Farmer Awareness and Implementation of Sustainable Agriculture Practices in Different Types of Farms in Poland

Monika Gebska 1, Anna Grontkowska 2, Wiesław Swiderek 3 and Barbara Golebiewska 2,*

1 Institute of Management, Warsaw, University of Life Sciences—WULS, Nowoursynowska 166, 02-787 Warsaw, Poland; monika_gebska@sggw.edu.pl
2 Institute of Economics and Finance, Department of Economics and Organisation of Enterprises, University of Life Sciences—WULS, Nowoursynowska 166, 02-787 Warsaw, Poland; anna_grontkowska@sggw.edu.pl
3 Institute of Animal Sciences, Department of Animal Genetics and Conservation, University of Life Sciences—WULS, Ciszewskiego 8, 02-786 Warsaw, Poland; wieslaw_swiderek@sggw.edu.pl
* Correspondence: barbara_golebiewska@sggw.edu.pl; Tel.: +48-22-5934211

Received: 29 July 2020; Accepted: 24 September 2020; Published: 28 September 2020

Abstract: Sustainability has been an emerging issue for years in the economy and agriculture. Making agriculture sustainable has become so essential that it has become part of the Common Agricultural Policy (CAP). However, producers ultimately decide individually the practices they implement. This is why farmers play a central role in ensuring a sustainable agricultural system, which results from farmers’ knowledge and expectations. Although numerous studies address sustainability issues, little is known about farmers’ knowledge and implementation of sustainable practices at different types of farms, especially in central and eastern Europe. This study aimed to determine Polish farmers’ awareness of sustainability with regards to animal and crop production. This paper also shows how farmers value the advantages arising from sustainable production. The study was carried out among 300 farms classified by type (dairy, beef cattle, pork, and crop production). The research instrument used was a questionnaire, with the Likert scale. The results show that dairy farmers and pork farmers declared higher knowledge and better implement sustainable practices than other farmers. The producers’ views on the benefits coming from sustainable agriculture varied. However, the two most significant advantages were recognized—the protection of water against pollution and the reduction of greenhouse gas emissions.

Keywords: sustainable development; sustainable agriculture; farmers’ awareness; types of farms; advantages

1. Introduction

Many studies indicate that it is necessary to organize the economy, including agriculture, according to sustainable development principles [1]. Natural resources are derived excessively, particularly non-renewable ones [2,3]. Undoubtedly, agriculture is one of the economy’s branches that has a significant impact on shaping the natural environment [4]. This impact is related to the direct use of environmental resources in production processes. Intensive agricultural production requires the use of many industrial inputs (i.e., mineral fertilizers and plant protection products), and their inefficient or excessive use can cause a significant threat to the environment, for example, soil quality, biodiversity, and animal welfare [5–9]. In turn, in animal husbandry, considerable amounts of natural fertilizers rich in nitrogen and phosphorus are produced, which, if improperly used and stored, can be a source
of environmental pollution, mostly water pollution [10–12]. Other factors causing environmental degradation in agricultural activities include improper manure management within the farm, emission of gaseous and dust substances from intensive farming or animal husbandry to the air, and improper waste management [13,14]. It can be concluded that the degree of the negative impact of agricultural production on the environment depends on the farm type and production system [15,16]. Agricultural production is not homogeneous in terms of farm type. This factor is vital for its environmental impact. When analyzing this diversity, mainly agricultural systems are taken into account. As Le Gal et al. [17] stated, agricultural operations worldwide generate growing concerns about their environmental impact. The capital-intensive agriculture model widespread in Western countries has revealed environmental limits. However, the diverse effect of agricultural production on the environment can also be observed depending on the product type. Other factors will be important in plant production and others in animal production. Pig production will have a different impact on the environment than cattle production. From an economic point of view, the most important are industrialized livestock production systems characterized by high intensity, large scale, and concentration. The industrialized system can be run on farms with arable land and farms with almost no arable land (e.g., pork production based on purchase feed). Such high animal concentration creates many environmental issues related to waste management, manure, and odor emission [18]. For example, liquid manure is a significant threat to groundwater and surface watercourses. As indicated by Ramachandra [19], excessive doses of fertilizers containing a high proportion of water, such as liquid manure and slurry, disturb the soil’s physical properties. In Polish agriculture, farms specializing in only one product (milk or pork) for years were rare [20]. Even now the majority of farms in Poland are mixed farms, carrying out plant and animal production (Figure 1). However, the high concentration of rural production is also an issue under consideration in several provinces in Poland, particularly in the central and north-eastern parts, where farming is very intensive with a high livestock density (e.g., Kujawsko-pomorskie, and Wielkopolskie).

![Figure 1. Share of different types of farms. Source: [21].](image-url)

Recent literature shows that the share of greenhouse gas emissions produced in agriculture is significant. In Poland, about 9% of greenhouse gases emitted to the atmosphere come from agricultural production; in the European Union, it is about 10%. Livestock production generates about 18% of all greenhouse gases emitted to the atmosphere [22].

Additionally, production carried out on different farms influences soils, water, air, landscape, etc. Plant production is more dependent on natural conditions and resources (soil quality and climate) than activities concerning livestock production. Crop production is one of the most intensive activities in agriculture. As Jabłońska and Olewnicki [23] point out, the development of agriculture through the intensification of production and chemical usage poses many threats to the natural environment.
and human health. The primary agrotechnical practice affecting plant yield is fertilization [24–26], which burdens the environment when used excessively. The same result is caused by chemical plant protection with the use of pesticides, herbicides, and insecticides. As a result of the increased use of those products, the environment’s risk increases [27]. As indicated by Miszczyk et al. [28], it is vital to use legally available, certified products, not counterfeits.

Implementing sustainable practices at farms may reduce the undesirable effects resulting from agricultural activities. In fact, different production methods can be used in plant production to ensure its sustainability. They include, among others, precision production, conservation, organic agriculture, agroforestry, and integrated agro-farming systems [29]. Sustainable practices may help to preserve the ecosystems, to promote economic stability for farms, and to improve farmers’ quality of life [30,31].

This is why sustainable agriculture is the main subject of present debates. Conway [32] defines agricultural sustainability as “the ability of a system to maintain productivity despite a major disturbance”. He points out that there may be trade-offs between the goals of maximizing production and maximizing sustainability. Sustainable agriculture must conserve land resources without their degradation and must be economically viable and socially acceptable. According to UNEP [33], the principle of sustainable development means using environmental resources in quantities that do not exceed the ecosystems’ ability to restore them. Although the general nature of such a definition is pointed out [34], it is adopted especially in determining future generations’ possibilities to function. Sustainable agriculture is achieved when food is produced without compromising land resources and environmental pollution [35]. As indicated by Earles and Williams [36], this agriculture is guided by nature’s principles; it is the agriculture of social values, prosperous life for families on farms, and healthy food for all people. Farmers and agriculture specialists have indicated specific sustainable development principles, referring to efficient management and economic justice [1,2]. Attention has also been drawn to the fact that farmers increasingly see the legitimacy of introducing such restrictions [2].

Apart from environmental aspects, sustainability has multiple dimensions. It includes social and economic areas [9], but these are less frequent in the literature. The social dimension of sustainable agriculture is mainly neglected in the literature [37]. Garnett [9] stated that it is not clear whether sustainability standards help farmers to improve their production and livelihoods. Some findings [38] suggest that sustainability standards keep farmers in a vicious cycle of poor yields, low prices, low investments, and low profits [39–41]. Kilian [42] stated that conversion from conventional to certified sustainable production is perceived and promoted as a viable opportunity to differentiate products and, therefore, to achieve substantially higher prices. It seems that sustainability is a concept that is relatively easy to understand but difficult to define in practice. The likelihood of implementing sustainable actions depends on the potential financial benefits and future costs of activities [43]. The mix of environmental benefits, economic benefits, and economic costs determine whether or not a particular practice is implemented. Decision-making is also affected by the overall level of knowledge regarding different methods, and it has been shown that knowledge gaps are an increasing function of cost and a decreasing function of benefits [44].

In many studies, an essential aspect of sustainable activities is farmers’ awareness of the risks, in association with agricultural production and their knowledge about sustainable practices [45–47], along with their motivations, and beliefs that required actions are easy to implement [48]. Increasing awareness of conventional farmers about the environmental impact they make can lead to a move towards alternative farming systems (e.g., organic) [49].

The study by Kielbasa et al. [50] shows that farmers generally understood the importance of sustainable agriculture and of limiting the use of chemical fertilizers. This approach’s main drivers tended to be high prices and a need to fulfill EU regulations for economic purposes. The farmers interviewed took an intuitive approach to the problem of sustainable nutrient management. Ghosh and Hasan’s findings [51] show that most surveyed farmers (65%) had a medium attitude towards sustainable agricultural practices, while 21.1% had a poor attitude. Only 13.3% of farmers had a positive
attitude towards them. The authors suggest that this might be a result of insufficient training of farmers. They also show that education, farm size, annual income, and knowledge have a significant positive relationship with farmers’ attitudes toward sustainability practices. The role of knowledge is a crucial factor in the farm transition towards more sustainable agriculture [52]. The successful transition to sustainable agriculture depends on local farmers’ knowledge, which is linked to specific ethical, environmental, and social values [53]. Farmers’ practices generally reflect farmers’ expertise and ethics [54]. The implementation of sustainable practices requires improvements in farmers’ knowledge and capacity [55]. Alonge and Martin [56] found that farmers’ perceptions regarding the compatibility of sustainable practices with their farming systems emerged as the best predictors of adopting such practices. The farmers need to believe that sustainable practices are necessary before they use them. Economic factors may not be a critical factor when deciding on applying sustainable practices [57].

Although numerous studies describe various sustainability issues, little is known about farmers’ knowledge concerning sustainability and the implementation of sustainable practices at different types of farms. There is no research in this area concerning Central and Eastern Europe. This research aimed to seek answers to the following research questions:

1. What is the farmers’ awareness of sustainable agriculture principles, and how many farmers apply these principles in practice?
2. Which features of sustainable agriculture are considered by farmers to be the most important?
3. What benefits for the environment, society, and farmers result from applying the principles of sustainable agriculture?
4. Are there differences between farmers from different farm types in their opinion on sustainable agriculture’s broadly understood issues?

The hypothesis was that, depending on farm type, farmers are characterized by significant differences between their sustainability awareness levels. Confirming this would suggest that farmers differently value advantages resulting from sustainability practices and implement sustainability rules differently at various farm types.

2. Materials and Methods

Farm-level analyses were prepared based on research carried out in 2019. The data was collected using an interview questionnaire consisting of six questions with sub-questions. Some questions concerned farmers’ knowledge and awareness of sustainable development practices and its implementation in agricultural production. In the questionnaire, a scale with five (5) ratings was applied, where 1 means strongly disagree, and 5 means strongly agree. This scale is very often used to measure attitudes towards specific problems to obtain an answer regarding the degree of acceptance of a phenomenon or view on a given topic. Questions concerning benefits resulting from applying sustainability practices were asked using a scale with four (4) alternative answers, and the respondents were asked to rank them (Table 1). The statements used in the questionnaire were prepared based on the existing literature concerning awareness and application of sustainability rules [50–52,56] and benefits coming from sustainable agriculture.

| Statement                                                                 | Scale |
|---------------------------------------------------------------------------|-------|
| I know of the concept of sustainable agriculture.                         | 1–5 * |
| I use sustainable farming methods.                                        | 1–5 * |
| I apply agricultural practices according to standard recommendations.     | 1–5 * |
| Environmental benefits resulting from sustainable agriculture. (4 answers)| 1–4 **|
| Benefits for society resulting from sustainable agriculture. (4 answers)  | 1–4 **|
| Benefits for farmers resulting from sustainable agriculture. (4 answers)  | 1–4 **|

* Options: 1—strongly disagree, 2—disagree, 3—neutral, 4—agree, 5—strongly agree. ** Ranking: 1—the most important, 4—the least important. Source: Own research.
The research was carried out on 300 farms located in Poland’s typical agricultural regions (Kujawsko-pomorskie, Mazowieckie, Lubelskie, and Wielkopolskie voivodeships). These four voivodeships are characterized by the highest share of agricultural land, significant livestock production, and different agricultural output structures. Two provinces, Mazowieckie and Wielkopolskie, represent an area with a high share of animal production in the agricultural market output. One voivodeship (Kujawsko-pomorskie) represents an area with a medium percentage of animal production. At the same time, Lubelskie is an example of a province with a low share of animal production and a high plant production share. There are 1.42 million farms in Poland, including 1.37 million family farms, but only about 0.75 million are market oriented. The average UAA of the farms in Poland in 2018 was 10.81 ha (Table 2). An attempt was made to select the respondents in the way that the research sample reflects the structure of market-oriented farms for the area under analysis.

| Voivodship * (Province) | Number of Farms | Average Size of the Agricultural Land Area per Farm (UAA) in 2019 (ha/farm) |
|-------------------------|----------------|--------------------------------------------------------------------------|
| Dolnośląskie            | 56,994         | 17.10                                                                    |
| Kujawsko-pomorskie      | 63,462         | 16.43                                                                    |
| Lubelskie               | 168,032        | 7.93                                                                     |
| Lubuskie                | 20,868         | 21.90                                                                    |
| Łódzkie                 | 123,155        | 7.92                                                                     |
| Małopolskie             | 143,841        | 4.13                                                                     |
| Mazowieckie             | 236,911        | 8.75                                                                     |
| Opolskie                | 26,289         | 19.02                                                                    |
| Podkarpackie            | 128,998        | 4.90                                                                     |
| Podlaskie               | 76,229         | 12.51                                                                    |
| Pomorskie               | 40,090         | 19.58                                                                    |
| Śląskie                 | 57,748         | 8.02                                                                     |
| Świętokrzyskie           | 83,902         | 5.82                                                                     |
| Warmińsko-mazurskie     | 42,434         | 23.25                                                                    |
| Wielkopolskie           | 124,477        | 13.99                                                                    |
| Zachodniopomorskie      | 29,943         | 31.44                                                                    |
| **Total**               | **14,253.73**  | **10.81**                                                                |

* The administrative division divides the territory of Poland into 16 voivodeships (provinces); these are divided into powiats (counties or districts), and these are divided into gminas (communes or municipalities). The voivodeships are diversified in terms of potential and area. Source: [58].

The number of farms for research was determined in proportion to the number of farms in voivodeships. The farms were drawn with agricultural advisory centers' participation according to the established criteria: market-oriented farms with a specific type of production (pork/dairy cattle/beef cattle/crops). The questionnaires were addressed to 380 farms, making a proportional selection depending on the number of agricultural farms in each voivodeship. Because 18% of the respondents refused to answer the questionnaire and because 10 questionnaires were incomplete, answers from 300 questionnaires were analyzed. The proportion in the number of questionnaires by voivodeship was maintained. Due to the diverse impact of farm activities on the environment, farms were selected representing four types of farms (dairy, beef cattle, pork, and crop production). In the research, due to farmers’ reluctance to provide the value of production or income, we could not calculate the standard output (SO) needed to define farm type. The authors decided to adopt the methodology described by Wojtaszek published in 1965, which is broadly recognized in Poland. Farmers were asked...
about the production line that is dominant and yields at least 40% of the total production value [59]. The methodology takes into account that, in Poland, farms still have a significant share of self-supply. The crop production farm (excluding vegetables, fruit, and other special activities, e.g., wicker and hops) was defined as a farm with a 40% minimum value of plant production. Similarly, farms with animal production were classified using a share of given production as a criterion. A dairy farm was defined as a farm with a 40% minimum share of milk production values in total agricultural production. Similarly, a pork farm was described as a farm with a 40% share of pork production values in total agricultural production. Beef cattle farm was defined as a farm with a minimum 40% share of beef production values in total agricultural production. The farmers were drawn from different groups depending on professional experience (years)—<10, 11–20, 21–30, or >30; education—primary, vocational, secondary, or higher; participation in training sessions—yes or no; membership in a producer group—yes or no. Detailed data on farms are given in Table 3.

Table 3. Respondents by sociodemographic variables.

| Specification                  | n   | %  |
|-------------------------------|-----|----|
| Voivodship (Province)         |     |    |
| Kujawsko-pomorskie            | 43  | 14.3|
| Lubelskie                     | 45  | 15.0|
| Mazowieckie                   | 141 | 47.0|
| Wielkopolskie                 | 71  | 23.7|
| Professional experience (years)|     |    |
| <10                           | 84  | 28.0|
| 11–20                         | 80  | 26.7|
| 21–30                         | 93  | 31.0|
| >30                           | 43  | 14.3|
| Education                     |     |    |
| Primary                       | 17  | 5.7 |
| Vocational                    | 94  | 31.3|
| Secondary                     | 139 | 46.3|
| Higher                        | 50  | 16.7|
| Participation in training sessions |     |    |
| No                            | 115 | 38.3|
| Yes                           | 185 | 61.7|
| Membership in a producer group|     |    |
| No                            | 198 | 66.0|
| Yes                           | 102 | 34.0|
| Total                         | 300 | 100.0|

Source: Own research.

Most respondents (47%) came from the Mazowieckie voivodship. Varied professional experiences characterized the respondents (from <10 to >30 years), as did education (46.3%, the largest group, had a secondary school education). Over 61% of respondents enriched their knowledge by participating in courses and training. Among the production lines, the dominant group (44%) were milk producers; the least numerous were pork producers (11.3). Only 1/3 of respondents were associated with producer groups. An analysis of the surveyed farms’ features shows that they are larger than the average farm in Poland, amounting to about 11 ha of utilized agricultural area (UAA) [58]. In the statistical analysis of the survey data, non-parametric methods were used because the variables on the ordinal scale did not meet the requirements of the normal distribution (Kolmogorov–Smirnov and Shapiro–Wilk normality test). Mean ranks, instead of medians, were used in the presentation of the results. The mean ranks better reflect the actual diversity of the respondents’ answers. The significance of differences in responses to individual survey questions between respondents representing different types of farms and the significance of differences between the features of sustainable agriculture assessed by the respondents were calculated using the Kruskal–Wallis test. The relationship (relationship) between participation in training and sustainable agriculture practices declared by the respondents was estimated using the Spearman’s rank correlation coefficient. The calculations were made using the Statistica 13.3 program.
3. Results

It is crucial to examine producers’ opinions regarding their understanding of a modern management system in an environmentally friendly way, since producers rarely make decisions about their activities without considering numerous problems, possible outcomes, and desired results. According to farm type, in Tables 4–8, farmers’ opinions regarding selected aspects of sustainable agriculture are presented.

Table 4. Characteristics of respondents representing a specific farm type.

| Farm Type | n  | %  | Experience (years) | Secondary and Higher Education | Participation in Training | Membership in a Producer Group |
|-----------|----|----|--------------------|--------------------------------|--------------------------|-------------------------------|
|           |    |    | Mean              | %                | %                      |                                |
| BP        | 62 | 20.7| 20.4              | 66.1              | 50.0                    | 25.8 a                        |
| MP        | 132| 44.0| 21.1              | 60.6              | 67.4                    | 51.5 aA                       |
| CP        | 72 | 24.0| 20.3              | 68.1              | 55.6                    | 12.5 A                        |
| PP        | 34 | 11.3| 20.6              | 55.9              | 73.5                    | 26.5                          |
| Total     | 300| 100.0| 20.7              | 63.0              | 61.7                    | 34.0                          |

BP—beef cattle production, MP—milk production, CP—crop production, PP—pork production, values significant (the same letters): A—p < 0.01, a—p < 0.05 (Kruskal–Wallis test). Source: own research.

Table 5. Opinions of respondents representing various farm types regarding the knowledge and practical application of sustainable farming methods expressed in rank values.

| Opinion                                          | Farm Type | r         |
|-------------------------------------------------|-----------|-----------|
| BP                                              | n = 62    |           |
| MP                                              | n = 132   |           |
| CP                                              | n = 72    |           |
| PP                                              | n = 34    |           |
| OPN1: I know of the concept of sustainable agriculture. | Mean Rank | Mean Rank |
| OPN1: I use sustainable farming methods.         | Mean Rank | Mean Rank |
| Mean Rank                                       | 141.3     | 161.1     |
| OPN2: I use sustainable farming methods.         | Mean Rank | 137.7     |
| Mean Rank                                       | 153.3     |           |
| OPN2: I use sustainable farming methods.         | Mean Rank | 141.5     |
| OPN2: I use sustainable farming methods.         | Mean Rank | 161.1     |

r—Spearman’s rank correlation coefficient ** (p < 0.01). Source: own research.

Out of the 300 respondents (Table 4), milk producers (44%) were most numerous, and pork producers were the least (11.3%). Regardless of the farm type, the respondents had similar professional experience (average 20.3–21.1 years). However, considerable disproportions in the education levels of the respondents were noted. The highest percentage of people with secondary and higher education was associated with beef cattle and crop production (66.1–68.1%), and the lowest was associated with pork production (55.9%). Milk and pork producers participated in courses and training more often (67.4–73.5%) than producers of cattle and crops (50.0–55.6%). Few respondents (34.0%) declared belonging to the producer groups. Most people belonging to producer groups were recorded among milk producers (51.5%), and few were associated with crop production (12.5%).
Table 6. Opinions of respondents representing various farm types regarding the features of a sustainable farm expressed in mean rank values.

| Characteristic Features | BP (n = 62) | MP (n = 132) | CP (n = 72) | PP (n = 34) | Total (n = 300) |
|-------------------------|-------------|-------------|-------------|-------------|----------------|
|                         | RP Mean Rank| RP Mean Rank| RP Mean Rank| RP Mean Rank| RP Mean Rank   |
| C1: Applying agricultural practices according to standard recommendations | 159.8 | 147.3 | 154.1 | 138.3 | 1195.7 |
| C2: Applying pro-environmental practices | 149.6 | 149.1 | 153.4 | 151.6 | 1026.1 |
| C3: Guaranteeing a fair income for the farming family | 143.4 | 161.6 | 140.2 | 142.3 | 1232.8 |
| C4: Meeting the social needs of the farming family | 142.7 | 158.1 | 147.1 | 142.3 | 1074.5 |
| C5: Enabling the transfer of a farm to the successor | 142.9 | 168.6 | 129.4 | 139.0 | 1254.0 |
| C6: Guaranteeing animal welfare | 157.4 | 153.8 | 135.0 | 158.1 | 1357.9 |
| C7: Improving the farmer’s safety | 150.2 | 156.3 | 142.9 | 144.7 | 1247.9 |
| C8: Reasonably using energy and raw materials for production | 158.2 | 151.7 | 139.6 | 154.9 | 1214.9 |

BP—beef cattle production, MP—milk production, CP—crop production, PP—pork production, RP—ranking position, values statistically significant—same letters A—p < 0.01, a—p < 0.05 (Kruskal–Wallis test). Source: Own research.

Table 7. Ranking of environmental benefits resulting from the application of sustainable agriculture principles on a farm by respondents representing various farm types expressed in mean rank values.

| Environmental Benefits | BP (n = 62) | MP (n = 132) | CP (n = 72) | PP (n = 34) | Total (n = 300) |
|------------------------|-------------|-------------|-------------|-------------|----------------|
|                        | RP Mean Rank| RP Mean Rank| RP Mean Rank| RP Mean Rank| RP Mean Rank   |
| EB1: Water protection against pollution | 148.0 | 161.3 | 141.7 | 131.9 | 415.5 |
| EB2: Reduction of greenhouse gas emissions | 166.3 | 146.0 | 142.1 | 157.0 | 591.8 |
| EB3: Reduction of energy consumption from non-renewable sources | 149.0 | 150.5 | 155.1 | 143.7 | 629.0 |
| EB4: Increases in biodiversity in the natural environment | 144.4 | 147.9 | 153.4 | 165.6 | 765.7 |

EB—environmental benefits, BP—beef cattle production, MP—milk production, CP—crop production, PP—pork production, RP—ranking position, values statistically significant—same letters A—p < 0.01, a—p < 0.05 (Kruskal–Wallis test). Source: Own research.
Table 8. Ranking of benefits for society resulting from the application of sustainable agriculture principles on a farm by respondents representing various farm types expressed in mean rank values.

| Benefits to Society                      | Farm Type | Total | BP n = 62 Mean Rank | MP n = 132 Mean Rank | CP n = 72 Mean Rank | PP n = 34 Mean Rank | RP n = 300 Mean Rank |
|----------------------------------------|-----------|-------|---------------------|----------------------|--------------------|---------------------|----------------------|
| BS1: Increasing the attractiveness of rural areas | 159.8     | 4     | 154.6               | 3                    | 147.7              | 123.4               | 1                    | 731.3 ABC 4          |
| BS2: More secure food                  | 136.0     | 1     | 156.8               | 4                    | 149.7              | 154.2               | 3                    | 505.1 *A 1           |
| BS3: Improving working conditions on a farm | 145.3     | 2     | 144.5               | 2                    | 160.2              | 162.8               | 4                    | 573.4 B 2           |
| BS4: Improving livestock welfare       | 159.5     | 3     | 141.9               | 1                    | 157.6              | 152.7               | 2                    | 592.3 *C 3           |

BS—benefits to society, BP—beef cattle production, MP—milk production, CP—crop production, PP—pork production, RP—ranking position, values statistically significant—same letters A—p < 0.01, a—p < 0.05 (Kruskal–Wallis test). Source: Own research.
Table 5 summarizes the respondents’ answers (ranks values) regarding the issues of sustainable agriculture. Aspects of sustainable agriculture according to farm type are presented. The highest amount of knowledge of the principles of this form of farming was declared by milk producers (161.1) and pork producers (153.3), and a lesser amount of knowledge of the principles (statistically insignificant) was declared by producers of beef cattle and crops. Similar differentiation in responses was noted concerning the use of sustainable farming methods. Respondents (MP and SP) who showed greater knowledge in this field (OPN1) more often declared the use of sustainable farming methods in practice (OPN2). This relationship is confirmed by the estimated correlation coefficient ($r = 0.582, p < 0.01$).

Of the many features of a sustainable farm, respondents (overall) considered ensuring animal welfare (C6) and the possibility of transferring a farm to a successor (C5) the most important (Table 6). However, the application of pro-environmental practices (C2) and meeting the social needs of the agricultural family (C4) were considered significantly ($p < 0.01; p < 0.05$) less important. However, it should be emphasized that respondents’ opinions representing various forms of economic activity were usually different (statistically insignificant). According to beef cattle and crop producers, a sustainable farm’s most crucial feature was applying agrotechnical practices according to standard recommendations (C1). The opinion on animal welfare prevailed among pork producers (C6). On the other hand, milk producers’ opinions prevailed with respect to enabling the transfer of a farm to a successor (C5). In turn, in the opinions of the respondents from crop production, this feature obtained the lowest rating and was significant ($p < 0.05$).

In the opinion of most respondents, the most significant environmental benefit (Table 7) resulting from the application of sustainable agriculture principles on the farm was water protection against pollution (EB1) and the reduction of greenhouse gas emissions (EB2). The reduction of energy consumption from non-renewable sources (EB3) and increases in biodiversity in the natural environment (EB4) were considered to be less important ($p < 0.01$). Given the production type, pork and crop producers expressed a similar opinion. According to milk producers, the most significant benefit of applying sustainable agriculture principles was reducing greenhouse gas emissions (EB2); in the opinion of beef cattle producers, increases in biodiversity in the natural environment (EB4) were considered the most significant.

Among the suggested social benefits resulting from the implementation of sustainable farming principles on the farm (Table 8), respondents considered safe food as the most important (BS2) and the increase in the attractiveness of rural areas (BS1) the least important ($p < 0.01$). It should be noted that the respondents’ opinions differed depending on the direction of production. The pork and crop farmers considered the increase in the attractiveness of rural areas (BS1) to be the most significant, the producers of beef cattle considered safe food (BS2) to be the most significant, and milk producers considered the improvement of farm animal welfare (BS4) to be the most significant.

The introduction of sustainable farming principles on the farm, according to all respondents (Table 9), significantly ($p < 0.01$) contributed to smoother disposal of products (BF1) and thus to an improvement in the farm’s profitability (BF2). Acquiring knowledge and experience (BF3) was considered the least important benefit. Plant farmers and pork producers found the farm’s profitability (BF2) to be the main benefit. For milk producers, the most significant effect of sustainable agriculture was acquiring knowledge and experience (BF3); for producers of beef cattle, soil improvement (BF4) was the most significant.
Table 9. Ranking of benefits for the farmer resulting from the application of sustainable agriculture principles on the farm by the respondents representing different farm types expressed in mean rank values.

| Benefits for Farmer                                      | Farm Type | Total | RP | n = 62 | BP Mean Rank | n = 132 | MP Mean Rank | n = 72 | CP Mean Rank | n = 34 | PP Mean Rank | n = 300 | RP |
|----------------------------------------------------------|-----------|-------|----|--------|--------------|---------|--------------|---------|--------------|---------|--------------|---------|----|
| BF1: Easier sale of products                            | 158.3     | 3     |    | 152.5  | 3             | 140.7   | 2             | 149.0   | 2             | 548.4   | 1             | A       | 1  |
| BF2: Improving farm profitability                        | 151.7     | 2     |    | 164.8  | 4             | 130.6   | 1             | 135.2   | 1             | 563.0   | 2             | B       | 2  |
| BF3: Acquiring knowledge and experience                  | 167.9     | 4     |    | 136.7  | 1             | 154.3   | 3             | 159.5   | 3             | 719.9   | 4             | ABC     | 4  |
| BF4: Improving soil condition                            | 134.8     | 1     |    | 149.4  | 2             | 159.5   | 4             | 164.2   | 4             | 569.0   | 3             | C       | 3  |

BF—benefits for the farmer, BP—beef cattle production, MP—milk production, CP—crop production, PP—pork production, RP—ranking position, values statistically significant—same letters A—$p < 0.01$, a—$p < 0.05$ (Kruskal–Wallis test). Source: Own research.
4. Discussion

The choice of farm type and production method is the farmer’s. They must take into account environmental, economic, technical, and often cultural circumstances [17]. The farmers must decide how intensive their production will be and whether sustainable practices will be applied. Therefore, knowledge and willingness to comply with rules limiting agricultural production’s negative impact on the environment are essential.

Hou and Wu’s studies [60] indicate that the farmers’ knowledge about the consequences of using plant protection products affects how they use them. In turn, whether farmers use pesticides in a standardized way affects the amount of pesticide residue generated, ultimately affecting the safety of agricultural production. The need to make farmers aware of this issue has been pointed out. The importance of making farmers aware of the harmful effects of excessive intensification of agricultural production was indicated in the 1990s [61,62]. Moreover, Story and Forsyth [63] noticed that farmers are more likely to protect the environment when they are aware of environmental problems. The knowledge that the threat to the environment is significant creates a sense of responsibility for farmers’ actions. In the papers of Al-Zaidi et al. [64] and Maitah et al. [65], it was found that trained farmers are convinced about the negative impact of pesticides on the environment.

The empirical findings of our study confirm the views presented by Hou and Wu [60]. The highest amount of knowledge of the principles of this form of farming was declared by milk and pork producers, and these two groups more often proclaimed the usage of sustainable farming methods in practice.

Curry and Kirwan [66] and Kloppenburg [67] underlined that farmers applying sustainable agriculture due to its holistic, diverse, and distinctive nature require new content and knowledge and new forms of learning. It can often be challenging to obtain the necessary knowledge; this is why Polish research carried out by Sulewski and Golaś [47] indicated that only some farmers are aware of the negative impact of agriculture on the environment. This study showed that 30% to 60% of surveyed farmers showed environmental awareness depending on the type of resources used. Most often, producers from the Sulewski and Golaś study were worried about water. Simultaneously, the surveyed farmers considered two sustainability features as the most important: ensuring animal welfare and the possibility of transferring a farm to a successor. Additionally, according to the respondents, the most significant environmental benefits resulting from the application of sustainable agriculture principles on the farm is protection against water pollution and the reduction of greenhouse gas emissions.

The diverse way farmers perceive the issues of the negative impact of agriculture on the environment (including climate) was highlighted, among others, by Hyland et al. [68]. These authors divided respondents into four groups, Environmentalists, The Dejected, Countryside Stewards, and Producers, classifying farmers with the highest level of ecological awareness as Environmentalists. The Dejected did not precisely understand how emissions from livestock farming were generated, so their ability to use environmental protection measures was limited. In turn, Countryside Stewards were highly motivated to act green, but they lacked awareness of climate change. That is why they had a low behavioral ability to implement measures to solve the problem.

Research of De Olde showed that a modern farmer must be thoroughly familiar with both economic and environmental issues. Knowledge of sustainable development issues and their use on a farm is crucial from a sustainable production point of view, ensuring satisfactory financial results while maintaining an appropriate natural environment [69]. Tait and Morris [70] indicated the issues that should be addressed and made agricultural producers aware of sustainability at the farm level. The authors listed four practices in the study: improving the quality of habitats for wild animals and plants on the farm, reducing pesticide in crops, spraying when and where it is necessary, and reducing the toxicity of the chemicals used.

Among the benefits for society resulting from sustainable farming practices, food safety was rated the highest. Producers of beef cattle mainly noted this. This can be justified because health and food safety is a vital issue that is primarily addressed in most developed countries. Such a statement is in line with those presented by EU citizens in the survey organized by EFSA, where more than
41% of respondents showed great interest in safe food [71]. Among the suggested social benefits resulting from the implementation of sustainable farming principles on the farm (Table 8), respondents considered safe food the most essential and considered the increase in rural areas’ attractiveness the least important. The introduction of sustainable farming principles on the farm, according to all respondents, significantly contributed to smoother disposal of products and thus to the improvement of the farm’s profitability, which represents the economic pillar of sustainability. Actions taken on the farm are the result of the decisions and knowledge of the agricultural producer. A common reason for incorrect production decisions that negatively affect the natural environment is the farmer’s insufficient understanding of the sustainability concept. Over the past few decades, various concepts have been implemented in research and policy to encourage farmers to adopt sustainable farming practices. However, as Altieri et al. [72] stated, most efforts to improve agricultural production focus on intensification practices rather than pro-ecological activities. The study of Kielbasa et al. [50] shows that farmers generally understood the importance of sustainable agriculture and keeping down chemical fertilizers. This approach’s main drivers tended to be high prices and a need to fulfill EU regulations for economic purposes. It also seems that the topic is so essential that any additional analysis and ongoing monitoring of changes in this area allows for the accumulation of new knowledge that can be used to make decisions at a farm level and from a broader, national, and even global perspective.

5. Conclusions

For the majority of respondents representing 300 farms, sustainable development rules were known. However, the knowledge about sustainable development varied depending on the type of farm. Farmers producing pork and milk declared the highest knowledge of this form of farming. In contrast, producers of beef cattle and plant production presented a weaker understanding of these rules. Farmers with higher knowledge about this issue more often declared the use of sustainable farming methods in practice.

Farmers, when defining a sustainable farm, first mentioned animal welfare and the possibility of transferring it to a successor. These results indicate farmers’ interest in the farm and a need to ensure its continuity. Care for animal welfare suggests a high level of producers’ awareness of this aspect’s importance for an animal’s high performance and for the resulting high-quality production. However, it should be noted that mainly farmers running pork farms considered this attribute the most important. Applying pro-environmental practices and meeting the social needs of the family turned out to be less important. Therefore, the role of the workplace and its maintenance comes to the fore. Farmers from different types of farms considered various features of sustainable farms as the most important. According to producers of crops and beef cattle, a sustainable farm’s most important attribute is applying agrotechnical methods according to standard recommendations.

Environmental benefits resulting from sustainable agriculture practices varied depending on the farm type. However, protecting water against pollution and reducing greenhouse gas emissions were recognized as the most significant environmental benefits. Compliance in this respect occurred among farmers from pork, dairy, and crop production farms. On the other hand, producers of beef cattle mainly pointed to the increase of biodiversity in the natural environment. Among the farmer’s benefits, respondents indicated the easier sale of products and improvements in the farm’s profitability, as expected. These were the most important for pork and plant producers. The least essential element was knowledge and experience acquisition. The results suggest that implementing sustainable development rules depends significantly on farmers’ knowledge of best practices. The estimated correlation coefficient confirms this relationship. The policymakers should be aware that activities for sustainable development in agriculture should be supported by information and training campaigns. This may increase the applicability of sustainable practices, which is one of the greatest challenges for the Common Agricultural Policy (CAP). It seems that additional studies with a larger sample size are needed to gain a more in-depth understanding of farmers’ attitudes and behaviors. Still, in the current research, several interesting trends have emerged.
The authors are aware that the research suffers from some limitations. The main concern is that respondents came from four provinces of Poland, so this study’s findings cannot be generalized to the entire population of farmers. However, this study was exploratory. Efforts should be made to replicate this study with another larger group of farmers who operate in Poland. Other limitations are due to the restricted length of the questionnaire. Due to farmers’ reluctance to provide the value of production or income, it was not possible to calculate the standard output (SO) needed to define farm type. It would be interesting to find out if there is a relationship between the farm’s monetary economic size expressed in Standard Output (SO) and farmers’ awareness and implementation of sustainable practices. The presented study provides a basis for further research.

Author Contributions: Conceptualization, M.G. and B.G.; methodology, W.S. and A.G.; software, W.S.; validation, M.G. and W.S.; formal analysis, B.G. and A.G.; investigation, B.G., M.G., and A.G.; resources, M.G. and B.G.; data curation, M.G.; writing—original draft preparation, M.G., B.G., A.G., and W.S.; writing—review and editing, M.G. and B.G.; visualization, B.G.; supervision, M.G. and B.G.; project administration, M.G.; funding acquisition, M.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by ERA-NET SusPigSys project, grant number: SUSAN/I/SusPigSys/04,2018 and the APC was funded by ERA-NET SusPigSys project, grant number SUSAN/I/SusPigSys/04//2018.

Conflicts of Interest: The authors declare that there is no conflict of interest.

References
1. Majewski, E. Trwały rozwój i trwałe rolnictwo. Teoria i praktyka gospodarstw rolnych—Sustainable Development and Sustainable Agriculture. In Theory and Practice of Agricultural Farms; SGGW Publishing: Warsaw, Poland, 2008.
2. Siebrecht, N. Sustainable Agriculture and Its Implementation Gap—Overcoming Obstacles to Implementation. Sustainability 2020, 12, 3853. [CrossRef]
3. Foley, J.A.; Ramankutty, N.; Brauman, K.A.; Cassidy, E.S.; Gerber, J.S.; Johnston, M.; Zaks, D.P.M. Solutions for a cultivated planet. Nature 2011, 478, 337–342. [CrossRef] [PubMed]
4. Lamek, N.; Lanhai, L.; Alphonse, K.; Fidele, K.; Christophe, M.; Felix, N.; Enan, M.N. Agricultural impact on environment and counter measures in Rwanda. Afr. J. Agric. Res. 2016, 11, 2205–2212. [CrossRef]
5. Amani, O.; Unai, P.; Russell, N.P. Biodiversity Conservation and Productivity in Intensive Agricultural Systems. J. Agric. Econ. 2007, 58, 308–329.
6. Rodríguez-Eugenio, N.; McLaughlin, M.; Pennock, D. Soil Pollution: A Hidden Reality; FAO: Rome, Italy, 2018; p. 142.
7. Lal, R. Soils and food sufficiency. A review. Agron. Sustain. Dev. 2009, 29, 113–133. [CrossRef]
8. Hole, D.G.; Perkins, A.J.; Wilson, J.D.; Alexander, I.H.; Grice, P.V.; Evans, A.D. Does organic farming benefit biodiversity? Biol. Conserv. 2005, 122, 113–130. [CrossRef]
9. Garnett, T.; Appleby, M.C.; Balmford, A.; Bateman, I.J.; Benton, T.G.; Bloomer, P.; Burlingame, B.; Dawkins, M.; Dolan, L.; Fraser, D.; et al. Sustainable intensification in agriculture: Premises and policies. Science 2013, 341, 33–34. [CrossRef]
10. Thornton, P.K. Livestock production: Recent trends, future prospects. Philos. Trans. R. Soc. B Biol. Sci. 2010, 365, 2853–2867. [CrossRef]
11. Opio, C.; Gerber, P.; Mottet, A.; Falcucci, A.; Tempio, G.; MacLeod, M.; Vellinga, T.; Henderson, B.; Steinfeld, H. Greenhouse Gas Emissions from Ruminant Supply Chains—A Global Life Cycle Assessment; Food and Agriculture Organization of the United Nations (FAO): Rome, Italy, 2013.
12. Bos, J.F.F.P.; De Haan, J.; Sukkel, W.; Schils, R.L.M. Energy use and greenhouse gas emissions in organic and conventional farming systems in the Netherlands. NJAS Wagening. J. Life Sci. 2014, 68, 61–70. [CrossRef]
13. Haga, K. Animal Waste Problems and Their Solution from the Technological Point of View in Japan. JARQ 1998, 32, 203–210.
14. Ogbeuwa, I.P.; Odoemenam, V.U.; Omede, A.A.; Durunna, C.S.; Emenalom, O.O.; Uchebugu, M.C.; Okoli, I.C.; Iloje, M.U. Livestock waste and its impact on the environment. Sci. J. Res. 2012, 1, 17–32.
15. Batalla, I.; Knudsen, M.T.; Mogensen, L.; Hierro, Ó.; Del Pinto, M.; Hermansen, J.E. Carbon footprint of milk from sheep farming systems in Northern Spain including soil carbon sequestration in grasslands. J. Clean. Prod. 2015, 104, 121–129. [CrossRef]
16. Buratti, C.; Fantozzi, F.; Barbanera, M.; Lascano, E.; Chiorri, M.; Cecchini, L. Carbon footprint of conventional and organic beef production systems: An Italian case study. *Sci. Total Environ.* 2017, 576, 129–137. [CrossRef] [PubMed]

17. Le Gal, P.Y.; Dugué, P.; Faure, G.; Novak, S. How does research address the design of innovative agricultural production systems at the farm level? A review. *Agric. Syst.* 2011, 104, 714–728. [CrossRef]

18. FAO. Improved Manure Management Towards Sustainable Agri-Food Systems. Food and Agriculture Organization of the United Nations. 2019. Available online: https://unfccc.int/sites/default/files/resource/Keynote_2019120220COP25FAOKoronivia-version3.pdf (accessed on 27 July 2020).

19. Ramachandra, T.V. Soil and Groundwater Pollution from Agricultural Activities; Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore: New Delhi, India, 2011.

20. Wojtaszczyk, B. Produkcja Zwierząt Wczoraj, Dziś i Jutro. Farmer.pl 2016. Available online: https://www.farmer.pl (accessed on 11 December 2019).

21. FADN. Standard Results 2018 Obtained by Agricultural Holdings Participating in the Polish FADN. Part I; Standard Results: Warsaw, Poland, 2019.

22. Eurostat. Greenhouse Gas Emission Statistics-Emission Inventories. Statistics Explained. 2020. Available online: https://ec.europa.eu/eurostat/statistics-explained (accessed on 22 May 2020).

23. Jabłońska, L.; Olewnicki, D. The Willingness of Fruit and Vegetables Sector for the Implementation of Integrated Pest Management. *Rocz. Nauk. Ser. Agro. PAAA* 2014, 16, 92–98.

24. Gaj, R. Effect of Diversified Phosphorus and Potassium Fertilization on Plant Nutrition at the Stage of Initial Main Shoot Development and the Yield and Oil Content in the Seeds of Winter Rapeseed. *Acta Sci. Pol. Agric.* 2011, 10, 57–68.

25. Rae, Z.H.A. On Evaluating the Effect of Soil Treatment and Fertilizer on the Cultivation of Grain Crops. *J. Agric. Aquac.* 2019, 1, 1–5.

26. Herliana, O.; Harjoso, T.; Anwar, A.H.S.; Fauzi, A. The Effect of Rhizobium and N Fertilizer on Growth and Yield of Black Soybean (*Glycine* max (L) Merrill). Iop. *Conf. Ser. Earth Environ. Sci.* 2019, 255. [CrossRef]

27. Jankowiak, J.; Bienkowski, J.; Holka, M.; Dabrowicz, R.; Chudzinski, Z. Chemical Plant Protection and Its Environmental Impact Under Conditions of Resowing after Frost Killing of Winter Crops. *Infrastruct. Ecol. Rural. Areas* 2013, 2, 45–59.

28. Miszczysz, M.; Plonka, M.; Stobiecki, T.; Kronenbach-Dylong, D.; Waleczek, K.; Weber, R. Official control of plant protection products in Poland: Detection of illegal products. *Environ. Sci. Pollut. Res.* 2018, 25, 31906–31916. [CrossRef]

29. Meyer, R. Jak wyżywić 10 miliardów ludzi? Rozwiązania technologiczne. *Hodowla roślin i innowacyjne rolnictwo. Sci. Technol. Options Assess.* 2013. [CrossRef]

30. Elliott, J.A. *An Introduction Sustainable Development*, 4th ed.; Taylor & Francis Group: London, UK; New York, NY, USA, 2013.

31. Kata, R.; Kusz, D. Barriers to the Implementation of Instruments Assisting Sustainable Development of Agriculture. *Sci. Pap. Ser. Manag. Econ. Eng. Agric. Rural Dev.* 2015, 15, 239–248.

32. Conway, G.R. Agroecosystem analysis. *Agric. Adm.* 1985, 20, 31–55. [CrossRef]

33. UNEP. Sustainable Agriculture and the Sustainable Use of Agricultural Biodiversity: Concepts, Trends and Challenges. *Convention on Biological Diversity.* 2010. Available online: https://www.cbd.int/doc (accessed on 14 February 2020).

34. Mebratu, D. Sustainability and Sustainable Development: Historical and Conceptual Review. *Environ. Impact Asses Rev.* 1998, 18, 493–520. [CrossRef]

35. Tilman, D.; Cassman, K.G.; Matson, P.A.; Naylor, R.; Polasky, S. Agricultural sustainability and intensive production practices. *Nature* 2002, 418, 671–677. [CrossRef]

36. Earles, R.; Williams, P. Sustainable Agriculture: An Introduction. A Publication of ATTRA, the National Sustainable Agriculture Information Service. 2005. Available online: www.attra.ncat.org (accessed on 12 June 2020).

37. Očaji, J. Sustainable Agriculture in the UK. *Environ. Dev. Sustain.* 2005, 7, 253–270. [CrossRef]

38. Jones, S.; Gibbon, P. Developing Agricultural Markets in Sub-Saharan Africa: Organic Cocoa in Rural Uganda. *J. Dev. Stud.* 2011, 47, 1595–1618. [CrossRef]

39. Beuchelt, T.D.; Zeller, M. Profits and poverty: Certification’s troubled link for Nicaragua’s organic and fairtrade coffee producers. *Ecol. Econ.* 2011, 70, 1316–1324. [CrossRef]
40. Jena, A.; Biswas, P.; Saha, H. Advanced Farming Systems in Aquaculture: Strategies to Enhance the Production. *Innov. Farming* 2017, 2, 84–89.

41. Valkila, J. Fair Trade organic coffee production in Nicaragua—Sustainable development or a poverty trap? *Ecol. Econ.* 2009, 68, 3018–3025. [CrossRef]

42. Kilian, B.; Jones, C.; Pratt, L.; Villalobos, A. Is sustainable agriculture a viable strategy to improve farm income in Central America? A case study on coffee. *J. Bus. Res.* 2006, 59, 322–330. [CrossRef]

43. Fleming, A.; Vanclay, F. Farmer responses to climate change and sustainable agriculture. A review. *Agron. Sustain. Dev.* 2010, 30, 11–19. [CrossRef]

44. Stockdale, E.A.; Lampkin, N.H.; Hovi, M.; Keatinge, R.; Lennartsson, E.K.M.; Macdonald, D.W.; Padel, S.; Mustafa, G.; Latif, I.A.; Bashir, M.K.; Shamsudin, M.N.; Daud, W.M.N. Determinants of farmers’ awareness of climate change. *J. Rural. Stud.* 2011, 27, 1–19. [CrossRef]

45. Tattersall, F.H.; Wolfe, M.S.; Watson, C.A. Agronomic and environmental implications of organic farming systems. *Adv. Agron.* 2001, 261–327. [CrossRef]

46. Kilian, B.; Jones, C.; Pratt, L.; Villalobos, A. Is sustainable agriculture a viable strategy to improve farm income in Central America? A case study on coffee. *J. Bus. Res.* 2006, 59, 322–330. [CrossRef]

47. Sulewski, P.; Golaś, M. Environmental awareness of farmers and farms’ characteristics. *Ecol. Econ.* 2010, 69, 340–348. [CrossRef]

48. Karami, E.; Mansoorabadi, A. Sustainable agricultural attitudes and behaviors: A gender analysis of Iranian farmers. *Environ. Dev. Sustain.* 2009, 11, 461–471. [CrossRef]

49. Ghosh, M.K.; Hasan, S.S. Farmers’ Attitude towards Sustainable Agricultural Practices. *Bangladesh Res. Pub. J.* 2013, 8, 227–234.

50. Šūmane, S.; Kunda, I.; Knickel, K.; Strauss, A.; Tisenkopfs, T.; Riis, I.D.I.; Rivera, M.; Chebach, T.; Ashkenazy, A. Local and farmers’ knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture. *J. Rural. Stud.* 2018, 59, 232–241. [CrossRef]

51. Eckert, E.; Bell, A. Invisible Force: Farmers’ Mental Models and How They Influence Learning and Actions. *J. Ext.* 2005, 43. Available online: http://www.joe.org/joe/2005june/a2.php (accessed on 29 July 2020).

52. Lamarque, P.; Meyfroidt, P.; Nettier, B.; Lavorel, S. How Ecosystem Services Knowledge and Values Influence Farmers’ Decision-Making. *PLoS ONE* 2014, 9, e107572. [CrossRef] [PubMed]

53. Elliott, K.; Toulmin, C.; Williams, S. Sustainable intensification in African agriculture. *Int. J. Agric. Sustain.* 2011, 9, 5–24. [CrossRef]

54. Alonge, A.J.; Martin, R.A. Assessment of the Adoption of Sustainable Agriculture Practices: Implications for Agricultural Education. *J. Agric. Educ.* 1995, 3, 34–42. [CrossRef]

55. Meert, H.; Van Huylenbroeck, G.; Vernimmen, T.; Bourgeois, M.; Van Hecke, E. Farm household survival strategies and diversification on marginal farms. *J. Rural. Stud.* 2005, 21, 81–97. [CrossRef]

56. Alonge, A.J.; Martin, R.A. Assessment of the Adoption of Sustainable Agriculture Practices: The Role of Farm and Farmer Characteristics, Perceptions, and Health Hazards. *Land Econ.* 1998, 74, 114–127. [CrossRef]

57. Meert, H.; Van Huylenbroeck, G.; Vernimmen, T.; Bourgeois, M.; Van Hecke, E. Farm household survival strategies and diversification on marginal farms. *J. Rural. Stud.* 2005, 21, 81–97. [CrossRef]

58. Wojtaszek, Z. Kryteria i mierniki klasyfikacji gospodarstw indywidualnych według kierunk stopni wielostroności produkcji. *Rocz. Nauk. Rol. Ser. G* 1965, 78, 69–98.

59. Hou, B.; Wu, L. Safety impact and farmer awareness of pesticide residues. *Food Agric. Immunol.* 2010, 21, 191–200. [CrossRef]

60. O’Connor, R.E.; Bord, R.J.; Fisher, A. Risk perceptions, general environmental beliefs, and willingness to address climate change. *Risk Anal.* 1999, 19, 461–471. [CrossRef]

61. Traore, N.; Landry, R.; Amara, N. On-farm Adoption of Conservation Practices: The Role of Farm and Farmer Characteristics, Perceptions, and Health Hazards. *Land Econ.* 1998, 74, 114–127. [CrossRef]

62. Story, P.A.; Forsyth, D.R. Watershed conservation and preservation: Environmental engagement as helping behavior. *J. Environ. Psychol.* 2008, 28, 305–317. [CrossRef]

63. Al-Zaidi, A.A.; Elhag, E.A.; Al-Otaibi, S.H.; Baig, M.B. Negative Effects of Pesticides on the Environment and the Farmers Awareness in Saudi Arabia: A Case Study. *J. Anim. Plant. Sci.* 2011, 21, 605–611.
65. Maitah, M.; Zidan, K.; Hodroj, R.; Malec, K. Farmers Awareness Concerning Negative Effects of Pesticides on Environment in Jordan. *Mod. Appl. Sci.* **2014**, *9*, 12–19. [CrossRef]

66. Curry, N.; Kirwan, J. The role of tacit knowledge in developing networks for sustainable agriculture. *Soc. Rural. Sci.* **2014**, *54*, 341–361. [CrossRef]

67. Kloppenburg, J. Social Theory and the De/Reconstruction of Agricultural Science: Local Knowledge for an Alternative Agriculture. *Rural. Sociol.* **1991**, *56*, 519–548. [CrossRef]

68. Hyland, J.J.; Jones, D.L.; Parkhill, K.A.; Barnes, A.P.; Williams, A.P. Farmers’ perceptions of climate change: Identifying types. *Agric. Human. Values* **2016**, *33*, 323–339. [CrossRef]

69. De Olde, E.M.; Oudshoorn, F.W.; Sørensen, C.A.; Bokkers, E.A.; De Boer, I.J. Assessing sustainability at farm-level: Lessons learned from a comparison of tools in practice. *Ecol. Indic.* **2016**, *66*, 391–404. [CrossRef]

70. Tait, J.; Morris, D. Sustainable development of agricultural systems: Competing objectives and critical limits. *Futures* **2000**, *32*, 247–260. [CrossRef]

71. EFSA. Eurobarometr 91.3. Rule of Law, and Climate Change. 2019. Available online: [https://www.efsa.europa.eu/sites/default/files/corporate_publications/files/eurobarometer19/country-factsheets/EB91.3_EFSA_fact_pl_pl.pdf](https://www.efsa.europa.eu/sites/default/files/corporate_publications/files/eurobarometer19/country-factsheets/EB91.3_EFSA_fact_pl_pl.pdf) (accessed on 2 June 2020).

72. Altieri, M.A.; Nicholls, C.I.; Montalba, R. Technological Approaches to Sustainable Agriculture at a Crossroads: An Agroecological Perspective. *Sustainability* **2017**, *9*, 349. [CrossRef]