

THE COMPARISON OF CHANGES IN THE IMPLEMENTATION OF PRODUCTION AND ENVIRONMENTAL AIMS OF AGRICULTURE IN SELECTED GROUPS OF VOIVODSHIPS

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ABSTRACT

The importance of regionalization of Polish agriculture is constantly increasing, mostly due to its environmental, organizational and economic differences between regions. The process of regionalization has become especially visible after Polish accession to the European Union. The study compared the changes in the utilization of production capacity for selected voivodships, located in different parts of Poland, i.e. Dolnośląskie and Opolskie (A) and Małopolskie and Podkarpackie (B), in the years 2002–2004 and 2012–2014. The main data sources were Central Statistical Office of Poland publications and the results of an own study. The analysis showed significant differences in the production capacity of Polish agriculture and in the utilization of production potential in different regions. The differences between the analyzed groups of voivodships were mostly due to management and intensity differences of agricultural production, while habitat and natural conditions were of a minor importance. Agriculture of Dolnośląskie and Opolskie proved to be the most effective in achieving production and environmental objectives.

Key words: production-environmental aims, agro-environmental indicators, regional differentiation, Poland

INTRODUCTION

The production potential of Polish agriculture is quite significant when compared with most European Union countries, especially when agricultural production areas or a number of persons employed in agriculture are compared [Mierosławska 2001, Poczta 2010]. The assessment of agricultural production potential should include numerous indicators. According to Zięta [2003], one of the most important of them, apart from the means of production, is the way those factors are combined and managed together. Utilization of production capacity of agriculture depends on many factors including: the quality of natural conditions, measured by index of agricultural production space valuation (APSV), agrarian structure, labour resources, labour and pulling force, agro-technical level, technical infrastructure of farms, as well as on the local farming traditions [Bogocz et al. 2010]. The diversity of environmental, organizational, and economic conditions of different regions of Poland contributes to the differentiation of agriculture, which is especially visible since 2004 (when Poland accessed the European Union – EU). Moreover, agricultural development rate is different in various parts of the country [Rudnicki et al. 2015, Kopiński and Matyka 2016], the same applies to rural areas development [Stany 2013]. Regional heterogeneity of Polish agriculture has a much wider, European importance [Matuszczak 2013].

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Polish accession to the EU had a significant impact on utilization of production and economic objectives of agriculture as it shaped rural policies. This resulted in changed relations of the utilization costs of each of production means and in progress in technical development. Polish accession to the EU increased also the significance of subsidies and the financial resources allocated to the various activities of Rural Development Programme [Bułkowska 2011, Runowski 2014]. External factors, which have been extensively discussed in the study edited by Wigier [2011], also have a definite impact on the effects of changes in the agriculture and food economy.

The aim of the study is to compare the dynamics of realization of production and environmental objectives of agriculture in selected voivodships in different parts of Poland.

MATERIAL AND METHODS

Desk study of Central Statistical Office of Poland (CSO) reports [GUS 2003–2015a, b, c, d] as a primary source of information was performed. A comparative analysis of the two groups of voivodeships, namely Dolnośląskie and Opolskie (Group A) and the Małopolskie and Podkarpackie (Group B), located in the Southern Poland, belonging to two different regions, was made to obtain the standard gross margin characteristics. The comparison and evaluation of the above-mentioned groups of voivodships were performed using the principle of deliberate choice, subjective on the base of the production-economic and environmental results of Polish agriculture on the NUTS-2 level [Filipiak 2003]. Changes in individual regions between the periods of 2002–2004 and 2012–2014 (as three-year average) were taken into consideration. This approach reduces the effect of random fluctuations potentially present in analyses of annual values and allows to observe the trends.

The changes of differences between the compared groups of voivodships (A, B) were determined on the basis of differences in absolute values or percentage points (p.p.) between the tested characteristics (*x* indicators) in the different periods of research according to the formula:

$$\text{difference } x (A - B) = xA - xB$$

A comparative assessment of voivodships was performed using analytical indicators, based on the available literature [Klepacki 1997, Harasim 2013], characterizing:

- environmental and organizational conditions, described with index of agricultural production space valuation (APSV), quality index of soil, the share of soils potential threatened by erosion, and the average area of farms, structure of agricultural land use, cropping pattern, the level of livestock load, the level of persons employed in agriculture, and the value of fixed assets;
- production and economic indicators, determining the unit of crop and animal production, the level of mineral fertilization NPK, the value of gross agricultural output, the value and structure of agricultural market output, the share of areas under the direct payments, special and separate support or less favored area (LFA) subsidies;
- environmental indicators, described by the gross balance of nitrogen and phosphorus according to the methodology of the OECD Eurostat [Kremer 2013] and balance of soil organic matter according to the methodology proposed by Eich and Kundler [Fotyma and Mercik 1995].

The size of the analyzed indicators referred to the utilized of agricultural area (UAA – according to CSO definition). In this study, crop yields were calculated into cereal units (100 kg of cereal grains) [Harasim 2013], while animals – into livestock units (LU), based on the coefficients set out in the regulation of the Ministry of Agriculture and Rural Development (MARD) from 2004.

The scope of analysis includes only selected aspects of the assessment of the production capacity of agriculture. It constitutes an attempt to explain identified phenomena by analyzing the cause and effect relationships.

RESULTS AND DISCUSSION

Among the compared groups of voivodships the better quality of natural conditions for agricultural production (APSV) was identified for Group A which includes Dolnośląskie and Opolskie (Table 1). This group was also found to have better soil quality (by approx. 12%) than voivodships of Group B. Additionally, APSV and index of soil quality in both tested areas were higher than the average for whole Poland. The advantage of voivodships in Group A could be explained by the fact that the highest values of average annual temperature in Poland (what affects the length of climate growing season) were observed in Nizina Dolnośląska, where Group A voivodships are mainly located [Krasowicz et al. 2009]. Moreover, this region, compared to voivodships of Group B, is relatively under little risk of soil wind and water erosion. In Małopolskie and Podkarpackie, the percentage of these soils in the agricultural land (AL) area is 64% (Table 1).

The average farm area in Group A is over four times higher than in Group B. The difference in the size of area farms in the years 2002–2014 was 12.4 ha of AL. Although in both groups there was an increase in the size of farms. The polarization between these two regions deepened. Between the periods 2002–2014 and 2012–2014, Group B had a 28% decrease in the size of agricultural land, while in Group A, this decline was only 11% (Table 1). In Group B, permanent grassland has a significant share (39%) in the structure of the agricultural land. Compared to 2002–2004, within recent 10 years, there has been an increase in the share of permanent grasslands by 8% in this region. However, structural changes of land use in the Group A voivodships are steady. In both groups, in the reference period, there has been a decrease in the percentage of set-aside land. Although this decrease was more rapid in Group B, the share of such land in Group A is still larger (about 4 p.p.) than in Group B.

The comparison of the two groups of voivodships shows that the crops patterns on arable land are largely adapted to the needs of the main kinds of production and to organizational and market conditions. In Dolnośląskie and Opolskie, oil crops have a significant share in the total agricultural area. These plants, next to cereals, determine the structure of the market agricultural output. Group A have a significantly higher share of sugar beet in the sown area structure than Group B. In contrast, Group B had a significantly higher share of potatoes, fodder and other crops (tobacco, vegetables) compared to Group A. The decrease in the share of potato is clearly visible between 2002 and 2014. In Group B, the share of cereals increased for the years 2002–2004 by 8 p.p. and is currently by 2 p.p. higher than in Group A which are more suitable for cereal cultivation for organizational reasons. We may conclude that in Group B, since 2002, an organization of both crops and animal of production have been more and more simplified livestock load, in the years of 2012–2014 it was 31.5 LU·ha⁻¹ AL, after an approx. 28% decrease compared to the period of 2002–2004 (Table 1). The data presented in Table 1 show a reduction of the distance in terms of livestock load between the compared groups of voivodships. It may be assumed that Group B are heading towards non-livestock agricultural production, which is characteristic for Dolnośląskie and Opolskie voivodships (Group A). The animal stock pattern in both groups was dominated by cattle. More dynamic structural changes took place in Group A. The assessment of changes in the animal stock pattern showed the decrease of the differences between the two regions.

Factors which clearly differentiate the agriculture in the compared regions include work force and capital resources. In Group A of voivodships, the level of employment in agriculture, forestry, hunting and fishing in 2012–2014 was 10% compared to the total number of employees and was by 15 p.p. lower than in Group B (Table 1). In the Małopolskie and Podkarpackie, compared to the period of 2002–2004, the share of persons employed in agriculture increased by nearly 5 p.p. This phenomenon, together with visible simplifications in the organization of agricultural production, point to the deterioration of works productivity.

The average farm of the area over 1 ha in the Group A has a much higher value of fixed assets than the average farm from Group B. Compared to the period of 2002–2004 the difference between compared groups reached approx. 37 thousand PLN per farm (Table 1).

Table 1. Characteristics and changes of natural and organization agriculture conditions in compared voivodships groups

Specification	Group A of voivodships		Group B of voivodships		Difference (A – B)	
	Years 2012–2014	Change ^a	Years 2012–2014	Change ^a	Years 2012–2014	Years 2002–2004
Index of agricultural production space valuation (APSV) (points)	78.3	100	69.9	100	8.4	8.4
Index of soil quality AL (points)	0.95	100	0.83	100	0.12	0.12
Share of soil strong potential threatened by windy and water erosion in AL (%)	4.6	100	64.3	100	–59.7	–59.7
Area of agriculture land (thous. ha AL)	1 409.8	89.0	1 098.9	71.7	310.9	51.3
Area of farms above 1 ha (ha AL)	16.4	130	4.0	145	12.4	9.9
The structure of agricultural land use (% in AL)						
arable land (ArL)	86.1	1.3	59.0	–9.3	27.0	16.4
permanent crops	0.7	0.2	2.5	1.1	–1.8	–0.8
grasslands	13.2	–1.5	38.5	8.2	–25.2	–15.5
Set-aside land (% in ArL)	2.9	–9.6	6.8	–13.1	–3.9	–7.4
Cropping pattern (%)						
cereals	72.4	–5.5	74.4	8.1	–2.0	11.5
oil crops	17.1	8.5	4.9	3.5	12.2	7.2
pulses	0.7	0.3	1.5	0.8	–0.8	–0.3
potatoes	2.5	–1.8	8.9	–6.5	–6.4	–11.2
sugar beet	2.8	–1.5	0.8	–0.2	2.0	3.3
fodder crops	3.2	0.4	5.6	–2.7	–2.4	–5.5
other crops	1.4	–0.4	3.8	–2.8	–2.4	–4.9
Livestock load (LU·ha ⁻¹ AL)	20.9	80.6	31.5	71.6	–10.6	–17.9
Animal stock pattern (LU in %)						
cattle	55.0	8.2	63.0	4.6	–8.0	–11.7
pigs	25.6	–8.7	13.4	–2.1	12.2	19.0
other	19.4	0.5	23.6	–2.5	–4.2	–7.3
Share of employed persons in agriculture (%) ^b	10.4	–0.5	25.8	4.9	–15.4	–10.0
Value of fixed assets (thous. PLN·farm ⁻¹)	144.6	177.7	46.3	232.8	98.2	61.4

^a for absolute values the 2002–2004 years = 100; ^b – also in forestry, hunting and fishing.

Source: Own study on basic CSO data and Stuczyński et al. 2000, Harasim and Matyka 2009.

A factor, which differentiates the agriculture of the compared groups of voivodships, is an intensity of production, measured by the level of use of mineral fertilizers. Data in Table 2 indicate running a high-cost crop production in Group A, and a low-cost one in Group B. In this respect, the gap between them got significantly larger (by approx. 68 kg NKP·ha⁻¹). Compared to the period of 2002–2004, the level of production intensity in Group B has not significantly changed, whereas, in Group A, it has risen largely (by 70%). A negative phenomenon, visible in Group B, was the increase of the disproportion in the relation between N, P and K fertilizer consumption in favor of nitrogen, leading to an increased acidification of arable land [Filipek and Skowrońska 2013]. In result, this causes a low land productivity of Małopolskie and Podkarpackie, deepening the distance to Dolnośląskie and Opolskie (Table 2).

Differentiation of indexes of animal production per 1 ha of agricultural land is the result of animal stock density and their unit quantity. Unit quantity of milk per cow is significantly higher in Group A than in Group B. The gap between these groups extended further, amounting to 1,451 l·unit⁻¹·milk⁻¹ (Table 2) in the years 2002–2004. Analyses showed no significant differences in terms of the obtained gross and market agricultural output per 1 ha. The structure of market agricultural production is the evidence of production focus and specialization in the analyzed groups of voivodships. In Group A cereals and industrial crops have a fairly significant share in this structure market agriculture output (total 60%). In Group B, other market crops (excluding vegetables) and the animal for slaughter (together about 56%) constitute major products due to the agrarian structure and the specifics of an organization of agricultural production of the polish voivodships.

There was no significant difference in terms of investment outlays per AL area unit between the two groups, although in the analyzed period (2002–2014), there outlays grew at a faster pace in the voivodships of Group B (Table 2). To some extent, the level of outlays is also affected by the level of the use of resources for agriculture under the Common Agricultural Policy (CAP) after Poland's accession to the EU in 2004. In the years of 2012–2014, the total the amount of payments incurred 1 ha AL was on average, 1,008 PLN for Group A, and 1,060 PLN for Group B, although, in the period of 2002–2004, the differences between these groups were reversed. Currently, Group A receive a higher amount of direct payments (per 1 ha), while Group B obtain larger sums from specific and separate support and from subsidies for less favored areas.

The effect of a specific organization and intensity of the production are becoming more and more visible processes of specialization and concentration of production on the level of voivodships. These changes are then reflected in the state of the environment, there are changes in agro-environmental indicators related to soil fertility and the composition and quality of ground waters. Table 3 presents selected environmental indicators, characterizing the degree of the realization of environmental aims in the compared groups of voivodships.

The compared groups of voivodships, despite significant differences in the production intensity, mainly of crops (Table 2), exhibit very low gross nitrogen balances and negative or close to “0” balances of P and K (Table 3). In the discussed period, the differences between the compared groups in terms of balances of nitrogen, phosphorus and potassium significantly decreased. The existing state result from “spontaneous” greening of agriculture in the Group B (Małopolskie and Podkarpackie) and from a very good nutrient use despite that voivodships – Group A (Dolnośląskie and Opolskie) has a very intensity agriculture production.

Compared to the period of 2002–2004, the increase in the surplus affected only the gross nitrogen balance, up to the level of 36 kg N·ha⁻¹ UAA in Group A (Table 3). However, this level does not indicate any environmental risks (at a voivodship level) [Kopiński 2016]. In contrast, the surplus of nitrogen balance in Group B, being currently a little higher than the size of the estimated deposit of atmospheric in precipitation (11 kg·ha⁻¹ UAA). The found negative balances of P and K may indicate the process of impoverishment of soils in these macronutrients, leading to the decline in fertility and consequently to soil degradation. In the analyzed period the production aims (crop yields) and environmental aims (moderate balance and a good use efficiency of outputs nitrogen) which are evaluated through the results of nutrient balances they were the best combined in Dolnośląskie and Opolskie forming of Group A.

Table 2. Characteristics and changes of production and economic agriculture indices of compared group voivodships

Specification	Group of voivodships A		Group of voivodships B		Difference (A – B)	
	Years 2012–2014	Change ^a	Years 2012–2014	Change ^a	Years 2012–2014	Years 2002–2004
Mineral fertilizers (kg·ha ⁻¹ UAA)						
NPK total	180.1	169.2	74.6	108.3	105.5	37.6
N	101.5	186.6	42.2	133.1	59.3	22.7
P ₂ O ₅	36.1	162.6	15.0	83.6	21.1	4.2
K ₂ O	42.5	142.3	17.4	90.6	25.1	10.7
Crop output (cereal units·ha ⁻¹ UAA)	55.3	123.2	34.3	112.7	21.0	14.4
Milk production (l·units ⁻¹ ·year ⁻¹)	5 342	112.5	3 891	107.6	1 451	1 132
Animal for slaughter output (kg·ha ⁻¹ AL)	138.0	97.2	165.6	109.6	-27.6	-9.1
Gross agricultural output (PLN·ha ⁻¹ AL)	5 681	172.6	5 235	150.6	446	-184
Agricultural market output (PLN·ha ⁻¹ AL)	4 586	208.8	4 286	228.7	300	323
The structure of market auricular output (%)						
cereals	38.5	5.4	12.1	6.9	26.4	27.8
industrial	21.4	6.7	5.2	2.0	16.1	11.4
other crops	9.0	0.1	28.8	1.5	-19.7	-18.3
milk cows	8.3	-2.0	16.0	-7.2	-7.7	-12.9
animal for slaughter	18.5	-7.4	27.3	-1.8	-8.8	-3.1
eggs and other animals output	4.3	-2.8	10.6	-1.3	-6.3	-4.9
Investment outlays in agriculture ^b (PLN·ha ⁻¹ AL)	298.0	254.2	302	314.6	-4	21
The amount of payment – total (PLN·ha ⁻¹ AL)	1 007.5	568.6	1 059.5	633.9	-52.0	10.0
direct payments	952.6	659.7	878.2	780.0	74.4	31.8
specific and separate support	12.6	-	106.1	-	-93.5	-
payments of LFA	42.3	129.0	75.3	138.0	-33.0	-21.8

^a for absolute values the 2002–2004 years = 100; ^b also in forestry, hunting and fishing.

Source: Own study on basic CSO data.

In the years of 2012–2014 voivodships of Group A had a negative balance of soil organic matter amounting to 0.10 t d.m.·ha⁻¹ ArL (Table 3). This balance did not change in relation to 2002–2004. In contrast, Group B showed, after a large decrease, the surplus of soil organic matter amounting to 0.09 t d.m.·ha⁻¹ ArL. The negative balance of soil organic matter is the result of long terms of production specialization and non-livestock management in the Western Poland voivodships.

Table 3. Characteristics and changes of agri-environmental indicators of compared group voivodships

Specification	Group of voivodships A		Group of voivodships B		Difference (A – B)	
	Years 2012–2014	Change ^a	Years 2012–2014	Change ^a	Years 2012–2014	Years 2002–2004
Gross nutrients balance (kg·ha ⁻¹ UAA)						
N	36.0	158.1	14.1	49.4	21.9	-5.8
P	-0.6	-126.5	-1.2	-28.3	0.6	-3.9
K	0.4	-9.6	-6.9	-208.7	7.2	-7.1
Efficiency N use (%)	73.2	-3.9	83.4	15.7	-10.1	9.4
Balance of soil organic matter (kg dm·ha ⁻¹ ArL)	-0.10	105.2	0.09	43.9	-0.19	-0.30
Share of soil (%)						
acid and very acid	33.1	-9.9	59.2	-5.6	-26.1	-21.8
with a low and very low content of P	33.2	0.6	52.8	-2.7	-19.6	-22.8
with a low and very low content of K	25.6	-6.5	50.8	-2.4	-25.1	-21.1

^a for absolute values the 2002–2004 years = 100.

Source: Own study on basic CSO data.

Table 3 shows the results of the evaluation of the state of agrochemical soil, as measured by the share of acidic and very acidic soils and of soils with a very low and low resources in phosphorus and potassium. A high percentage (over 50%) of such soils in the voivodships of Group B points, alongside significant restrictions organizational and economic in these regions, the cause of much weaker utilization of its potential crop production than in the other two voivodships compared, i.e. Dolnośląskie and Opolskie (Table 3). This is confirmed by the results of Filipiak [2003] which indicate a low productivity of land in Central and South-Eastern Poland. In the South-Eastern Poland specific feedback was created, difficult to break. However, according to Faber [2002] only after the structural reorganization of agriculture, especially in this part of Poland, it will be possible to make a better use of agricultural production space.

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CONCLUSION

In conclusion, the simplified nature of the performed assessment should be noted. The collected data and assessment method, based on subjectively selected indicators, do not allow forming final opinions. However, the analysis indicates a quite considerable diversification of the production capacity of Polish agriculture and its use at a regional level. The differences between the analysed groups of voivodships, i.e. Dolnośląskie, Opolskie (Group A), and Malopolskie and Podkarpackie (Group B), are to a lesser extent caused by habitat and natural conditions, but result mainly from the different levels of the organization and the intensity of

agricultural production. A number of the analyzed organizational and production indicators reveals that these differences largely increased between the period of 2002–2004 and 2012–2014.

Among the compared two groups of voivodships, Group A (including Dolnośląskie and Opolskie) was more efficient in terms of production organization. By contrast, Malopolskie and Podkarpackie show a tendency to simplify plant and animal production with the simultaneous stabilization of intensity at a fairly low level. Despite these differences, both the level of investment in agriculture and the amount of the payments incurred are at a similar level in the both groups.

The characteristic feature of Małopolskie and Podkarpackie is a high number of persons employed in agriculture, and at the same time, low land productivity. In the analyzed period, Dolnośląskie and Opolskie are the most efficient in combining production (crop yields) and environmental objectives (moderate balance and good use of inputs nitrogen). It is confirmed by the assessment of agrochemical soil conditions in the compared groups of voivodships.

The conducted analysis has confirmed the existence of the different models of the utilization of agricultural production, evidenced by the divergent level of organization and intensity. This points out the need to regionalize the national agricultural policy, what in the future should be reflected, *inter alia*, in the *ex-ante* evaluation of the current Rural Development Programme as well as in the new improved version of the program.

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PORÓWNANIE ZMIAN REALIZACJI CELÓW PRODUKCYJNO-ŚRODOWISKOWYCH ROLNICTWA W WYBRANYCH GRUPACH WOJEWÓDZTW

STRESZCZENIE

W opracowaniu dokonano porównania zmian w realizacji możliwości produkcyjnych rolnictwa w wybranych województwach, tj. dolnośląskiego i opolskiego (A) oraz małopolskiego i podkarpackiego (B), między okresami 2002–2004 a 2012–2014. Podstawowym źródłem informacji były dane statystyczne GUS oraz rezultaty badań własnych. Przeprowadzona analiza wskazała na dość znaczne zróżnicowanie możliwości produkcyjnych polskiego rolnictwa w przekroju regionalnym. Różnice między analizowanymi grupami województw w mniejszym stopniu odnoszą się do warunków siedliskowych i przyrodniczych, a wynikają przede wszystkim z odmiennego poziomu organizacji i intensywności produkcji rolniczej. Pod tym względem różnice te uległy dość dużemu pogłębieniu. Najlepszym łączeniem celów produkcyjno-środowiskowych charakteryzuje się rolnictwo województw dolnośląskiego i opolskiego. Cele produkcyjno-środowiskowe rolnictwa najlepiej łączone są w województwach dolnośląskim i opolskim.

Słowa kluczowe: cele produkcyjno-środowiskowe, wskaźniki agrośrodowiskowe, zróżnicowanie regionalne, Polska