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**EDUCATION AS THE DIFFERENTIATING FACTOR
IN APPLYING SUSTAINABLE DEVELOPMENT PRINCIPLES
ON FARMS¹**

Key words: sustainable development, farmers' awareness, education of farmers, farms, environment

ABSTRACT. The study is dedicated to the issue of implementing rules of sustainable development on farms. Research was conducted on 310 farms. The farm classification criterion was the education of the farm manager. Farms in four provinces were analyzed: Kujawsko-Pomorskie, Mazowieckie, Lubelskie, and Wielkopolskie. The aim was to determine the knowledge and scope of applying sustainable development in farming, depending on the farmer's education level. The research consisted of determining the importance attached by farmers, depending on their declared level of formal education, to features of a sustainable farm and advantages of this mode of management for the environment, the society, and agricultural producers themselves. It was assumed that the higher the farmer's education level, the better the familiarity with sustainable development principles and their practical application. It was found that depending on the agricultural producer's education, the importance attached to individual variables characterizing a sustainable farm varied. In terms of environmental advantages, the most important feature was water protection; among benefits for the society, safe food was considered to be of the highest significance, while for producers, the most important was a higher income. The research results did not make it possible to unambiguously state that university education determines farmers' familiarity and compliance with sustainability principles. In some cases, farmers, who had good knowledge of sustainable agricultural practices, failed to apply them in their operations.

INTRODUCTION

Careful use of natural resources due to their limited availability is becoming an increasingly important factor, making it necessary to comply with sustainable development principles in the economy. Last century, it was determined that people made excessive use of natural resources, particularly non-renewable. For instance, as early as 1992, the Earth Summit adopted documents specifying the principles enforcing environmental protection in socio-economic activity, including agricultural production. It is always

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necessary to keep environmental objectives in mind whenever it aims to satisfy farmers own needs or produce products. It has been pointed out, among others, by Justyna Góral and Włodzimierz Rembisz [Góral, Rembisz 2017]. They claimed that farming microeconomic production objectives are not always achieved in compliance with environmental and general social purposes. Pollution of water [Evans et al. 2019], soil, loss of biological diversity [Brodhagen et al. 2017], air pollution [Balsalobre-Lorente et al. 2019], as well as the degradation of environmental resources [Olanipekun et al. 2019] are the main harmful "by-products" of agriculture [DeLonge et al. 2016]. It has been estimated that global greenhouse emissions are caused by farming (24%) and changes in utilizing land [IPCC 2014]. As Józef Zegar has pointed it out, the future of agriculture depends on implementing a paradigm that would be consistent with sustainable agricultural production needs. Polish agriculture is mainly represented by conventional farms, varying in terms of the degree of their industrialization and the scale of impact on the natural environment [Zegar 2014]. Implementation of sustainable development principles on farms depends on farm managers' decisions, resulting, among other things, from the knowledge and awareness of farmers. According to David Rose and others [Rose et al. 2019], research conducted so far has shown that integrated farm management is not understood correctly – or widely practiced. Therefore, the study aimed to assess the state of knowledge and awareness of farmers in terms of applying sustainable development principles in agricultural production depending on their education level. It was assumed that the education level would determine compliance with sustainable development principles at the farm. The higher the farm manager's education level, the better the knowledge and stricter compliance with sustainable development principles.

MATERIAL AND METHODS

The research data was collected based on research conducted in 2019. An interview questionnaire was used, consisting of six general closed-ended questions, which pertained to farmers' knowledge and awareness regarding sustainable development rules. Some data were also obtained on implementing sustainable development principles in agricultural production. Answers were grouped based on a 5-point Likert scale, where 1 represents "I decidedly disagree", and 5 – "I decidedly agree". This scale is most often used for the measurement of complex socio-economic phenomena [Tarka 2015]. It is usually utilized to measure attitudes towards specific problems to determine the degree of acceptance of a given phenomenon. As underlined by Jagoda Jezior [2013], its popularity is due to the relative simplicity of the scale, the standard rules of verification of single-dimensionality and reliability, and the possibility of grasping many aspects of the phenomenon analyzed. It is assumed that the feature being examined is an existing, hidden attitude of the respondent, shown through their responses on the Likert scale. As an internal symptom of human reasoning, an attitude is a construct that is too complex to measure using the scale. A direct measurement using a simple scale (a single question) would be somewhat unreliable in a research project of this kind [Tarka 2015]. As indicated by Tait Joyce and Dick Morris [Tait, Morris 2000], assessment will depend on the perception of a given phenomenon by the respondent, their interests and system of values, and the mode of operation of the method adopted.

Research was conducted on 310 farms located in four provinces, characterized by substantial potential for agricultural production. These were the Kujawsko-Pomorskie, Mazowieckie, Lubelskie, and Wielkopolskie Provinces. The aim was to determine the knowledge and scope of applying sustainable development in farming. What was determined was how farmers assessed the characteristics of a sustainable farm depending on their education level. Table 1 presents the characteristics of respondents according to their socio-demographic features.

The assessment of implementing sustainable farming principles consists of examining the correlation between farmers' education level and the practical implementation of sustainable farming practices by them. Among the socio-demographic features, significant characteristics include professional experience, participation in training, or the external environment (such as membership in producer groups). Most of the farms examined were characterized by a large area (average area of around 80 hectares of arable land). The least numerous in the sample were farmers with an elementary education (6.5%). Most farmers had a secondary education. Most respondents declared that they participated in trainings (60-70%). Farmers with a university education (58%) less often claimed that they participated in any training.

Table 1. Respondents according to socio-demographic variables

Specification		Respondents with education:			
		elementary n = 20	secondary n = 144	vocational n = 95	university n = 51
Professional experience [years]	≤ 10	6	41	25	12
	11-20	5	38	22	17
	21-30	5	46	32	14
	> 30	4	19	16	8
Participation in trainings	no	10	54	35	16
	yes	10	90	60	35
Membership in producer groups	no	13	93	68	30
	yes	7	51	27	21
Age (average)	x	45.9	45.5	45.9	40.7
Average farm area	ha	79	55	51	151
Number of family members	average	5.9	4.7	4.9	4.9
Specialized farm	no	6	49	25	12
	yes	14	95	70	39

Source: own research

SIGNIFICANCE OF EDUCATION LEVEL IN IMPLEMENTING SUSTAINABLE DEVELOPMENT PRINCIPLES – A REVIEW OF LITERATURE

Many studies have been dedicated to sustainable development in agriculture, presenting the methods, criteria, and conditions of implementing them. According to UNEP [2010], the sustainable development principle means using natural resources in quantities that do not exceed the capability of ecosystems to recreate them. Desta Mebratu has pointed to the general nature of this definition [Mebratu 1998]. However, it has played a significant role in developing a "global perspective" of our planet's future. Sustainable development is one of the critical topics of agricultural research in the world [Li et al. 2019]. However, agriculture is an economic sector too broad and diversified to allow for the general assessment of its aspects. Therefore, the issue is multifaceted; moreover, it is challenging to determine specific boundaries and reference points, pointed out by Rafał Baum [2008]. Baum underlined the necessity to develop proper methods of assessing the degree of farm sustainability. It is also necessary to be familiar with these assessments and principles of determining the degree of sustainability of farms. Otherwise, they cannot be applied in practice. As underlined by Józef Zegar and others [Zegar et al. 2013], the deteriorating demographic structure of the farming population and its low education level can threaten the use of all opportunities to implement the rules of sustainable development in farming actively. In Poland over the years, existed the belief that farming, as a profession, is associated with low social and economic attractiveness. It caused running the farm to be not in favor, and farmers often had no motivation to get a professional background. Lack of current knowledge was a barrier to face the challenges of modern methods and techniques of agricultural production in a manner that would warrant environmental protection and the achievement of good economic results.

The issue of sustainable development has been analyzed in many works [e.g., Majewski 2008, Sulewski, Gołaś 2019], pointing to the significance of farmers' knowledge and awareness regarding the negative impact of their activity. Research conducted by Ghulam Mustafa and others [Mustafa et al. 2019] has shown that farmers' awareness concerning climate change is only a step towards adapting and mitigating these farming changes. Abdou Ado Matsalabi and others [Matsalabi et al. 2018], on the other hand, have found that the effective adaptation to effects of climate changes largely depends on the level of awareness of society and the perception of these changes by farmers. The implementation of sustainable development principles is subject to many difficulties and various factors [Tatlidil et al. 2008, Kata, Kusz 2015, Tey et al. 2017]. Among these, socio-demographic characteristics are viewed as particularly significant [D'Souza et al. 1993, Kostecka, Mroczek 2007, Kałuża 2009, Sowula-Skrzyńska et al. 2019]. In many studies, it has been underlined that farmers knowing sustainable development, do not always use it in agricultural practice [Sulewski, Gołaś 2019, Gołębiewska et al. 2020]. As indicated by Piotr Sulewski and Marlena Gołaś [Sulewski, Gołaś 2019], only some of the interviewed farmers were aware of the negative impact of agriculture on the environment (from 30% to more than 60% of respondents, depending on the environmental factor being assessed).

RESEARCH RESULTS

The research conducted indicates that most respondents failed to give decisive answers on their knowledge and compliance with the rules of sustainable development (Figure 1). Most respondents stated that they had no decisive opinions regarding knowledge and compliance with the rules of sustainable development in farming. Their statements varied depending on their education level. As expected, the highest number of farmers decisively declaring that they knew and followed the rules of sustainable development had a university education, although, at the same time, around 10% stated they definitely did not know or apply these rules. This may seem surprising as respondents with secondary and vocational educations chose these responses only in 2 to 5% of all cases. Only approx. 14% of farmers with a university education definitively declared that they followed the principles of sustainable development in their agricultural practices. In this case, there was a visible correlation between the education level and the definite declaration of implementing sustainable development at a farm (the higher the education level, the stronger the tendency to comply with these principles in practice).

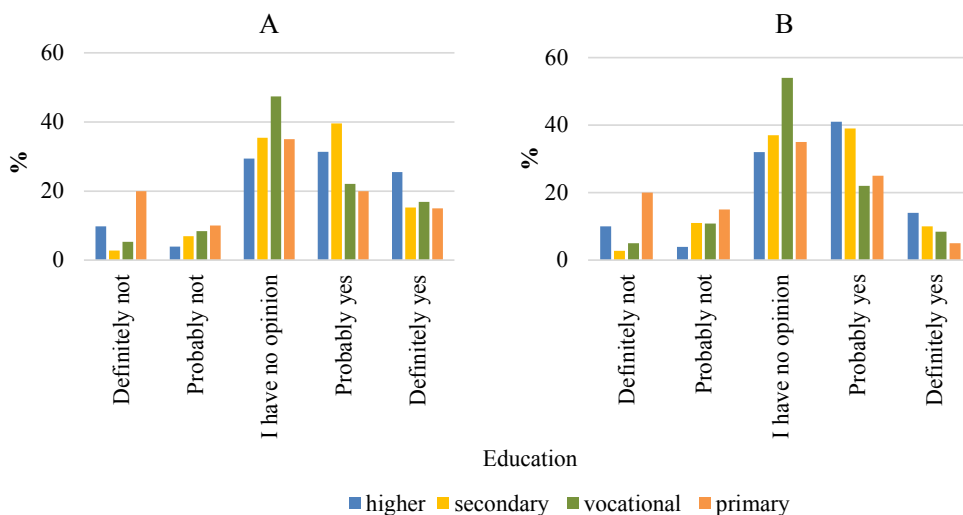


Figure 1. Opinions of respondents with a varying educational background concerning: (A) the knowledge of the concept of sustainable agriculture, (B) the application of the rules of sustainable farming

Source: own research

Most respondents declared different evaluations regarding their level of knowledge about sustainable agriculture. They assessed their accordance with sustainable development rules differently as well. Their statements varied depending on their education level. As expected, the highest number of farmers decisively declaring that they knew and followed sustainable development rules had a university education. At the same time, around 10% stated they did not know or apply these rules. The results may seem surprising as

Table 2. Assessment of environmental advantages of applying sustainable development principles in agriculture as viewed by farmers depending on their education level

Specification	Share of respondents indicating the place in the ranking with education [%]			
	1.	2.	3.	4.
Primary				
Water protection against pollution	40.0	30.0	10.0	20.0
Reduction of greenhouse gas emissions	30.0	20.0	30.0	20.0
Increases in biodiversity in the natural environment	20.0	20.0	20.0	40.0
Reduction of energy consumption from non-renewable sources	10.0	30.0	30.0	30.0
Vocational				
Water protection against pollution	52.6	23.2	17.9	6.3
Reduction of greenhouse gas emissions	12.6	29.5	36.8	21.1
Increases in biodiversity in the natural environment	9.5	17.9	17.9	54.7
Reduction of energy consumption from non-renewable sources	22.1	32.6	29.5	15.8
Secondary				
Water protection against pollution	50.7	27.1	12.5	9.7
Reduction of greenhouse gas emissions	25.7	31.9	31.9	10.4
Increases in biodiversity in the natural environment	11.8	17.4	12.5	57.6
Reduction of energy consumption from non-renewable sources	13.2	27.8	39.6	19.4
Higher				
Water protection against pollution	41.2	27.5	19.6	11.8
Reduction of greenhouse gas emissions	35.3	27.5	21.6	15.7
Increases in biodiversity in the natural environment	21.6	25.5	27.5	25.5
Reduction of energy consumption from non-renewable sources	11.8	21.6	43.1	23.5

Source: own research

respondents with secondary and vocational educations chose these responses only in 2 to 5% of all cases. Only approx. 14% of farmers with a university education definitively declared that they followed sustainable development principles in their agricultural practices. In this case, there was a visible correlation between the education level and the definite declaration of implementing sustainable development at a farm (the higher the education level, the stronger the tendency to comply with these principles in practice).

Research made it possible to determine the significance of sustainable farms' characteristics as viewed by farmers depending on their education level (Tables 2-4). The respondents were asked to rank sustainable farm features, from the most important to the least important in terms of their activity's effects, taking the advantages for the environment, society, and themselves (agricultural producers) into account.

Table 3. Assessment of societal advantages of applying sustainable development principles in agriculture as viewed by farmers depending on their education level

Specification	Share of respondents indicating the place in the ranking with education [%]			
	1.	2.	3.	4.
Primary				
More secure food	30.0	20.0	30.0	20.0
Improving animal welfare	20.0	20.0	20.0	40.0
Improving working conditions on a farm	10.0	30.0	30.0	30.0
Increasing the attractiveness of rural areas	30.0	20.0	30.0	20.0
Vocational				
More secure food	32.6	27.4	29.5	10.5
Improving animal welfare	27.4	30.5	24.2	17.9
Improving working conditions on a farm	32.6	27.4	21.1	18.9
Increasing the attractiveness of rural areas	13.7	15.8	23.2	47.4
Secondary				
More secure food	38.2	24.3	27.8	9.7
Improving animal welfare	22.9	29.9	20.8	26.4
Improving working conditions on a farm	22.2	27.8	27.8	22.2
Increasing the attractiveness of rural areas	18.8	19.4	18.1	43.8
Higher				
More secure food	39.2	19.6	21.6	19.6
Improving animal welfare	11.8	39.2	25.5	23.5
Improving working conditions on a farm	21.6	15.7	43.1	19.6
Increasing the attractiveness of rural areas	19.6	17.6	21.6	41.2

Source: own research

In the case of some variables, significance assessments were similar in all groups of respondents. Such was the case with environmental advantages of protection of water against pollution (highest scores). On the other hand, biological diversity in the natural environment was considered least important by all groups.

As for assessing societal advantages, most respondents in all groups agreed that food safety was the most important factor, and it was assigned the highest score by most respondents. Farmers in all of the examined groups were also of the opinion that rural areas' attractiveness was the least significant of all factors. In this case, education did not result in any differentiation of the scores assigned. Other opinions varied depending on the education level.

Assessing advantages for themselves as agricultural producers, farmers decided that obtaining knowledge was the least important factor. Also, in this case, all of the examined groups shared the same opinion. Interestingly enough, the same responses were given by all farmers, including those with elementary education. However, it could be expected that education should be significant regarding views on obtaining knowledge and experience.

Table 4. Assessment advantages for agricultural producers of applying sustainable development principles in agriculture as viewed by farmers depending on their education level

Specification	Share of respondents indicating the place in the ranking with education [%]			
	1.	2.	3.	4.
Primary				
Improving soil condition	35.0	15.0	35.0	15.0
Improving farm profitability	10.0	30.0	40.0	20.0
Acquiring knowledge and experience	5.0	35.0	30.0	30.0
Easier sale of products	35.0	15.0	35.0	15.0
Vocational				
Improving soil condition	23.2	33.7	23.2	20.0
Improving farm profitability	28.4	28.4	24.2	18.9
Acquiring knowledge and experience	25.3	21.1	30.5	23.2
Easier sale of products	21.1	21.1	26.3	31.6
Secondary				
Improving soil condition	27.8	31.9	19.4	20.8
Improving farm profitability	29.9	32.6	20.1	17.4
Acquiring knowledge and experience	29.2	29.2	25.0	16.7
Easier sale of products	11.8	18.8	29.9	39.6
Higher				
Improving soil condition	31.4	29.4	15.7	23.5
Improving farm profitability	31.4	27.5	19.6	21.6
Acquiring knowledge and experience	7.8	29.4	19.6	43.1
Easier sale of products	23.5	27.5	21.6	27.5

Source: own research

Many respondents, on the other hand, viewed the improvement of profitability (25-40%) as “very important” (the first place in the ranking) or 'important' (second place in the hierarchy) – the economic aspect seemed to be dominant here. It was underlined more frequently by farmers with a secondary and university education. These results show that despite their knowledge and awareness of sustainable development principles, they viewed providing the farmer's family with a proper economic condition level as more significant. Therefore, as Michel Duru and others [Duru et al. 2015] indicated, it is necessary to implement a systemic and comprehensive approach to agricultural production to apply the rules of sustainable development. The same results were presented by David Debertain and Angelos Pagoulatos [2015], who found that farmers usually understood the threats related to the production practices they applied quite nicely. Substantial technical knowledge and skills are required to generate a satisfying level of income in sustainable farming. However, farmers may still decide to abandon sustainable farming systems. Farmers may be reluctant towards sustainable production, even if they are convinced that the system can be equally profitable as the one they are performing currently. Still, they may fear that the volatility of profit over time would be more significant than the traditional system.

CONCLUSIONS

Compliance with principles of sustainable development on farms depends, most of all, on the agricultural producer's decisions, based on knowledge and awareness, as well as the willingness to take these issues in their activity into account. The study assumed that education level determined knowledge about sustainability rules and compliance with sustainable development principles in agricultural production. However, the results show that neither education nor compliance with the regulations of sustainable developments on farms was directly proportional to farmers' education levels. Farmers with an elementary education (20% responses) reported weaker knowledge and the least frequent use of sustainable development principles on their farms. Surprisingly the second group of respondents, which showed no familiarity with sustainable development, were farmers with a university education (10% responses). It may be due to the young age or a different field of education. Among those highly educated farmers (40%) declared good knowledge of the sustainability issues, which can be considered a positive aspect.

As for environmental advantages, most respondents decided that the most significant feature of a sustainable farm was water protection against pollution. Only among farmers with a university education did a considerable part also point to greenhouse emission reduction. Among societal advantages, safe food was considered the most important aspect, while producers' responses concerning producers' benefits varied. Respondents with a university education underlined the importance of improving the soil condition and profitability of farms. However, no feature of sustainability was pointed out more frequently among the other respondents. On the other hand, in all of the examined groups, respondents considered knowledge and experience as the least important aspect.

Based on the research conducted, it can be stated that familiarity with the principles of sustainable development is not equivalent to compliance with these rules in the production process. Frequently, farmers, who had good knowledge of sustainable agricultural practices, failed to apply them in their operations due to fear of income reduction due to lesser intensity of production in a sustainable farming system.

It seems that, although many works have been published on the subject, its importance calls for subsequent detailed research to collect additional information. A better understanding of farmers' decision-making process and behavior can help develop sustainable policy at a broader, regional, or global perspective, which is of high significance.

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Słowa kluczowe: zrównoważony rozwój, świadomość rolników wykształcenie rolników, gospodarstwa, środowisko

ABSTRAKT

W opracowaniu podjęto zagadnienie wdrażania zasad zrównoważonego rozwoju w gospodarstwach rolnych. Badania przeprowadzono w 310 gospodarstwach. Kryterium podziału gospodarstw było wykształcenie kierownika gospodarstwa. Analizowano gospodarstwa w czterech województwach: kujawsko-pomorskim, mazowieckim, lubelskim oraz wielkopolskim. Celem badań było określenie znajomości i zakresu stosowania zasad zrównoważonego rolnictwa przez rolników w zależności od posiadanego wykształcenia. W badaniach określano, w jaki sposób rolnicy w zależności od deklarowanego formalnego wykształcenia, oceniają ważność cech gospodarstwa zrównoważonego oraz korzyści z takiego sposobu gospodarowania dla środowiska, społeczeństwa i samych producentów rolnych. Przyjęto założenie, że im wyższe wykształcenie rolnika, tym większa znajomość zasad zrównoważonego rozwoju i ich stosowanie w praktyce. Stwierdzono, że w zależności od wykształcenia producenta rolnego, oceny ważności poszczególnych zmiennych charakteryzujących gospodarstwo zrównoważone były zróżnicowane. W zakresie korzyści środowiskowych jako najważniejszą wskazywano ochronę wód, wśród korzyści dla społeczeństwa najwyższą ocenę uzyskała bezpieczna żywność, natomiast w przypadku korzyści dla producentów – możliwość uzyskania wyższych dochodów. Wyniki badań nie pozwoliły jednoznacznie stwierdzić, że wyższe wykształcenie warunkuje znajomość i stosowanie zasad zrównoważenia gospodarstw. Występowała sytuacja, że rolnicy, mimo dobrej znajomości zasad zrównoważonego rolnictwa, nie stosowali ich w praktyce.

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