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THE PROVISION OF ENVIRONMENTAL BENEFITS BY SMALL FARMS FROM A REGIONAL PERSPECTIVE – SELECTED PROBLEMS

The changing model of functioning of agriculture brings new directions of its development, including functions related to providing environmental benefits. Environmental protection has become the most important point of reference in shaping all policies implemented by the European Union (EU), including the Common Agricultural Policy. Farmers, as its main beneficiaries, should take this into account. Decisions made by agricultural producers in their production processes are of great importance to the environment. The aim of the paper was to show and analyze regional differentiation of environmental benefits resulting from the functioning of small farms on the example of selected farm characteristics. The data for the analysis was obtained from the System of Collection and Use of Farm Accounting Data (Polish FADN) from three years (2017, 2018 and 2019). On the basis of a comparative and statistical analysis, it was concluded that the provision of environmental benefits by small farms is regionally differentiated. Soil protection and pro-environmental measures are emphasized in the Common Agricultural Policy's new arrangements for 2023-2027. This will primarily require knowledge transfer at the level of the institutional environment of agriculture (primarily of an advisory nature) at the national and regional level.

Keywords: environmental protection, small farm, region, differentiation

JEL Codes: Q12, Q18

Introduction

The discussion on environmental protection is a key issue today and absorbs the attention of numerous national and international forums. Environmental issues are present everywhere in the modern world, and their circle continues to expand¹. Over the last two decades, the Common Agricultural Policy (CAP)² has undergone a gradual change from market intervention instruments (e.g., price support) to farm-specific measures attempting to enhance the environmental performance of the EU agricultural sector. In every sector of the economy, especially in the European Union (EU), there has been a recent intensification of activities emphasizing the environmental aspect. The changing paradigm of rural areas and agriculture implies that one of the essential elements of land management will be the provision of environmental services³. Agriculture significantly affects the environment. The environmental effects of individual activities can positively or negatively affect

¹ A. Jaworowicz-Rudolf: Środowisko jako dobro chronione, [in:] Z. Duniewska (ed.), *Dobra chronione w prawie administracyjnym*, Uniwersytet Łódzki, Łódź 2014, p. 176.

² K. Louhichi, P. Ciaian, M. Espinose, A. Perni, S. Gomez y Paloma. Economic impacts of CAP greening: application of an EU-wide individual farm model for CAP analysis (IFM-CAP), *European Review of Agricultural Economics* 45, 2/2018, p. 205.

³ R. Baum, J. Śleszyński: Nowe funkcje rolnictwa – dostarczanie dóbr publicznych, *Zeszyty Naukowe Stowarzyszenia Rolnictwa i Agrobiznesu* 11, 2/2020, p. 19.

the quality of public goods produced/provided by agriculture⁴. The environmental benefits of small farms include providing public goods by maintaining biodiversity and diversity in the rural landscape, practicing environmentally friendly farming, or sustaining the vitality of problem areas such as less favored areas⁵. According to the Act⁶ of 27 April 2001 Environmental Protection Law, (Article 3, Point 39) the environment is all natural elements, including those transformed as a result of human activity—in particular, the Earth's surface, minerals, waters, air, landscape, climate, and other elements of biodiversity, as well as the mutual interaction between these elements. Resources and values of the environment are public goods, and protecting the environment in the sense of reducing and eliminating threats which may negatively influence its condition meets the assumptions of public goods. In the case of public goods, it is impossible to exclude anyone from their consumption (non-excludable goods) with a simultaneous lack of rivalry (non-rivalrous goods). In solving environmental problems, the direction of agricultural development is particularly important⁷. From the point of view of environmental benefits in agriculture, organic production is important. By its nature, it can be considered as one of the basic tools for providing environmental services. Organic farming⁸ is a crop production method respecting the rules of nature, targeted to produce nourishing, healthy and pollution-free food. With regard to public goods, the generation of positive externalities is important. Public goods in their theoretical and empirical content should become the subject of broad economic analysis – in particular, concerning agriculture and rural areas⁹.

Research methodology

The research material consisted of data obtained from the System for Collection and Use of Farm Accountancy Data – Polish FADN – Farm Accountancy Data Network (FADN PL) from three years (2017, 2018, and 2019). The analysis was performed on small farms separated by economic size, for which the range of standard output (SO) is below EUR 25,000. The analysis of data on individual farms was presented according to four designated regions in Poland: Pomorze and Mazury, Wielkopolska and Śląsk, Mazowsze and Podlasie, and Małopolska and Pogórze. The regions were assigned national symbols, A, B, C, and D, respectively. The symbolism of the regions was used in the tabular and graphic representations and the data analysis in the paper. To analyze the influence of small farms on the environment, data from the Polish FADN System was obtained on average per one small farm. The aim of the paper was to show and analyze the regional differentiation of small farms from the point of view of environmental benefits, which are the effect of selected agricultural practices or possessed resources:

⁴ I. Duer: Dobra publiczne użytkowane i dostarczane przez rolnictwo – wspierane w ramach programu rozwoju obszarów wiejskich, *Studia i raporty IUNG-PIB*, 21/2010, p. 85.

⁵ M. Czekaj, M. Szafrńska, K. Żmija, Ł. Satoła, A. Płonka, D. Żmija, E. Tyran, J. Puchała: Rola małych gospodarstw rolnych. Diagnoza i perspektywy na przyszłość na przykładzie Podregionu Rzeszowskiego, Difin, Warszawa 2020, p. 57.

⁶ Ustawa z dnia 27 kwietnia 2001 r. Prawo ochrony środowiska, Dz.U.2001 Nr 62 poz. 627.

⁷ A. Ginter: Małe gospodarstwa rolne wobec wyzwań zrównoważonego rozwoju i Zielonego Ładu, Uniwersytet Przyrodniczo-Humanistyczny w Siedlcach, Siedlce 2021, p. 7.

⁸ E. Somasundaram, D. Udhaya Nandhini, M. Meyyappan: Organic crop production techniques, [in:] E. Somasundaram, D. Udhaya Nandhini, M. Meyyappan (eds), *Principles of organic farming*, CRC Press, London 2021, p. 252.

⁹ M. Maciejczak: Rolnictwo i obszary wiejskie źródłem dóbr publicznych – przegląd literatury, *Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej*, 75/2009, p. 131.

1. Having organic production – the share of organic farms producing only by organic, the organic and conventional methods;
2. Having forests in the land resources – forest area on average per 1 small farm (ha);
3. The area of winter cover on average per one small farm (ha), cultivation of winter catch crops – share of small holdings using this type of catch crops (%);
4. The area of winter catch crops on average per one small agricultural holding (ha);
5. The importance of public goods subsidies – share of public goods subsidies in total subsidies (%).

The selection of agricultural practices (1-4) presented in the article was based on current discussions about soils. Increasing attention is being paid to the quality of soils, their functions, and the ecosystem services they provide. The subjective treatment¹⁰ of soils is pointed out, and their importance in the human economy – especially in areas such as agriculture – is emphasized. These practices are important for the quality of the soil, and this is influenced by the farmer.

Among subsidies that agricultural producers receive under the Common Agricultural Policy (CAP), there are set-aside subsidies, agri-environmental subsidies, subsidies for less favored areas, and rural development subsidies which, according to Grzelak¹¹, are subsidies for public goods (which is assumed in this paper). The greater the share of these subsidies, the more beneficial for the environment. The most important characteristics of public goods are non-excludability and non-rivalry. These two characteristics imply that users have no incentive to pay for the consumption of such goods and, on the supply side, there are no incentives for providing public goods because the producers, such as the farmers, are not remunerated by the market to do. According to Francesco Vanni¹², the combination of these factors explains the so-called “market failure”, and the reason for the need for public intervention in order to achieve a socially optimal level of public goods, consistent with societal demand. This approach explains the choice of the last feature described the share of public goods payment in total direct payment (5).

The method of data analysis, as well as the tabular and graphic methods of the collected material, were used in this paper. The one-way analysis of variance was used to compare the regions in terms of selected characteristics. For characteristics whose distribution was not close to normal, the Bliss transformation and the square root transformation ($y = \sqrt{x + a}$) were applied. The Tukey test was used to compare means at the significance level of $p \leq 0.05$. All calculations were made in Statistica 12.0¹³.

Results

In the surveyed years in the field of observation of the Polish FADN, the number of small farms by economic size, below EUR 25,000, was increasing (Table 1). On average, in Poland, in the third year of research, compared to 2017, by about 13%. The highest number of them was characterized by the region of Mazowsze and Podlasie, and the lowest by

¹⁰ A. Gałązka, B. Smreczak: Jakość gleb użytkowanych rolniczo i wskaźniki jej oceny, *Studia i raporty JUNG-PIB*, 54, 8/2017, p. 7.

¹¹ A. Grzelak: Akumulacja majątku w gospodarstwach rolnych w Polsce ze względu na typy produkcyjne i kontekst paradygmatu rozwoju zrównoważonego, *Zagadnienie Ekonomiki Rolnej*, 360, 3/2019, p. 89.

¹² F. Vanni: *Agriculture and Public Goods – The Role of Collective Action*, Springer Science+Business Media, Dordrecht 2014, p. 1.

¹³ StatSoft. Inc. 2014. STATISTICA (data analysis software system), Version 12.

Pomorze and Mazury. In each of the regions, there was a growing trend in the number of described farms, and when comparing 2017 with 2019, it could be seen that in Region A the change was the largest (about 18%), and in Region D it was the smallest (about 10%).

Table 1. Small farm number in the FADN PL system by region in the years 2017, 2018, and 2019

Year	The regions				Total number of small farms in Poland
	A	B	C	D	
2017	693.0	1353.0	2147.0	775.0	4968.0
2018	768.0	1432.0	2310.0	834.0	5344.0
2019	815.0	1543.0	2392.0	856.0	5606.0

Source: own calculation based on Polish FADN data.

The first characteristic of the farms that was presented and analyzed was the use of organic ways of producing agricultural products. Organic farming is mainly based on the use of natural environmental values and processes in agrocenosis, and its promotion is one of the most important objectives of the EU in agriculture in the near future. Organic production is considered to be a farm management system that combines practices that are most beneficial to the environment and climate, which justifies the choice of the first issue addressed in the paper. This type of production is attributed to the conservation of natural resources and the maintenance of high standards relating to agricultural production. Considering the environmental benefits of organic farming, it should be said that organic agricultural production has an inherent environmental protection function. In the organic production system¹⁴, the set objective is achieved by complying with certain methods. These are very broad and deeply interfering in legal production regulations unified on the whole territory of the community, in the nature of directives and regulations. From the Polish FADN system, data on organic production methods in small farms was obtained from the database and, according to the methodology adopted in the system, farms applying only organic production methods – using both organic and conventional methods – and farms in the process of converting their production methods to organic were analyzed. Table 2 presents the first of the above-mentioned groups of farms.

Table 2. Share (%) of farms using only organic production methods on small farms by region in 2017-2019

Year	The regions			
	A	B	C	D
2017	10.1	1.3	4.8	5.3
2018	9.6	1.5	4.5	4.9
2019	9.8	1.1	3.8	3.5
Average in years	9.8a	1.3c	4.4b	4.6b

Source: own calculation based on Polish FADN data; the averages for the years marked with different letters are significantly different at $p \leq 0.05$

Small farms in the region of Pomorze and Mazury were characterized by the highest share of farms applying only organic methods (Table 2). In this area of Poland, almost every 10th small farm provided environmental benefits. In second place in terms of the described characteristics of farms was the region of Małopolska and Pogórze, where the share was, on average (in the studied years), more than twice lower as in Region A. In

¹⁴ B. Sazońska: Zasady prowadzenia gospodarstw w systemie rolnictwa ekologicznego, Centrum Doradztwa Rolniczego w Brwinowie, Oddział w Radomiu, Radom 2020, p. 5.

Mazowsze and Podlasie, similar results to the southern region of Poland were recorded, while in Wielkopolska and Śląsk, the smallest number of small farms applying exclusively organic production methods was found. The share of farms applying only organic production methods in Region B, on average in the years studied, was more than seven times lower than in Region A. In regional terms, the data for small farms with mixed production methods (Table 3) was similar to that using only organic production methods. The highest percentage was in the northern region of Poland (Region A), and the lowest in Wielkopolska and Śląsk (Region B).

Table 3. Share (%) of farms using both organic and conventional methods on small farms by region 2017-2019

Year	The regions			
	A	B	C	D
2017	1.7	0.4	0.8	1.0
2018	2.5	0.4	0.9	1.4
2019	2.2	0.4	1.0	1.5
Average in years	2.1a	0.4c	0.9bc	1.3b

Source: own calculation based on Polish FADN data; lettering as in Table 2.

Soil conservation falls within the scope of environmental goods¹⁵. The anti-erosion agrotechnology applied in the process of plant production in farms is an important element of it because of the protective function of soil, and the cultivation of winter crops is essential for it. It should be emphasized that soil is a limited resource, and the need for it is growing primarily because of the increasing demand for food or the production of energy crops.

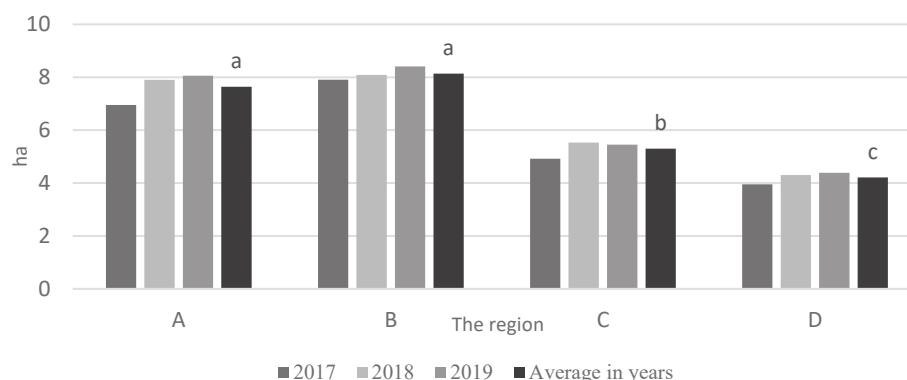


Figure 1. Winter cover area (ha) on average per one small farm by region in 2017-2019

Source: own elaboration based on Polish FADN data; lettering as in Table 2.

Winter cover is the area of winter crops to be harvested in the following year and all winter catch crops to be ploughed in the following spring. Small farms in the Wielkopolska and Śląsk regions recorded the largest average area of winter cover (Figure 1). On average, in the studied years, it was slightly larger (by 6%) than in the region of Pomorze

¹⁵ J. Wilkin: Dobra dostarczane przez rolnictwo w świetle teorii dóbr publicznych, [in:] J. Wilkin (ed.) Wielofunkcyjność rolnictwa. Kierunki badań, podstawy metodologiczne i implikacje praktyczne, IRWiR-PAN, Warszawa 2010, p. 42.

and Mazury. Smaller winter cover in small farms protected soil in the other two regions. It should be noted that an increase in winter cover area was recorded in all regions in the study period, which was beneficial for the soil. Due to the duration of their cover, winter catch crops inhibit soil erosion processes and, if left as mulch for the winter, maintain soil moisture at a higher level¹⁶. Especially valuable is the fact that they affect the number of elements contained in the soil. The number of macroelements protected from leaching from soil by winter catch crop plants was significantly lower compared to summer catch crop plants¹⁷.

Due to the beneficial effect of winter catch crops on the conservation of soil natural resources, the paper shows their area (Figure 2). The largest acreage of winter catch crops was recorded on small farms in the region of Pomorze and Mazury (A), which had a special expression in 2019. In three years in this part of the country in small farms, there was the largest, almost threefold increase in their area. A wide variety¹⁸ of changes in production methods and land uses have been promoted to farmers. Key examples included soil protection and soil quality. The key to controlling soil erosion by water is to maintain soil groundcover. Compared to the other regions, on average, in the years of research, the area of winter catch crops was more than twice as large as in Region B, almost twice as large as in C and more than seven times as large as in Region D. Based on a comparative analysis, it could be stated that in the first of the presented regions (A), soil protection resulting from the applied agrotechnical practices covered the largest area.

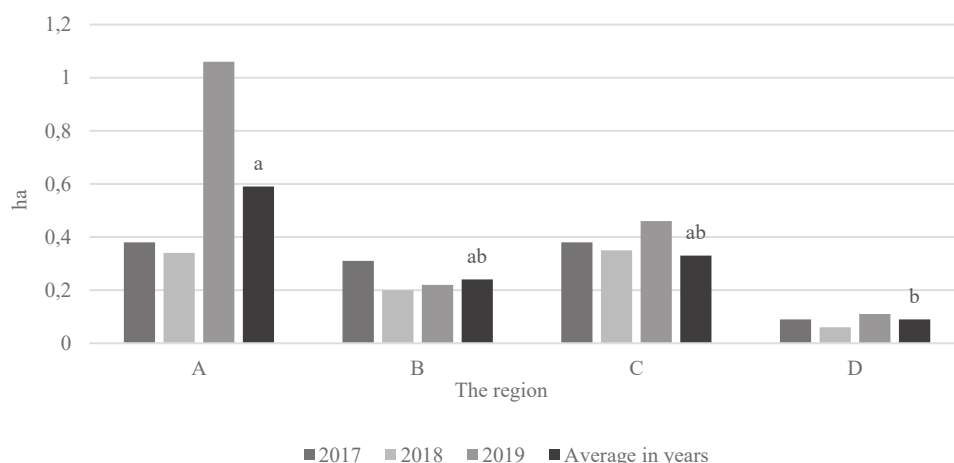


Figure 2. Winter catch crops area (ha) in small farms by region in 2017-2019

Source: own calculation based on Polish FADN data; lettering as in Table 2.

¹⁶ D. Nowak, Z. Bilski, I. Kajdan-Zysnarska: Metody wpływające na poprawę żyzności gleby, Centrum Doradztwa Rolniczego w Brwinowie, Oddział Poznań, Poznań 2019, p. 22.

¹⁷ A. Zaniewicz-Bajkowska, J. Franczuk, R. Rosa, E. Kosterna: Nawozy zielone na Mazowszu, Urząd Marszałkowski Województwa Mazowieckiego w Warszawie, Warszawa 2012, p. 44.

¹⁸ D. Pannell, A. Roberts: Public goods and externalities: Agri-environmental policy measures in Australia, OECD Food, Agriculture and Fisheries Papers No 80, OECD Publishing, Paris 2015, p. 10.

Forests play an important role in the environment and have a beneficial effect on the climate and the balance of nature. They emphasize the uniqueness of the agricultural landscape and are an environmental asset. The highest average forest area per farm was observed in Mazowsze and Podlasie regions (Figure 3). It was slightly smaller than in the regions of Pomorze and Mazury and Małopolska and Pogórze. A much smaller area of forest land was found in small farms in Wielkopolska and Śląsk regions. Sustainable management must take into account the preservation of forests and their beneficial impact on the climate and natural balance¹⁹. The need to protect the forest and maintain the continuity of the multifaceted functions performed by forests is becoming increasingly important²⁰. The demand for the forest's social functions forest is increasing²¹.

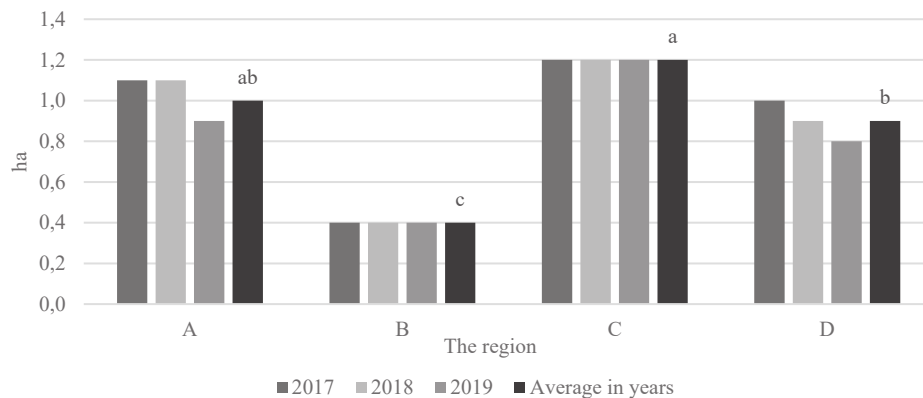


Figure 3. Forest area (ha) on average per one small farm by region in 2017-2019

Source: own elaboration based on Polish FADN data; lettering as in Table 2.

The last selected issue in the study concerning the provision of environmental goods by small farms was the share of payments for so-called “public goods” in total payments (Figure 4). As mentioned in the methodology of the paper, in the group of payments received by agricultural producers, four types of financial support (i.e., agri-environmental payments, set-aside payments, payments to less favored areas and rural development payments) are considered public goods payments. In the surveyed years, the share of these subsidies was the largest in small farms located in Region A – Pomorze and Mazury. In this area of Poland, more than one-fifth of the received support included subsidies for public goods. In other regions, the characterized subsidies were less important. In the regions Mazowsze and Podlasie by 4.5% (on average in 2017-2019), and in the regions

¹⁹ M. Machoń: Gospodarka leśna w obliczu potrzeb ochrony przyrody, *Roczniki Administracji i Prawa*, 13/2013, p. 158.

²⁰ B. Olejniczak, M. Maciantowicz: Zagrożenia biotyczne i abiotyczne na terenie Leśnego Kompleksu „Bory Lubuskie” i podejmowane działania zapobiegawcze, *Inżynieria Środowiska*, 13/2007, p. 330.

²¹ J. Glura: Wielofunkcyjne leśnictwo jako element dobrobytu człowieka, [in:] K. Kanenberg, H. Szramka (eds), *Zarządzanie ochroną przyrody w lasach*, Wyższa Szkoła Zarządzania w Tucholi, Tuchola 2007, p. 136.

Małopolska and Pogórze by 5.5%. In the Wielkopolska and Śląsk regions, the importance of the subsidies in question was the lowest, and their share of the examined years (on average, 2017-2019) amounted to 14.6%. It should be noted that in subsequent years of research, only in Region A the share of these subsidies slightly increased. In other regions it fluctuated (Region D), and in the other two (B and C) it decreased. During one rotation period²² (for example, 100 years), the requirements of society from forests changed dramatically; from sole timber production to increased timber production, as well as other functions such as maintenance of biodiversity, recreation drought and flood control, and erosion control.

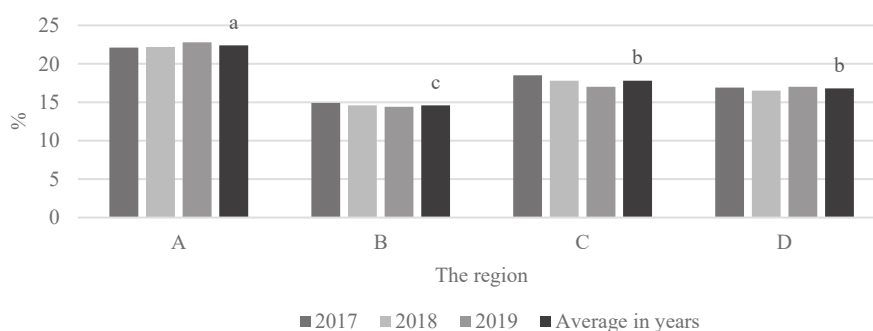


Figure 4. Share (%) of public goods payments in total direct payments

Source: own calculation based on Polish FADN data; lettering as in Table 2.

In small farms located in the regions of Pomorze and Mazury (A), the share of CAP support for public goods was the highest, which meant the most favorable situation, compared to the other regions (from the perspective of environmental protection). In the remaining regions (B, C, D), the results were at a similar level, but in Wielkopolska and Śląsk, the share of the subsidies in question was the lowest. Ecological safety for the present and future generations is to be ensured by every type of policy implemented, among others, the EU, including the Common Agricultural Policy affecting production processes shaped by agricultural producers. European public goods provided to the EU citizens are financed from its budget and fulfil the characteristics of national public goods²³. It should be added that the agricultural policy aims to support the development of rural areas and is an attempt to apply the laws of economic theory in practice in order to achieve objectives set by the state²⁴. These objectives, in recent times, relate primarily to environmental protection, and each country in the EU, including Poland, treats it as a priority. Public support, established by the CAP²⁵ and provided by the Rural Development Program (RDP), is now

²² L. Salek, A. Sivacioğlu: Forests for future – multifunctional forests, *International Journal of Plant and Soil Science*, 24 (6)/2018, p. 1.

²³ A. Biernat-Jarka: Dobra publiczne w rolnictwie w nowej perspektywie finansowej Unii Europejskiej, *Zagadnienia Ekonomiki Rolnej*, 1 (346)/2016, p. 147.

²⁴ M. Wigier, M. Podstawka: Measurement of the effectiveness of public aid for farms in Poland, *Polityki Europejskie, Finanse i Marketing*, 26 (75)/2021, p. 68.

²⁵ L. Melece, I. Shena: Valuation of public goods and ecosystems services providing by agriculture. *Engineering For Rural Development 2018., Conference paper: Proceeding 17th International Scientific Conference Engineering for Rural Development*, Jelgava, 23-25.05.2018, p. 1229.

increasingly oriented towards the provision of environmental and other public goods. Sustainable agriculture²⁶ will require that society appropriately rewards ranchers, farmers and other agriculturalists for the production of both food and ecosystem services. The Common Agricultural Policy²⁷ was heavily criticized, partly for its lack of contribution towards achieving sustainable agriculture. There are important changes²⁸ due to take place. The most important of which are changes to the CAP. It is clear that there will be significant changes in the agri-environment programs. The concept of ecosystem services²⁹ has gained a strong political profile during the last 15 years. The ecosystem services concept is already embedded in recent EU (environmentally-related) policies.

Based on the statistical analysis, it was found that the selected characteristics of small farms varied significantly by region.

Conclusions

The spectrum of functions performed by farms, especially small farms, is abundant. These entities play an important role in shaping the quality of the environment. The increase in the number of small entities according to the analyzed economic criterion, one of the most important in the EU, in each of the separated regions of Poland confirms the need to analyze them in a regional system. On the basis of the conducted research, it can be concluded that in the group of small farms, there is a regional differentiation in their provision of environmental benefits. It should be remembered that small farms have greater possibilities to react to changes occurring in the agricultural market. There is a need for knowledge transfer in terms of public goods and the need to create a specific stream of financial support for these units to realize their potential in providing environmental benefits.

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²⁶ K. Sepp: Landscape Functions and Ecosystem Services, *Rural Development and Land Use*, 3 (2)/2012, p. 42.

²⁷ I. Antonopoulos: Public money for public goods and property rights, [in:] I. Antonopoulos, M. Bell, A. Cavoški, L. Petetin (eds), *The Governance in Agriculture in Post – Brexit UK*, Routledge, London 2022, p. 67.

²⁸ J. Jones, P. Silcock, T. Uetake: Public goods and externalities: agri-environmental policy measures in the United Kingdom, *OECD Food, Agriculture and Fisheries Paper*, 83/2015, p. 25.

²⁹ I. Bouwma, C. Schleyer, E. Primmer, K.J. Winkler, P. Berry, Y. Yang, E. Carmen, J. Špulerová, P. Bezák, E. Preda, A. Vadineanu: Adoption of the ecosystem services concept in EU policies, *Ecosystem Services*, 29/2018, p. 213.

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Dostarczanie korzyści środowiskowych przez małe gospodarstwa rolne w ujęciu regionalnym – wybrane problemy

Streszczenie

Zmieniający się model funkcjonowania rolnictwa niesie ze sobą nowe kierunki jego rozwoju, w tym nowych jego funkcji związanych z dostarczaniem korzyści środowiskowych. Ochrona środowiska stała się najważniejszym punktem odniesienia w kształtowaniu wszystkich polityk realizowanych przez Unie Europejską (UE), w tym Wspólnej Polityki Rolnej, a rolnicy jako główni jej beneficjenci powinni mieć to na uwadze. Decyzje producentów rolnych podejmowane w procesach produkcyjnych mają duże znaczenie dla środowiska. Celem pracy było ukazanie i analiza regionalnego zróżnicowania korzyści środowiskowych dostarczanych przez małe gospodarstwa rolne na przykładzie wybranych cech gospodarstw. Dane do analizy pozyskano z Systemu Zbierania i Wykorzystywania Danych Rachunkowych z Gospodarstw Rolnych (Polski FADN) z trzech lat, tj. 2017, 2018 i 2019. Na podstawie przeprowadzonej analizy porównawczej i statystycznej stwierdzono, że dostarczanie korzyści środowiskowych przez małe gospodarstwa rolne jest regionalnie zróżnicowane. Ochrona gleby i działania prośrodowiskowe są szczególnie podkreślane w nowych rozwiązaniach Wspólnej Polityki Rolnej na lata 2023-2027. Wymagać to będzie przede wszystkim transferu wiedzy na poziomie instytucjonalnego otoczenia rolnictwa (przede wszystkim o charakterze doradczym) nie tylko w skali kraju, ale i regionu.

Słowa kluczowe: ochrona środowiska, małe gospodarstwo rolne, region, zróżnicowanie

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