

CHANGES IN THE RELATIONS OF PRODUCTION FACTORS IN AGRICULTURE (THE CASE OF POLAND)

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Abstract

Observed trends in the changes in relations between the production factors and the level of price of agricultural products cause in the long term the necessity to adopt new production technologies. In the situation of fast growth of the labour cost in relation to other production costs there is necessity to adopt labor-saving technology in order to improve the capital – labour relation. It results in substitution of more expensive labour by less expensive capital. The aim of this study is to analyze the changes in relation of production factors in agriculture on the example of Poland. It has been stated that in agriculture in Poland, the loss of land used for agriculture and decapitalization of fixed assets in the absence of outflow of the agricultural population to non-agricultural departments are observed. The result is a deterioration in the relationship between labor resources and the resources of land and capital.

Key words: capital, efficiency of production factors, labor, land, relationships between factors of production

INTRODUCTION

The organization of production processes in agriculture is based on the appropriate binding together the individual factors of production (land, labor and capital). The connection method of production factors in certain production processes is defined as technique of production. Each farmer in the manufacture of products has to choose the appropriate manufacturing techniques. Mutual relations of production factors depend mainly on the relative prices of factors of production and performance. Behaving rationally manufacturer tries to always use the factors of production to a greater extent that are relatively cheaper (compared with their productivity), and reduce the consumption of these, which are expensive. Factors of production can replace each other, so they are substitutable provided that there is a certain (often very large number of production techniques). If there is only one production techniques, substitution of production factors is impossible [7]. In a market economy the correct allocation of factors of production (in terms of their relationship and their level) is the basis for effective management.

Analysis of the world's agricultural diversity indicates the existence of some general regularities, based on which the proportions of the factors of production are arranged, determining the level and structure of agricultural production costs. In each country there are in a particular historical moment some resources of production factors, which determine their supply and prices. This in turn affects the way the management of enterprises by the choice of the optimal production techniques. Pricing system makes the combination of factors of production in each country and in all circumstances different. With the abundance of land and scarcity of capital ratio of cost of land to capital is that it pays off to combine large areas of land with a relatively small amount of capital. Production remains at low levels of capital intensity. But where there is a large abundance of technical resources (capital), their price is relatively low. Because of that, the share of capital in the production process will be greater [5, 9]. In the case of agriculture, there are two important types of relationships: (i) between labor and capital inputs and land resources; (ii) between the resources of land and capital and labor resources. The first type of

relationship is used to measure the so-called the intensity of agricultural production. The second type of relationship is in turn the meter of equipping labor with land and other production means, particularly technical.

The aim of this study is to analyze the changes in relation of production factors in agriculture on the example of Poland.

MATERIALS AND METHODS

The empirical material were statistical data from the Central Statistical Office of Poland for the years 1995 - 2013, and data from the European Farm Accountancy Data Network (FADN) for the years 2004-2012.

The paper presents the basic relationship between the three factors of production: land, labor and capital. Changes in the efficiency of production factors of production resources involved were shown against the background of these relations. Gross agricultural output³, intermediate consumption⁴, gross value of fixed assets, net value of fixed assets were expressed in constant prices of 2011, making adjustments based on inflation.

RESULTS AND DISCUSSIONS

The management of the production potential in agriculture is based on existing opportunities for combination of and substitution of factors of production. The phenomenon of substitution of factors of production creates many possibilities of their combination, depending on the socio-economic and technical nature. Particularly important for the relationship of factors of

production are their prices, especially rising labor costs compared to other factors of production [8]. In conditions of rapid growth in labor costs compared to other factors of production it becomes necessary to implement labor-saving technology resulting in an increase in the capital-labor relations. The result is a substitution of increasingly expensive inputs of labor by relatively cheaper capital. However, the problem of substitution of factors of production in agriculture is complicated. In this case, substitution of production factors is loaded by the factor of the land. Agricultural production is described by the three-factor production function, rather than the two-factor as in other fields. Hence the efficiency and cost of materials is limited by the efficiency of the factor of the land. Land as a factor of production is characterized by a lack of mobility, which among other things implies inefficient, by Pareto, allocation of production factors. In addition, land factor due to natural reasons has a naturally limited opportunity to stimulate productivity.

Production potential of agriculture depends on the level of equipping with the factors of production. Land resources in Poland in the analyzed period decreased from 17.9 million hectares to 14.6 million hectares, an change of 18.5% (Figure 1). The decline in the agricultural area is an inevitable process, resulting from an increase in the competitiveness of land use between both agricultural and non-agricultural use as. Agricultural and economic analysis on the countries of medium and highly developed market economy indicate the prevalence of these trends. The high rate of loss of agricultural land means a new economy of land resource utilization. The consequence of this is the new shape of the production processes in agriculture, which is to increase the intensification of effort per unit area of agricultural land, with all the consequences, such as negative externalities, including environmental. This process can be observed in agriculture in Poland, the decrease in the area of agricultural land has increased the production intensity reflected in an increase in the intermediate consumption per unit of

³ Gross agricultural output includes: crop output, i.e., raw (not processed) products of plant origin (harvests for a given year); animal output, i.e., production of animals for slaughter, raw (not processed) products of animal origin as well as the increase in farm animal stocks (livestock - the basic and working herd) which include: cattle, pigs, sheep, horses and poultry.

⁴ Intermediate consumption includes the value of agricultural products from own production, agricultural products utilised for production purposes as well as the purchase of materials (including fuels), energy, outside services (external processing, agricultural, veterinary, insemination and transport services, current repairs, telecommunications services, commissions paid for banking services), financial intermediation services indirectly measured (FISIM), costs of business travels (excluding data regarding private farms) and other costs (e.g. insurance, rentals and leasing). The valuation of materials used in production was performed using annual average purchase prices.

utilized agricultural area (Figure 9).

Economic development of any country is associated with changes in the level and structure of employment. Reaction of agriculture to economic development is facilitated by structural changes (especially the concentration processes occurring in agriculture) and the outflow of the agricultural population to non-agricultural sectors. Analyzing the labor force in agriculture in Poland, we can see that despite the economic development of the country there has not been a significant outflow of population employed in agriculture to non-agricultural departments, and even since the year 2010 the number of people employed in agriculture has increased

(Figure 1). Relationship of the number of people working in agriculture per 100 ha (Figure 2) and the percentage of people working in agriculture in total employment (in the years 2005 to 2013, this ratio at the level of 16-17%) also remained at a high level. This situation may be related to the inability to move away from agriculture resulting from high unemployment persisting in the national economy (Figure 3). In addition, it may be due to the nature of farms in Poland, where family farms, spatially small, with excess of labor are predominant.

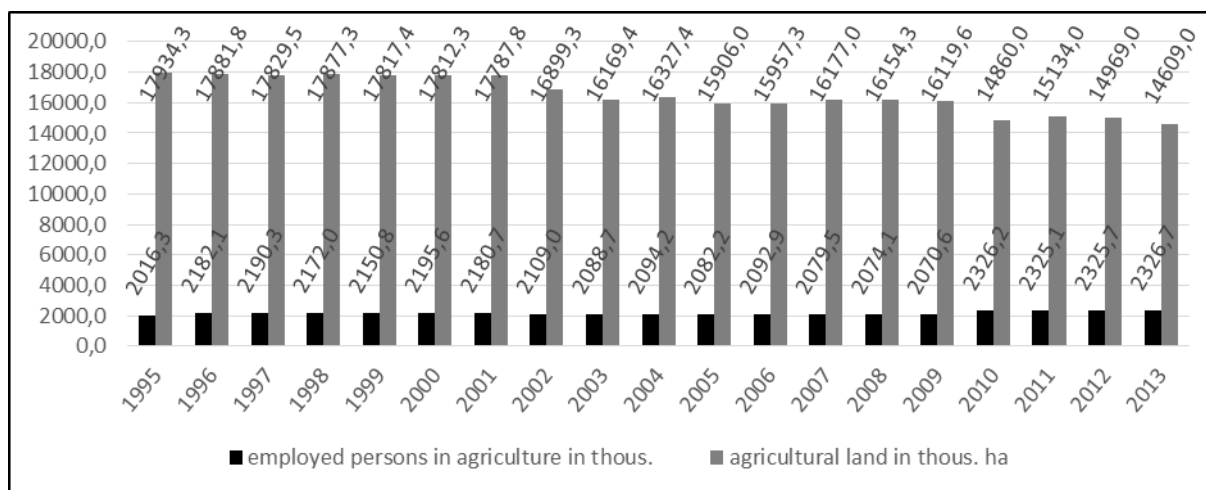


Fig. 1. The number of people employed in agriculture and the agricultural area in Poland in the years 1995-2013
Source: own calculations based on statistical data of the Central Statistical Office

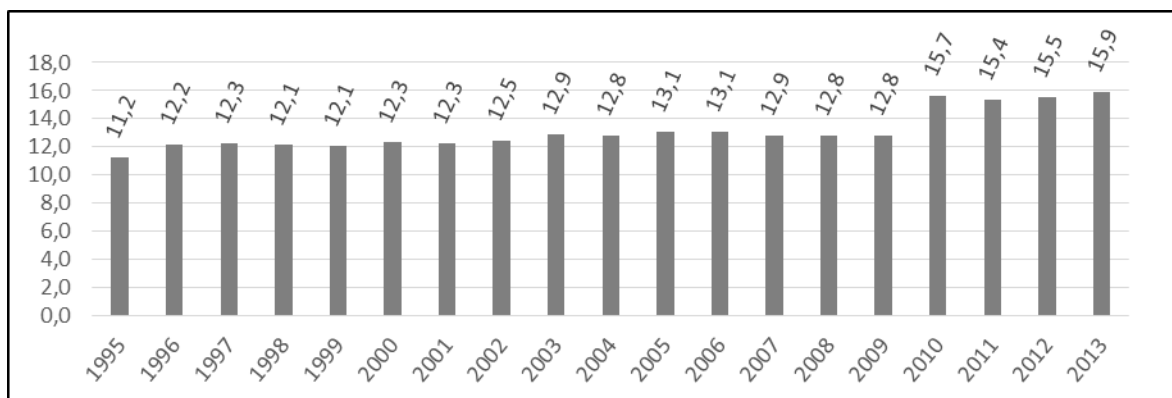


Fig. 2. Number of persons engaged in agriculture per 100 ha of agricultural land in Poland in the years 1995-2013
Source: own calculations based on statistical data of the Central Statistical Office

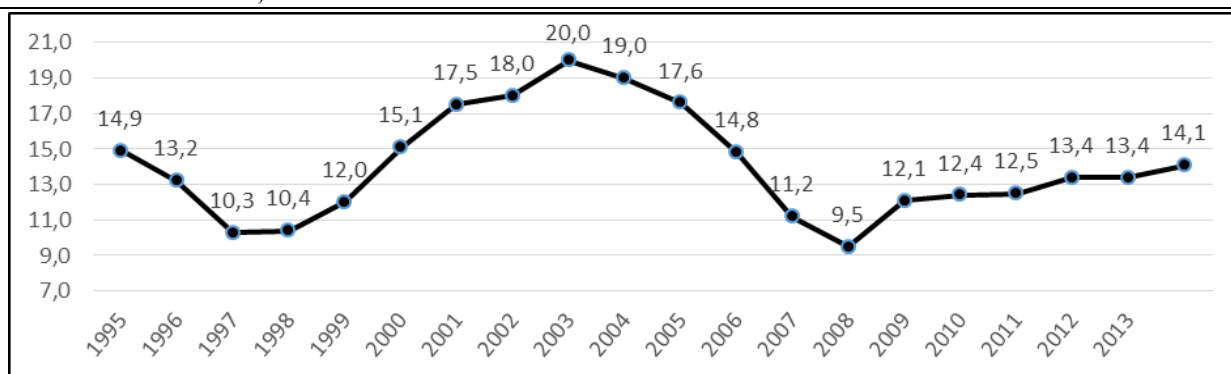


Fig. 3. The unemployment rate in Poland in the years 1995-2013 [%]

Source: own calculations based on statistical data of the Central Statistical Office

The level of agricultural equipment in fixed assets determines the degree of agriculture technisation. The real value of the gross and net assets in agriculture in Poland in the analyzed period of time was reduced (Figure 4). Similarly, the value of fixed assets per employee and per 1 ha of agricultural land decreased. However, in 2013 this trend was halted and technical equipping of land and work has increased compared to 2012 (Figure 5 - 8). Cited statistics include all farms in Poland, but do not show the state of differentiation of Polish agriculture. Generally it is manifested in the existence of many small, vulnerable households having a social character, with marginal contacts with the market and the relatively small number of larger farms producing for the market (Table 1). In small farms, representing the vast majority there is a lack of investment capacity and the process of depreciation of fixed asset is present. Investment capabilities are held by greater farms with potential for development. The changes that occur in the group of commodities farms can be observed by analyzing the data obtained from the Polish FADN (Farm Accountancy Data Network). The observed relationship between the factors of production tend to be different than those observed in agriculture in Poland. Labor input per unit area of agricultural land decreased, and labor resources and land equipment in total assets and fixed assets increased (Table 2). While analyzing the relationship of selected non-current assets (buildings and machinery) to the land resources and effort, the ratio of machines than buildings increased to a greater extent (Table 2). This situation

indicates that changes in the structure of fixed assets in the advantage of mobile assets over nonmobile. Investments in mobile assets, compared to non-mobile fixed assets, are characterized by a greater degree of reversibility due to the higher degree of liquidity of these assets and a market for used machines [3]. Therefore, the flexibility of agricultural holdings increased. It is worth to pay attention to a relationship, despite the decline in the value of the gross and net assets per 1 ha of agricultural land, the level of intermediate consumption increased (expenditure of current assets, such as: yield-forming agents, fertilizers, pesticides) on agricultural area (Figure 9). It is related to the need to implement technical progress in agriculture [6], especially biological, but also is related to the availability of technical and biological agents not only in a substantive sense, but also because of their price decrease [7]. The need to implement biological and chemical technology is also associated with the loss of agricultural land in Poland and the desire to increase the productivity of the land. The observed trend of increasing expenditures related to the current assets while reducing fixed assets may also be associated with a desire to improve the structure of capital employed in curbing capital assets (generating fixed costs, which is characterized by a lack of mobility, irreversibility or less flexibility) in favor of the current assets. Furthermore, it can also be a reflection of the structural changes in agriculture in Poland, consisting of a slow decrease in the share of smallest-area households (Table 1).

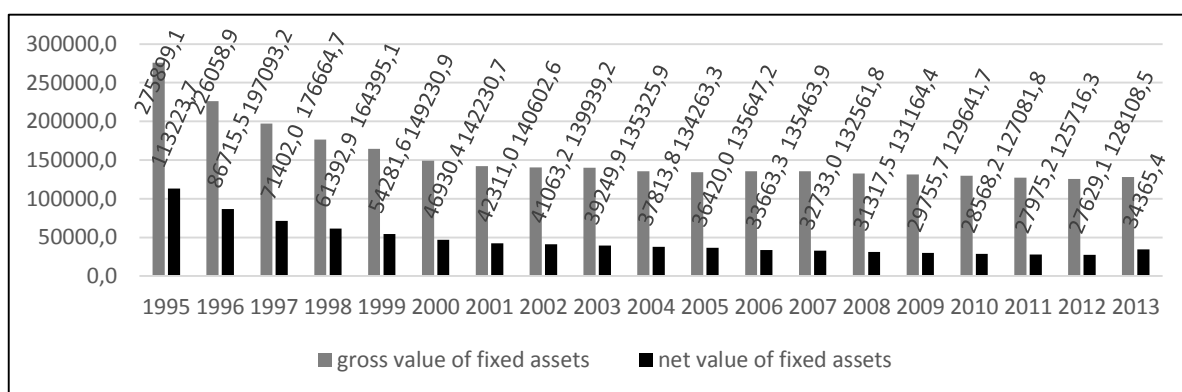


Fig. 4. The gross and net value of the assets in agriculture in Poland in the years 1995-2013 [million PLN] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

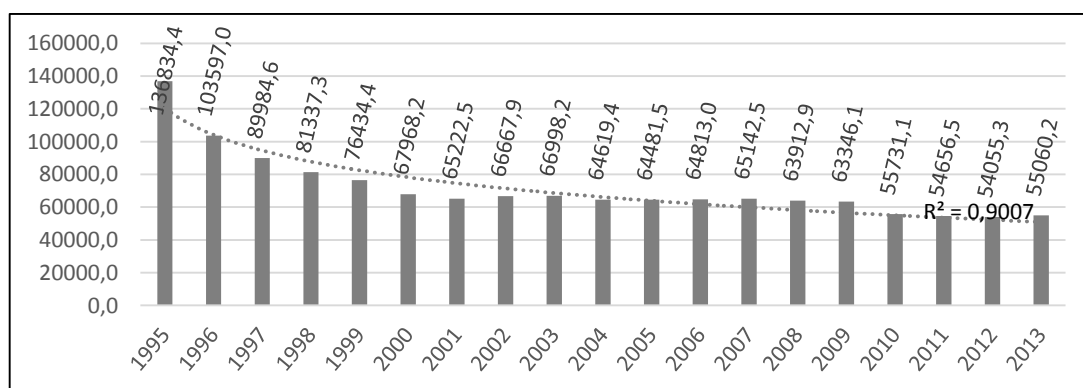


Fig. 5. The gross value of fixed assets per worker in agriculture in Poland in the years 1995-2013 [PLN] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

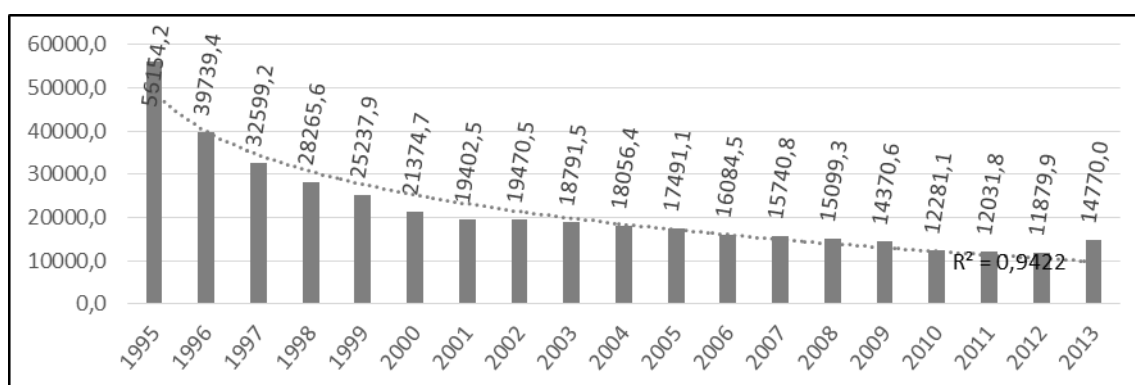


Fig. 6. The net value of fixed assets per worker in agriculture in Poland in the years 1995-2013 [PLN] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

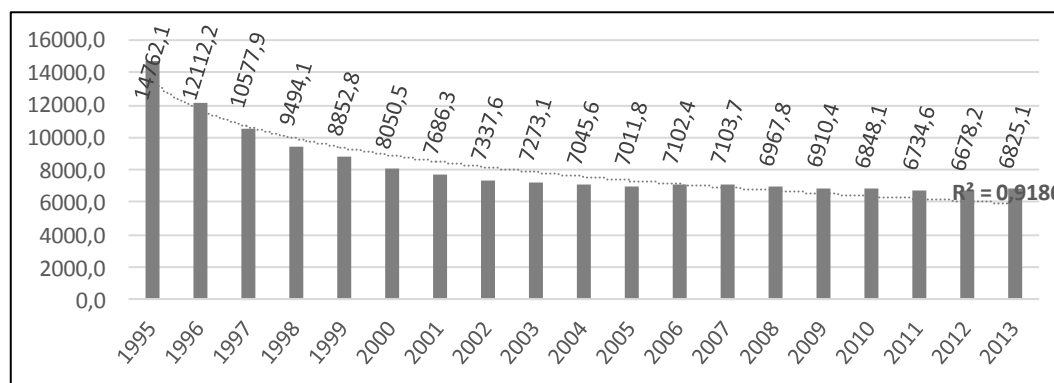


Fig. 7. The gross value of fixed assets per 1 ha AL in agriculture in Poland in the years 1995-2013 [PLN/1 ha AL] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

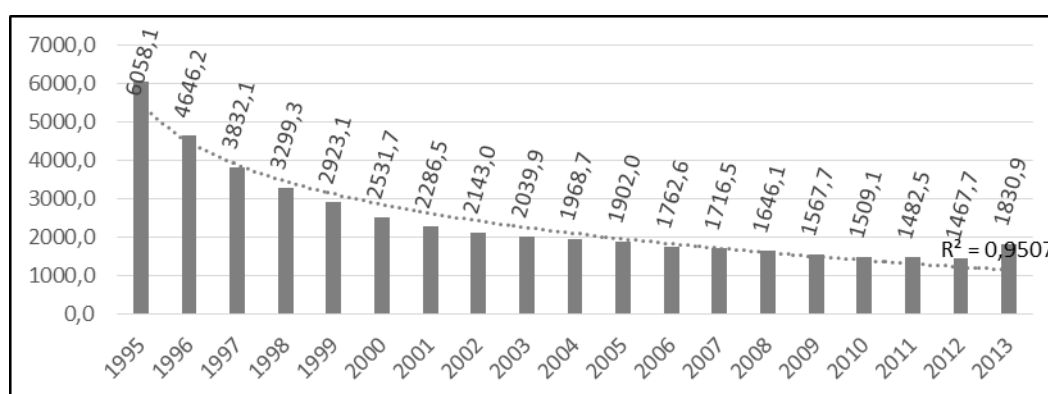


Fig. 8. The net value of fixed assets per 1 ha AL in agriculture in Poland in the years 1995-2013 [PLN/1 ha AL] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

Table 1. Number of farms of the area exceeding 1 ha in Poland in the period 2002-2013 (in thousands)

Year	Total	Farm size clusters			
		1-5	5-20	20-50	>50
2002	Number 1,951.7	1,146.3	692.8	95.5	17.1
	% 100	58.7	35.5	4.9	0.9
2010	Number 1,480.2	790.0	569.4	96.6	24.3
	% 100	53.37	38.47	6.53	1.64
2013	Number 1,391.1	732.5	526.3	102.9	29.3
	% 100	52.66	37.83	7.40	2.11

Source: own calculations based on statistical data of the Central Statistical Office

Table 2. Relations of production factors in farms engaged in agricultural accounting according to the rules of the FADN

Parameter	Year								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total labor input AWU*/100 ha AL	11.19	10.31	10.09	9.60	9.12	9.23	9.09	9.23	9.18
Total assets EUR/1 ha AL	4325.75	4073.33	4298.15	4861.65	5296.74	7281.92	7901.35	8048.26	8292.78
Total assets EUR/total labor AWU*	38661.36	39513.56	42588.57	50632.95	58056.98	78901.76	86914.88	87173.84	90309.83
Total fixed EUR/1 ha AL	3674.19	3428.31	3565.40	4017.89	4377.68	6518.57	7003.63	7061.08	7246.55
Total fixed EUR/total labor AWU*	32838.07	33256.50	35328.00	41845.45	47983.24	70630.59	77039.88	76481.40	78916.18
Buildings EUR/1 ha AL	1681.25	1713.16	1722.84	1812.22	1957.75	1681.43	1783.06	1770.21	1786.52
Buildings EUR/total labor AWU*	15026.14	16618.64	17070.86	18873.86	21458.66	18218.82	19613.69	19173.84	19455.49
Machinery EUR/1 ha AL	991.99	969.89	975.09	1054.94	1209.33	1066.99	1106.33	1151.74	1206.21
Machinery EUR/total labor AWU*	8865.91	9408.47	9661.71	10986.93	13255.31	11561.18	12169.64	12475.00	13135.84

* AWU – annual work unit – full time person equivalent

Source: own calculations based on statistical data FADN

http://ec.europa.eu/agriculture/rica/database/database_en.cfm

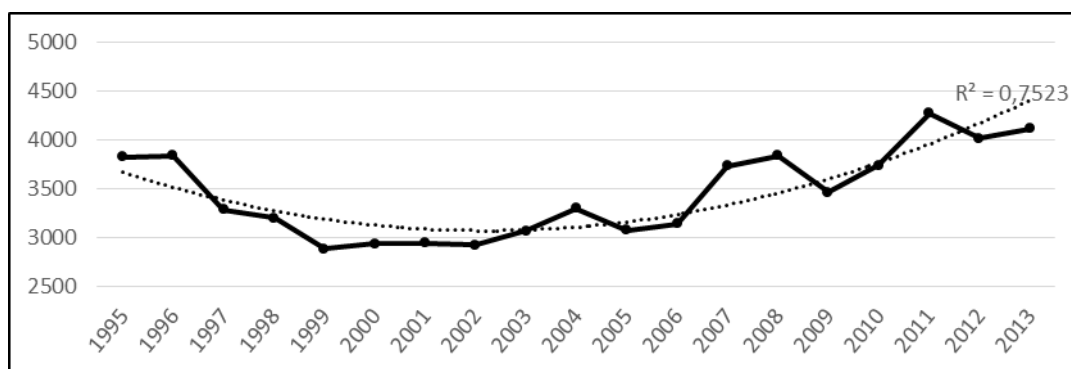


Fig. 9. The intensity of agricultural production - the value of intermediate consumption per 1 ha AL [PLN/ha] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

Attention should be paid to the differences observed in the mutual relations of production factors between agricultural holdings under Polish FADN and the total of farms. They result from structural defects of agriculture in Poland, particularly related to high agrarian dispersion. As a result, it is difficult to achieve proper relations of production factors. The pace of concentration in agriculture influences the ability to improve the relations between labor and capital expenses and land resources and between resources of land and capital and labor resources. Activation of this

process requires a selection of appropriate instruments in support of concentration in agriculture, particularly the possibility of increasing off-farm employment. However, this depends on the level of economic development of the country, especially the absorbency of the labor market.

Changes in the relationship between the factors of production should also be considered in the context of changes in the effectiveness of individual factors of production.

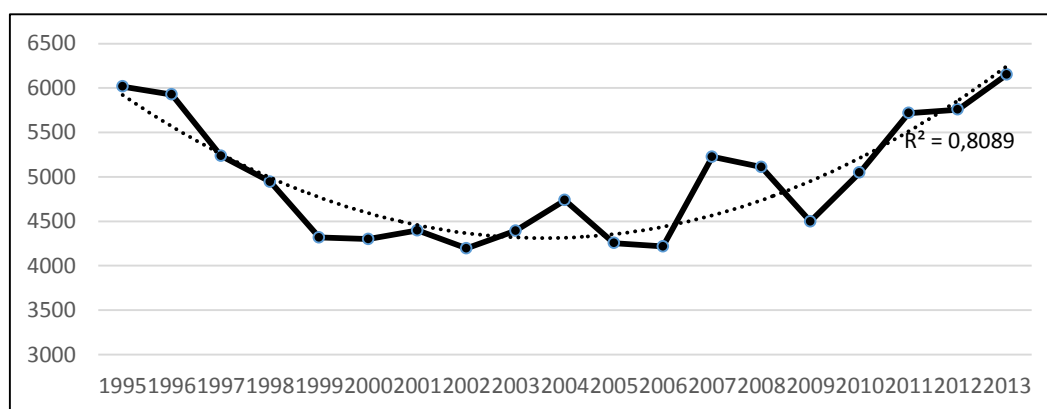


Fig. 10. Productivity of land in Poland [gross agricultural output minus payments PLN/1 ha AL] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

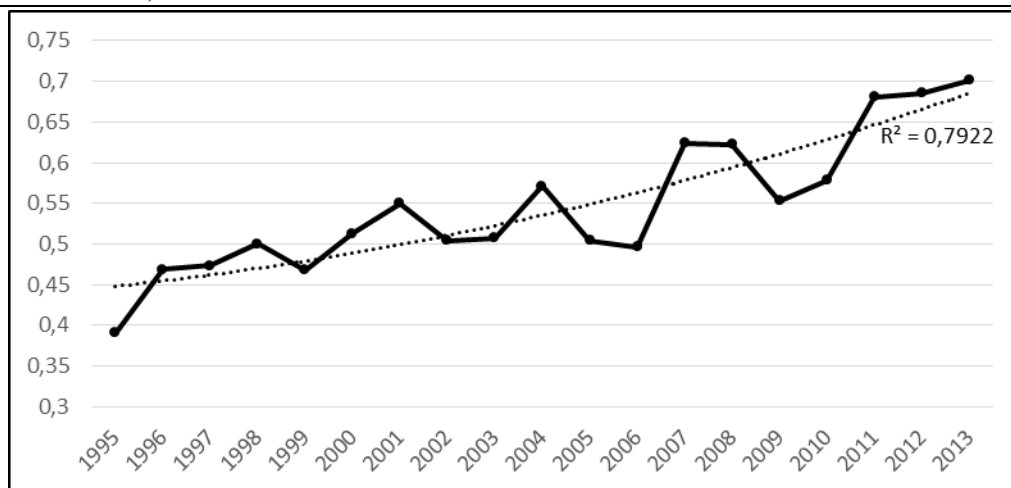


Fig. 11. Productivity of gross value of fixed assets in Poland [gross agricultural output minus payments PLN/gross value of fixed assets PLN] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

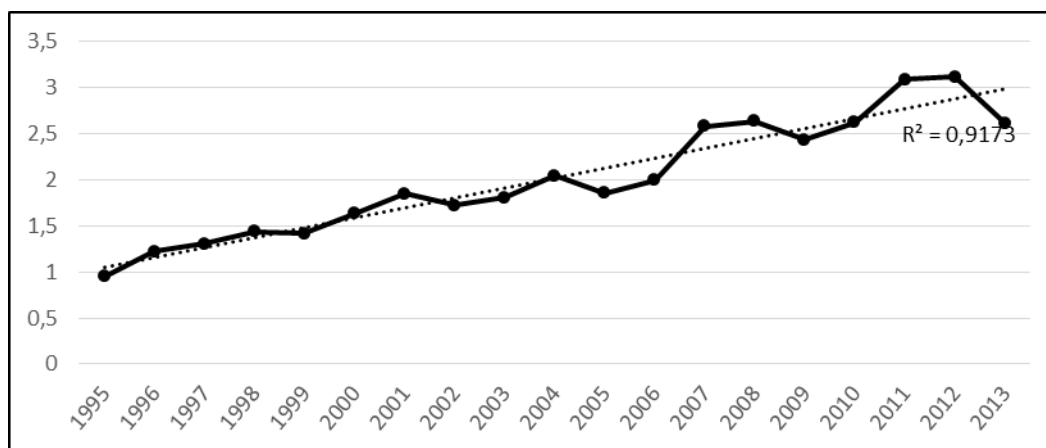


Fig. 12. Productivity of net value of fixed assets PLN in Poland [gross agricultural output minus payments PLN/ net value of fixed assets PLN] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

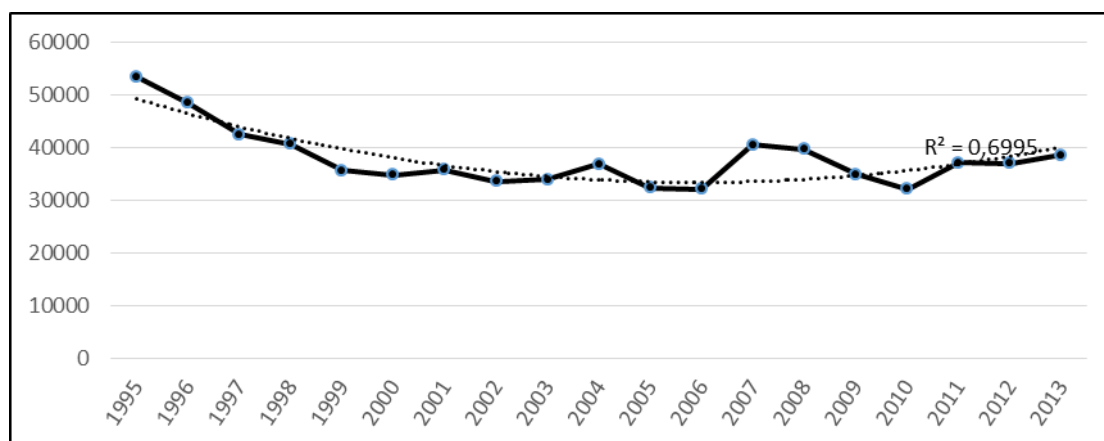


Fig. 13. Labor productivity in agriculture in Poland [gross agricultural output minus payments PLN/per one employee] - fixed prices in 2011

Source: own calculations based on statistical data of the Central Statistical Office

In Poland, as presented above, the loss of the land used for agriculture occurs and the value of the assets at the disposal of the farmers was

reduced, and in the case of the labor force decline was not observed. Gross agricultural output minus the amount of payments made

under direct payments schemes was used to assess the effectiveness of the factors of production. The analysis shows that increased land productivity (Figure 10) and the effective use of gross fixed capital formation (Figure 11) and net fixed capital formation (Figure 12). In the case of labor since the Polish accession to the European Union in 2004, there has been a downward trend, after the accession, this trend has been slightly reversed (Figure 13). However, to improve the work efficiency, issues related to the possibility of migration from agriculture will be the most important. In broad terms, the mechanism of loss of employed in agriculture is described by the model of D.W. Jorgenson [2] and A.C. Kelly, J.G. Williamson and R.J. Cheetham [4]. Better known is the theory of mechanism of loss of employment in agriculture based on "*labor push - labor pull*." Pushing the labor force from agriculture occurs due to improvements in agricultural technology combined with Engel's law release resources from agriculture ("*labor push*"), and improvements in industrial technology attract labor out of agriculture ("*labor pull*") [1].

CONCLUSIONS

The relationship between the factors of production affect the effectiveness of the factors of production on the one hand, on the other hand indicate the directions of changes in agriculture. The study allows us to formulate the following conclusions:

-In agriculture in Poland, the loss of land used for agriculture and decapitalization of fixed assets in the absence of outflow of the agricultural population to non-agricultural departments are observed. The result is a deterioration in the relationship between labor resources and the resources of land and capital. To improve these relationships, it is important to stimulate agrarian changes in agriculture especially concentration processes, the implementation of technical progress resulting in pushing labor from agriculture. At the same time forces must also act to allow to pull labor from agriculture, and these are mainly related to the country's economic development, especially the development of

the labor market in non-agricultural sectors.

-Comparing the relationship of factors of production in agriculture in Poland to the same relationship in farms covered by FADN accounting difference in relationships is noticeable. The farms covered by Polish FADN positive changes are observed. The reason for such differences is the polarization of farms in Poland. There is a large group of small farms, economically weak and relatively small group of farms that are larger, economically stronger, investing, modernizing its production workshop.

-Changes in the relations of production factors cause changes in the efficiency of individual stocks. The research shows that productivity of land and the performance of fixed assets in agriculture increased. For labor efficiency a downward trend was mitigated.

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