

**ENVIRONMENTAL AWARENESS OF FARMERS
AND FARMS' CHARACTERISTICS***

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Abstract

The major objective of the article was to assess how farmers perceive the environmental impact of agriculture and to identify the characteristics of farms managed by farmers differing in terms of environmental awareness. The studies covered 600 commercial farms across Poland, participating in the FADN. Awareness of farmers in this area was assessed using the Likert scale. Depending on the included element of the natural environment, from about 30 to 60% of the farmers were aware of the negative environmental impact of agricultural production. According to the farmers surveyed, the main motive justifying a need to protect the environment is care for health – relatively few farmers associate a need to protect the environment with the conditions of economic activities. The analyses carried out also showed that farmers aware of the negative environmental impact of agricultural production managed farms with the higher production potential on average, higher intensity and better economic results. The higher level of awareness of farmers from farms conducting the more intensive production contradicts the argument that intensively farming farmers do not see environmental problems.

Keywords: awareness of farmers, farm, natural environment, environmental risks.

JEL codes: Q01, Q10, Q50.

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Introduction

One of the key challenges of economics is to attempt to identify the rules governing the way people function in the economy. Classical economics is based in this regard on the *homo oeconomicus* concept (Grzesiuk, 2014), that assumes that despite the fact that man seeks to maximise their personal economic benefits, this should, by assumption, be beneficial to the whole society because – as indicated by A. Smith – “By pursuing his own interest, an individual frequently promotes that of the society more effectually than when he really intends to promote it” (Smith, 2007). Since the 60s of the 20th century, it has been more and more frequently emphasised that the implementation of particular interests of individual actors in the economic system becomes for societies a source of numerous ecological and social problems which are referred to as externalities and external costs (Buchanan and Stubblebine, 1962). In the second half of the 20th century, the growth in social awareness of environmental consequences of human economic activities was supported by such publications as “Cicha wiosna (Silent spring)” by Rachel Carson (1962) or “Granice wzrostu (The limits to growth)” (Meadows D.H., Meadows D.I., Randers and Behrens, 1972). Of relevant importance in the environmental awareness development process were also probably numerous natural disasters which developed countries had to face in the 70s (Rogall, 2010). Among the relevant events indicating the growth in awareness of environmental problems, we can also mention the fact that in 1969 the UN Secretary-General – U Thant – presented a report entitled “Człowiek i jego środowisko (The problems of human environment)” and in 1972 a UN conference on the protection of environment was organised in Stockholm. Growing awareness of relationships between economic activities and the state of the environment and the consequences of these relationships for human living conditions led to arranging, at the 1992 United Nations conference in Rio de Janeiro, the objectives of a new model of development specified as *sustainable development* (Rogall, 2010), whose formal definition had been formulated several years before by the so-called Brundtland Commission (UN, 1987). One of the characteristics of this concept is a change in perceiving production factors, which, since the times of A. Smith, included labour, land and capital. In terms specific to *sustainable development*, which also gave rise to the concept of “sustainable development economics”, the land factor is replaced by the concept of natural resources, which in a classical approach were treated only as a “production input”, which, however, is an excessively narrow point of view. In the approach specific to “sustainable development economics”, environmental resources such as air, water, soil, raw materials or energy carriers are seen both in terms of inputs in production processes and also as a “natural base for life of all organisms”, including humans (Rogall, 2010). Depletion of non-renewable resources or destruction of renewable environmental resources may cause not only the adverse conditions for further economic development but may, literally, determine the absence of conditions for further existence of humans. Today, the protection of environmental resources is,

therefore, a prerequisite for the civilisation to survive – without guaranteeing their sustainability (at least in a sense of so-called weak sustainability by Daly¹), any other socio-economic problems will become irrelevant. In this context, it is worth pointing out that natural resources perform not only production functions, by providing means of production, but also are used to absorb substances formed during production and consumption processes, among which we most often mention CO₂.

Although the implementation of sustainable development rules has been intensely discussed for more than 30 years, the current degree of implementing this concept can be deemed unsatisfactory (Rogall, 2010; UN, 2013). One of the likely reasons is the departure from the original objective of this concept, i.e. mainly care for the protection of natural resources, for the benefit of many objectives assigned to three dimensions of sustainable development (e.g. in 2014, the UN Open Working Group developed, following the Rio+20 conference, a set of “updated” sustainable development goals, which includes as many as 17 points²) (UN, 2014). Among reasons for the too slow implementation of sustainable development demands, there is also relatively poor understanding of this concept by society or the excessive ideologisation of this concept suggesting its utopian nature (Rogall, 2010). The sustainable development goals and principles have been defined by international organisations (starting with the UN) and then an attempt was made to transfer them to lower levels of organisation of countries and societies, therefore, they are not always understood by people who, by means of daily decisions, determine the degree of their implementation. In relation to these problems, it seems quite obvious to work at the grass roots with the aim to increase the level of awareness of environmental challenges facing modern societies. This also applies to the sphere of agriculture, which is increasingly criticised as one of the sectors of economy significantly contributing to the destruction of the environment, including its significant contribution to generating climate change (Tilman, Cassman, Matson, Naylor and Polasky, 2002). Given the growing population of the world (Alexandratos and Bruinsma, 2012), we should expect the further growth in the demand for food (Kulawik, 2015), which, in relation to the negative environmental impact of agricultural production leads to contradictory objectives. As indicated by Adam Kagan (2011), the increased quantity of produced food may take place either by increasing the cultivation area or by increasing inputs and changing production technologies with the use of the existing area. One of possible

¹ A wider discussion on “strong” and “poor” sustainability, in particular, on the *critical natural capital* concept may be found, e.g. in the study by Daly: Daly H.E. 1990: Sustainable Development: From Concept and Theory to Operational Principles. Population and Development Review, 16, pp. 25-43; or also its interpretation by T. Żylicz in articles: Żylicz, T. (2008). “Silna” trwałość rozwoju (“Strong” sustainability of development). AURA, 6, p. 7; and Żylicz, T. (2008). “Słaba” trwałość rozwoju (“Weak” sustainability of development). AURA, 7, pp. 4-5.

² These objectives are contained in slogans such as „no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice and strong institutions; partnerships for the goals”.

responses to these challenges is the sustainable agricultural intensification concept (Weltin et al. 2018; Pretty 1997; Czyżewski and Staniszewski 2018), although the scientific community is not fully unanimous as to the scope of its usefulness (Cook, Silici, Adolph and Walker 2015). However, regardless of existing doubt as to the way of practical implementation of challenges facing agriculture, it seems clear that addressing the growing problems requires farmers themselves to understand relationships between the agricultural production and the environment. Today, the conclusion that the strive for reducing the negative environmental impact of agriculture requires strengthening internal motivation of farmers to introduce environment-friendly practices (van Herzele et al., 2013; Beedell and Rehman 1999) is rather unquestionable, although there is still an open question on how to implement this demand. It seems that the first and necessary step is to better identify how the natural environment is perceived by farmers themselves. This diagnosis should indicate the actual educational or training needs, the satisfaction of which can become a factor shaping an appropriate attitude towards environmental resources. In this context, the objective of the study was to determine how farmers perceive the environmental impact of agriculture and to identify the characteristics of farms managed by farmers who are aware or unaware of negative environmental consequences of agricultural activities.

Agriculture and environment

The development of agriculture in several recent decades has brought huge benefits to humans, as mainly demonstrated by the increase in food security (Tilman et al., 2002). As opposed to many catastrophic visions (starting with Malthus from the 18th century), agriculture keeps up with the growing demand for food, and the progress (biological, technological, organisational) made in this sector allows to provide food to almost the entire population of the world – the causes of hunger in some regions of the world should be sought mostly in the political and economic environment (Gołębiewska, Chlebicka and Maciejczak, 2016). This became possible, *inter alia*, thanks to the so-called “green revolution” implemented by the FAO (UN Food and Agriculture Organisation) in developing countries since the 60s of the 20th century. Its major result was a radical increase in productivity. It was the so-called “second green revolution”, as the first one concerned changes taking place in European agriculture since the end of the 19th century (van Zanden, 1991). Owing to changes in production technologies, when the global population has doubled, the production of cereals has tripled with an increase in the cultivation area only by 30% (Wik, Pingali and Broca, 2008). However, the success of the “green revolution” and the intensification of agriculture initiated in the 20th century entailed adverse changes in the natural environment associated with, *inter alia*, excessive chemisation of agricultural production (Pingali, 2012). Agriculture, however, impacts the natural environment in a number of other ways, which may include (Pingali, 2012; 2017; Essays, 2017; OECD, 2004; Gołębiewska and Pajewski, 2016; Kagan, 2011; Majewski, Sulewski and Wąs, 2018):

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- Impact on climate change through greenhouse gas emissions – from the data of the Intergovernmental Panel on Climate Change (IPCC, 2006) it results that agriculture is responsible for 13.5% of global greenhouse gas emissions on a global scale. Agriculture is a primary source of emissions of methane (CH₄) and nitrous oxide (N₂O). The main source of emissions of methane from agriculture is the rearing of ruminants, and nitrogen oxide is emitted into the atmosphere as a result of denitrification processes taking place in the soil (Marcinkowski, 2010), which occur during processing of nitrogen fertilisers in the soil. Carbon dioxide is emitted from agriculture mainly as a result of decomposition processes of various types of biomass and soil respiration, although it should be added that agricultural land is a specific storage of this compound which limits its amount in the atmosphere (Staniszewska, 2013).
 - Water pollution – the main cause of this phenomenon is the misuse of fertilisers resulting in the penetration of harmful substances into waters, which leads to eutrophication and pollution of water reservoirs (Pajewski, 2016). Agriculture is also one of major consumers of water (it is estimated that it consumes about 66-70% of fresh water derived from ground and underground resources) (Zegar, 2012).
 - Air pollution – in addition to greenhouse gas emissions, the agricultural production also results in emissions of ammonia (Sapek, 2013; Bobrecka-Jamro and Janowska-Miąsik, 2014), which in the atmosphere undergoes a cycle of chemical transformations that can finally contribute to adverse effects, both in the soil and in waters, e.g. soil acidification (Pinder, Adams, Pandis and Gilliland, 2006). Agriculture is also a source of emissions of particulate matter (PM10 and PM2.5) and local impact odours (Jugowar, Rzeźnik and Mielcarek, 2015).
 - Soil degradation – including physical, chemical and biological degradation processes. The impact of agriculture on soil degradation processes is due to, *inter alia*, improper practices increasing the soil susceptibility to the impact of factors, such as wind and water (improper crop rotation and fertilisation, agrotechnical treatments, depletion, etc.). Soil degradation leads to a reduction in their environmental role consisting in storing water, minerals and preventing effects of accumulation of harmful substances (Gołębiewska and Pajewski, 2016). Wind and water erosion phenomena affect, on a global scale, as much as 1.2 billion ha, while the annual loss of agricultural land is estimated at about 13 million ha (Zegar, 2012). The manifestation of soil degradation processes is also their salinity and reduced content of organic matter. One of the main anthropogenic causes of salinity are excessive doses of mineral fertilisers, which may lead to the excessive concentration of minerals in the soil (Gliniak and Sobczyk, 2013). Soil salinity leads to the destruction of its structure, distortion in water management of plants, and, consequently, their destruction. Irrigation is also an important cause of soil salinity. It is estimated that on a global scale, 20-50% of the irrigated area are afflicted by the effects of salinity (Hatton, 2003), and taking into account climate change manifested by the increased frequency of drought, we should expect that this problem is going to become more and more important.

- Reduced biodiversity – resulting from the excessive use of pesticides that reduces the number of species of wild plants and animals (McLaughlin and Mineau, 1995). According to the WWF data (2018), the LPI (Living Planet Report) index measuring changes in the number of wild species all over the world indicates that global populations of fish, birds, mammals and reptiles decreased by, on average, 60% from 1970 to 2014. This process results from, *inter alia*, the cultivation of monocultures, which increases the susceptibility to invasions of weeds, diseases and pests, thus generating a need for the intensive use of chemical plant protection products. The cultivation of monocultures also results in soil depletion and increases the demand for fertilisers (Tilman, 1999; Zegar, 2012).

However, in the context of many negative environmental impacts of agriculture, we cannot forget about its fundamental importance in satisfying food needs of humans. Also, it is worth pointing out that, in addition to being a food producer, agriculture performs a number of other socially useful functions related to delivery of both food and public goods (Zegar, 2007; OECD, 2001; Małażewska, 2019; Wilkin, 2010). Bearing in mind that agriculture is necessary to satisfy one of the fundamental needs of humans, we should emphasise a need to look for solutions allowing to conduct the agricultural production while reducing its negative environmental impact (Tanentzap, Lamb, Walker and Farmer, 2015).

Environmental awareness of farmers

The multifaceted environmental impact of agriculture requires farmers understand the existing relationships because, through practices applied and production decisions made, they can significantly decrease or increase the negative impact of agricultural production on the individual elements of the ecosystem. It can, therefore, be assumed that the issue of environmental (ecological) awareness of farmers is of key importance to reducing the negative impacts of agricultural production. Many studies by foreign authors show that farmers are more willing to protect the natural environment if they are aware of the environmental problems created by agricultural activities (Hyland, Jones, Parkhill, Barnes and Williams, 2015; Story and Forsyth, 2008).

According to Perepeczko (2011, p. 188), environmental awareness is a “form of social awareness that manifests itself in a concept and in socially accepted standards of understanding, perception and response to the needs and qualities of the environment, being a basis for the development of man who wants to and can live in harmony with nature”. In this aspect, being ecologically aware seems to be an essential prerequisite for the practical implementation of the sustainable development concept. This assumption is all the more justified that – as highlighted by the above-quoted author – most researchers are certain as to the correlation between ecological awareness and attitude towards the natural environment.

So far, the problem of perceiving the environmental issues by farmers has not been the subject of scientific research much often, although both in the national and foreign literature this issue has appeared in various contexts. In Poland, it was

subject to, *inter alia*, the studies taken by Majewski (2001) in the context of the wider issue of management quality on farms. The results of these studies pointed to a rather low level of awareness of environmental issues, although awareness of some issues was higher than it could result from practical actions of farmers themselves. The studies of Kostecka and Mroczek (2007) also point to a low level of knowledge with regard to management compliant with the sustainable development principles. In turn, Kałuża (2009) observed that many farmers represent mutually contradictory attitudes, which, on the one hand, are characterised by a high level of declared ecological awareness and, on the other hand, by the lack of knowledge of links between agriculture and the environment. From the studies by this author it also resulted that one of motives of environment-oriented behaviour of farmers are economic considerations.

On the other hand, the problem of ecological awareness of farmers participating in agri-environment schemes was analysed by Brodzińska (2012). Her studies showed that an important role in agricultural practices is played by motivation to take environment-oriented actions, contributing to changes in behaviour. However, this motivation does not guarantee the sustainability of these changes, which, according to the author, determines a need to raise ecological awareness of farmers. In turn, the studies by Wrzaszcz (2012) showed that despite declared knowledge of environmentally safe production rules, many farmers in practice apply solutions which are far from perfect.

Also, in the foreign literature of the subject, we can find the studies on environmental awareness of farmers. Many publications highlight the existence of a gap between declared environmental awareness of farmers and the implementation of environmentally friendly activities by them (Hyland et al., 2015). Some authors indicate that the perception of environmental issues is determined by current political agendas – basically, farmers are more aware of issues being a subject of public debate (Holloway and Ilbery, 1996). Another group of analyses consists of the studies aimed at searching for factors related to ecological awareness of farmers. By examining the factors making English farmers participate in agri-environment schemes, Schroeder, Chaplin and Isselstein (2015) observed that the factors motivating them to take such actions include social pressure and the impact of agricultural advisers. Therefore, these factors can be expected to encourage building environmental awareness of farmers. In turn, Alex Inman et al. (2018) attempted to identify the factors due to which the British water protection policy has brought only quite moderate effects so far. Their analyses of various behavioural factors show that the assumption that farmers will permanently implement environment-oriented actions as a result of various incentives or regulatory stimuli is unrealistic and the key to permanent change in attitudes is to build in farmers the will to make such changes. However, this requires farmers themselves understand the place and role of agriculture in society, which cannot be expected without raising environmental awareness of farmers. External stimuli (politics, advice) can facilitate this process, but without understanding the existing relationships by farmers, the effects will not be stable.

A detailed review of the factors influencing propensity and willingness of farmers to manage the farm in the more environment-oriented manner was carried out by Jane Mills et al. (2013). According to the specification presented, the will to adopt environment-oriented attitudes is determined by factors related to awareness of farmers, such as: personal interest in environmental issues, philosophy (perception) of agriculture, sense of social responsibility and belief in the effectiveness of actions being carried out. The second group of factors resulting in the practical possibility of adapting environment-oriented behaviour is related to the elements of the farm characteristics, such as: its size (physical, economic), production type, ecological infrastructure, finance, share of leases, elements of the characteristics of the farmer and household, knowledge on nature and access to advisory services. The issue of relationships between the production system and the economic characteristics of farms has been analysed by, *inter alia*, Wioletta Wrzaszcz and Konrad Prandecki (2015) – their analyses showed that the economic efficiency of “environment-friendly” farms did not significantly differ from the efficiency of other entities (except for organic farms that achieved weaker results than other entities).

The issues related to environmental awareness of farmers are also present in the studies which focus on searching for factors influencing the perception of the sustainable development and sustainable agriculture concept (Halbrendt, Gray and Chan-Halbrecht, 2012; Hayran, Gul and Saridas, 2018; Kiełbasa, Pietrzak, Uleń, Drangert and Tonderski, 2018; Tatlidil, Tatlidil and Boz, 2008). The issue of perception and environmental awareness was also analysed in the context of practiced agricultural systems. For example, McCann, Sullivan, Erickson and De Young (1997) compared a number of characteristics of conventional and organic farms, demonstrating, *inter alia*, that in the second group mentioned, the level of environmental awareness was clearly higher. In recent years, many studies on environmental awareness of farmers have also been carried out in the context of climate change issues (Hyland et al., 2015; Elia, 2017; Arbuckle, Morton and Hobbs, 2015; Niles and Mueller, 2016; Mitter, Larcher, Schönhart, Stöttinger and Schmid, 2018). From the studies by Hyland et al. (2015), it is clear that farmers who are more aware of climate change are also more willing to introduce changes aimed at reducing the negative environmental impact of agricultural production. They are usually younger and better educated. The studies show that farmers are aware of climate change and this awareness results from, *inter alia*, the type of means of transport used, as well as the economic situation (Elia, 2017). In turn, the studies by Gordon Arbuckle et al. (2015) point out that although farmers see a need to implement climate change adaptation strategies, many of them do not believe that sources of climate change processes are of anthropogenic origin. The possibility of lower, than commonly believed, awareness of climate change among farmers is, on the other hand, indicated by the analyses by Hermine Mitter et al. (2019). The studies by these authors show that the factor shaping the perception of climate change by farmers are their personal experiences with this phenomenon. The studies by Niles

and Mueller (2016) show, in turn, that the perception of climate change by farmers is very individual and determined by a number of factors, including, for example, possession of irrigation infrastructure.

These examples of studies show that so far no factors have been identified that would be clearly correlated with environmental awareness of farmers. In particular, the issue of production and economic characteristics of farms managed by farmers aware and unaware of the environmental impact of agriculture remains poorly identified. The recognition of these factors is important as environmental decisions made by farmers concern the wider context covering production and economic characteristics of the farm and social and psychological characteristics of the farmer (Greiner, 2015).

Methodology

In the studies carried out, two fundamental data sources have been used, i.e. the FADN database (Farm Accountancy Data Network) and data obtained using questionnaire interviews. The questionnaire survey carried out in 2017 covered a group 600 farms from among all farms participating in the FADN. The objects to be surveyed were selected using the stratified random sampling procedure. This sampling included 4 strata corresponding to the regions, 3 strata according to the standard output criterion and 4 strata according to the specialisation criterion. The number of farms in each stratum has been designated using the Neyman method (1934), also used in determining the size of the FADN sample. Interviews with the farmers were carried out by advisers from agricultural advisory centres, coordinating the collection of data under the FADN system. The completed questionnaires allowed to extend the set of variables available in the FADN database by the variables covering social and environmental aspects. The data from the interviews was combined with selected financial and production data included in the FADN database. This enabled the assessment of awareness of farmers as regards the impact of agriculture on basic environmental resources which were mentioned in the review parts of this study. This assessment did not refer to the impact of a specific farm or production system but of agriculture as a whole. The assessment of awareness of farmers in this regard was carried out using the Likert scale. In the further part of the study, an attempt was made to identify differences in characteristics of farms of farmers aware and unaware of the negative environmental impact of agriculture. Bearing in mind that the surveyed farmers differently assessed the impact of agriculture on individual elements of the natural environment, the variable reflecting the highest possible level of environmental awareness has been adopted as the distribution criterion. From analyses carried out, it resulted that this condition is fulfilled by the variable indicating the impact of agriculture on the aquatic environment. The policy of protection of waters against agricultural pollution has been pursued in the EU from many years, hence we can assume that virtually all farmers should be aware of this impact. Therefore, it has been assumed that unawareness of the environ-

mental impact of agriculture in this regard suggests generally low environmental awareness. Differences between groups of farmers noticing and not noticing the impact of agriculture on the aquatic environment have been presented using the tabular and descriptive analysis, and the significance of differences has been assessed using variance analysis (ANOVA) and chi-squared test.

Results

Assessment of the impact of agriculture on selected elements of the environment

The studies analysed how the surveyed farmers perceive the impact of agriculture on such elements of the environment as: water cleanness, air quality, biodiversity, landscape, climate change and condition of soils. The surveyed farmers rated the impact of agricultural activities³ on the individual elements of the natural environment using the scale from (-5) to (+5), where (-5) meant the very negative impact of agriculture on the given element of environment while (+5) meant the very positive impact. The average score granted by the farmers to each included elements of the environment, given the division of farms by production type and economic size, has been presented in Table 1, while Table 2 provides the information (also divided into production type and economic size class) on the percentage of the farmers who do not notice the negative environmental impact of agriculture (the “not noticing” group included also the farmers indicating the absence of the environmental impact of agriculture). From the table presented it results that, on average, in the analysed group, depending on the assessed element, the negative environmental impact of agriculture is noticed by from less than 30 to more than 60% of the surveyed. Most often, the negative impact was indicated by the surveyed farmers with respect to the impact of agriculture on the state of waters (65% of all indications), then of soil (46%) and biodiversity (45%), and least often in the case of landscape (29%). Those results were slightly more diversified when taking into account the division into the groups identified according to the production type and economic size, although, just like at the level of average values for the whole group, the element of the environment which, according to the surveyed, is most strongly impacted by agriculture is water. Particularly aware of this fact are the farmers from the group with the greatest economic power and the group of pig farms, where more than 3/4 of the surveyed pointed to the negative impact of agriculture on this element of the natural environment. Relatively high awareness of the negative impact of agriculture on the aquatic environment is also confirmed by the average values of scores calculated using the scale from (-5) to (+5), in this case being at the level of -1.15 (while other elements of the environment, on average in the group, were not rated below (-0.5). From the point of view of the environmental impact of agriculture, the best result was achieved by landscape (average rating +0.54), which is reasonable as it is one of public goods generated by agriculture. It is worth noting that the particularly clearly positive impact of ag-

³ The question concerned agricultural activities in general rather than a specific farm.

riculture on landscape is noticed by the farmers from the smallest group (in terms of the economic size criterion). However, this group of the farmers, on average, less negatively rate the impact of agriculture on the majority of other elements of the natural environment.

Table 1

Percentage of farmers noticing the negative impact of agriculture on the selected elements of the natural environment

Farm division criterion	Group of farms	Number	Water	Air	Biodiversity	Landscape	Climate	Soil
			% of farmers					
Production type ^a	Cattle	133	60.2	37.6	42.1	28.6	39.8	45.1
	Mixed	222	62.3	37.2	48.4	32.7	46.2	49.3
	Crop	189	69.8	42.3	47.6	27.5	45.0	45.0
	Pig	56	75.0	37.5	33.9	23.2	37.5	37.5
Economic size class ES6 ^b	ES 1	46	65.2	50.0	52.2	32.6	41.3	56.5
	ES 2	229	64.2	34.5	45.0	30.6	46.7	49.3
	ES 3	150	61.3	40.7	45.3	29.3	36.0	41.3
	ES 4	107	67.3	39.3	41.1	25.2	52.3	44.9
	ES 5 and 6	68	76.5	42.6	50.0	29.4	38.2	39.7
Total		600	65.4	38.9	45.4	29.3	43.6	45.9

^a Due to the small size of certain groups, some types have been combined according to the following principle: crop farms – included farms specialising in field crops, horticultural crops, permanent crops and mixed crops, cattle farms – included farms specialising in rearing animals fed in the grazing system and mixed farms of “various animals” subtype, pig farms – included entities specialising in rearing animals fed with concentrated feed (mainly pigs), mixed farms – included farms from the group various crops and animals.

^b ES – economic size: ES1 – “very small” farms with standard output (SO) between EUR 2 and 8 thousand; ES2 – “small farms” – SO between EUR 8 and 25 thousand, ES3 – “medium small” farms – SO between EUR 25 and 50 thousand; ES4 – “medium-large” farms, SO between EUR 50 and 100 thousand; ES5 – “large farms” – SO between EUR 100 and 500 thousand; ES6 – “very large” farms – SO above EUR 500 thousand. Due to the small number of entities in the ES6 class, the ES5 and ES6 classes have been combined.

Source: own studies.

The results obtained show that, in general, a significant percentage of the farmers are aware of the negative environmental impact of agriculture, although, on average, the surveyed do not perceive this impact as very strong. High awareness of risks to the aquatic environment can be considered understandable in the context of the so-called Nitrates Directive, introduced in the EU as early as in 1991 and regarding the protection of waters against contaminants caused by nitrates of agricultural origin. This document forms the basis of many regulations under the Common Agricultural Policy, hence probably many farmers had an opportunity to become familiar with some of its guidelines, which translates into the high level of awareness of the impact of agriculture on cleanness of surface waters and ground-

water. This problem is particularly important in intensive animal farms, which often have problems with managing animal faeces, that is why probably high awareness of risks is demonstrated by the farmers from pig farms. It is worth stressing, however, that the impact of agricultural production on ecosystems is much more complex, hence it can be considered alarming that, on average, less than half of the surveyed notice the negative impact of agriculture on biodiversity or the condition of soils. However, the use of these environmental resources is not subject to such detailed regulations as the protection of waters, hence it is likely that awareness of farmers in these thematic areas is lower. In general, however, in particular with respect to the lack of environmental awareness of the farmers, as identified in the literature part, the significant percentage of responses highlighting the negative environmental impact of agriculture must be assessed positively, although it must be emphasised that the surveyed group consists of the farmers participating in the FADN (i.e. includes only commercial farms, and, in addition, the mere fact of participating in the FADN may suggest a broader view of reality). On the other hand, it is worth remembering that farms covered by the FADN field of observation are responsible for about 90% of the production delivered to the market, hence their environmental impact can be considered as particularly important.

Table 2

Average rating of the impact of agriculture on indicated environmental resources using the scale from -5 (strongly negative impact) to +5 (strongly positive impact) according to the surveyed farmers

Farm division criterion	Group of farms	Number	Water	Air	Biodiversity	Landscape	Climate	Soil
			Average rating from (-5) to (+5)					
Production type	Cattle	133	-0.97	-0.44	-0.16	0.54	-0.63	-0.17
	Mixed	222	-1.03	-0.40	-0.10	0.42	-0.69	-0.19
	Crop	189	-1.29	-0.46	-0.31	0.77	-0.59	-0.17
	Pig	56	-1.54	-0.34	0.18	0.57	-0.52	0.09
Economic size class	ES 1	46	46	-0.78	-0.46	-0.07	0.78	-0.54
	ES 2	229	229	-1.12	-0.34	-0.09	0.61	-0.70
	ES 3	150	150	-0.98	-0.48	-0.22	0.49	-0.55
	ES 4	107	107	-1.27	-0.64	-0.16	0.43	-0.64
	ES 5 and 6	68	68	-1.64	-0.39	-0.33	0.46	-0.65
Total		600	-1.15	-0.44	-0.16	0.54	-0.63	-0.17

Source: own studies.

Perception of the state of the environment

In addition to the above-mentioned rating of the environmental impact of agriculture, the farmers also rated the state of the natural environment in their area of residence (Table 3). In general, relatively few farmers rated the state of the environment as low (i.e. ≤ 2 points using the scale from 0 to 6). On average, more than half of the farmers rated the state of the environment as average, and the quite large percentage (28%) – as good (rating ≥ 5). The worst rated element of the natural environment was the state of the aquatic environment – more than half of the surveyed rated this element low. Given the distribution of responses in the groups by production types and economic size, it can be concluded that it did not differ significantly from the distribution for the entire group, which indicates that the farmers perceive the state of the environment similarly in all identified groups. In general, average ratings for each element of the environment included in the analysis were relatively high (> 3 points using the scale from 0 to 6), which, in the context of the distribution of responses, indicates that the farmers tend to positively rate the state of the surrounding natural environment.

As part of the studies, it has also been attempted to determine motives justifying, according to the farmers, a need to protect the natural environment. Just like in previous phases, the surveyed farmers rated the indicated motives using the scale from 0 (completely unimportant) to 6 (very important). Table 4 lists the distribution of responses by production types and economic size groups and the average rating value for each individual motive in the entire group. Regardless of the type and economic size, as the most important among four motives the farmers indicated the argument regarding care for human health – more than 80% of the farmers found it important, and the average rating was as high as 5.43 (using the scale of 0-6). The motive of „care for future generations” was rated slightly poorer. The motives of the protection of natural environment such as “care for the beauty of nature” and „care for long-term economic benefits” were perceived by the surveyed as clearly less important. Probably, the low rating for the latter suggests that the significant percentage of the surveyed do not see a relationship between the economic development and the state of the natural environment, which may indicate the lack of knowledge. Probably, the surveyed farmers are aware that the state of the natural environment affects health, but do not see that a primary source of economic development are natural resources (however, we can assume that this relationship would be more noticeable if the question referred to the issue of importance of the state of the environment for the farm owned by the farmer).

Table 3

Rating of the state of the environment in the area of residence according to the surveyed farmers – distribution of responses and average rating values

Group of farms	Rating of the state of the environment ^a	Rated elements of the natural environment							
		Environment in general	Water	Air	Animals	Plants	Landscape		
		% of farmers							
Production type	cattle	low	8.3	21.1	15.8	6.8	12.0	9.0	
		medium	62.4	64.7	51.1	44.4	53.4	50.4	
		high	29.3	14.3	33.1	48.9	34.6	40.6	
	mixed	low	7.6	22.0	15.2	14.3	18.4	12.1	
		medium	64.1	61.0	52.9	40.8	52.0	51.1	
		high	28.3	17.0	31.8	44.8	29.6	36.8	
	crop	low	10.6	23.3	20.6	17.5	22.2	13.8	
		medium	62.4	58.2	48.7	42.3	48.7	41.8	
		high	27.0	18.5	30.7	40.2	29.1	44.4	
	pig	low	10.7	19.6	14.3	17.9	19.6	8.9	
		medium	64.3	60.7	50.0	48.2	55.4	55.4	
		high	25.0	19.6	35.7	33.9	25.0	35.7	
	Economic size class ES6	ES1	low	4.3	15.2	23.9	4.3	13.0	4.3
			medium	65.2	60.9	34.8	39.1	39.1	54.3
			high	30.4	23.9	41.3	56.5	47.8	39.1
ES2		low	9.6	26.6	15.7	18.3	18.3	11.8	
		medium	62.0	55.9	51.1	39.3	55.9	48.0	
		high	27.5	16.2	31.9	41.0	24.5	38.4	
ES3		low	8.7	22.7	18.7	11.3	16.0	11.3	
		medium	63.3	61.3	52.7	44.0	53.3	48.7	
		high	27.3	16.0	28.7	44.7	30.7	39.3	
ES4		low	6.5	15.9	13.1	11.2	15.9	7.5	
		medium	68.2	73.8	56.1	49.5	53.3	50.5	
		high	24.3	9.3	29.9	38.3	29.9	41.1	
ES5		low	7.4	13.2	13.2	11.8	25.0	14.7	
		medium	57.4	57.4	48.5	42.6	38.2	39.7	
		high	33.8	29.4	38.2	45.6	36.8	45.6	
Total	low	8.2	21.3	16.3	13.5	17.7	10.7		
	medium	63.3	61.0	51.0	42.8	51.7	48.3		
	high	27.8	17.2	32.2	43.2	30.2	40.0		
	average scoring from 1 (poor) to 6 (very good)	3.84	3.35	3.75	4.03	3.72	4.05		

^a low: ≤ 2 points, medium: ≥ 3 points and ≤ 4 points; high: ≥ 5 points.

Source: own studies.

Table 4

Importance of selected motives of the environmental protection

Group of farms	Rating of the importance of the given motive ^a	Motives justifying the protection of environment				
		Care for future generations	Care for human health	Care for the beauty of nature	Care for long-term economic benefits	
		% of farmers				
Production type	cattle	low	2.3	0.0	9.8	13.5
		medium	19.5	17.3	42.1	42.9
		high	78.2	82.7	48.1	43.6
	mixed	low	2.7	2.2	4.9	12.1
		medium	21.5	13.0	39.9	41.3
		high	75.8	84.8	55.2	46.6
	crop	low	3.7	2.1	7.4	10.6
		medium	21.7	14.3	32.8	45.0
		high	74.6	83.6	59.8	44.4
pig	low	5.4	0.0	10.7	14.3	
	medium	16.1	17.9	37.5	35.7	
	high	78.6	82.1	51.8	50.0	
Economic size class ES6	ES1	low	6.5	2.2	2.2	23.9
		medium	10.9	13.0	26.1	34.8
		high	82.6	84.8	71.7	41.3
	ES2	low	1.3	1.3	7.0	10.5
		medium	20.1	14.4	35.8	41.0
		high	78.2	83.8	56.8	48.0
	ES3	low	1.3	2.0	8.7	15.3
		medium	20.7	13.3	34.0	39.3
		high	78.0	84.7	57.3	45.3
	ES4	low	5.6	0.9	4.7	7.5
		medium	20.6	11.2	49.5	44.9
		high	73.8	87.9	45.8	47.7
	ES5	low	7.4	1.5	11.8	10.3
		medium	27.9	26.5	44.1	51.5
		high	64.7	72.1	44.1	38.2
Total	low	3.2	1.5	7.3	12.2	
	medium	20.7	14.8	38.0	42.2	
	high	76.2	83.7	54.7	45.7	
average scoring from 1 (poor) to 6 (very good)		5.17	5.43	4.48	4.15	

^a low: ≤ 2 points, medium: ≥ 3 points and ≤ 4 points; high: ≥ 5 points.

Source: own studies.

Perception of the environmental impact of agriculture vs the selected characteristics of farms and farmers

Recognising the characteristics of the farmers differing in terms of their attitude towards the natural environment seems particularly important from the point of view of shaping the agricultural policy and a need to develop such tools of environment-oriented support which are better tailored to the needs of various farm groups. In order to identify differences in the profile of the farmers differing in terms of their attitude towards the natural environment within the identified groups (noticing and not noticing the environmental impact of agriculture), the elements of characteristics of farms, as described in Table 5, have been compared. They include the basic characteristics of the production potential, economic results and selected characteristics of the farmers themselves.

Table 5

Specification of variables used to look for differences between farms of the farmers noticing and not noticing the negative environmental impact of agriculture

Definition of the variable	Described characteristic of the farm or farmer	Type of the variable	Measure unit
Area	Farm area	quantitative	ha
% of leases	Share of leases in utilised agricultural area	quantitative	%
SVI	Soil valuation index being a ratio of the number of conversion hectares to physical hectares	quantitative	index
Stocking density	Stocking intensity measured by the number of animals per livestock units in relation to utilised agricultural area	quantitative	Number of LU/100 ha of UAA
Assets	Value of assets of the farm exclusive of land	quantitative	PLN/farm
Age	Age of the farm manager	quantitative	years
Experience	Years of work of the farm manager in agriculture	quantitative	years
Management	Years of management of the farm by the current manager	quantitative	years
AWU	Total labour inputs (AWU – Annual Work Unit)	quantitative	number of fully employed persons
Production	Value of the farm production	quantitative	thousand PLN/farm
Income	Family farm income	quantitative	thousand PLN/farm
Profitability of assets	Ratio of farm income to the value of assets	quantitative	ratio (PLN/PLN)
Income per AWU	Ratio of farm income to the value of labour inputs	quantitative	PLN/AWU
Intensity of fertilisation	Costs of mineral fertilisation per 1 ha of UAA	quantitative	thousand PLN/ha

cont. tab. 5

Intensity of plant protection	Costs of chemical plant protection per 1 ha of UAA	quantitative	thousand PLN/ha
Off-farm income	Estimated share of non-agricultural income in available income of the household	quantitative	%
Rating of the general state of the environment	Rating of the state of the environment in the area of residence, made by the farmer	Likert scale	score 0-6
Rating of water cleanness	Rating of the state of surface waters in the area of residence, made by the farmer	Likert scale	score 0-6
Rating of the importance of nature for economy	Rating of the importance of a need to protect nature due to provision of long-term economic benefits	Likert scale	score 0-6
Rating of the usefulness of publications	Rating of the usefulness of traditional sources of knowledge and information (magazines, books) for improving knowledge	Likert scale	score 0 (very low) – 6 (very high)
Rating of the usefulness of the Internet	Rating of the usefulness of Internet sources of knowledge and information for improving knowledge	Likert scale	score 0-6
Rating of the usefulness of advisors	Rating of the usefulness of meetings with advisors (both those from AAC and others) for improving knowledge	Likert scale	score 0 (very low) – 6 (very high)
Production type	Ntf14 farm strata identified based on the FADN typology – crop farms, – cattle farms, – pig farms, – mixed farms	qualitative	Share of the type in the group
Education	Level of education including: primary, vocational, secondary, higher	qualitative	Share of education in the group
Agricultural education	Agricultural education by the farm manager	qualitative	Share of farmers in the group
Training	Participation in any type of training in the last five years	qualitative	Share of farmers in the group
Understanding of the world	Farmer's declaration on general understanding of economic and social processes taking place in the modern world. Possible options of responses: "I fully understand", "I partially understand", "I am lost in it and I am frustrated"	qualitative	Share of farmers in the group

Source: own study.

Table 6 contains the information on the incidence of individual levels of qualitative variables. It is clear from the specification that only some variables significantly differentiate the farmers noticing and not noticing the negative environmental impact of agriculture. Some differences can be seen in the case of some variables, although they are statistically insignificant at the level of $p < 0.1$. When

analysing the nature of these differences, we may observe a fairly clear principle, manifesting itself in the higher level of most parameters for the group of the farmers “noticing the negative environmental impact of agriculture”. First of all, farms of these farmers are, on average, by about 20% larger in terms of their area, as well as are characterised by the slightly higher share of leased land, while the quality of soils is, on average, slightly higher than for farms of the farmers “not noticing the negative environmental impact of agriculture”. This suggests that the group aware of the environmental impact of agriculture is generally characterised by the higher production potential than other entities. This is also supported by the significantly higher value of assets of the average farm in that group. At the same time, it can be observed that farms of the farmers noticing the negative impact of agriculture are characterised by stocking density per area unit which is, on average, by several percent higher, as well as are characterised by higher costs of mineral fertilisation and chemical plant protection, which points to the higher production intensity. As a consequence of the differences in the organisation and production potential of the analysed farm groups, we can also observe quite clear differences in their production and economic results. Farms belonging to the farmers more aware of the environmental impact of agriculture, on average, demonstrated the higher level of income and production (particularly clearly visible across the entity). We can also observe significant differences in the structure of analysed groups by division into production types. In the group of the farmers aware of the negative environmental impact of agriculture, the percentage of specialised crop and pig farms was higher while that of mixed and cattle farms was lower. Farms of the farmers noticing the negative environmental impact of agricultural activities were also characterised by the significantly higher (by around 18%) labour profitability (measured by income per AWU). At the same time, the estimated share of non-agricultural income in the household budget was slightly smaller in this group than in other entities, which points to the greater importance of agriculture in providing a livelihood for the family.

The farmers noticing the negative environmental impact of agriculture were, on average, slightly younger and worked in agriculture for a shorter time although differences in this case were not clear and statistically significant. However, a significant difference was observed in the case of the duration of farm self-management, which in the group noticing the negative environmental impact of agriculture was more than 2 years shorter, suggesting that persons with a shorter seniority are more aware of environmental problems. As opposed to the farmers not noticing the negative impact of agriculture, persons with such awareness were more critical of the state of the environment in their area of residence. In particular, they rated water cleanness significantly lower which, in relation to noticing the negative impact of agriculture on this element of environment, suggests that the presented views are consistent. What is more, the farmers aware of the negative environmental impact of agriculture also showed significantly higher awareness of the importance of nature for human economic activities.

In this context, it is also worth noting that this group rated the usefulness of traditional (magazines and books) and modern (Internet) sources of knowledge slightly higher than other groups, although differences were not significant in statistical terms. The differences between the identified groups in terms of the level of education (Table 7) were relatively small and statistically insignificant. In general, both groups are dominated by persons with secondary education, although it may be observed that in the group of the farmers not noticing the negative impact of agriculture the share of persons with primary and vocational education is slightly higher while that of persons with higher education is lower. Between the identified groups there are virtually no differences with regard to the percentage of persons with agricultural education. Given that the average age of the surveyed exceeds 45 years, this situation can be considered as compliant with expectations, as it is difficult to expect that at the time of receiving education by the farmers (regardless of its level) curricula included the content stressing the environmental impact of agriculture. However, what may be somewhat surprising is the fact that there are no clear differences in the perception of the environmental impact of agriculture depending on participation in training, which can be related to the weak discriminating power of this question (most respondents participated in some training). However, it is worth noticing that the percentage of persons participating in training in the group noticing the negative environmental impact was, on average, slightly higher (by about 3 percentage points) than in other farms. Given the importance of psychosocial conditions for the perception of reality, the surveyed farmers were also asked about their general reception of the complexity level of the modern world. However, no significant differences have been observed in this regard and the majority of the surveyed in both groups indicated that they fully understand the world around them (it can be assumed that, given the nature of the question, that percentage is overstated, although at the same time the belief that the perception of reality is correct can strongly affect the farmers' decisions on the environmental impact).

Table 6

Specification of the selected characteristics of farms of the farmers differing in the perception of the environmental impact of agriculture – quantitative variables.

Variable	Group of farmers				Relative difference (%) (group 1 = 100%)	Value of test statistics F
	Farmers not noticing the negative environmental impact of agriculture (n=207)		Farmers noticing the negative environmental impact of agriculture (n=393)			
	Mean	Standard deviation	Mean	Standard deviation		
Area	33.5	32.3	40.2	57.1	120	2.43*
% of leases	22	22	24	23	109	0.99
SVI	0.79	0.31	0.85	0.37	108	4.36**
Assets (thousand PLN)	61.4	58.4	72.2	95.1	118	2.23*
Stocking density (LU/100 ha)	83.5	103.0	96.5	157.16	116	1.15
Intensity of fertilisation (thousand PLN/ha)	0.66	0.98	0.88	1.89	133	2.35*
Intensity of plant protection (thousand PLN/ha)	0.29	0.65	0.41	1.83	138	0.74
Production (thousand PLN)	213.5	312.5	261.9	467.0	123	1.79
Income (thousand PLN)	70.4	91.9	87.7	154.4	124	2.16*
Profitability of assets (exclusive of land)	0.11	0.19	0.12	0.23	106	0.16
Income per AWU (thousand PLN/AWU)	39.0	49.1	46.2	56.9	118	0.55
Share of off-farm income (%)	82.3	23.3	79.9	24.2	97	1.27
Labour (AWU)	1.80	0.92	1.90	1.63	105	0.58
Age (years)	46.59	9.94	45.80	10.08	98	0.84
Experience (years)	28.43	11.21	27.15	10.63	95	1.90
Management (years)	22.62	10.43	20.40	9.89	90	6.54**
Rating of the general state of the environment	3.89	1.14	3.81	1.12	98	0.640
Rating of the state of waters	3.58	1.30	3.23	1.25	90	10.10***
Rating of the importance of nature for economy	3.95	1.69	4.26	1.41	108	5.72**
Rating of the usefulness of magazines	3.46	1.26	3.61	1.23	104	2.04
Rating of the usefulness of the Internet	2.06	1.67	2.09	1.56	102	0.05
Rating of the usefulness of advisors	4.18	1.17	4.10	1.22	98	0.60

Level of significance *** p<0,01; ** p<0,05; * p<0,1.

Source: own study.

Table 7

Specification of the selected characteristics of farms of the farmers differing in the perception of the environmental impact of agriculture – qualitative variables

Selected qualitative characteristics		Group of farmers		Chi-squared test statistics
		Farmers not noticing the negative environmental impact of agriculture (n=207)	Farmers noticing the negative environmental impact of agriculture (n=393)	
		% of farmers		
Production type	crop	27.5	33.6	6,3162*
	cattle	25.6	20.4	
	pig	6.8	10.7	
	mixed	40.1	35.4	
Education	primary	3.9	2.8	3,5449
	vocational	40.1	34.1	
	secondary	42.0	45.6	
	higher	14.0	17.4	
Agricultural education	yes	61.4	61.1	0,0046
	no	38.6	38.9	
Training	yes	76.3	79.6	0,8829
	no	23.7	20.4	
Understanding of the surrounding world	Full understanding	56.0	57.0	3,014
	Partial understanding	32.1%	30.9%	
	Being lost and frustrated	12.0%	12.1%	

Level of significance *** p<0,01; ** p<0,05; * p<0,1.

Source: own study.

Summary

Over the past few decades, the issues related to the state of the natural environment have become one of the important issues raised in public debate. This involves both the increase in the environmental problems resulting from the intense economic development and growing awareness of the relationship between the state and quality of natural resources and the possibility of continuing the development in the future. These issues also apply to agriculture, whose environmental impact, particularly in the context of climate change, is increasingly exposed in the media. This creates increasing pressure on finding solutions allowing to maintain the high agricultural productivity with the maximum reduction in environmental damage. More and more often, it is pointed out that achieving such a state requires the involvement of farmers themselves, which is fostered by the high level of environmental awareness.

The existing studies by both Polish and foreign authors show that environmental awareness of farmers is quite diversified, although it is its quite low level what is pointed out most often. This generates a need for targeted educational activities, which, however, require recognising the characteristics of farmers who differ as regards awareness of the environmental impact of agriculture.

The main motive justifying, according to the surveyed farmers, a need to protect the environment is care for health. Relatively few respondents notice the relationship between the natural environment and economic activities, which points to a need to carry out activities raising awareness of these relationships.

The analyses carried out show that only some of the surveyed farmers are aware of the negative environmental impact of agriculture (from 30% to more than 60% of the surveyed, depending on the rated element of the environment). Most often, this impact was noticed in relation to the aquatic environment. Comparing the characteristics of farms of the farmers noticing the negative impact of agriculture with other entities shows that, on average, they are larger, economically stronger and conducting the more intensive production. On average, they were larger in terms of their area by about 20% and were also characterised by the higher share of leased land and better soil quality, as well as by the higher value of assets, higher stocking density and significantly higher costs of mineral fertilisation and chemical plant protection. This is somehow surprising as it could be expected that the farmers who are aware of the negative environmental impact of agriculture should manage their farms in the less intensive manner. Assuming that environmental awareness is correlated with the management practice (as mentioned in the review part of the study), it can be expected that better organised intensive farms may be less harmful to the environment than extensive farms managed by farmers with the low level of environmental awareness. This observation supports the thesis on the relevance of disseminating the “sustainable intensification” concept, although unanimous decisions on this issue require further in-depth studies.

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ŚWIADOMOŚĆ ŚRODOWISKOWA ROLNIKÓW A WYBRANE ELEMENTY CHARAKTERYSTYKI GOSPODARSTW

Abstrakt

Głównym celem artykułu była ocena postrzegania przez rolników wpływu rolnictwa na środowisko naturalne oraz identyfikacja cech gospodarstw zarządzanych przez rolników różniących się stopniem świadomości środowiskowej. Badaniami objęto 600 gospodarstw towarowych z terenu całej Polski uczestniczących w FADN. Ocenę świadomości rolników w przedmiotowym zakresie przeprowadzono z wykorzystaniem skali Likerta. W zależności od uwzględnionego elementu środowiska naturalnego od ok. 30 do 60% rolników było świadomych negatywnego wpływu produkcji rolniczej na przyrodę. Głównym motywem uzasadniającym potrzebę ochrony przyrody jest zdaniem badanych rolników troska o zdrowie – stosunkowo niewielu rolników wiąże potrzebę ochrony środowiska z warunkami działalności gospodarczej. Przeprowadzone analizy wykazały też, że rolnicy świadomi negatywnego wpływu produkcji rolniczej na środowisko naturalne prowadzili gospodarstwa o przeciętnie większym potencjale produkcyjnym, wyższej intensywności i lepszych wynikach ekonomicznych. Wyższy poziom świadomości rolników z gospodarstw prowadzących bardziej intensywną produkcję przeczy tezie, że rolnicy intensywnie gospodarujący nie dostrzegają problemów środowiskowych.

Słowa kluczowe: świadomość rolników, gospodarstwo rolne, środowisko naturalne, zagrożenia środowiskowe.

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