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Study of the attitudes of Bulgarian farmers for the implementation of innovations

Petia Branzova* **and Annie Dimitrova***

Economic Research Institute at the Bulgarian Academy of Sciences
**Corresponding authors:* petia.branzova@gmail.com; a.dimitrova@iki.bas.bg

Abstract

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The benefits of implementing innovations in agriculture are many, various and proven at a global level. The purpose of the paper is to present the attitudes of the agricultural producers concerning the implementation of technological innovations in Bulgaria. Through cluster analysis, the agricultural producers participating in a study are divided into four groups by six characteristics. This provides an insight into the main attitudes of the producers regarding agricultural innovations. The results show that agricultural producers with large capital and large holdings adopt and use innovations in their holdings. The majority of the farmers do not have a specific attitude and are neutral on the issues related to the implementation of innovations in the holdings. There are also those who are pessimistic and do not see development in the agrarian sector as a whole.

Keywords: agriculture; agricultural producers; technological innovation

Introduction

Agriculture is one of the most advanced and innovative industries in the world. Farmers often use modern technologies since they make their work easier, more productive, more efficient and of better quality. The use of technological innovations in agriculture in recent years gives more and more confidence in facing the challenges related to climate change, nutrition and survival of the human species (Grozdanova S., 2019).

Regarding the Bulgarian agriculture, the application of innovations has not reached the world level. The attitudes of the agricultural producers towards the implementation of technological innovations in the holdings, at national level, are rather skeptical (Totev S., M. Mochurova, M. Kotseva-Tikova, 2021). Concrete actions are needed to promote innovations in agriculture, as well as understanding the benefits of their use by the agricultural producers. The purpose of the paper is to present the attitudes of the agricultural producers towards the implementation of technological innovations in Bulgaria. The presented study examines the attitudes of the agricultural producers in Bulgaria towards the implementation of technological innovations with main goal to increase the productivity and the competitiveness of their production. Statistical and econometric methods are applied to the analysis of the available data in order to study the farmers' views regarding the adoption of innovative technologies.

Material and Methods

Structured interviews are conducted as online questionnaires. Their purpose is to identify certain cases of adoption of technological innovations by agricultural producers in Bulgaria. The questionnaires are filled out online personally by the farmers, or in a phone conversation with them (Dimitrova A., 2021). The used data have not been analyzed till now in the context of the present study. The survey covers the period August – November, 2021. Interviewed are 50 agricultural producers. They are selected according to the following methodology: The territory of Bulgaria is divided

into 6 regions, 28 districts and 264 municipalities. (Markov N., Toneva K., Mutafov E., 2016) The planning regions in Bulgaria have their own specifics, which require developing and following a methodology that is closest to the real state of the agricultural sector in the country (Ruscheva D., 2019). For the purposes of this study, the following sequence is used:

1. Choice of types of holdings to study, according to their significance to the agrarian sector – crop growing and animal husbandry;
2. Choice of ratio between the different types of holdings according to their main agrarian activity – crop growing and animal husbandry;
3. Choice of region where the holdings selected in step one and two have the largest number/area/number of animals;
4. Outlining conceptual models of holdings from each sector.

Concerning the main criteria for choosing a region for conducting a study, it can be concluded that the choice of the study is based on a quota selection method with available information on the main structure-determining ratios in the general aggregate.

Using the basic data on the economic size of the holdings in Bulgaria specializing in crop growing, calculations are made and the values of these holdings are derived in economic units. The results show that in the country the holdings growing cereals, oilseeds and protein crops with an economic size of more than 250 000 (267000000 economic units) predominate. Other field crops are the next largest economic activity, with the largest number of economic units having an economic size in the range of 100 000 – 250 000 (43575000 economic units). In the economic activity Vegetables, flowers and mushrooms, the economic units have an economic size mainly in the range of 50 000 – 100 000 (16500000 economic units). Orchards are the next economic activity in the crop growing by economic units, and their largest number has an economic size of 25 000 – 50 000 (8137500 economic units). In economic activity Vineyards, the most significant number of economic units (9700000 economic units) have an economic size of the holding under 2000. The smallest size is Mixed perennials, and the largest number of economic units (700000 economic units) have an economic size between 100 000 and 250 000.

Using the basic data on the economic size of the holdings in Bulgaria specializing in animal husbandry, calculations are made and the values of these holdings are derived in economic units. The results show that in the country there is a predominance of the holdings raising Dairy cattle with an economic size of 100 000 to 250 000 (267000000 economic units). Sheep, goats and other herbivores is the next largest economic activity, with the largest number of economic units having an economic size in the range of 25 000 – 50 000 (31425000 economic units). In the economic activity Pigs, poultry and rabbits, the economic units have economic size mainly in the range above 250 000 (61250000 economic units). Beef cattle is the next economic activity in animal husbandry by economic units, and the most of them have economic size 15 000 – 25 000 (6040000 economic units). The smallest size is for dairy and beef cattle, and the largest number of economic units (7175000 economic units) have an economic size between 100 000 and 250 000.

Using the basic data on the economic size of the holdings in Bulgaria specializing in both crop growing and animal husbandry, calculations are made and the values of these holdings are derived in economic units. The results show that holdings growing cereals, oilseeds and protein crops predominate in the country (775849000 economic units), and they also have the largest areas. Other field crops are the next largest economic activity (230652000 economic units) in the crop growing. The smallest economic activity is mixed perennials (4693000 economic units). In animal husbandry, holdings raising dairy cattle predominate (304535000 economic units). Sheep, goats and other herbivores is the next largest economic activity (165174500 economic units). The smallest size is dairy and beef cattle (28152500 economic units).

Largest share in the agricultural sector of Bulgaria have: Cereals, oilseeds and protein crops (42%); Dairy cattle (17%); Other field crops (12.6%). Economic activities in the crop growing and animal husbandry, considered an average group in terms of their contribution to the country's agriculture, are: Sheep, goats and other herbivores (9%); Pigs, birds and rabbits (6%) and Vegetables, flowers and mushrooms (4.8%). Economic activities with the least significant impact are: Orchards (3%); Vineyards (2%); Beef cattle (1.8%); Dairy and beef cattle (1.5%) and mixed perennials (0.3%).

All economic activities of animal husbandry have the most representatives in the South Central region, respectively: Dairy cattle (99498500 economic units); Beef cattle (11081500 economic units); Dairy and beef cattle (8276000 economic units); Sheep, goats and other herbivores (44462500 economic units); Pigs, birds and rabbits (25859500 economic units).

In crop growing, almost all economic activities have the biggest concentration in the South Central region: Other field crops (88751500 economic units); Vegetables, flowers and mushrooms (39498000 economic units); Vineyards (15843000 economic units); and Mixed perennials (1897500 economic units). Exceptions are Cereals, oilseeds and pro-

tein crops, which have the most representatives in the North East region (240396500 economic units) and Orchards – in South East region (14509000 economic units).

Due to the diversity of the agrarian sector and the limited resources for conducting a full survey, 50 holdings are surveyed, representing a mini excerpt of the sector in the country.

To conduct the study of the agrarian sector according to the described methodology, the following types and number of farms have to be studied: Cereals, oilseeds and protein crops (21 holdings); Dairy cattle (8.5 (9)); Other field crops (6.3 (6)); Sheep, goats and other herbivores (4.5 (4)); Pigs, birds and rabbits (3); Vegetables, flowers and mushrooms (2.4 (2)); Orchards (1.5 (1)); Vineyards (1); Beef cattle (0.9 (1)); Dairy and beef cattle (0.75 (1)); Mixed perennials (0.15 (1)).

From the point of view of choosing the location of the objects, it is assumed that a region is specialized in certain activity if this certain economic activity is most significant for this region. The results of the specialized holdings are systematized in Table 1. They show that a large number of types of economic activity are represented in the South Central region. The South Eastern region specializes in Orchards, and the North Eastern region – in the production of Cereals, oilseeds and protein crops.

It is assumed that agricultural holdings are not a homogeneous group and accordingly differ in their social and economic characteristics (Blagoev A., 2023). Different methods of data grouping can be used to attempt to distinguish the types of the holdings. A suitable method for such type of groupings is the cluster analysis. Two types of clusters are distinguished: hierarchical and non-hierarchical. In the agrarian sector, there are often different types of groupings (clusters), for which a similar solution to the problems is sought (Harizanova-Metodieva T., Gaidarska V., Ivanova, T., 2016), (Nestorov N., 2021). Often, the clustering covers sectors, territories, size of holdings or another characteristic that enables a correct and targeted analysis. This type of clustering is embedded in the statistical product SPSS and is suitable for processing data from one's own survey. For this purpose, the requirements for its application will be observed (including lack of correlation between the variables). The used variables are six. It is preliminarily assumed that there are four groups of agricultural producers, of which at least one should be positively disposed to the possibility of implementing innovations and innovative practices in their activities. It is also assumed that the main reasons for the lack of innovation implementation will also be revealed. The conclusions from the derived clusters support the discovery of opportunities for overcoming the obstacles before the Bulgarian producer in terms of innovations.

Table 1. Ratio of specialized holdings by economic size

Specialization	Ratio by economic size (%)	Ratio by studied number N = 50 (%)
Cereals, oilseeds and protein crops	42	21
Dairy cattle	17	8.5
Other field crops	12.6	6.3
Sheep, goats and other herbivores	9	4.5
Pigs, birds and rabbits	6	3
Vegetables, flowers and mushrooms	4.8	2.4
Orchards	3	1.5
Vineyards	2	1
Beef cattle	1.8	0.9
Dairy and beef cattle	1.5	0.75
Mixed perennials	0.3	0.15

Source: Calculations based on statistical data from the Ministry of Agriculture, Food and Forestry; "Agrostatistics" 2019; General Directorate of Agriculture and Regional Policy; Structure of agricultural holdings in 2016

Results and Discussion

For the purpose of this paper, a cluster analysis is made, which divides the 50 holding managers (participants in the study) into 4 clusters (based on the chosen methodology), using six independent variables:

- Crops/breeds grown;
- Income last year;
- Innovative – new technologies;
- Traditionalist;
- Investment next 5 years;
- Environmental protection.

The *first cluster* is the most extensive. It consists of 17 farmers, who are positive towards the implementation of innovations in the holding (Table 1-4). The *second cluster* is the smallest and includes 8 agricultural producers who define themselves as neither innovative nor traditionalists. The *third cluster* consists of 13 farmers who, like the farmers in the second cluster, define themselves as neither innovative nor traditionalists, with the difference that they are engaged in animal husbandry and not in crop growing. The *fourth cluster* consists of 12 agricultural producers who are the most indecisive and do not have a firm position on the questions in the survey. The percentage of holdings growing cereals, oilseeds and protein crops is the largest, but this is explained by the chosen methodology for selecting agricultural holdings.

Table 2. Number of units in each cluster

Cluster	1	17.000
	2	8.000
	3	13.000
	4	12.000
Valid		50.000
Missing		.000

Source: Own calculations

Table 3. History of the iteration

Iteration	Change in Cluster Centers			
	1	2	3	4
1	1.285	2.055	1.530	1.196

Source: Own calculations

Table 4. Significance of the variables in the cluster

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Crops/breeds grown	164.467	3	.550	46	298.795	.000
Income last year	10.610	3	.976	46	10.873	.000
Innovative	2.726	3	.466	46	5.847	.002
Traditional	.274	3	.348	46	.787	.507
Investment next 5 yrs.	4.385	3	.246	46	17.809	.000
Environmental protection	3.044	3	.521	46	5.837	.002

Source: Own calculations

Table 5. Distances between the end cluster centers

Cluster	1	2	3	4
1		8.521	4.982	2.556
2	8.521		3.956	8.172
3	4.982	3.956		4.453
4	2.556	8.172	4.453	

Source: Own calculations

Table 6 shows that the first and second clusters include farmers, who grow crops, and the third and fourth clusters are farmers who breed animals. In the first cluster the farms have the highest income for the last year, and in the third and fourth cluster – the smallest. Concerning the environmental protection, in the second and third clusters the holding managers strive to protect the environment, while in the largest first cluster they are not interested in environmental protection.

In the first and largest cluster, the agricultural producers grow cereals, oilseeds and protein crops. The profit of the farm for the last year is over BGN 300 000. The investments in the holding made in the last three years are in machinery, equipment, land and innovative practices. The self-assessment of the farmers in this cluster is that they are innovative because they apply new technologies in their holdings and easily adopt them. Their holding is competitive because, apart from being innovative, it is also more innovative than the competitive holdings. Investments in innovation help to overcome the business risk, increase the income and the competitiveness. (Georgieva S., 2020) Farmers intend to continue purchasing and implementing innovative solutions in their holdings in the next 5 years. The interviewed agricultural producers consider themselves among the first to introduce innovations in their holdings and prefer to use new technologies and sorts. According to their self-assessment, they tend to take more risks than other farmers, both in the holding and in the agriculture in general. Farmers indicate that they have invested in their holdings in the last year as well as in the past five years. According to them, the use of innovations in the economy leads to reduced costs and increased profit. The reasons for implementing innovations are the increase of the productivity of the holding and the reduction of the labor costs.

Table 6. End cluster centers

	Cluster			
	1	2	3	4
Crops/ breeds grown	Cereals, oilseeds and protein crops	Other arable crops	Milk-producing livestock	Sheep, goats and other herbivores
Income last year	> 300 000	> 50 000	< 50 000	< 50 000
Innovative	yes	no	no	no
Traditional	no	no	no	no
Investment next 5 yrs.	yes	yes	yes	no
Environmental protection	no	yes	yes	maybe

Source: Own calculations

In the second cluster, the holding managers grow other field crops (other than cereals, oilseeds and protein crops). The profit of the farm for the last year is over BGN 50 000. The investments in the last three years are in machinery and equipment. Farmers from this cluster cannot define themselves as innovators or traditionalists, they are rather neutral. Their opinion about the innovations in agriculture is that perhaps they are useful and facilitate the work process, but even without their use, good results are also achieved. Farmers intend to continue purchasing and investing in their holdings

in the next 5 years. Protecting the environment is important to farmers in cluster 2 and they strive to minimize the damages from the holding activities.

In the third cluster, the holding managers breed mainly dairy cattle. The profit of their holding for the last year is up to BGN 50 000. Farmers from this cluster, like the farmers from cluster 2, cannot define themselves as innovative or traditionalists, they are rather neutral. Environmental protection is important to producers in cluster 3, and they strive to use natural resources sparingly and to avoid polluting the environment as much as possible. Thefarmers indicate that they have invested in their farms in the last year as well as in the past five years, and their investments are mostly in machinery and equipment, animal breeds.

In the fourth cluster, holding managers breed sheep, goats and other herbivores. The profit of the farm for the last year is up to BGN 50 000. They have not made any investment in the holding in the last three years and do not intend to invest in anything in the next 5 years.

Farmers from this cluster do not define themselves as either innovative or traditionalists, they are rather not interested in modernizing agriculture. Environmental protection is not among the factors that encourage the farmers in cluster 4 to invest in innovations. This cluster includes the most pessimistic and desperate farmers who struggle to survive in the current state of the agriculture.

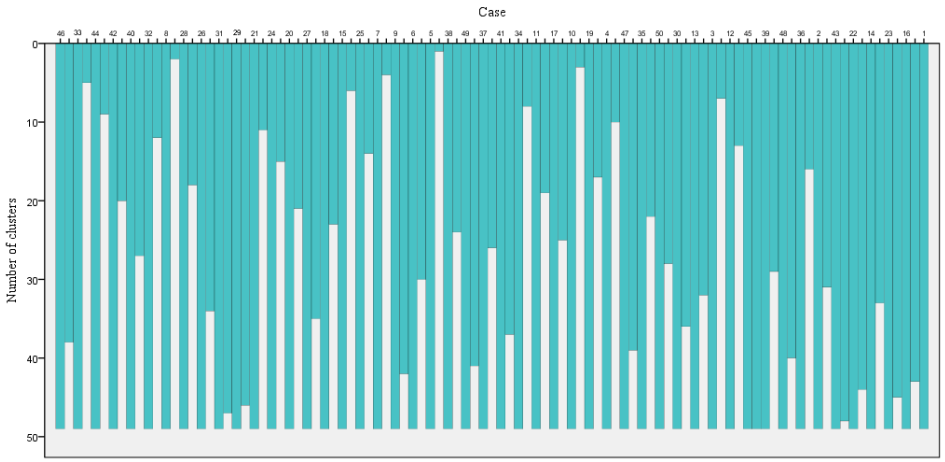

Fig. 1. Distances between the end cluster centers
Source: Own calculations

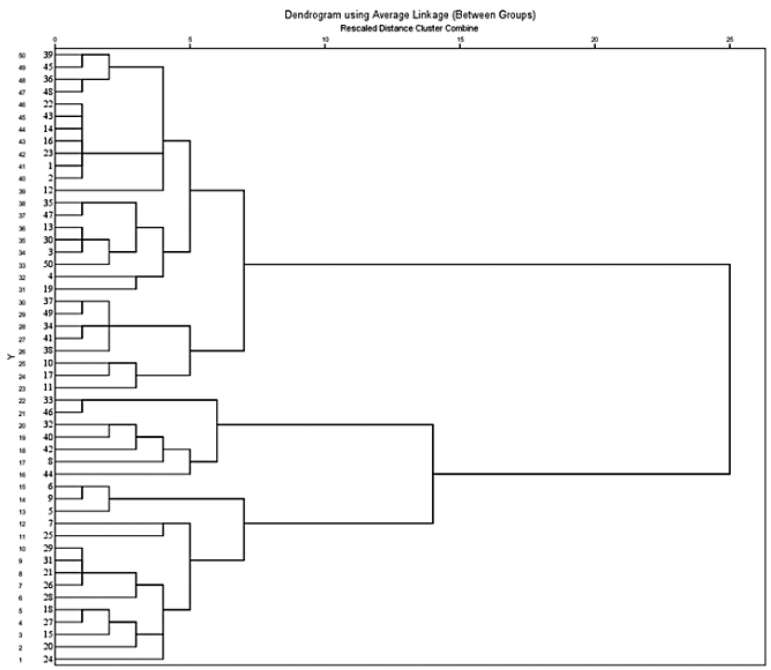

Fig. 2. Dendogram using average linkage
Source: Own calculations

Conclusions

The following conclusions are drawn from the conducted study:

- Farmers from cluster 1 are innovative, with modern thinking, and they benefit from the scientific achievements because they are certain of their effectiveness. This is probably due to their ability to invest in innovations, they have large farms with large incomes.
- Cluster 2 includes farmers who cannot define themselves as innovative or traditionalists, but intend to develop their holding and invest in it in the next 5 years. Environmental protection is extremely important to them.
- Farmers from cluster 3 differ from those in cluster 2 only by the type of their specialization – animal husbandry. There is an absolute match in their views on innovation and environmental protection. If the specialization of farmers from cluster 2 and 3 is not taken into account, they can be grouped into a new group, which will be a little less than half of the surveyed producers. This means that cluster 2 and 3 reflect the mass attitude of the farmers regarding the implementation of innovations in the holding.
- Cluster 4 includes holding managers who are pessimistic about the development of the agriculture, the innovations and the environmental protection. They do not develop their holdings. A possible reason for this could be low incomes and high prices of investments in innovations.

Based on the drawn conclusions, it can be generalized that the lack of awareness regarding the offered innovations and the limited capital available to the majority of the Bulgarian agricultural producers are the main obstacles to the mass implementation of technological innovations in the holdings. All this can change with an active government policy. It would be good to develop more extensive programs to address environmental issues and resource efficiency. These directions should be coordinated with other government actions within and outside the CAP that constrain and/or encourage farmers through subsidies, taxes and agri-environment contracts.

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