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THE CONCENTRATION AND POTENTIAL OF ORGANIC FARMING AND PROCESSING ON THE ORGANIC FOOD MARKET IN POLAND

Abstract: The global organic food market is constantly growing. Poland is in line with this trend; however, relatively high levels of organic food prices are destabilizing the market. One of the conditions of the present decline is the increase in the dynamics of supply accompanied by the standardization of production and spatial concentration. Therefore, the aim of the article is to indicate the spatial diversity of the production of organic farming and processing and to determine their potential. From the conducted analysis, we identified four groups of voivodships by selecting diagnostic features using cluster analysis algorithms. The identified differences between voivodships in the number and arable area of organic farms and the number of organic food processors are not transitory. These disproportions will persist or deepen due to different directions taken by voivodships, especially their policy on rural development and support for organic farming and processing. The deepening spatial concentration on the or-

ganic food market should, however, translate into growth in its potential and result in decreasing prices. The condition for such a scenario, however, is to overcome the barrier resulting from the fact that voivodships recording the highest concentration of organic agricultural production and voivodships where the most processors are located are not the same.

Keywords: organic farming, organic food processing, concentration, potential.

JEL codes: L14, L16, L66, Q13.

KONCENTRACJA I POTENCJAŁ ROLNICTWA EKOLOGICZNEGO I PRZETWÓRSTWA NA RYNKU ŻYWNOŚCI EKOLOGICZNEJ W POLSCE

Streszczenie: Światowy rynek żywności ekologicznej stale rośnie. W Polsce trend ten także jest podtrzymywany, jednak stosunkowo wysoki poziom cen żywności ekologicznej destabilizuje rynek. Jednym z warunków ich spadku jest wzrost dynamiki podaży przy standaryzacji produkcji i jej koncentracji przestrzennej. Dlatego celem artykułu było wskazanie przestrzennego zróżnicowania produkcji rolnictwa ekologicznego i przetwórstwa oraz określenie ich potencjału. W toku przeprowadzonej analizy wyodrębniono cztery grupy województw na podstawie cech diagnostycznych za pomocą algorytmów analizy skupień. Wydaje się, że zidentyfikowane różnice między województwami pod względem liczby i powierzchni upraw gospodarstw ekologicznych a liczbą ekologicznych przetwórców żywności nie są przejściowe. Dysproporcje te utrzymają się lub pogłębią ze względu na różne kierunki rozwoju podejmowane przez województwa, w szczególności ich politykę rozwoju obszarów wiejskich oraz wsparcie rolnictwa ekologicznego i przetwórstwa. Pogłębiająca się koncentracja przestrzenna na rynku żywności ekologicznej powinna jednak się przełożyć na wzrost jego potencjału i doprowadzić do spadku cen. Warunkiem takiego scenariusza jest jednak przełamanie bariery wynikającej z tego, że województwa o najwyższej koncentracji ekologicznej produkcji rolniczej i województwa, w których znajduje się najwięcej przetwórców, nie są tożsame.

Słowa kluczowe: rolnictwo ekologiczne, przetwórstwo żywności ekologicznej, koncentracja, potencjał.

Introduction

The organic food market has been one of the most dynamically developing food segments in the European Union in recent years (Sahota, 2008, p. 53).

Taking all food sectors into account, one can conclude that in comparison eco-food has very high growth rates. This situation results from very high consumer interest in organic food due to its high quality, which is often also treated as a reflection of an effective element of public health awareness. The widespread use of the latest achievements in the field of biochemistry or biotechnology in the food production process encourages consumers to look for alternatives. This is the result of declining confidence in a market-dominated with food produced by conventional methods. Farms that use organic methods aim at producing food free from chemicals used in agriculture and food processing. The establishment of organic farms that offer products of higher quality, delivered under the principles of organic farming, i.e., through the substantial limitation of the use of chemicals in agriculture and the simultaneous institutional support of organic food trading organizations may result in a further increase of the importance of this market category in the food products industry. The modern means of production that are used in this type of activity are also aimed at limiting the degradation of the natural environment. One can say that in the case of organic agricultural production, we are dealing with a combination of best practices concerning the environment, natural resources, and animal welfare standards (Hamzaoui-Essoussi & Zahaf, 2012, p. 63).

The dynamic development of the organic food market also takes place in Poland. This process has accelerated especially after joining the European Union (Gołaś, 2016, p. 533). The growing demand for eco-products is a factor that also determines the development of the organic food market. However, limited supply with increasing demand results in higher prices. Recently, there has been a downward trend in the prices of eco-products in countries with a higher level of market development. In Poland, it is too early for this process due to the superiority of the growth in the supply dynamics over the increase in demand growth. Financial subsidies for producers granted by the European Union, as well as a significant share of organic food imported from other countries, affect the dynamics of the supply growth (Pilarczyk & Nestorowicz, 2010, p. 9).

The issue of development trends of organic farming in Poland is one of the four main research problems which have been undertaken after accession to the European Union (Łuczka, 2016, p. 67). Over time, organic farming and processing, which together form the marketing chain of the organic food market, are subject to the process of regional concentration (Kuberska & Grzybowska-Brzezińska, 2017, p. 597). Thanks to it, individual regions polarize regarding the degree of development of the supply side of the organic food

market. For example, organic farming in the north-western regions of Poland such as, (Lubuskie, Wielkopolskie, and Zachodniopomorskie voivodships) can be considered the most developed, followed by the northern regions of (Kujawsko-Pomorskie, Pomorskie, and the Warmińsko-Mazurskie voivodships). The eastern regions of (Lubelskie, Podkarpackie, Podlaskie, and Świętokrzyskie voivodships), the central regions of (Łódzkie and the Mazowieckie voivodships) as well as the south-western regions of (Dolnośląskie and the Opolskie voivodships) and the southern regions of (Małopolskie and the Śląskie voivodships) rank next (Szarek & Nowogródzka, 2015, pp. 131–134).

The mentioned concentration and standardization of production may be an opportunity to reduce the costs of the production and distribution of raw materials or finished products, which should translate into a drop in the prices of finished products. Therefore, it is imperative to determine the dynamics of the development of organic farming production and related processing and to identify the areas in which they accumulate. The organic food market can function efficiently and develop only when the supply of raw materials and finished products is optimized. Another activity that limits the barrier of over-priced organic food may also be the introduction of products to large-area stores. Such a maneuver reduces transport costs and allows for lower sales margins (Maciejczak, 2008, p. 5).

On the organic market, as in other markets, supply, demand, price, and competition are key. Manufacturers are often small producers, none of which has a direct impact on market prices because their supply share is too small. Thus, one of the factors hampering the development of the market is the problem of the organization of the market for the sale of organic farming goods (Grzybowska-Brzezińska, 2008, p. 115). Besides, all producers must sell the same product whose manufacturing method is predetermined and leave the producers little or no choice as to how to produce. Although the producers may leave the market at any time, it will be difficult to re-enter (Duczkowska-Małysz, 2007, p. 5).

1. Material and methods

The article presents the results of research based on secondary data obtained from the information collection of the Central Statistical Office and the Agricultural and Food Quality Inspection (AFQI/IJHARS). The diagnostic features used include: the number of organic farms, the area of organic agricultural land (both are related to farms with certificates and farms during land conver-

sion), which were presented at the NUTS level 2 – voivodship and the number of organic processing plants and their location identified at the NUTS 2 level – voivodship. The time range of the acquired data varied.

The aim of the article was to indicate the spatial diversity of the production of organic farming and processing and to determine their potential. However, another goal was to capture the dynamics of the above phenomena.

The analysis was carried out using classification methods. They are employed in various fields of science and areas of the economy. The division of regions into clusters was carried out using cluster analysis algorithms. This classification was made using one of the non-hierarchical grouping methods, which is the k -means method. Its application made it possible to identify regions with the highest similarity within clusters. At the beginning of the procedure, this method requires an arbitrary decision on the number of clusters that will divide the original set of objects (Walesiak, 2012, pp. 417–418). Another problem is the selection of primary centers of gravity, i.e., initial cluster centers¹. The basic idea of this method is the allocation of taxonomic units to k groups, which minimizes the variability within the resulting clusters and at the same time, maximizes the variability between them. As a result of the classification, we performed a grouping of objects (in the case of the analysis voivodships were presented) so that we could achieve the highest level of significance of analysis of variance (ANOVA).

2. Results and discussion

Looking for the answer to the question on the shape of spatial diversity given the two levels of the organic food market in Poland (organic agricultural production and organic food processing) and what their potential is at the outset, their number was determined. Due to the increasing number of consumers for whom environmental considerations are one of the most important reasons for purchasing such products, but also incentives for agricultural producers in the form of financial support, changes in the number of entities dealing with organic agricultural production can be observed (Table 1).

Taking into account the changes in the number and area of organic farms between 2010 and 2016, one can conclude that organic farming in Poland is

¹ In the selection of initial cluster centers, a method was chosen in which the distances between all objects are sorted, and objects with fixed intervals are selected for the initial cluster centers.

Table 1. The number of organic farms and the organic arable land area in Poland in 2010 and 2016

Voivodship	Number of organic farms (certified and in conversion)		Organic arable area (certified and in conversion) in ha	
	2010	2016	2010	2016
Dolnośląskie	1 227	813	39 703	29 200
Kujawsko-pomorskie	327	470	7 688	9 263
Lubelskie	1 962	1 980	34 855	31 343
Lubuskie	833	1 148	35 797	43 235
Łódzkie	420	497	7 671	9 986
Małopolskie	2 156	1 093	21 968	12 364
Mazowieckie	1 935	2 426	46 229	49 517
Opolskie	79	68	3 180	3 216
Podkarpackie	2 091	1 252	31 868	15 486
Podlaskie	2 033	3 437	42 917	55 168
Pomorskie	648	679	22 554	23 328
Śląskie	228	180	5 739	5 324
Świętokrzyskie	1 243	834	13 123	10 739
Warmińsko-mazurskie	2 279	4 142	75 242	108 667
Wielkopolskie	748	843	32 513	29 171
Zachodniopomorskie	2 373	2 573	98 023	100 570
Total	20 582	22 435	519 069	536 579

Source: Based on GUS data (15.05.2018).

on the growth exponentially, whose dynamics amounted to 9.0% and 3.4%, respectively. However, the changes noted in individual regions varied. The most significant increase in the number of entities dealing with organic agricultural production took place in the Warmińsko-Mazurskie (81.7%), Podlaskie (69.1%) and Kujawsko-Pomorskie (43.7%) voivodships. In 2010, these voivodships involved 22.5% of organic farms, while six years later it was 35.9%. In 2016, the Warmińsko-Mazurskie voivodship was the leader in terms of both analyzed features. It means that in comparison with 2010 it overtook the Zachodniopomorskie voivodship. This shows the growth potential of the region in the market under consideration. Unfortunately, this positive growth rate does not go hand in hand with equally high dynamics of growth of organic agricultural production.

The different regions vary concerning the features considered. To distinguish groups of voivodships (clusters), for which we can talk about their

similarity, an analysis of variance was carried out (Table 2). Differences in the average values of the analyzed variables in 2010 between clusters were lower than in 2016. As a result of the undertaken analysis, it was assumed, arbitrarily, that the group of 16 voivodships would be divided into four clusters. The regions grouped in this way contain objects characterized by similarities regarding the analyzed features.

Table 2. Variance analysis of discriminant variables in 2010 and 2016

Variable	Variance analysis for 2010					
	Between groups variation	df	Within groups variation	df	F-statistic	P Value
Number of farms	6 083 295	3	4 078 309	12	5.96649	0.009920
Arable area	9 389 316 000	3	489 722 300	12	76.69095	0.000000
Variable	Variance analysis for 2016					
	Between groups variation	df	Within groups variation	df	F-statistic	P Value
Number of farms	14 885 230	3	6 165 242	12	9.657513	0.00160137
Arable area	15 012 880 000	3	242 376 600	12	247.7612	0.00000000

Source: Based on GUS data (15.05.2018) Statistica12.

In 2010, the cluster with the highest average number of entities (cluster 3) belonged to the Zachodniopomorskie and Warmińsko-Mazurskie voivodships (Table 3). These levels exceed several times their corresponding values in other clusters and can be interpreted as the primary centers for the location of organic farms in Poland. It also corresponds with a large number of farms as well as the density of employment of the population in the area indicated by this concentration.

Cluster 1 covers the Małopolskie and Pomorskie voivodships, and cluster 2 includes the Dolnośląskie, Lubelskie, Lubuskie, Mazowieckie, Podkarpackie, Podlaskie and Wielkopolskie voivodships. These areas are characterized by a relatively high average level of certified organic farms. The difference between them is in the area used for organic farming. In the case of cluster 2, it is at a higher level. Cluster 4 is a group of voivodships with the lowest average number of analyzed farms and the lowest average area. It includes the voivodships of central Poland, such as the Łódzkie and Kujawsko-Pomorskie voivodships as well as the voivodships of southern Poland – Opolskie, Świętokrzyskie, and Śląskie voivodships. The average number of farms for this cluster is about three times lower than its corresponding levels in clusters 1 and 2.

In 2016, the number of farms producing organic goods and their area increased, which translated into changes in the composition and characteristics

Table 3. Clusters of voivodships in 2010

Cluster	Elements	Variable	Descriptive statistics		
			Mean	Standard deviation	Variance
1	Małopolskie, Pomorskie	number of farms	1 402.00	1 066.317	1 137 032
		arable area	22 260.85	414.577	171 874
2	Dolnośląskie, Lubelskie, Lubuskie, Mazowieckie, Podkarpackie, Podlaskie, Wielkopolskie	number of farms	1 547.00	592.382	350 916
		arable area	37 697.30	5 425.587	29 437 000
3	Warmińsko- mazurskie, Zachodnio- pomorskie	number of farms	2 326.00	66.47	4 418
		arable area	86 632.45	16 108.67	259 489 300
4	Kujawsko- pomorskie, Łódzkie, Opolskie, Śląskie, Świętokrzyskie	number of farms	459.400	455.895	207 840
		arable area	7 480.160	3 655.110	13 359 830

Source: Based on GUS data (15.05.2018) Statistica12.

of particular clusters (Table 4). The high variability between the highlighted clusters and the relatively low inside them proves the proper grouping of voivodships due to the analyzed variables. The *F* test results indicate that all variables, both in 2010 and 2016, discriminate well the aggregates at the significance level of 0.05.

In 2016, the Zachodniopomorskie and Warmińsko-Mazurskie voivodships still belonged to the cluster with the highest average level of the analyzed features. The most numerous, however, is cluster 4, in which the average level was the lowest concerning both of the investigated features. Descriptive statistics for clusters indicate a significant variation of voivodships regarding the variables adopted for analysis. If one assumes that the proxy variable for determining the potential of organic farming is the number of organic farms and their acreage, then the potential is definitely different in the NUTS-2 regions in Poland. What is more, disparities between regions persist over time and deepen.

Table 4. Clusters of voivodships in 2016

Cluster	Elements	Variable	Descriptive statistics		
			Mean	Standard deviation	Variance
1	Małopolskie, Pomorskie	number of farms	1 402.00	1 066.317	1 137 032
		arable area	22 260.85	414.577	171 874
2	Dolnośląskie, Lubelskie, Lubuskie, Mazowieckie, Podkarpackie, Podlaskie, Wielkopolskie	number of farms	1 547.00	592.382	350 916
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		arable area	7 480.160	3 655.110	13 359 830

Source: Based on GUS data (15.05.2018) Statistica12.

Table 5. The percentage share of industries in organic food processing in Poland in 2010 and 2016 (in %)

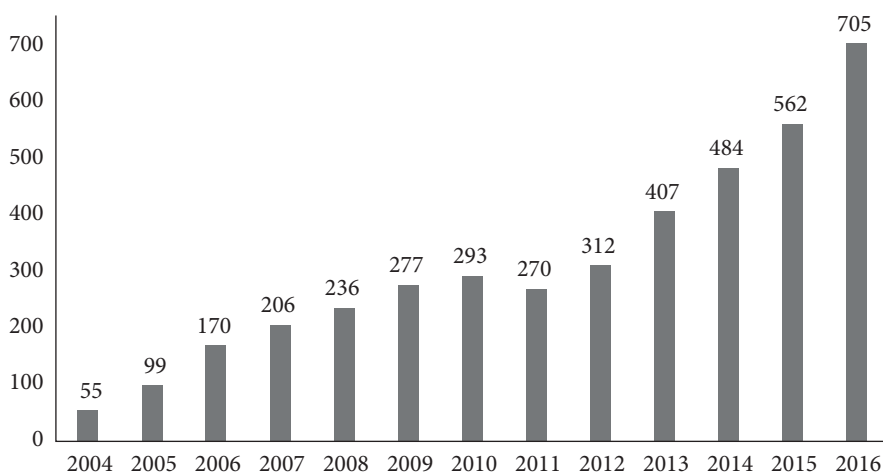
Industry	Year	
	2010	2016
Fruit and vegetables	32.40	31.10
Other	32.80	30.80
Cereal	19.40	17.20
Meat, poultry, and fish	5.1 ^a	6.10
Milk and cheese	2.70	4.90
Coffee and tea	6.00	4.90
Vegetable and animal fats	1.30	3.50
Sugar	0.30	1.50

^a Meat and poultry processing.

Source: Based on: (Instytut, 2011; 2017).

The development of the processing industry also determines the potential of the organic food market. In Poland, the processing of organic food products predominantly takes place in the fruit and vegetables sector (Table 5). In 2016, this industry covered 31.1% of the value of organic food processing. High rates are also recorded in the production of cereal products (17.2%) and the production of other food products (30.8%); (the “other food products” industry includes, among others, articles such as sugar, cocoa, tea, coffee, spices, chocolate, or ready-made meals). A much smaller share is recorded in the meat, poultry, and fish production and processing industry or dairy products (in 2016 it was 6.1% and 4.9% respectively). On the other hand, a very small share belongs to the vegetable and animal fats industry.

Taking into account the time perspective covering the years 2004–2016, a sustained increase (except in 2011) characterizes the number of organic food processing plants² (Figure). Particularly significant increases were recorded first in the funding perspective ending in 2006, after which the dynamics decreased, to revive again in the funding perspective that started in 2013. The almost 13-fold increase in the number of organic processing plants is testimony to the growth of the potential of the Polish organic food market.



The number of organic food processors in Poland in 2004–2016

Source: Based on: (Instytut, 2011, 2013, 2015, 2017).

² As defined in Council Regulation 834/2007, preparation means the preservation or processing of organic farming products including the slaughter and cutting of products of animal origin as well as the packaging, marking or alteration of the labeling relating to the organic production method.

Organic food processing in Poland is subject to spatial concentration processes, which, as indicated earlier, also takes place in the case of organic agricultural production. At the level of the NUTS-2 regions, Mazowieckie is the voivodship with the highest number of organic processing plants in Poland. Both in 2010 and in 2016, the highest percentage of entities with such a business profile was located there (with an increase from 16% to 24.7%). The Wielkopolskie voivodship was ranked second in the analyzed years (at respectively 12.3% and 11.3%).

Based on the results of the analysis, one can conclude that the lists of regions being the largest agglomerations of organic agricultural producers and organic food processors are not harmonized. This fact is the premise for identifying a significant structural problem in the context of further development of the market under consideration. Voivodships with a considerable number of agricultural producers are not the same as those with the most significant concentrations of food processors. Ample production potential lies within the limits of the cluster comprising the Warmińsko-Mazurskie and Zachodniopomorskie voivodships. At the same time, the most substantial number of organic processing plants is located in the Mazowieckie and Wielkopolskie voivodships. As a consequence, one of the critical problems of the organic food market in Poland, which is a hindrance to the functioning of organic food processors, is the significant dispersion of organic farms and the relatively small area of most of those that constitute the raw material base for them. The market potential at both levels considered is therefore dispersed. The considerable distance between farms and processing plants is the reason why its further development can be inhibited.

Conclusions

Growing demand drives the development of the organic food market. It is enforced by the enrichment of Polish society and the accompanying process of greater awareness in the field of healthy eating. About 8–10% of the population buys organic food; however, the average expenditure is at a relatively low level compared to developed and highly developed countries. However, this is proof of the existence of significant growth potential.

The high level of the prices of organic food products counterbalances these positive trends. It is a critical barrier of purchase and a factor hindering the further development of the market. This state of affairs is slowly becoming chronic, which leads to adverse effects from the perspective of the demand

and supply side of the market. As soon as possible this stage of development should be subject to further transformation, resulting in a fall in the prices of food products. One of its conditions is a spatial concentration of entities appearing in the analyzed industries, whose occurrence was confirmed in the course of the conducted analyzes.

The processing potential is concentrated in several voivodships, with the Mazowieckie and Wielkopolskie voivodships leading the way. However, the regions that are the most significant concentrations of organic processing are not the same as those with the largest concentration of the number of organic farms (this cluster includes the Warmińsko-Mazurskie and Zachodniopomorskie voivodships). What is more, significant differences in the number and the area of the agricultural land of organic farms and organic food processing plants between particular voivodships are not transitory. In the longer term, one may expect that disproportions in the scope of the analyzed features will persist or deepen. They may be the result of various directions of the economic development of individual voivodships, especially the applied policy tools in the field of rural development and support for the development of organic food production and processing.

There are indications that the potential accumulated on the demand side of the market will increase. However, its condition is a drop in prices. It can be achieved when there is the condition of spatial concentration. As it has been shown, it is fulfilled in Poland. However, the problem is that clusters at the level of agricultural production and food processing do not coincide geographically. Due to the lack of appropriate links between the considered areas, there is a need to import processed products that are significantly more expensive than domestic ones. The situation in which the Polish organic food industry is an exporter of processed food rather than its importer would be more favorable. The way to decrease the prices of organic food products may be to manage relations within supply chains and marketing chains. Organic agricultural producers and food processors should strive for cooperation. It would provide the former with outlets for their production, and the latter with constant access to raw materials.

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