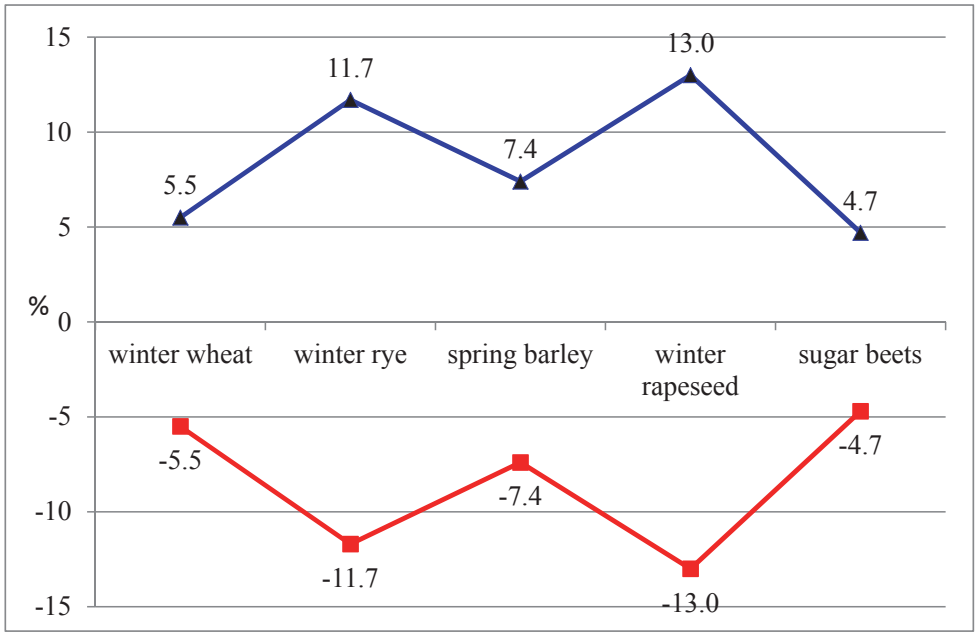
The above-presented results show what kind of outputs from the production of selected agricultural products of plant origin may be expected in 2020 under average production and price conditions, i.e. those resulting from the

long-term trend. However, during the vegetation and harvest of plants, unusual weather conditions may occur in this year, which may result in the yield level deviating from the trend. Also, product selling prices and cultivation costs may deviate from the trend line. In agriculture, it is impossible to develop an accurate forecast of economic phenomena for a specific year, and it is only possible to anticipate the limits of variability and observe the direction of changes in obtained results.

The results of findings allowed to calculate how income from individual activities may change due to a change in its determinants. A change in the rye yield, calculated for the trend, by 1 dt will result, for example, in the fact that in the target year income from 1 ha of this crop may be higher or lower by 11.7% than the values specified in the projection, while for winter wheat this difference may be only 5.5%. An increase in cultivation costs by PLN 100 in 2020 will result in the increase or decrease in income without subsidies by 16.4% in case of rye and by only 2.9% in case of sugar beets.

Chart 5

Projection of changes (%) in 2020, for income without subsidies from selected agricultural crops due to the increase or decrease in their yield by one unit (of cereals and rapeseed by 1 dt and of sugar beets by 10 dt)



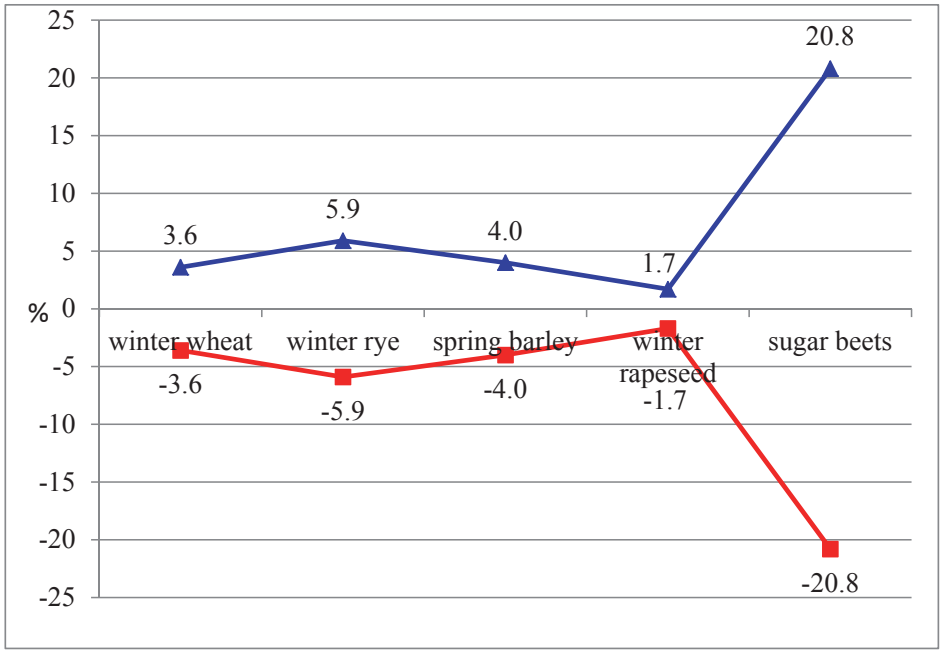
Source: elaboration based on own studies.

The results presented in Chart 5 show that the change in the yield by one unit will have the greatest (positive or negative) impact on income from the cultivation of rapeseed and rye, i.e. activities whose yields, against the background of other analysed crops, are much lower and will most probably continue to be like that. This evidences the high sensitivity of rapeseed and rye to changes in the natural conditions of management in the following years.

From Chart 6 it results that changes in prices of products will have the greatest (*in plus* or *in minus*) impact on fluctuations in income changes in the specific years in case of sugar beets. It is difficult to indicate clearly the reasons for this phenomenon.

Chart 6

Projection of changes (%) in 2020, for income without subsidies from selected agricultural crops due to the increase or decrease in their selling price by PLN 1

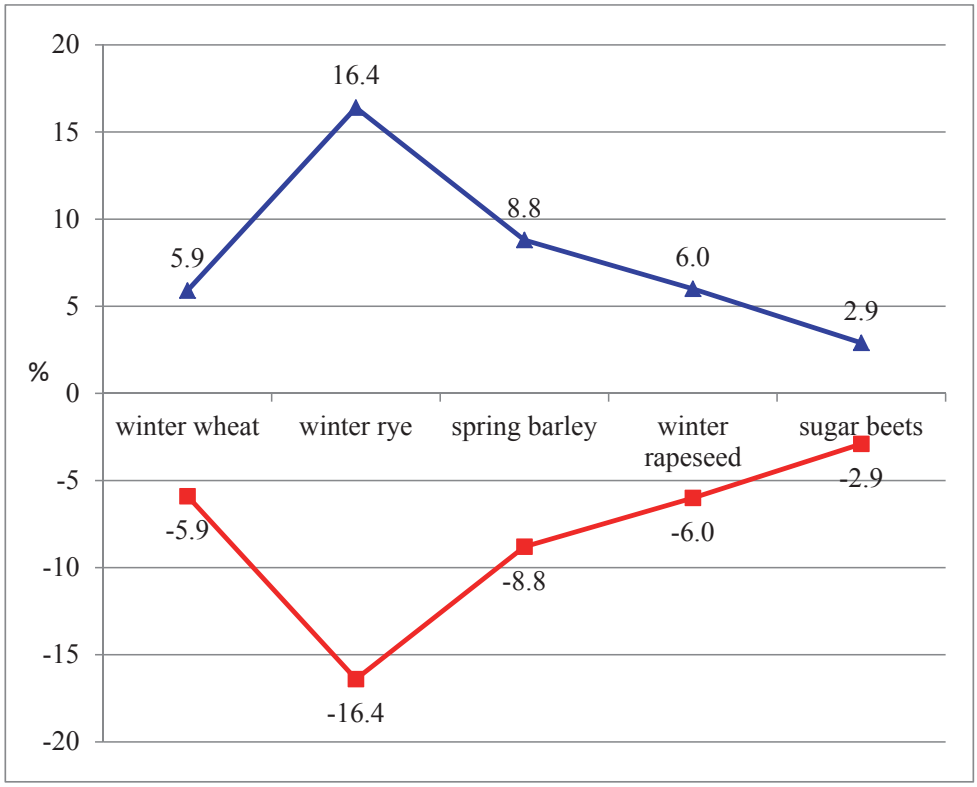


Source: own studies.

When considering the impact of the unit change of costs on the income level in the target year (Chart 7), it should be stated that definitely the biggest sensitivity will be characteristic of rye, and the second position will be occupied by barley. Production costs per 1 ha of these activities – when compared to others – are lower, therefore, the response of income, expressed as a percentage, on each change in their level will be greater.

Chart 7

Projection of changes (%) in 2020, for income without subsidies from selected agricultural products due to the increase or decrease in total production costs by PLN 100



Source: own studies.

When analysing how unit changes in the yield and price of products affect the income level, it was considered appropriate to determine their variability based on the CSO data covering the years 1995-2013 (Table 9).

Table 9

Variability in the yield and selling price of selected agricultural products in 1995-2013

Specification	Yield (%)	Selling price (%)
Winter wheat	6.1	19.8
Winter rye	7.9	23.9
Spring barley	8.3	19.0
Winter rapeseed	12.6	20.9
Sugar beets	7.6	7.9

Source: own elaboration based on the CSO data.

The calculations have shown that the variability in the yield of winter wheat, winter rye and spring barley was similar against each other. It ranged from 6.1% in case of wheat to 8.3% for barley. The variability of yields of cereals was by two times lower than that of rapeseed (12.6%). This means that rapeseed is a plant which responds much stronger to the cultivation conditions.

The variability of yielding of sugar beets was at the level of 7.6%, thus, it was similar to that of cereals and by 5.0 pp lower than that of rapeseed. Whereas the variability of cereal grain selling prices was greater than the variability of their yields and was within the range of 19.0-23.9%. It was, thus, similar to that of the rapeseed price specified at 20.9%. The smallest variability of prices (7.9%) was characteristic of sugar beets, probably due to the fact that for the majority of the years of the analysed period, these prices were subject to official control.

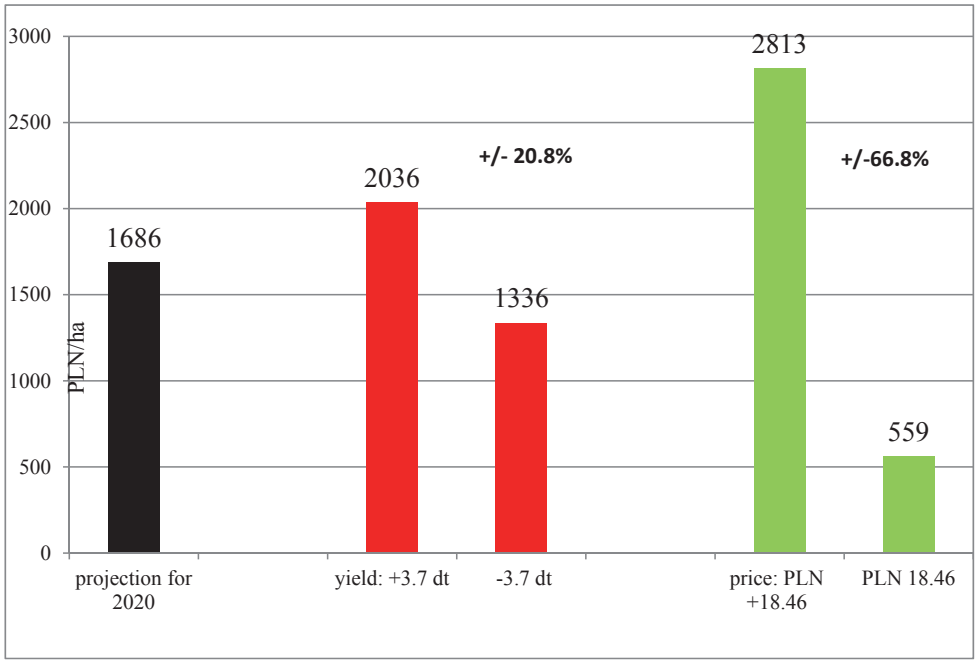
Given the variability of the yield and price of agricultural products, observed in 1995-2013, we may predict the size of deviations of income from the projections results for 2020 (drawn up under production and price conditions resulting from the long-term trend). An analysis of the correlation between the yield and price showed that the relation between them is not statistically significant. Therefore, we could separately determine the impact of each of these factors on the income level. It should be added that in the calculation method it was adopted that the fluctuations applied only to the yield or price while other variables are subject to changes resulting from the trend.

In case of **winter wheat**, the variability of the yield is 6.1% and of the grain price – 19.8%. In absolute numbers, this means a change in the yield by +/-3.7 dt, and in the price by PLN +/-18.46 per dt. From the above it follows that the change in the yield will result in the fluctuations in income from activity

without subsidies by PLN +/-350 per ha, meaning the increase to the level of PLN 2,036 per ha or decrease to PLN 1,336 per ha (change by +/-20.8%). On the other hand, the price change will result in (Chart 8) the fluctuations in income from activity without subsidies by PLN +/-1,127 per ha, which then will be within the range from PLN 2,813 to PLN 559 per ha (change by +/-66.8%).

Chart 8

Level of income from activity without subsidies from the cultivation of winter wheat and its deviations from the projection results for 2020, resulting from the variability in the yield and price



Source: own studies.

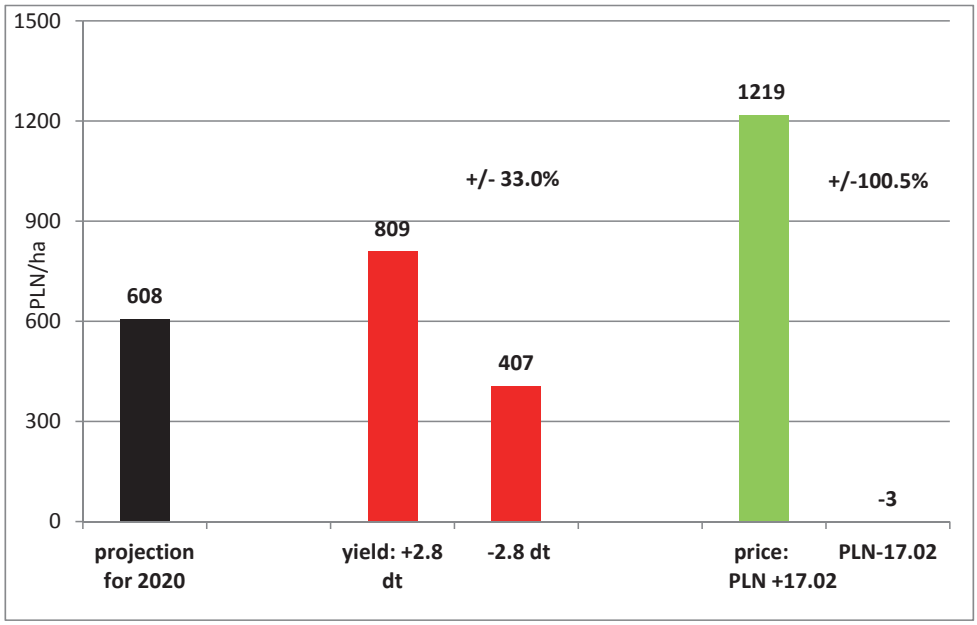
The variability of the yield (7.9%) and grain price (23.9%) of **winter rye** observed over a period of 19 years (1995-2013) means that in analysed holdings the yield changed by +/-2.8 dt, and the price by PLN +/-17.02 per dt. Having regard to these fluctuations in the projection for 2020, income from activity without subsidies will change *in minus* or *in plus* in the former case by 33.0%, and in the latter by as much as 100.5% (Chart 9).

In the past, the variability of the rye grain price was by three times higher than that of the yield, thus in the situation of its maximum decrease the cultivation of rye would not be cost-effective.

This indicates a high risk of the cultivation of rye due to the fluctuations in the grain price. In addition, the low – when compared to other species of cereals – level of income from the cultivation area unit also does not encourage farmers to cultivate this cereal.

Chart 9

Level of income from activity without subsidies from the cultivation of winter rye and its deviations from the projection results for 2020, resulting from the variability in the yield and price



Source: own studies.

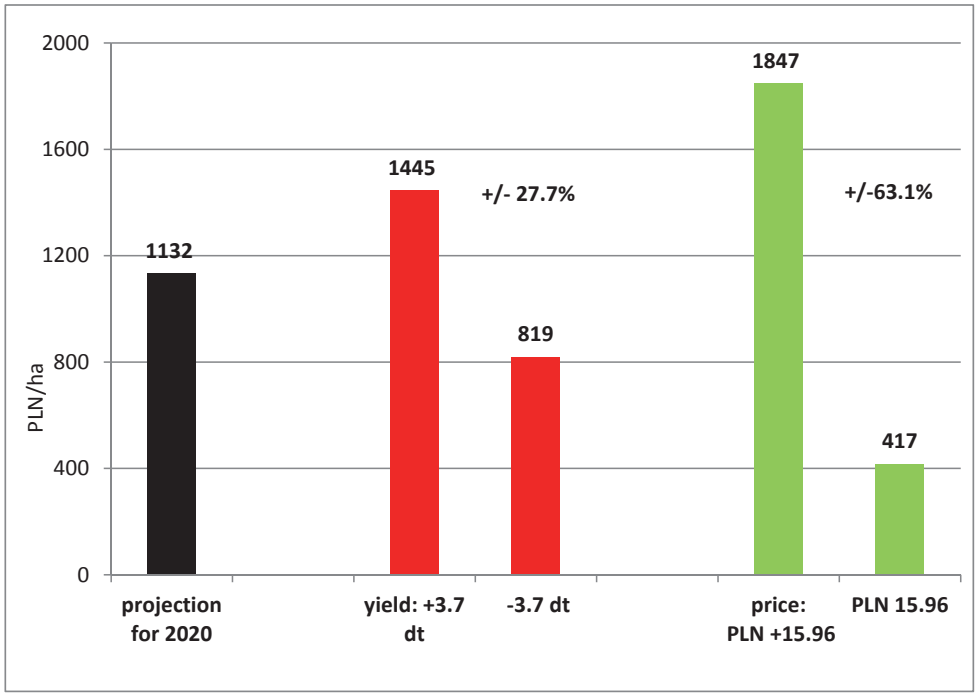
From the studies, it results that due to the variability of the yield and price of **spring barley** grain over the years, respectively, by 8.3% and 19.0%, the fluctuations in the yield may be +/-3.7 dt per ha and in the price of 1 dt of grain – PLN +/-15.96.

As in the case of wheat and rye, a much greater impact on the deviations of income from the level expected for 2020 has the grain selling price.

In an extreme case (change by PLN 15.96 per dt) it may lead to an increase or decrease in income from activity without subsidies by as much as 63.1%. On the other hand, the change in the yield by 3.7 dt will result in deviations in income by 27.7% (Chart 10).

Chart 10

Level of income from activity without subsidies from the cultivation of spring barley and its deviations from the projection results for 2020, resulting from the variability in the yield and price



Source: own studies.

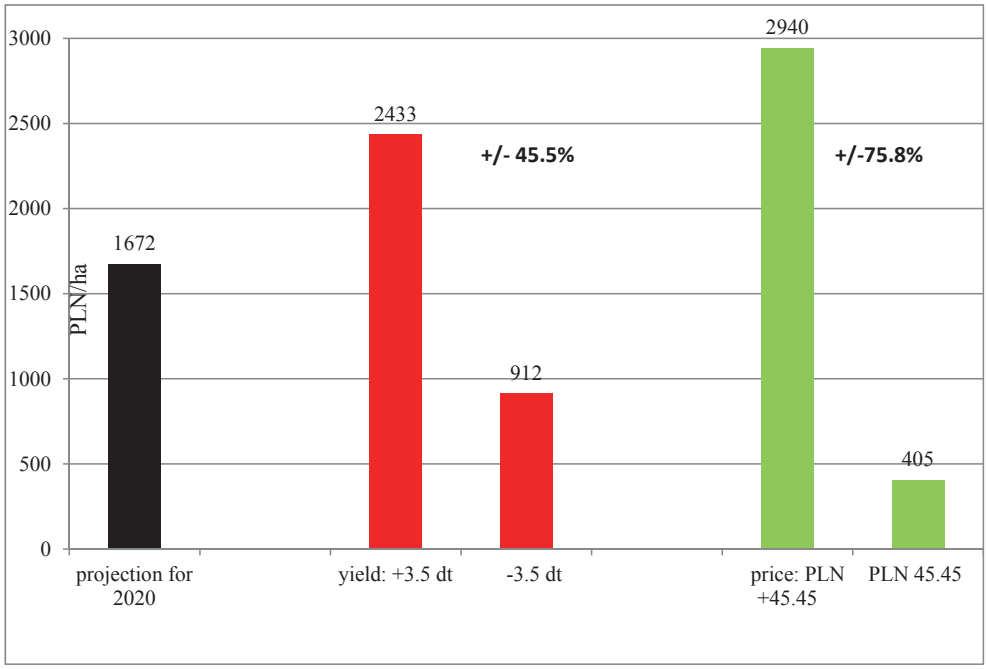
Chart 11 shows the deviations from the projection results for 2020 for income from activity without subsidies from the cultivation of **winter rapeseed** due to the variability of the yield (12.6%) and price (20.9%) in the last 19 years.

The results indicate that the fluctuations in the yield of rapeseed by +/-3.5 dt will result in the increase or decrease in income without subsidies by 45.5%. In this situation, its extremely low level (PLN 912 per ha) will account for 54.5% of income which is expected in 2020. The fluctuations in the price of 1 dt of seeds by PLN 45.45 up or down will make the deviations of income amount to as much as 75.8%.

This means that in a particularly adverse case, income without subsidies from 1 ha of rapeseed will amount to only 24.2% of the level (PLN 405) anticipated for 2020. The results of the calculations evidence the high sensitivity of rapeseed to both the natural conditions of cultivation and the market environment.

Chart 11

Level of income from activity without subsidies from the cultivation of winter rapeseed and its deviations from the projection results for 2020, resulting from the variability in the yield and price

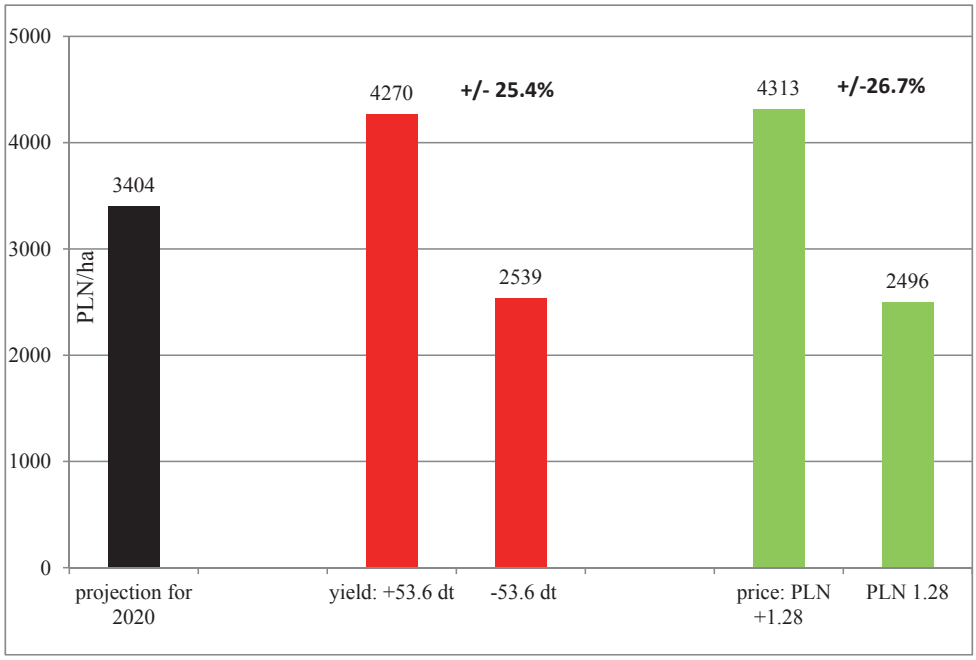


Source: own studies.

The cultivation of **sugar beets** is characterised by the relatively low variability in the yield (7.6%) and the root selling price (7.9%). This variability corresponds to the fluctuations in the yield by +/-53.6 dt per 1 ha and in the price of 1 dt of roots by PLN +/-1.28. A consequence of these fluctuations are the deviations of income from activity without subsidies from the level projected for 2020. These deviations are relatively small when compared to other analysed crops. In the event of the fluctuations in the yield the deviations of income are +/-25.4%, and the fluctuations in the price are +/-26.7% (Chart 12).

Chart 12

Level of income from activity without subsidies from the cultivation of sugar beets and its deviations from the projection results for 2020, resulting from the variability in the yield and price



Source: elaboration based on own studies.

The results of the calculations indicate that the fluctuations in the yield from 1 ha of sugar beet (by 53.6 dt) cause the change in income from activity without subsidies by PLN 866 per ha, *in plus* or *in minus*. Sugar beets are slightly more sensitive to the variability of the price of roots. A change by PLN 1.28 per 1 dt results in the increase or decrease in income from activity without subsidies by PLN 908 per ha.

Summing up the projection results for 2020, drawn up for the average conditions resulting from the long-term trend, it should be stated that an upward trend will probably occur in case of cereals, which will result from better yielding and higher grain price.

The production of winter wheat and spring barley, however, may be characterised by a stronger growth rate in costs than that in revenues, so a small decrease in the cost-effectiveness of their production is possible. On the other hand, the cost-effectiveness of the rye production is likely to be higher, due to the stronger growth in revenues.

It is estimated that the yield of winter rapeseed will increase, so will the price of this crop. In the target year, the cost-effectiveness of the cultivation of this oilseed plant can thus improve. The same situation will occur in case of the cultivation of sugar beets, but its cost-effectiveness will increase much less than the cultivation of rapeseed.

However, from these general trends there may be annual deviations which are difficult to be determined either due to the variability of the climatic conditions or due to the particularly large price fluctuations. From the analyses carried out it results that rye is the activity which among cereals is the most sensitive to each of income-making factors, i.e. the yield, grain selling price and cultivation costs.

Only under extremely favourable conditions, the cultivation of rye may provide decent income, but its cultivation is and most likely will continue to be biased by a high risk, maybe because it is cultivated in the worst areas. On the other hand, winter rapeseed – when compared to cereals – is and will probably be characterised by the larger percentage deviation of income from the projection determined based on the trends, due to the fluctuations of yields. The fluctuations of the yield of sugar beets will also affect the level of income from their cultivation, without subsidies, although to a lesser extent than rapeseed.

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ANNEX II

Table A.II.1

Results of winter wheat cultivation in the base year 2013*
and the projection until 2020 (in current prices)

Specification	Level for 2013*	Projection for			Indicator of changes 2013 = 100		
		2016	2018	2020	2016	2018	2020
Number of surveyed farms	161				-	-	-
Area of cultivation [ha]	23.84				-	-	-
Yield of grain [dt/ha]	56.3	58.4	59.7	61.1	103.6	106.0	108.4
Selling price of grain [PLN/dt]	79.13	85.26	89.34	93.42	107.7	112.9	118.1
	Per 1 ha of area of cultivation, in PLN						
Total value of production	4482	5001	5360	5731	111.6	119.6	127.8
Total direct costs	1420	1625	1762	1900	114.4	124.1	133.8
in this: sowing materials	231	271	298	325	117.2	128.8	140.5
fertilisers	845	986	1081	1176	116.6	127.8	139.1
plant protection products	303	324	338	352	106.9	111.5	116.1
Gross margin without subsidies	3062	3376	3598	3830	110.2	117.5	125.1
Total indirect costs	1690	1883	2013	2144	111.4	119.1	126.8
Income from activity without subsidies	1372	1493	1585	1686	108.8	115.5	122.9
Subsidies**	969	1008	1008	1008	104.0	104.0	104.0
Income from activity	2341	2501	2593	2694	106.8	110.8	115.1
TOTAL COSTS	*3111*	*3508*	*3775*	*4044*	*112.8*	*121.4*	*130.0*
Measuring the economic efficiency							
Indicator of profitability [%]	144.1	142.6	141.0	141.7	98.9	98.5	98.3
Total costs per 1 dt [PLN]	55.23	60.11	63.23	66.23	108.8	114.5	119.9
Income from activity without subsidies per 1 dt of grain [PLN]	24.36	25.59	26.55	27.61	105.0	109.0	113.4
Total costs per PLN 1 of income from activity without subsidies [PLN]	2.27	2.35	2.38	2.40	103.6	105.1	105.8
Subsidies per PLN 1 of income from activity without subsidies [PLN]	0.71	0.68	0.64	0.60	95.6	90.0	84.6
Share of subsidies in income from activity [%]	41.4	40.3	38.9	37.4	97.4	93.9	90.4

* 2013 – base for the projection model, the results reflect average values in 2011-2013.

** In 2011-2013, subsidies will include Complementary Area Payment and Single Area Payment, for the projection years subsidies were adopted at the level of 240 EUR/ha (according to the CAP assumptions for 2014-2020). In calculations the following exchange rate was adopted: EUR 1 = PLN 4.20.

Source: prepared on the basis of the author's research.

Table A.II.2

Results of winter rye cultivation in the base year 2013* and projection until 2020 (in current prices)

Specification		Level for 2013*	Projection for			Indicator of changes 2013 = 100		
			2016	2018	2020	2016	2018	2020
Number of surveyed farms		118				-	-	-
Area of cultivation	[ha]	9.39				-	-	-
Yield of grain	[dt/ha]	32.2	33.7	34.8	35.9	104.9	108.2	111.6
Selling price of grain	[PLN/dt]	58.31	63.82	67.49	71.17	109.5	115.8	122.1
		Per 1 ha of area of cultivation, in PLN						
Total value of production		1890	2168	2364	2569	114.7	125.1	135.9
Total direct costs		665	760	825	889	114.4	124.0	133.7
in this:	sowing materials	159	181	195	210	113.8	123.0	132.2
	fertilisers	396	462	507	551	116.6	127.8	139.1
	plant protection products	103	110	115	119	106.9	111.5	116.1
Gross margin without subsidies		1225	1407	1539	1680	114.8	125.6	137.1
Total indirect costs		850	944	1008	1072	111.1	118.6	126.2
Income from activity without subsidies		376	463	531	608	123.2	141.5	161.8
Subsidies**		970	1008	1008	1008	104.0	104.0	104.0
Income from activity		1345	1471	1539	1616	109.3	114.4	120.1
TOTAL COSTS		*1515*	*1705*	*1832*	*1961*	*112.5*	*121.0*	*129.5*
Measuring the economic efficiency								
Indicator of profitability	[%]	124.8	127.2	129.0	131.0	101.9	103.4	105.0
Total costs per 1 dt	[PLN]	47.10	50.54	52.66	54.65	107.3	111.8	116.0
Income from activity without subsidies per 1 dt of grain	[PLN]	11.68	13.73	15.27	16.94	117.5	130.7	145.0
Total costs per PLN 1 of income from activity without subsidies	[PLN]	4.03	3.68	3.45	3.23	91.3	85.5	80.0
Subsidies per PLN 1 of income from activity without subsidies	[PLN]	2.58	2.18	1.90	1.66	84.3	73.5	64.2
Share of subsidies in income from activity	[%]	72.1	68.5	65.5	62.4	95.1	90.8	86.5

* 2013 – base for the projection model, the results reflect average values in 2011-2013.

** In 2011-2013, subsidies included Complementary Area Payment and Single Area Payment, the subsidies adopted for the period of projection were at the level of 240 EUR/ha (according to the assumptions of the CAP for 2014-2020). The exchange rate adopted in the calculations: EUR 1 = PLN 4.20.

Source: prepared on the basis of the author's research.

Table A.II.3

Results of spring barley cultivation in the base year 2013* and the projection until 2020 (in current prices)

Specification	Level for 2013*	Projection for			Indicator of changes 2013 = 100		
		2016	2018	2020	2016	2018	2020
Number of surveyed farms	142				-	-	-
Area of cultivation [ha]	11.09				-	-	-
Yield of grain [dt/ha]	43.3	43.9	44.4	44.8	101.5	102.5	103.5
Selling price of grain [PLN/dt]	70.79	76.52	80.33	84.15	108.1	113.5	118.9
	Per 1 ha of area of cultivation, in PLN						
Total value of production	3079	3376	3578	3784	109.7	116.2	122.9
Total direct costs	954	1091	1183	1275	114.3	124.0	133.6
in this: sowing materials	167	189	204	219	113.1	121.9	130.7
fertilisers	620	723	792	862	116.6	127.8	139.1
plant protection products	146	156	162	169	106.9	111.5	116.1
Gross margin without subsidies	2124	2285	2395	2509	107.6	112.8	118.1
Total indirect costs	1081	1207	1291	1377	111.6	119.4	127.3
Income from activity without subsidies	1043	1078	1104	1132	103.4	105.8	108.5
Subsidies**	969	1008	1008	1008	104.0	104.0	104.0
Income from activity	2013	2086	2112	2140	103.7	104.9	106.3
TOTAL COSTS	*2035*	*2298*	*2474*	*2652*	*112.9*	*121.6*	*130.3*
Measuring the economic efficiency							
Indicator of profitability [%]	151.3	146.9	144.6	142.7	97.1	95.6	94.3
Total costs per 1 dt [PLN]	47.01	52.29	55.76	59.19	111.2	118.6	125.9
Income from activity without subsidies per 1 dt of grain [PLN]	24.10	24.54	24.88	25.27	101.8	103.3	104.9
Total costs per PLN 1 of income from activity without subsidies [PLN]	1.95	2.13	2.24	2.34	109.2	114.9	120.1
Subsidies per PLN 1 of income from activity without subsidies [PLN]	0.93	0.93	0.91	0.89	100.6	98.3	95.8
Share of subsidies in income from activity [%]	48.2	48.3	47.7	47.1	100.3	99.1	97.8

* 2013 – base for the projection model, the results reflect average values in 2011-2013.

** In 2011-2013, subsidies included Complementary Area Payment and Single Area Payment, the subsidies adopted for the period of projection were at the level of 240 EUR/ha (according to the assumptions of the CAP for 2014-2020). The exchange rate adopted in the calculations: EUR 1 = PLN 4.20.

Source: prepared on the basis of the author's research.

Table A.II.4

Results of winter rapeseed cultivation in the base year 2013*
and the projection until 2020 (in current prices)

Specification	Level for 2013*	Projection for			Indicator of changes 2013 = 100		
		2016	2018	2020	2016	2018	2020
Number of surveyed farms	149				-	-	-
Area of cultivation [ha]	16.29				-	-	-
Yield of seeds [dt/ha]	25.9	26.8	27.3	27.9	103.6	105.8	107.8
Selling price of seeds [PLN/dt]	173.99	192.45	204.75	217.05	110.6	117.7	124.7
	Per 1 ha of area of cultivation, in PLN						
Total value of production	4499	5154	5600	6053	114.5	124.5	134.5
Total direct costs	1711	1953	2115	2278	114.1	123.6	133.1
in this: sowing materials	161	189	208	226	117.1	128.6	140.0
fertilisers	1086	1267	1388	1511	116.6	127.8	139.1
plant protection products	388	415	433	451	106.9	111.5	116.1
Gross margin without subsidies	2788	3201	3485	3775	114.8	125.0	135.4
Total indirect costs	1662	1849	1976	2103	111.3	118.8	126.5
Income from activity without subsidies	1125	1351	1509	1672	120.1	134.1	148.6
Subsidies**	970	1008	1008	1008	104.0	104.0	104.0
Income from activity	2095	2359	2517	2680	112.6	120.2	127.9
TOTAL COSTS	*3374*	*3802*	*4090*	*4380*	*112.7*	*121.2*	*129.8*
Measuring the economic efficiency							
Indicator of profitability [%]	133.4	135.5	136.9	138.2	101.6	102.7	103.6
Total costs per 1 dt [PLN]	130.47	141.98	149.57	157.08	108.8	114.6	120.4
Income from activity without subsidies per 1 dt of grain [PLN]	43.52	50.47	55.18	59.97	116.0	126.8	137.8
Total costs per PLN 1 of income from activity without subsidies [PLN]	3.00	2.81	2.71	2.62	93.8	90.4	87.4
Subsidies per PLN 1 of income from activity without subsidies [PLN]	0.86	0.75	0.67	0.60	86.6	77.5	69.9
Share of subsidies in income from activity [%]	46.3	42.7	40.0	37.6	92.3	86.5	81.2

* 2013 – base for the projection model, the results reflect average values in 2011-2013.

** In 2011-2013, subsidies included Complementary Area Payment and Single Area Payment, the subsidies adopted for the period of projection were at the level of 240 EUR/ha (according to the assumptions of the CAP for 2014-2020). The exchange rate adopted in the calculations: EUR 1 = PLN 4.20.

Source: prepared on the basis of the author's research.

Table A.II.5

Results of sugar beets cultivation in the base year 2013*
and projection until 2020 (in current prices)

Specification			Level for 2013*	Projection for			Indicator of changes 2013 = 100		
				2016	2018	2020	2016	2018	2020
Number of surveyed farms			140				-	-	-
Area of cultivation		[ha]	8.91				-	-	-
Yield of roots		[dt/ha]	611	653	682	710	106.9	111.5	116.1
Selling price of roots		[PLN/dt]	14.30	15.10	15.63	16.16	105.5	109.2	112.9
			Per 1 ha of area of cultivation, in PLN						
Total value of production			8754	9875	10660	11475	112.8	121.8	131.1
Total direct costs			2600	2961	3214	3477	113.9	123.6	133.8
in this:	sowing materials		740	862	954	1056	116.4	128.9	142.6
	fertilisers		1133	1322	1448	1576	116.6	127.8	139.1
	plant protection products		668	714	745	776	106.9	111.5	116.1
Gross margin without subsidies			6154	6914	7446	7997	112.4	121.0	130.0
Total indirect costs			3590	4014	4302	4593	111.8	119.8	128.0
Income from activity without subsidies			2564	2900	3145	3404	113.1	122.6	132.8
Subsidies**			3836	4097	4230	4363	106.8	110.3	113.7
Income from activity			6401	6997	7374	7767	109.3	115.2	121.3
TOTAL COSTS			*6189*	*6975*	*7515*	*8070*	*112.7*	*121.4*	*130.4*
Measuring the economic efficiency									
Indicator of profitability		[%]	141.4	141.6	141.8	142.2	100.1	100.3	100.5
Total costs per 1 dt		[PLN]	10.12	10.67	11.03	11.37	105.4	108.9	112.3
Income from activity without subsidies per 1 dt of grain		[PLN]	4.19	4.44	4.61	4.80	105.8	110.0	114.4
Total costs per PLN 1 of income from activity without subsidies		[PLN]	2.41	2.40	2.39	2.37	99.6	99.0	98.2
Subsidies per PLN 1 of income from activity without subsidies		[PLN]	1.50	1.41	1.35	1.28	94.4	89.9	85.7
Share of subsidies in income from activity		[%]	59.9	58.6	57.4	56.2	97.7	95.7	93.7

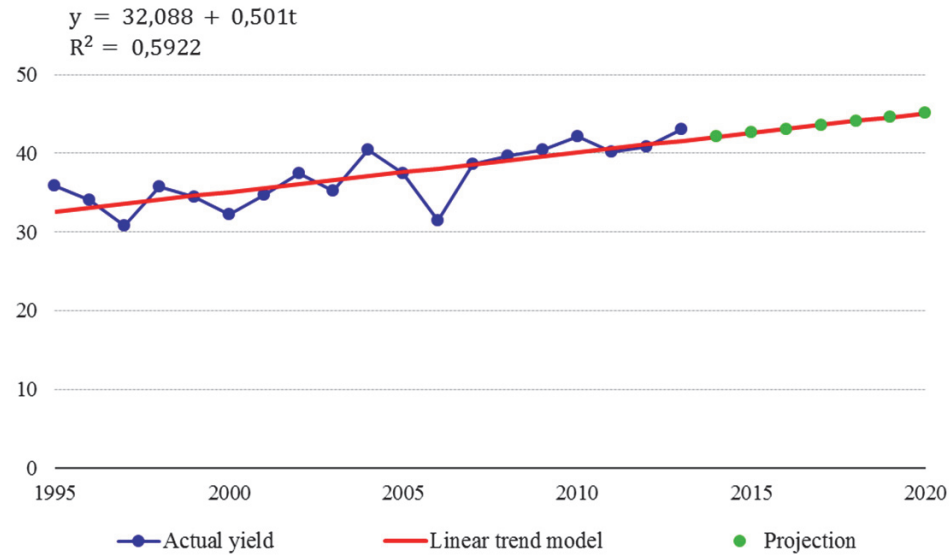
* 2013 – base for the projection model, the results reflect average values in 2011-2013.

** In 2011-2013, subsidies included Complementary Area Payment and Single Area Payment, the subsidies adopted for the period of projection were at the level of 240 EUR/ha (according to the assumptions of the CAP for 2014-2020). The exchange rate adopted in the calculations: EUR 1 = PLN 4.20.

Source: prepared on the basis of the author's research.

Chart A.II.1

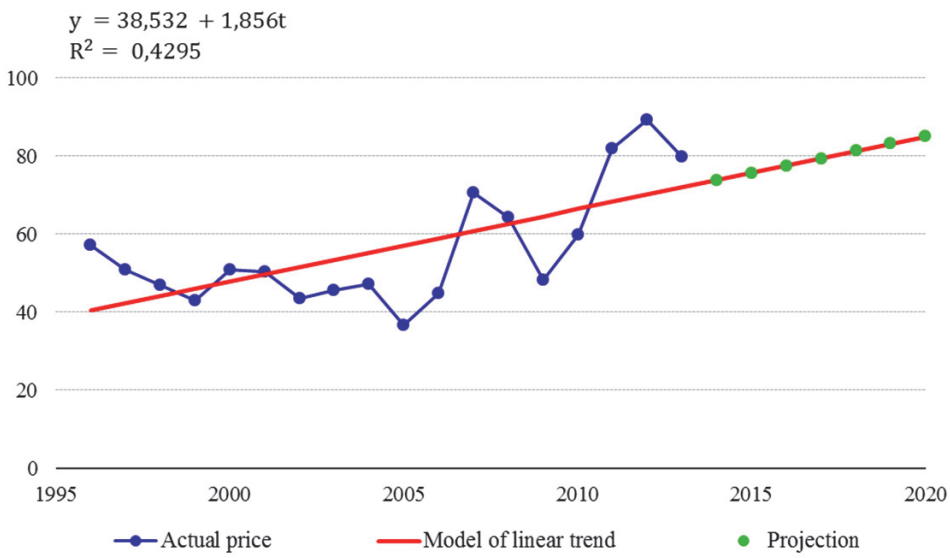
Yield of winter wheat in individual farms (dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.2

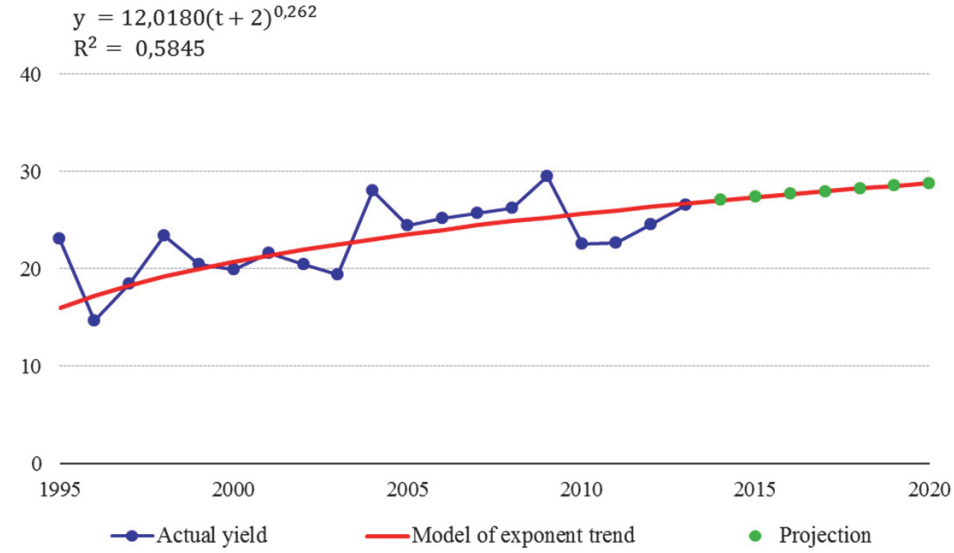
Buying-in price of wheat (PLN/dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.3

Yield of winter rapeseed in individual farms (dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

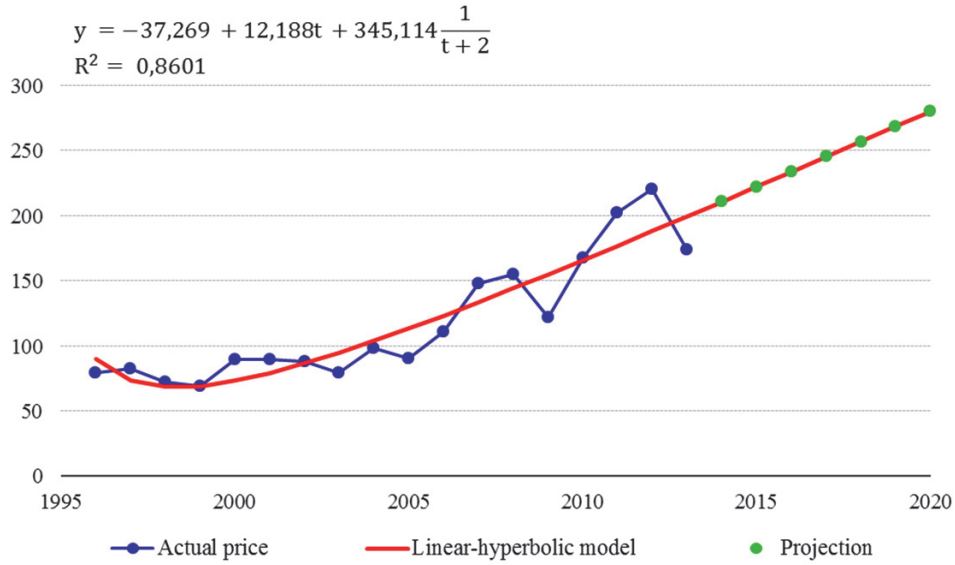
Chart A.II.4

Buying-in price of rapeseed (PLN/dt) and selected development trend model

Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.5

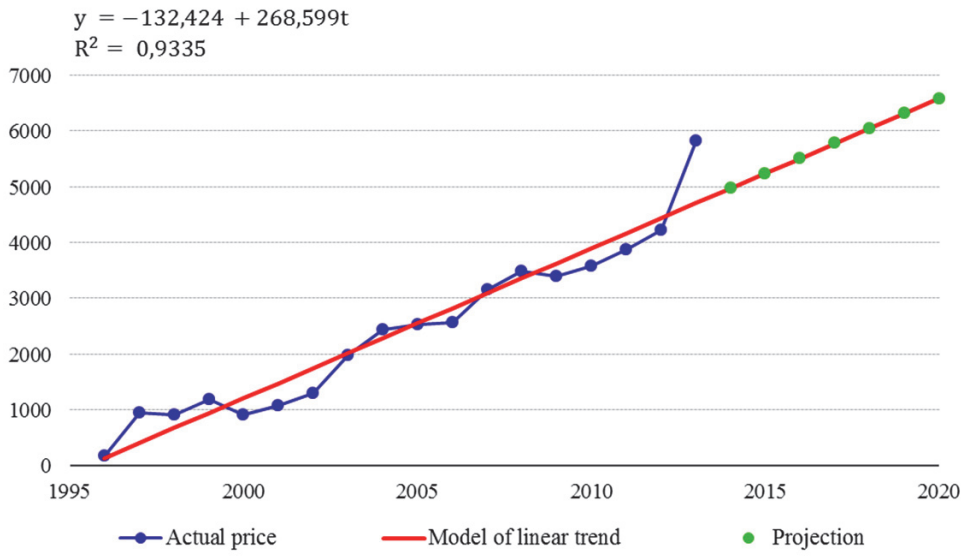
Price of wheat seed material (PLN/dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.6

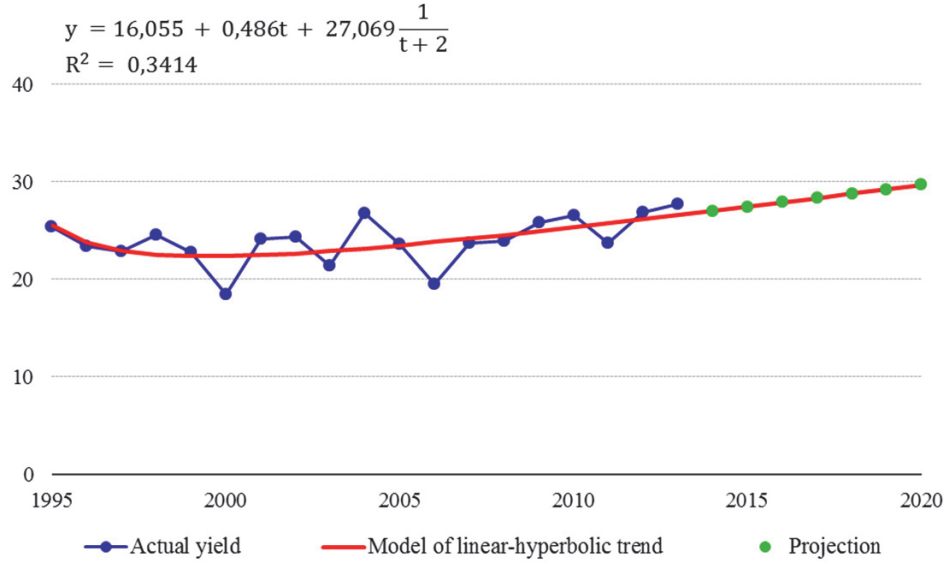
Price of winter rapeseed seed material (PLN/dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.7

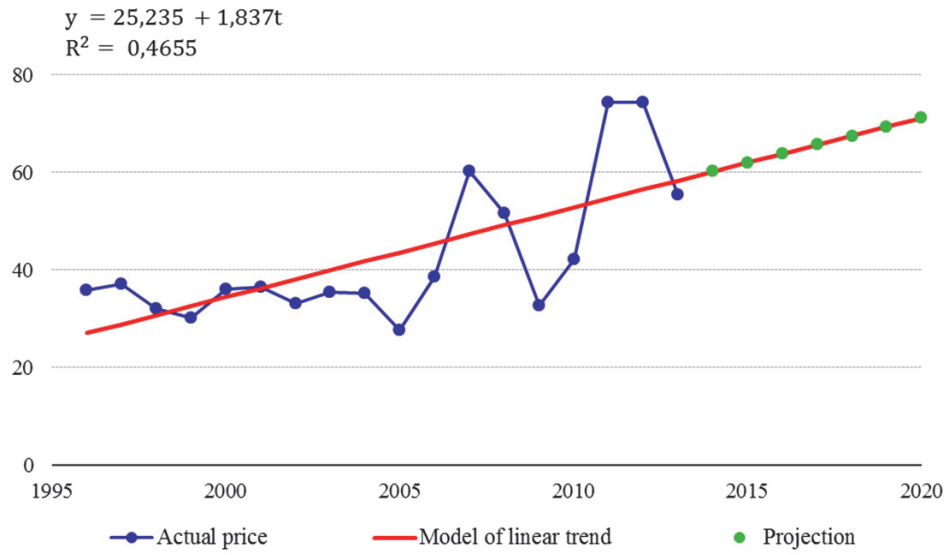
Yield of rye in individual farms (dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.8

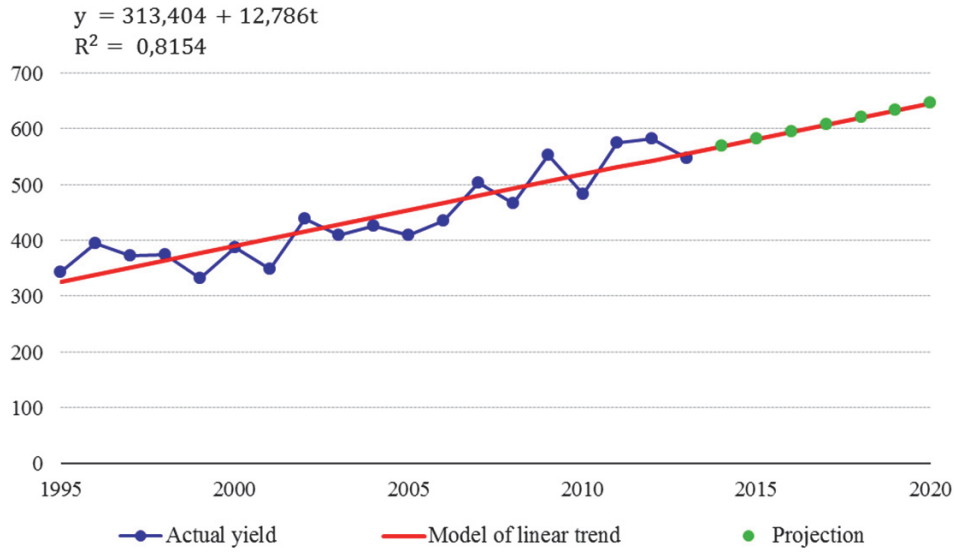
Buying-in price of rye (PLN/dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.9

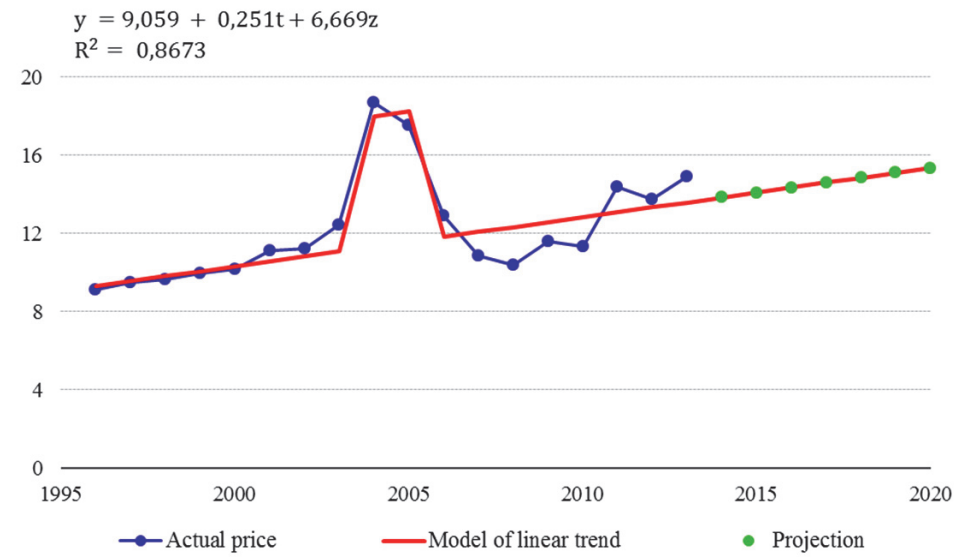
Yield of sugar beets in individual farms (dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.10

Buying-in price of sugar beets (PLN/dt)
and selected development trend model

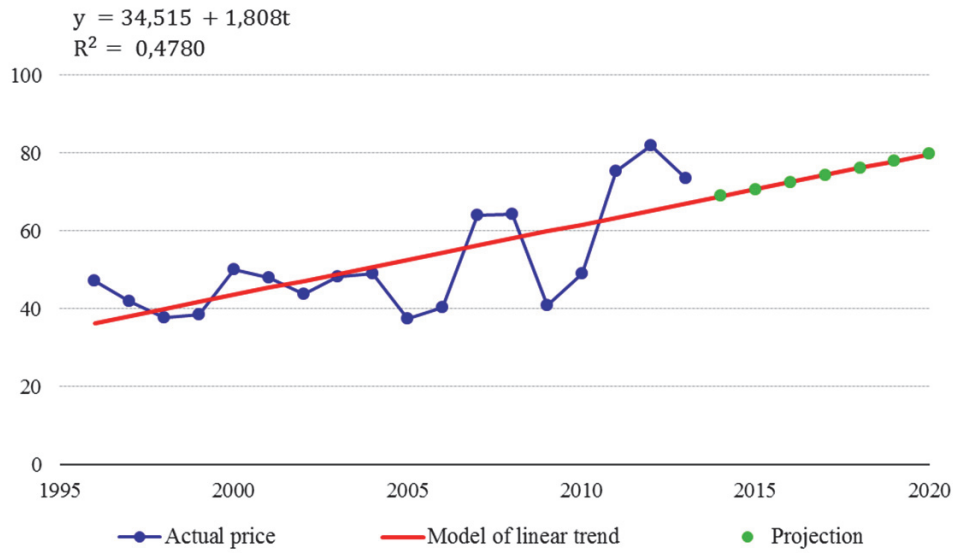


z – variable has value 1 in 2004 and 2005 and value 0 in other years.

Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.11

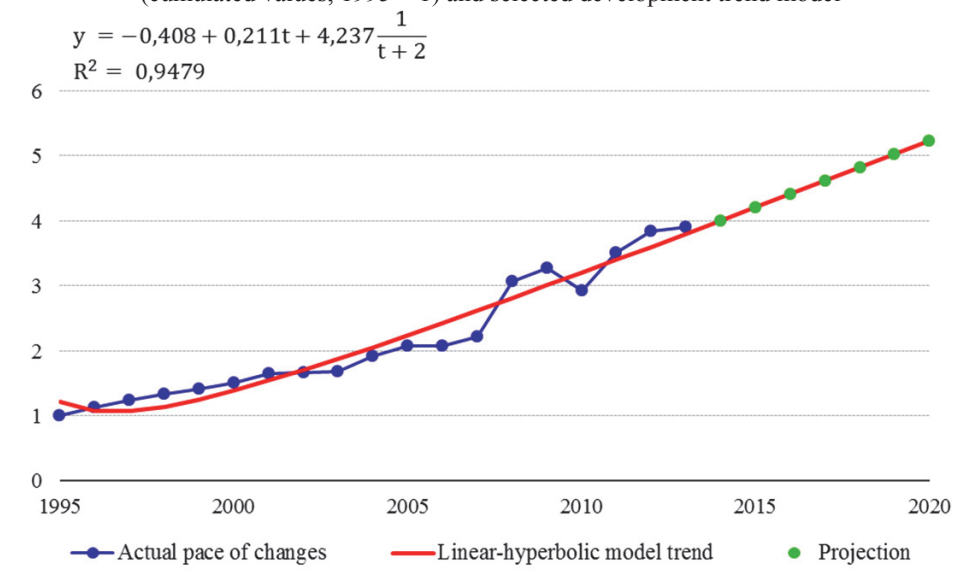
Buying-in price of barley (PLN/dt)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.12

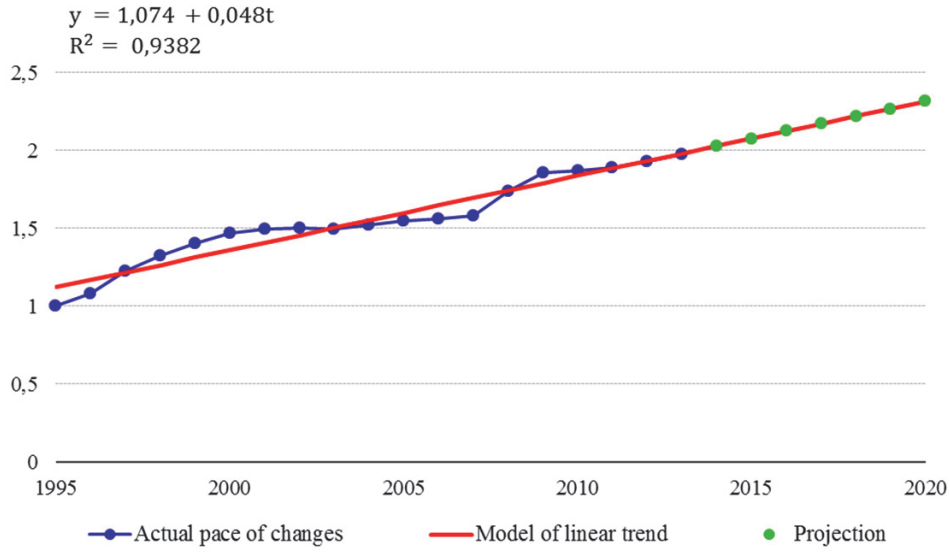
Pace of changes in prices of mineral and calcium fertilisers
(cumulated values, 1995 = 1) and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.13

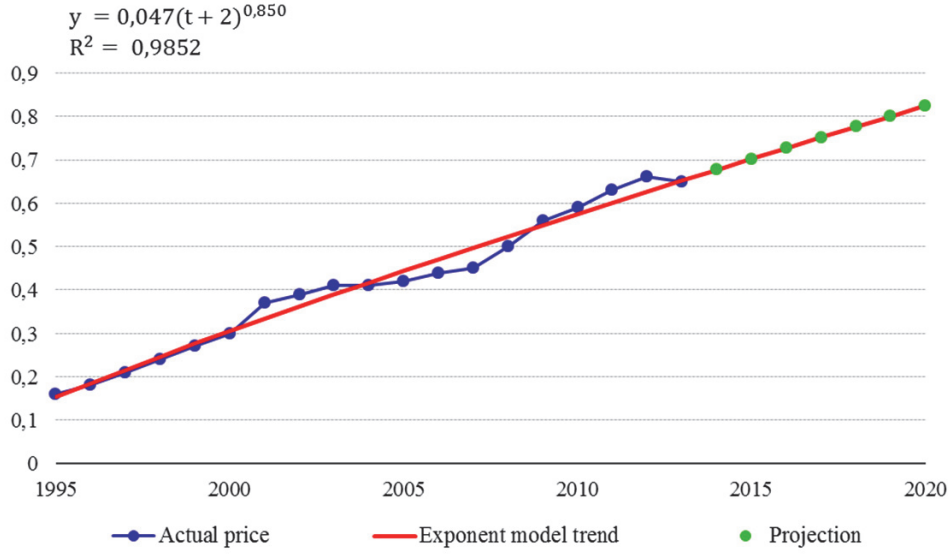
Pace of changes in prices of plant protection products (cumulated values, 1995 = 1)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.14

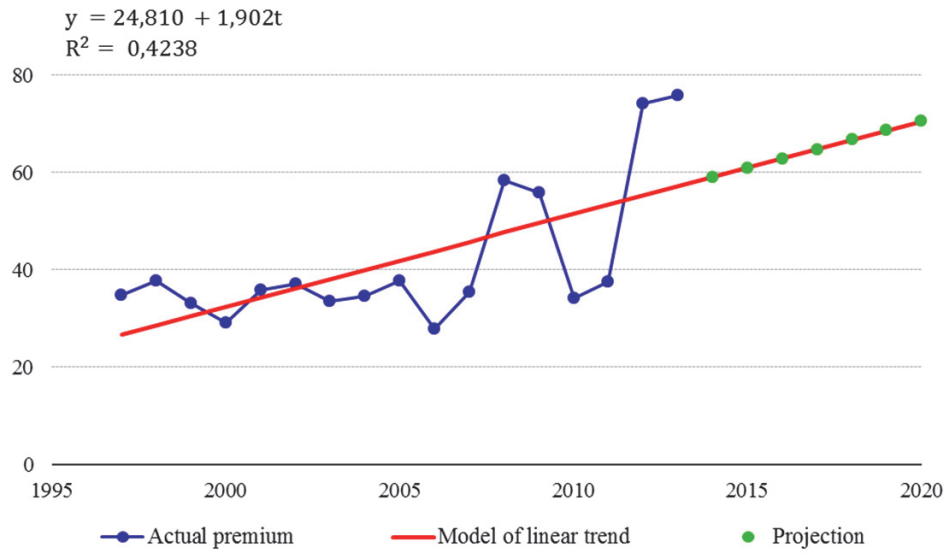
Price of electric energy (PLN/kWh)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.15

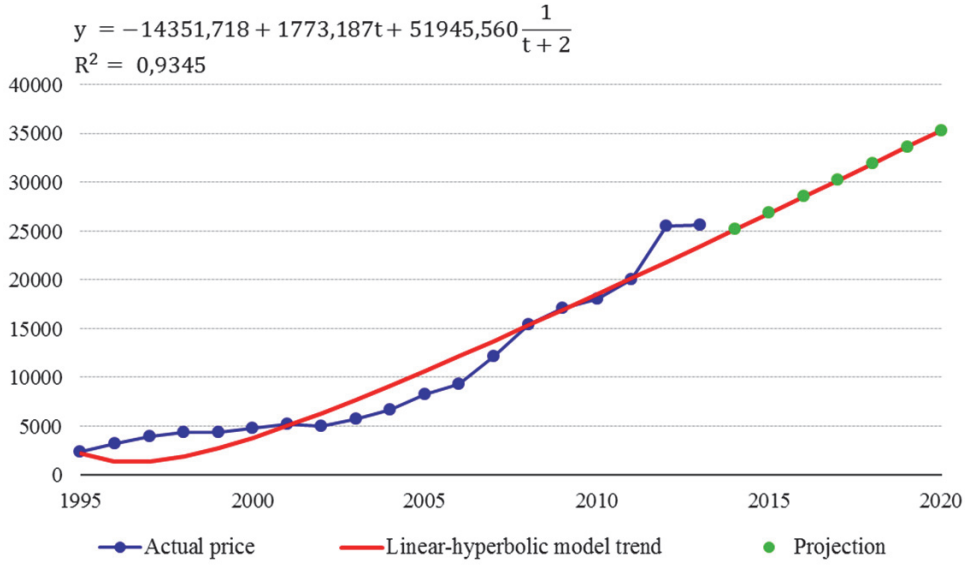
Agricultural tax rate (PLN/ha)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.16

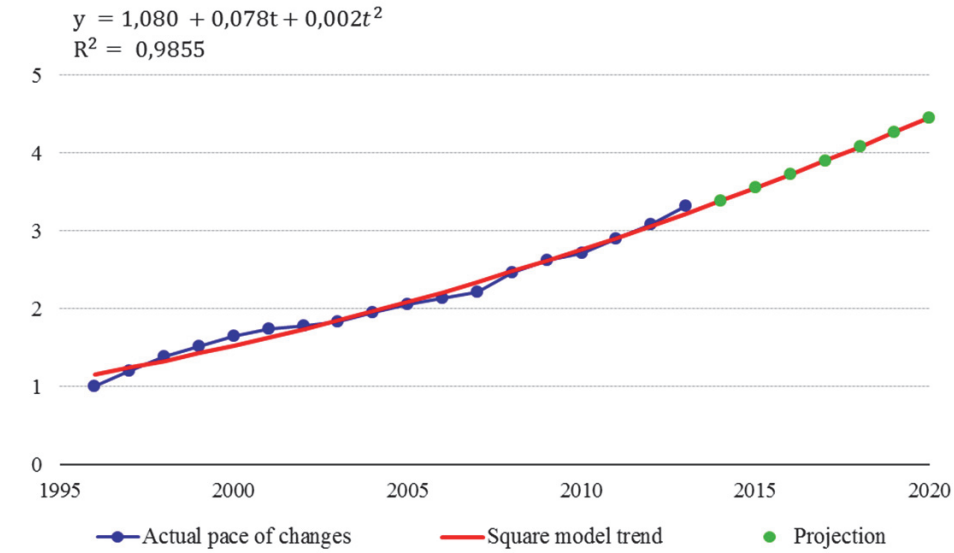
Average price of arable lands (PLN/ha)
and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.17

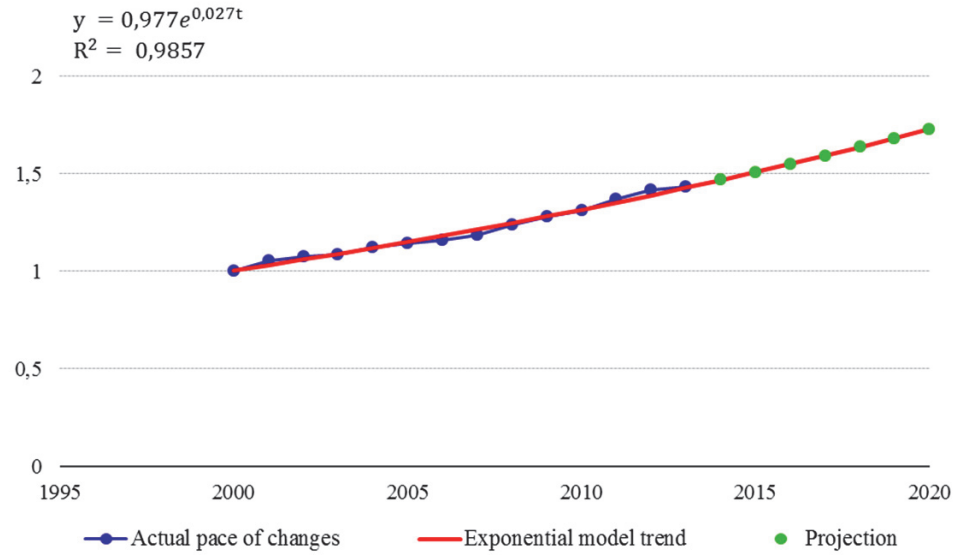
Pace of changes in prices of agricultural services (cumulated values, 1996 = 1) and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

Chart A.II.18

Pace of changes in prices of consumer goods and services of plants (cumulated values, 2000 = 1) and selected development trend model



Source: calculations of the author on the basis of data from the Central Statistical Office.

FINAL COMMENTS

● Estimates drawn up on the basis of empirical materials indicate that at the end of the last decade of the last century more than 100 thousand of Polish agricultural holdings were characterised by the expanded reproduction of fixed assets. It was a signal that in case of an economic upswing for national agriculture, the situation of its competitiveness will improve. This improvement was initiated at the start of preparations for accession to the European Union and gained momentum over several post-accession years.

In 2004-2013, there were three main circumstances which were conducive to the emergence of Polish holdings with the competitive capacity and of those which could be able to achieve that capacity soon. It has been largely enabled by an increase in subsidies for agricultural holdings, which increased their income and supported their investment activities. The second important circumstance was the development of the food industry and the low wage level, which led to an increase in the export of food products, and that, in turn, resulted in a relatively rapid rise in prices of products of agricultural origin. The third important circumstance of the emergence of holdings with the competitive capacity and of those which could be able to achieve that capacity soon, was the active attitude of some agricultural producers, which consisted in looking for and implementing various efficiency-oriented activities.

And indeed, based on empirical materials covering the years 2006-2008, it has been estimated that back then there were about 90 thousand holdings owned by natural persons and characterised by the extended reproduction of fixed assets as well as by large income from the holding per unit of own labour input. Moreover, it has been estimated that more than twice as many holdings have similar characteristics. In total, that population included about 290 thousand holdings rated as competitive and those which had the potential to be able to achieve that capacity soon.

The estimates presented in this book and drawn up based on the more convincing method and figures covering the years 2005-2007 partially adjusted those values. They confirmed the accuracy of the number of holdings with the competitive capacity (with net profit and extended reproduction of own assets), but pointed out that the number of those potentially able to achieve such capacity was not about 200,000, but only 84 thousand. Some of the latter were characterised by profit from their own assets and the negative reproduction of assets, while others – by loss and the positive reproduction of assets.

All or most of the holdings forming those groups simplified or specialised their production, took in all sorts of innovation, abandoned the cultivation of less--favoured utilised agricultural area and that with unfavourable layout as well as small-scale animal rearing, usually not much effective. On the other hand, some were part of producer groups and organisations, in order to improve their competitive capacity.

Similar findings have also been drawn up using the figures covering the years 2010-2012. They pointed out that the number of agricultural holdings of natural persons and with the competitive capacity remained almost at the same level as in 2005-2007, while the number of those potentially able to achieve the competitive capacity increased. In 2010-2012, there were about 119 thousand of such holdings. This was due to an increase in the number of holdings which gained profit from their own assets but were characterised by the negative reproduction of fixed assets. So, in total, in 2010-2012 there were about 205,000 agricultural holdings with the competitive capacity and those which were able to achieve that capacity.

For the purpose of explanation, it should be added that the conditions which occurred in 2010-2012, differed from those of previous years. Direct payment rates expressed in EUR stopped growing and remained at the level from 2010, and a rise in prices of agricultural products no longer stayed ahead of a rise in prices of means of production. So, it is likely that the economic downturn discouraged some households with the competitive capacity from investing on a scale guaranteeing the extended reproduction and, as a result, they joined the group of holdings with the potential to regain that capacity in case of an economic upswing.

In the community of holdings of legal persons, the situation was different than that in holdings of natural persons. In 2007-2009, as much as 93-94% of them had the competitive capacity or had the conditions to be able to achieve that capacity soon, and as part of it, more than half were characterised by the competitive capacity. In 2010-2012, when compared to the aforementioned period, the number of holdings in all three distinguished groups decreased. The number of those with the competitive capacity – by 4.8%, those having grounds for being able to achieve that capacity soon should the conditions improve – by 13.7%, and those without the competitive capacity – by 36.0%. As a result, during the process of ownership transformations, being not only derivatives of an economic downturn, but also caused by institutional reasons, private holdings of legal persons and natural persons were established or their divided assets were purchased or leased by individual agricultural producers.

Concern is raised by the level of the sustainability of agricultural holdings which determines the sustainability of holdings in a longer term. This refers to an overall assessment of the economic situation and the environmental impact of the agricultural production. The literature studies showed that among holdings of natural persons having 2 and more ESU only 13% could be regarded as sustainable. On that basis and on the basis of the CSO data it may be estimated that only 5-6% of all agricultural holdings in the country, with the agricultural activity and the area of 1 ha or more of utilised agricultural area were characterised by that feature at the end of the first decade of the current century. They were usually larger holdings.

The sustainable production did not pose any bigger threats to the natural environment, and gained income gave possibilities to modernise holdings, increase the scale of their production and support farmers and their families at the level not lower than that of families of employees with the average salary in the whole national economy. Therefore, it may not be ruled out that the share of holdings characterised by sustainability would be larger, if in assessing that phenomenon "payment" for own labour was adopted at the level adopted in the above calculation, which was used to determine the number of holdings with the competitive capacity.

The share of holdings, which implemented only the selected activities affecting sustainability was, naturally, higher. Based on the literature, it is known, for example, that in the second half of the first decade about 74% of holdings specialised in the production of cereals and technologically similar plants and covered by the monitoring of the Polish FADN, were characterised by a positive balance of carbon dioxide storage (sequestration) in the soil. Therefore, these holdings limited the negative impact of the agricultural production on the climate.

This means that some Polish agricultural holdings may pose a threat to the environment which is expressed, *inter alia*, by: progressive mineralisation of soil organic matter, pollution of surface waters and confined groundwaters, succession of wild and undesirable vegetation in areas so far used extensively for agricultural purposes, etc.

Similar phenomena take place, although to a smaller extent, in agricultural holdings located in areas covered by nature protection. In total, they cover 32.5% of the country, which is a reason why our country is perceived as a "green island" of the EU grouping, and this facilitates and will facilitate, in the future, our foreign trade in agri-food products.

● Comparing Polish agricultural holdings characterised by the competitiveness with similarly selected holdings, from several other EU countries, indicates that in most cases their description differs. Those analyses were carried out in different years of the 2006-2011 period, thus economic sizes of selected groups of holdings have been presented in two different units.

The minimum size of the following types of Polish competitive holdings is:
– cereal holdings, the size was within the range of 8-16 ESU (European Size Unit = European unit of the size of agricultural holdings measured by the specific amount of direct surplus calculated in a normative manner) and 42 ha of utilized agricultural area. The same situation was in Hungary, but in Germany those values were, respectively, more than 100 ESU and 522 ha of utilised agricultural area;
– holdings with mixed fieldcrops, 8-16 ESU and 25 ha of utilised agricultural area, so just as in Hungary. In Germany, however, it was 40-100 ESU and 78 ha of utilised agricultural area, respectively;
– fruit-growing holdings – 8-16 ESU, so just as in Poland and Hungary in holdings of both previously described types, but only 13 ha of utilised agricultural area. In Hungarian and German holdings of this type, there were 40-100 ESU and 60 and 14 ha of utilised agricultural area, respectively. We may guess that Hungarian holdings, in addition to the fruit production, conducted extensive production of other crops. The minimum size of fruit-growing holdings in the Netherlands was more than 100 ESU and had an area of nearly 23 ha of utilised agricultural area;
– vegetable-growing holdings – in Poland, 16-40 ESU and 6 ha of utilised agricultural area, so almost like in Hungary, but in German and Dutch holdings it was 40-100 ESU and about 2 and 6 ha, respectively. Certainly, in Poland and Hungary vegetables were produced mainly as fieldcrops, while in the remaining two countries under the protected production;
– holdings specialising in the milk production – in Poland, as well as in Hungary, within the range of EUR 50-100 thousand SO (Standard Output = the amount of revenues measured in a normative manner), they had the area of, respectively, 48 and 78 ha of utilised agricultural area and kept, respectively, 35 and 30 cows. The minimum size of German and Danish holdings of this type was within the range of EUR 100-500 thousand SO and they had the area of, respectively, 77 and 93 ha of utilised agricultural area and a herd with, respectively, 63 and 88 cows, while Dutch holdings had the size of more than EUR 500 thousand SO, the area of about 99 ha of utilised agricultural area and herd with 173 cows;

– holdings specialising mainly or exclusively in rearing of commercial groups of cattle other than cows – within the range of EUR 50-100 thousand SO and they had the area of 73 ha of utilised agricultural area, while German holdings were within the range of EUR 100-500 thousand SO and had the area of about 91 ha of utilised agricultural area. The main source of income in the latter were grants, whose share in income exceeded 150%;
– holdings specialising in rearing pigs – EUR 50-100 thousand SO, with the area of 30 ha of utilised agricultural area and a herd of pigs of 74 LU (Livestock Units = unit of livestock similar to the so-called manure unit rarely used in Poland). The same situation was in Hungary. The economic size of German, Danish and Dutch holdings was within the range of EUR 100-500 thousand SO, their area of utilised agricultural area was, respectively, 54, 73 and 6 ha, and the population of pigs was above 212 LU. It is very probable that manure management in Dutch holdings was conducted differently than in German and Danish holdings. It is estimated that German, Danish and Dutch holdings, despite the large scale of production, had limited development abilities in relation to Polish and Hungarian holdings;
– holdings specialising in the poultry production, just as in Hungarian and German holdings – within the range of EUR 50-100 thousand SO. They had the area of utilised agricultural area of, respectively, 16, 12 and 19 ha and poultry flocks of, respectively, 63, 58 and 45 LU. Danish and Dutch holdings specialising in the poultry production did not show development abilities regardless of their economic size.

From the above information it results that in the first decade of this century the minimum size of competitive Polish agricultural holdings deviated, to a small extent, from the size of competitive Hungarian holdings, but most often it was significantly smaller than the minimum size of holdings of that kind in Germany, the Netherlands and Denmark. The essential reasons for that situation were most probably the differences in the level of costs of production factors. These differences were smaller in relation to the situation in Hungary.

Over the years under the analysis, land tenure costs were lower there than in Poland by 11-27%, and costs of interest on capital by about 24%, but the wage level of contract workers in agriculture was higher by 24-31%. In Germany, on the other hand – for example – land tenure costs were higher by 134-187% and the wage level of contract workers in agriculture was higher by 241-285%, while the interest rate on loans was lower by about 29%.

From the above comparisons it may be concluded that the higher level of the economic development of countries is positively correlated with higher land and labour costs, and negatively with costs of foreign capital, and this, in turn, forces an increase in the scale of production in agricultural holdings so that they could maintain their competitiveness. Simply, cheap capital under these conditions substitutes for expensive land and labour. This conclusion has important implications for assessing the directions of the evolution of Polish agricultural holdings in the next few decades.

● It may be assumed, without fear of making a great mistake, that in 2015-2020 some of our business-oriented agricultural producers will continue to benefit from progress resulting from the implementation of various types of innovation (specialisation of production, increase in its scale and other efficiency-oriented solutions) in order to improve the functioning of their holdings. However, it is certainly known that subsidies will be of lower importance in the income increase than in 2004-2013. The final phase of the current global economic recession will also be underway, in combination with the probable increase in the demand for products of agricultural origin in the developing countries, as a result of the globalisation of the world economy, with the limited possibilities of the increase in the supply of these goods due to climate change. All of this could lead to the boom for agricultural products and foodstuffs which is not smaller than the current one, and due to the fact that since 2003 Poland has participated in the global division of labour in this regard. Polish agricultural producers could also benefit from that. However, there are questions which tone down this optimism and for which some answers are missing.

The EU and Polish analysts estimate that the liquidation, in 2015, of milk production quotas throughout the European Union will translate into a decrease in prices of this good by 10-20%, and, consequently, an increase in its supply. In Poland, however, a small increase in the milk supply is envisaged due to rather unfavourable climatic conditions (increasing occurrence of droughts in vegetation seasons which limit the growth of grass and other fodder plants) and rather unfavourable economic situation of smaller agricultural holdings specialising in the milk production. Lower costs of labour and services are, in fact, reduced in these holdings by large unit costs of keeping animals in too small herds, poor reproduction results, high cow culling rate and high mortality of calves. Another aspect are the ambitious plans of the countries in Asia and South America with regard to the increase in the milk production. For example, it is known that by 2020 the Chinese, in order to meet the internal

market's needs, are planning to increase their milk production by 40%. Some experts anticipate, however, that not all developing countries will be able to make such effort.

Doubts also apply to the cultivation of sugar beets after 2017, when both quotas for sugar and its competitive good – isoglucose – and the application of minimum sugar beet prices are going to be liquidated. The cultivation of this plant is one of the more profitable in Polish agriculture, not only against the background of winter rye, but also against the background of income gained from winter wheat and another important industrial plant in our country – winter rapeseed. The rules for the functioning of the EU sugar market after the liquidation of production quotas have not been specified yet, but it may be expected that the increased sugar production will lead to a reduction in the sugar price, and, consequently, also in the average price level of sugar beets. Based on the literature of the subject, it is also known that the significant increase in the variability of these prices, year by year, is probable.

In two years, we will also take up the issue of extending the moratorium on the import of soy meal, which is mostly produced from modified soy varieties using methods appropriate for genetic engineering (GMO plants). Its properties do not differ from meal produced of varieties grown in a more traditional way, but it is cheaper. Soy meal is a hard-to-replace feed component used in rearing young poultry, broilers, piglets and weaners but in Poland there is resistance on the part of the public as to the cultivation of such plants, so we may not rule out a situation that the moratorium on the import of GMO soy meal will not be extended. Therefore, we have to expect that the production of eggs, poultry for slaughter and pig livestock will rise in price.

The share of milk, poultry and pig livestock, eggs and sugar beets in 2013 amounted to 52-53% of the domestic agricultural commodity production, thus, the above-mentioned changes may have a considerable negative impact on the economic results of many national agricultural holdings.

The projection for 2020, drawn up for the conditions resulting from the long-term trend, indicates that in the case of cereals an upward trend of revenues is likely to occur, as a result of better yielding and higher grain price. The production of winter wheat and spring barley, however, may note a stronger growth in costs rather than in revenues, therefore a small decrease in the cost-effectiveness of their production is possible. Whereas the cost--effectiveness of the rye production will be probably higher, due to the faster growth in revenues rather than in production costs. It is also estimated that the

yield of winter rapeseed will increase, just like the price of that crop. In the target year, the cost-effectiveness of the cultivation of this oilseed plant may thus improve.

However, these averaged trends characterising the cost-effectiveness of producing manufactured goods of agricultural origin may demonstrate the deviations upwards and downwards, in the subsequent years, due to the variability of weather and price fluctuations. From the calculations carried out it results that rye is the activity which, among cereals, is the most sensitive to each of income-making factors – yield, grain selling price and cultivation costs. Only under extremely favourable conditions, the cultivation of rye may provide decent income, but its cultivation entails and most likely will continue to entail a high risk, maybe because it is cultivated in the worst areas. On the other hand, winter rapeseed – when compared to cereals – is and will probably be characterised by larger percentage deviation of income from the projection determined based on the trends, due to the fluctuations of the yields resulting from the variability of weather, mainly in late autumn, winter and early spring.

The experiences of the past few years shown in the literature demonstrate that probably there will be an increase in the demand for organic food, although its share in the domestic production of food will be small.

However, we may not completely rule out the development of the situation according to the pessimistic scenario, mainly due to the prolonged economic recession, as indicated by the economic situation of the European Union southern countries – Greece, Portugal, Spain and Italy. The prolonged recession may also be influenced by the tensions, which have occurred in Eastern Europe and in some Muslim countries of the Middle East.

All these may have a negative impact on the economic situation of some world countries for several subsequent years and reduce a boom in agri-food products. In Poland, other phenomena may coincide with this. As a result of the parliamentary elections, in 2016 there may be a change in the distribution of political forces, which will lead to the long-time postponed national reform of social security for the agricultural population and of the taxation system for agricultural holdings. Of course, we may hope on the adaptation abilities of the national food industry and national agricultural holdings which will limit negative effects of those phenomena but will not eliminate them completely.

Nevertheless, in such a situation, it is probable that the number of agricultural holdings with the competitive capacity will reduce its growth rate until 2020, and we may not even rule out a reduction in this number as a result of

joining the group of those with the potential to regain that capacity in case of an economic upswing.

● Some issues regarding the period after 2020 do not require any projections as they are already a subject of political arrangements. The most important issues will include a reduction in greenhouse gas emissions within the framework of the European Union by 2030. Poland is a significant emitter in relation to the generated GDP, so both the absence of investment aimed at reducing these emissions (paying contractual penalties), as well as taking such investments using public funds may slow down the Polish economy for some time, and this will have a negative impact on the domestic demand for agri-food products and, as a consequence, on the number of national agricultural holdings with the competitive capacity and of those which will be able to achieve it.

The need to make new modernisation transformations in the nearest quarter-century in the Polish economy is more and more frequently and seriously discussed. These future transformations are to be composed of, *inter alia*, the emergence of the creative society and building an economy based on constantly growing knowledge gained using scientific methods. The success in the implementation of these transformations, and in fact, the modernisation leap (also known as the scientific and technical revolution) will facilitate the solution of problems resulting from: climate change, ageing of the society and possibly others. Therefore, salaries in the national economy will rise, which will result in continuing the abandonment of running small agricultural holdings. As a result, agriculture will be dominated by holdings with the medium and large concentration of production and the majority of them will be characterised by the competitive capacity or will have the features showing that they could achieve this capacity.

Finally, we may try to identify even the more distant time perspective. After all, futurologists do formulate forecasts to indicate future potential threats and opportunities for the further development.

In the mass media, we are often attacked by disastrous images relating to the nutrition of the global population and the agricultural development in the future, but the futurological literature indicates their falseness. About 2/3 of owners of agricultural holdings on a global scale have very small agricultural holdings, which are cultivated using hand-held tools. Income from them barely provides a minimum standard of living for owners and their families and it is not sufficient to purchase means to intensify the production. However, this situation is changing. Globalisation increases the urbanisation processes, which leads to

the concentration of land in a decreasing number of holdings, increased intensification of the production and increase in income of the farming population, just as it was before in the countries which are currently economically well-developed. Urbanisation has another important consequence for this reasoning. It leads to a decline in the total fertility rate of women, and thus to the slower growth in the demand for food.

Processes of land concentration in a decreasing number of holdings in the economically developed countries are becoming less important and there is nothing strange about it. The population here does not grow almost at all and the environmental protection is becoming essential, with an emphasis on procedures aimed at reducing greenhouse gas emissions. Technicised agriculture has a negative impact on the environment, also on its most important aspect – climate. A change in the economic policy objectives in these countries does not necessarily lead to a decrease in the supply of goods of agricultural origin. To a certain extent, procedures associated with sequestration of some greenhouse gases (mainly carbon dioxide) in the soil are complementary to agricultural income. For the above reasons, national agriculture after 2030 will be composed of agricultural holdings with the large concentration of production and large labour productivity, applying production techniques limiting the negative impact of the agricultural production on global climate and most probably also on other aspects of the environmental protection.

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