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Projection of income in the mid-term perspective for selected agricultural products

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

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Projection of income in the mid-term perspective for selected agricultural products

Collective work under the guidance of
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The authors are employees of the
Institute of Agricultural and Food Economics –
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The work was carried out under the following theme:

Competitiveness of Polish agricultural holdings and agricultural products at present and in a mid-term perspective

in the task:

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

The aim of the study was to make a mid-term projection of income in five crop production activities of great importance in Poland, i.e. for winter wheat, winter rye, spring barley, winter rapeseed and sugar beet. The study shows the impact on the level of income, projected rate of change in the prices of materials for agricultural production and the dynamics of expected changes in the level of production and income of the studied activities in agricultural holding groups with different direct costs incurred for crops farming.

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due to the electronic method of data processing for certain calculations - due to rounding - there may be differences

I. Selected aspects of forecasting

At the outset it should be noted that there is no single, clearly defined and widely accepted theory for predicting economic phenomena. There is no well-founded and widely accepted cohesive understanding of the shaping of economic phenomena. Astronomers, for example, have such knowledge, owing to which their forecasts of eclipses of the sun and the moon prove exactly true. Economists do not have such knowledge, and there are no single, generally accepted principles of economic forecasting, a set of which deserves to be called a stable economic forecasts theory. Therefore, the economic studies use different models by which economists try to justify the proposed transitions from observing the past to predict the future. The role of scientific laws is substituted by multidirectional relationships between economic variables, described by econometric models. These relationships, however, provide only approximate results[1].

The desire to know the future was a major preoccupation of man since the ancient times. The future is inherently unpredictable and therefore forecasting occasionally causes associations with the "crystal ball" and ironic smiles of rational people. However, the development of civilization and science introduced methods that rely on finding the relationships between the facts of the past that may determine the future. Forecasting is one of such methods, defined by Cieślak[2] as rational, scientific prediction "of future events".

There are many definitions of economic forecasts, in general, it can be said that it is a choice – as part of a given system – of the most likely route for development of an economic phenomenon in the coming period, and the basis for this choice is the history of this phenomenon and the current state of the system[3].

According to Stańko[4], forecasting is a cognitive activity, aiming to identify the most probable directions of socio-economic development of future facts, phenomena or events on the basis of the conditions laid down in the course of research. Zeliaś[5] presents the following definition: "forecasting is a rational, scientific prediction of future events". The scientific prediction of

[1] A. Zeliaś, *Przyczynek do dyskusji o trudnych problemach prognozowania ekonomicznego*, Zeszyty Naukowe Uniwersytetu Szczecińskiego No. 394*,* Prace Katedry Ekonometrii i Statystyki No. 15, Szczecin 2005.
[2] M. Cieślak, *Prognozowanie gospodarcze. Metody i zastosowania*, PWN, Warsaw 2004.
[3] A. Zeliaś, B. Pawełek, S. Wanat, *Prognozowanie ekonomiczne. Teoria, przykłady, zadania,* PWN, Warsaw 2003.
[4] S. Stańko, *Prognozowanie w rolnictwie,* 2nd edition, Warsaw University of Life Sciences – SGGW, Warsaw 1999.
[5] A. Zeliaś, *Teoria prognozy*, 3rd edition, PWE, Warsaw 1997.

the future is understood as the process of concluding that applies the rules of science – different from common knowledge because of e.g. accurate language and specific test methods.

Synonymous with the term forecasting is the term "prediction". Prediction is the process of econometric inference about the future. The purpose of this process is to estimate the unknown value of forecasted variable during the forecasted period. Another term used in the discussion about the future is "projection". This term refers to the most general predictions of the future. This is a very simplified (often schematic) transposition of past developments into the future[6].

According to Sobczak[7], forecasting is a valuable tool in the activities of economic entities. When dynamic changes take place in their more proximate and more distant environment, the future-oriented information is crucial. Forecasting is an integral part of the management process, it especially concerns the sphere of economic phenomena where the result of decisions made today largely depends on what happens tomorrow. Forecasting reduces uncertainty and helps to increase accuracy of decision-making, and thus to eliminate losses.

The result of forecasting is preparation of forecasts, but their accuracy is hindered by the specific conditions of the forecasting process. Agriculture is an area which is particularly difficult to predict because it is characterised by a high volatility and high risk. This is due to the biological and technical nature of production. In agriculture, there are random events, such as droughts, floods and frosts, which cannot be predicted. Also the government policies for agriculture may not be stable over the years. Economic conditions are constantly changing, therefore it is important to have the knowledge of existing patterns, the impact of various factors on the studied phenomenon and the strength and type of relationship between them. The more we know about the formation of a phenomenon in the past, the more informed predictions we can expect, and the deviations of real data from the planned data are smaller. Forecasting facilitates decision-making in the context of actions to be taken in order to achieve the expected goal.

[6] S. Stańko, *Prognozowanie w rolnictwie*, 2nd edition, Warsaw University of Life Sciences – SGGW, Warsaw 1999.
[7] M. Sobczak, *Prognozowanie. Teoria, przykłady, zadania*, PLACET, Warsaw 2008.

The development of agriculture, its various branches and production activities are affected by various factors. They can be divided into two groups depending on the possibility of their impact on the subject of the forecast[8]:

- endogenous (internal) in nature – resulting from the production potential, i.e. the resources of production factors (land, labour and capital), their quality and manner of use,
- exogenous (external) in nature – resulting from external impact on agriculture and other parts of the economy.

In economic activities events are related through various dependencies that are subject to certain regularities, such as the formation of prices depending on supply and demand. The impact of external forces on agriculture (farms) significantly strengthened since Poland's accession to the EU. It is also influenced, to some extent, by the process of globalisation. These conditions are reflected in the development and direction of change of macro-environmental factors, e.g. in the level and direction of changes in prices of agricultural products.

Rational forecasting requires the use of appropriate methods considered as the most relevant to the situation. According to Zeliaś[9], forecasting methods can be divided into two groups: non-mathematical methods and mathematical and statistical methods (Figure I.1).

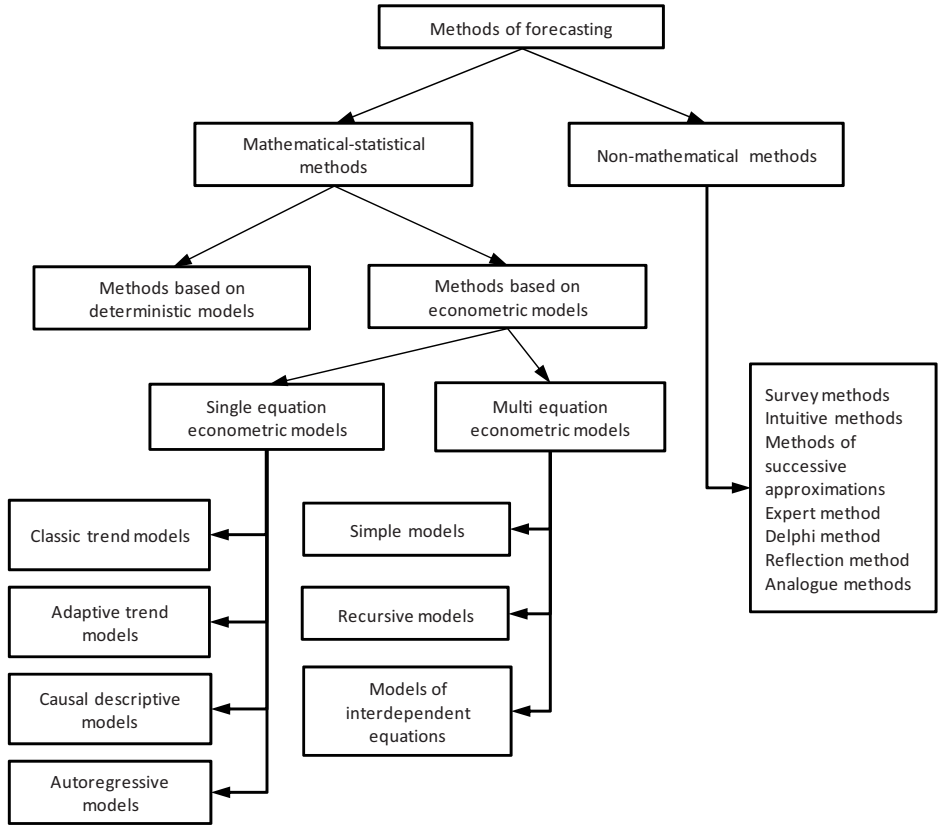
Non-mathematical methods – also called qualitative or heuristic methods – rely on the use of opinions of a large group of experts, their experiences and knowledge of the forecasted situation. Predicting the future in this case does not consist in extrapolating regularities found in the past into the future, but in forecasting the possible scenarios for the evolution of the phenomenon and indicating the most viable alternative[10].

Much more important group of forecasting methods are mathematical-statistical methods (also known as quantitative methods). These are methods, in which the forecasts are calculated using statistical or econometric models. Forecasting models are estimated on the basis of empirical data on the development of the distinguished variables, i.e. the predicted variable and explanatory variables in the past. The data take the form of time series. Forecasting with the use of these methods is usually performed through projection (extrapolation) to the future of the regularities observed in the past. Thus, using statistical and econometric models in forecasting, assumes stability in time of the structural

[8] S. Stańko, *Perspektywy produkcji rolniczej w Polsce w kontekście podaży i popytu w Europie*, Zagadnienia Doradztwa Rolniczego No. 2, Poznań 2009.
[9] A. Zeliaś, *Teoria prognozy*, 3rd edition, PWE, Warsaw 1997.
[10] A. Zeliaś, B. Pawełek, S. Wanat, *Prognozowanie ekonomiczne. Teoria, przykłady, zadania*, PWN, Warsaw 2003.

relationships described by the model and the admissibility of extrapolation of regularities outside the statistical sample. This justifies determination of the level of future events based on a model that describes regularities in the scope of development of this phenomenon over time[11].

Figure I.1. Diagram of the main methods of forecasting



Source: [Zeliaś 1997][12].

According to the objectives of the forecasts they can be divided into different types, the classification criteria of forecasts are also numerous. Table I.1. presents an example of a classification scheme for forecasts.

The most important criterion for the division of economic forecasting is the time horizon of the forecast, i.e. the period for which it was constructed. The longer it is, the confidence of the forecast is reduced. Thus, long-term forecasts should be treated with caution.

[11] E. Nowak, *Zaawansowana rachunkowość zarządcza*, 2nd edition, PWE, Warsaw 2009.
[12] A. Zeliaś, *Teoria prognozy*, 3rd edition, PWE, Warsaw 1997.

Table I.1. Classification of forecasts

Criterion of division	Types of forecasts
Time horizon	Long-, Medium-, Short-term and direct, Operational and strategic
Nature or structure	Simple and complex Quantitative and qualitative, quantitative can include: -point and interval -scalar and vector Disposable and repeatable Comprehensive and sequential Self-verifying and destructive
Level of detail	General and specific
Scope	Comprehensive and partial (or: global and segmental)
Range	Global, international, national, regional
Method of development	Minimum, average, maximum Clean (primary), verifiable, model Unencumbered, by the maximum probability, minimizing expected loss
Purpose or function	Research, including: -warning -normative -active and passive

Source: [Zeliaś et al. 2003][13].

The period, which is taken as a forecast horizon is conventional, it depends on the nature of the phenomenon under study. Some authors consider economic forecasts not exceeding one year, or covering only one production cycle as the short-term forecasts. Due to the function they have to meet, such forecasts are defined as operating forecasts. They are useful in the current decision-making process (e.g. for farms). On the other hand, medium-term forecasts are made for a period of 2 to 5 years, and long-term forecast for a period of over 5 years. They are referred to as strategic forecasts and they act as long-term and perspective planning tools. The primary purpose of these forecasts is to lay the foundation for long-term economic decision-making process[14].

[13] A. Zeliaś, B. Pawełek, S. Wanat, *Prognozowanie ekonomiczne. Teoria, przykłady, zadania*, PWN, Warsaw 2003.
[14] E. Nowak, *Ogólne zagadnienia prognozowania*, [in:] *Prognozowanie gospodarcze. Metody, modele, zastosowania, przykłady* (scientific ed. E. Nowak), Agencja Wyd. PLACET, Warsaw 1998.

Each correctly drawn up forecast is a plausible picture of the future. One will learn from it about the development trends of the studied phenomena and processes, the effects of various factors, the strength and nature of relationships between processes, as well as the possibilities and limitations of development. Based on this information, we are informed about the future[15].

At present, the importance of forecasts (projections) increases due to, *inter alia,* a rapid technological progress and the effects that it produces, internal changes in farms (enterprises) and changes in their environment. Farms are forced to constantly adapt to changing conditions. For the process of adaptation to be quick and aimed in the right direction, it becomes necessary to use relevant management tools. These are the instruments which allow to take the right decision or choose – under the given circumstances – the best business option, from among many other alternatives. One of the management tools is forecasting, and forecasts begin to perform different functions.

The first and simplest function is the ***informative function*** – it is based on informing the public about the upcoming changes. However, the main goal of the forecasts is to support decision-making processes, as different functions of the forecasts are related thereto. ***Preparatory function*** is considered as the most important. It assumes that the forecast is to assist the decision-making processes in micro- and macro-economics. For example, with relation to farms these can be forecasts on the structure of crop or livestock structure, depending on the expected changes in the prices of agricultural products. ***The activation function*** is to stimulate actions conducive to the implementation of the forecast when it expects favourable events and opposing to it, when the predicted events are unfavourable. **The *warning function*** of the forecast is intended to alert before the advent of adverse events and the consequences of certain actions. In the ***research function*** (informative) – the role of the forecast is reduced to recognising the future and showing the most probable future events, or even several possible versions of their development. Is also accustoms people to imminent changes and reduces the fear of the future[16].

Operating a farm (enterprise) is associated with making various decisions, which result in a choice of specific variants actions. These decisions relate to the future, which is why they are based on predictions as to future operating

[15] S. Stańko, *Prognozowanie w rolnictwie*, 2nd edition, Warsaw University of Life Sciences – SGGW, Warsaw 1999.

[16] P. Wroński, *Rola prognoz w gospodarce narodowej* [in:] *Prognozowanie gospodarcze. Metody, modele, zastosowania, przykłady* (scientific ed. E. Nowak), Agencja Wyd. PLACET, Warsaw 1998. S. Stańko, *Prognozowanie w rolnictwie*, 2nd edition, Warsaw University of Life Sciences – SGGW, Warsaw 1999.

conditions and the development of the given activity. In this situation, making good decisions is not easy. Inaccuracy of forecasts on future conditions of farm macro-environment and the results obtained is one of the factors that must be taken into account when making economic decisions. Even scientific "prediction" of the future, i.e. the process of forecasting, does not allow for a fully accurate state of the given phenomenon in the future. Inability to forecast error-free results is, *inter alia*, due the fact that the environmental conditions in agriculture (e.g. temperature, precipitation) considerably deviate from the average, which in turn has an impact on the obtained results (e.g. crops). In addition, business processes have always involved a man, and every process involving humans is not fully predictable, and therefore one cannot develop a correct forecast of economic phenomena. However, one can predict the changeability limits of the results.

It should also be noted that in each case the best choice under the circumstances of the forecast requires the adoption of an appropriate criterion for its assessment. Generally it can be said that this criterion is a benefit, which can be an expression of a certain level of income. However, due to the uncertainty of the forecast at the time of decision-making, income derived by using different strategies when making forecasts is also uncertain. There are therefore situations in which in order to provide the greatest benefit, the decision should be taken without the results of the forecast and settle for *a priori* knowledge of the forecasted phenomenon.

Forecasting process is characterised by a number of different conditions that affect the result. The problem may be even the quality of the data. In practice, one must take into account the occurrence of errors resulting from mistakes, such as during the collection and processing of data. Quality of the forecasting information depends also on whether the data used to create the forecast have been properly prepared, and on their completeness, accuracy and reliability.

Zeliaś[17] states that despite the enormous progress that has been made in methods of predicting the future, in particular the dynamic development of the theory of econometric forecasting (aided by modern computer technology), the forecast used by economists is still burdened with greater or lesser error. Error-free forecasts in the complex reality of economic life cannot be found. This raises up a question of how to use the forecast. According to the author, the issue of the rational use of projection is not simple and, so far, too little atten-

[17]A. Zeliaś, *Przyczynek do dyskusji o trudnych problemach prognozowania ekonomicznego*, Zeszyty Naukowe Uniwersytetu Szczecińskiego No. 394, Prace Katedry Ekonometrii i Statystyki No. 15, Szczecin 2005.

tion has been paid to this issue. In business practice one should not apply a strategy in which decisions are taken as if the forecast was flawless. Economic phenomena are more complex than physical phenomena, they are affected by such large number of explanatory variables that identification of the role and importance of each variable is practically impossible (this means that the variable may not be subjected to the experiment, i.e. observing it in the artificial conditions where only selected variables can be found). Economic forecasts should primarily inspire users of research results to undertake projects aimed at consolidating the direction of development recognised as beneficial or to prevent the development direction, which is considered undesirable.

Similarly, Sobczak[18] believes that even if the forecasts are correct, they only inform about these phenomena and trends that may shape the predicted phenomenon in the coming years. Thereby enabling to undertake measures to eliminate adverse events. Accurate forecasting is a skill given to few and it is a combination of knowledge and art. A.D. Aczel in this context states "it is better to know the truth vaguely than to be exactly wrong"[19].

[18] M. Sobczak, *Prognozowanie. Teoria, przykłady, zadania*, PLACET, Warsaw 2008.
[19] A.D Aczel, *Statystyka w zarządzaniu*, WN PWN, Warsaw 2000.

II. Materials and research methods and the treatment of results

The study, which aimed at projection of income on selected crop production for 2014, used empirical material from 2006-2011, collected and processed according to the assumptions used in the AGROKOSZTY system (Agricultural Products Data Collection System). The study dealt with five crop production activities – winter wheat, winter rye, spring barley, winter rapeseed and sugar beet. Farms involved in the research of production activities at the same time conducted accounting in Polish FADN. These were commercial farms and economically stronger as compared to the total of individual farms in the country.

The method of choosing farms for studies on production activities, the structure of direct costs and methodology of accounting to the level of gross margin, are discussed in detail in Chapter II (Materials and research methods), part A of the publication, entitled "Gross margin obtained from selected agricultural production activities in 2011".

The study, the results of which are presented in this part of the work, assessed the value of production, costs and economic effects, but the basic measure adopted for evaluation of achieved effects was the level of income from activities without subsidies and income from activities. The method of calculating these categories is presented below:

(1) **Income from activity without subsidies** =

= value of production – (direct + indirect costs),

(2) **Income from activity** =

= [value of production – (direct + indirect costs)] + subsidies.

The computation, which leads to the calculation of income from operations includes direct and indirect costs. Direct costs are the cost components which, without doubt, can be attributed to a given activity. However, the indirect costs are costs which at the time of their emergence cannot be divided into specific products (production activities), these are the costs common to the whole farm.

Indirect costs are incurred under operating activities of a farm, they include all costs incurred in connection with the operation or only its existence. These costs are allocated to the activities according to certain distribution key. According to the assumptions made in the study – according to the share of the value of production of each activity in total production value of the farm. Indirect cost structure is shown in the diagram II.1.

Diagram II.1 Structure of indirect costs of a farm

1. Indirect real costs

general economic costs
- electricity
- fuel
- propellant
- repairs, maintenance, inspections
- services
- insurance (e.g. buildings, property, communication)
- other (e.g. fee for water, sewer, telephone)

taxes
- agricultural
- other (e.g. forest, special branches, real estate)

cost of external factors
- cost of hired labour
- lease payments
- interest

2. Estimated indirect costs - depreciation

- buildings and structures
- machines and technical devices
- means of transport
- other (e.g. irrigation, orchards and perennial plantations)

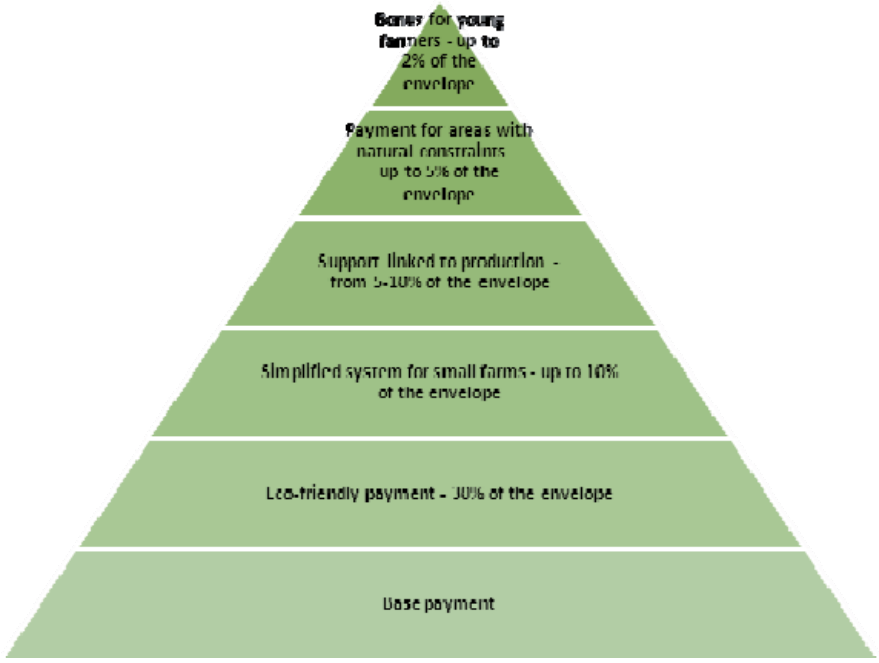
The data used to calculate the indirect costs of the analyzed production activities was derived from Polish FADN accounting database, which identifies farms conducting activities examined in the AGROKOSZTY system. Indirect cost allocation algorithm was applied individually for each farm and activity.

In accordance with the principles of the Common Agricultural Policy, direct payments are the instrument for supporting and stabilizing farmers' incomes. Poland currently uses a simplified form of the direct payment system, i.e. the Single Area Payment Scheme (SAPS). Payments under this scheme are paid per hectare of agricultural land maintained in good agricultural condition as of 30 June 2003 and can be replenished from the national budget (for 2012) by the complementary national direct payments, amounting to 30% of the payments used in the EU-15 on 30 April 2004 (to the level of payments in the EU-15).[20]

[20] *Płatności bezpośrednie*; http://www.minrol.gov.pl/pol/Wsparcie-rolnictwa-i-rybolowstwa/Platnosci-bezposrednie [access from September 2011].

In the budget for 2014-2020, as proposed by the European Commission, the direct payments are based on the reformed CAP, however, the European Commission proposes a number of changes in the granting system. According to experts, the requirements in relation to farmers are much more complicated than it is now. Direct payments model proposed by the Commission is shown in Figure II.1.

Figure II.1. Direct payments
Model proposed by the European Commission



Source: M. Zagórski, Zmiany we Wspólnej Polityce Rolnej oraz wnioski z nich płynące. Material presented at the seminar "The legislative package of the Common Agricultural Policy – proposed modifications and the possible consequences for Polish agriculture", which was held on 22.02.2012, in the building of the Ministry of Agriculture and Rural Development in Warsaw.

At the time of going to print, negotiations are underway for the final shape of the CAP for the period 2014-2020. It is therefore difficult to estimate the amount of subsidies that farmers can receive in 2014. In the performed projection, the rate of payment was accepted at the level of 212 EUR/ha, based on Poczta estimates[21]. One factor that has a major impact on the level of subsidies

[21] W. Poczta, *The possible effects of selected proposals of the European Commission legislative package on the future of the CAP after 2013 for Polish agriculture.* Material presented at the seminar "The legislative package of the Common Agricultural Policy – proposed modifications and the possible consequences for Polish agriculture", which was held on 22.02.2012, in the building of the Ministry of Agriculture and Rural Development in Warsaw.

is the euro exchange rate, the calculation assumes that in 2014 the rate will be: 1 EUR = 4.00 PLN. Taking the above assumptions, it was estimated that in 2014 payments for 1 hectare is expected to reach PLN 848.

Profitability of production and the amount of income from production activities shape revenues and expenses, there is a strong correlation between these areas. The decisive element which is very important in the production are direct costs, the amount of which depends mainly on the farmer. The structure of the direct costs of crop production is dominated by two components: the cost of mineral fertilizers and the cost of plant protection products. Their share of the total may be as high as about 90%.

Costs and expenses are two concepts functioning in the economic accounting, which is closely associated with the choice of optimal management. Currently, the assessment of production processes and the competitiveness of individual operations uses very often calculation which takes account only of direct costs. However, under certain assumptions, calculations are made, which in addition to the direct costs also include indirect costs and those calculations have to fulfil important functions. They allow to get to know the cost structure and linking them to the various processes on the farm, which can be helpful in the search for a way to reduce them. They can be performed in different sections – and because there is no ideal model for the assessment of the development of the level of costs – this approach allows comparisons, such as with obtained revenues, costs of the previous period or planned costs and costs of other farms. Cost calculations and their analysis should be used to streamline operations in the future, it is therefore important to know the relationship of effort/effect, the knowledge in this area will make it possible to achieve the desired objectives with the involvement of lower costs.

One factor that man can control to a great extent is certainly the intensity of production, and determination (selection) of a reasonable level of production intensity is one of the most important decisions of a farmer – a farm manager. The study adopts as the measure of production intensity the volume of production, which are expressed in value by the level of direct costs. Farms from the research sample were put in order according to the amount of direct costs per 1 ha of crops of studied activities.

The aim was to examine the changes in the production and economics performance of crop production activities, grouped under the adopted criterion. Results were expressed by quartiles, but to show the scale of differentiation they were presented only for the two boundary quartiles, i.e. groups of farms with low (I quartile) and high (fourth quartile) level of direct costs per 1 ha of crops of studied activities.

The aim of the study is the projection of income and thus determination of the direction of change in the medium term. The results show the effect on the level of income for the forecasted rate of change in prices of agricultural inputs (such as seed, fertilizers, pesticides). They also allow for specifying the dynamics of the expected changes in the level of production and income in the analyzed crop production activities in the groups of farms that differ in the amount of direct costs for 1 ha of crops.

Due to the availability of source data, for activities: winter wheat, winter rye and winter rapeseed, individual variables, i.e. the components of the value of production and costs were estimated for 2011 based on data from the years 2006-2011, while for barley and sugar beet – for 2007-2011. Amounts in subsequent years, however, have been adjusted with change rates assigned on the basis of trend function. Average of several years is calculated based on the corrected data. It was the starting point to build a projection for 2014, i.e. it has been extrapolated into the future based on trends observed for the time series of analyzed variables. The time series were set for the period 1995-2011.

This means that for all cost elements and components of the production value of each activity, selected models described well the variability of the studied phenomenon. The selection of models for use in the projection was based on the size of the coefficient of determination and expert knowledge on the formation of the phenomenon over time. The projection model assumes constancy of the structure and amount of expenditure incurred on various activities in the production process. This means that expenditures represent the average level in base years.

The results are presented graphically and in tables. The average of several years and the results projected for 2014 (in current prices) are given in the tabular appendix (Tables 1-6). Chapter IV presents only selected data describing the profitability of production in the studied period. The term "data" means the variables that generate a certain level of production (yield, price) and the components of direct and indirect costs.

It should be noted that these figures reflect the average performance of groups of studied farms, and therefore should not be directly translated into the average results for the country. However, they allow for presentation of certain phenomena and relationships and trends (for example, formation of production profitability) and in this context, they provide a basis for conclusions relating not only to the tested sample.

III. Income projection method

This chapter presents a manner (procedure) for building a model of income projection in the medium term for crop production activities. The object of the study was five activities, i.e. winter wheat, winter rye, spring barley, winter rapeseed and sugar beet.

The input data used for the construction of the projection model were the data collected in the AGROKOSZTY system and the Polish FADN. In order to present the results of production activities they were processed in accordance with the methodology used in the AGROKOSZTY system. More specifically, the data that were extrapolated into the future in case of the individual activities are the components of the structure of:

- the value of production (yield, price)
- direct costs (cost of seeds, fertilizers, pesticides, growth regulators, other costs),
- indirect costs (presentation in the diagram II.1).

The empirical material for the three activities (winter wheat, winter rye and winter rapeseed) came from the years 2006-2011, and for two activities (spring barley, sugar beet) from the years 2007-2011. Given the time series of data (6 or 5 years), the projection of the results for the next three years (i.e. until 2014) would be burdened with a very big error. According to the researchers, extrapolation should reach no more than ¼ of the number of data used to estimate the model[22]. To solve this problem, the construction of the model for projection of income from production activities used a different solution.

Data describing production activities in the years of the study (i.e. components of the structure of the value of production and costs) were used as the starting point for further calculations and to produce a projection. The aim of the work was to project results for the years 2012-2014. The simplest solution would be to adopt data from 2011 as input data. However, it was an unusual year with particularly high fluctuations in sales price of grain. Therefore, in order to exclude the impact of unusual situations on the results of the projection, the average of research years was assumed as input data for each crop production activities. However, it should be expected that during this period some progress has been made. Production technology could have been improved and the value of money also changed. In order to take account of

[22] S. Stańko, *Wyznaczenie prognozy i ocena jej realności* [in:] *Zarządzanie ryzykiem cenowym a możliwości stabilizowania dochodów producentów rolnych – aspekty poznawcze i aplikacyjne,* IAFE-NRI, PW Report No 148, Warsaw 2009.

these factors and be able to treat the calculated average as a starting point for drawing up projections for 2012-2014, specific variables were adjusted prior to averaging by indicators of change (from year to year) calculated using the specific trend functions. More information on the trend function and the correction can be found later in this chapter.

The next stage was to find time series long enough that they can be extrapolated for the next three years, and which at the same time characterized very well the variability of the studied phenomena. These data were largely derived from studies of official statistics (CSO). Time series were created for 17 years, from 1995 to 2011. A limitation to the length of these series and determining development trends for individual phenomena was the denomination of zloty, which was carried out on 1 January 1995 (based on the act on denomination of zloty of 7 July 1994 – Dz. U. No. 84, item 386). In order to maintain uniformity of the data we abandoned construction of longer time series.

The projection model assumes constancy of the structure and amount of expenditure incurred on various activities in the production process. This means that expenditures represent the average level in the studied years.

For each of the components of the value of production (in the case of each activity independently) and direct and indirect costs, we chose a time series (in exceptional cases more than one), whose course was the most similar to the studied phenomenon. Diagram III.1 shows an example of the assignment of the selected variables, such as output variables from the AGRO-KOSZTY database assigned to variables derived from official statistics, which were used to build the time series.

After selecting the time series there was an attempt to prepare their modelling and projection. For this purpose, we used classic models of development trends[23].

Models of development trends describe development of events in time and can be used to draw up medium-term forecasts. Forecasting based on them is done by extrapolating the trends observed in the past. It is necessary, however, to assume that the test variable will be affected by the same factors as before and in the same way as before. This means that the structural relationships included in the model and observed in the past will not change during the fore-

[23] The choice of this method was influenced primarily by practical considerations such as the availability of data, forecast horizon and depth and technical capabilities of its use. This method is relatively simple in terms of calculations, and the results are easily interpretable.

cast horizon[24]. This assumption, in practice, and in particular in describing the events as unpredictable as taking place in agriculture, is difficult to meet.

Diagram III.1 Example of variable assignment in the projection model

Variables from the AGROKOSZTY database		*Variables of public statistics*
Yield of winter wheat	⟷	Yield of winter wheat in individual farms
Price of winter rye	⟷	Average annual price of rye
Cost of sugar beet seed	⟷	Price of sugar beet seed
Cost of mineral fertilizers	⟷	Indicator of changes in the prices of mineral fertilizers
Cost of electricity	⟷	Retail price of electricity
Cost of agricultural services	⟷	Indicator of changes in the prices of agricultural services

Using the models of development trends requires separation of a trend, which is an essential component of a time series. This is done by smoothing the series or filtering any random, cyclical or seasonal variations. In the conducted studies, development trends were extracted by finding the mathematical function, called a trend function, that best describes the phenomenon changes over time (this is an analytical method for extracting development trend[25]).

[24] S. Bartosiewicz, *Ekonometria. Technologia ekonometrycznego przetwarzania informacji*, PWE, Warsaw 1989; M. Cieślak, *Organizacja procesu prognostycznego* [in:] *Prognozowanie gospodarcze. Metody i zastosowania* (scientific ed. M. Cieślak), PWN, Warsaw 1999.
[25] E. Wasilewska, *Statystyka opisowa od podstaw*, Warsaw University of Life Sciences – SGGW, Warsaw 2011.

Function of development trend can be seen as a special case of the regression function, where explanatory variable is the time *(t)*, and the dependent variable is the level of the studied phenomenon *(s)*. The analytical method assumes, therefore, that the level of the analyzed phenomena is a function of time.

$$\hat{y}_t = f(t)$$

where:

t – time variable (period number), *t = 1, 2, …., n,*

$\hat{y}_t$ – estimated level of the phenomenon at time *t.*

However, the procedure for the prediction based on the regression (trend) model requires the adoption of two principles, i.e. that the regression function does not change and that random factors do not distort the studied phenomenon in the prediction horizon. [26]

Selection of the trend function was made with the heuristic method, i.e. several regression (trend) functions were estimated, followed by the choice according to the applied criterion. Five functions were taken into account: linear, second-degree polynomial (quadratic), exponential, power and logarithmic functions. For each of the considered series a model of development trends was drawn up in the following form:

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

$Y_t = \beta_0 + \beta_1 t + \beta_2 t^2 + \varepsilon_t$ – quadratic trend model (second-degree polynomial)

$Y_t = \beta_0 e^{-\beta_1 t + \varepsilon_t}$ – 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 dependent variable at the point t,

t – explanatory variable (time) takes integer values from 1 to n,

β_0 – independent part,

β_1, β_2 – directional coefficients of the function,

ε_t – random component.

[26] B. Pułaska-Turyna, *Statystyka dla ekonomistów*, 3rd edition, Difin 2011.

The parameters of these models were estimated using the method of least squares. This method consists in finding such parameter estimates, for which the sum of the squared deviations of the values calculated from the model, from the values observed, will be the lowest. For this purpose, the exponential and power models were previously taken logs of both sides.

After calculating the parameters of the models, they were used to calculate the theoretical values of the tested variable along with its predicted values for 2012-2014, i.e. the selected series was extrapolated into the future. Then one model was selected according to established criteria.

An important criterion was the statistical significance of parameters. In order to test the significance the t-student test was used. This is a test of the null hypothesis of no significance of the parameters in relation to the alternative hypothesis, which states that the tested parameter is significant. The significance level for this test was set at 0.05. The easiest way to verify the null hypothesis is to compare the level of significance to the p-value. It is automatically calculated in Excel, where most of the calculations were made. In the case of the t-student test on the significance of the parameters, this value indicates the probability of obtaining assessment of the parameter, obtained as a result of the estimation, if it is in fact insignificant. If it is lower than the assumed level of significance there are grounds for rejecting the null hypothesis in favour of the alternative hypothesis, i.e. the parameter is statistically significant.

It was important that the parameter standing at the t variable was statistically significant, it means that the time has an important impact on the level of a given phenomenon. The coefficient of determination, however, does not always have to be the highest. In some cases, in particular when all models were of poor quality, the choice was made based on knowledge of the formation of a given phenomenon in time and its predicted values.

However, the primary criterion for selecting a model for future work was the amount of the coefficient of determination and the significance of parameters. The standard example of such selection were the models for time series containing data on the average annual rate of liability insurance of tractors. The results of the estimation of models for this series are shown in Table III.1.

Table III.1. Results of the estimation of selected trend models for the annual average liability insurance rate of tractors

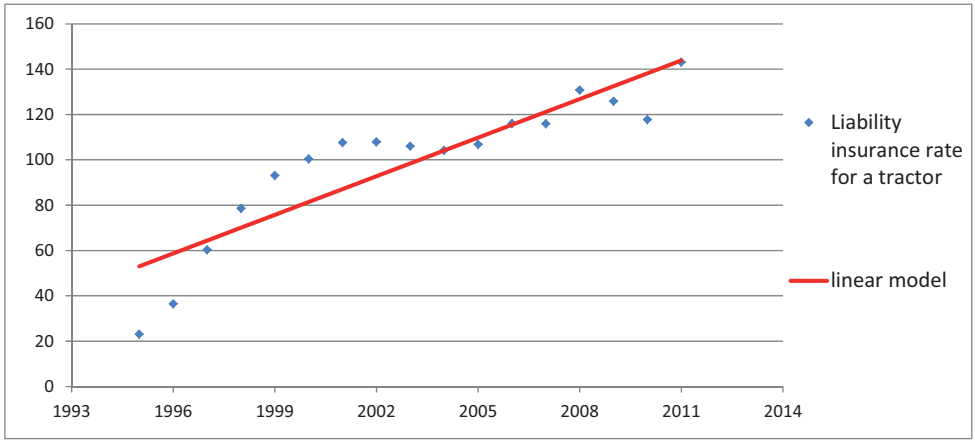
Typ modelu	R^2	Parametr	Ocena parametru	P-value
Model trendu linowego	0.796	β_0	47.361	1.6089E-05
		β_1	5.677	1.47952E-06
Model trendu kwadratowego	0.902	β_0	20.254	0.037826887
		β_1	14.237	1.9448E-05
		β_2	-0.476	0.001603774
Model trendu wykładniczego	0.643	β_0	45.734	9.25671E-14
		β_1	0.076	0.000109086
Model trendu potęgowego	0.905	β_0	29.328	1.78941E-15
		β_1	0.573	4.60643E-09
Model trendu logarytmicznego	0.944	β_0	21.145	0.001061166
		β_1	39.226	8.67559E-11

Source: Authors' own compilation based on the data of the Central Statistical Office.

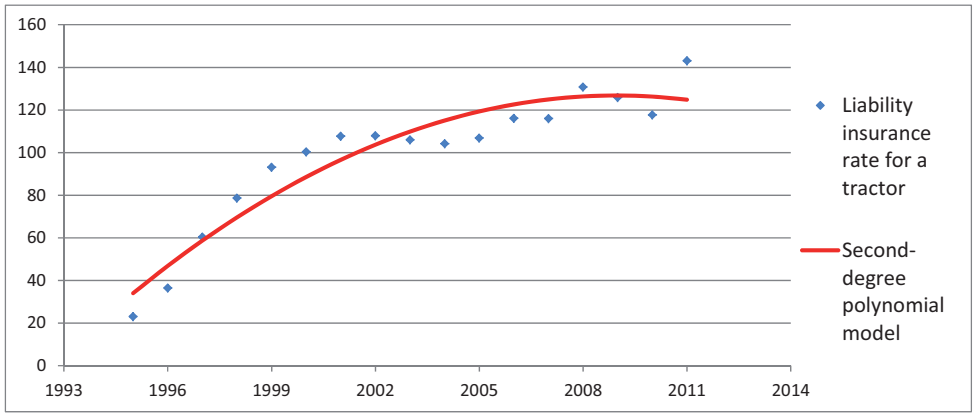
As shown in Table III.1, the parameters of all models are statistically significant (p-value < 0.05), and the coefficient of determination is high which may indicate good adjustment of models to empirical data. The highest R^2 is in logarithmic trend model and that is why it was taken into account in further work. Also the analysis of charts of individual models is in favour of this model. Figure III.1 shows the development of average rates of liability insurance for tractors and how these data fit with the theoretical values calculated on the basis of individual models.

Figure III.1. Average rate of liability insurance of tractors and trend functions

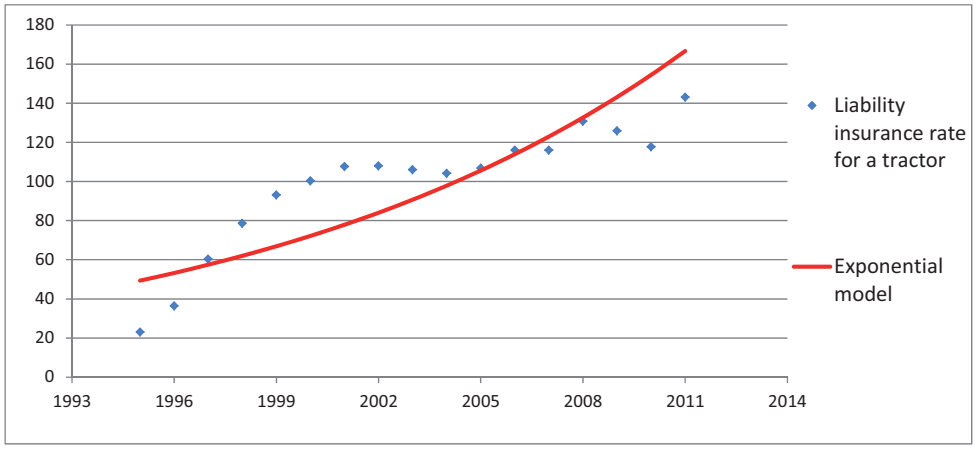
A. Linear trend



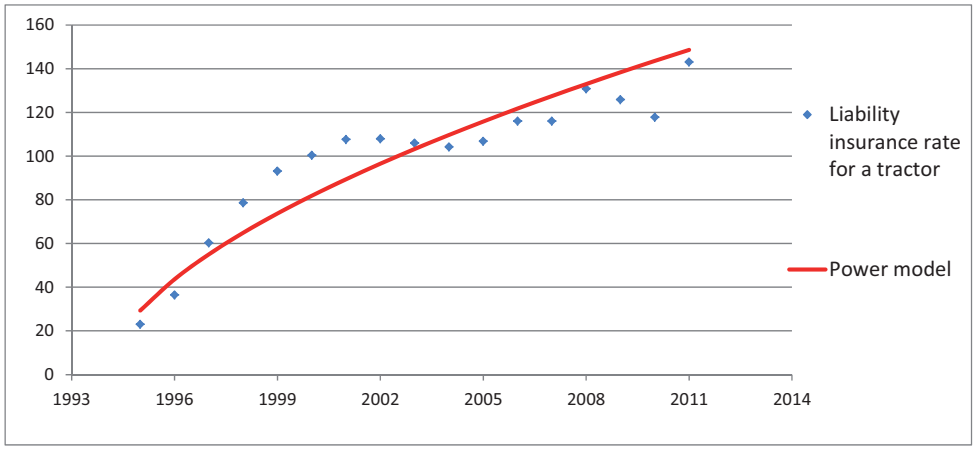
B. Quadratic trend



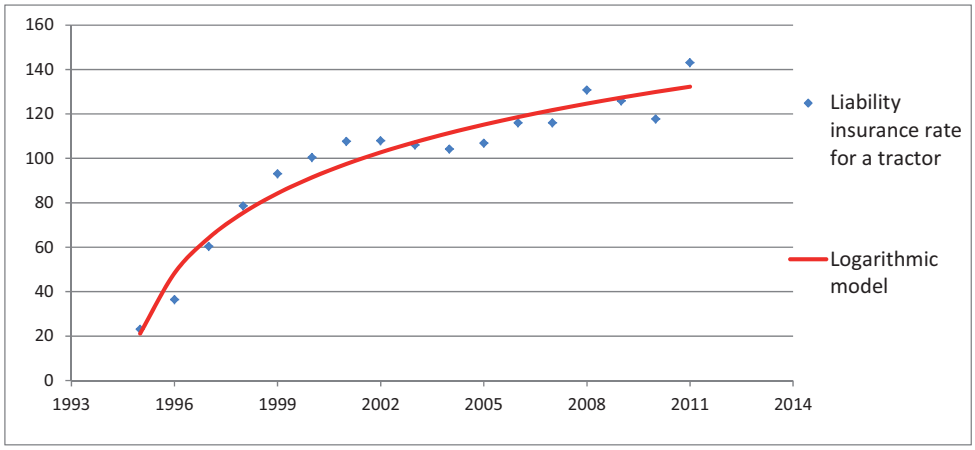
C. Exponential trend



D. Power trend



E. Logarithmic trend



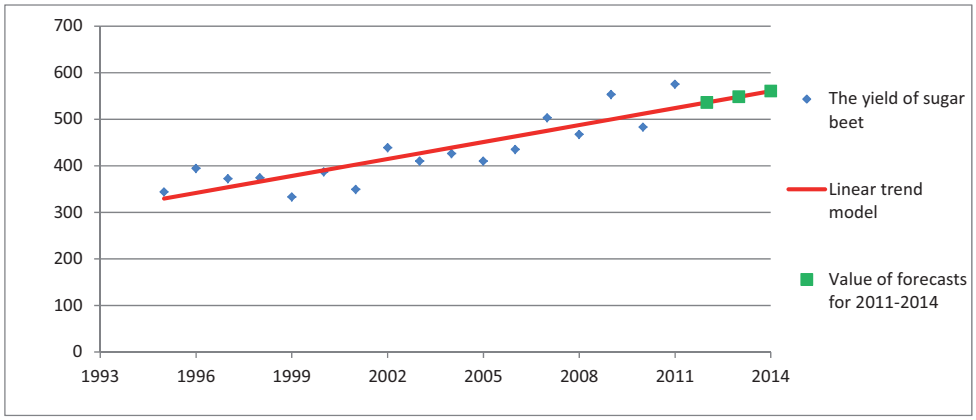
In the case of this series, the model with the highest coefficient of determination, i.e. the logarithmic trend model, seems to be the best. Sometimes, however, this coefficient gives a misleading impression of the adjustment of the model to empirical data. We could deal with the apparent regression or not all assumptions of the method of estimating the parameters, in this case, the least squares method, are met. For the purpose of analyses we did not perform a full review of models and did not examine the stationary of the series. Therefore, taking account only of the amount of R^2 may be wrong. With some knowledge about the formation of the phenomenon over time it can be noted that the model for which this factor was the highest is not always the best to describe the variability of the tested series. The specificity of the data means that often the best model, according to established criteria, was the quadratic trend model. Unfortunately, the values predicted with this model can be highly inflated or deflated even if the model seems to be well adjusted to the data. Therefore, to avoid confusion relating to the mechanical approach to model selection, often the model was selected on the basis of the knowledge about the studied phenomenon, taking into account only the amount of the coefficient of determination (i.e. it was important it is as high as possible without sacrificing the quality of the forecast). A good examples are the models describing the development of the sugar beet crop over time.

Figure III.2 shows the linear and quadratic models, for which the coefficient of determination was 0.758 and 0.831, respectively. In addition, it shows the projected amounts – on the basis of these models – of the yield of sugar beet. Quadratic trend model has a higher R^2, but the forecasted values are not very reliable. It is difficult to expect that the sugar beet crop in 2012-2014 grew so

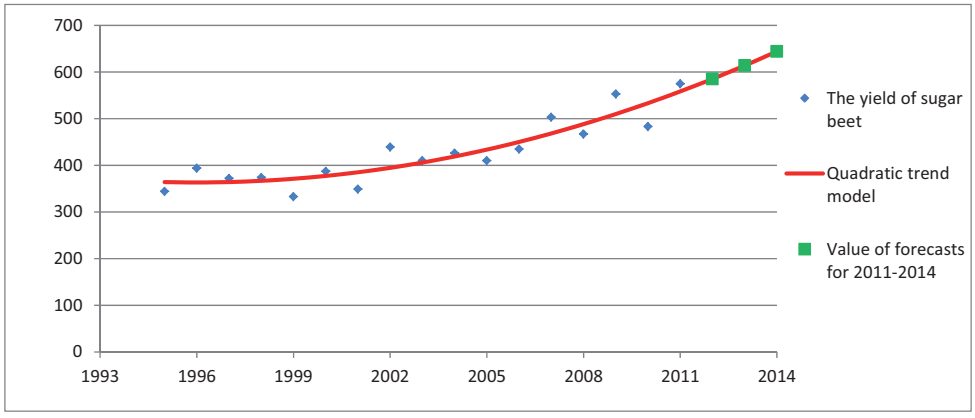
rapidly. For the same reason, we rejected the exponential trend model, where the coefficient of determination was 0.768 and was also higher than that obtained in the linear model. Ultimately we selected the linear trend model for analyses.

Figure III.2. Sugar beet yield and selected trend functions

A. Linear trend



B. Quadratic trend



In a similar manner as in the above examples, we selected the model for each of the analyzed time series. Using the selected models, we calculated theoretical values of individual variables, along with forecasts for 2012-2014. On this basis we calculated indicators of change from year to year where the previous year = 1.

Continuing the discussion of the example, i.e. the yield of sugar beet, the table III.2. shows the amount of sugar beet yield according to CSO, the theoretical values calculated from the linear trend model and change indicators

calculated on the basis of the theoretical data. Such calculations were also performed for earlier years, but the table shows only the data that were used for further work.

Table III.2. Empirical and theoretical values of the sugar beet crop and indicators of changes for the years 2007-2014

Specification	2007	2008	2009	2010	2011	2012	2013	2014
Sugar beet yield (acc. to CSO)	503.00	467.00	553.00	483.00	575.00			
Sugar yield theoretical values calculated from the linear model	475.28	487.43	499.57	51172.00	52386.00	536.01	548.15	560.30
Indicator of changes from year to year (previous year = 1) calculated on the basis of theoretical values	1.0262	1.0256	1.0249	1.0243	1.0237	1.0232	1.0227	1.0222

Source: Authors' own compilation based on the data of the Central Statistical Office.

After calculating the indicators of change for all series, we returned to input data of the AGROKOSZTY database. As mentioned at the beginning of the chapter, the starting point for drawing up a projection was the average of the years of research activity, i.e. 2006-2011 or 2007-2011. Prior to averaging the data were corrected to take account of their potential change in time. The previously calculated indicators of change were used for this purpose.

Analyzing further the example of sugar beet yield (according to CSO data), we calculated the product of the indicators of change in the yield in 2008-2011 (it was assumed that 2007 = 1). This resulted in an indicator of change from 2007 to 2011. With this indicator we adjusted the sugar beet crop in 2007 (from AGROKOSZTY data). This resulted in a theoretical value of the beet crop in 2011, taking into account changes over the years 2007-2011. In the same way, we made an adjustment of yield from the AGROKOSZTY system for the remaining years (i.e. 2008, 2009 and 2010), and then calculated the average yield for the years 2007-2011 based on the corrected data. The calculated mean was used as the starting point to calculate the projection. A similar method was used in calculating input data for each variable.

At the final stage of constructing the projection we used the previously calculated indicators of changes for the years 2012-2014, which were calculated on the basis of selected models prepared for the CSO data. These indicators were used to reassess the input data of the AGROKOSZTY for projection years. An example of such results is shown in Table III.3.

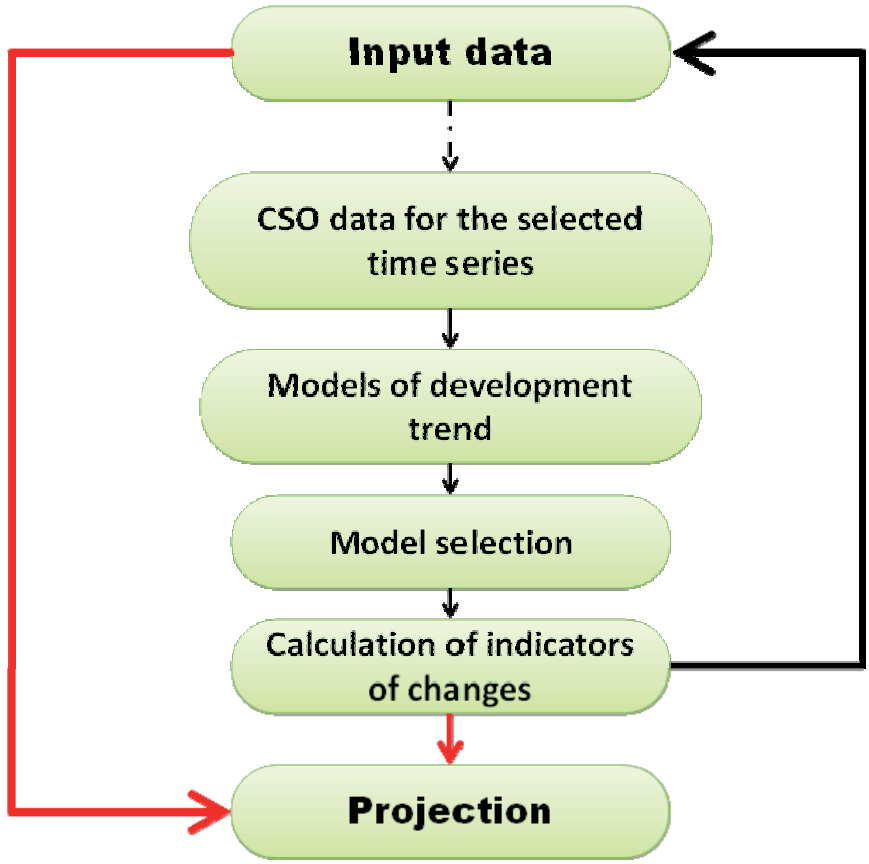
Table III.3. Input data and projection of sugar beet crop

Specification	Average for the years 2007-2011	2012	2013	2014
Indicator of changes from year to year (previous year = 1) calculated on the basis of theoretical values		1.0232	1.0227	1.0222
Projection of the sugar beet crop	576.70	590.07	603.44	616.81

Source: Authors' own compilation based on the data of the Central Statistical Office.

The above-described example is intended to illustrate the techniques of the procedure. In this way, we projected all components of the structure of production and cost values, and then we calculated the income from operations without subsidies for the studied crop production activities. Diagram III.2. presents in a synthetic manner the various stages of the construction of this projection model.

Diagram III.2. Steps in the construction of the projection model



The first stage of work on the construction of the model was to prepare the input data that describe production activities. Then we assigned them to the corresponding rows of data from the official statistics. For each of these series we built 5 models of development trends. On the basis of the adopted criteria – for each of the series – we selected one model for further analyses. Based on selected models we calculated theoretical values with the projection for the next three years. These values were used to calculate the indicators of changes from year to year. Indicators for the period 2006-2011 were used to correct the input data from AGROKOSZTY database. Then based on the corrected data we calculated the average for each activity. The average was the starting point for the projection for 2014.

Mean values of individual variables (adjusted by the indicators designated on the basis of the trend function) were reassessed with the previously calculated indicators of changes for the years 2012-2014. In this manner, we obtained the expected results for 2014 for all variables, i.e. the components of the structure of production and cost values of studied activities. Then we calculated the expected level of income from activities without subsidies. The results of the projection obtained in this manner may be an indication as to the direction of changes and the evolution of the income situation of the analyzed activities for crop production in 2014.

Using the available data, we also made an *ex post* assessment of the model. For this purpose, we used the average relative prediction error. Empirical data were compared with the projected values year to year. Given that the starting point for the construction of the projection was the average of several years and that for the determination of anticipated changes we used the models of development trend that depict the average rate of changes, it can be stated that the results of projections also show some average values. Therefore, the second comparison has been made, where the proposed values were compared with the average of several years, adjusted in the same manner as the input data used for the forecast. In both cases, the errors were calculated for the individual components of the value of production and costs, and for the resultant categories, i.e. the gross margin and income from operations without subsidies. It should be noted that when comparing data year to year, the average relative forecast errors were relatively large, often amounted to more than 10%, and for the main resultant category, namely income – almost 50%. Prediction of yield or selling prices of individual agricultural products for the year ahead is virtually impossible. Changing weather conditions may cause that the results will be dramatically different than expected. In addition,

the piling up of the following errors results in large differences in the categories of income.

If, however, the predicted values were compared to the averaged data for several years, at least partially the impact of unique situations and those different from the norm was eliminated. Average relative prediction errors obtained in this way are much smaller, e.g. the actual cost of mineral fertilizers for winter wheat differed from the values obtained in the projection by only 1.5%. Of course, not all errors were so low, in addition after the accumulation they caused that the expected level of income differed from the real one to a much greater extent.

The evaluation of the model was not a determinant of its usefulness for analyses. Such assessment is required primarily for short-term forecasts, which are often used to make operational decisions. The constructed projection model was used to investigate the trends and based on that to determine the expected directions of changes in the medium term. An attempt to determine precisely the yield or the selling price of agricultural products for the upcoming years is rather doomed to failure. However, by taking some assumptions we can determine the directions in which the investigated phenomena follow. Practical considerations also favour the use of the presented projection method, e.g. the availability of data, a relatively simple calculation and easy interpretation of results.

IV. Projection for 2014 of production costs and economic performance of selected agricultural products

The specificity of agriculture, which consists of working with living organisms causes that forecasting in this area is burdened with many problems that are not found in other sectors. Decisions taken by farmers are always associated with some risk as to the results. This is due to the differences, when decisions are made, and when there are consequences of those decisions.

In general it can be stated that the importance of forecasting in achieving the objectives results mainly from the uncertainty of the future, as well as from the passage of time between the decision and its implementation and effect. With specific knowledge and proper assessment of the development of various economic phenomena and processes one can take advantage of emerging opportunities, but also reduce the risk of action. Although many people distrust forecasting we cannot escape from it. Zeliaś[27] point out that *„…anticipation of tomorrow is essential for being able to work today".* He also states: *"We must try to predict the course of future events the best we can, realizing the weakness of methods we have now".*

Predicting changes in the economic situation of the products produced on the farm is hard, but can be very helpful in making many decisions. Forecasts play an important information and warning role.

In chapter IV, in view of the data from previous years, we present the results of the projection for 2014 regarding profitability of growing **winter wheat, winter rye, spring barley, winter rapeseed and sugar beet** on average in the sample farms and in groups with different levels of direct costs per 1 ha in the above-mentioned growing activities. In addition, the tabular appendix contains tables 1-6 presenting detailed results of the calculations.

It should be noted, however, that constructed projections, which are based on the time series, do not take into account the possible occurrence of changes in various environmental factors that can significantly alter the expected values.

Cereal crops are highly volatile, it results from changes in the sown area and yield fluctuations. Sown area of cereals in Poland in recent years ranged from 8.3 to 8.8 million hectares. However, in 2010, it fell to 7.6 million hectares (according to PSR 2010 [28]). Reasons for this are several, mainly the total sown area decreased as compared to the results of PSR 2002 by 1.8%. Also the structure of the

[27] A. Zeliaś, *Przyczynek do dyskusji o trudnych problemach prognozowania ekonomicznego*, Zeszyty Naukowe Uniwersytetu Szczecińskiego No 394, Prace Katedry Ekonometrii i Statystyki No 15, Szczecin 2005.
[28] *Raport z wyników,* Powszechny Spis Rolny 2010, CSO, Warszawa 2011.

crop changed, i.e. the area for cereals decreased and the area for industrial crops and fodder increased. In 2011, the total area for cereals amounted to more than 7.8 million ha and compared to 2010 increased by 2.2%[29].

In recent years, there has been also the changes in the structure of cereal crops – the share of more fertile cereals increased and decreased for less fertile cereals. These trends have a positive impact on the harvest. The main source of growth in grain production will be the improved yield. Yields of wheat can increase relatively quickly (1.4% per year), just like yields of barley (1.2% annually) and maize (about 1.6% per year), while the slowest increase can be observed in the case of rye (0.7% per year). As a result of these trends, the seed production in Poland can be increased by 1.3% per year.[30]

Changes in the production of grain and its use affect its price. The factor that caused the weakening of these relationships was the opening of the market after the Polish accession to the EU. Grain prices in the country are strongly linked to those in the EU, although the level of domestic prices is also affected by the situation on the world markets. Any trade barriers lead to increase in prices. An example would be the 2007/2008 season and the introduction by the major manufacturers (including Russia, Ukraine, Argentina, China) restrictions on export. It should be noted that in the 2007/2008 season, cereal prices in Poland, despite satisfactory harvest, reached a very high level.

In the season 2011/2012, despite record global harvest estimated at 1 billion 838 million tonnes, there is an excess of demand over supply. In the EU-27 cereal harvest in 2011 was estimated at 285 million tonnes, i.e. 3.5% higher than in 2010. However, due to the smaller stocks, the pressure of demand can be felt on the EU market. This situation affects the high level of prices among others in Poland. Until the new harvest, the information on its estimated level in major manufacturers, including the EU will have a large impact on price level.[31]

In Poland, according to CSO data, the stock of cereals (including maize, millet and buckwheat) in 2011 reached the level of 26.8 million tonnes, i.e. 1.7% lower than a year earlier. In 2012 we should expect a further reduction in crop yield due to frost. The Ministry of Agriculture estimates that the losses occurred in the area of 1.4 million hectares, so it was necessary to resow plantation in

[29] *Wyniki produkcji roślinnej w 2011 r.*, CSO, Warsaw 2012.
[30] S. Stańko, *Perspektywy produkcji rolniczej w Polsce w kontekście podaży i popytu w Europie*, Zagadnienia Doradztwa Rolniczego No 2, Poznań 2009.
[31] *W 2012 r. ceny zbóż będą na wysokim poziomie*; http://www.farmer.pl/agroskop/analizy-i-komentarze/w-2012-r-ceny-zboz-beda-na-wysokim-poziomie,35927.html [access: May 2012].

spring. However, spring cereals give lower yields than winter cereals, and therefore one can expect production to decrease by 5-10% as compared to the previous year and the long-term average.[32]

The first forecast for world cereal harvest for the season 2012/2013 is good and price forecasts indicate a decline in cereal prices. It should be noted, however, that in the last few seasons the cereal market has become less predictable. The determinants for prices on the world market, despite the differences at the domestic markets, are the stock prices of cereals, including primarily from the U.S. market. Stock exchanges in Chicago, Kansas and Minneapolis determine grain price trends which to a lesser or greater degree have influence on the prices in other countries. The less the market is regulated by internal agricultural and trade policy instruments, the greater the impact. Poland, as a Member State of the Union, departing from intervention on cereal market, is largely linked to the world market. In the last few seasons, the level of cereal prices was partially artificially "jacked up" through speculation on stock exchanges and in derivatives trading (e.g. oil prices) on off-market.

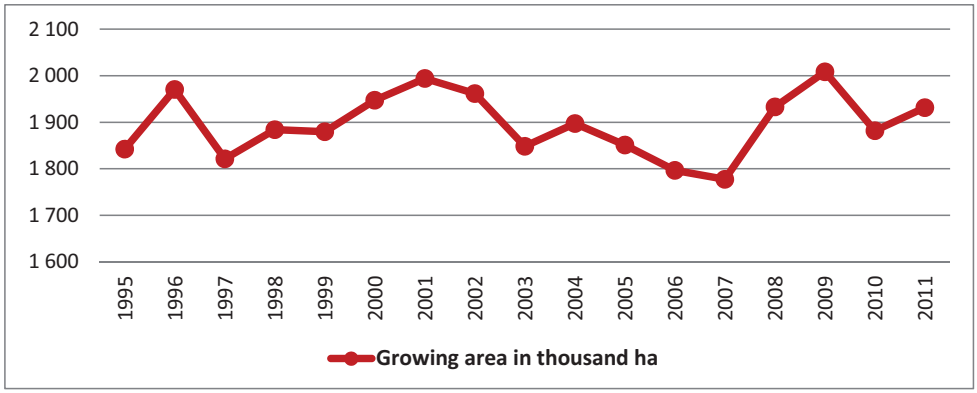
The rapidly growing demand for cereals, largely generated by the biofuel industry, becomes increasingly important for the pricing. Profitability of biofuel production depends on the pricing of oil, so rising prices of conventional fuels are a factor which "drives" the production of bioethanol, causing contraction of the stock of feed cereals, including primarily maize. Another factor on the demand side is the increasing demand for feed cereal recorded in south-east Asia. A lot also depends on the "availability" of grain on the market, related to the amount of harvest in countries belonging to the key producers and exporters. Competition for markets is also one of the important factors affecting the prices of cereals.[33]

[32] *W 2012 r. ceny zbóż będą na wysokim poziomie*; http://www.farmer.pl/agroskop/analizy-i-komentarze/w-2012-r-ceny-zboz-beda-na-wysokim-poziomie,35927.html [access: May 2012].
[33] M. Kosewska, *Co nas czeka w sezonie 2012/13 na rynku zbóż?*, FAMMU/FAPA; http://ksow.pl/pl/ rynki-rolne/news/entry/2944-co-nas-czeka-w-sezonie-201213-na-rynku-zboz.html [access: May 2012].
Dobre perspektywy dla unijnego rynku zbóż w sezonie 2012/'13, FAMMU/FAPA; http://ksow.pl/ rynki-rolne/news/entry/2674-dobre-perspektywy-dla-unijnego-rynku-zboz-w-se.html [access: May 2012].

1. Winter wheat

According to CSO data, the area for cultivation of winter wheat fluctuated over the years. After years of downward trend (in fact since 2001) in 2008 and 2009 there has been a significant increase. On the other hand, there was a breakdown in 2010, but it was not as deep as in 2007. However, in the last year of the study, i.e. in 2011, the area sown with wheat grown again – figure IV.1.1. It should be added that in the last four years (2008-2011), despite fluctuations in the area for cultivation of wheat, its share in the total surface of cereals was similar – 23-25%.

Figure IV.1.1. Winter wheat growing area in the years 1995-2011, total in the country



Source: CSO data.

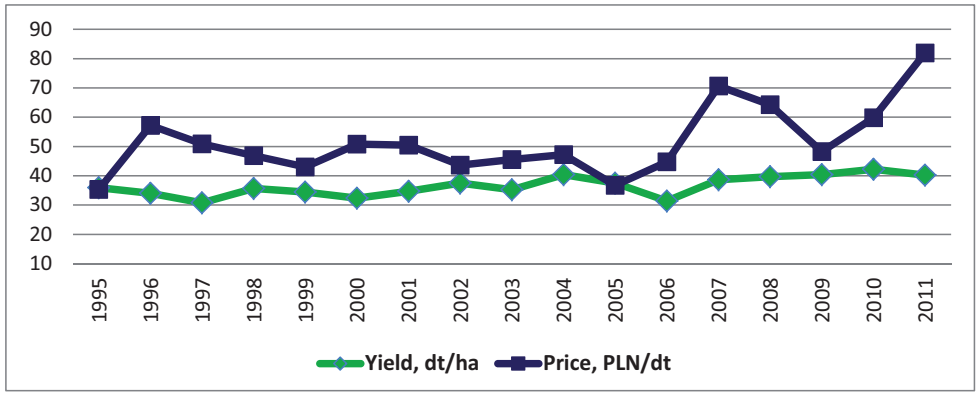
The growing area of wheat mainly depends on its price that shapes farmers' incomes. Low price and profitability of crops in a given year usually results in a reduction of sown area in the next period. Wheat is a plant competing for a position in the crop rotation with rapeseed cultivation, so the low profitability of wheat may encourage farmers to replace it with rapeseed.

Sales prices of wheat in Poland, before integration with the EU, were higher than in the EU. In 2000-2003, the average price in Poland was 120.2 EUR/t, while in Germany 109.8 EUR/t, in Czech Republic – 106.8 EUR/t, in Hungary – 103.4 EUR/t, and in Slovakia – 92 EUR/t. Since 2004, the level of prices and trends are similar to those in the EU[34].

[34] S. Stańko, *Zewnętrzne uwarunkowania rozwoju rolnictwa,* Roczniki Nauk Rolniczych, Series G, vol. 94, p. 2, Warsaw 2008.

Development of wheat prices in Poland in the last few years is shown in figure IV.1.2.

Figure IV.1.2. Winter wheat crop in individual farms and the selling price of grain in 1995-2011



Source: CSO data.

In Poland in 2010 and 2011, wheat prices rose rapidly, to a certain extent the cause could have been lower yields. According to the Central Statistical Office, in 2010 wheat harvest decreased in comparison to the previous year by 3.9%, and in 2011 – by 0.7%. The world wheat harvest in 2011/2012 was estimated by USDA at 683.3 million tonnes, i.e. 5.4% more as compared to the previous season. However, the July report estimates 665.3 million tonnes for the season 2012/2013, i.e. 2.6% less as compared to the previous season. However, experts from many of the leading analytical centres point out that the prices are not solely dependent on the balance sheet. They are influenced by other factors, including in particular the state of the world economy. The continuing uncertainty in the euro zone and in the whole Union, reports on the condition of the U.S. economy have and will have impact on financial markets and commodity exchanges.[35]

In the case of wheat, one of the drivers of growth in grain prices is the economic strengthening of developing countries, and thus more demand for grain. The impetus for higher prices is particularly large where the increase in demand comes from the most populous countries in the world – with China and India in the lead. China is expected to become a net importer of wheat as early as in 2011/2012 season. It is estimated that this will make a decisive impact on the level of global food prices[36].

[35] *Światowy rynek zbóż, oleistych i komponentów paszowych*, Foreign Agricultural Markets Monitoring Unit. FAPA. Version under review 2011.
[36] Ł. Wróbel, *Import Chin przewyższył eksport*, 2010; http://www.firma.egospodarka.pl/51705, Import-Chin-przewyzszyl-eksport,2,11,1.html [access: September 2011].

Another factor that should be considered is the creation and development of the market of biofuels, which are also produced from wheat. In connection with the programs for financing the sector by the governments of many developed countries, one can expect further increase in demand by biofuel producers. Wheat grain is also a valuable feed, but due to the relatively high price and use for bread, it is of limited use in animal nutrition. Considering the factors which differentiate the wheat prices level, one should also taken into account the stock prices of cereals and trends in the currency market. These conditions indicate that the formation of the wheat prices is a complex and multifactorial process. Forecast for the next few years is extremely difficult to make, and also taking into account the biological nature of production and the variability of weather conditions – it is almost always burdened with error.

As for the level of wheat crop, for several years we have seen a slight increase (figure IV.1.2). The direction of change is promising and is an evidence of changes in the technology of cultivation and farmers' efforts in this regard. The results show that, in practice, wheat yields constitute only half of what is obtained in the experiments. The dynamics of yield potential of varieties grown in Poland and share of genetic progress in the growth of crops in recent years were similar to those in other European countries. Progress in growing, however, is often coupled with the intensive use of other means of production. As a result, the potential for yielding of new more yielding varieties in conditions of low level of agricultural technology cannot be fully utilized.[37]

This is not possible because of other factors. According to Krasowicz[38], compared to Western European countries, Poland has clearly inferior soil and less favourable climate for the cultivation of cereals. The level of these factors is lower by 20-25 percent compared to their level in Belgium, France, Germany and the Netherlands. In assessing the use of agri-environment production capacity of wheat, Poland is sometimes positioned on a par with Denmark, i.e. at the yield level of about 7 tons per 1 ha (assessment carried out for the years 2003-2007).

Research conducted in the AGROKOSZTY system indicates that in recent years the income situation of winter wheat was favourable (table 2). In the studied set of farms, estimated for 2011, the gross margin obtained from 1 ha, without the support of subsidies amounted to PLN 2,467, and income to PLN 1,164. However,

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M. Trętowska, *Jak zarobić na pszenicy*?, 2009; http://excluzive.pl/finanse/majatek/jak-zarobic-na-pszenicy/8119 [access: September 2011].

[37] E. Arseniuk, T. Oleksiak, *Postęp w hodowli głównych roślin wprawnych w Polsce i możliwości jego wykorzystania do 2010 roku. Studia i Raporty IUNG-PIB*, No. 14, Puławy 2009.

[38] *Perspektywy produkcji zbóż*, 2010; http://www.kpodr.pl/index.php/produkcja-rolinna/39-zboa/154-perspektywy-produkcji-zbo [access: September 2011].

after taking into account subsidies (complementary area payment + single area payment) the income amounted to PLN 1,916. This means that for each PLN 1 of the income without subsidies farmers received support in the amount of PLN 0.65. The share of subsidies in the income is 39.3%.

Wheat production was also cost-effective – the measure was the profitability index, which stood at 144.4%. Its height is determined by factors dependent on the agricultural producer and the external forces over which the farmer has no control. Profitability can be shaped by factors that affect the value of production (yield, price), but also by the level and structure of costs, which reflect the level of outlays and their prices. The ratio of the value of one unit of production and the sum of the values of units of individual outlays determines the profitability of production. Numerator and denominator of this operation are expressed in current prices and it is through these prices (market in nature, and therefore variable) that the influence of external factors independent of the manufacturer on his economic performance is expressed.[39]

The costs are therefore an important element of calculating profitability, and knowledge of their component elements and associated relationships, both within themselves and between the area of revenue and income, can be useful in decision-making by the manufacturer.

For a more in-depth analysis of this issue, the farms of the study sample were grouped according to direct costs incurred for 1 ha of wheat. The results are shown in the quartiles, but in order to show the scale of differences, they are presented only for the two boundary quartiles, i.e.

- I quartile – 25% of farms with the lower level of direct costs,
- IV quartile – 25% of farms with the higher level of direct costs.

Taking into account the yield of winter wheat and grain sales price, the lower values were recorded on farms from the first quartile, respectively 32.5 and 4.7%. Furthermore, in the case of farms from the I quartile, as compared to the IV quartile of direct costs, the following were recorded per 1 ha (table 2):

- value of production – lower by 35.5% (by PLN 1,548),
- direct costs – lower by 58.9% (by PLN 1,020),
- total costs – lower by 46.2% (by PLN 1,440),
- gross margin without subsidies – lower by 20.1% (by PLN 529),
- income from operations without subsidies – lower by 8.6% (by PLN 108),
- indicator of profitability – higher by 28 percentage points.

[39] A. Kowalski, W. Rembisz, *Rynek rolny i interwencjonizm a efektywność i sprawiedliwość społeczna*, IAFE-NRI, Warsaw 2005.

The results show that the effectiveness of production of wheat on farms from the I quartile was higher than in the IV quartile, while the revenue without subsidies available to farmers was lower, although the difference in value was not large – PLN 108/ha.

In this context, it should be clarified that the issue directly related to the profitability is the intensity, but also the volume of production on the farm. Higher yields are generally associated with higher costs, but the key is that the increase in costs was less than or at most equal to the increase in the value of production. It is important, therefore, at what level of yield the marginal cost is equal to the price. Clarification of this issue is of fundamental importance in the context of answering to the question at what yield the production is the most profitable, defined as the ratio and the difference between the value of production and costs.

Referring to the case of winter wheat it is estimated that in case of farms that were in the first quartile, the intensity of the production was too low to generate the expected amount of income (i.e. equal to or higher than in the fourth quartile farms). The difference in outlays, which are expressed in value by the level of direct costs, was high – PLN 1,020/ha. As a result, the yield of wheat in groups of farms – to the detriment of the I quartile – differed by as much as 22 dt. It can be assumed that if the difference was smaller, the level of profitability would be significantly larger.

Estimated data for 2011 were used to construct a projection (based on time series) of production and economic results of winter wheat in 2014. The need of forecasting is related to the fact that people when planning actions and making decisions tend to prepare for various eventualities. Information on prices and the incomes of future production is useful to farmers as well as to many other individuals.

The dynamics of the expected changes in production and selected items of costs and revenues, in 2014 as compared to the input data, which is the base year 2011, are presented in table IV.1.1.

Table IV.1.1. Dynamics of selected data describing the profitability of cultivation of 1 ha of winter wheat in 2014 compared to the base year 2011* in groups of farms

Specification	Average in surveyed farms	Farm groups-quartiles of direct costs	
		Bottom (I)	Top (IV)
Yield	103.5		
Grain sale price	105.7		
Value of production (income from sales)	109.4	109.4	109.6
Direct costs	**111.0**	**111.8**	**110.8**
Gross margin without subsidies	108.4	108.6	108.7
Total costs (direct and indirect)	112.1	112.0	112.1
Income from business without subsidies	**103.2**	**105.7**	**103.2**
Income from operations (with subsidies)	**106.9**	**108.6**	**106.8**
Profitability index	97.6	97.7	97.7
Operating income without subsidies / 1 dt of grain	99.7	102.1	99.7
Total costs for PLN 1 of income from operations without subsidies	108.7	106.0	108.6
Subsidies for PLN 1 of income from operations without subsidies	109.3	107.1	109.2

* Estimation for 2011, data for years 2006-2011 were adjusted by rates of changes determined based on the trend function and averaged.

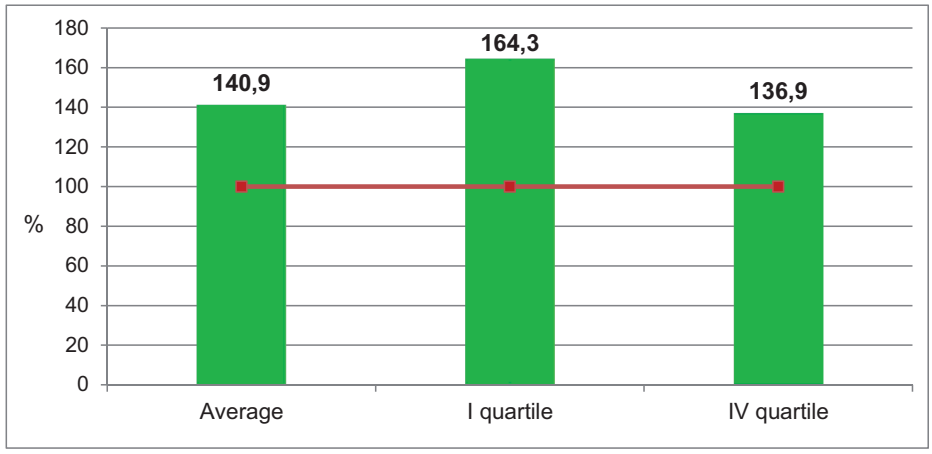
The results of the projection indicate an upward trend in the yield of winter wheat, close to 1.2% per annum. At this rate, in 2014 the crop will be 3.5% higher compared to 2011. It is expected that the price of grain will rise at the rate of 1.9-1.8% per annum and in 2014 will increase by 5.7%. This rate of growth in yields and grain prices will allow for obtaining revenue in 2014 increased by 9.4%. In case of farms in the top quartile of direct costs it will increase by 9.6%, due to the increase in the price of straw sold in these farms[40].

The calculation results indicate a much stronger – in the perspective of 2014 – increase of costs than of the value of production of wheat (table IV.1.1). The expected increase in direct costs may reach on average 11.0% in the set, while in the farms of the I quartile – 11.8%, and of the IV quartile – 10.8%. The annual rate of growth is expected to be between 3.9 and 3.3%. The cost of mineral fertilizers will grow the fastest (4.8-4.3%), the second position is occupied by the cost of seed (4.4-4.0%) – Table 1.

[40] According to the methodology, the value of production of crop production activity is the sum of the main products and by-products traded in the market. In the case of the main product, it is assumed that the whole set is traded on the market, whereas in case of the by-product the calculations only recognizes its actual amount.

In the case of total costs (direct and indirect combined), it is expected that the average growth will not exceed 4% per annum. As a result, in 2014 – compared to 2011 – they will be higher by 12.1%, and in case of farms farms with a lower level of direct costs (I quartile) – by 12.0%. This means that the growth in total costs will be stronger than that of the production value, average of 2.7 percentage points in the set, and in the following groups of farms by 2.6 and 2.5 percentage points. As a result, the index of profitability of wheat production (the ratio in percentage of the value of production to the total costs) will decrease by more than 2 percentage points; the level at which it can be in 2014 is shown in the figure IV.1.3.

Figure IV.1.3. The projection of the profitability of winter wheat cultivation in 2014 as a ratio, on average in surveyed farms and in groups – I and IV quartile of direct costs



In light of the expected changes in production, price and costs of production of winter wheat, it is interesting to know the direction and dynamics of changes in the next few years in the level of income. One should also ask whether the assumed increase in costs will have the same impact on the economic performance of wheat in the studied groups of farms, or perhaps differences in the cost structure and the different growth rate of the individual components of costs will result in changes *in plus* or perhaps *in minus*. The projection we made should attempt to answer these questions.

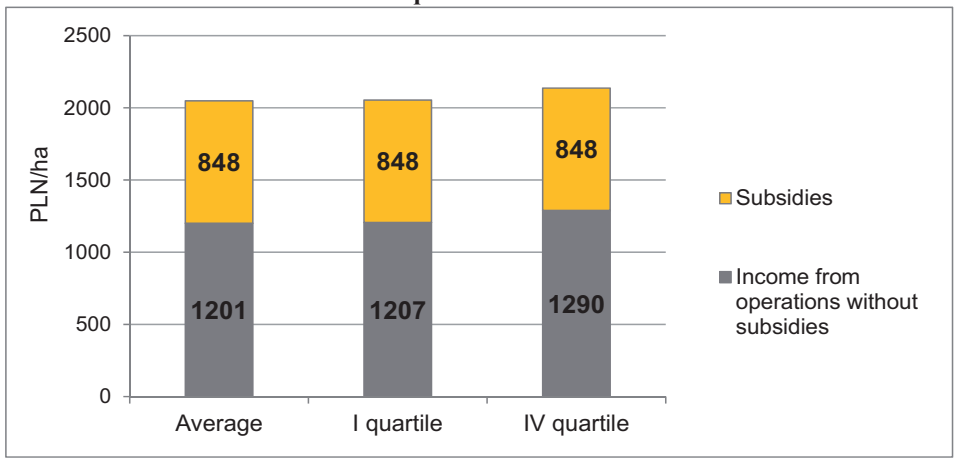
The next page shows the direction of changes in the costs of production and the income from operations without subsidies, estimated for 2014 – in relation to the base year 2011 – per 1 ha of crop[41]:

[41] The expected direction of change (increase or decrease) and the strength of this phenomenon is shown as a percentage. Changes are also expressed in terms of value, but the numbers should not be taken as absolute values, they are to show the scale of change in view of the percentage change, if the bench-

- **on average in the studied set of farms:**
  - increase in direct costs – by 11.0% (by PLN 145),
  - increase in total costs – by 12.1% (by PLN 316),
  - increase in income from operations without subsidies – by 3.2% (by PLN 37);
- **in farms from the I quartile of direct costs:**
  - increase in direct costs – by 11.8% (by PLN 84),
  - increase in total costs – by 12.0% (by PLN 200),
  - increase in income from operations without subsidies – by 5.7% (by PLN 65);
- **in farms from the IV quartile of direct costs:**
  - increase in direct costs – by 10.8% (by PLN 186),
  - increase in total costs – by 12.1% (by PLN 378),
  - increase in income from operations without subsidies – by 3.2% (by PLN 40).

The applied method of projection shows that by 2014, in case of farms from the I quartile of direct costs, the direction and the dynamics of change in the analyzed variables will be much more favourable than in the sample from the IV quartile (table IV.1.1.). This is evidenced by a stronger (by 2.5 percentage points) income growth of operations without subsidies from 1 ha of crops and the expected growth of income per 1 dt of grain – by 2.1%, while in the set of the IV quartile it is expected to decline by 0.3%. The growth dynamics of the costs of producing PLN 1 of income from operations without subsidies will also be lower – by 2.6 percentage points.

Figure IV.1.4. Projection of income from operations without subsidies for winter wheat for 2014 and the level of subsidies, on average in surveyed farms and in groups – I and IV quartile of direct costs



marks are different values – in the present case the results of the farms from the I and IV quartile of direct costs. It should also be noted that at lower or higher reference base – and the same percentage rate of change, and a similar cost structure – the change of value will also be lower or higher.

Comparing the income level from operations without subsidies in the years of research and in case of farms from the lower (I) and upper (IV) quartiles of direct costs, it should be noted that in 2014 the difference against the I quartile decreased by about 23% – amounts to PLN 83/ha, while in base year 2011 it was PLN 108 (see table 2).

Figure IV.1.4 shows the level of income from operations without subsidies on 1 ha of winter wheat in the studied set of farms and in separate groups, according to the projection for 2014. Differences in the amount of income are not large, in contrast to the incurred costs. The difference in the level of direct costs – in favour of farms from the I quartile – amounted to PLN 1,122/ha, i.e. 58.5%, while in the case of total costs – PLN 1,618/ha, i.e. 46.3% (table 2).

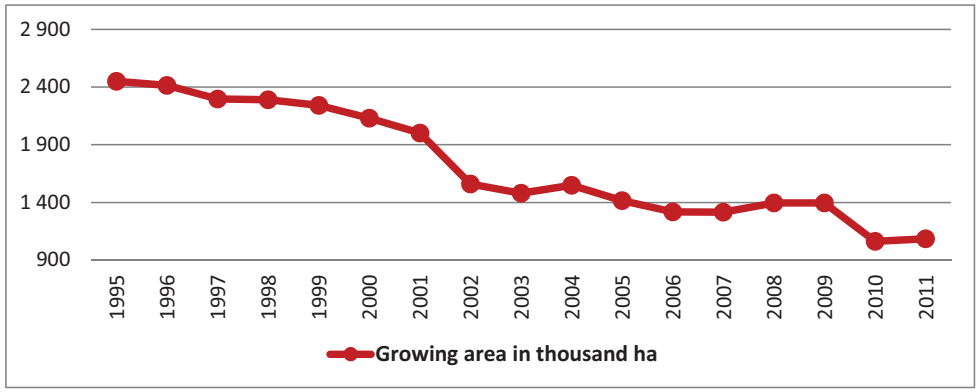
The analysis of these data suggests a conclusion that farmers who want to obtain income from agricultural production in the long-term should seek to reduce the cost of production, of course, while maintaining a certain level of quality. According to the research the costs play an important role in the production process, their impact on the final financial performance (profit) is significant and what is important they are a category shaped within a farm, and so dependent on it. This forces the acquisition of information on costs and, above all, forces measures to manage costs on farms. Cost management is a process that actively shapes the efficiency, because the costs have a significant impact on the effect-effort relation, while cost reduction is a simple process which is a reaction to changes in the environment.

In conclusion it should be noted that in the next few years, farmers will surely not lose on winter wheat. Despite the strong increase in production costs one can expect income higher than in 2011 by nearly 6% (with an average cultivation area of about 13 ha). Subsidies will of course provide additional support. One should, however, expect income disparities between farms, the impact factor which is evaluated as the most powerful are the production costs, this is evidenced by their high rate of growth. Expected production growth in 2014 is weaker than increase in costs, which may result in lower production efficiency. It is estimated that the rational use of the means of production, taking into account both the quantity but also the time of their introduction, as well as the attention to the appropriate level of agricultural technology, may result in more favourable economic effects as compared to highly intensive technologies, which are characterized by high expenditures.

2. Winter rye

Rye prevailed for centuries among the cereals grown in Poland. However, for decades the area for the cultivation of this cereal is steadily decreasing. In the 1970s, rye comprised 40% of the total sown area of cereals, in the late 1980s – 36%, in 1999 27% and in 2011 only 15%.[42] Figure IV.2.1 presents the changes that have occurred over the last 17 years in the area of rye cultivation in Poland.

Figure IV.2.1. Winter rye growing area in the years 1995-2011, total in the country



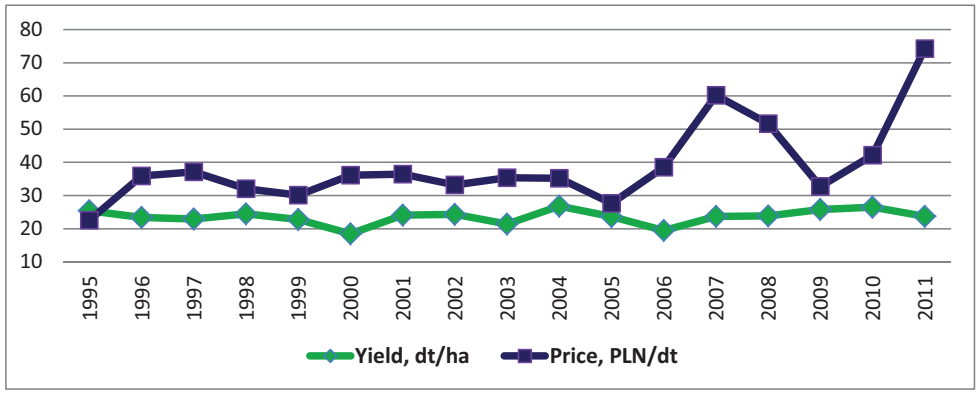
Source: CSO data.

The size of the area intended for the cultivation of wheat is influenced by the fact that it is not a very profitable business, as evidenced by the results of previous studies. The decrease in the area was related also to the low price of grain and the difficulties with selling it. This is the result of a much less value in use of rye grain than e.g. wheat grain. In addition, continued development of cultivation techniques, as well as the possibility of increasing inputs (e.g. fertilizer) allows sowing of wheat on less fertile soils, which were originally intended for the cultivation of rye.

Rye prices after the Polish accession to the European Union are shaped by market forces. In 2000-2003, the price in Poland was 88.9 EUR/t, while already in 2004-2005 only 73.2 EUR/t. In the EU, a ton of rye cost in those years respectively 97.2 and 91 EUR[43]. Figure IV.2.2 shows changes in rye prices in Poland in 1995-2011.

[42] W. Budzyński, *Czynniki ograniczające plonowanie żyta*, University of Warmia and Mazury in Olsztyn; http://www.zboza.iung.pulawy.pl/czyn.htm [access: May 2012]
[43] S. Stańko, *Wpływ integracji z UE na warunki prowadzenia działalności gospodarczej w rolnictwie, obrocie i przetwórstwie rolno-spożywczym*, PW Report No 90, Warsaw 2008.

Figure IV.2.2. Winter rye crop in individual farms and the selling price of grain in 1995-2011



Source: CSO data.

Before the Polish accession to the European Union rye prices were relatively stable at PLN 30-40/dt. The period 2006-2007 was characterized by a rapid increase in prices, also for other cereals. In 2011, there were again record prices of rye on the Polish market – figure IV.2.2. This was the result of decrease in production and low quality of harvested grain. In connection with the reduction of stocks, it is anticipated that in the season 2012/2013 rye prices will continue to remain at a high level[44].

The yield of rye over the last 17 years did not show significant variations. Its amount ranged between 20 and 30 dt/ha – figure IV.2.2. No improvement in yielding of rye results from cultivation on poor soils, as well as from the lack of development of cultivation technology. Rye due to low agrotechnical and soil demands can be grown on poor soils which cover about one third of the total area of agricultural land in Poland. That is why farmers, in order to bring the weaker soils into cultivation, sow rye out of necessity, rather than choice. Farmers focus their attention on other kinds of cereals (including wheat), which leads to more intensive cultivation of these plants. Countries engaged in intense rye cultivation are Germany and the United Kingdom, where the area sown is more than 3-fold lower than in Poland, but the yield is twice as high, respectively 50 dt/ha and 70 dt/ha[45]. An opportunity to improve the income situation of rye cultivation is the growing popularity of grain as feedstock digester for biogas plants. This is due to the fact that rye contains a large amount of energy quickly

[44] http://www.portalspozywczy.pl/zboza-oleiste/wiadomosci/ceny-zboz-w-polsce-w-tym-sezonie bedanizsze-niz-w-dwoch-poprzednich-latach,68850.html [access: June 2012]
[45] *Rolnictwo polskie na tle rolnictwa Unii Europejskiej*, SAEPR team in collaboration with FAPA. 2009; http://www.fapa.com.pl/gfx/saepr/Polskie%20rolnictwo%20na%20tle%20UE-raport%2009_08.pdf [access: June 2012]

available to the bacteria and in combination with maize can significantly increase the yield of gas[46].

Researches carried out for the purposes of this study were carried out on the basis of data from a selected group of farms growing winter rye. The results indicate that rye allowed for obtaining revenue. It is estimated that in the base year 2011 the gross margin from 1 ha was PLN 1,033, and income without subsidies 332 PLN/ha. Support for farmers in the form of subsidies is essential for the cultivation of this cereal. Average income in the years in question stood at PLN 1,084 PLN/ha, subsidies constituted up to 69.4%. The profitability index of winter rye was 123.7% – table 3.

The study was also designed to show the impact of production costs on the profitability of crops of winter rye. To accurately depict this phenomenon, a group of farms growing wheat was grouped into quartiles of direct costs. The scale of diversity is best shown by two extremes: I quartile shows 25% of the lower results, and IV – 25% of the upper results.

Calculations show that on average in 2011 farms qualified for the I quartile, as compared to the IV quartile sample, reached a much lower yield (by 31.0%), which decided the lower value of production. Despite this, gross margin, income from operations, as well as the profitability index stood at a much higher level.

In base year 2011, in the sample of farms from the I quartile, as compared to the fourth quartile of direct costs, per 1 ha the following were recorded (table 3):

- value of production – lower by 30.0% (by PLN 630),
- direct costs – lower by 70.7% (by PLN 748),
- total costs – lower by 56.6% (by PLN 1,089),
- gross margin without subsidies – higher by 11.4% (by PLN 119),
- income from operations without subsidies – 3.6-fold higher (by PLN 458),
- indicator of profitability – higher by 66.7 percentage points.

What will be the indicator of profitability and revenue in the near future? This question should be answered by projection for 2014, which was carried out on the basis of the average results from the years 2006-2011.

The calculations in the table IV.2.1 show the changes of data forecasted for 2014 with respect to input data, on average in the set of studied farms and in separate groups. A disturbing phenomenon is the rapid rate of growth of production costs in comparison with the rate of increase in the price of grain, which conditions the weaker growth of the value of production.

[46] http://ioze.pl/energetyka-biogazowa/zyto-hybrydowe-jako-substrat-do-produkcji-biogazu [access: June 2012]

Table IV.2.1. Dynamics of selected data describing the profitability of cultivation of 1 ha of winter rye in 2014 compared to the base year 2011* in groups of farms

Specification	Average in surveyed farms	Farm groups-quartiles of direct costs	
		Bottom (I)	Top (IV)
Yield	100.9		
Grain sale price	108.7		
Value of production (income from sales)	109.6	110.0	109.9
Direct costs	**112.7**	**113.9**	**112.3**
Gross margin without subsidies	107.6	108.9	107.5
Total costs (direct and indirect)	112.9	113.2	112.8
Income from business without subsidies	**96.0**	**105.8**	**78.3**
Income from operations (with subsidies)	**107.6**	**109.3**	**106.5**
Profitability index	97.1	97.2	97.5
Operating income without subsidies / 1 dt of grain	95.1	104.8	77.6
Total costs for PLN 1 of income from operations without subsidies	117.6	107.0	144.0
Subsidies for PLN 1 of income from operations without subsidies	117.5	106.1	144.3

* Estimation for 2011, data for years 2006-2011 were adjusted by rates of changes determined based on the trend function and averaged.

According to the projections for the next few years there will be no significant increase in the yield of winter rye – only 0.9% over three years, i.e. until 2014. Price of grain should demonstrate much more faster growth, which in 2014 is estimated at 8.7%. This situation will affect the growth of the value of production, at about 3.2-3.0% per year for the period of three years, i.e. in 2014, on average in a set it will reach a level of about 9.6% higher as compared to the estimated level for 2011 – table IV.2.1.

Projection envisages a substantial increase in the cost of production means. The fastest growth is expected for the cost of seed, which can be 5.0-4.5% per year and consequently in 2014, as compared to the input data, the cost will be higher by 14.9%. A similar increase (by 14.2%) is envisaged also for the cost of mineral fertilizers. In 2014, with respect to the input data, direct costs of rye crop may be higher: on average by 12.7% in the study population, in the lower quartile of direct costs by 13.9%, and 12.3% in the upper quartile. The increase in total cost of cultivation of 1 ha of winter rye will be 4.2-4.0% per year and in 2014, as compared to the input data, on average will be higher by 12.9% in the surveyed farms, in a sample from the lower quartile of direct costs by 13.2%, and in the upper quartile – by 12.8%.

It can be concluded from the projection results that in 2014, as compared to 2011, there will be a drop in profitability of growing rye – by about 3 points percent. This will be primarily due to weaker growth dynamics of the value of production than the cost of cultivation. The possible level of the cost-effectiveness index (the ratio of production to total costs in percentage) is shown in figure IV.2.3.

Figure IV.2.3. Projection of profitability of cultivation of winter rye in 2014 as a ratio, on average in surveyed farms and in groups – I and IV quartile of direct costs

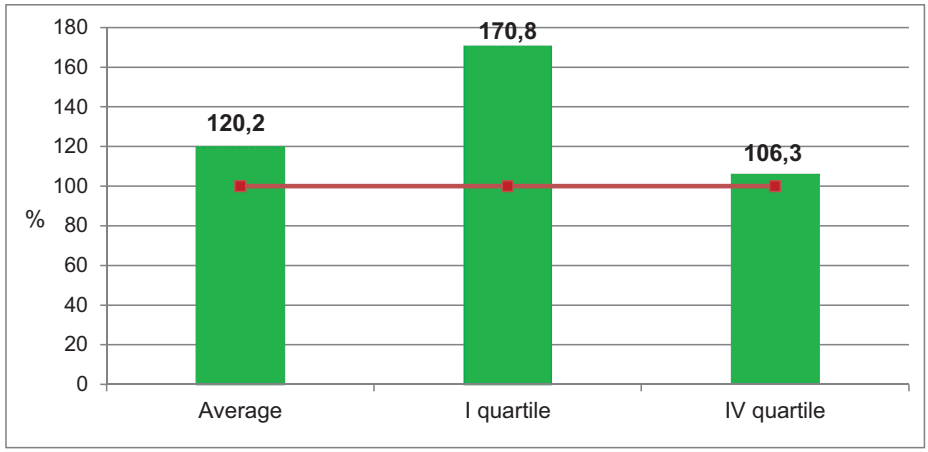


Figure IV.2.3 shows that in 2014 the profitability of rye cultivation will be the highest in case of farms from the I quartile of direct costs. Profitability index reached the level 50.6 percentage points higher than the average in the surveyed farms and 64.5 percentage points higher as compared to farms from the IV quartile of direct costs.

Below are the direction of changes in the costs of production and the income from operations without subsidies, estimated for 2014 – in relation to the base year 2011 – per 1 ha of crop[47]:

- **on average in the studied set of farms:**
  - increase in direct costs – by 12.7% (by PLN 89),
  - increase in total costs – by 12.0% (by PLN 180),

[47] The expected direction of change (increase or decrease) and the strength of this phenomenon is shown as a percentage. Changes are also expressed in terms of value, but the numbers should not be taken as absolute values, they are to show the scale of change in view of the percentage change, if the benchmarks are different values – in the present case the results of the farms from the I and IV quartile of direct costs. It should also be noted that at lower or higher reference base – and the same percentage rate of change, and a similar cost structure – the change of value will be lower or higher.

- decrease in income from operations without subsidies per 1 ha of crop – by 4.0% (by PLN 13);

♦ **in farms from the I quartile of direct costs:**
- increase in direct costs – by 13.9% (by PLN 43),
- increase in total costs – by 13.2% (by PLN 110),
- decrease in income from operations without subsidies per 1 ha of crop – by 5.8% (by PLN 37);

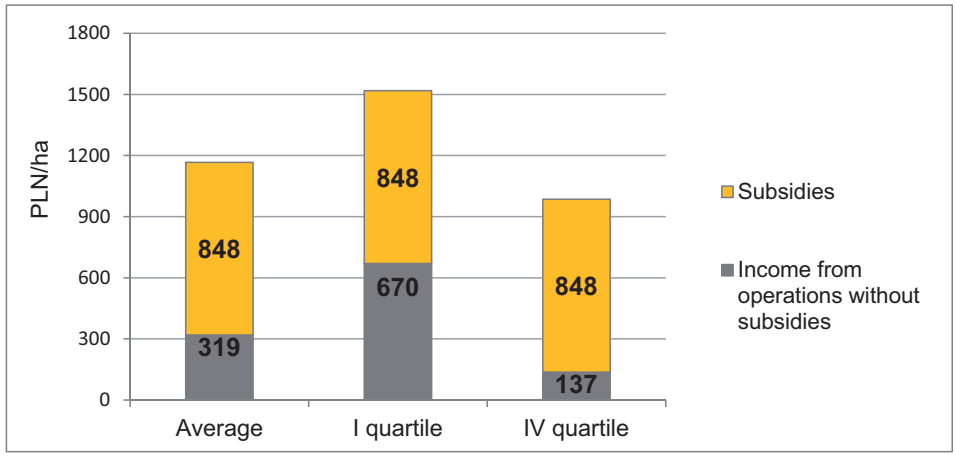
♦ **in farms from the IV quartile of direct costs:**
- increase in direct costs – by 12.3% (by PLN 130),
- increase in total costs – by 12.8% (by PLN 246),
- decrease in income from operations without subsidies per 1 ha of crop – by 21.7% (by PLN 38).

The study shows that in 2014 – as in 2011 – farms with lower levels of direct costs incurred in the cultivation of winter rye (I quartile) will be in the best income situation. Income derived from operations without subsidies will be 4.9-fold higher than in the IV quartile. However, in case of farms with a high level of direct costs (IV quartile), despite much better production results in 2014 (compared to 2011), one can expect a decline in income from operations without subsidies (by 21.7%). It will be a consequence of the rapid increase in production costs as compared to the price of rye and of stagnation in rye yielding.

It is estimated that the stagnation of yields expected for 2012-2014 will cause an annual average increase in the cost of production of 1 dt of grain within 3.9-3.7%. The cost of PLN 1 of income from operations without subsidies in 2014, on average in the studied group of farms will be higher by 17.6%, in a sample from the first quartile of direct costs by 7.0%, and from IV quartile – by 44.0%.

Figure IV.2.4. shows the level of income from operations without subsidies and the impact of subsidies on the results in separate groups of farms, according to the projections for 2014. It is expected that in 2014, just as in 2011, subsidies for farmers who cultivate rye will be of great importance. On average in the studied population of farms, their share in the income from operations can be as high as 72.7%.

Figure IV.2.4. Projection of income from operations without subsidies for winter rye for 2014 and the level of subsidies, on average in surveyed farms and in groups – I and IV quartile of direct costs



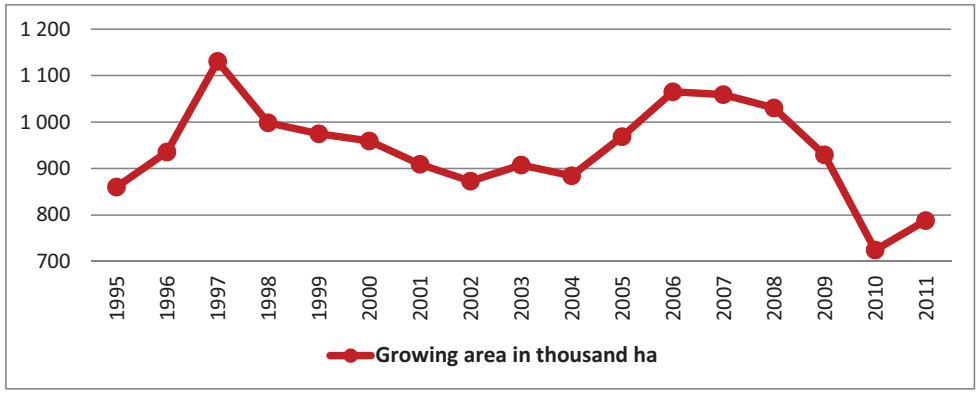
One can assume that in 2014 the production of winter rye will generate income, but its level will be relatively low. A disturbing phenomenon is the expected decline in economic efficiency of production. Profitability index will decrease in the surveyed farms on average by 2.9 percentage points in relation to the level in 2011. The cause of this decline will be faster increase in costs compared to the production value.

Projection for 2014 foresees a decline in income from operations without subsidies on average in the studied farms by 4.0%, and in the sample from the IV quartile of direct costs by 21.7%. A positive exception will be farms from the I quartile in which, despite a much lower yield, the income without subsidies may be higher by 5.8%. This is related to the inputs of means of production, and therefore the amount of the costs, their structure and dynamics of changes in the various components of costs. It should be noted that the area of rye cultivation in these farms was 6.87 ha and was about 8 hectares less than in the IV quartile. It can be assumed that due to the smaller area of cultivation, farmers apply agrotechnical approach with more care, while the means of production were used more rationally. It is worth noting that in 2014, as in previous years, subsidies will have a significant impact on the amount of income from operations. It will be particularly hard for farmers from farms in the IV quartile, as the income without subsidies derived from rye crop may fall below the level in 2011. Subsidies will compensate for the decline and provide income from operations (including subsidies) by 6.5% higher than in the base year, i.e. 2011.

3. Spring barley

According to the CSO the growing area of spring barley in the years 1995-2011 underwent strong fluctuations. The downward trend continuing since 1997 was reversed only after the Polish accession to the European Union. In 2005-2006 there was a sharp increase in the cultivation area of that cereal. The next two years saw a slight decrease and a sudden collapse in 2009 and 2010, when the cultivation area of barley in Poland was the lowest in years of research and was about 725 thousand ha. In the last year of the study, i.e. in 2011 there was a slight increase, but still the cultivation area of barley was smaller than in 1995 – figure IV.3.1.

Figure IV.3.1. Spring barley growing area in the years 1995-2011, total in the country



Source: CSO data.

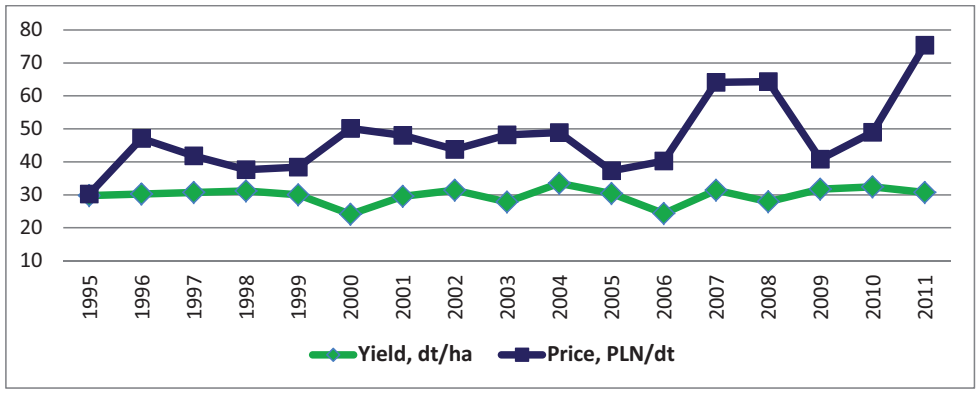
Barley is a cereal with versatile applications, but it is mainly used for fodder purposes for mixing fodder on the farm and in the feed industry. More than 60% of the national consumption of barley is for feed. Another important use is for the food industry, especially the production of malt. In addition, the grain of barley is used in the manufacture of groats, flakes, cereal germ, baby food and in baking.[48]

In 2000-2003, barley prices were higher in Poland than in the EU. However, after accession they are at the same level as in neighbouring Member States.[49]

Changes in the prices of barley in Poland in recent years are shown in figure IV.3.2.

[48] A. Najewski, *Zboże wysokiej jakości*, 2nd edition, Agro Serwis, June 2005.
[49] S. Stańko, *Zewnętrzne uwarunkowania rozwoju rolnictwa*, Roczniki Nauk Rolniczych, Series G, vol. 94, p. 2, Warsaw 2008.

Figure IV.3.2. Yield of spring barley in individual farms and the selling price of grain in 1995-2011



Source: CSO data.

In 2009-2011, barley prices rose rapidly. In 2011, in relation to the previous year, the national harvest of spring barley were higher by 3.3% and amounted to 2.5 million tons. Detachment of prices from the amount harvested reflects how little effect it has on the market price of the grain.

The reasons for price increases are, among others, the situation on the world market and in major exporters, which are: Russia, Ukraine, Canada, Australia. The amount of the world's barley harvest significantly affects its price in EU despite small imports (159 thousand tonnes in 2010/11), compared to exports (4360 thousand tonnes in 2010/11)[50]. Also, grain production in the EU strongly affects the level of prices. In addition to harvested amounts and the balance of barley grains an important factor are the forecasts of future harvests and the demand of feed and brewing industries.

In contrast to the price level, in the last 17 years, the yield of spring barley was quite balanced, it was around 30 dt/ha, with periodic small fluctuations – figure IV.3.2. In EU countries, the average yield of spring barley is about 44 dt/ha. Highest yields are in the Netherlands, France and Belgium, in these countries thanks to the use of modern production technology the level of crops exceeds 60 dt/ha[51] In Poland in 2011, the yield of spring barley was 31.3 dt/ha and was 4.9% lower than in the previous year (according to the CSO).

[50] *Rynek zbóż i oleistych*, Foreign Agricultural Markets Monitoring Unit. FAMMU/FAPA, Wiadomości No 21, 25 May 2012.
[51] eurostat.ec.europa.eu [access: June 2012].

According to studies conducted in the AGROKOSZTY system in 2007-2011, the cultivation of spring barley was profitable. Income from operations without subsidies, estimated for 2011 in the surveyed farms amounted to 722 PLN/ha. After taking into account subsidies available to farmers (complementary area payment + single area payment), income from operations amounted to 1,510 PLN/ha. It should be noted that the subsidies represented 52.2% of revenue. This demonstrates the significant role of the CAP mechanisms in the stabilization of income for farmers.

Production of barley is also characterized by high economic efficiency as compared to other activities covered by studies. Cost-effectiveness index expressed as the ratio of total production to total costs amounted to 142.6% and was only smaller by 1.8 percentage points than index for winter wheat. Costs are one of the factors determining the profitability of production. Detailed knowledge of the structure and relationships present in the production process allows for making more informed and therefore better decisions by the producer.

Farms that grow spring barley were categorized according to the level of direct costs and divided into quartiles. To illustrate the differences between those farms, the results are presented for the two extreme quartiles, i.e. farms with the lowest and highest direct costs incurred for 1 ha of spring barley (table 4.).

In base year 2011, in the sample of farms from the I quartile, as compared to the fourth quartile of direct costs, per 1 ha the following were recorded (table 4):

- value of production – lower by 20.7% (by PLN 524),
- direct costs – lower by 61.0% (by PLN 680),
- total costs – lower by 44.5% (by PLN 920),
- gross margin without subsidies – higher by 11.0% (by PLN 156),
- income from operations without subsidies – higher by 85% (by PLN 395),
- indicator of profitability – higher by 52.3 percentage points.

The results show that the efficiency of spring barley production in case of farms from the I quartile was higher than in the IV quartile, which translated into the income of the farmer. Income from operations without subsidies was almost two times higher in case of farms with a lower level of direct costs, it amounted to 859 PLN/ha, while in case of farms with the upper level of direct costs it was only 464 PLN/ha.

As mentioned in one of the previous chapters, in order to achieve a satisfactory level of profitability it is essential that the increase in costs is less than or at most equal to the increase in the value of production. It is important, therefore, at what level of yield the marginal cost is equal to price. Referring to

the analyzed case of spring barley, it should be stated that in 2011 in the sample from the IV quartile, the outlays for the production did not provide the expected increase in income. Compared to farms from the I quartile, units from the IV quartile incurred higher costs for plant protection and fertilization, respectively, 91.1% and 3.8-fold higher. Increased outlays translated into an increase in yield, but only by 6.3 dt. The realized value of production provided for the covering of costs, but the remaining surplus, i.e. income from operations without subsidies, was much lower compared to farms that made smaller outlays for the production (from the I quartile). It should be noted that the cultivation area of barley in case of farms from the I and IV quartile was respectively 8.05 and 13.68 ha – table 4.

The dynamics of the expected changes in the value of production of spring barley and selected items of costs and revenues – in 2014 as compared to the input data – on average in the studied set of farms and in separate groups, are presented in table IV.3.1.

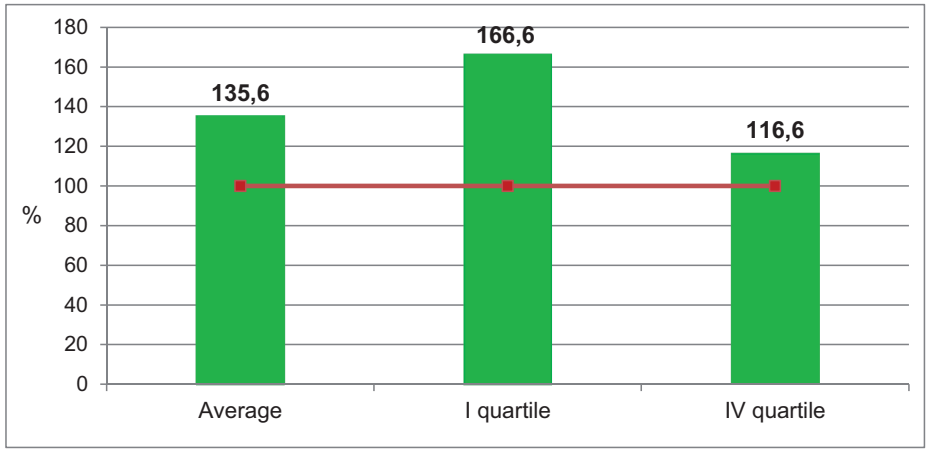
Table IV.3.1. Dynamics of selected data describing the profitability of cultivation of 1 ha of spring barley in 2014 compared to the base year 2011* in groups of farms

Specification	Average in surveyed farms	Farm groups-quartiles of direct costs	
		Bottom (I)	Top (IV)
Yield	100.5		
Grain sale price	106.3		
Value of production (income from sales)	106.9	106.7	106.8
Direct costs	**112.0**	**111.1**	**111.9**
Gross margin without subsidies	104.3	105.5	102.9
Total costs (direct and indirect)	112.4	112.0	112.2
Income from business without subsidies	**93.9**	**99.7**	**83.0**
Income from operations (with subsidies)	**101.0**	**103.5**	**98.4**
Profitability index	95.0	95.3	95.2
Operating income without subsidies / 1 dt of grain	93.4	99.1	82.5
Total costs for PLN 1 of income from operations without subsidies	119.8	112.4	135.3
Subsidies for PLN 1 of income from operations without subsidies	114.6	108.0	129.7

* Estimation for 2011, data for years 2007-2011 were adjusted by rates of changes determined based on the trend function and averaged.

According to the projection based on time series it is expected that the yield of spring barley in 2014 will remain at a level similar to the base year, i.e. 2011. The increase in revenues (value of production) will be mainly affected by the price per 1 dt of grain, which may increase by 6.3%. The direct cost increase on average in the studied set of farms is estimated at 12.0%, at an annual rate of change in the range of 4.0-3.7%. The projected increase in the total costs for 2014 may reach an average of 12.4%. Results for selected groups of farms are formed at a similar level. The sample from the I quartile of direct costs the total cost may be higher by 12.0%, and in the IV quartile by 12.2%. The expected increase in the value of production will be within the limits of 6.7-6.9% (value of production includes the value of the main product, i.e. the grain and the value of straw in an amount which was marketed in initial years). The much higher growth rate of the cost of crop production in relation to the value of production will result in declining profitability of spring barley by about 5 percentage points. The level of the profitability index in 2014 for the whole population and for groups of farms selected in terms of direct costs is shown in figure IV.3.3.

Figure IV.3.3. Projection of profitability of spring barley crop in 2014 as a ratio, on average in surveyed farms and in groups – I and IV quartile of direct costs



In spite of the same rate of change of each variable in the groups of farms, a different level of costs and their structure will affect the level of income. Barley production will remain profitable but economic surplus at the disposal of farmers will be different.

Below is presented the direction of change in the cost of production and the income from operations without subsidies, estimated for 2014 – in relation to the base year 2011 – per 1 ha of crop[52]:

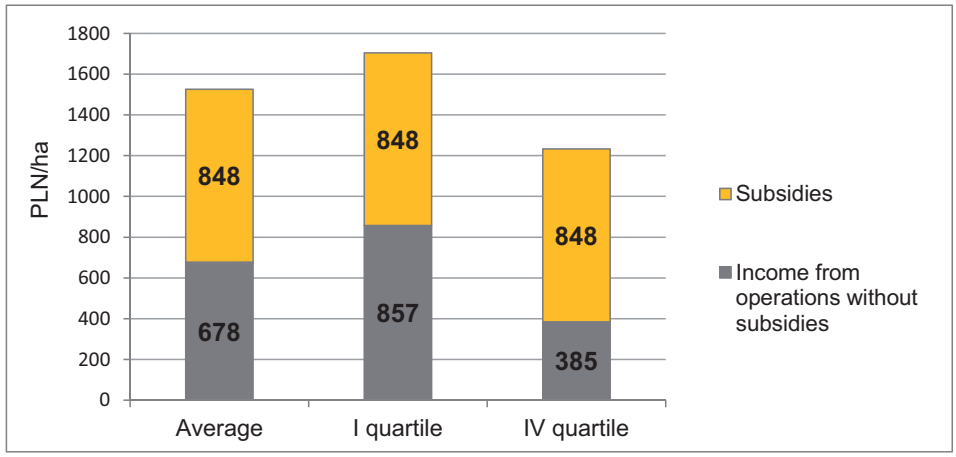
- **on average in the studied set of farms:**
  - increase in direct costs – by 12.0% (by PLN 98),
  - increase in total costs – by 12.4% (by PLN 210),
  - decrease in income from operations without subsidies – by 6.1% (by PLN 44);
- **in farms from the I quartile of direct costs:**
  - increase in direct costs – by 11.1% (by PLN 48),
  - increase in total costs – by 12.0% (by PLN 138),
  - decrease in income from operations without subsidies – by 0.3% (by PLN 2);
- **in farms from the IV quartile of direct costs:**
  - increase in direct costs – by 11.9% (by PLN 133),
  - increase in total costs – by 12.2% (by PLN 252),
  - decrease in income from operations without subsidies – by 17.0% (by PLN 79).

The presented data show that in general one can expect reduction in income from growing spring barley. Farms from the first quartile of direct costs will be in the most favourable situation – the decrease will be only 0.3%, thus it can be considered that the income will remain unchanged. While in the sample from the IV quartile of direct costs, one expects a decline in revenue of 17.0%. The cost of producing PLN 1 of income without subsidies will increase in this group of farms by 35.3%, as compared to 12.4% in the group with the lowest direct costs. Comparing the level of income from operations without subsidies in case of farms from the bottom (I) and upper (IV) quartile of direct costs, it should be noted that, in 2011, the difference in favour of the I quartile was PLN 395, in 2014 it may reach PLN 472, thus it will increase by 19.5% (table 4). One can expect this situation despite stronger growth dynamics of costs than those of the value of production. The level and structure of production costs will be the determining factor.

[52] The expected direction of change (increase or decrease) and the strength of this phenomenon is shown as a percentage. Changes are also expressed in terms of value, but the numbers should not be taken as absolute values, they are to show the scale of change in view of the percentage change, if the benchmarks are different values – in the present case the results of the farms from the I and IV quartile of direct costs. It should also be noted that at lower or higher reference base – and the same percentage rate of change, and a similar cost structure – the change of value will also be lower or higher.

Figure IV.3.4 illustrates the projection of income from operations without subsidies for spring barley in 2014 and the level of subsidies, on average in the studied set of farms and in separate groups.

Figure IV.3.4. Projection of income from operations without subsidies for spring barley for 2014 and the level of subsidies, on average in surveyed farms and in groups – I and IV quartile of direct costs



According to the projection for 2014, the income from operations without subsidies in case of farms from the I quartile of direct costs will be close to the estimated level for base year 2011. It will exceed 2.2 times the income earned in case of farms with high inputs of means of production, that is from the fourth quartile of the direct costs. As a result, income from operations without subsidies per 1 dt of grain in the first group of farms (I quartile) will be PLN 23.95, and in the second (IV quartile) – PLN 9.15.

After taking into account subsidies it is expected that in 2014 the income from operations in the group of farms with a lower level of direct costs for cultivation of spring barley will be 103.5% of the level of income in the base year 2011. However, in households with high direct costs, the income from operations, even after adding subsidies, will remain below the average level for 2011 (will constitute 98.4%). The share of subsidies in income from operations may reach an average of 55.6% in the set, and 49.8% and 68.8% respectively in the farms from the I and IV quartile of direct costs. This represents an increase of the share of subsidies in the income within 2.0-5.9 percentage points (table 4). However, due to the still uncertain situation concerning the future of the CAP, the projections which take into account the amount of support for farmers should be treated with great caution.

In summary, it should be stated that as a result of rapid increase in the cost of production in relation to the value of production, all groups of farms growing spring barley can expect a decline in profitability in 2014. In case of farms from the I quartile of direct costs, cost-effectiveness ratio would be 166.6%, and compared to 2011 will be lower by 8.2 percentage points. In case of farms from the IV quartile the ratio will be 116.6%, which represents a decrease of 5.9 percentage points. Despite this, the cultivation of spring barley remains a profitable business. As is clear from the analysis, the expected income situation varies depending on the size of inputs devoted to production. In case of farms with low inputs (I quartile of direct costs), the income from operations without subsidies will remain at a level similar to that estimated for 2011. However, in case of farms with high inputs (IV quartile of direct costs) the income may fall by as much as 17.0%. In these farms subsidies play an important role, stabilizing the level of income. In relation to the input data which was used to make the projection, in 2014 the subsidies per PLN 1 of income from operations without subsidies in the sample from the I quartile of direct costs may be higher by 8.0%, and in the IV quartile – by as much as 29.7%.

4. Winter rapeseed

Oilseeds are the second most important group of plants on the market of food and feed products. In this group, more than half of the world production is soybean, while in the EU the leader is rapeseed, its share in total oilseed production in 2009 was 71.9%.

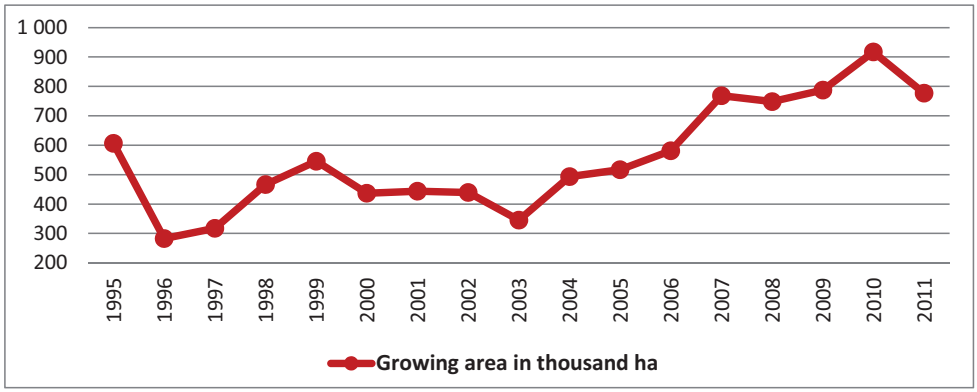
Rapeseed production in the world has a long-term upward trend, mainly due to the fact of growing doubly improved varieties, so called "00", containing 40-49% fat and 19-22% protein in seeds, with the result that the oil and rapeseed crush obtained from them are food and feed products of full value, and a raw material for various industries. It is estimated that over 80% of the world production of rapeseed is derived from EU countries and China, Canada and India, with the largest growing area in China and the highest yields in EU Member States.[53]

In the EU, until 2000, the area of rapeseed grew rapidly, especially in France and Germany, where it increased more than 3-fold. The main stimulus for this process was the deepening deficit in protein feed, as well as a growing interest in the use of rapeseed oil for biodiesel production. Also in Poland, the growing market for biofuels led to a sharp increase in rapeseed cultivation area in 2007. In 2013 the development of the biofuels sector will be the main driving force behind the growth of domestic demand for rapeseed. In earlier years it was grown primarily for the oil industry. The cultivation of winter rapeseed prevails, it gives a higher and more stable yields than spring rapeseed. Winter rapeseed in Poland occupies more than 95% of the area intended for cultivation of oilseeds.

Changes in the cultivation area of winter rapeseed in the last 17 years are shown in figure IV.4.1. Its fluctuations have been mainly affected by the decline in profitability of rapeseed (primarily due to fluctuations in raw material purchase prices of processing plants), the variable weather conditions (an example is damaging of rapeseed by frost in season 1996/1997), as well as the structural changes in the agricultural sector.

[53] *Rzepak gwarancją dochodu*; http://www.piagro.pl/artykuly-rolnicze/produkcja-roslinna/rzepak-i-rzepik-rosliny-oleiste/rzepak-gwarancja-dochodu.html [access: May 2012].

Figure IV.4.1. Winter rapeseed growing area in the years 1995-2011, total in the country

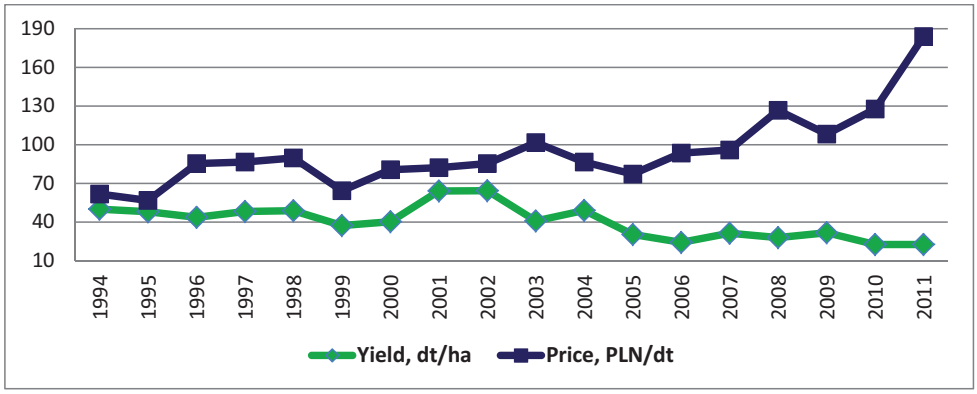


Source: CSO data.

In spite of the possibility of increasing the cultivation area of rapeseed, its production capacity is limited by natural conditions (soil quality, weather conditions) and organizational conditions (fragmented farm structure and the low share of rapeseed in the crop structure). Taking these factors into account, experts estimate that the cultivation area of rapeseed in Poland may reach a maximum of 1 million ha[54].

Figure IV.4.2 shows the development of the crop and selling prices of rapeseed in recent years.

Figure IV.4.2. Winter rapeseed crop in individual farms and the sale price of seed in 1995-2011



Source: CSO data.

[54] J. Kuś, *Produkcja biomasy na cele energetyczne*, Biuletyn informacyjny No 7, PAN, Lublin 2002.

Rapeseed is a plant with large climatic and soil requirements. Yield levels depend on the quality of soil, the inputs of means of production (such as fertilizers), high-quality crop varieties, as well as weather conditions.

Seed sales price are also determined by a number of factors. Their growth in recent years was mainly dictated by the continuing strong demand for raw material and the noticeable stagnation in production. In 2010, the national rapeseed crop was lower by 16.8% in comparison to the previous year, which resulted in an 18-percent increase in the sales price. In 2011, the rapeseed crops again declined – by 10.1% (as a result of decline in cultivation area and yields). In the domestic market, there was a large excess of demand over supply, as a result the seed prices had increased substantially.[55] Prices of rapeseed in Poland are determined by the relationship of supply and demand. Although they also depend on world prices of rapeseed and soybeans and products produced from them. They are also strongly influenced by the ratio of the zloty against the euro.

Rapeseed production forecasts for 2012 predict harvest in the EU at 18.2 million tonnes, i.e. at the lowest level in 6 years (by FAMMU/FAPA). Oil World forecasts smaller harvest in Romania, Bulgaria, Poland, Hungary, France and Germany. In Poland, according to the assessment of the National Association of Rapeseed Producers, one third of rapeseed plantations was damaged by frost and therefore it should be assumed that seed prices will not fall below the level a year ago.

The results show that winter rapeseed is a profitable plant. In the analyzed set of farms, estimated for 2011 the gross margin of farmers, without the subsidies, amounted to PLN 2,338, and income from operations without subsidies was PLN 720 per 1 ha of crops. However, considering the support mechanisms of the CAP, the income from operations, i.e. including subsidies, reached 1,486 PLN/ha. This support was very important, the subsidies exceeded by 6.3% the income derived from the production (i.e. without subsidies). The profitability of rapeseed production, expressed as a percentage ratio of the value of production to the total costs amounted to 121.6% – table 5.

With regard to profitability one should note that it is decided not only by yields and prices, but equally important are the costs of production. The level and structure of inputs (costs) is closely linked to the production technology. Often the level of direct costs is taken as a synthetic measure of the intensity of technology, they are related to the size of material inputs and their market prices.

[55] *Rynek Rzepaku. Stan i perspektywy*, No 40, Warsaw 2011.

It was interesting to know the economic results of the rapeseed on farms with a low and a high level of direct costs per 1 ha of crops. This aspect of the research is of particular importance in the medium term and in the light of the observed stronger growth dynamics of production costs than the growth of rise in prices of agricultural products, and the often realized value of production.

To this end, the panel of farms that cultivated winter rapeseed was grouped into quartiles of direct costs. To illustrate the scale of differentiation, results are presented for two extremes: I quartile shows 25% of the lower performance, and the IV quartile – 25% of the upper performance.

The calculations presented in table 5 show the prevalence of farms with a lower level of direct costs (I quartile). The production results and the selling price of rapeseed were lower, in base year 2011, respectively by 21.4 and 3.0%. However, the profitability of production, both expressed as a ratio and the surplus from which the farmer can benefit (i.e. income), greatly exceeded the level achieved by farms from the upper quartile (IV) of direct costs.

In base year 2011, in the sample of farms from the I quartile, as compared to the fourth quartile of direct costs, per 1 ha the following were recorded (table 5):

- value of production – lower by 23.7% (by PLN 1,038),
- direct costs – lower by 56.2% (by PLN 1,314),
- total costs – lower by 45.2% (by PLN 1,868),
- gross margin without subsidies – higher by 13.6% (by PLN 278),
- income from operations without subsidies – 4.3-fold higher (by PLN 830),
- indicator of profitability – higher by 41,6 percentage points.

In light of the results estimated for 2011, it was interesting to determine the direction of change in terms of profitability for 2014, expressed as a ratio, and the level of income in groups of farm with different direct costs of winter rapeseed cultivation. The projection attempts to answer to this question, using the direction of change observed in the past, and built on the basis of average values from 2006-2011. It should be noted that the indicators of changes in the cost items used to build the projection model (table 1) are the same for all groups of farms (as well as for production activities included in the study). Therefore, the observed differences in the dynamics of changes of aggregate items, such as direct costs, only arise from different structures.

The calculations in the table IV.4.1 show the changes of data forecasted for 2014 with respect to output data, on average in the set of farms under study and in separate groups.

Table IV.2.1. Dynamics of selected data describing the profitability of cultivation of 1 ha of winter rapeseed in 2014 compared to the base year 2011* in groups of farms

Specification	Average in surveyed farms	Farm groups-quartiles of direct costs	
		Bottom (I)	Top (IV)
Yield	100.7		
Seed sale price	109.8		
Value of production (income from sales)	110.6	110.6	110.6
Direct costs	**111.6**	**112.4**	**111.2**
Gross margin without subsidies	109.9	109.8	109.9
Total costs (direct and indirect)	112.5	112.5	112.7
Income from business without subsidies	**101.9**	**106.6**	**75.9**
Income from operations (with subsidies)	**106.5**	**107.9**	**102.6**
Profitability index	98.3	98.3	98.1
Operating income without subsidies / 1 dt of seeds	101.2	105.9	75.4
Total costs for PLN 1 of income from operations without subsidies	110.3	105.5	148.4
Subsidies for PLN 1 of income from operations without subsidies	108.7	102.9	146.6

* Estimation for 2011, data for years 2006-2011 were adjusted by rates of changes determined based on the trend function and averaged.

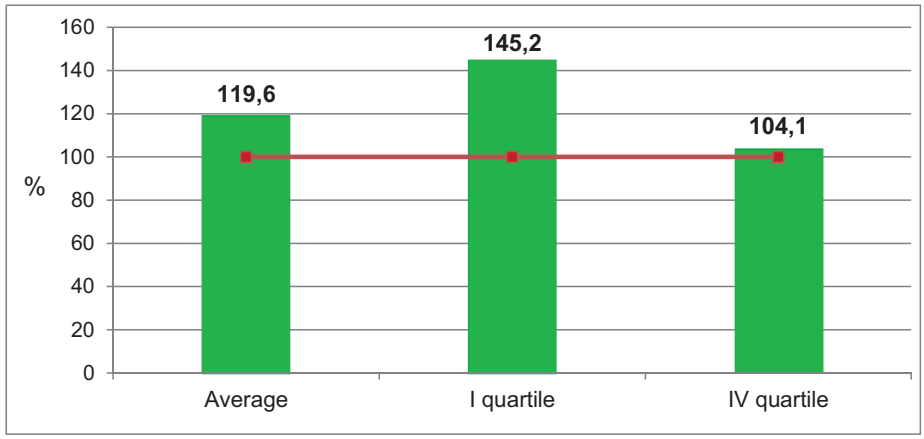
Projection results show that in the coming years one should not expect significant improvement in the yielding of rapeseed, in the perspective of three years the yield growth is estimated only at 0.7%. However, the selling price of seed – in relation to 2011 – could rise by 9.8%, then the annual growth will be between 3.3-3.1%. As a result of these changes in the value of production, the income from 1 ha of rapeseed will accumulate annually from 3.7 to 3.1% and in 2014 will reach a level higher by 10.6% – table IV.4.1.

Assuming constancy – in relation to the input data – of outlays and putting direct costs together, it is estimated that the annual growth rate will be between 4.1 and 3.5%. This will cause that in 2014 they will exceed the level from 2011 on average in surveyed farms by 11.6%, in the set of the lower quartile of direct costs by 12.4%, and in the top quartile – by 11.2%. The cost of seed will grow the fastest (6,2-5,5%), resulting in a cumulative increase in three years (2012-2014) of 18.6%. The second item are mineral fertilizers, whose cost may be higher by 14.2% – table 1.

However, the total costs (direct and indirect together) of growing 1 ha of winter rapeseed, will accumulate each year within the limits of 4.1-3.9%. As a result, in 2014 – in comparison to the base year 2011 – they will rise by 12.5%, and in case of farms with the upper level of direct costs (IV quartile) – by 12.7%.

Results of the projection indicate a weaker growth of the value of production than the total cost of cultivation of winter rapeseed. As a result, in 2014 – in comparison to 2011 – one expects a fall in the profitability of rapeseed cultivation by about 2 percentage points. The level that can be achieved by the cost-effectiveness ratio, i.e. the ratio of the value of production to total costs expressed as a percentage, is presented in figure IV.4.3.

Figure IV.4.3. Projection of the profitability of winter rapeseed in 2014 as a ratio, on average in surveyed farms and in groups – I and IV quartile of direct costs



The decline in profitability means that the economic efficiency of the production of rapeseed will be weaker. The increase in the value of production will occur in a manner that is too expensive. Rapeseed, however, will remain a viable activity, and farmers will have at their disposal the surplus in the form of income from operations without subsidies.

Below is shown the direction of changes in the costs of production and the income from operations without subsidies, estimated for 2014 – in relation to the base year 2011 – per 1 ha of crop[56]:

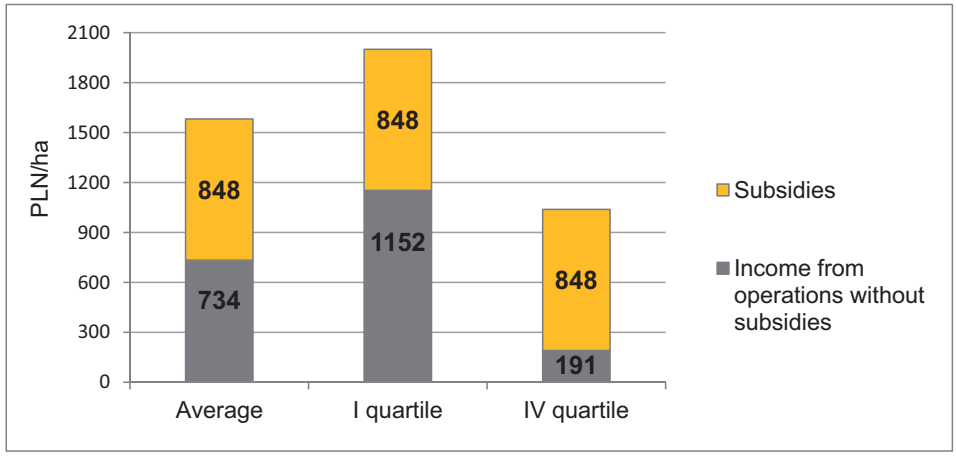
- **on average in the studied set of farms:**
  - increase in direct costs – by 11.6% (by PLN 198),
  - increase in total costs – by 12.5% (by PLN 415),
  - increase in income from operations without subsidies – by 1.9% (by PLN 14);

[56] The expected direction of change (increase or decrease) and the strength of this phenomenon is shown as a percentage. Changes are also expressed in terms of value, but the numbers should not be taken as absolute values, they are to show the scale of change in view of the percentage change, if the benchmarks are different values – in the present case the results of the farms from the I and IV quartile of direct costs. It should also be noted that at lower or higher reference base – and the same percentage rate of change, and a similar cost structure – the change of value will also be lower or higher.

- **in farms from the I quartile of direct costs:**
  - increase in direct costs – by 12.4% (by PLN 127),
  - increase in total costs – by 12.5% (by PLN 283),
  - increase in income from operations without subsidies – by 6.6% (by PLN 71);
- **in farms from the IV quartile of direct costs:**
  - increase in direct costs – by 11.2% (by PLN 262),
  - increase in total costs – by 12.7% (by PLN 524),
  - decrease in income from operations without subsidies – by 24.1% (by PLN 60).

Based on the presented results it can be concluded that in 2014 the farms with the lower level of direct costs (I quartile) incurred in the cultivation of winter rapeseed will be in the best situation. Improper management of costs is inappropriate allocation of inputs, which leads to lower profitability, and which may be caused by e.g. overfertilization of plants or improper use of pesticides. Figure IV.4.4. shows the level of income from operations without subsidies and the impact of subsidies on the results in separate groups of farms, according to the projection for 2014.

Figure IV.4.4. Projection of income from operations without subsidies for winter rapeseed for 2014 and the level of subsidies, on average in surveyed farms and in groups – I and IV quartile of direct costs



It is expected that in 2014 – as compared to the estimated level for 2011 – in the farms from the I quartile of direct costs, the income from operations without subsidies per 1 ha of rapeseed will increase by 6.6%, and counted for 1 dt of seed, by 5,9%. The cost of PLN 1 of this income will increase by 5.5%, in

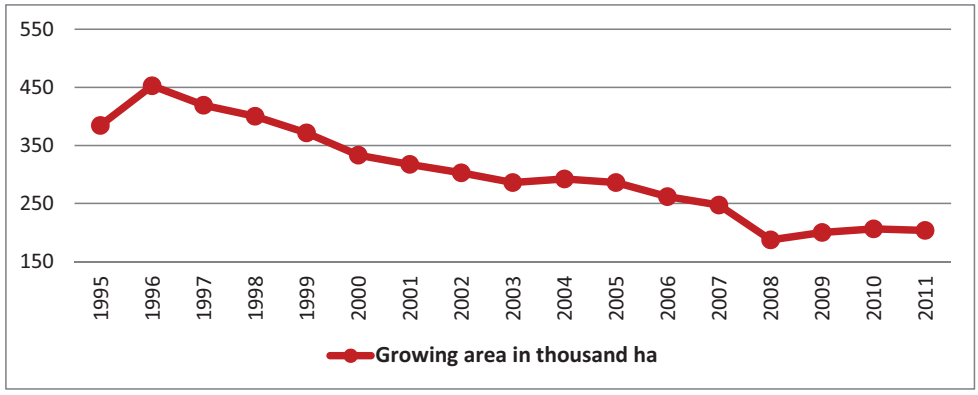
comparison with the use of high inputs (IV quartile of direct costs) – by as much as 48.4%. In the farms from the IV quartile of direct costs, despite better production and price results one should expect a decrease in income (by 24.1%). This will be decided by the rate of increase in costs and, consequently, the greater increase than that of the value of production. It is estimated that with the obtained volume of production, the marginal cost of producing an additional unit was higher than the price of its sale. Such a situation has not occurred in case of farms from the I quartile of direct costs, it can be assumed that in this case the intensity limit was not exceeded, and despite the fact that the increase in total costs was stronger than the increase in the value of production, the farmers have the right to expect a slight increase in income.

In conclusion it should be noted that in 2014 the producers will not lose in the cultivation of rapeseed. Income from operations without subsidies from 1 ha will even surpass the level achieved in base year 2011 – on average by 1.9%. It should be noted, however, that in some farms the increase in income will be stronger, while in other income may fall below the level form 2011. Studies have shown that the income situation of rapeseed is strongly affected by the level of inputs of means of production, the measure of which are the direct costs. It is estimated that in the case of farms that used less inputs of means of production, their productive potential has been fully exploited, as compared to farms using high inputs, and thus incurring higher costs. It should be noted that on farms where direct costs of rapeseed cultivation were lower (I quartile), the area of cultivation was also lower, compared to farms with high costs (IV quartile), by approximately 10 hectares (was respectively 15.89 and 25.62 ha). At high inputs of means of production (IV quartile), the income from rapeseed cultivation was lower than in the case of farms from the I quartile and in comparison to an average of 2011. In this situation, the role of subsidies as income stabilizer was highlighted. It can be expected that in 2014, thanks to subsidies for farms in the IV quartile of direct costs, the income from operations, i.e. calculated including subsidies, will exceed by 2.6% the level of 2011. It will remain, however, still significantly lower (by 48%) as compared to farms from the I quartile of direct costs.

5. Sugar beet

Another agricultural production activity for which the projection of costs and revenues was made for 2014 was sugar beets. In the second half of the 1990s it was one of the most important production activities in the country, as indicated by a substantial area of cultivation (453-372 thousand ha)[57]. However, over the years, cultivation of sugar beet in Poland, though still important, has lost its importance, and cultivation area has been gradually decreasing. Although in the last three years (2009-2011) the decline slightly decelerated (cultivation area was successively 200, 206 and 204 thousand ha)[58], but in the period from 1996 to 2011 the national growing area decreased more than 2-fold – figure IV.5.1.

Figure IV.5.1. Sugar beet growing area in the years 1995-2011, total in the country



Source: CSO data.

Reduction in the cultivation area of sugar beet in Poland was caused, among others by the regulatory reform of the sugar market under the Common Agricultural Policy, which was launched during the campaign 2006/2007. The aim of this reform was to reduce sugar production in the European Union (EU) and increase its price competitiveness, while maintaining a decent income from sugar beet. However the result was the concentration of cultivation in larger farms and in areas with more favourable agro-meteorological conditions for growing sugar beet.[59] It is worth noting that, according to

[57] *Rocznik Statystyczny Rzeczypospolitej Polskiej 1998*, *Rok LVIII*. CSO, Warsaw 1998; *Rocznik Statystyczny Rzeczypospolitej Polskiej 1999*, *Rok LIX*. CSO, Warsaw 1999; *Rocznik Statystyczny Rzeczypospolitej Polskiej 2000*, *Rok LX*. CSO, Warsaw 2000.

[58] *Rocznik Statystyczny Rzeczypospolitej Polskiej 2011*, *Rok LXXI*. CSO, Warsaw 2011; *Wyniki produkcji roślinnej w 2011 r.*, CSO, Warsaw 2012.

[59] *Rynek cukru*, No 38, IAFE-NRI, AMA, MARD, Warsaw 2011; *Wspólna Polityka Rolna po 2013. Sektor cukru. Reakcja europejskich rolników i spółdzielni rolniczych na wnioski ustawodawcze*

experts in the sugar market, in the season 2012/2013 the sugar industry contracted in Poland about 190 thousand ha of sugar beet, which is an area similar to the previous season.[60]

Long-term trend of decline in the cultivation area of sugar beet is observed not only in Poland or Europe, but around the world. However, the acreage of sugarcane is gradually increasing. FAO[61] reports that from 1990 to 2010 sugar beet growing area in the world decreased by 46% (from about 9 to less than 5 million hectares). However, in the last two years (2010-2011), this trend has been somewhat slowed down. World acreage of sugar beet – just as in Poland – was in those years a few percent higher than in 2009. This happened mainly due to increase in cultivation area in Europe, especially in countries outside the EU (Russia, Ukraine), and the main driving force behind these changes was a more favourable level of sugar prices than before 2010.[62]

The FAO data also shows that in 2010 the area occupied in Europe by sugar beet was more than 3 million hectares and accounted for 69% of the global area of sugar beet cultivation, 17% were in Asia, and 10% in North America. It is also worth noting that one third of the world acreage was located in the EU-27. As for the season 2011/2012 (October-September), the European Commission estimates that EU sugar beet cultivation area will be 1.6 thousand ha and will be higher by 3% than in the previous season.[63]

Sugar beet cultivation area is not the only element conditioning sugar beet production in the country and in the world, it is also determined by the amount of crops. These in turn are the result of mutual arrangement of many elements: seed quality, fertilization (mineral and organic), the number and timing of agricultural practices, soil type, weather conditions, etc. In Poland, for many years there has been an upward trend in yields of sugar beet (figure IV.5.2). When analyzing subsequent years it can be noted, however, that a change in the level of yields is not a one-way change, which except for the differences in production technology is primarily the result of different weather conditions (drought, heavy rain) in individual years. For example, in the period 1995-2011 the

Komisji Europejskiej dotyczące sektora cukru w UE po roku 2015, Copa-Cogeca, Bruxelles 2012; www.copa-cogeca.eu [access: June 2012].

[60] *Rynek rolny*, No. 5, IAFE-NRI, Warsaw 2012.

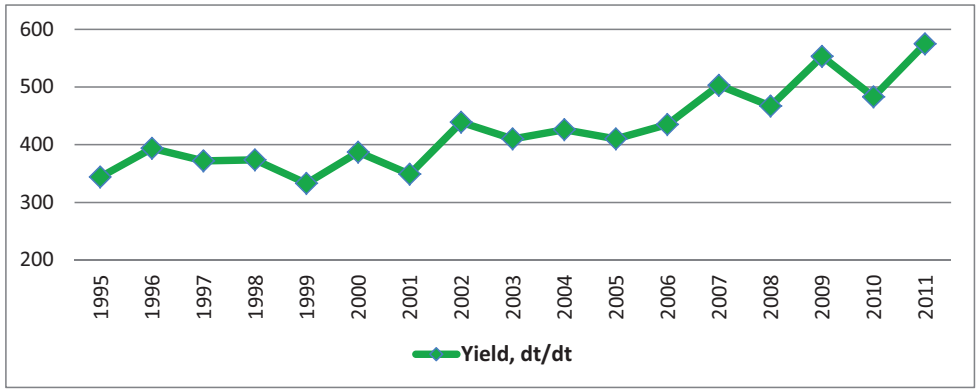
[61] FAO – Food and Agriculture Organization of The United Nations. This organization was founded in 1945. It develops the so called campaign to fight hunger. It conducts the World Food Programme together with the UN; http://portalwiedzy.onet.pl/53335,,,,fao,haslo.html [access: June 2012].

[62] Ł. Chmielewski, *Światowy Rynek Cukru. Opracowanie sygnalne – najnowsze dane*, FAMMU/FAPA, Warsaw 2012.

[63] As above.

highest yield of sugar beet in individual farms (574 dt/ha)[64] was achieved in 2011, and the lowest (333 dt/ha)[65] in 1999.

Figure IV.5.2. Yield of sugar beet in individual farms in 1995-2011



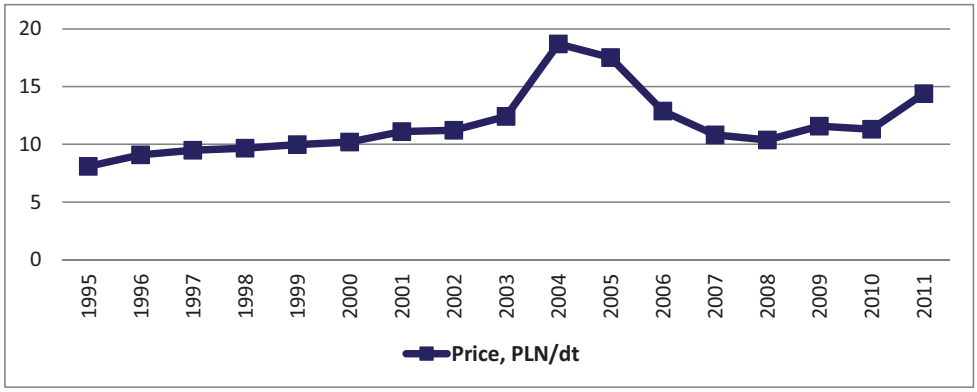
Source: CSO data.

Similar to the above, the changes in the sugar beet yield are observed all over the world.[66] Over the years, with the improvement of production technologies there has been a gradual increase in yields of this plant, but in subsequent years a major factor in determining the amount of crops were the meteorological conditions occurring during the growing season.

The selling price of roots is also very important for sugar beet growers. Figure IV.5.3 shows that in Poland, in the period covering the years 1995-2011 the highest price paid for sugar beet (18.70 PLN/dt)[67] was in 2004, soon after the accession to the EU, whereas the lowest price (8.08 PLN/dt)[68] was recorded in 1995. However, in 2011 – according to unpublished CSO data – sugar beet price was 14.40 PLN/dt, so it was lower by 23.0% than in 2004, but higher by 78.2% than in 1995. It is worth noting that in 2011, sugar beet roots had an extremely high content of sugar (17.5%)[69], therefore, the sale price exceeded the price level from the previous five years (2006-2010).

[64] *Wyniki produkcji roślinnej w 2011 r.*, CSO, Warsaw 2012.
[65] *Rocznik Statystyczny Rzeczypospolitej Polskiej 2000*, *Rok LX*. CSO, Warsaw 2000.
[66] Ł. Chmielewski, *Światowy Rynek Cukru. Opracowanie sygnalne – najnowsze dane*, FAMMU/FAPA, Warsaw 2012.
[67] *Rocznik Statystyczny Rzeczypospolitej Polskiej 2005*, *Rok LXV*. CSO, Warsaw 2005.
[68] *Rocznik Statystyczny Rzeczypospolitej Polskiej 2000*, *Rok LX*. CSO, Warsaw 2000.
[69] *Rynek rolny*, *No. 1*, IAFE-NRI, Warsaw 2012.

Figure IV.5.3. Sale price of sugar beet roots in 1995-2011



Source: CSO data.

Starting from the 2006/2007 season, when the EU reform of the sugar market was introduced, the national sugar beet procurement prices have depended on the quality of the raw material supplied to sugar factories and on the minimum purchase price of roots in the season[70]. For the season 2012/2013 this price is set at 26.29 EUR/t, i.e. the same amount as in the three previous seasons[71]. According to data from European Central Bank, the average exchange rate of the EU currency in September 2012 was: 1 EUR = 4.1345 PLN[72], it means that in season 2012/2013 the minimum price paid for Polish beet (with standard sugar content of 16%) will stand at 10.87 PLN/dt.

The minimum price for sugar beet is a kind of compensation for the lack of balance in negotiations between growers and sugar factories and for the fact that due to the low stability of roots, farmers must quickly sell the product having a limited choice of processing plants and negotiations of the selling price. Also, the minimum price, in addition to sugar quotas, guarantees farmers stable and predictable revenues from production.[73] The abolition of sugar quotas and minimum price at the end of season 2014/2015 as proposed by the European Commission, and an earlier liquidation of sugar payment (at the end of season 2012/2013) could lead to a significant reduction in the profitability of sugar beet cultivation. Therefore, it is recommended to take actions to strengthen the price

[70] *Rynek cukru*, No 38, IAFE-NRI, AMA, MARD, Warsaw 2011.

[71] Council Regulation (EC) No 318/2006 of 20 February 2006 on the common organisation of the markets in the sugar sector.

[72] According to data from the European Central Bank; http://sdw.ecb.europa.eu/quickview.do?DATASET=0&sfl1=4&FREQ=M&sfl3=4&CURRENCY=PLN&node=2018794 [access: June 2012].

[73] *Wspólna Polityka Rolna po 2013. Sektor cukru. Reakcja europejskich rolników i spółdzielni rolniczych na wnioski ustawodawcze Komisji Europejskiej dotyczące sektora cukru w UE po roku 2015,* Copa-Cogeca, Bruxelles 2012; www.copa-cogeca.eu [access: June 2012].

competitiveness of the EU sugar in relation to Brazilian or Indian sugar (e.g. through a high duty). At the same time the price of sugar in the EU must be sufficiently high, so that the income from the cultivation of sugar beet will remain at a level which is favourable to farmers.[74]

Sugar payment, which was introduced by the reform of the sugar market, significantly improves the income situation of the sugar beet crop. Since 2009, the total amount awarded each year to Poland for sugar payment has been EUR 159,392 thousand. [75] In 2011, this payment (in PLN) was PLN 56.00 for 1 ton of roots, while in the previous year it was lower by about 10%, and in 2009 – by more than 4%. These changes resulted from the fluctuations of the Polish currency, as from 2009 to the present, the sugar payment denominated in EU currency is EUR 12.64/t.[76] Unfortunately, it is likely that the abolition of sugar payments scheduled for the end of season 2012/2013 will contribute significantly to a reduction of income realized from sugar beet in 2014 (and beyond). This is also suggested by the results of the projection.

Studies conducted in the AGROKOSZTY system indicate that in recent years the cultivation of sugar beet in Poland has been a profitable business. In base year 2011, in the population of farms covered by the analysis, the gross margin obtained from 1 ha and income from operations without subsidies amounted respectively to PLN 3,886 and 889. However, after adding sugar payments and the single area payment (total of PLN 3.18 to PLN 1 of income without subsidies), the income from operations, i.e. counted together with subsidies, reached the level of 3,714 PLN/ha. The share of subsidies in income was 76.1% – table 6.

The cost-effectiveness ratio, calculated as the ratio of the value of production to the total costs and expressed as a percentage, also demonstrates good effects of sugar beet production. In 2011 it was at the level of 115.8%, which confirms that the economic efficiency of sugar beet production was quite favourable.

Direct costs are an important item in the costs of sugar beet cultivation. It follows from literature sources that the size of achieved economic and production effects largely depends on their level. Therefore, this study evaluates the results of the cultivation of sugar beet in case of farms grouped into quartiles according to the level

[74] Ł. Chmielewski, *Rynek cukru – co może oznaczać zniesienie kwot produkcyjnych na cukier w UE?*, FAMMU/FAPA, Warsaw 2012.
[75] *Oddzielna płatność z tytułu cukru (płatność cukrowa)*; http://www.arimr.gov.pl/pomoc-unijna/platnosci-bezposrednie/oddzielna-platnosc-z-tytulu-cukru-platnosc-cukrowa.html [access: June 2012].
[76] Ł. Chudoba, *Rynek cukru w Polsce w trakcie wdrażania reformy systemu regulacji,* Nowe Cukrownictwo No 3,4/2008; http://www.minrol.gov.pl; http://prow.rolnicy.com; http://www.arimr.gov.pl; http://www.kzpbc.com.pl [access: October 2011].

of direct costs. In order to show the diversity, we compared the results of the units classified to boundary quartiles, i.e. the bottom (I) and upper (IV) quartiles.

Studies have shown that although in base year 2011 on the farms of the I quartile – as compared to the IV quartile – the value of production was a little lower (it was decided by a lower selling price of roots by about 2.7%), the level of cost of cultivation decided that the gross margin and income from operations without the subsidies were much higher. This is important because the difference in the results in the two quartiles was not the result of the scale of production, as defined by the cultivation area. The area in case of farms from the I quartile was 8.20 ha, and from the IV quartile – 9.64 ha, so it only differed by 1.44 ha. The results of the calculations are shown below.

In base year 2011, in the sample of farms from the I quartile, as compared to the fourth quartile of direct costs, per 1 ha the following were recorded (table 6):

- value of production – lower by 1.6% (by PLN 105),
- direct costs – lower by 41.3% (by PLN 1,379),
- total costs – lower by 24.2% (by PLN 1,570),
- gross margin without subsidies – higher by 38.1% (by PLN 1,274),
- income from operations without subsidies – 8.3-fold higher (by PLN 1,466),
- indicator of profitability – higher by 30,9 percentage points.

The studies show that in case of farms from the I quartile of direct costs, in addition to the higher economic surplus, which remained at the disposal of the farmer, the economic efficiency of sugar beet production was also higher (by 30.9 percentage points). The results in these farms would be even better had the producers achieved a better sales price for roots. One can only surmise that the lower level of the price – in relation to farms of the IV quartile – was due to lower sugar content in the roots, which could be the result of less favourable local weather conditions.

Average results from the period 2007-2011 were the basis for projecting the production and economic effects of sugar beet cultivation in 2014. Predicting future events is useful in making many decisions on a farm, for example, about the structure of sown area.

The dynamics of the expected changes in production and selected cost and revenue items in 2014 – compared to the corresponding data in base year 2011 – are shown in the table IV.5.1.

Table IV.5.1. Dynamics of selected data describing the profitability of cultivation of 1 ha of sugar beet in 2014 compared to the base year 2011* in groups of farms

Specification	Average in surveyed farms	Farm groups-quartiles of direct costs	
		Bottom (I)	Top (IV)
Yield	107.0		
Sale price of roots	105.3		
Value of production (income from sales)	112.6	112.1	112.8
Direct costs	**110.0**	**110.3**	**110.0**
Gross margin without subsidies	114.4	112.9	115.6
Total costs (direct and indirect)	111.8	111.9	112.0
Income from business without subsidies	**118.2**	**112.8**	**139.6**
Income from operations (with subsidies)	**51.1**	**65.0**	**36.2**
Profitability index	100.8	100.2	100.7
Operating income without subsidies / 1 dt of roots	110.5	105.4	130.5
Total costs for PLN 1 of income from operations without subsidies	94.6	99.2	80.2
Subsidies for PLN 1 of income from operations without subsidies	25.4	29.7	20.8

* Estimation for 2011, data for years 2007-2011 were adjusted by rates of changes determined based on the trend function and averaged.

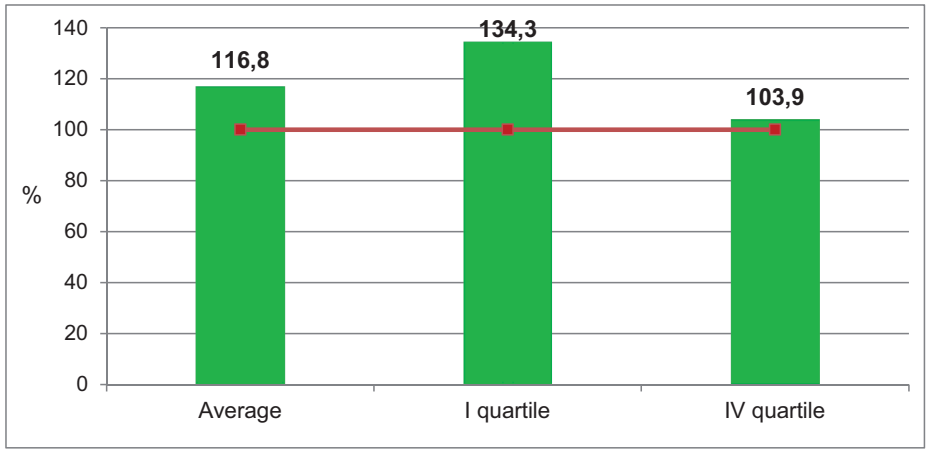
The results of the projection indicate a rising trend in sugar beet yield, estimated at 2.3-2.2% per year. It is expected that at this rate, in 2014 the crop will be higher by 7.0% in relation to the year 2011. One can also expect the upward trend in sales prices of roots – within the limits of 1.8-1.7% per year, which in 2014 will result in an increase by 5.3%. The consequence of these changes will be the increase in the value of production. It is estimated that over three years (2012-2014) on average in the studied set of farms the income from 1 ha of sugar beet will increase by 12.6%, and in the two other groups, respectively by 12.1 and 12.8%. These differences result from the fact that some farms marketed beet leaves, which are a by-product of sugar beet cultivation. Their share in the value of production was marginal, however, they had an impact on its increase.

Calculations show that by 2014 the growth of the value of production from sugar beet cultivation will be stronger than that of the costs of cultivation. Considering the direct costs it is estimated that the annual rate of growth will be within 3.4-3.1%. Finally, in 2014 in the reference population and in case of farms from the top quartile, on average the costs will be about 10.0% higher than in the base year 2011, and in case of farms from the lower quartile higher by 10.3%. These differences are due to different direct cost structure in the examined sets of farms, because the rates of change for individual items were the same.

It is expected that on average in the analyzed sets of farms total costs (i.e. direct and indirect together) of sugar beet cultivation will accumulate within the limits of 3.9-3.7% per year. As a result, in 2012-2014, the average of the set will increase by 11.8%, in case of farms from the I quartile of direct costs – by 11.9%, and in case of farms from the IV quartile – by 12.0%.

Taking into account the results of the calculations, it is estimated that in 2014 – on average in surveyed farms – the increase in the value of production from sugar beet cultivation will be about 0.8 percentage points higher than the increase in costs (total). The farms from the IV quartile the advantage will be the same, and in the sample from the I quartile – it will be only 0.2 percentage points. As a result, in 2014, compared to the estimated level for 2011, the profitability of sugar beet production will increase, but in a very small way – no more than 1.0 percentage points. A slight increase in profitability means that the economic efficiency of sugar beet production will be close to the average level recorded in the initial years adopted for the projection (i.e. 2007-2011). Sugar beet will continue to be a viable business, and growers will receive income from the crop, even without adding subsidies. The expected level of cost-effectiveness ratio is presented in figure IV.5.3.

Figure IV.5.3. Projection of the profitability of growing sugar beet in 2014 as a ratio, on average in surveyed farms and in groups – I and IV quartile of direct costs



The next page is presented the direction of change in the cost of production and the income from operations without subsidies, estimated for 2014 – in relation to the base year 2011 – per 1 ha of crop[77]:

[77] The expected direction of change (increase or decrease) and the strength of this phenomenon is shown as a percentage. Changes are also expressed in terms of value, but the numbers should not be taken as absolute values, they are to show the scale of change in view of the percentage change, if the benchmarks are different values – in the present case the results of the farms from the I and IV quartile

♦ **on average in the studied set of farms:**
- increase in direct costs – by 10.0% (by PLN 262),
- increase in total costs – by 11.8% (by PLN 660),
- increase in income from operations without subsidies – by 18.2% (by PLN 162);

♦ **in farms from the I quartile of direct costs:**
- increase in direct costs – by 10.3% (by PLN 202),
- increase in total costs – by 11.9% (by PLN 584),
- increase in income from operations without subsidies – by 12.8% (by PLN 213);

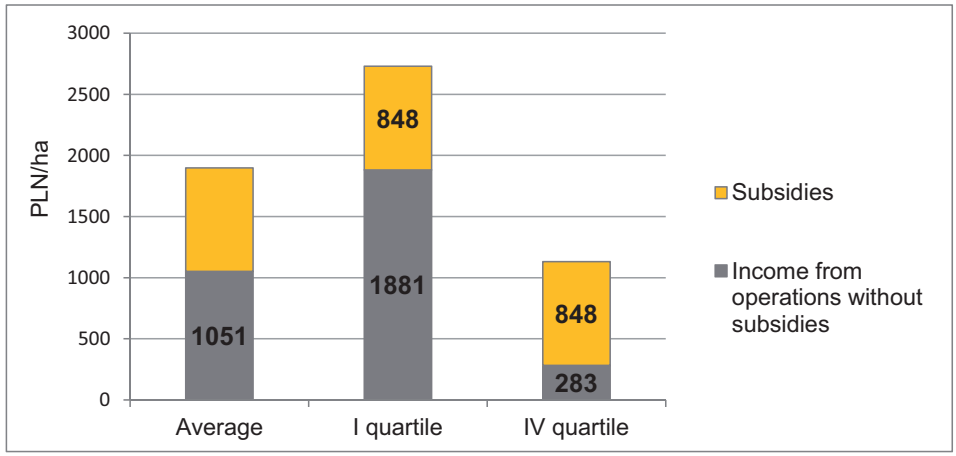
♦ **in farms from the IV quartile of direct costs:**
- increase in direct costs – by 10.0% (by PLN 334),
- increase in total costs – by 12.0% (by PLN 775),
- increase in income from operations without subsidies – by 39.6% (by PLN 81).

It is expected that in 2014 the results of growing sugar beet in case of farms from the lower quartile of direct costs will be the best, although the rate of increase in income from operations without subsidies was stronger in case of farms from the upper quartile of direct costs. The graph IV.5.4 presents the level of income from operations without subsidies and the impact of subsidies on the economic results of growing sugar beet in surveyed groups of farms.

Based on the projection it is estimated that in 2014 – in relation to the base year 2011 – in case of farms from the I quartile of direct costs, the income from operations without subsidies from 1 ha of sugar beet will be higher by 12.8% (i.e. about PLN 213), so it will increase to PLN 1881, and in terms of 1 dt of roots it will grow by 5.4%. The cost of PLN 1 of this income will decrease by 0.8% – to PLN 2.92. In comparison, in case of farms from the IV quartile, income from operations without subsidies will increase by 39.6% – but only by PLN 81, i.e. to the level of just PLN 283. The cost of generating PLN 1 of this income will decrease by 19.8%, but will still be very high: PLN 25.66 in 2014 as compared to PLN 32.00 in base year 2011.

of direct costs. It should also be noted that at lower or higher reference base – and the same percentage rate of change, and a similar cost structure – the change of value will also be lower or higher.

Figure IV.5.4. Projection of income from operations without subsidies for sugar beet for 2014 and the level of subsidies, on average in surveyed farms and in groups – I and IV quartile of direct costs



In summary, it is estimated that in 2014 sugar beet crop will be profitable. Both on average in the studied population, as well as in case of farms from the I and IV quartile of direct costs the income from operations without subsidies will be realized. Its highest level is expected in the sample of farms from the bottom quartile (I). Calculations show that in 2014 the increase in the value of production from sugar beet crops will be slightly stronger than that increase in costs (in total). Consequently, the economic efficiency of sugar beet production – measured by cost-effectiveness – will be slightly higher compared to the level of 2011. The most favourable economic results in the cultivation of sugar beet in case of farms from the I quartile will be the result of the relatively low costs of cultivation.

Support in the form of subsidies, especially the sugar payment, is of great importance for sugar beet growers. In the base year 2011, in case of farms from the I quartile of direct costs the subsidies accounted for 60.3% of income from operations, and in the sample from the IV quartile – as much as 93.5%. However, there are plans to eliminate sugar payment by the end of the season 2012/2013. Therefore – in accordance with the results of the projection – in 2014 subsidies for sugar beet may be up to 3-fold lower with respect to the level in the base year 2011. One can therefore expect that in 2014 the income from operations obtained from 1 ha of sugar beet will be significantly lower as compared to the base year 2011.

V. Summary

The part of the study entitled "Projection of income of selected agricultural production activities for 2014" presents the results of projected profitability of growing winter wheat, winter rye, spring barley, winter rapeseed and sugar beet. Calculations were made on average in the set of farms, where individual activities were analyzed and in separate groups. The criterion for grouping farms were the direct costs incurred per 1 ha of analyzed crops. Although the studies only reached a certain percentage of individual farms in Poland, in separate groups they accurately reflect the trends in the evolution of costs and give a true picture of profitability.

Problems discussed here indicate phenomena and relationships relevant to the profitability of the production, but also relevant to environmental protection and quality of products. The advantage of the study is that it presents the economic results of activities depending on the amount of direct costs of cultivation. This approach is particularly interesting in the medium term (until 2014), and in the light of the observed increase of production costs which is stronger than the rise in prices of agricultural products, as well as often realized value of production.

Projections focus on historical information and determine the possible processes without preconceived scenarios. By following this principle, based on trends observed in the 17-year period (1995-2011), it became possible to determine the likely trends in 2014. The input data for projection were the multi-year averages of 2006-2011 (collected and processed according to the assumptions used in AGROKOSZTY system), adjusted by rates of changes based on the trend function.

The results indicate that with lower costs of production one can obtain more favourable economic effects compared to more intensive technologies, which are characterized by a high level of inputs of production means. It can be therefore assumed that with lower inputs they were applied more rationally – having regard to both the quantity but also the time of their introduction. Thus, farmers who want to derive long-term income from agricultural production should seek to reduce the costs of production.

It should be noted that the prediction of changes of economic performance of agricultural products is very difficult. In general, economic projections are much more complicated than, for example that of physical phenomena (because some variables that affect the result cannot be subjected to experiment in artificial conditions), they are affected by too many environmental fac-

tors that may modify the predicted values. Therefore, the direction of ongoing changes is of essential importance in the analyses, rather than absolute values which should be approached with caution.

On the basis of the projection it is estimated that in 2014, compared to the base year 2011, the profitability of **winter wheat** crops, expressed as a ratio, will decrease by more than 2 percentage points. This will be due to the stronger growth rate of costs than the value of production. Farms with relatively low direct costs of wheat crops will be in the best situation – they were qualified to the I quartile. The profitability index of winter wheat production in these farms may reach 164.3%, while in case of farms from the IV quartile – 136.9%, the difference in favour of the I quartile will be 27.4 percentage points. On average in the studied set of farms growing winter wheat, the profitability index may be at a level of 140.9%.

Research has shown that in 2014 in case of farms from the I quartile – as compared to the IV quartile – the direct costs of winter wheat crops may be lower by 58.5% and total costs by 46.3%. While the difference in the level of income from operation without subsidies is estimated only at 6.4%, to the detriment of the I quartile. This means that farmers will have substantially comparable income levels at much lower cost.

It is expected that in 2014 also the economic efficiency of the production of **winter rye** will be higher in case of farms with a lower level of direct costs (I quartile of direct costs). Profitability index, which was adopted as a measure of efficiency, in the sample from the I quartile amounted to 170.8%, and in the IV quartile to 106.3% (average was 120.2%). Compared to the estimated level for base year 2011 profitability of rye in 2014 may be lower by about 3 percentage points. This will be due to the stronger growth rate of costs than the value of production.

The advantage of farms from the I quartile of direct costs is also evident if we take into account the income from production (i.e. without subsidies). Its level compared to farms using high inputs – can be almost 5-fold higher. This result can be achieved at much lower inputs of means of production – in terms of value by direct costs by 70.3% and total costs by 56.4%. The role of cost as a factor shaping the efficiency of production is clearly visible.

Analysis of the projection for 2014 provided for **spring barley** indicates that in groups of farms, i.e. in the I and IV quartile of direct costs, the change in the cost-effectiveness ratio will be the same as in the case of wheat and rye. It is

expected that in case of farms from the I quartile the profitability index will reach 166.6%, while in the sample from the IV quartile it will be 116.6%. The difference in favour of farms using low-input technology (I quartile) is significant – 50 percentage points. On average in the surveyed farms, the profitability in percentage terms will be 135.6%. In 2014 – in relation to the base year 2011 – the increase in the value of production of barley is estimated at 6.9%, while the increase in the cost will be 12.4% (average in the set). Stronger dynamics of the increase in costs than that of the value of production will impair economic efficiency of barley production by about 5 percentage points.

Spring barley in 2014 will remain a profitable activity, but the level of income from operations without subsidies in the group of farms will differ 2.2-fold in favour of the I quartile. It should be noted that direct costs in the sample from the I quartile compared to IV quartile will be lower by 61.3% and total costs – by 44.6%. Thus, farmers will receive higher income with less inputs of means of production and lower costs.

The projection for 2014 made for **winter rapeseed** also indicates the advantage of farms with lower levels of direct costs (I quartile). Although these farms are expected to have lower performance results and lower sales prices of rapeseed, respectively by 21.2 and 3.0%, the profitability index of production will exceed the level of farms in the top quartile (IV) of direct costs by 41.1 percentage points (it is expected that in the I quartile it will be 145.2%, and in the IV quartile – 104.1%, and the average of the set will be 119.6%). Compared to the base year 2011, the profitability winter rapeseed can be lowered by about 2 percentage points.

It is expected that in 2014 in case of farms from the I quartile, as compared to the IV quartile, the direct costs of cultivation of 1 ha of winter rapeseed will be lower by 55.7% and total costs – by 45.3%. Despite lower inputs of means of production, and thus lower costs, the income from production (without subsidies) can be 6-fold higher. Advantage of rapeseed grown in case of farms using low-input technologies is evident. It is estimated that the higher level of inputs stimulated the increase in costs, but did not bring the expected increase in yields.

Sugar beets are the only activity of the five subjects, where the projection in the perspective of 2014, in relation to the base year 2011, provides for a stronger growth rate of the value of production than of the costs – by about 1 percentage point. This will happen due to increase in yield (by 7.0%) as well as higher selling prices of roots (by 5.3%). However, the costs could increase by about 12%. Consequently, one should expect a slight improvement in profitabil-

ity, both in percentage terms and expressed as the difference between the value of production and the costs incurred.

Similarly to the activities discussed previously, the economic performance of sugar beet in case of farms using low-input technologies (from the I quartile of direct costs) compared to farms using high-input technologies (from the IV quartile) was more favourable. Profitability index was higher by 30.4 percentage points and amounted to 134.3% and 103.9%, while the average in the set was 116.8%. Income from production, i.e. without the support of subsidies was also higher, the difference in favour of farms from the I quartile was 6.6-fold. It should be noted that the area of cultivation and yielding of sugar beet in both groups of farms were similar, so in the units from the I quartile, the inputs of means of production were used more rationally. Perhaps it was the effect of different agri-technical treatments and greater care of farmers in their application.

Production on the farm is conducted in specific natural and economic conditions. Decisions taken by farmers always involve uncertainty and risk. This is mainly due to differences in the time when decisions are made and when the effects of the adopted solutions become visible.

The results show that inputs of means of production, which are expressed in value terms by the level of direct costs, are an important element in decision-making. Taking into account the production and economic aspects, the choice of production technology (e.g. more environmentally friendly) is extremely important. The role of soil is also of great importance, adjusting the level of fertilization to the actual needs of plants ensures better use of fertilizer ingredients and reduces costs, but requires testing soil fertility. This is not the only factor that stimulates the growth of crops, the relationship between the amount of crops and fertilizer dose is actually a very complicated and depends on many factors, such as forecrop, quantity and distribution of rainfall, the number and amounts of fertilizer doses and timing of fertilization, N:P:K fertilizer ingredients ratio, and the pH of the soil. A certain level of yield can be obtained without fertilization, it is the effect of the natural fertility of soil. Furthermore, the same yield effect can be obtained with suitable amount or event several times higher fertilizer doses. Fertilization instead of the positive effect can produce decrease in crop.[78]

[78] M. Gębska, T. Filipiak, *Podstawy ekonomiki i organizacji gospodarstw rolniczych*, Warsaw University of Life Sciences – SGGW, Warsaw 2006.

Optimal pH of the soil is extremely important for obtaining high-quality and high yields. It decides the structure of the soil, its water holding capacity, biological activity, thermal properties and the absorption of nutrients by plants. More than half of the arable land in Poland is acidic. Excessive acidification of soils is very unfavourable for crop production. The plants are undernourished, including as a result of inhibition of the development of the root system and reduced availability of nutrients.[79] Acidification of soil in the Polish soil and climate conditions is a natural process. In recent years, however, this process has been greatly accelerated, this phenomenon is a consequence of [80]:

- increasing impact of industrial emissions of sulphur and nitrogen compounds and associated acid rain,
- irrational fertilization and acidifying effects of mineral fertilizers,
- commodity nature of agricultural production and moving large amounts of elements including agricultural produce earmarked for sale outside farms.

The study showed that in case of farms from the I quartile production results of examined activities were worse than in the IV quartile (except sugar beet), but despite this economic side of their production was more favourable. This was due to lower production costs.

Farmers often pay attention to price as the determinant of the profitability of production, but research shows that cost is a factor as important, perhaps even more important, because it largely depends on the farmer. In the case of the five examined production activities, their economic efficiency was higher in case of farms classified in the I quartile of the direct costs. This is indicated in the analysis of multi-year data which were used to build a projection for 2014, but also by the results of this projection. In the next few years one should expect a stronger growth in costs than that of the value of production, in this context, the level of cost of cultivation is essential to maintain profitability at a satisfactory level.

[79] *O zanieczyszczeniu wód azotem – raz jeszcze*; http://kpodr.com.pl/srodowisko/inne/o_zanieczyszczaniu_wod_azotem_raz_jeszcze.php [access: June 2012].
[80] *Kwasowość gleb*; http://nawozy.com.pl/Wiadomo%C5%9Bci/Kwasowo%C5%9B%C4%87-gleb-8747.html [access: June 2012].

TABULAR ANNEX

Table 1. Selected indicators of changes in cost items, according to the projections of results of activities made in 2014

Specification	2012 / Level for 2011*	2013 / 2012	2014 / 2013	2014 / Level for 2011*
Seed:				
winter wheat	104.4	104.2	104.0	113.1
winter rye	105.0	104.7	104.5	114.9
spring barley	104.5	104.3	104.1	113.4
winter rapeseed	106.2	105.8	105.5	118.6
sugar beet	103.4	103.3	103.2	110.2
Mineral fertilizers	104.8	104.5	104.3	114.2
Crop protection products	101.1	101.0	101.0	103.2
Electricity	104.6	104.4	104.2	113.7
Fuel	104.4	104.2	104.0	113.0
Repairs**	103.4	103.3	103.2	110.1
Agricultural services	104.0	103.8	103.7	111.8
Farm insurance	102.5	102.4	102.3	107.4
Interest on loans	97.6	97.7	97.9	93.3

* Estimation for 2011, data for years 2006-2011 were adjusted by rates of changes determined based on the trend function and averaged.
** According to the changes in the prices of construction materials and renovation and construction service.

Table 2. Results of winter wheat growing in the base year 2011* and the projection for 2014 (in current prices)

Specification	On average in surveyed farms		Farms with a lower level of direct costs (I quartile)		Farms with an upper level of direct costs (IV quartile)	
	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014
Number of surveyed farms	150		37		37	
Crop area [ha]	19.85		13.14		30.87	
Yield of grain [dt/ha]	59.5	61.6	45.8	47.4	67.8	70.2
Grain sales price [PLN/dt]	63.42	67.01	61.40	64.88	64.40	68.05
	Per 1 ha of crops, in PLN					
Total value of production	3,784	4,137	2,819	3,084	4,367	4,784
Total direct costs	1,317	1,462	711	795	1,731	1,917
of which: seed	186	210	183	207	205	232
mineral fertilizers in total	765	874	386	441	1,003	1,146
crop protection products	316	326	131	135	443	457
Gross margin without subsidies	2,467	2,675	2,107	2,289	2,636	2,867
Indirect costs in total	1,303	1,474	965	1,082	1,387	1,577
Income from operations without subsidies	1,164	1,201	1,142	1,207	1,250	1,290
Subsidies**	752	848	749	848	752	848
Income from operations	1,916	2,049	1,891	2,055	2,002	2,138
TOTAL COSTS	*2,620*	*2,936*	*1,677*	*1,877*	*3,117*	*3,495*
Measures of economic performance						
Profitability index [proc.]	144.4	140.9	168.1	164.3	140.1	136.9
Total costs/1dt of grain [PLN]	44.02	47.67	36.62	39.62	45.99	49.81
Income from operations without subsidies/1dt of grai [PLN]	19.56	19.50	24.95	25.47	18.44	18.38
Total costs/PLN 1 of income from operations without subsidies [PLN]	2.25	2.45	1.47	1.56	2.49	2.71
Subsidies for PLN 1 of income from operations without subsidies [PLN]	0.65	0.71	0.66	0.70	0.60	0.66
Share of subsidies in the income from operations [proc.]	39.3	41.4	39.6	41.3	37.6	39.7

* Estimation for 2011, data for years 2006-2011 were adjusted by rates of changes determined based on the trend function and averaged.

** In the period 2006-2011 subsidies include complementary area payments and single area payments, and for 2014 the estimate of subsidies in accordance with the planned objectives of the CAP for the period 2014-2020.

Table 3. Results of winter rye growing in the base year 2011* and the projection for 2014 (in current prices)

Specification	On average in surveyed farms		Farms with a lower level of direct costs (I quartile)		Farms with an upper level of direct costs (IV quartile)	
	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014
Number of surveyed farms	122		31		31	
Crop area [ha]	10.94		6.87		14.60	
Yield of grain [dt/ha]	33.6	33.9	27.8	28.0	40.3	40.7
Grain sales price [PLN/dt]	51.32	55.77	52.78	57.36	52.03	56.54
	Per 1 ha of crops, in PLN					
Total value of production	1,732	1,899	1,470	1,616	2,100	2,308
Total direct costs	699	788	310	353	1,058	1,188
of which: seed	124	142	107	123	158	182
mineral fertilizers in total	467	533	188	214	694	792
crop protection products	84	86	15	15	136	140
Gross margin without subsidies	1,033	1,111	1,160	1,263	1,041	1,120
Indirect costs in total	701	793	526	593	867	982
Income from operations without subsidies	332	319	633	670	175	137
Subsidies**	752	848	755	848	750	848
Income from operations	1,084	1,167	1,389	1,518	925	985
TOTAL COSTS	*1,401*	*1,581*	*836*	*946*	*1,925*	*2,171*
Measures of economic performance						
Profitability index [proc.]	123.7	120.2	175.8	170.8	109.1	106.3
Total costs/1dt of grain [PLN]	41.69	46.62	30.10	33.76	47.77	53.38
Income from operations without subsidies/1dt of grai [PLN]	9.88	9.40	22.81	23.90	4.34	3.37
Total costs/PLN 1 of income from operations without subsidies [PLN]	4.22	4.96	1.32	1.41	11.00	15.84
Subsidies for PLN 1 of income from operations without subsidies [PLN]	2.27	2.66	1.19	1.27	4.29	6.19
Share of subsidies in the income from operations [proc.]	69.4	72.7	54.4	55.9	81.1	86.1

* Estimation for 2011, data for years 2006-2011 were adjusted by rates of changes determined based on the trend function and averaged.

** In the period 2006-2011 subsidies include complementary area payments and single area payments, and for 2014 the estimate of subsidies in accordance with the planned objectives of the CAP for the period 2014-2020.

Table 4. Results of spring barley growing in the base year 2011* and the projection for 2014 (in current prices)

Specification	On average in surveyed farms		Farms with a lower level of direct costs (I quartile)		Farms with an upper level of direct costs (IV quartile)	
	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014
Number of surveyed farms	210		53		53	
Crop area [ha]	10.42		8.05		13.68	
Yield of grain [dt/ha]	39.7	39.9	35.6	35.8	41.9	42.1
Grain sales price [PLN/dt]	60.70	64.54	56.16	59.72	60.29	64.11
	Per 1 ha of crops, in PLN					
Total value of production	2,416	2,582	2,008	2,143	2,532	2,705
Total direct costs	814	912	435	483	1,115	1,248
of which: seed	163	185	135	153	187	212
mineral fertilizers in total	499	570	184	210	703	803
crop protection products	136	140	101	105	193	199
Gross margin without subsidies	1,602	1,671	1,573	1,659	1,417	1,457
Indirect costs in total	420	467	358	398	455	505
Income from operations without subsidies	722	678	859	857	464	385
Subsidies**	788	848	788	848	788	848
Income from operations	1,510	1,526	1,647	1,705	1,252	1,233
TOTAL COSTS	*1,694*	*1,904*	*1,148*	*1,286*	*2,068*	*2,320*
Measures of economic performance						
Profitability index [proc.]	142.6	135.6	174.8	166.6	122.5	116.6
Total costs/1dt of grain [PLN]	42.67	47.72	32.28	35.95	49.39	55.12
Income from operations without subsidies/1dt of grai [PLN]	18.19	16.99	24.16	23.95	11.09	9.15
Total costs/PLN 1 of income from operations without subsidies [PLN]	2.35	2.81	1.34	1.50	4.45	6.03
Subsidies for PLN 1 of income from operations without subsidies [PLN]	1.09	1.25	0.92	0.99	1.70	2.20
Share of subsidies in the income from operations [proc.]	52.2	55.6	47.8	49.8	62.9	68.8

* Estimation for 2011, data for years 2007-2011 were adjusted by rates of changes determined based on the trend function and averaged.

** In the period 2006-2011 subsidies include complementary area payments and single area payments, and for 2014 the estimate of subsidies in accordance with the planned objectives of the CAP for the period 2014-2020.

Table 5. Results of winter rapeseed growing in the base year 2011* and the projection for 2014 (in current prices)

Specification		On average in surveyed farms		Farms with a lower level of direct costs (I quartile)		Farms with an upper level of direct costs (IV quartile)	
		Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014
Number of surveyed farms		133		33		33	
Crop area	[ha]	18.31		15.89		25.62	
Seed yield	[dt/ha]	31.6	31.8	26.5	26.7	33.7	33.9
Seed sales price	[PLN/dt]	128.47	141.07	126.42	138.83	130.32	143.11
		Per 1 ha of crops, in PLN					
Total value of production		4,054	4,483	3,349	3,704	4,387	4,851
Total direct costs		1,717	1,915	1,026	1,153	2,340	2,602
of which: seed		168	199	117	139	217	257
mineral fertilizers in total		1,055	1,205	686	783	1,369	1,564
crop protection products		414	428	203	209	613	632
Gross margin without subsidies		2,338	2,568	2,324	2,551	2,046	2,249
Indirect costs in total		1,617	1,834	1,243	1,399	1,795	2,059
Income from operations without subsidies		720	734	1,081	1,152	251	191
Subsidies**		765	848	773	848	762	848
Income from operations		1,486	1,582	1,854	2,000	1,013	1,039
TOTAL COSTS		*3,334*	*3,749*	*2,268*	*2,551*	*4,136*	*4,660*
Measures of economic performance							
Profitability index	[proc.]	121.6	119.6	147.7	145.2	106.1	104.1
Total costs / 1dt of seeds	[PLN]	105.63	117.96	85.62	95.63	122.87	137.49
Income from operations without subsidies / 1 dt of seeds	[PLN]	22.83	23.11	40.80	43.20	7.45	5.62
Total costs/PLN 1 of income from operations without subsidies	[PLN]	4.63	5.10	2.10	2.21	16.48	24.46
Subsidies for PLN 1 of income from operations without subsidies	[PLN]	1.06	1.15	0.72	0.74	3.04	4.45
Share of subsidies in the income from operations	[proc.]	51.5	53.6	41.7	42.4	75.2	81.7

* Estimation for 2011, data for years 2006-2011 were adjusted by rates of changes determined based on the trend function and averaged.

** In the period 2006-2011 subsidies include complementary area payments and single area payments, and for 2014 the estimate of subsidies in accordance with the planned objectives of the CAP for the period 2014-2020.

Table 6. Results of sugar beet growing in the base year 2011* and the projection for 2014 (in current prices)

Specification		On average in surveyed farms		Farms with a lower level of direct costs (I quartile)		Farms with an upper level of direct costs (IV quartile)	
		Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014	Level for 2011*	Projection for 2014
Number of surveyed farms		158		39		39	
Crop area	[ha]	8.48		8.20		9.64	
Yield of roots	[dt/ha]	577	617	586	627	583	623
Sales price of roots	[PLN/dt]	11.25	11.85	11.15	11.75	11.46	12.07
		Per 1 ha of crops, in PLN					
Total value of production		6,505	7,326	6,577	7,375	6,682	7,537
Total direct costs		2,619	2,881	1,959	2,161	3,338	3,672
of which: seed		751	828	605	666	956	1,053
mineral fertilizers in total		1,134	1,295	872	997	1,423	1,625
crop protection products		682	704	459	474	851	878
Gross margin without subsidies		3,886	4,445	4,618	5,214	3,344	3,865
Indirect costs in total		2,996	3,394	2,950	3,332	3,142	3,582
Income from operations without subsidies		889	1,051	1,668	1,881	202	283
Subsidies**		2,825	848	2,531	848	2,922	848
Income from operations		3,714	1,899	4,199	2,729	3,124	1,131
TOTAL COSTS		*5,615*	*6,275*	*4,909*	*5,493*	*6,479*	*7,254*
Measures of economic performance							
Profitability index	[proc.]	115.8	116.8	134.0	134.3	103.1	103.9
Total costs / 1dt of roots	[PLN]	9.74	10.17	8.38	8.77	11.12	11.64
Income from operations without subsidies / 1 dt of roots	[PLN]	1.54	1.70	2.85	3.00	0.35	0.45
Total costs/PLN 1 of income from operations without subsidies	[PLN]	6.31	5.97	2.94	2.92	32.00	25.66
Subsidies for PLN 1 of income from operations without subsidies	[PLN]	3.18	0.81	1.52	0.45	14.43	3.00
Share of subsidies in the income from operations	[proc.]	76.1	44.7	60.3	31.1	93.5	75.0

* Estimation for 2011, data for years 2007-2011 were adjusted by rates of changes determined based on the trend function and averaged.

** In the period 2007-2011 subsidies include sugar payments and single area payments, and for 2014 the estimate of subsidies in accordance with the planned objectives of the CAP for the period 2014-2020.

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