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Bioeconomy in Romania: Investigating Farmers' Knowledge

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Abstract: The approach of studying the perceptions of Romanian farmers regarding the bioeconomy brings an element of novelty, and the study intends to add value to works in the field. The literature regarding the attitudes of farmers towards the adoption of new bioeconomic practices is quite limited at the European level and even more so in Romania. However, Romania's agricultural potential is recognized nationally and internationally. This article aimed to explore the attitudes of Romanian farmers towards the bioeconomy and to take a step forward in determining a set of scientific actions necessary for the initiation of a national strategy dedicated to the bioeconomy. The quantitative research presented is based on a comprehensive survey. The analysis revealed the role of the bioeconomy in agricultural activities and the expectations of respondents in relation to the main aspects addressed by the concept of bioeconomy. The findings pointed out the contribution of Romanian public institutions in explaining and promoting this complex phenomenon to agricultural workers. The results led to three main conclusions: (i) farmers' attitudes towards the bioeconomy are generally positive, although their knowledge is limited; (ii) public authorities are not sufficiently involved in supporting and promoting the bioeconomy; (iii) the bioeconomy is underfinanced at the national level. The findings draw attention to a great investment potential in the agricultural field that could foster job creation and regional development in Romania. A closer collaboration between researchers, decision-makers, local authorities, and farmers as well as the expansion of technological research are the conditions needed for the development of the bioeconomy in the agriculture of Romania.

Keywords: bioeconomy; sustainable economy; Romania; farmers attitude

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1. Introduction

The bioeconomy is a concept that encompasses activities in several economic sectors. The bioeconomy is based on the use of natural raw materials and environmentally friendly technologies in the economic process of transforming them into finished products [1]. In addition, during the bioeconomic cycle, recycling and reusing finished products is an important step requiring environmentally friendly technologies. All of these shape the sustainable development characteristic of the bioeconomy.

At the same time, the bioeconomy has a substantial socio-economic impact [2,3], as it contributes to the creation of new jobs but also to raising the living standard of the population by increasing the gross value added [4]. The bioeconomy is particularly important for a state's sustainable economic development because it contributes to environmental protection.

There are several views on the bioeconomy worldwide [5,6]; therefore, the European Commission (EC) made an effort to express a unitary point of view on the bioeconomy at the community level and recommended that member states (MS) reorganize their national economies based on bioeconomic principles. To this end, in 2018, the EC updated its 2012 Bioeconomic Strategy, entitled "A sustainable bioeconomy for Europe: strengthening the links between the economy, society and the environment" [7].

In the framework of the 2018 Strategy, the EC identifies the main role of agriculture in the development of the bioeconomy as the supplier of raw materials for biomass

production [8–10]. On the other hand, other researchers believe that agriculture can contribute to the development of the bioeconomy by its ability to mitigate and adapt to climate change, achieve sustainable farming systems, and use efficient and clean technologies [11,12].

International scientific approaches have been carried out in recent years to respond to the need for transition to the bioeconomy in various regions [13–15]. Romania is still in the early stages of its bioeconomy, but it is making progress in this direction. The purpose of this analysis was to determine the Romanian farmers' knowledge of the bioeconomy and their willingness to get involved in it, determine the involvement of decision-makers, as well as to find out whether farmers set annual budgetary amounts directed towards recycling or reuse of agricultural waste from their current activities. The bioeconomy in Romania is a concept that is virtually unknown to the public and to the main actors of the economy in particular. We affirm this in light of the fact that, from the literature studied, the hypothesis has emerged that the notion of bioeconomy is more clearly defined among researchers and specialists in the field than among farmers. Therefore, we aimed to fill this knowledge gap with regards to the contribution of agriculture to the development of the bioeconomy in our country and to help foster the bioeconomic strategy among agricultural workers. We carried out pilot research based on a survey among farmers. The questionnaire aimed to identify the perceptions of the subjects about the bioeconomy, their needs in order to get involved in the bioeconomy, as well as their expectations about their relationships with the Romanian state institutions or the community.

Our research goes beyond a pure theoretical process and aims to reach those who can actively implement the concept in their own activities. Thus, we respond to the specialists' assertion that sustainability is a challenge for the life and activity of the population [16–18]. We go further, stating that the bioeconomy is indeed a challenge for the activity of the population in general, but farmers are certainly more actively engaged in this transformation. The novelty of our study is anchored in approaching those directly involved in the bioeconomy. The farmers are those who participate actively in the implementation and development of agriculture, as the main component sector of the bioeconomy in Romania. The importance of this paper is derived from the need to complete the picture of the bioeconomy situation at the national level, including from the perspective of farmers.

We assessed the situation of the bioeconomy in Romania during a first step by studying the specialized articles in the scientific literature, aiming to achieve a clearer picture of the field from a theoretical perspective. Then, quantitative research, based on the survey, was used to evaluate the perceptions about the bioeconomy among Romanian farmers by including various elements, from basic notions to investments in the field.

Objectives and Research Hypotheses

The quantitative research, based on a self-administered questionnaire, aimed at fulfilling the three major objectives of the paper: researching the level of the bioeconomic knowledge of the farmers in Romania (6 questions), applying the concept of bioeconomy in the current activities of agricultural farms (7 questions), and identifying farmers' characteristics (9 questions).

The research questions we aimed to answer were as follows:

1. Is the concept of bioeconomy known and understood by Romanian farmers?
2. Are the public institutions of Romania perceived as being involved in informing agricultural workers about what the bioeconomy entails?
3. What are the expectations of Romanian farmers from a bioeconomic perspective and what are the institutions from which they have these expectations?
4. Do Romanian farmers know how important the role and contribution of the bioeconomy are to the economic development of the country?
5. Do Romanian farmers invest in the recycling and reuse of agricultural waste to contribute to the development of the bioeconomy?

6. What are the education level, age, and area of residence of the subjects? This information was used to paint a picture of the capacity to implement the bioeconomy in the medium- and long-term in Romania.
7. Are there differences in bioeconomic knowledge or understanding of the concept, depending on farmers' characteristics?

To achieve the stated objectives, we formulated the following research hypotheses:

- The level of knowledge of the bioeconomy at the level of Romanian agricultural workers:

Hypothesis 1 (H1). *Romanian farmers know and understand the term bioeconomy by associating it with common notions in the field.*

Hypothesis 2 (H2). *Romanian state institutions are involved in informing agricultural workers about the bioeconomy.*

Hypothesis 3 (H3). *Romanian farmers expect a closer collaboration with decision-makers in the agricultural field from a bioeconomic perspective.*

- Application of the bioeconomy concept in the current activities of agricultural farms:

Hypothesis 4 (H4). *The role and contribution of the bioeconomy to the economic development of Romania are considered to be very important by agricultural workers.*

Hypothesis 5 (H5). *Romanian farmers invest in the recycling and reuse of agricultural waste to contribute to the development of the bioeconomy.*

- Identifying farmers' characteristics:

Hypothesis 6 (H6). *Romanian farmers have higher level education.*

Hypothesis 7 (H7). *Farmers are aged between 30 and 65 years and come from rural areas.*

Through the quantitative research, we wanted to detail the situation of the bioeconomy in Romania among agricultural workers at the national level, and to investigate their desire to realize a strategy dedicated to the bioeconomy in Romania. To this end, we needed to identify the characteristics of farmers and analyze their perceptions and approach to the principles underlying this economic field. This research is a step towards the set of scientific actions that can contribute to the initiation and debate of a strategy dedicated to the bioeconomy in Romanian society, and even more importantly, in the agricultural sector.

Our paper follows the directions targeted by other Romanian researchers who initiated analyses on the specificities of agriculture in Romania from a bioeconomic perspective [19–21]. However, the previous works of specialists did not present or detail the specific characteristics of farmers in Romania, including how they perceive or approach the phenomenon of the bioeconomy. Therefore, we believe that our analysis provides an element of novelty that will be useful for future agricultural policies in our country focusing on the bioeconomy. The information provided by our inquiry is even more useful since Romania's full agricultural potential is yet untapped.

2. Literature Review

The theoretical definition of the term bioeconomy given by the EC in the 2012 and 2018 strategies is not sufficient. There is still a lack of clarity that prevails in the scientific literature regarding the role, contribution, and implementation of the bioeconomy in the current socio-economic context [21–23].

The bioeconomy is a final field of transition from economic sectors based on fossil fuels to renewable ones [24]. In recent years, research has been predominantly focused on the theoretical side of the issue. The effects of climate change, the dependence of agriculture on weather conditions, deforestation, and soil pollution are determining factors of a more

active and concrete approach to ecological agriculture [12,25,26]. Organic farming can be the catalyst towards a circular bioeconomy and a reorientation of investors towards a new economy of the future [27,28]. Panait and Cucu [25] believe that, in the short- and medium-term, emphasis must be placed on protection of the environment and natural resources, so that the development of the agricultural sector takes into account the impact on the environment both within agricultural activities and throughout the agri-food supply chain.

As a supplier of food and biomass, agriculture is a sector of paramount importance for development of the bioeconomy. The bioeconomy seeks economic growth and job creation by applying biological and physical laws to the production and use of natural resources, thus providing environmentally sustainable goods and services [29]. This goal can be achieved in the rural economy if sustainable agricultural practices are used. As the agricultural sector expands, the benefits to the local and rural economies are substantial and lead to better living conditions and lifestyles for people [30]. Agriculture plays key roles in economic development, food security, poverty reduction and well-being at the regional level [31]. The benefits are especially greater in rural areas, where resources are not fully exploited [32].

At the level of European Union (EU) institutions, the bioeconomy is dealt with in official documents and strategies, but the education process of those involved in activities specific to the component sectors is not taken into account [19]. Although strategies are developed to achieve a better economic, social, and climatic environment in order to meet the needs of the population and foster regional, national, and global development, the role of farmers and citizens, in general, has been overlooked [33].

The efforts of the academic community in recent years have focused on comparisons between EU MS in many respects, but especially on environmental issues [34–36]. Bubanic and Detelj [37] carried out a cluster analysis on budgetary allocations for research and development and revealed severe gaps in innovation efficiency between EU MS. Similar results have highlighted disparities between bioeconomic sectors in Romania and groups from other developed EU countries [38]. Nowak et al. [4] and Pișțalu and Chirescu [39] showed that Romania has a large untapped potential regarding the contribution of agriculture to the bioeconomy in the EU relative to other MS. Morone et al. [40] found that agriculture prevailed as a socio-economic indicator for the bioeconomy and Romania led the MS in this regard.

Research papers that have addressed farmers' perceptions about the bioeconomy are quite scarce worldwide. Rodino, Butu A. and Butu M. [19] argued that bioeconomy is an abstract and undervalued concept. Of those who heard or understood the concept, more than 80% associated the bioeconomy with agriculture. After being introduced to the concept, respondents in the authors' sample of 92 considered the bioeconomy to be very important (25%) and important (20%) [19]. Polimeni et al. [41] showed that understanding farmers' attitude towards bioeconomic policies determined a higher level of environmental protection, reduced vulnerabilities to climate change, and diminished difficulties in rural and regional development. At the level of the EU, farmers are more skeptical about the new economic model that the bioeconomy implies compared to other social categories, but they associate the term with the sustainability of consumption [24], environmental protection [22], and food safety [42].

From the analysis of the literature, we found that the concept of bioeconomy in correlation with agriculture was very briefly treated in Romania and almost unknown at the level of agricultural farms in the country. In Romania, only a few regional agencies include the term bioeconomy in strategies regarding intelligent specialization as an existing field at the level of innovation and technological exchange companies formed within universities, research centers, public institutions, and private companies [31,43–47]. In Romania, the main actors of the agricultural sector, farmers, small and medium-sized enterprises, working units with medium capitalization, and agricultural associations are insufficiently supported and underfinanced [48].

In this context, we started this pilot project to find out the perceptions of Romanian farmers about the bioeconomy and to facilitate the connection between them and state institutions. The literature regarding the attitudes of farmers towards the adoption of new practices enforcing the bioeconomy concept is quite limited at the European level and even more so in Romania [49].

3. Materials and Methods

3.1. Sampling Procedure and Data Collection

This research methodology was based on a sample consisting of 101 respondents who benefited from a self-administered questionnaire with 22 questions. According to the Taro Yamane formula [50–52], the representativeness of the sample was calculated as follows:

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

where n is the sample size, N is the population size, and e is the margin of error.

$$n = \frac{15{,}541}{1 + 15{,}541 * 0.1^2} = 99.36 \quad (2)$$

We applied the formula to a statistical population N = 15,541, used a 10% error margin, and we obtained a representative sample size of 99 people. Therefore, the 101 sample was valid for the purpose of the study, at a 90% confidence level. We used a simple random sampling technique [53]. Because of data scarcity, we constructed our sample framework based on the total number of active local agricultural units in Romania [54]. We resorted to the simple random sampling technique, and we contacted one representative of each agricultural unit for which we had access. The sample intensity computed by dividing our sample by the total population was 0.65%.

The questionnaire data preparation, distribution, and analysis stages took place between November 2021 and June 2022. The questionnaires were completed online and face-to-face.

The stages of research are revealed in Table 1.

Table 1. Gant diagram of the research stages.

Activity	Time (Month)							
	1	2	3	4	5	6	7	8
The preparatory phase of research								
Pre-testing								
Online transmission								
Distribution face-to-face								
Centralization and interpretation of results								

Green bars represent the research stages by month.

3.2. Questionnaire Development

The elaboration of the questionnaire took into account the perception, understanding, and evaluation of the concept of bioeconomy [19], based on the model developed by the EC in Eurobarometer 501 from 2020 [21,55,56]. Based on scientific papers [57,58], we argue for the usefulness of this quantitative research in determining the agricultural workers' perceptions about the bioeconomy, which materialized during the collection and analysis of the data after the questionnaire was developed and distributed. We relied on secondary sources for the structure of the Eurobarometer questionnaire; hence, it was the closest in scope to our research hypotheses. Additionally, we drew on the results and conclusions of the existing works [57,58] on closely related topics to argue the necessity of our approach.

When drawing up the questionnaire, we considered the optimal number of questions to cover the ample range of research questions to which we set out to find the answers. Additionally, another important element in elaborating the questionnaire was the time

allocated to the respondents to complete the questionnaire. All of this led to the elaboration of a questionnaire with 22 mixed questions, with an estimated time of completion of ten minutes. In addition, respondents were informed that the results would be anonymous and used only for scientific purposes, and the questions did not contain personal information.

The research methodology was based on univariate and bivariate descriptive analyses of the variables for verifying the declared research hypotheses. Therefore, the first step of the systematic statistical study consisted of preparing the data in SPSS software (IMB SPSS Statistics 20): identification of variables, data definition, cleaning, recoding, creation of new variables, etc.

The research tool included a total of 22 questions (associated variables were noted with Q), out of which nine were about identification: age (variable Q22), gender (variable Q21), higher studies in agriculture (Q20), level of study (Q19), place of activity (variable Q18), residential environment (variable Q17), occupation (variable Q17), and number of employees in the economic unit in which the activity is carried out (variable Q16). The questions were closed and dichotomous with single or multiple answers. For example, out of the 22 questions (Supplementary Materials), only seven had the option of an open answer: 'What term do you associate bioeconomy with?', 'Have you allocated part of your investment budget for the reuse or recycling of the agricultural waste in your activity? If the answer is yes, please specify the average annual amount', 'What is the type of agricultural enterprise in which you operate?', 'What is your occupation?', 'Please specify where you work', and 'Do you have any studies in specific fields of agriculture?'.

The statistical research was based on sample characteristics and reliability testing of scales. In the first stage, we performed descriptive analysis to verify the situation of the sample for the variables of profile identification of the respondents. The researched information was related to the type of agricultural enterprise in which they operate (variable Q14), the number of employees in the working unit of the respondent (variable Q15), occupation (variable Q16), residence (variable Q17), locality (including classification by regions at NUTS 2 level) (variables Q18 and Q18_recode), level of education (variable Q19), agricultural studies (variable Q20_recode), gender (variable Q21), and age (variable Q22). All of these variables were nominal and were coded according to how many response options were given.

According to theoretical practice [19,59–61], we used descriptive analysis to analyze the characteristics of the sample. For the nominal variables, the absolute and relative frequencies are presented in Table A1 (Appendix A).

To study the homogeneity and degree of asymmetry of the variables that characterized the sample, we calculated the coefficient of variation C_v [62], according to the following formula:

$$C_v = \frac{s}{\widetilde{x}} * 100 \quad (3)$$

where: s—standard deviation, $\widetilde{x}$—arithmetic average.

3.3. Study Area

The survey took place in Romania, exclusively within the country's borders. Romania is a country in southeastern Europe, with an approximate population of 19 million people [63]. Romania has a total surface of 24 million ha, of which 14.6 million ha represent agricultural land [64]. Romania is located in a continental climatic zone and benefits from a surface that includes varied landforms, which provides a significant agricultural potential.

At the level of development regions (Nomenclature of Territorial Units for Statistics-NUTS 2) in Romania, the geographical distribution of the absolute and relative frequencies of the respondents (Q18_recode) is highlighted in Figure 1. Figure 1 shows that the highest relative frequencies of respondents were from the South-Muntenia region (28.7%) and the West (26.7%), in areas with landscape characteristics suitable for the agricultural sector.

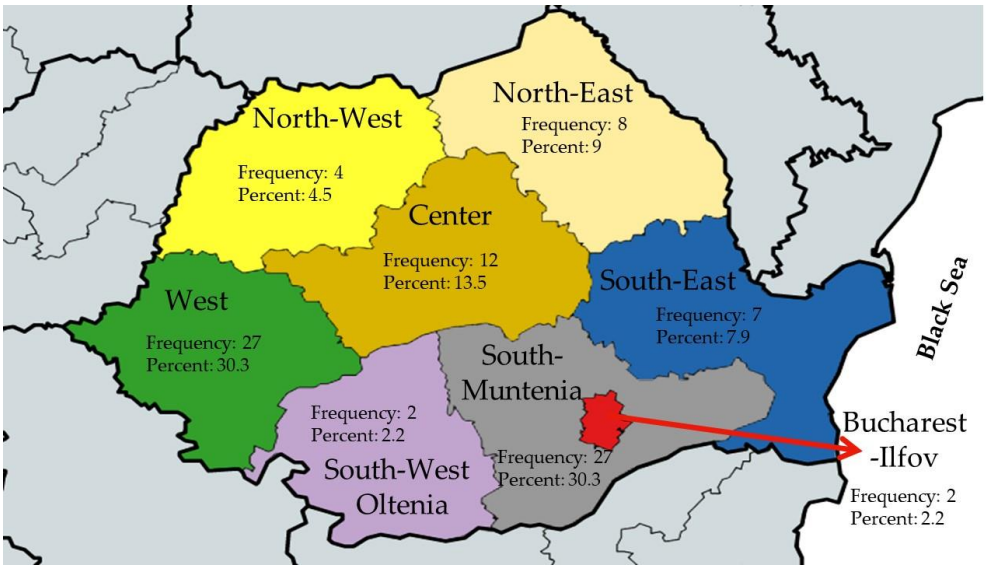

Figure 1. Regional distribution of respondents in Romania (coordinates 45.9432° N, 24.9668° E).

The demographic and socioeconomic characteristics of the sample are also provided in Appendix A Table A1. The surveyed people lived mainly in rural areas, which is typical for agricultural endeavors.

3.4. Variables and Their Measurement

The first two questions referred to the knowledge of responders about the term bioeconomy and its eventual association with another more usual word in the current language: 'Have you heard about bioeconomy?' (Q1) and 'What term do you associate the bioeconomy with' (Q2).

Question 3 concerned the knowledge of responders about the official documents issued by the Romanian authorities that made reference to the term bioeconomy. The question had several answer options, from which the respondents could select multiple options. The question was broken down into five official documents that were the most relevant from the point of view of the bioeconomy in Romania: 1. "Strategy for the development of the agri-food sector on the medium and long term 2020–2030"; 2. Romania's National Strategy 2020–2025; 3. National Research, Development and Innovation (RDI) Strategy 2014–2020; 4. The project "Research on the identification of bioeconomy development priorities in Romania for 2016–2030"; and 5. "Increasing the administrative capacity of the Ministry for the Business Environment, Trade and Entrepreneurship to develop and implement the evidence-based public policy system-SIPOCA 5". The response options were dichotomous 'I heard of' and 'I did not hear of', and each option was considered a variable (Q3.1, Q3.2, Q3.3, Q3.4, and Q3.5). The categories of each variable were turned into 'Yes' and 'No'.

Since each question had several items, we first tested the reliability of the scale by using Cronbach's alpha coefficient. Its value was 0.617 with all items included, and when excluding one item at a time, the value of the coefficient dropped below 0.6. Therefore, we decided to keep all of the items, despite the lower reliability of the scale.

Question 5: 'Do public institutions in Romania get involved in explaining bioeconomy to agricultural workers?'. For Question 5, the answer options were grid-type: 'Yes, I was informed'; 'Yes, but I don't know the details'; 'No, I was not informed'; 'Don't know/Don't answer'.

Question 10 used a Likert scale to answer the following statement: 'Regarding the role of the bioeconomy in the economic activity of Romania, how do you assess the importance of the following: the involvement of public institutions in the implementation of the bioeconomy; a closer connection between specialists and farmers; informing farmers about how to create a symbiosis between agriculture and the bioeconomy?'. The response options

were: 'unimportant', 'slightly important', 'moderately important', 'important', and 'very important'. When testing the reliability of the scale, the alpha coefficient value was 0.901 (>0.7), which showed a high reliability of the measurement scale. Question 10.1 referred to the involvement of public institutions in Romania in the implementation of the bioeconomy. Respondents were asked to rate how important this aspect was from their point of view. The scale-type variable (Q10.1) had several answer options, from which the respondent could choose only one. Question 10.3 referred to the degree of importance of informing farmers regarding the link between agriculture and the bioeconomy.

Question 13 aimed to identify the institutions or private investors from Romania and the EU considered by respondents to be responsible for funding the bioeconomy field in Romania. The question had several answer options, from which the respondent could select more than one option. The question was divided into four answer options, respectively: 1. The public authorities in Romania; 2. European Commission; 3. Romanian private investors; and 4. Foreign private investors. The response options were dichotomous, and each response option transformed into a variable (Q13.1, Q13.2, Q13.3, and Q13.4). The categories of each variable were coded with 'No' (0) and 'Yes' (1).

Questions 4 and 6 referred to the importance of agriculture, as considered by respondents, as a component of the bioeconomy (variable Q4), as well as the importance of the bioeconomy to Romania's economy (variable Q6). The answers to both questions were scale-type, and the respondents could opt for one of five options: 'unimportant', 'slightly important', 'moderately important', 'important', and 'very important'.

Before testing the degree of association between the two variables, the reliability of the scale was checked through the value of Cronbach's alpha coefficient, which was 0.738 (>0.7). In the case of metric variables, Q4 and Q6 respectively, values of the Pearson coefficient were used to identify the level of correlation between them.

The questionnaire included a set of three questions regarding the role of the bioeconomy in the Romanian economy. Question 7 inquired about the respondents' opinions regarding some aspects of the bioeconomy and included seven elements of primary interest on the perceptions Romanian farmers about the role and contribution of the bioeconomy to the economy and social life of the population. The seven subjects had dichotomous responses and are reproduced in the Supplementary Materials.

For the statistical analysis of the data, given the large number of items that made up question 7, we investigated the reliability of the scale to verify the consistency of the measurement tool used. The general value of Cronbach's alpha coefficient was 0.897, and the values were above 0.8 for all items of the construct. The parameter analysis showed good scale reliability (Cronbach's alpha > 0.7) for all seven items (0.897). Additionally, the correlation coefficient indicated a large and positive connection between the variables, with $r^2 \in [0.6;0.8]$. These results showed that the answer options to the question were suitably chosen and exhibited a significant connection between them.

Question 11 of the questionnaire intended to find the opinions of the respondents in relation to the contribution of the bioeconomy to the economic development of Romania. The answers were scale-type, and the respondents could opt for one of five options: 'not at all', 'very little', 'little', 'moderately', and 'a lot'.

Question 12 of the questionnaire was open-ended and asked respondents to state whether they allocated part of the investment budget to the reuse or recycling of agricultural waste. In the case of an affirmative answer, they were asked to specify the average monthly amount. The items in the list were transposed into a dichotomous variable, with two categories: 'Yes' and 'No'.

We formulated the following null hypotheses:

(H_{01}): *There are no statistically significant differences between variables Q12 and Q22;*

(H_{02}): *There are no statistically significant differences between variables Q12 and Q20_recode.*

The alternative hypotheses had the following statements:

(H_{11}): *Farmers allocate amounts of money for recycling/reuse of agricultural waste according to age (Q22_recode);*

(H_{12}): *Farmers allocate amounts of money for recycling/reuse of agricultural waste according to completion of specialized studies in the field of agriculture (Q20_recode).*

The survey included two questions regarding the characteristics of the agricultural unit in which each person operated: enterprise type (variable Q14) and numerical range of employees (variable Q15). Question 14 was 'What is the type of agricultural enterprise in which you operate?' and the answers were semi-closed with the following answer options: 'Vegetable farm', 'Livestock farm', 'Mixed farm (vegetable and animal breeding)', 'Agricultural processing unit', 'Rural household', and 'Other'. Most of the survey participants worked in rural households (35.6%), on vegetable farms (19.8%), and on mixed farms (13.9%). For Question 15, 'How many employees are there in the agricultural unit you work in?', the answers were scale-type and had response options for the intervals: 0–50, 51–100, 101–250, and over 250 employees.

Question 16 (variable Q16) had the following statement: 'What is your occupation?' and the answers were semi-closed. Respondents could opt for one of the options: 'Member of an agricultural association', 'Farmer', 'Householder', 'Seasonal employee in agriculture', and 'Other'. In addition to the level of education (variable Q19), we considered it necessary to find out if the respondents had completed specialized studies in the field of agriculture. Therefore, question 20 was 'Do you have studies in fields specific to agriculture?'. The answer options were as follows: 'Agricultural high school', 'Faculty of Agronomy', 'Specialization courses in the field of agriculture', and 'No, I do not have agricultural studies'. For the option, 'Other', the respondents were free to add another form of professional training. In the descriptive analysis, the affirmative answers were compiled into a single answer, and the variable Q20 was recoded with only two types of answer 'Yes, I have specialized studies in the agricultural field' or 'No, I do not have specialized studies in the agricultural field' (Q20_recode). Questions 21 and 22 referred to the gender of the people participating in the survey (Q21), as well as their age range (Q22). Question 17 (Q17) referred to the residential environment of the respondents. The answers were dichotomous: 'Urban' and 'Rural'.

3.5. Data Analysis

The descriptive statistics of the sample distribution by region, residence, age, and gender are given in Table 2.

Table 2. Descriptive statistics of the sample distribution.

		NUTS 2	**Residence**	**Age**	**Gender**
N	Valid	101	101	101	101
	Missing	0	0	0	0
Std. Deviation		1.909	0.434	0.928	0.492
Variance		3.645	0.188	0.861	0.242
Skewness		0.198	1.188	−0.421	0.432
Kurtosis		−0.832	−0.602	−0.166	−1.851

The full sample included 101 valid observations for the studied characteristics. For the most part, the series met the conditions of normal distribution. The values for Skewness and Kurtosis of all four characteristics considered fell within the typical ranges of the Gaussian bell curve. We noticed a slight right Skewness of the residence distribution and a leptokurtic tendency of the gender distribution. However, the values were within the customary limits for a sound statistical inference.

4. Results

Below we present the results of the data analysis with related comments for each question in the questionnaire.

4.1. Knowledge and Understanding of the Term Bioeconomy among Romanian Agricultural Workers

The answers to question 1 were unanimously affirmative, which led the respondents to move on to the following questions and complete the questionnaire in its entirety. The question was transposed into SPSS (IMB SPSS Statistics 20) as a nominal variable (Q1).

Most of the respondents associated the term bioeconomy with natural resources (25) and biodiversity (24) (Figure 2). The perception was derived from the fact that misunderstanding of the term bioeconomy led to a direct association with nature and its constituent elements. This correlation was also observed by other researchers [65–67] in scientific works developed for different regions of Poland and Slovakia.

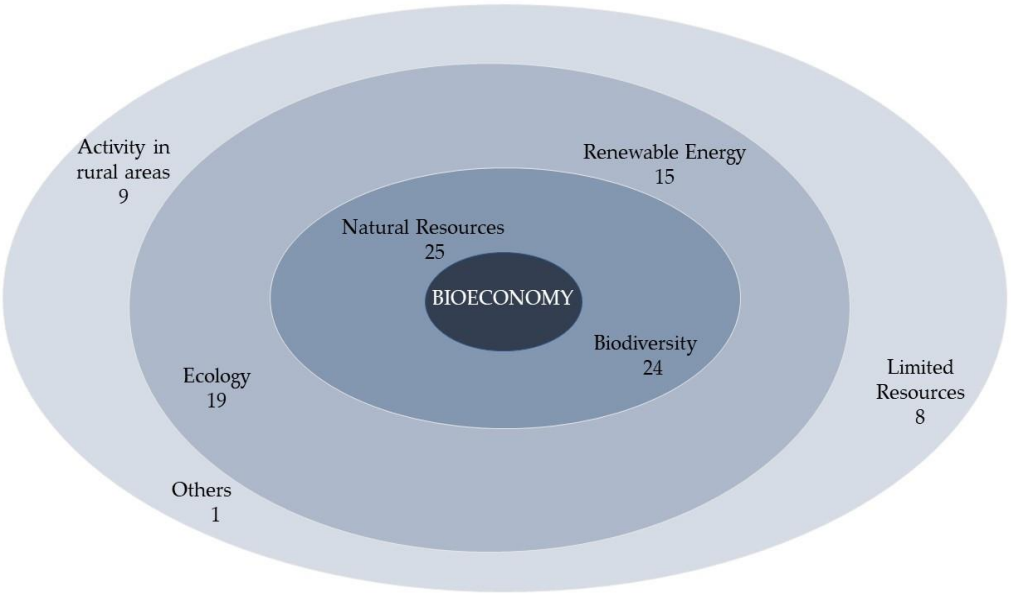

Figure 2. Associations of the term bioeconomy with environmental elements.

A relevant element that drew attention was that those who associated the term bioeconomy with natural resources and biodiversity came mostly from rural areas (79.17%), and in terms of age, 39.47% of them were aged 35–49 years and 31.58% were aged 50–64 years. Additionally, the results confirmed the research hypothesis (H1), according to which Romanian farmers knew and understood the term bioeconomy and associated it with common notions in their main field of activity or related activities.

4.1.1. Involvement and Support from Public Authorities

As Table 3 reveals, none of the documents specified as being issued by the Romanian authorities in which reference was made to the term bioeconomy were known to the majority of respondents. In addition, the relative frequency of survey respondents who answered that they had heard of all five official documents referring to the bioeconomy was 6.93%.

Table 3. Answers regarding knowledge of the official documents issued by the Romanian authorities using the term bioeconomy.

		Answer Variants	I Heard of	I Did Not Hear of
			Percent	
Valid	Q3.1	Strategy for the development of the agri-food sector on the medium and long term 2020–2030	50.5	49.5
	Q3.2	Romania's National Strategy 2020–2025	51.5	48.5
	Q3.3	National RDI Strategy 2014–2020	47.5	52.5
	Q3.4	The project "Research on the identification of bioeconomy development priorities in Romania for the period 2016–2030"	23.8	76.2
	Q3.5	Increasing the administrative capacity of the Ministry for the Business Environment, Trade and Entrepreneurship to develop and implement the evidence-based public pol-icy system"-SIPOCA 5	31.7	68.3
		All variants	6.93	93.07

As shown by the data in Table 4, most respondents did not consider that they were informed by state institutions about the term bioeconomy (64.4%), and among those who gave an affirmative answer, almost 15% did not know the details.

Table 4. The respondents' opinions about the explanations of the term bioeconomy given by state institutions.

	Answers	Frequency	Percent	Valid Percent
Valid	No, I was not informed	65	64.4	77.4
	Yes, but I don't know the details	15	14.9	17.9
	Yes, I was informed	4	4.0	4.8
	Total	84	83.2	100.0
Missing	I don't know/ I don't answer	17	16.8	
	Total	101	100.0	

The results obtained for questions 3 and 5 led us to the hypothesis that the interdependence between the decision-makers and those to whom the documents are issued by the state institutions is almost non-existent. To verify this research hypothesis, we resorted to correlating the answers from question 3 with those from question 5. In relation to the selected documents, the respondents did not think that the representatives of the state institutions explained the term bioeconomy to them. From the analysis of the correlation table (Table 5), the frequency of responses (count) differed significantly from the predicted ones, which represented the theoretical responses (expected count). Those who did not consider themselves informed represented the respondents who had not even heard of any of the official documents issued by the Romanian authorities referring to the bioeconomy.

The frequency distribution regarding the importance of the involvement of public institutions in Romania in the implementation of the bioeconomy (Figure 3) showed that the majority (78.2%) of respondents considered this involvement to be very important and important.

Table 5. Correlation between knowledge of official documents and information from state institutions on the notion of bioeconomy.

				Did Public Institutions Explain the Term Bioeconomy to You?			Total
				No, I Was Not Informed	Yes, but I Don't Know the Details	Yes, I Was Informed	
Which documents have you heard of?	Q3.1	I never heard of	Count	34	5	1	40
			Expected Count	31.0	7.1	1.9	40.0
		I heard of	Count	31	10	3	44
			Expected Count	34.0	7.9	2.1	44.0
	Q3.2	I never heard of	Count	32	5	1	38
			Expected Count	29.4	6.8	1.8	38.0
		I heard of	Count	33	10	3	46
			Expected Count	35.6	8.2	2.2	46.0
	Q3.3	I never heard of	Count	36	6	2	44
			Expected Count	34.0	7.9	2.1	44.0
		I heard of	Count	29	9	2	40
			Expected Count	31.0	7.1	1.9	40.0
	Q3.4	I never heard of	Count	52	9	0	61
			Expected Count	47.2	10.9	2.9	61.0
		I heard of	Count	13	6	4	23
			Expected Count	17.8	4.1	1.1	23.0
	Q3.5	I never heard of	Count	44	11	1	56
			Expected Count	43.3	10.0	2.7	56.0
		I heard of	Count	21	4	3	28
			Expected Count	21.7	5.0	1.3	28.0
		Total	Count	65	15	4	84
			Expected Count	65.0	15.0	4.0	84.0

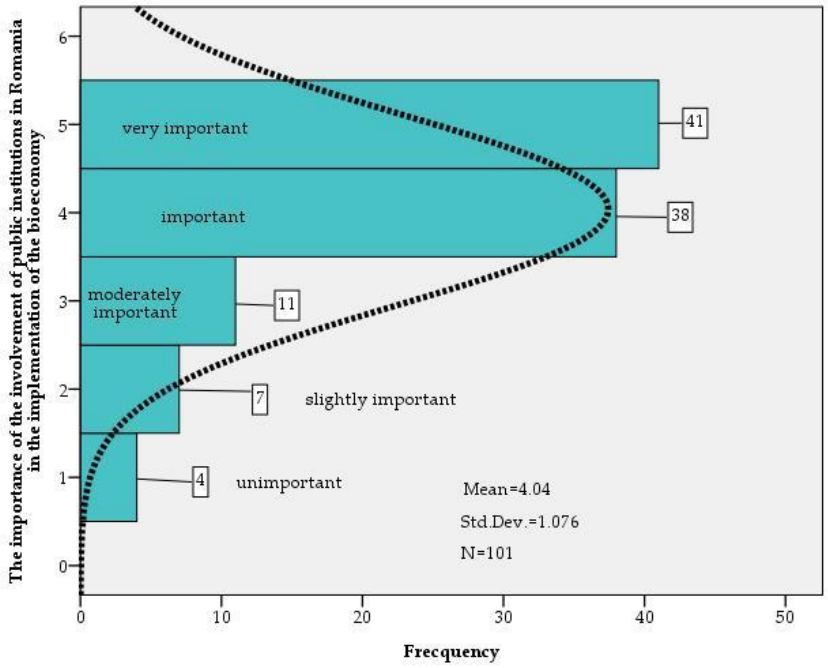

Figure 3. Frequency histogram of the importance of the involvement of public institutions in Romania in the implementation of the bioeconomy.

As shown in Figure 4, 65% of the respondents considered it to be very important to inform farmers about the relationship between agriculture and the bioeconomy, only 22% considered it to be important, and the rest believed that this information had a reduced importance (14% of the respondents).

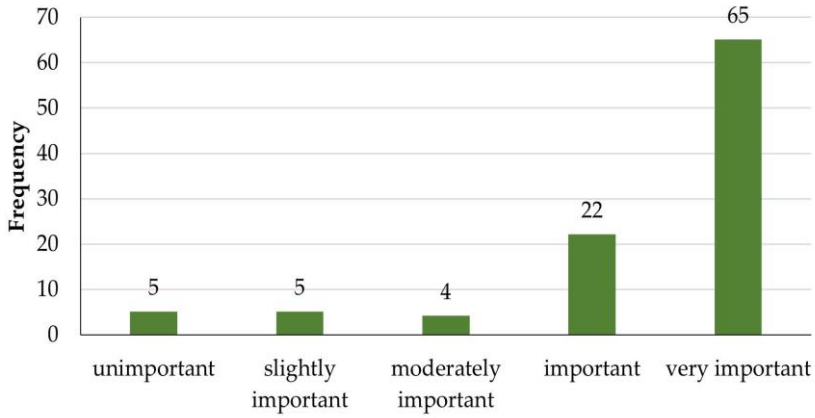

Figure 4. The importance of informing farmers about the link between agriculture and the bioeconomy.

Question 10.1 could be correlated with question 10.3, which referred to the degree of importance of informing farmers about the link between agriculture and the bioeconomy. They were of the same type and had similar answer options. The reliability of the scale was verified, the value of Cronbach's alpha coefficient being 0.703. In order to test the level of correlation between the two questions, the descriptive analysis used the Pearson correlation coefficient to determine the level of association between two metric variables. The value of this coefficient was 0.773 (>0), which meant that there was a convergent validity between the two variables; the correlation was direct and of medium to high intensity. There was a strong link between the two measured variables, as the *p*-value (Sig 2-tailed) was 0.000 at a significance level of 99% (Table 6).

Table 6. The intensity of the correlation between the importance of the involvement of public institutions in Romania in the implementation of the bioeconomy and informing farmers about the relationship between agriculture and the bioeconomy.

Indicator/Variable	Q10.1	Q10.3
Pearson Correlation	1	0.773 **
Sig. (2-tailed)		0.000
N [1]	101	101

[1] The number of observations. ** Correlation is significant at the 0.01 level (2-tailed).

The results showed that 76.2% of the respondents considered that the bioeconomy must be financed by the Romanian public authorities and 60.4% thought it should be financed by the European Commission. Out of the 101 people interviewed, only 30% believed that Romanian investors need to get involved in the national bioeconomy and 18% expected investments from foreign private individuals.

We can state that most of the respondents believed that public institutions in Romania and the EU must finance the bioeconomy in our country. Most respondents who had expectations from the two public forums belonged to the 35–49 and 50–64 age groups and came from rural areas (Table 7).

Table 7. Correlation between the age and residential environment of the respondents in their responses regarding the sources of financing for the bioeconomy in Romania.

Variable		The Public Authorities in Romania		European Commission		Romanian Private Investors		Foreign Private Investors	
		Yes	No	Yes	No	Yes	No	Yes	No
Age (Q22)	18–24	3	2	2	3	3	2	0	5
	25–34	11	6	11	6	6	11	2	15
	35–49	34	5	25	14	11	28	9	30
	50–64	25	11	21	15	9	27	6	30
	over 65	4	0	2	2	1	3	1	3
Residence (Q17)	Rural	57	19	46	30	23	53	13	63
	Urban	20	5	15	10	7	18	5	20
Total		77	24	61	40	30	71	18	83

The perception of the surveyed farmers was that the institutions of the Romanian government were not involved in informing them about the bioeconomy in their current activities. Therefore, the research hypothesis (H2) was rejected. At the same time, the data led to the confirmation of the research hypothesis (H3), according to which farmers in Romania expected a closer collaboration with decision-makers in the agricultural field from a bioeconomic perspective. From the respondents' point of view, the main institutions they expect to get involved were the public authorities in Romania and the European Commission, in the sense that they could finance the bioeconomic model in agriculture at the local and regional levels.

The expectations of Romanian farmers regarding the involvement of national and European institutions in clarifying the concept of bioeconomy, in explaining it at a practical level, were similar to those of farmers from other countries. According to Dieken, Dallendörfer, Henseleit, Siekmann, and Venghaus [22], the non-involvement of institutions and lack of public debates regarding the bioeconomy contradict the importance of the bioeconomy in contributing to sustainable development.

4.1.2. The Symbiosis between Agriculture and the Bioeconomy from the Perspective of Farmers

Figure 5 shows the importance of agriculture, as considered by the respondents, as a component of the bioeconomy as well as the importance of the bioeconomy to Romania's economy.

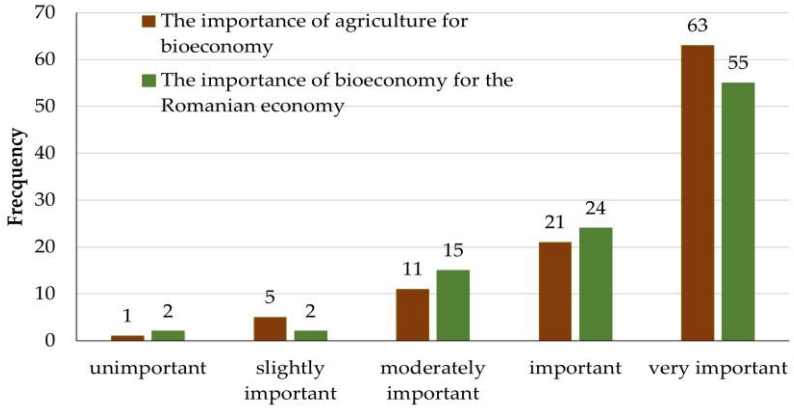

Figure 5. The importance of agriculture to the bioeconomy and the importance of the bioeconomy to the Romanian economy.

We issued the null hypothesis (H_0), according to which there was no statistically significant correlation between the importance of agriculture to the bioeconomy and of the bioeconomy to the national economy. The alternative hypothesis (H_1) was that there was a statistical relationship between the two variables. The results of the inferential statistical analysis are shown in Table 8.

Table 8. Correlation between the perceived importance of agriculture to the bioeconomy and the importance of the bioeconomy to the national economy.

		The Importance of Agriculture to the Bioeconomy (Q4)	**The Importance of the Bioeconomy to the Romanian Economy (Q6)**
The importance of agriculture to the bioeconomy (Q4)	Pearson Correlation	1	0.585 **
	Sig. (2-tailed)		0.000
	N [1]	101	98
The importance of the bioeconomy to the Romanian economy (Q6)	Pearson Correlation	0.585	1
	Sig. (2-tailed)	0.000	
	N	98	98

[1] Number of observations. ** Correlation is significant at the 0.01 level (2-tailed).

Based on the results, we can state that there was a statistically significant linear relationship between the importance of agriculture within the bioeconomy and of the bioeconomy to the national economy because $r = 0.585$ and $p < 0.001$. The direction of the relationship was positive, i.e., Q4 and Q6 were positively correlated and both variables tended to increase simultaneously. The strength of the association was moderate, since $|r| \in (0.3; 0.5)$. Consequently, the null hypothesis was rejected and the alternative hypothesis was accepted.

The analysis confirmed the H4 research hypothesis, according to which Romanian farmers believed that the bioeconomy plays a very important role and contributes a lot to Romania's economic development. In addition, agricultural workers also considered the synergy between agriculture and the bioeconomy to be very important.

4.2. Applying the Bioeconomy Concept in the Current Activity of Agricultural Farms

4.2.1. The Role and Contribution of the Bioeconomy to Economic Development

In the opinion of the interviewees, all aspects raised by the question about the role of the bioeconomy in economic activity, in living standards, in protecting the environment, in the food supply, and also in attracting young people to the agricultural field were factors consistent with their expectations and hopes in the short-, medium-, and long-term for the bioeconomy field (Figure 6).

The analysis confirmed research hypothesis H4, according to which Romanian farmers believed that the bioeconomy has a very important role and contributes significantly to the economic development of Romania. In addition, agricultural workers also considered the synergy between agriculture and the bioeconomy to be very important, not only from the point of view of biomass supply.

The relative frequencies of variable Q11 revealed that 45% of the respondents considered the bioeconomy to have a very large contribution to the economic development of Romania, and 36% appreciated that it could contribute a lot (Figure 7).

4.2.2. Investment in Recycling and Reuse of Agriculture Waste

The responses to Q12, regarding the budgetary amounts allocated by farmers for the reuse or recycling of agricultural waste are highlighted in Figure 8.

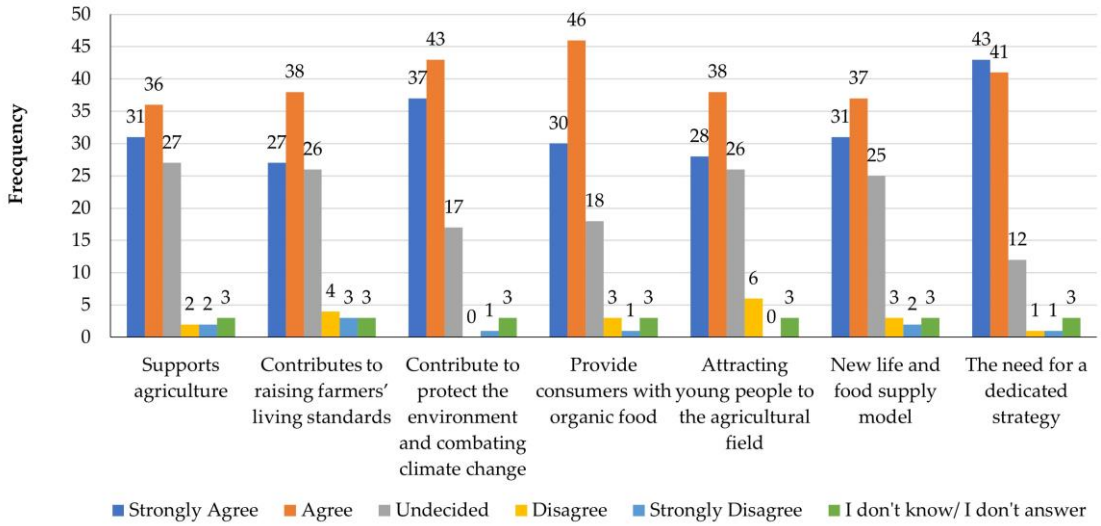

Figure 6. The opinions of those interviewed about the role of the bioeconomy.

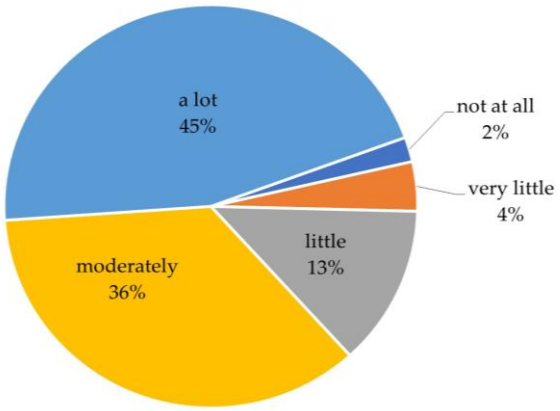

Figure 7. The contribution of the bioeconomy to the economic development of Romania.

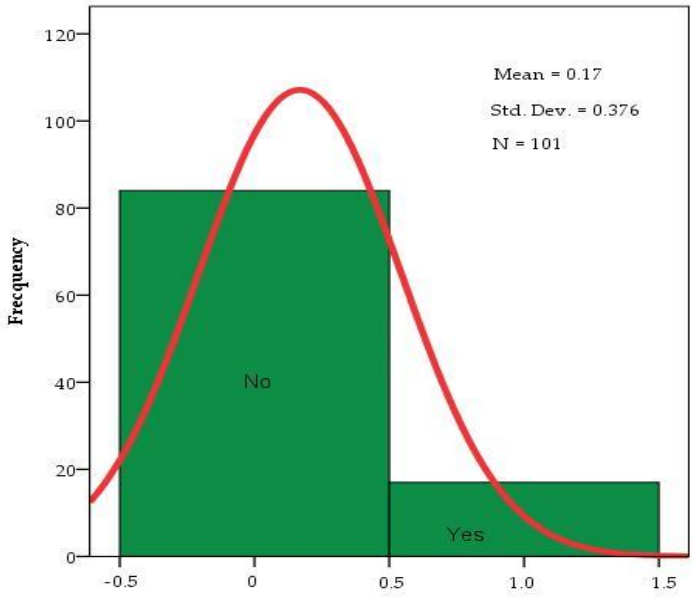

Figure 8. Histogram of the budgetary amounts allocated by farmers for the reuse or recycling of agricultural waste.

Out of the 101 valid answers, the majority (83.2%) were negative, which indicated both a lack of concern on the part of farmers to invest in recycling/reuse techniques for waste from their agricultural activity and the lack of interest of local authorities to get involved in the process of guiding and raising people's awareness regarding the economic circularity of agricultural residues. Since most of the answers to question 12 were negative, i.e., the respondents did not allocate budgetary amounts for the recycling/reuse of waste from agricultural activity, we considered transforming the variable into a dichotomous one.

Studying the absolute frequencies of the variables Q12, Q20_recode, and Q22_recode led us to discover the statistical significance of the three variables. The absolute frequencies revealed that adults between the ages of 35 and 64 years, without specialized studies in the agricultural field, were the ones who allocated sums of money for waste recycling. In this sense, to investigate the connection between the answers to question 12 (Q12) and the age and specialized studies in the agricultural field variables, we performed the bivariate χ^2 test (Table 9). The correlation between age, completion of specialized studies, and budgetary allocations for agricultural waste recycling/reuse is shown in Table 9.

Table 9. Test of the hypothesis that farmers allocate amounts of money for agricultural waste recycling/reuse depending on their age and completion of specialized studies in agriculture.

Variables	The Investment Budget to the Reuse or Recycling of Agricultural Waste			
	Pearson Correlation	**Sig. (2-Tailed)**	**Contingency Coefficient**	**N** [1]
Farmers allocate amounts of money for recycling/reuse of agricultural waste according to completion of specialized studies in the field of agriculture (Q20_recode)	0.085	0.591	0.091	101
Age range (Q22_recode)	−0.054	0.398	0.085	101

[1] Number of observations.

According to the χ^2 test (Table 9), the level of significance $p > 0.0$ showed that the null hypothesis was accepted, i.e., there were no statistically significant differences between the age of the farmers, the specialized studies they had completed, and the decision to allocate budgetary amounts for agricultural waste recycling/reuse. The values of the Pearson coefficient indicated a weak but direct relationship between the variables Q12 and Q22_recode, and a strong and opposite relationship with Q20_recode. The contingency coefficient had a value below 0.1, which showed a very low influence of the age and specialized studies variables on the budgetary amount allocated for recycling or reuse of waste.

The research hypothesis (H5) was rejected, i.e., Romanian farmers did not invest in the recycling and reuse of agricultural waste in order to contribute to the development of the bioeconomy. This result was not conditioned by education, age, or other characteristics of the subjects.

Regarding the positive answers to question 12, the 16.8% of the farmers who allocated budgetary amounts for waste reuse/recycling declared themselves as members of rural households (25% of respondents), mixed farms (31.3%), vegetable farms (12.5%), and livestock farms (6.3%), but also non-governmental organizations (NGO) (18.8%) and Local Action Groups (LAGs) (6.3%). Most of them were between 50 and 64 years old (62.5% of the respondents) and had no agricultural education. The amounts declared to be allocated varied from 10% of the profit to fixed amounts between RON 400 and 5000.

4.3. Farmers' Characteristics and Sample Traits

We included in the analysis several variables in order to identify the level of education of the respondents who completed the survey, the type of activity they carried out, as well as their geographical location.

The batch structure consisted of 101 respondents, aged from 18 to over 65 years, with a standard deviation of 0.928. The survey participants were 60.4% male and 39.6% female. The majority of those interviewed were active workers, aged 25–34 years (16.8% of respondents), 35–49 years (38.6%), and 50–64 years (35.6%). More than half of the interviewees had higher education (63.4%), and 43.6% of the sample had completed studies in agriculture.

In terms of occupation, most of those who took part in the survey (28.7%) declared themselves as householders (people who live in the countryside and own an establishment in which they cultivate land and raise animals for their own or their close relatives' consumption), 28.7% were farmers (owner or administrator of a farm), 20.8% were members of an agricultural association (group of people who contribute financially, through their knowledge, or work at an activity of common or community interest, based on an agreement), and 10.9% were managers (people who run an agricultural business).

The coefficient of variation (C_v) showed that for the variables Q15, Q17, Q19, Q21, and Q22, the studied population of the sample was homogeneous because $C_v < 35\%$ (vertical red line) (Figure 9), and the sample was heterogenous for the rest of the variables (Q14, Q16, Q18, and Q20_recode) [62].

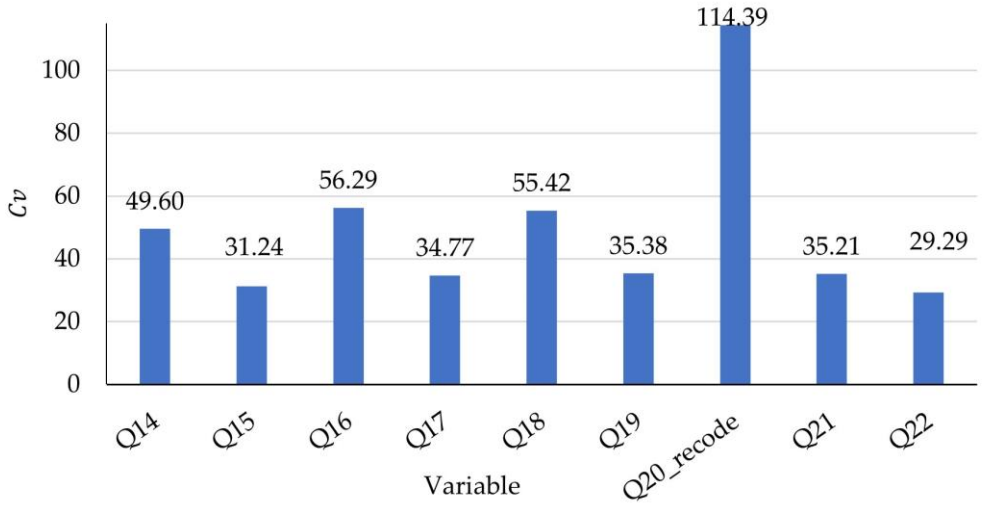

Figure 9. Values of the coefficient of variation of the variables characterizing the sample.

4.3.1. Characteristics of the Agricultural Society

Most of the survey participants worked in rural households (35.6%), on vegetable farms (19.8%), and on mixed farms (13.9%) (Figure 10).

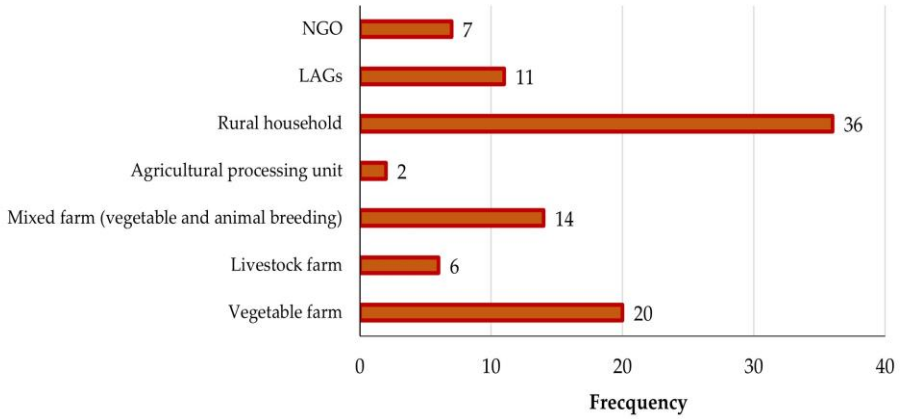

Figure 10. The type of agricultural unit of the respondents.

Additionally, a significant number of those surveyed (11%) were part of LAGs, which were established at the level of rural areas for easier absorption of European funds in order to develop regional agriculture.

The overwhelming proportion of respondents, 97% (Figure 11), worked in agricultural units with less than 50 employees.

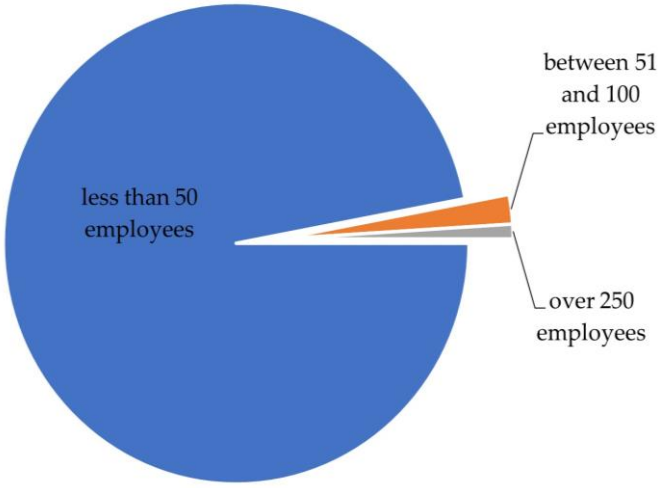

Figure 11. Classification of agricultural units in the sample according to the number of employees.

This showed that the agricultural activities of respondents in Romania were carried out for their own consumption purposes or, at most, for sale on a reduced scale, due to the large number of holdings that had small agricultural areas of under 2 ha [68].

4.3.2. Respondents' Characteristics

Of the 101 people surveyed, only 5.9% did not want to express their options regarding their occupation. As Figure 12 shows, more than half of the total number of subjects participating in the survey were householders (28.7%), farmers (28.7%), and members of an agricultural association (20.8%). We also added the relative frequency of 21% of the respondents as members of an agricultural association.

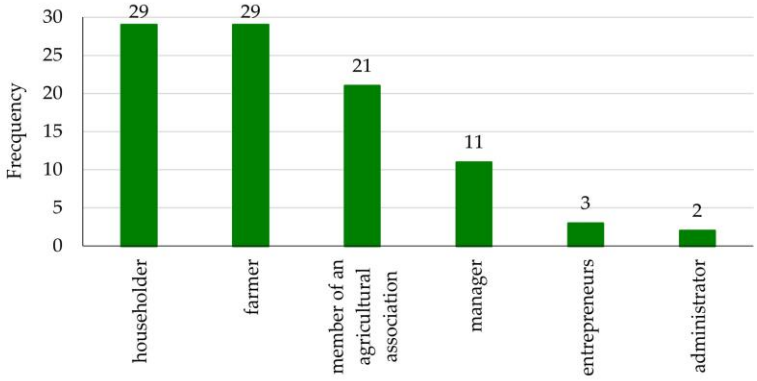

Figure 12. Respondents' occupations.

The education of the respondents was of higher level. Most of them (65.3%) declared that they were graduates of higher education (faculty, masters, and doctorate), 27.7% had a high school diploma, and 5.9% had completed post-high school studies.

The results showed that 56.4% of the respondents had not completed specialized studies in the agricultural field, while 43.5% were part of the category of those who had completed specialized courses in the agricultural field (Q20.3). Out of those who completed studies in agriculture, 20.5% graduated from agricultural high schools, 40.9% graduated from the Faculty of Agronomy, and 38.6% took specialized courses in the field (Figure 13).

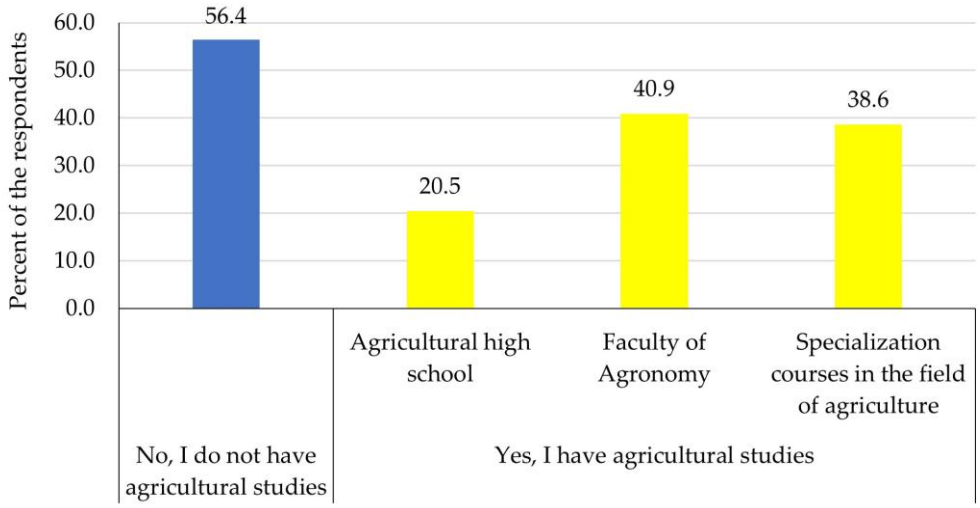

Figure 13. Specialization of respondents with studies in the agricultural field.

The structure of the sample consisted of 60.4% men and 39.6% women, and most respondents belonged to the age categories of 35–49 years (38.6%) and 50–64 years (35.6%) (Figure 14). The data showed that 72.22% of people aged 50 to 64 years were men, and 51.28% of people aged 35 to 49 years were women.

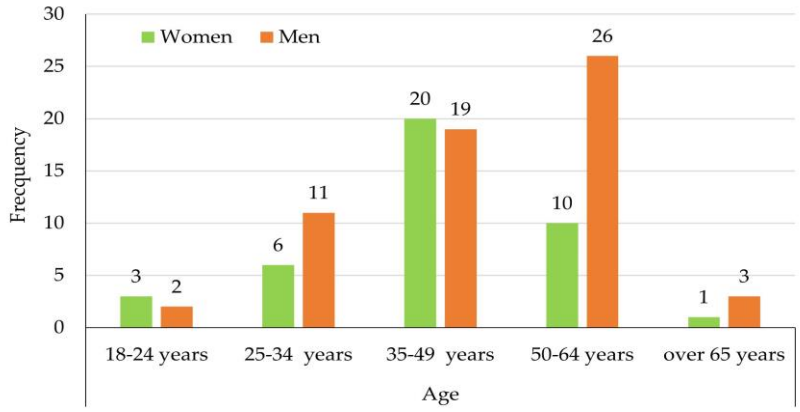

Figure 14. Frequency of respondents according to gender and age.

According to the frequencies of variable Q17, of the 101 respondents, 76 declared themselves to be from rural areas and 25 from urban areas. Regarding the hypothesis (H7), the results confirmed the assertion that farmers had an active age of 30–65 years and were from rural areas.

5. Discussion

Through quantitative analysis we achieved the three main objectives underpinning our research, namely: the state of knowledge of the bioeconomy in Romania, the application of the concept of bioeconomy in the current activities of agricultural farms, and identification of the characteristics of farmers.

All of the secondary objectives set out above were achieved following the statistical analysis of the data, i.e., the seven hypotheses were confirmed or rejected, as follows:

- H1: Romanian farmers know and understand the term bioeconomy and associate it with other common terms in the field—confirmed.
- H2: Romanian public institutions are involved in informing agricultural workers about the bioeconomy—rejected.

- H3: Romanian farmers expect closer cooperation with agricultural policymakers from a bioeconomic perspective—confirmed.
- H4: The role and contribution of the bioeconomy to Romania's economic development is considered to be very important by agricultural workers—confirmed.
- H5: Romanian farmers invest in the recycling and reuse of agricultural waste to contribute to the development of the bioeconomy—rejected.
- H6: Romanian farmers have completed specialty studies in agriculture—rejected.
- H7: Farmers are in the active range of 30–65 years and come from rural areas—confirmed.

The survey respondents were predominantly members of rural associations with up to 50 people, and most of them were men aged 35–64 years with higher education but not specialized in agriculture. Three-quarters of the research sample came from rural areas, and the development areas from which most farmers' opinions were collected were the West and South-Muntenia regions. The farmers surveyed had a positive attitude towards aspects of the role of the bioeconomy in economic activity and the way of living. Additionally, the perceived roles of the bioeconomy in protecting the environment, the food supply, and also in attracting young people to agriculture were in line with the expectations and hopes of the respondents in the short-, medium-, and long-term for this new economic field.

An important aspect of the economic analysis was the lack of budgetary allocations of periodic amounts for the reuse or recycling of agricultural waste. Most respondents did not foresee annual budgetary amounts dedicated to this activity, which indicated both a lack of concern of farmers to invest in recycling/reusing techniques of waste from their agricultural activities and the lack of interest of local authorities to get involved in the process of mentoring and raising people's awareness about the economic circularity of agricultural waste.

A relevant element that drew our attention was that those who associated the term bioeconomy with natural resources and biodiversity came mostly from rural areas (79.17%), and in terms of age, 39.47% were between 35 and 49 years and 31.58% were between 50 and 64 years. The main institutions from which the participants in the survey expected massive involvement were the public authorities of Romania and the EC. More importantly, they expected the new field of the bioeconomy to be financed by public authorities at local and regional levels. At the same time, Romanian farmers believed that the bioeconomy plays a significant role and contributes a lot to the economic development of our country. Furthermore, they also considered the synergy between agriculture and the bioeconomy to be very important, beyond only biomass supply.

We recognize the enormous potential of Romanian agriculture. The understanding by all actors involved in the sector of the benefits that the bioeconomy can entail is essential for developing this field [69,70]. In this respect, we consider that decision-makers must be strongly involved in working with farmers through local institutions. Furthermore, researchers and specialists from all sectors of the bioeconomy also need to remove communication barriers and work together on innovative technologies in order to produce sustainable finished products throughout the circular economic chain [71,72]. Van Lancker et al. [73] and Wydra [74] consider that knowledge and innovation are essential to the transition to a green economy and should provide solutions to major economic, ecological, and social challenges.

The first observation that emerged from the statistical analysis of the sample and scientific literature studied was that the link between Romanian farmers and authorities was of low intensity. This makes it very difficult to implement a strategy dedicated to the bioeconomy in Romania, especially since the new economic model may involve the use of modern technologies in the activities of farmers. To implement the bioeconomy in the agriculture of Romania, we consider that a closer collaboration between researchers, decision-makers, local authorities, and farmers is a priority. These issues have also been pointed out in other EU countries, such as Poland [42] and Slovakia [66]. Meanwhile, in Germany in recent years, education and collaboration between stakeholders have led to an adequate understanding of bioeconomic principles and strengthening of the connections

between researchers, institutions, and farmers, finally increasing the added value to the national economy [75].

Another element that we consider essential is the expansion of technological research in agriculture in order to correlate bioeconomic processes with efficient recycling of waste from agricultural activities. We agree with the opinion of previous researchers [42,76] who stated there is actually a contradiction between modern technologies used in the bioeconomy and the notion of environmental protection, as technological development has led to environmental deterioration by accelerating global warming. We believe the full potential of agriculture is not optimally and efficiently exploited in order to make it a development pillar of the bioeconomy.

The bioeconomy brings together the sectors of agriculture, forestry, fisheries, and aquaculture (primary sectors) on the one hand, and sectors that produce food, chemicals, materials, and energy on the other [18,77]. Agriculture, the food industry, the chemical industry, and the energy and biotechnology sectors have supported the development of the bioeconomy in countries that applied it effectively [78]. The primary components of the Europe 2020 Strategy are food production, animal feed, organic products, and bioenergy [79]. According to EC researchers [80], from a mathematical point of view, the bioeconomy is the sum of the primary, secondary, and tertiary production of the activities within the ecological industry, i.e., Bioeconomy = Primary Production + Secondary Production + Tertiary Production. The classification facilitates the assessment of the distribution of organic products within the value-added chain, all the more so as the economic and political debates regarding the economy focus on quantifying the added value that producers achieve from the processing of organic raw materials.

The probabilistic results show a shortage of specialists in Romania's agriculture, which leads us to affirm that an understanding of the concept as well as implementation of the bioeconomy in Romania will be a lengthy process, which will most likely need long-term investments to achieve the goals of the bioeconomy. Other researchers [81,82] also affirmed that regional policies and investments by public authorities and private companies are essential for developing agriculture and the bioeconomy.

We believe that the bioeconomy involves the contribution of all actors: from European and national institutions, investors, farmers, and managers of industrial units to the public, who realize that the bioeconomy is a sustainable alternative to the current economy based on environmentally unfriendly raw materials [48,83,84]. Therefore, a closer link between researchers, policymakers, and those directly involved in the bioeconomic process is necessary on the short-, medium-, and long-term. The need is derived from the importance that the bioeconomy can have in the economic and social development of national economies in the current context of globalization.

6. Conclusions

The quantitative research elaborated on in this article investigated farmers' perceptions about the bioeconomy. The analysis revealed the role of the bioeconomy in agricultural activities, what expectations respondents had from national and community-level institutions, but also the contribution of Romanian public institutions in explaining and promoting the complex phenomenon of the bioeconomy to agricultural workers.

The data showed higher knowledge of the term bioeconomy with rural, active, and professionally mature workers. Respondents in the survey considered that the active involvement of public institutions in Romania in the implementation of the bioeconomy is more important than giving information about the link between agriculture and the bioeconomy. At the same time, from the analysis of the involvement and support of the authorities in the principles of the bioeconomy in Romania, we derived several conclusions:

- Farmers are not informed of the normative acts of the Romanian government in stipulating the term bioeconomy.
- They believe that the involvement of public institutions in the bioeconomy is very important.

- They expect better information from state institutions on what the term bioeconomy means and entails for their agricultural activities.
- They consider that the financing of the bioeconomy should be done by public institutions in Romania and the European Commission.

The results draw attention to investment potential in the agricultural field by allocating financial resources to create new jobs and opportunities for area development. Local institutions could and should play a pivotal role in fostering the development of the bioeconomy in Romania. Additionally, public–private partnerships are needed to realize modern technologies throughout the chain of economic circularity. For the development of the bioeconomy in the agriculture of Romania, it is of paramount importance for farmers to associate in large agricultural units, both for fostering the workforce and increasing the area of agricultural land.

This paper presents an analysis of the understanding of the main aspects of the bioeconomy. It contributes to the scientific bibliography on the bioeconomy in Romania and will be useful for decision-makers to understand and create close links with Romanian farmers.

The scientific approach was limited by the clear lack of knowledge on the part of farmers of the role and contribution of the bioeconomy in their current activities. Moreover, we remarked a lack of interest of the central authorities in Romania, especially at the level of the Ministry of Agriculture, to promote the concept among agricultural workers. Another impediment to our research was the shortage of scientific articles or documents from official EU institutions dealing with surveys appropriate to the bioeconomic field. This limitation challenged us to create one based on precarious empirical knowledge of agriculture, ecology, the environment, and sociological surveying.

The following scientific steps will focus on a continuation and expansion of research on the bioeconomy in Romania. The approach of studying the perceptions of Romanian farmers regarding the bioeconomy is an element of novelty in the Romanian literature, and the study intends to add value to works in the field, which, so far, are extremely scarce and deal with the topic from narrow perspectives. In addition, the contribution of agriculture to the development of the bioeconomy is seldom addressed by researchers in Romania. In the future, the authors intend to actively engage with the managers of the departments and directorates as well as with the decision-makers within the National Institute of Statistics Romania in order to use their logistic infrastructure for data collection.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su15107883/s1.

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Appendix A

Table A1. Absolute and relative frequencies of variables.

Variable		Absolute Frequency	Relative Frequency
Type of agricultural unit (Q14)			
Valid	Rural household	36	35.6
	Vegetable farm	20	19.8
	Mixed farm (vegetable and livestock farming)	14	13.9
	GAL	11	10.9
	NGO	7	6.9
	Livestock farm	6	5.9
	Agricultural processing unit	2	2.0
	Total	96	95.0
Missing		5	5.0
TOTAL		101	100.0
Occupation (Q16)			
Valid	Householder	29	28.7
	Farmer	29	28.7
	Member of an agricultural association	21	20.8
	Manager	11	10.8
	Entrepreneur	3	3.0
		2	2.0
	Total	95	94.1
Missing		6	5.9
TOTAL		101	100.0
Residence (Q17)			
Valid	Rural	76	75.2
	Urban	25	24.8
TOTAL		101	100.0

Table A1. *Cont.*

Variable		Absolute Frequency	Relative Frequency
Locality (Q18)			
Valid	Timis	23	22.8
	Calarasi	20	19.8
	Suceava	7	6.9
	Brasov	6	5.9
	Arges	4	4.0
	Sibiu	3	3.0
	Iasi	3	3.0
	Giurgiu	3	3.0
	Dolj	3	3.0
	Vaslui	2	2.0
	Tulcea	2	2.0
	Neamt	2	2.0
	Hunedoara	2	2.0
	Dambovita	2	2.0
	Constanta	2	2.0
	Cluj	2	2.0
	Bucuresti	2	2.0
	Valcea	1	1.0
	Olt	1	1.0
	Mures	1	1.0
	Ialomita	1	1.0
	Galati	1	1.0
	Covasna	1	1.0
	Caras-Severin	1	1.0
	Buzau	1	1.0
	Braila	1	1.0
	Bistrita-Nasaud	1	1.0
	Bihor	1	1.0
TOTAL		101	100.0
Development regions (Q18_Recode)			
Valid	South-Muntenia	29	28.7
	West	27	26.7
	North-East	13	12.9
	Centre	12	11.9
	South-East	9	8.9
	South-West Oltenia	5	5.0
	North-West	4	4.0
	București-Ilfov	2	2.0

Table A1. *Cont.*

Variable		Absolute Frequency	Relative Frequency
TOTAL		101	100.0
Education (Q19)			
Valid	Faculty	45	44.6
	Secondary school	28	27.7
	Masters	19	18.8
	Post-secondary	6	5.9
	Doctorate	2	2.0
	Middle school	1	1.0
TOTAL		101	100.0
Agricultural Studies (Q20)			
Valid	Agricultural high school	9	8.9
	Faculty of Agronomy	18	17.8
	Specialization courses	17	16.8
	No	57	56.5
TOTAL		101	100.0
Gender (Q21)			
Valid	Male	61	60.4
	Female	40	39.6
TOTAL		101	100.0
Age (Q22)			
Valid	35–49 years	39	38.6
	50–64 years	36	35.6
	25–34 years	17	16.8
	18–24 years	5	5.0
	over 65 years	4	4.0
TOTAL		101	100.0

Source: Authors' computation in SPSS (IMB SPSS Statistics 20).

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