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CHALLENGES ASSOCIATED WITH ENVIRONMENTAL PROTECTION IN RURAL AREAS OF POLAND: EMPIRICAL STUDIES' RESULTS

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ABSTRACT. The paper focuses on important and topical issues of agricultural economy development within the paradigm of sustainable development and reorientation towards a low-carbon economy. The main purpose of this study is to identify the contemporary challenges in the field of environmental protection in rural areas of Poland. Specially designed survey of a large representative sample (random sampling) of Polish agricultural producers has been used. The study is based on the results of quantitative research (questionnaire surveys) carried out among 1101 agricultural holdings and a qualitative research carried out among 24 experts (professional agri-environmental advisors). The research shows that the main challenges in the investigated material and spatial scope include low-altitude emissions and the issues associated with waste sorting. There was a significant variation in responses, taking into account the locations of agricultural holdings as well as characteristics of the respondents and farms. Independent experts indicated and assessed environmental threats in rural areas and classified the activities and implementations in the scope of pro-environmental innovation that may reduce the negative impact of agriculture on the natural environment in rural areas of Poland.

JEL Classification: Q01, Q20, Q58

Keywords: low-carbon economy, development challenges, rural areas, environmental protection, farmers' behaviors, Poland

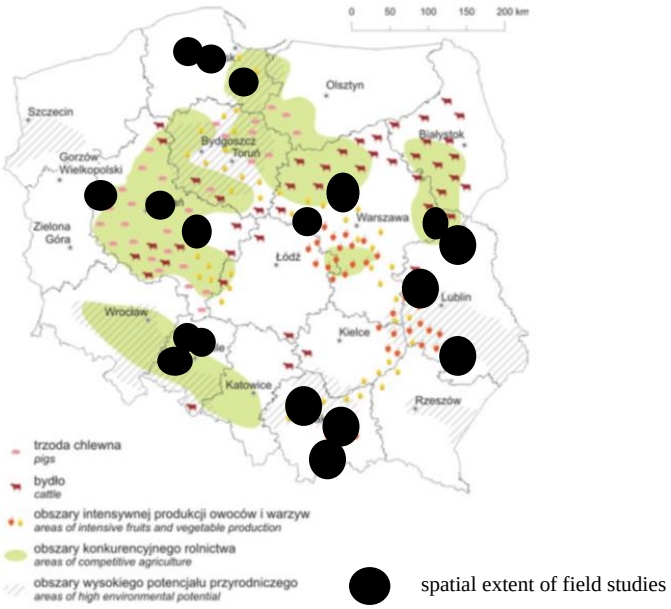
Introduction

Poland belongs to a group of countries in the European Union with a distinctive position in terms of the agricultural production volume and the value of production generated by the food industry. This is mainly predetermined by the size of agricultural resource base (area and structure of agricultural lands, structure of crops, livestock population) as well as by natural (soil quality, etc.) and economic factors (e.g., demand for food, volume and dynamics of export) (Firlej et al., 2017; Olszańska et al., 2017; Bański, 2018; Piwowar, 2019a). Agricultural production in Poland still plays a considerable role in terms of human capital and participation in generation of gross added value. Agriculture plays an important role in social and economic development of rural areas, which occupy a large part of Poland's territory and are inhabited by approx. 39% of the country's population.

The scale of agricultural production in Poland (both plant and animal production), including relatively high consumption of agrochemicals in crop production and large livestock population poses a threat to the cleanness of water, air and soil. Intensive farming and non-sustainable fertilization exert a negative impact on the environment (Balsalobre-Lorente et al., 2019; Peoples et al., 2019; Świtek et al., 2019; Šarauskis et al., 2019). In general, it is estimated that agriculture generates 24% of the total emissions of greenhouse gases in the world, while the global food system contributes 35% of global greenhouse gas emissions. Calculating emissions and concentrations of pollutants from the agricultural sector is a particularly complex issue (Mohammed et al., 2019). Agriculture's contribution to the EU's greenhouse gas emissions in the years 2007-2016 increased by 1.5 pp. The level of such emissions is determined primarily by animal production (Pondel, 2019). Thus, agricultural production should be an elementary, critical element in the processes aimed at reduction of emissions (Niles et al., 2018; Xu & Lin, 2017; Ibidhi et al., 2017; Giannakis et al., 2019; Bai et al., 2019, He et al., 2019; Han et al., 2019).

In literature on the subject, this problem is increasingly emphasized in relation to agricultural economy in Poland (Dzikuć et al., 2019; Lewandowska-Czarnecka et al., 2019; Wardal & Pawlak, 2019). There is a considerable need for analyses in this context which will allow identifying potential threats and highlighting the key areas for additional research and programs necessary for the development of low-carbon economy in relation to agriculture and rural areas (Wang et al., 2015; de Moraes Sá et al., 2017; Früh-Müller et al., 2019; Piwowar, 2020). It is important to know challenges and barriers in the investigated area, which affect not only agricultural economy but also the level and the quality of life in rural communities in general. It is also necessary to strive for balancing socioeconomic and natural aspects of agricultural economy. Such a construct contributes to realizing, possibly at the same time, all the developmental values essential for improving the quality of life for the population living in rural areas (Kristensen et al., 2016; Melece, 2016; Pezzagno et al., 2020). It is not only a guarantee of food security, but it also plays an important role in energy security (agricultural biogas plants) etc. (Koryś et at., 2019; Piwowar & Dzikuć, 2019; Czekała et al., 2020). The use of resources in a way that does not damage their ability for renewal, as well as preservation of high quality of the natural environment are the features desired by the society in general and by local rural communities in particular. When performing analyses, it is important to examine the problem at various levels, i.e., at economic (resource allocation), technological (clean technologies), legal (legal regulations, good practices) and sociological (social functions in rural areas) levels.

Of course, rural areas in Poland differ in terms of their potential, threats, spatial arrangement, direction and intensity of the conducted agricultural activity. Plant production is dispersed throughout Poland, while the main areas of animal production are relatively more concentrated spatially (Graph. 1).



Graph. 1. Main food producing areas in Poland and spatial extent of field studies
Source:https://www.igipz.pan.pl/tl_files/igipz/ZGWiRL/ARP/01.Znaczenie%20rolnictwa%20w%20gospodarce%20Polski.pdf

Problems of environmental protection in rural areas are taken up in the literature of the subject in various scientific fields and disciplines. One of the main points of reference for considerations on the environmental protection in rural areas are decisions taken by farmers (Prokopy et al., 2015; Barragán-Ocaña & del Carmen del-Valle-Rivera, 2016; Hyland et al., 2016; Bachev, 2017; Widayati & Yusuf, 2017; Cui et al., 2018; Bayramoglu et al., 2018). They are making decisions on what, where and how to produce, taking into account legal, economic and environmental factors. Protection of rural areas, preservation and development of natural methods of management, protection of traditional agricultural landscapes and biodiversity, challenges associated with closed-loop economy in rural areas (inter alia with respect to waste) are the topics combining many disciplines in social sciences (Martins, 2016; Toop et al., 2017; Blades et al., 2017; Wiśniewski & Kistowski, 2017).

1. Objective, methodology and sources of information

The main purpose of this study is to identify contemporary challenges in the field of environmental protection in rural areas in Poland in spatial arrangement. The study presents results of the research conducted under a scientific project funded from financial resources of the National Centre of Science in Poland. Questionnaire surveys, the basic research method used in this project, were carried out in the period from November 2017 to March 2018. The spatial extent of the analyses conducted as part of the project covered entire Poland, while the empirical studies were carried out among 1101 farmers in six randomly selected provinces (one from each macroregion in Poland). In each province, 3 districts were drawn, in which the questionnaire surveys were conducted.

The sample was representative. All the subjects of the target population (agricultural producers in Poland) had the same possibility of being selected in this sample and the sample was sufficiently large (Hogarth, 2005). The exact size of the survey sample was estimated using the following formula (Sobczyk, 1995, Suresh & Chandrashekara, 2012):

$$n \geq \frac{1}{4}\left(\frac{u_{\frac{\alpha}{2}}}{d}\right)^2$$

where:
n - minimum representative size of the sample
u - critical value of the normal distribution
d - maximum estimation error
$u_{\frac{\alpha}{2}}$ - normal deviate for two- tailed alternative hypothesis at a level of significance

The calculation of the sample was performed using the above formula. The number of observations should not be less than 1036. It has been assumed that the structure index will be estimated at the confidence level of 0.99 (α = 0.01). Statistical error 4% (d = 0.04).

In total, the area of the agricultural holdings surveyed was 31,819.75 ha of agricultural lands, while the average area of an agricultural holding surveyed was 28.90 ha of agricultural lands. Intensive agricultural production, both plant and animal production (see Graph. 1), was conducted on a significant area of rural regions under consideration. In turn, the experts in the surveys were mainly employees of agricultural advisory centers from the provinces, where the surveys with farmers were conducted (24 professional experts). As in the case of farmers' surveys, the basic research tool in the experts' surveys was the author's survey questionnaire. In the analyses, there were used statistical data analysis methods that allow identifying and assessing the variability of the examined features (structure indicators, taking into account the spatial extent of the studies and characteristics of the studied population).

2. Conducting research and results

In the survey questionnaire, which was the basic research tool in the project, the respondents indicated challenges concerning the environmental protection in the rural areas, in which they conduct agricultural activity (results are presented below). The respondents could indicate three most important factors (a series of percentages may validly sum to greater than 100%). Table 1 presents the results of the studies in this scope.

According to the analyses, the most important challenges in the investigated scope included low-altitude emissions from individual sources (domestic furnaces, local boiler rooms) and waste sorting. Such responses were given by 67.1% and 60.5% of the respondents, respectively. Subsequently, the respondents indicated issues associated with the protection of biodiversity in crop production, excessive chemicalization of agriculture, and challenges associated with thermomodernization of livestock buildings (40%, 34.6% and 30.7% of responses, respectively). Less important problems included:

- disappearance of grazing land due to withdrawal of farmers from livestock grazing;
- high concentration of livestock production and related emissions (methane, ammonia, etc.);
- degradation of agricultural space caused by fallowing;
- progressing eutrophication of waters.

None of the above four responses was indicated more frequently than by every fifth respondent.

Table 1. Farmers' declarations regarding challenges related to environmental protection in the rural areas, in which they conduct agricultural activity

Specification	Strenght	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	[pcs.]	[%]									
Lubelskie[a]	**183**	67.8	55.7	37.2	44.3	37.7	13.7	15.8	7.1	12.6	8.7
Bialski [b]	60	55.0	66.7	48.3	40.0	18.3	13.3	16.7	11.7	8.3	13.3
Lubartowski [B] District	62	74.2	45.2	33.9	58.1	22.6	14.5	22.6	6.5	22.6	1.6
Zamojski [B]	61	73.8	55.7	29.5	34.4	72.1	13.1	8.2	3.3	6.6	11.5
Małopolskie[a]	**188**	78.2	61.2	41.0	22.9	28.2	16.5	12.8	4.8	20.2	10.1
Gorlicki [B]	68	88.2	73.5	50.0	22.1	8.8	19.1	10.3	4.4	22.1	1.5
Proszowicki [B]	60	78.3	53.3	43.3	11.7	36.7	21.7	6.7	10.0	6.7	20.0
Tarnowski [B]	60	66.7	55.0	28.3	35.0	41.7	8.3	21.7	0.0	31.7	10.0
Mazowieckie[a]	**180**	51.1	66.7	32.8	33.3	32.8	11.1	10.0	37.8	5.0	8.3
Łosicki [B]	60	51.7	58.3	43.3	38.3	20.0	15.0	8.3	26.7	3.3	3.3
Makowski [B]	60	68.3	71.7	46.7	36.7	21.7	10.0	10.0	21.7	5.0	10.0
Żuromiński [B]	60	33.3	70.0	8.3	25.0	56.7	8.3	11.7	65.0	6.7	11.7
Opolskie[a]	**190**	84.2	63.2	43.2	43.2	34.2	12.6	7.9	3.2	7.4	4.7
Kluczborski [B]	61	86.9	55.7	36.1	55.7	26.2	13.1	4.9	1.6	4.9	8.2
Oleski [B]	69	78.3	58.0	78.3	27.5	18.8	15.9	8.7	0.0	11.6	0.0
Opolski [B]	60	88.3	76.7	10.0	48.3	60.0	8.3	10.0	8.3	5.0	6.7
Pomorskie[a]	**180**	63.9	56.7	49.4	36,7	21.7	43.9	5.6	3.3	7.2	7.8
Gdański [B]	60	73.3	60.0	48.3	43.3	28.3	41.7	3.3	0.0	3.3	5.0
Kartuski [B]	60	35.0	58.3	45.0	36.7	20.0	45.0	8.3	8.3	13.3	6.7
Sztumski [B]	60	83.3	51.7	55.0	30.0	16.7	45.0	5.0	1.7	5.0	11.7
Wielkopolskie[a]	**180**	56.1	59.4	36.1	27.2	29.4	20.0	21.1	12.8	7.2	15.6
Gnieźnieński [B]	60	60.0	61.7	23.3	28.3	21.7	20.0	25.0	8.3	13.3	23.3
Koniński [B]	60	56.7	53.3	46.7	36.7	26.7	21.7	21.7	6.7	8.3	8.3
Międzychodzki [B]	60	51.7	63.3	38.3	16.7	40.0	18.3	16.7	23.3	0.0	15.0
Total	***1101***	67.1	60.5	40.0	34.6	30.7	19.5	12.2	11.4	10.0	9.2

a voivodships
b districts

1*Low-altitude emissions from individual sources (domestic furnaces, local boiler rooms)
2*waste sorting
3*thermomodernization of residential buildings
4*protection of biodiversity in crop production (cereals, maize, rape, etc.)
5*excessive chemicalization of agriculture (high doses of mineral fertilizers, pesticides, etc.)
6*thermomodernization of livestock buildings
7*disappearance of grazing land due to withdrawal of farmers from livestock grazing
8*high concentration of livestock production and related emissions (methane, ammonia, etc.)
9*degradation of agricultural space caused by fallowing
10*progressing eutrophication of waters

Source: *own study based on questionnaire surveys conducted among agricultural producers (n = 1101)*

As mentioned in the introduction, the issues raised in this study are generally of local nature (especially the threats associated with intensive animal production) and hence there was a significant differentiation of responses in terms of the spatial extent of the research. For example, the issue of thermomodernization of livestock buildings was very important for the respondents from Pomorskie Province (on average, this factor was declared by 43.9% of the respondents). The issues associated with thermomodernization in the scope of low-carbon economy were described in earlier works of the author (Piwowar, 2019b). In turn, a high concentration of animal production and related emissions (methane, ammonia, etc.) were relatively more often indicated by farmers from Wielkopolskie and Lubelskie Provinces (Olszańska et al., 2017). These two Polish provinces are characterized by a high livestock population. From the cognitive point of view, it is interesting to consider the diversity of declarations regarding the examined factors, taking into account the demographic and social features of the respondents (Table 2).

Table 2. Farmers' declarations regarding challenges associated with the environmental protection, taking into account the demographic and social features of the respondents

Specification	Strength	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	[pcs.]	[%]									
Age											
18-29 yrs.	128	69.5	56.3	41.4	28.1	27.3	18.0	15.6	12.5	7.8	10.2
30-39 yrs.	250	64.8	60.8	37.2	36.8	32.0	20.8	9.2	14.4	9.6	10.0
40-49 yrs.	328	67.7	62.2	40.2	37.2	30.8	16.5	11.3	11.3	10.1	9.8
50-59 yrs.	281	69.0	58.0	39.9	35.2	32.0	21.7	13.2	10.0	12.8	7.5
> 60 yrs.	102	60.8	68.6	42.2	30.4	28.4	19.6	15.7	6.9	6.9	7.8
Gender											
Women	197	64.5	64.0	42.6	29.9	36.0	19,8	7.6	12.2	8.1	10.2
Men	901	67.7	59.8	39.2	35.7	29.6	19,4	13.2	11.1	10.3	9.0
Education											
Primary	44	61.4	65.9	52.3	27.3	25.0	27.3	2.3	2.3	9.1	11.4
Graduate vocational school	389	64.5	62.2	42.9	34.2	28.5	19.3	12.1	9.5	12.3	7.2
Secondary	518	70.5	57.7	39.6	35.5	30.9	20.8	11.6	13.5	9.1	8.7
Higher	142	62.7	64.1	31.7	34.5	36.6	14.1	18.3	12.0	7.7	15.5
Experience											
1-5 yrs.	90	65.6	52.2	44.4	32.2	26.7	25.6	13.3	15.6	7.8	7.8
6-10 yrs.	146	67.8	62.3	32.9	31.5	33.6	19.2	12.3	16.4	10.3	10.3
11-15 yrs.	119	65.5	58.0	31.9	34.5	37.0	10.1	10.9	16.8	6.7	15,1
16-20 yrs.	172	65.1	58.1	41.9	40.1	30.2	15.7	13.4	9.9	12.2	11.6
21-25 yrs.	138	73.2	62.3	37.0	38.4	26.8	20.3	8.7	5.8	11.6	7.2
26-30 yrs.	152	62.5	63.2	43.4	36.2	30.9	22.4	12.5	9.9	11.2	6.6
> 31 yrs.	282	63.5	59.6	41.8	28.4	29.1	20.2	12.8	8.5	8.2	6.7

1*Low-altitude emissions from individual sources (domestic furnaces, local boiler rooms)
2*waste sorting
3*thermomodernization of residential buildings
4*protection of biodiversity in crop production (cereals, maize, rape, etc.)
5*excessive chemicalization of agriculture (high doses of mineral fertilizers, pesticides, etc.)
6*thermomodernization of livestock buildings
7*disappearance of grazing land due to withdrawal of farmers from livestock grazing
8*high concentration of livestock production and related emissions (methane, ammonia, etc.)
9*degradation of agricultural space caused by fallowing
10*progressing eutrophication of waters
Source: *own study based on questionnaire surveys conducted among agricultural producers (n = 1101)*

According to the analyses, there was a significant variation in the respondents' indications depending on the age of the respondents (especially in relation to factors No. 8 and 10). High concentration of livestock production and related emissions (methane, ammonia, etc.) – declared more frequently by relatively younger people. For example, in the age group of 18–29 years, it was declared by 12.5% of the respondents, while in the age group of over 60 years – by less than 7%. A similar variation in responses was observed with respect to the factor "progressing eutrophication of waters". Also the education of the respondents clearly determined their declarations, especially in relation to factors No. 5, 7 and 8. In these cases, the higher the level of education, the greater percentage of the respondents selected these responses. The number of years worked is a feature that differentiated responses concerning factor No. 8. Farmers' declarations regarding challenges associated with the environmental protection, taking into account characteristics of the examined agricultural holdings, are presented in Table 3.

Table 3. Farmers' declarations regarding challenges associated with the environmental protection, taking into account characteristics of the examined agricultural holdings

Specification	Strength	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	[pcs.]	[%]									
Agricultural land [ha]											
< 5	88	58.0	54,5	42.0	29.5	43.2	19.3	11.4	8.0	18.2	10.2
5-9.99	195	69.2	62.1	43.6	29.2	28.7	18.5	11.3	9.2	15.9	7.7
10-14.99	191	61.3	62.8	42.9	30.4	30.4	21.5	11.0	14.1	7.9	7.9
15-19.99	136	56.6	62.5	39.0	36.8	30.1	19.9	12.5	15.4	8.8	7.4
20-29.99	164	69.5	56.7	45.1	33.5	27.4	14.6	15.9	10.4	6.7	13.4
30-49.99	170	74.1	60.6	27.6	40.0	30.0	19.4	12.9	12.9	8.8	10.0
50-99.99	115	73.9	64.3	44.3	41.7	36.5	24.3	10.4	8.7	8.7	6.1
>100	41	80.5	53.7	26.8	46.3	17.1	22.0	9.8	7.3	0.0	14.6
Economic size (Standard Output = SO)											
< 10 thous. euro	316	64.9	64.2	42.7	32.3	29.7	19.9	11.1	11.7	13.0	7.3
10,1-13 thous. euro	156	66.0	57.1	42.9	28.2	32.1	12.8	12.8	9.6	11.5	8.3
13,1-20 thous. euro	188	61.2	61.2	37.2	27.7	29.8	20.2	17.6	12.8	12.2	12.8
20,1 – 50 thous. euro	232	72.0	63.4	37.9	42.2	31.5	20.3	8.2	11.6	6.5	6.0
50,1 – 100 thous. euro	99	71.7	53.5	43.4	45.5	23.2	26.3	13.1	12.1	3.0	8.1
100,1 – 200 thous. euro	40	82.5	65.0	35.0	35.0	42.5	27.5	10.0	7.5	5.0	12.5
>200 thous. euro	4	100.0	75.0	25.0	25.0	50.0	25.0	0.0	25.0	0.0	0.0

1*Low-altitude emissions from individual sources (domestic furnaces, local boiler rooms)
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10*progressing eutrophication of waters

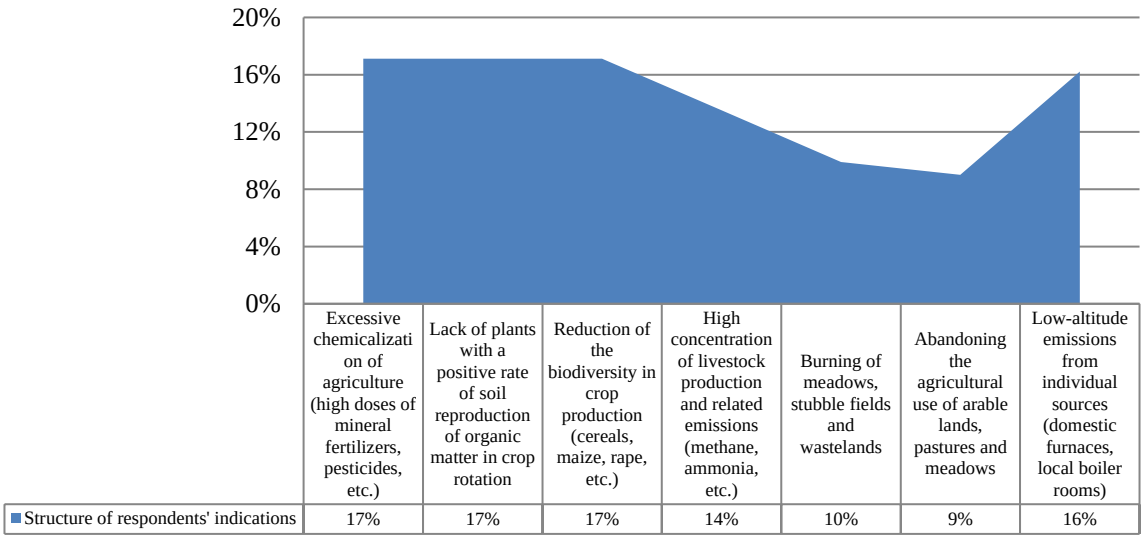
Source*: own study based on questionnaire surveys conducted among agricultural producers (n = 1101)*

As it results from the surveys, the area of agricultural holdings diversified the responses concerning the examined challenges in rural areas. Especially distinctive were more frequent declarations of importance of factor No. 4 (protection of biodiversity in crop production) made by the farmers with larger areas of agricultural land. A reverse tendency, taking into account the area of agricultural holdings, was observed with respect of the factor "degradation of agricultural space caused by fallowing".

The problems of environmental protection were taken into account also in the surveys conducted among independent experts. The respondents were asked to answer, inter alia, the following questions:

- What poses the greatest threat to the quality of the natural environment in rural areas?
- What can have the greatest effect on the intensification of implementation of pro-environmental innovations, i.e. techniques and technologies reducing negative impact of the agriculture on the natural environment?

The respondents could indicate five most important factors and then rank them according to the degree of importance by assigning them numbers from 1 to 5 in the table, where 1 is the most important factor and 5 – the least important factor. The results of the surveys in this material scope are presented in Graph. 2 and 3 and in Tables 4 and 5.



Graph. 2. Declarations of experts regarding the most important threats to the quality of the natural environment in rural areas

Source: *own study based on questionnaire surveys conducted among experts (n = 24)*

The experts participating in the study most frequently indicated the following factors: excessive chemicalization, lack of plants with a positive rate of soil reproduction of organic matter in crop rotation, and a reduction of biodiversity in crop production (17% in case of all indications). In addition to the total value of the indications, their structure is also important, taking into account the assessment of the importance of factors (Table 4).

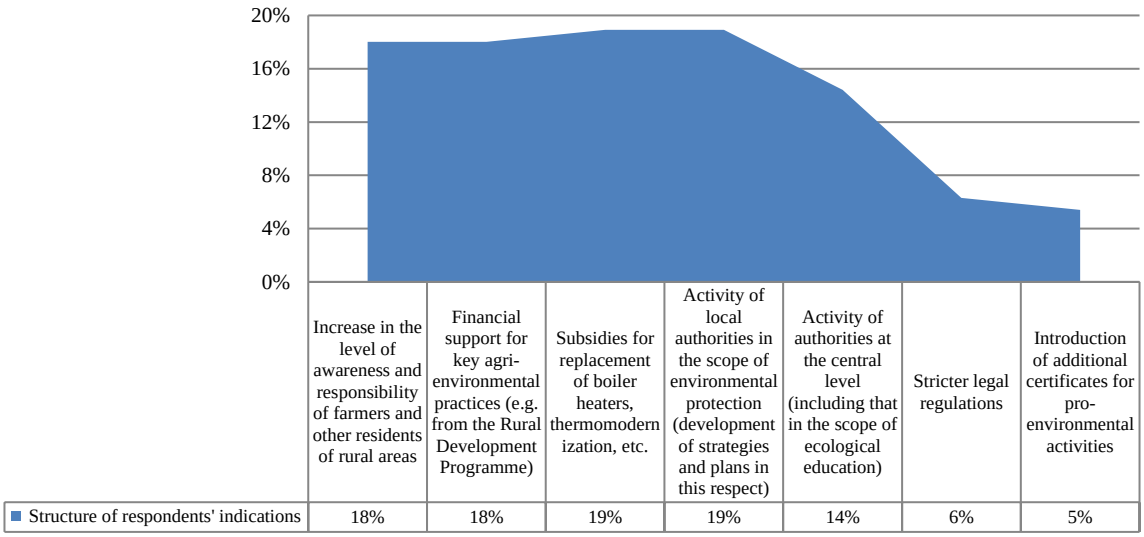
Table 4. The structure of indications provided by the experts regarding the most important threats to the quality of the natural environment in rural areas

Classification of factors*	Excessive chemicalization of agriculture (high doses of mineral fertilizers, pesticides, etc.)	Lack of plants with a positive rate of soil reproduction of organic matter in crop rotation	Reduction of the biodiversity in crop production (cereals, maize, rape, etc.)	High concentration of livestock production and related emissions (methane, ammonia, etc.)	Burning of meadows, stubble fields and wastelands	Abandoning the agricultural use of arable lands, pastures and meadows	Low-altitude emissions from individual sources (domestic furnaces, local boiler rooms)
	[%]						
1	29	0	48	5	0	0	19
2	17	22	13	17	4	4	22
3	10	38	5	0	5	24	19
4	17	13	13	26	17	0	13
5	13	13	9	17	22	17	9

* (1– most important, 5 – least important)

Source: *own study based on questionnaire surveys conducted among experts (n = 24)*

The most important factor, indicated at the 1st place in the expert surveys, was a reduction of biodiversity (48% of responses) and an excessive use of agrochemicals (29% of responses). Lack of plants with a positive rate of soil reproduction of organic matter in crop rotation was indicated most frequently on the 3rd and 2nd place in the scale. According to the respondents, the least important were the following factors: "Burning of meadows, stubble fields and wastelands" and "abandoning the agricultural use of arable lands, pastures and meadows". The experts also declared actions that must be conducted or intensified in relation to implementations of pro-environmental innovations reducing the negative impact of the agriculture on the natural environment in rural areas (Graph. 3).



Graph. 3. Declarations of experts regarding the necessity to intensify the activities and implementations of pro-environmental innovations reducing the negative impact of the agriculture on the natural environment in rural areas

Source: *own study based on questionnaire surveys conducted among experts (n = 24)*

According to the experts, the improvement of the current state depends on the following factors: activity of local authorities; subsidies for replacement of boiler heaters, thermomodernization, etc., support in the scope of agri-environmental programs, and an increase in the level of awareness and responsibility of rural residents (including farmers). The structure of indications provided by the experts (including an assessment in a scale from 1 to 5) is presented in Table 5.

Table 5. The structure of indications of the experts regarding the necessity to intensify the activities and implementations of pro-environmental innovations reducing the negative impact of the agriculture on the natural environment in rural areas

Classification of factors *	Increase in the level of awareness and responsibility of farmers and other residents of rural areas	Financial support for key agri-environmental practices (e.g. from the Rural Development Programme)	Subsidies for replacement of boiler heaters, thermomodernization, etc.	Activity of local authorities in the scope of environmental protection (development of strategies and plans in this respect)	Activity of authorities at the central level (including that in the scope of ecological education)	Stricter legal regulations	Introduction of additional certificates for pro-environmental activities
	[%]						
1	35	26	17	4	0	13	4
2	17	29	17	17	13	4	4
3	21	8	29	21	4	0	17
4	5	14	14	27	27	14	0
5	11	11	17	28	33	0	0

* (1– most important, 5 – least important)

Source: *own study based on questionnaire surveys conducted among experts (n = 24)*

As the most important factors, the experts most frequently indicated an increase in the level of awareness of rural residents, and then financial support (e.g. under the Common Agricultural Policy). A significant percentage of the respondents indicated the need to introduce stricter legal regulations (13% of the respondents) as the most important factor. Activity of authorities at the central level is an important factor, which is noticed by the experts, but on the scale adopted it is assessed mainly as 4th or 5th factor.

Conclusion

An important issues in the area of social and agricultural sciences include a search for and implementation of programs in rural areas, as well as programming the development of these areas in order to ensure the durability and continuity of functioning, while meeting the needs of all groups of stakeholders, taking into account all the variability of the internal and external environments. Low-carbon economy should provide a basis for the rural development policy, while its objectives, priorities, instruments and activities should be permanently included in the development programs. The implementation of the above principles requires not only changes in technologies and law, but also full acceptance by local communities. It is necessary to prepare special programs in the scope of low-carbon economy in agriculture and households in rural areas, which would engage local communities. In this context, there is a lot of room to act for public authorities, including cooperation between various levels of government (central, regional and local). The main goal of these activities should be to create conditions for social and structural diversity in rural areas, including conditions for the development of food economy without damaging the natural resources. It is also a field for development for bottom-up initiatives, including entities in the area of social economy.

From the research conducted it appears that in order to achieve the intended goals (development of low-carbon economy), it is necessary to increase the level of farmer's awareness in the material scope under consideration (production techniques and technologies in the scope of plant and animal production, waste disposal considerations in agricultural holdings and households, etc.). The implementation of the sustainable development principles for solving the problems occurring in rural areas requires the involvement of the local communities, the use of educational programs for this purpose, leaders in the investigated fields, as well as the media. It is necessary to implement many development projects, subsidized from local and central government funds as well as from external sources, in the economic and social life of rural areas. Sustainable management of natural resources in agricultural production (green development through innovation and mitigation of climate change) is a challenge for the coming years and for the new financial perspective in the scope of the Common Agricultural Policy.

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