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ORGANIC FARMING IN POLAND IN THE LIGHT OF MULTIVARIATE COMPARATIVE ANALYSIS

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ABSTRACT

Organic farming is an environmentally-friendly production system, which has been dynamically developing since 2004. The study attempts to conduct a spatial assessment of the development of this management method. The analysis covered data at the level of voivodships, originating from GIJHARS[1] and from the Central Statistical Office (GUS) from 2014, concerning producers respecting the production in the environmentally-friendly system. They include characteristics such as: average surface area, proportion of the area of arable lands, number of processing plants, production volume of: milk, cereals, vegetables, and fruit. The analysis uses the method of linear ordering of a set of objects, based on the created synthetic variable. The results of the study suggest that Polish voivodships are generally characterised by an average or low level of development of organic farming. A positive phenomenon is observed in the fact that organic farming develops in voivodships with a more fragmented agrarian structure.

Key words: organic farming, methods of linear ordering, diversity

INTRODUCTION

Organic farming fits within the concept of sustainable development. The strategy that should pursue social, economic and environmental objectives. It combines, as written by Kahl et al. [2010], actions which are to satisfy the basic needs of the society, improve the quality of life, and ensure appropriate quantity of goods and services with activities aiming at improvement in the condition of the natural environment and protection of its resources. Zegar [2012] emphasises the fact of the growing belief that the paradigm of industrial agriculture is an out-of-date concept, and the present challenge set for the agriculture is to feed the world, while simultaneously preserving biodiversity and the capacity of the global ecosystem to provide environmental services, and relieving the humanity of threats resulting from the overuse of synthetic chemical substances and other artificial growth-inducing substances.

Organic farming, as compared to integrated farming and conventional farming, is a form of management and production the most heavily related to the quality of the natural environment. It has more than a hundred years of history around the world. The basic purposes of organic farming are holistic and refer e.g. to production of high-quality food, implementation of activities supporting and preserving fertility and biological activity of soil, maintenance of genetic diversity of ecosystems, production of renewable raw materials, as well as

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support of local and regional production and distribution [Kreisberg 2006]. The base criteria of organic farming, which have become the basis for preparation of the first international regulation on organic farming and labelling of its products, were developed by the International Federation of Organic Agriculture Movements (IFOAM), created in 1972[2]. IFOAM adopted the following underlying principles, on which organic farming is based: health, ecology, fairness, and care.

Production of ecological food is developing both in well-developed countries, as well as in developing countries, which see the development of this type production as the source of export opportunities, a chance for workforce surplus management, an increase in incomes, as well as development of poor agricultural farms [Willer and Yussefi 2007]. The growing consumer expectations with regard to quality and health-improving qualities of food cause the growth in demand for organic products, and, at the same time, in opportunities for development of agricultural production generated using ecological methods [Komorowska 2014]. The organic food market, as written e.g. by Łuczka-Bakuła [2007], Runowski [2012], is developing in numerous countries around the world, but, above all, in wealthy countries, since the prices of organic products are usually explicitly higher than conventional products.

In Poland, organic farming has over half a century of tradition. Significant growth in the number of organic farms as well as the acreage of their crops was recorded after farmers had been directly covered in 1999 by financial support and after introduction of legal regulations in 2001. Poland's accession to the EU has created greater possibilities of financial support for organic producers and has opened sales markets, thus contributing to the increased interest in this agricultural system. Financial support of this production system is justified by the need to minimise the private risk of business operations related to [Łuczka-Bakuła 2013]: incurring additional costs of farm relocation, losses caused by reduction in yields, low acceptance of the price of organic food by consumers. The policy of supporting production and market of organic food, as stated by Komorowska [2006], is an important factor influencing the development of organic farming in Poland. It is also necessary to emphasise, as stated by the author, the utilisation of export opportunities, the combination of ecological production with the development of agritourism, or the development of entities integrating dispersed production.

Currently, the framework for all levels of production, distribution, control, and marking in the European Union is determined by the Council Regulation (EC) 834/2007[3], which is being continuously updated by regulations amending this Regulation. In Poland, the most important legal act is currently the Act of 25 June 2009 on Organic Farming[4], which is also subject to amendments and is published in subsequent legal acts. Since 2014, tasks related to the development of organic farming and the organic food market are implemented in Poland also in accordance with the Framework Action Plan for Organic Food and Farming for 2011–2014, prepared by the Ministry of Agriculture and Rural Development[5]. It is assumed that implementation of the planned activities (market development, promotion, information, production principles, control and certification, testing, environmental protection, cooperation) will lead to development of the whole eco-sector.

Agriculture in Poland is characterised by significant regional diversity. It is determined to a great extent by history. Also important is the impact of other environmental, demographic, economic, as well as sociocultural factors [Klepacki 2006]. Typological assessment of the development level of regions according to

[2] International Federation of Organic Agriculture Movements.

[3] Council Regulation EEC 834/2007/EC of 28 June 2007 on organic production and labelling of organic products. Official Journal of the EU of 2007, No 189, item 1, as amended.

[4] Act of 25 June 2009 on Organic Farming. Journal of Laws 2009. No 116, item 975.

[5] http://www.minrol.gov.pl/Jakosc-zywnosci/Rolnictwo-ekologiczne/Ramowy-Plan-Dzialan-dla-Zywnosci-i-Rolnictwa-Ekologicznego-w-Polsce (accessed on 1.08.2017).

Wysocki [2010] can be used as a tool for regional programming. The study covered a spatial analysis of the development of organic farming in Poland. For the purpose of comparison, groups of voivodships were distinguished, which are similar owing to the performed agricultural functions. The analysis used the method of linear ordering of a set of objects based on a synthetic variable, selected from an initial list of methods. The synthetic indicator allowed for arranging voivodships in terms of the development level of organic farming, as well as for selecting groups of similar objects.

MATERIALS AND METHOD OF STUDY

The analysis was conducted on the basis of data originating from Reports on the condition of organic farming in Poland[6], as well as Yearbooks of Agriculture[7]. The study covered Polish voivodships. Taking account of substantive and statistical premises, as well as the availability of data for the analysis the development level of organic farming, the following indicators were selected: average surface area of an organic farm[8] [ha] (X_1); number of processing plants of organic products and production of fodder and/or yeast (X_2); share of the area of arable lands (AL) of certified organic farms in total AL [%] (X_3); production volume of milk [million l] (X_4); production volume from certified organic cultivations, respectively: cereals [thousand t] (X_5), vegetables [thousand t] (X_6), fruit [thousand t] (X_7). All variables may be qualified to a set of stimuli[9]. It was assumed in the study that each variable is a stimulus and contributes the same portion of information to the evaluation of the examined objects, and that the weights of all variables are the same and amount to one.

In the first stage of the study, seven methods of linear ordering were selected, based on the synthetic variable[10], which are often used and, in the author's opinion, have are commonly found in the subject literature, and then rankings[11] of the examined objects were prepared with the use of each of them:

- model methods: R1 – Hellwig's method, standardisation of features with the use of variable standardisation; R2 – TOPSIS method, standardisation of features with the use of variable standardisation; R3 – positional method, standardisation of features with the use of positional standardisation with the Weber's median;
- non-model methods[12], taking account of standardisation of features with the use of: R4 – variable standardisation[13]; R5 – zero unitarisation method; R6 – Strahl's method; R7 – Nowak's method.

In the second stage of analysis, from among the prepared rankings (and thus the applied methods), a ranking most similar to the other ones was selected, namely one for which $\overline{u}_p$ is the highest [Kukuła, Luty 2015], when:

[6] http://www.ijhar-s.gov.pl/index.php/raporty-o-ekologii.html (accessed on 01.08.2017).

[7] http://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-rolnictwa-2016,6,10.html (accessed on 01.08.2017).

[8] An ecological farm is understood as an agricultural producer after the end of the conversion period (certified) or during the conversion period.

[9] A stimulus is a variable, high values of which are a desired phenomenon from the point of view of the object, while low values of which are undesirable.

[10] The aforementioned procedures were used and discussed e.g. in the work of Kukuła and Luty [2015].

[11] In the further part of the paper, the methods (or rankings prepared with their use) will be marked, respectively: R1, R2, R2, R3, R4, R5, R6, R7.

[12] A synthetic variable is determined as an arithmetic mean of sums of standardised values of diagnostic variables.

[13] Standardised Value Sums method (SVS).

$$\overline{u}_p := \frac{1}{v-1}\sum_{\substack{q=1 \\ p\neq q}}^{v} m_{pq}, \qquad p, q = 1, 2, ..., u \tag{1}$$

where: v – number of rankings,
n – number of objects,
m – number of diagnostic variables;

$$m_{pq} = 1 - \frac{2\sum_{i=1}^{n}\left|c_{ip} - c_{iq}\right|}{n^2 - z},$$

where: c_{ip} – position of the i-th object in the ranking with number p,
c_{iq} – position of the i-th object in the ranking with number q,

$$z = \begin{cases} 0, & n \in P \\ 1, & n \notin P \end{cases}, \text{ and}$$

P – set of even natural numbers.

The method selected in the manner described above is the basis for preparation and interpretation of the ranking of examined objects. Within the ordered set, a topological classification of similar voivodships was conducted as follows:

- I – high level of development: $Q_i \in \left\lfloor \overline{Q} + S(Q);\ \max_i Q_i \right\rfloor$,
- II – average level of development: $Q_i \in \left[\overline{Q};\ \overline{Q} + S(Q)\right)$,
- III – low level of development: $Q_i \in \left[\overline{Q} - S(Q);\ \overline{Q}\right)$,
- IV – very low level of development: $Q_i \in \left\lfloor \min_i Q_i;\ \overline{Q} - S(Q)\right)$,

where: Q_i – value of the synthetic indicator being the basis for preparation of the ranking,
$\overline{Q},\ S(Q)$ – respectively, the arithmetic mean and the standard deviation of the value Q_i.

RESEARCH RESULTS

On the basis of data from 2014 published by GIJHARS and GUS, an analysis was conducted covering indicators typical of producers respecting production in the environmentally-friendly system, which were used to assess Polish voivodships in terms of the development of the examined phenomenon.

The first indicator considered in the analysis, characterising the agrarian structure of organic farms, is the average size, which is a determinant of production and specialisation capacity. The average size of organic farms in Poland in 2014 was at the level of 26.3 ha (Table 1) and was greater by 4.3 ha than in 2004. In voivodships, this figure ranged from 11.3 ha to 44.1 ha and was characterised by average diversity (Table 2). The smallest average surface areas were recorded in farms in south-eastern Poland (Małopolskie, Świętokrzyskie, Podkarpackie, Lubelskie, Podlaskie). The largest average surface area was recorded in the Opolskie Voivodship (44.1 ha), where the number of organic farms was the smallest.

Table 1. Variables describing organic farming in Poland in 2014

Specification	Diagnostic features						
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Dolnośląskie	35.4	21.0	3.6	1.1	15.3	1.2	0.8
Kujawsko-Pomorskie	28.9	18.0	1.0	0.7	3.9	2.4	1.0
Lubelskie	16.5	48.0	2.4	0.1	8.1	5.7	11.2
Lubuskie	38.9	9.0	10.1	0.2	10.5	2.6	0.2
Łódzkie	22.1	34.0	0.9	0.3	4.1	1.3	4.1
Małopolskie	11.3	38.0	2.7	8.0	2.6	2.5	3.2
Mazowieckie	25.4	107.0	2.7	0.8	11.4	3.5	7.5
Opolskie	44.1	5.0	0.5	0.0	0.9	0.2	0.2
Podkarpackie	15.9	30.0	3.6	3.6	3.3	4.1	8.0
Podlaskie	18.9	14.0	4.8	0.7	11.6	3.8	1.7
Pomorskie	34.6	27.0	3.4	1.9	5.5	1.6	0.8
Śląskie	33.9	21.0	1.9	0.1	1.4	0.1	0.2
Świętokrzyskie	13.1	12.0	2.4	1.0	4.1	5.8	4.1
Warmińsko-Mazurskie	27.7	12.0	9.0	2.2	15.9	6.2	1.0
Wielkopolskie	43.6	57.0	2.1	0.1	10.6	2.4	2.2
Zachodniopomorskie	36.7	31.0	13.9	4.2	22.8	3.9	2.3
Poland	26.3	484.0	3.8	25.2	131.9	47.3	48.5

Source: Prepared by the author.

Table 2. Basic numeric characteristics of selected variables describing organic farming in Poland in 2014

Numeric characteristics	Diagnostic features						
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
maximum value	44.1	107.0	13.9	8.0	22.8	6.2	11.2
minimum value	11.3	5.0	0.5	0.0	0.9	0.1	0.2
arithmetic mean	27.9	30.3	4.1	1.6	8.2	3.0	3.0
median	28.3	24.0	2.7	0.8	6.8	2.5	1.9
Weber's vector coordinates	28.5	24.5	3.8	1.5	7.5	2.6	2.3
standard deviation	10.4	24.2	3.6	2.1	6.0	1.8	3.2
variability coefficient	0.4	0.8	0.9	1.3	0.7	0.6	1.0
quotient of extreme values	3.9	21.4	27.3	–	26.1	56.5	66.6

Source: Prepared by the author.

The second indicator considered in the study is the number of organic processing plants, the number of which is still low, whereas the interest in ready-made organic products increases. In total, in 2014, Poland had 484 processing plants (in 2004, they amounted to 55), 22.1% of which were located in the Mazowieckie Voivodship. Their number constitutes only 1.9% of all organic producers. On the other hand, in the Opolskie Voivodship, only five organic processing plants were registered. Half of the voivodships (Mazowieckie, Wielkopolskie, Lubelskie, Małopolskie, Łódzkie, Zachodniopomorskie, Podkarpackie, Pomorskie) had at least 27 organic processing plants within their administrative borders.

The third very important feature is the share of arable lands of certified organic farms in the arable lands of all farms. Despite the fact that, in 2006–2014, this share increased in Poland over eight times, it is still very small and reaches the level of 3.8%. The Zachodniopomorskie Voivodship has the highest share of AL in all AL managed using ecological methods (13.9%).

Two voivodships should be distinguished: Lubuskie and Warmińsko-Mazurskie, where this indicator is at the level of, accordingly: 10.1% and 9.0%. In other voivodeships, the value of this feature ranges from 0.5% up to 4.8%.

The subsequent four indicators refer to production as the source of organic milk and selected organic cultivations (cereals, vegetables, fruit). In 2014, 252376.6 hectolitres of organic milk were produced in Poland. Most of that amount was produced in organic farms of the Małopolskie Voivodship (31.9%). Great volumes of organic milk are also produced in the following voivodships: Zachodniopomorskie (4.2 million l), Podkarpackie (3.6 million l), Warmińsko-Mazurskie (2.2 million l), and Pomorskie (1.9 million l). In other voivodeships, this production is at a level not higher than 1.1mln litres, and in six of them (Opolskie, Śląskie, Wielkopolskie, Lubelskie, Lubuskie, Łódzkie) it does not exceed the value of 0.3 million litres. This feature is characterised by the largest variability (130%).

In 2014, the production of cereals in organic farms after the end of the conversion period was the highest in the Zachodniopomorskie Voivodship (22,000 t), and the smallest in the Opolskie Voivodship (900 t). Over 10,000 tons of cereals in the examined year were produced in the following voivodships: Lubuskie (10,500 t), Wielkopolskie (10,600 t), Mazowieckie (11,400 t), Podlaskie (11,600 t), Dolnośląskie (15,300 t), and Warmińsko-Mazurskie (15,900 t). This indicator is characterised by moderate variability (70%).

47,300 t of vegetables originated from production of organic cultivations in Poland in 2014, wherein potatoes constituted 36.1%. On average, the voivodship produced 3,000 tons of vegetables, the majority of which came from the following voivodships: Warmińsko-Mazurskie, Świętokrzyskie and Lubelskie.

The diversity of fruit production in certified organic farms in voivodships in 2014 was high. The value of this production ranged from 200 t (Śląskie, Opolskie, Lubuskie) to 11,200 t (Lubelskie).

As a result of application of the aforementioned methods, based on the selected set of features, the voivodships were hierarchised according to the values of synthetic indicators. Ordinal arrays differ significantly. Extreme ranks differed by seven positions. The largest similarity characterises a pair of rankings obtained with the use of two non-model ordering methods, where the standardising formula was, respectively, the variable standardisation method and the zero unitarisation method (m_{45} = 0,984). On the other hand, the largest diversity characterises a pair of rankings obtained with the use of the TOPSIS method and the positional method (m_{23} = 0,713). The ranking constructed with the use of the positional methods turned out to "stand out" the most [Kukuła and Luty 2017] among other rankings. Using the procedure supporting selection of the linear ordering method [Kukuła and Luty 2015] to perform gradation and typology of Polish voivodships in terms of the development level of organic farming, the standardised values method was chosen (Fig. 1, Fig. 2).

The highest classification was given to the Zachodniopomorskie Voivodship, for which nearly all (except for fruit production) indicators taken into consideration in the analysis exceed the average values set for all voivodships, additionally reaching maximum values in two indicators (percentage of AL, cereals production).

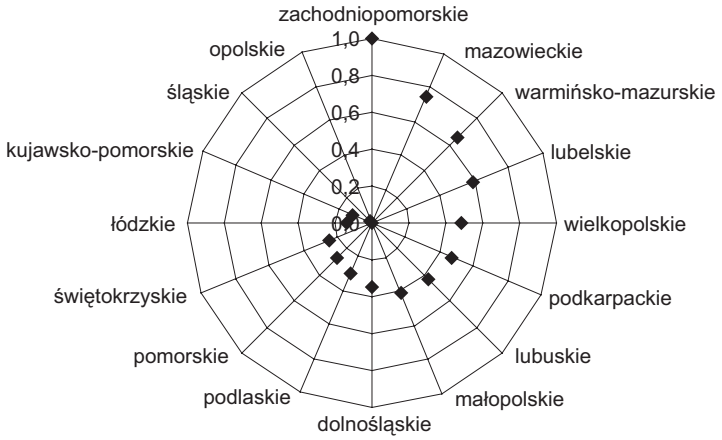

Fig. 1. Gradation of Polish voivodships due to the development level of organic farming in 2014

Source: Prepared by the author.

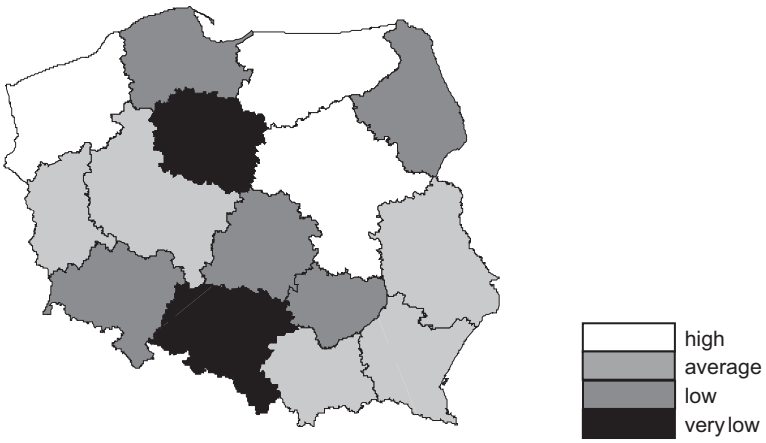

Fig. 2. Polish voivodships according to the development level of organic farming in 2014

Source: Prepared by the author.

The lowest classification was given to the Opolskie Voivodship, for which as many as five indicators reached the minimum value.

Based on values of the synthetic variable, Polish voivodships were divided into four classes. The first class – with a high level of development of the examined phenomenon, included three voivodships: Zachodniopomorskie, Mazowieckie and Warmińsko-Mazurskie.

A characteristic feature of voivodships of this class are the most beneficial values of all partial indicators covered by the analysis. At least four indicators significantly exceed the average values. The second class, characterised by an average level of development of organic farming, covers five voivodships: Lubelskie, Wielkopolskie, Podkarpackie, Lubuskie, Małopolskie. Three values of the analysed features exceed the voivodships' average. Low level of development characterises voivodships from group III, to which the following voivodships were classified: Dolnośląskie, Podlaskie, Pomorskie, Świętokrzyskie, Łódzkie. The development of organic farming was assessed as particularly unfavourable in voivodships from group IV, i.e. in the following voivodships:

Kujawsko-Pomorskie, Śląskie and Opolskie. These voivodships are characterised only by above-average size of organic farms. The other features are below the average values. For the purpose of comparison, the spatial diversity was assessed in terms of fulfilment of the agricultural functions, using the same algorithm (Fig. 3). The assessment was based on the following set of variables: average surface area of a farm [ha], share of arable land in the surface area of AL [%], share of large-area organic farms in the total number of organic farms [%], livestock in LSU. As indicated by the research results, organic farming is also developing in areas with fragmented agrarian structure. Selection of this management system may be a good direction for further transformations.

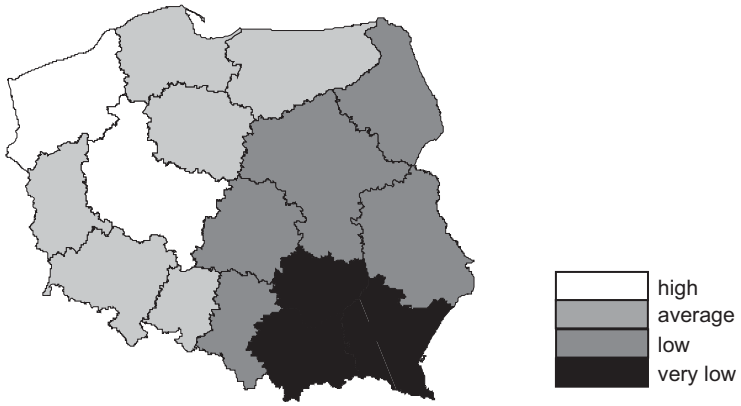

Fig. 3. Polish voivodships according to the level of performed agricultural functions in 2014

Source: Prepared by the author.

CONCLUSIONS

Organic farming is an environmentally-friendly production system of food with guaranteed quality. Creation of the idea of sustainable development leads to visible positive effects. The image of the development of organic farming in Poland is affected by many factors. Poland, being a member of the European Union, not only uses the support systems, but must also respect guidelines concerning the production methods and organisation. An important role in creation of this development is played by state institutions. Their goal should be not only to provide financial support from the national budget, but also to constantly increase the ecological knowledge, both among the producers and the consumers, as well as to create relations and organise cooperation between producers, institutions.

In 2014, organic farms in Poland constituted 97.6% of all organic producers. On average, they had a greater surface area of arable land than average agricultural farms. A positive phenomenon is the growth in the number of organic processing plants in the recent years. Their spatial distribution is not even. The percentage of surface area of arable lands where organic production is conducted distinctly exceeds the level of 5% only in three voivodships (Zachodniopomorskie, Lubuskie, Warmińsko-Mazurskie). A considerable part of organic agricultural producers conducts plant production, where production of vegetables and fruit, for which the demand increases, constitutes ca. 42%.

The analysis was based on selected conditions, which may determine the level of organic farming in the examined regions. However, the presented spatial structure should be still considered unsatisfactory, requiring actions aiming towards increase in the importance of organic farming. Polish voivodships are generally characterised by an average or low level of organic farming. A positive phenomenon is observed in the fact that

this alternative to the conventional management system is developing in voivodships with fragmented agrarian structure, where the percentage of people employed in agriculture is high.

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ROLNICTWO EKOLOGICZNE W POLSCE W ŚWIETLE WIELOWYMIAROWEJ ANALIZY PORÓWNAWCZEJ

STRESZCZENIE

Rolnictwo ekologiczne to przyjazny środowisku system produkcji dynamicznie rozwijający się od 2004 roku. W opracowaniu dokonano próby oceny przestrzennej rozwoju tego sposobu gospodarowania. Analizie poddano dane na poziomie województw, pochodzące z GIJHARS i GUS z 2014 roku, które dotyczą producentów respektujących produkcję w systemie ekologicznym. Uwzględniają one cechy, takie jak: średnia powierzchnia, udział powierzchni użytków rolnych, liczba przetwórni, wielkość produkcji: mleka, zboża, warzyw i owoców. W przeprowadzonej analizie wykorzystano metodę porządkowania liniowego zbioru obiektów, opartą na utworzonej zmiennej syntetycznej. Wyniki przeprowadzonego badania wskazują na to, że województwa Polski charakteryzują się na ogół średnim lub niskim poziomem rozwoju rolnictwa ekologicznego. Pozytywnym zjawiskiem jest, że rolnictwo ekologiczne rozwija się w województwach z bardziej rozdrobnioną strukturą agrarną.

Słowa kluczowe: rolnictwo ekologiczne, metody porządkowania liniowego, zróżnicowanie