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THE IMPORTANCE OF FARMS FROM AREAS WITH PARTICULAR RISK OF WIND EROSION IN POLAND AS A SOURCE OF PUBLIC GOODS IN THE CONTEXT OF THE EU CAP

Key words: wind erosion, public goods, farms, agri-environmental-climate measure (AECM), organic farming measure, logistic regression model, EU CAP

ABSTRACT. The aim of the study is to characterize agriculture, including the assessment of its economic situation in areas (municipalities) of varying saturation with utilized agricultural area (UAA) particularly at risk of wind erosion in Poland, and to determine the factors that influence the willingness to better adapt to existing difficulties through the implementation of selected measures under the Common Agricultural Policy 2014-2020 (CAP 2014-2020). We are talking here about the agri-environment-climate measure (AECM) and organic farming measure, which, by improving the condition of agricultural soils, are able to simultaneously guarantee the society many public goods related to better protection of the natural environment. For the purposes of the study, data from the Institute of Soil Science and Plant Cultivation – State Research Institute in Puławy and the Agency for Restructuring and Modernization of Agriculture, as well as data from farms continuously keeping accounts for the Polish FADN in 2019-2021 were used. A logistic regression model was used to indicate the factors that were statistically significant in order to farmers from municipalities with an exceptionally high share of agricultural land particularly at risk of wind erosion, decided to participate in the AECM and/or organic farming measure. Based on this model, it was established that in these municipalities important factors of greater willingness to implement them concerned lower income cleared of operating subsidies per 1 ha of UAA, the farmer's higher level of education, the presence of other farms participating in them in the immediate vicinity, as well as a larger area of UAA and location in Natura 2000 areas.

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INTRODUCTION

The European Commission (EC) is currently strengthening its existing efforts to protect agricultural soils. In 2019 established the European Green Deal (EGD) strategy and thematic strategies, including in particular the strategy for soil protection until 2030, the EU biodiversity strategy 2030 – Bringing nature back to our lives, the strategy "From farm to fork" and a new strategy on adaptation to climate change [EC 2020a,b,c, 2021]. According to the findings of the EC contained in the strategy for soil protection until 2030, the good condition is of key importance for combating climate change, protecting human health, preserving biodiversity and ecosystems, and ensuring food security. Therefore, it should be emphasized that agriculture, taking care of it in a proper way, is able to provide the society with many public goods, which it expects to an increasing extent. As Jerzy Wilkin [2012] and Andrzej Czyżewski and Piotr Kułyk [2015] write, agriculture is a branch of the economy in which not only market goods are created, but also a large range of goods with features of public goods, which are increasingly noticed and appreciated by the society. According to Adam Harasim [2015], this state of affairs is primarily the result of a direct relationship between agriculture and the natural environment.

According to the European Court of Auditors [ECA 2018], the European Environment Agency [EEA 2019] and the Food and Agriculture Organization of the United Nations [FAO 2019], one of the sources of soil degradation is erosion and the consequent loss of organic carbon. Such a situation results in additional emissions of carbon dioxide (CO_2) into the atmosphere, which threatens to exacerbate current climate change, reduce adaptability and further loss of biodiversity. In Poland, large losses in agricultural production are caused by wind erosion, which is threatened to at least an average degree by 51.8% of the total utilized agricultural area (UAA) [Józefaciuk et al. 2018][2].

Actions against wind erosion are particularly important in areas with poor soil quality and low natural organic matter content, where its effects in the form of loss of organic carbon are very quickly visible. They are areas facing natural or other specific constraints (ANCs), the current share of which is 58.7% of the total UAA in Poland [Jadczyszyn 2022]. This means that agriculture in the areas is particularly vulnerable to wind erosion, and therefore institutional measures to maintain the good condition of soils are highly desirable, because this is the only way to provide the society with sufficient quantities of not only market goods but also public goods related to better protection of the natural environment. In this context, it is therefore necessary to have appropriate rules (institutions) that are able to coordinate, motivate and direct the activities of farmers and foster the emergence of socially optimal behavior in them. According to Jerzy Wilkin [2016], institutions create a structure that regulates the daily activities of a human being, and thus

[2] For comparison, 9.9% of the total UAA in the country is threatened by water erosion to at least an average degree [Wawer, Nowocień 2018].

reduce the uncertainty of their actions in economic reality. In turn, Tomasz Żylicz [2016, 2022] is of the opinion that thanks to the presence of institutional mechanisms, people›s actions fulfill what is expected of them, and their role is to take into account those values for society that cannot be observed in the form of market prices. As stated by Douglass C. North [1991] – winner of the Nobel Prize in economics in 1993 and one of the founders of the New Institutional Economics (NEI) – in everyday functioning, formal institutions responsible for the effective operation of the mechanism of regulating human behavior are important in making decisions. In his opinion, these institutions should, however, be supported by informal institutions created by society, based on the values professed by the human individual and motivations resulting from the knowledge, skills and commitment shown. According to the NEI, formal and informal institutions dictate to people the types of skills and knowledge that are perceived as those that bring them and society maximum benefit [Hall, Jones 1999, Rodrick et al. 2002, Rudolf 2016, Staniek 2017]. In the context of agriculture, both institutions are able to give the proper structure to its objectives, including those related to the provision of public goods to the society resulting from the good condition of agricultural soils.

The aim of the study is (1) to characterize agriculture, including the assessment of its economic situation in areas (municipalities) with varied saturation of utilized agriculture area (UAA) particularly at risk of wind erosion, and (2) to determine the factors which, in farms from areas with an exceptionally high share of UAA particularly at risk of wind erosion, have a statistically significant impact on their tendency to better adapt to their difficulties through participation in the agri-environmental-climate measure (AECM) and/or organic farming measure under the Common Agricultural Policy 2014-2020 (CAP 2014-2020).

MATERIAL AND METHODS

In order to achieve the first objective of the study, the characteristics of municipalities with different saturation of UAA particularly at risk of wind erosion in Poland, was made. For this purpose, the data of the Institute of Soil Science and Plant Cultivation – State Research Institute (IUNG-SRI) in Puławy, included in the study by Anna Józefaciuk et al. [2018] on the spatial distribution of areas with different saturation of UAA affected with varying intensity of wind erosion in terms of municipalities, was used. Anna Józefaciuk et al. [2018] used a 6-point scale to determine the strength of the wind erosion risk of UAA in terms of municipalities. A value of 0 was assigned to UAA not at risk of wind erosion, and a value of 5 to that with a very strong risk of wind erosion. Three groups of municipalities were distinguished. The study assumes that UAA particularly at risk of wind erosion is land where wind erosion occurs at a level of at least 3 as determined by Institute of Soil Science and Plant Cultivation – State Research Institute. The first had

an equal or greater than 75% of UAA particularly at risk of wind erosion in the total UAA, hereinafter referred to as municipalities with exceptionally high saturation of them. The second group consisted of municipalities with the share of UAA particularly at risk of wind erosion in the total area of UAA ranging from 25 to less than 75% of the total UAA, hereinafter referred to as municipalities with a large share of them. The third group consisted of other municipalities with the share lower than 25% of the total UAA. In these groups of municipalities, attention was first paid to the share of ANCs areas in the total UAA[3]. Then, the organizational features of their agriculture were determined based on data from the Agency for Restructuring and Modernization of Agriculture (ARMA). The data came from 1,345.2 and 1,269.5 thousand farms applicated for direct payments under the campaign for 2016 and 2021 within CAP 2014-2020. In addition, data from the animal identification and registration system of the ARMA was obtained, which concerned the livestock units (cattle, pigs, goats and sheep) for 2016 and 2021. The status of the area supported under the agri-environment-climate measure (AECM) and organic farming measure, came from applications submitted by farms for granting them as part of the 2021 campaign. It should be emphasized that farms implementing these measures in areas particularly at risk of wind erosion significantly contribute to ensuring good quality and high biodiversity of agricultural soils.

The assessment of the economic situation of farms from municipalities with different saturation of UAA particularly at risk of wind erosion, was based on data from farms continuously keeping accounts for the Polish FADN in 2019-2021. The analysis covered farms from municipalities with a share of UAA particularly at risk of wind erosion of less than 25%, < 25-75%) and at least 75% of their total UAA. The strength of this analysis is its performance on farms separated by type of farming (TF8): field crops (1), milk and other grazing livestock (5 and 6) and mixed with non-specialized production (8), and additionally according to the economic size expressed by the value of standard output (SO). When separating farms according to their type of farming, their importance in the structure of farms in the country was taken into account. In the farms, land productivity and farm income were determined per 1 family work unit of farmer and family members (Family Work Unit – FWU, 1 FWU = 2,120 hours of own work) were calculated.

The second objective of the study was to determine the direction and strength of the influence of factors which, in farms from municipalities with exceptionally high saturation of UAA particularly at risk of wind erosion, influenced their decisions to implement the AECM and organic farming measure under the CAP 2014-2020. They were determined on the basis of a logistic regression model using data from farms participating in the two

[3] In Poland, the current delimitation of ANCs areas was carried out at the request of the Ministry of Agriculture and Rural Development and the European Commission in 2019 by the Institute of Soil Science and Plant Cultivation – SRI – under the biophysical criteria, while under the fine tuning procedure by the Institute of Agricultural and Food Economics – NRI [Zieliński et al. 2022].

analyzed measures (339 farms) and other farms (2,789 farms) continuously covered by the Polish FADN accounting in 2019-2021.

In the analyzed model, the dependent variable is represented by a binary variable, where 1 means the farm's participation in AECM and/or organic farming measure, while 0 means that the farm did not participate in either of the two measures in 2019-2021. The model was estimated using Statistica, version 13.3. The model made it possible to determine the impact of given independent variables on the probability (P) of the occurrence of the expected situation for the binary dependent variable (value 1) and was expressed by the equation [Stanisz 2016]:

$$P(y \mid x_1, x_2 \ldots x_k) = \frac{e^{\beta_0 + \sum_{i=1}^{k} \beta_i \times x_i}}{1 + e^{\beta_0 + \sum_{i=1}^{k} \beta_1 \times x_i}}$$

where:

$P(y \mid x_1, x_2, \ldots x_k)$ – probability that the variable y will take the value equal to 1 for the values of the independent variables: $x_1, x_2, \ldots x_k$;

β_i for $i = 0, \ldots k$ – regression coefficients;

$x_1, x_2, \ldots x_k$ – independent variables in quantitative (continuous) or qualitative (binary) terms.

The first stage of building the model was performed using the option of the correlation matrix included in the Statistica program. When selecting the independent variables for the model, the occurrence of a weak correlation between them and their correlation with the dependent variable were taken into account [Kufel 2011].

The following were taken into account as potential independent variables subject to further statistical evaluation:

1) number of farms participating in the AECM and/or organic farming measure in a given municipality;
2) UAA on a farm (ha), including;
   – rented area (ha);
   – UAA in Natura 2,000 areas (ha);
3) farmer's education level (continuous variable, where 1 – primary education, 2 – basic agricultural or non-agricultural education, 3 – secondary agricultural or non-agricultural education and 4 – higher agricultural or non-agricultural education);
4) age of the farmer (years);
5) the fact insurance of the farmer at the Agricultural Social Insurance Fund (binary variable, where 1 – insured at the Agricultural Social Insurance Fund; 0 – insured outside the Agricultural Social Insurance Fund);
6) the fact that the farmer has a successor (binary variable, where 1 – having a successor, 0 – no successor indicated);
7) income cleared of operating subsidies per 1 ha of UAA (PLN thousand/ha).

The quality of the logistic regression model was assessed by the Likelihood Ratio test and the Wald test, implemented by default in the Statistica program, they inform about the statistical significance for the model *i* – independent variable. Nagelkerke's pseudo R^2 measure was also used, showing the degree of explanation of the variability of the dependent variable by the independent variables present in the model [Stanisz 2016]. It should be noted, however, that according to Tadeusz Kufel [2011], Marek Gruszczyński [2012] and Andrzej Stanisz [2016], pseudo R^2 statistics usually take values much lower than 1 in the types of models. In the analyzed model, the value of Nagelkerke's pseudo R^2 was 0.460190.

CHARACTERISTICS OF AGRICULTURE FROM AREAS (MUNICIPALITIES) WITH VARIOUS SATURATION OF UAA PARTICULARLY RISKED BY WIND EROSION

Poland is characterized by spatial variability of natural conditions for farming, with a large share of ANCs areas with difficult and even particularly difficult conditions and with different specificity of limitations for intensive agricultural production. Since 2019, the share of ANC areas accounted 58.7% of the total area of UAA in Poland [Jadczyszyn 2022]. These areas are present in 86.8% of municipalities, and in 52.4% of the municipalities their share is equal to or greater than 75% of the total UAA (Figure 1) [Zieliński et al. 2022]. The weakness of municipalities with an exceptionally large share of ANCs areas (at least 75%) is their high saturation of UAA with particular risk of wind

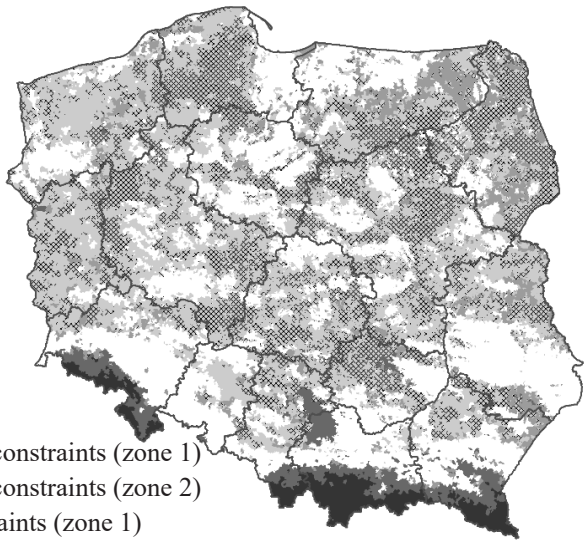

Figure 1. Distribution of ANCs areas in Poland

Source: [Zieliński et al. 2022]

erosion. In these municipalities, their average share in the total UAA is 64.2%. While in other municipalities – 36.9%.

As mentioned earlier, Anna Józefaciuk et al. [2018] determined that in Poland 51.8% of UAA in the strongest degrees (3-5) is at risk of wind erosion. The areas are present in 94.6% of all municipalities. It should be emphasized, however, that their average share varies and ranges from 0.0005 to 99.1% of the total UAA. In 23.7% of municipalities, a particular risk of wind erosion occurs on at least 75% of the total UAA. In 48.0% of

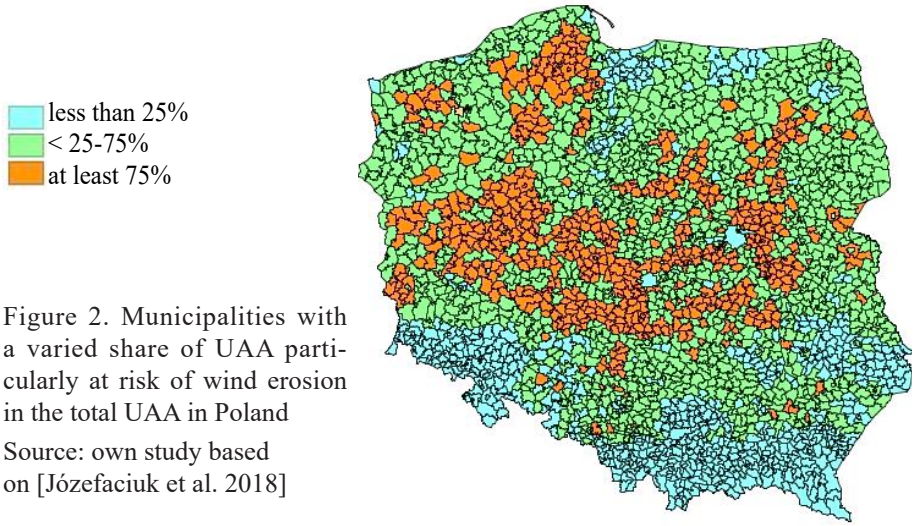

Figure 2. Municipalities with a varied share of UAA particularly at risk of wind erosion in the total UAA in Poland

Source: own study based on [Józefaciuk et al. 2018]

municipalities, they constitute from 25 to less than 75%, and in the remaining 28.3% of municipalities, less than 25% of the total UAA (Figure 2) [Józefaciuk et al. 2018].

In 2021, in municipalities with an exceptionally high share of UAA particularly at risk of wind erosion in the total UAA, there were 307.9 thousand farms, which accounted for 24.2% of the total number of farms in Poland (Table 1). Definitely the largest number of farms functioned in municipalities with a high saturation of UAA particularly at risk of wind erosion, i.e. 596.7 thousand. On the other hand, in the remaining municipalities their number amounted to 364.9 thousand. It should be added that in 2016-2021, in all the analyzed groups of municipalities, there was a decrease in the number of farms, mainly due to the ongoing process of concentration and specialization of agricultural production in the country.

In 2016 and 2021, in municipalities with an exceptionally high share of UAA particularly at risk of wind erosion, the UAA accounted for 24.8% and 24.6% of the total UAA in Poland, respectively. A higher average livestock density expressed in Livestock Unit (LU) per 1 ha of UAA (Table 1) turned out to be a more important characteristic feature of these municipalities than municipalities being the reference point. This means

Table 1. Selected organizational features of agriculture in municipalities with various saturation of UAA particularly at risk of wind erosion in Poland in 2016 and 2021

Variables	Municipalities:					
	with exceptionally high saturation of UAA particularly at risk of wind erosion		with high saturation of UAA particularly at risk of wind erosion		others	
Years	2016	2021	2016	2021	2016	2021
Number of farms [thousands]	323.5	307.9	629.6	596.7	392.1	364.9
UAA area [thousand ha], including:	3,522.9	3,503.0	7,423.6	7,453.0	3,263.7	3,255.0
– share of arable land [%]	78.7	79.8	76.2	77.0	80.0	80.8
– share of permanent grassland [%]	18.4	17.6	20.0	19.7	15.3	14.9
Livestock density [LU/ha]	0.58	0.62	0.50	0.52	0.26	0.25

Source: own study based on ARMA data for 2016 and 2021

that many farms in these municipalities see an opportunity to improve their economic situation in animal production. This situation is understandable, because one of the important conditions for profitable agricultural production in areas with natural constraints is their breeding. It should also be emphasized that on soils with a high risk of wind erosion, it is extremely important to use animal-based natural fertilizers, which increase the content of organic matter in them and thus significantly reduce the effects of wind erosion. They also improve their sorption capacity, including increasing the content of nutrients available to plants and their water capacity.

Taking into account the increasingly frequent effects of climate change in Poland, in the form of e.g. droughts with longer and longer duration, it should be emphasized that farms from municipalities with an exceptionally large share of UAA particularly at risk of wind erosion will first feel their growing consequences in the form of lower production effects. One of the important possibilities of limiting the occurrence of this unfavorable situation is their participation in the AECM and organic farming measure, the application of which – among the available measures under the CAP – is the most beneficial for the natural environment, as it enables the optimal protection of natural resources, including agricultural soils and additionally allows to obtain subsidies in this respect [Zieliński 2022]. In 2021, in municipalities with an exceptionally high share of UAA particularly at risk of wind erosion, there were 358.0 thousand ha of UAA covered by support under the AECM and organic farming measure, which accounted for 10.2% of their total UAA. For comparison, in municipalities with a high saturation of UAA particularly at risk of wind

Table 2. Area and share of the UAA covered by the AECM and organic farming measure under the CAP 2014-2020 in the total UAA of municipalities with various saturation of UAA particularly at risk of wind erosion in Poland in 2021

Description	Municipalities:		
	with exceptionally high saturation of UAA particularly at risk of wind erosion	with high saturation of UAA particularly at risk of wind erosion	others
Area of UAA covered by the AECM [thousand ha]	266.8	656.2	227.3
Area of UAA covered by the organic farming measure [thousand ha]	91.2	284.3	54.9
Area of UAA covered by the AECM and organic farming in total [thousand ha]	358.0	940.5	282.2
Share of UAA covered by AECM and organic farming measure in the total of UAA [%]	10.2	12.6	8.7

Source: own study based on ARMA data for 2021

erosion, and in other municipalities, their share in the total UAA amounted to 12.6 and 8.7%, respectively. It should also be added that in 2021, 22.6% of the total UAA covered by support under the AECM and organic farming measure was located in municipalities with an exceptionally high share of UAA particularly at risk of wind erosion (Table 2).

ASSESSMENT OF THE ECONOMIC SITUATION OF FARMS FROM AREAS (MUNICIPALITIES) WITH VARIOUS SATURATION OF UAA PARTICULARLY AT RISK OF WIND EROSION

In this part of the study, the economic situation of farms from municipalities with a different share of UAA particularly at risk of wind erosion, continuously keeping accounts for the Polish FADN in 2019-2021, was analyzed.

In farms with an economic size of less than 25 thousand euro SO in the case of farms with field crops and mixed production land productivity expressed in thousand PLN/ha decreased along with the increase in the saturation of UAA particularly at risk of wind erosion (Figure 3). The situation was similar in the case of income per 1 FWU (thousand PLN/ha) in both types of farming mentioned above. On the other hand, when analyzing farms with milk and other grazing livestock production, land productivity remained at a similar level and was even higher in farms where the threat of wind erosion was the highest. A similar situation occurred in the case of their income per 1 FWU.

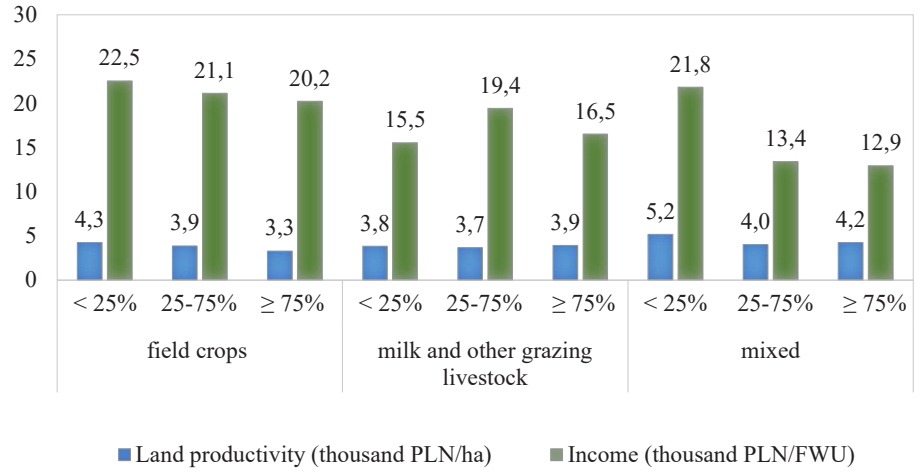

Figure 3. Economic situation of farms with economic size below 25 thousand euro SO in type of farming: field crops, milk and other grazing livestock and mixed production from municipalities with different share of UAA particularly at risk of wind erosion (average for 2019-2021)

Source: own calculations based on data from the Polish FADN for 2019-2021

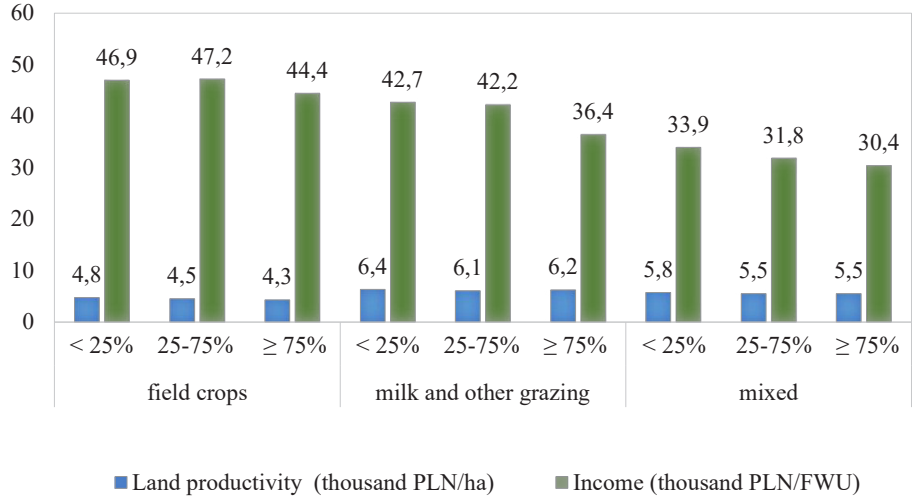

Figure 4. Economic situation of farms with economic size of 25-50 thousand euro SO in type of farming: field crops, milk and other grazing livestock and mixed production from municipalities with different share of UAA particularly at risk of wind erosion (average for 2019-2021)

Source: own calculations based on data from the Polish FADN for 2019-2021

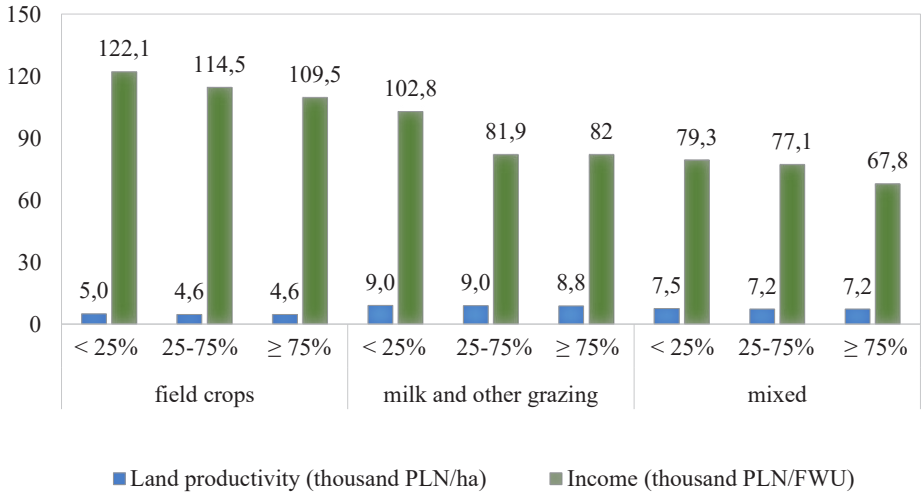

Figure 5. Economic situation of farms with economic size above 50 thousand euro SO in type of farming: field crops, milk and other grazing livestock and mixed production from municipalities with different share of UAA particularly at risk of wind erosion (average for 2019-2021)

In farms with an economic size of 25-50 thousand euro SO land productivity and income per 1 FWU in all three analyzed types of farming decreased with the increase in the saturation of UAA particularly at risk of wind erosion (Figure 4). The same situation occurred in farms with an economic size of over 50 thousand euro SO (Figure 5).

ANALYSIS OF FACTORS AFFECTING THE DECISIONS OF FARMS FROM MUNICIPALITIES WITH EXTREMELY HIGH SATURATION OF UAA PARTICULARLY AT RISK OF WIND EROSION ON PARTICIPATION IN THE AECM AND/OR ORGANIC FARMING MEASURE UNDER THE CAP 2014-2020

For the analyzed logistic regression model, the numbers characterizing the values of its parameters, as well as the statistics of the Wald test, likelihood ratio (LR) test and Nagelkerke's pseudo R^2 are included in Table 3. It turned out that the statistically significant factor whose increase by one unit determined the increase in the chance of farms participation in the AECM and/or organic farming measure was the fact that the farmer had a higher level of education (Figure 6). Thus, based on the obtained odds ratio at the level exp (β) = 1.599589, this meant that this situation resulted in an increase in a chance of participating in these measures by 59.9%. The number of farms involved in

the implementation of the AECMs and/or organic farming measure in a given municipality turned out to be an statistically significant variable in the model. Each additional farm participating in the immediate vicinity increases the chance of their implementation at the next farm by 5.8% (exp (β) = 1.057991). This means that the proximity of other farms involved in the implementation of the AECM and/or organic farming measure makes it easier for others to decide to participate. In literature, this relationship is often emphasized [Siebert et al. 2006, Barreiro-Hurle et al. 2008, Defrancesco et al. 2008, Wittstock et al. 2022]. To a lesser extent, the increase in the chance of participation in the activities is also positively – statistically significantly – influenced by having a larger area of UAA and their belonging to Natura 2000 areas. If the conditions are met, the chance of their participation in them increases by 0.6% (exp (β) = 1.005904) and 2.3% (exp (β) = 1.023382) (Figure 6).

The increase in income cleared of operating subsidies per 1 ha of UAA had a statistically significant negative impact on the chances of farms participating in the AECM and/or organic farming measure. An increase by 1 thousand PLN decreased this willingness to implement by 9.5% (exp (β) = 0.904526) (Figure 6). This proves that farms obtaining favorable income from conventional agricultural production in the difficult conditions were less interested in participating in them. It cannot be ruled out that the subsidies received after their conversion are not able to compensate them the loss of part of the income caused by the extensification of production.

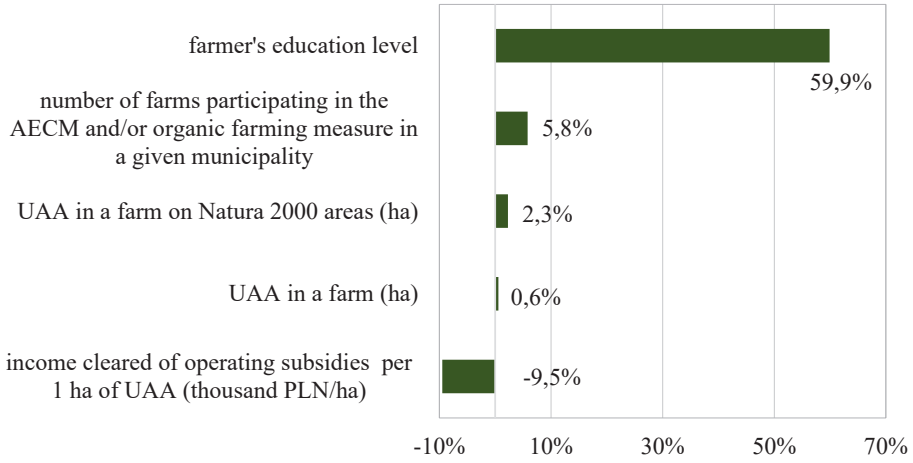

Figure 6. Change in the probability of participation of farms from municipalities with an exceptionally high share of UAA particularly at risk of wind erosion in the AECM and/or organic farming measure resulting from an increase in a given independent variable by one unit

Source: own study in Statistica version 13.3 based on Polish FADN and ARMA data for 2019-2021

Table 3. Estimated parameters of the logistic regression model

Description	β	Standard Error (SE)	Wald	Confidence intervals (95%):		ρ	exp(β)
				upper	lower		
Free item	-5.42705	0.540602	100.7796	-6.48661	-4.36749	0.000000	-
Number of farms participating in the AECM and/or organic farming measure in a given municipality	0.05637	0.002807	403.4374	0.05087	0.06187	0.000000	1.057991
UAA in a farm [ha]	0.00589	0.001950	9.1148	0.00206	0.00971	0.002536	1.005904
Area of rented UAA in a farm [ha]	0.00188	0.003094	0.3710	-0.00418	0.00795	0.542451	1.001886
UAA in a farm on Natura 2000 [ha]	0.02311	0.007226	10.2309	0.00895	0.03727	0.001381	1.023382
Farmer's education level	0.46975	0.111155	17.8596	0.25189	0.68761	0.000024	1.599589
Farmer's age [years]	-0.00337	0.006815	0.2450	-0.01673	0.00998	0.620632	0.996633
Farmer's insurance at the Agricultural Social Insurance Fund	-0.03032	0.093300	0.1056	-0.21319	0.15254	0.745190	0.941159
Possession of a successor by the farmer	-0.01020	0.079164	0.0166	-0.16536	0.14496	0.897440	0.979799
Income cleared of operating subsidies per 1 ha of UAA	-0.10034	0.022969	19.0854	-0.14536	-0.05533	0.000012	0.904526
Nagelkerke's pseudo $R^2 = 0.460190$							

Source: own study in Statistica version 13.3 based on Polish FADN and ARMA data for 2019-2021

Table 3. Estimated parameters of the logistic regression model

Description	Confidence intervals (95%):		ρ	Likelihood ratio test (LR test)		
	upper	lower		maximum likelihood logarithm (lnL)	Chi-square	ρ
Free item	-	-	-	-1073.01	-	-
Number of farms participating in the AECM and/or organic farming measure in a given municipality	1.052188	1.063827	0.000000	-700.20	745.6073	0.000000
UAA in a farm [ha]	1.002067	1.009755	0.002536	-694.72	10.9629	0.000930
Area of rented UAA in a farm [ha]	0.995829	1.007981	0.542451	-694.54	0.3705	0.542750
UAA in a farm on Natura 2000 [ha]	1.008990	1.037978	0.001381	-689.35	10.3676	0.001282
Farmer's education level	1.286451	1.988949	0.000024	-678.61	21.4769	0.000004
Farmer's age [years]	0.983409	1.010034	0.620632	-678.52	0.1915	0.661649
Farmer's insurance at the Agricultural Social Insurance Fund	0.652874	1.356742	0.745190	-667.42	0.1080	0.742454
Possession of a successor by the farmer	0.718402	1.336308	0.897440	-667.41	0.0166	0.897496
Income cleared of operating subsidies per 1 ha of UAA	0.864709	0.946177	0.000012	-667.47	22.0917	0.000003
Nagelkerke's pseudo $R^2 = 0.460190$						

Source: own study in Statistica version 13.3 based on Polish FADN and ARMA data for 2019-2021

CONCLUSIONS

The intensification of the currently occurring negative changes in the natural environment caused by agriculture results in the conclusion that in order for it to be able to effectively reduce it in the near future, it is necessary to have permanent rules of conduct that would be able to motivate farmers and foster the formation of behavior expected by the society, including those serving to provide it with a wide range of public goods related to its protection. In the New Institutional Economics, they were called institutions, understood as norms and principles shaping the framework of management. They are formal institutions in the form of established acts and legal norms, as well as informal institutions including rules of conduct, professed value systems, along with manifested commitment and ideas that affect the organization and functioning of a human being, as well as the entire society.

There is no doubt that effective protection of the natural environment in the EU is not possible without ensuring good conditions of agricultural soils, able to guarantee long-term benefits to farmers and the entire society. Therefore, the EC is currently strengthening its existing regulations for soil protection, including by increasing the importance of measures to reduce the occurrence of wind erosion. The set of the intentions was included in the EGD strategy of 2019, and in its thematic strategies for 2020-2021. However, it should be emphasized that for the regulations to be successfully implemented in a wide range in EU agriculture, it is also important to shape the values and motivation of farmers to use them permanently.

Poland is a country with diverse natural conditions for agricultural production and a large share of ANCs areas, where the conditions are extremely unfavorable, including due to the high risk of wind erosion. It should be noted that in Poland 51.8% of UAA is particularly at risk of wind erosion. Undoubtedly, in the areas only farms with the skills to cope with the existing difficulties are able to maintain their viability in the long term. It is worth emphasizing that one of the most important skills in the areas is agricultural production to the benefit of the natural environment. Such an opportunity is provided by participation in the AECM and/or organic farming measure, which are a permanent part of the EU CAP, adjusted every few years, and which, especially in these areas, are able to support uncertain agricultural income related to difficult conditions for agricultural production, and on the other hand, serve in a unique way to provide the society with a wide range of public goods related to the protection of the natural environment.

In the study, a special analysis covered municipalities with at least 75% share of UAA strongly threatened by wind erosion in the total UAA. It turned out that in 2021 in the municipalities there were 307.9 thousand farms that used 3,503.0 thousand ha, which accounted for 24.2% of all farms and 24.6% of the total UAA in Poland, respectively. In these municipalities, from the point of view of better protection of agricultural soils, participation in the AECM and/or organic farming measure is an important opportunity for farms. In 2021, these measures were implemented on 11.1% of the total UAA in Poland.

In municipalities with an exceptionally high share of UAA particularly at risk of wind erosion, it was slightly lower and amounted to 10.2%. It should be added that in these municipalities accounted for 22.6% of the total area covered by support under the AECM and organic farming measure. In addition, it was established that the farms operating in them, regardless of the agricultural type and economic size, as compared to other farms, were usually characterized by lower land productivity. As a consequence, they were also characterized by lower income per 1 FWU.

Based on the logistic regression model, it was found that in municipalities with an exceptionally high share of UAA particularly at risk of wind erosion, farms with lower income cleared of operating subsidies per 1 ha of UAA were more likely to implement the AECM and/or organic farming measure. A higher level of farmers' education also contributed to the increased chance of their participation in these measures. The presence of other farms involved in their implementation in the vicinity turned out to be a favorable factor. A larger area of UAA in farms and their location in Natura 2000 areas were also significant.

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ZNACZENIE GOSPODARSTW ROLNYCH Z OBSZARÓW SZCZEGÓLNIE ZAGROŻONYCH EROZJĄ WIETRZNĄ W POLSCE JAKO ŹRÓDŁA DÓBR PUBLICZNYCH W KONTEKŚCIE WPR UNII EUROPEJSKIEJ

Słowa kluczowe: erozja wietrzna, gospodarstwa rolne, dobra publiczne, działanie rolnośrodowiskowo-klimatyczne, działanie ekologiczne, model regresji logistycznej, WPR UE

ABSTRAKT. Celem opracowania jest charakterystyka rolnictwa, w tym ocena jego sytuacji ekonomicznej na obszarach (gminach) o zróżnicowanym nasyceniu użytkami rolnymi (UR) szczególnie zagrożonymi erozją wietrzną w Polsce, a także ustalenie czynników, które w gospodarstwach rolnych z gmin z wyjątkowo dużym ich udziałem mają wpływ na skłonność do lepszego dostosowania się do posiadanych utrudnień, przez realizację wybranych działań w ramach Wspólnej Polityki Rolnej 2014-2020 (WPR 2014-2020). Wzięto pod uwagę 2 działania: rolnośrodowiskowo-klimatyczne (DRŚK) oraz rolnictwo ekologiczne, które służąc poprawie stanu gleb użytkowanych rolniczo są w stanie równocześnie gwarantować społeczeństwu wiele dóbr publicznych związanych z lepszą ochroną środowiska przyrodniczego. Do realizacji celów wykorzystano dane Instytutu Uprawy Nawożenia i Gleboznawstwa – PIB w Puławach oraz Agencji Restrukturyzacji i Modernizacji Rolnictwa, a także dane z gospodarstw rolnych nieprzerwanie prowadzących rachunkowość dla Polskiego FADN w latach 2019-2021. W celu wskazania czynników, które miały istotne statystycznie znaczenie przy podejmowaniu przez rolników z gmin z wyjątkowo dużym udziałem UR szczególnie zagrożonych erozją wietrzną decyzji o uczestniczeniu w działaniu DRŚK i/lub rolnictwo ekologiczne wykorzystano model regresji logistycznej. Na podstawie tego modelu ustalono, że w tych gminach ważnym czynnikiem większej skłonności do ich realizacji były: mniejszy uzyskiwany dochód oczyszczony z dopłat w przeliczeniu na 1 ha UR, wyższy poziom wykształcenia rolnika, obecność w najbliższej okolicy innych gospodarstw rolnych w nich uczestniczących, a także posiadanie większej powierzchni UR oraz ich lokalizacja na obszarach Natura 2000.

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