

## **RESEARCH OF THE INNOVATION CAPACITY OF AGRICULTURAL PRODUCERS**

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**Abstract.** Bulgarian agriculture lags behind global trends in innovation activity. This is largely due to the fact that it is carried out by predominantly small owners (farmers), who usually do not have a good opportunity to introduce innovations or they underestimate their importance. The results are reduced operational efficiency and problematic development sustainability.

Given this, the purpose of this publication is to briefly present the results of a study of the innovation capacity of a sample of Bulgarian farmers, as a condition for the activation of innovations. Such research has not yet been done in our country. The studied sample is not representative of Bulgarian agriculture, but the obtained results are indicative of the innovative possibilities of agricultural producers. Based on them, various comparisons can be made and analyzes relevant to theory and business practice can be carried out.

*Keywords:* agricultural; farmers; innovation; innovation capacity; determinants

### **Introduction**

Agriculture is extremely important for feeding the population and as a source of income. They are also of great importance for the development of regions and settlements in our country, especially given the depopulation of some of them. Improving their sustainable management and development is of great economic, demographic and environmental importance.

Agriculture in our country faces many problems. In many cases, it uses outdated approaches and tools, has low returns and damages the land and the environment. In doing so, it is considered to be one of the sectors that has the potential to increase its efficiency, reduce its impact on the climate and nature, while at the same time increasing its resilience to environmental shocks. The key word for success in this sphere of human activity is “innovation”. They mean better solutions for farmers and consumers, better quality of life and environmental sustainability.

Modern developments in science and technology show that there is no

better time to innovate in agriculture. However, Bulgarian agriculture lags behind global trends. This is largely due to the fact that it is carried out by predominantly small owners (farmers), who usually do not have a good opportunity to introduce innovations or they underestimate their importance. The results are reduced operational efficiency and problematic development sustainability.

In recent years, there has been a growing interest in the problems of innovation and innovation capacity in agriculture. The number of scientific publications dedicated to them is also growing, and many empirical studies are being carried out. However, a number of important issues, including the nature and measurement of innovative capacity of agricultural producers, are not sufficiently well developed.

Most of the authors focus their attention on the problems of the innovation capacity of the agricultural sector of the countries, in general, (Alejandro Nin-Pratt Gert-Jan Stads 2023; Grovermann et al. 2017), but not to individual farmers. For example, innovation capacity in agriculture is usually associated with the definition given by FAO: “Capacity to Adapt and Respond in order to Realize the Potential of Innovation” (Grovermann 2017). Another similar definition is “the ability of people, organizations and society as a whole to manage their affairs successfully”<sup>1</sup>. There are significantly fewer developments defining the innovation capacity of individual farmers. Such is the definition that connects innovation potential with the ability of companies to design and put into production a new or undeveloped product/service, to conquer new markets, to implement new processes, i.e. their ability to develop based on new knowledge, thereby deriving a competitive advantage (Krasteva 2018).

Given the above, the authors of this publication adopted the following working definition of the innovative capacity of the agricultural producer (adapted from Velev, Atanasova 2013; Velev et al. 2017): It is the ability of the agricultural producer to innovate and includes its ability to identify new knowledge from the external environment, to assimilate, create and use novelties of commercial significance, providing higher value for users and for itself.

In the specialized literature, various methods are presented for assessing the innovation capacity in agriculture. All authors point to the difficulties in achieving an accurate assessment given the multiple factors on which capacity depends (Tropical Agriculture Platform (TAP), 2016). Most often, the methodologies are for evaluating the innovation capacity of the agricultural sector of countries, as a whole (TAP 2016), but not of individual farms. Most of these are primarily descriptive and provide a qualitative assessment (Klerkx, Aarts, Leeuwis 2010). The number of methodologies based on quan-

titative assessment is relatively limited (Sartas et al. 2017; Schut et al. 2015), but they also focus on soft skills. Such, for example, is the one developed by (TAP 2016), which offers an assessment of the general innovation capacity based on four assessments that make it up: Capacity to Navigate Complexity; Capacity to Collaborate; Capacity to Reflect and Learn; Capacity to Engage in Strategic and Political Processes. Later, this methodology was supplemented with two more formative assessments (Grovermann 2017) – Technical skills; Enabling environment.

In our country, research has been done on the innovative activity of agricultural producers (Bachev, Milanova 2019; Bachev, Labonne 2000; Koteva et al. 2021, Lyubenov 2011, etc.), but no full research has been done on their innovation capacity, as a condition for activating innovation. This is especially true for small producers. E. Krasteva (2018) offers a three-step approach for evaluating the innovation capacity of individual agricultural producers, including: 1. Carrying out a SWOT analysis at the sector level for the region in which the specific business organization operates; 2. Conducting an internal technological audit in a specific organization from the sector; 3. Benchmarking and comparison of leading factors. A weakness of the approach is its descriptive nature and strong subjectivity in assessments.

Given the above, the purpose of this publication is to briefly present the results of a study of the innovation capacity of a sample of Bulgarian farmers. Although the studied sample is not representative of Bulgarian agriculture, the obtained results would be indicative of the innovative possibilities of agricultural producers. Based on them, various comparisons can be made and analyzes relevant to theory and business practice can be carried out.

### **Methodology**

The research is based on our own methodological developments and was conducted using the survey method in 2023. The researched sample includes Bulgarian farmers from different regions. The prepared survey questionnaire was sent by mail and e-mail, but a large part of the information was collected by telephone and workplace interviews. Owners and managers of farms were surveyed. Statistical methods and specialized software (IBM SPSS, Google Forms, Canva Pro, etc.) were used to process and analyze the information.

The main hypothesis of the study is: *the level of innovation capacity in agriculture is low, and it is the lowest among small producers.*

For the purposes of the study, an algorithm adapted by the authors for the assessment of innovation capacity was used, based on the developments of (Velev, Atanasova 2013; Velev et al. 2017, Idriz 2019), taking into account the peculiarities of agricultural producers. The following system of key determinants of the innovative capacity of agricultural producers was used (Velev, Tsvetanova, Veleva 2019):

1. Clearly defined company goals and innovative strategies;
2. Entrepreneurial capabilities of management;
3. Share of personnel with higher education;
4. Share of personnel with technical education (secondary and higher);
5. Staff experience;
6. Company culture promoting the search for and the introduction of novelties;
7. Level of production base;
8. Degree of development of innovation activity;
9. Financial possibilities of the agricultural producer;
10. Extent of use of ICT;
11. Possibilities of the agricultural producer to market the results of the introduced new technologies.

The higher degree of development of the determinants favors the rapid assimilation of novelties by the agricultural producer and vice versa. The level of development of these factors is a consequence of the efforts made by the manufacturers so far. Therefore, clarifying the possible benefits of changing the levels of one or other of these factors is of great importance in determining priorities in developing strategies and in targeting management impacts.

The levels of development of the determinants of the innovative capacity of the relevant agricultural producer are evaluated by the surveyed owners on a scale from 1 to 7, where 1 is the lowest level of development, 7 is the highest level of development.

The impact of the determinants and the innovation capacity on the following types of innovations that the agricultural producer could implement was reported<sup>2</sup>:

- product innovations – T1;
- process innovations – T2;
- organizational innovations – T3;
- marketing innovations – T4;
- complex innovations – T5.

Complex innovation here means the simultaneous implementation of several types of interrelated innovations. For example, simultaneously realized product and marketing innovation caused by it, etc. This type of innovation also includes the overall innovation of the business model.

The individual determinants of innovation capacity have different significance for the formation of the agricultural producer's ability to innovate. They influence differently, both in the implementation of different types of innovation, and on innovation capacity, in general. The importance of the determinants of innovation capacity is determined by the surveyed manufacturers in the range of 1 to 7.

Taking into account the relative importance of the determinants and the levels of their development, weighted estimates of the strength of their impact on the farmer are determined. They are determined by individual types of innovation ( $P_{ij}$ ) and overall innovation capacity ( $O_i$ ).

The formulas are used:

– For an individual type of innovation:

$$P_{ij} = N_i \cdot t_{ij} \quad (2)$$

The value of the calculated indicator is in the range from 1 to 49.  
and

– Averaged over all types of innovation

$$O_i = \sum_j^5 N_i \cdot t_{ij} / 5$$

The value of the calculated indicator is in the range from 1 to 49.

where:

$P_{ij}$  – weighted assessment of the impact of the  $i$ -th determinant ( $i = 1-11$ ) on the ability of the agricultural producer to implement innovations of the  $j$ -th type ( $j=1-5$ )

$N_i$  - degree of development (level) of the  $i$ -th determinant at the farmer;

$t_{ij}$  – importance of the  $i$ -th determinant of the innovation capacity for implementing innovations of type  $j$ ;

$O_i$  – weighted average estimate of the power of impact of the  $i$ -th determinant on the capacity of the agricultural producer to carry out innovations of all kinds.

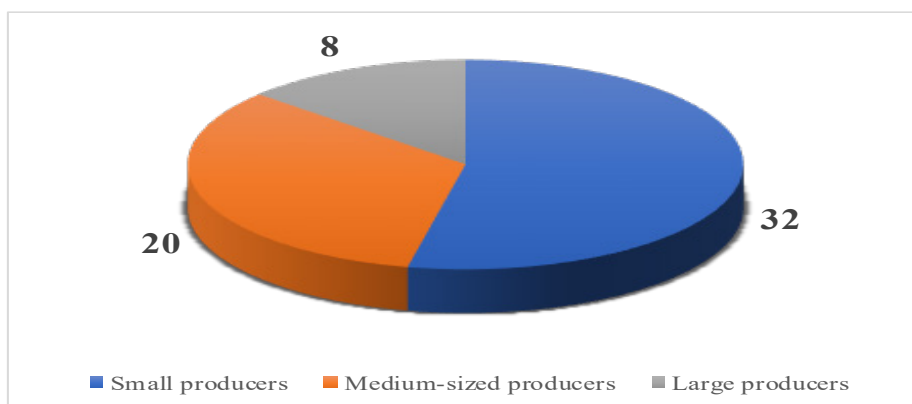
The value of the indicator of the innovative capacity of the agricultural producer is defined as the sum of the weights of the evaluations of the impact of each of the determinants ( $O_i$ ), i.e.:

$$A_K = \sum_{i=1}^{11} O_i / 11$$

The value of the calculated indicator is in the range from 1 to 49.

### **Main results**

The research was conducted among agricultural producers in the regions of Sofia, Dobrich and Plovdiv. The authors tried to cover a larger number of small and medium-sized producers, given their predominant number in the country. A total of 60 farmers were surveyed, of which 32 were small producers, 20 were medium-sized and 8 were large producers.



**Figure 1.** Distribution of surveyed farmers by size

For the purposes of this publication, the results of the research on the innovation capacity of agricultural producers are summarized by the size of the farms and for the entire studied sample. Due to the limited volume of the publication, the results for small farms will be presented in more detail, and for the rest only the final results for innovation capacity and its determinants will be presented.

The average values of the levels of development of the determinants of innovation capacity of farmers with different farm sizes are shown in the following table:

**Table 1.** Level of development of the determinants of innovation capacity of farmers – average values

Determinants of innovation capacity (i)	Small farmers	Medium-sized farmers	Large scale farmers	Total
Clearly defined company goals and innovative strategies	2.0	2.75	2.8	2.36
Entrepreneurial capabilities of management	4.0	4.5	4.5	4.23
Share of personnel with higher education	2.0	3.75	3.0	2.72
Share of personnel with technical education (secondary and higher)	2.5	2.5	2.6	2.51

Staff experience	4.0	4.0	3.5	3.93
Company culture promoting the search for and the introduction of novelties	2.2	3.0	3.5	2.64
Level of production base	2.4	2.0	3.0	2.35
Degree of development of innovation activity	2.0	3.2	3.5	2.6
Financial possibilities of the agricultural producer	1.4	2.5	3.0	1.98
Extent of use of ICT	2.2	4.5	4.0	3.21
Possibilities of the agricultural producer to market the results of the introduced new technologies	1.8	2.0	4.0	2.16

The average values for the development of the determinants for the whole set of studied farmers show their alarmingly low level. Their level is low in all three studied groups, according to the size of their holdings. As expected, the results are worst for small farms, and better for large ones.

The lowest is the level of the determinant “Financial possibilities of the agricultural producer”, which indicates one of the possible guidelines for supporting farmers from the state. In the case of small producers, the level of the determinant “Opportunities of the farmer to market the results of the introduced new technologies” is particularly low, which also indicates the need for support.

From the table it can be seen that despite the better condition of large farms, they have lower results for two of the determinants. One is “Share of staff with higher education”, which is not due to the smaller number of such staff, but to the larger total number of staff with lower qualifications. The other determinant is “Staff Experience”. The lower level of this determinant in large farms is the result of their practice of employing a large number of seasonal workers with low experience and of the significant staff turnover.

For all three groups of agricultural producers, according to their size, the level of the determinant “Entrepreneurial capabilities of management” is the highest. To some extent, this can be taken as a higher self-esteem of the surveyed owners who gave these answers.

The low levels of development of the determinants of the innovative capacity of agricultural producers do not create prerequisites for the develop-

ment of their innovative activity, but rather hinder it. Moreover, it can be assumed that they are an obstacle to the overall development of agricultural holdings, and therefore to agriculture in general.

There are a number of reasons accumulated over the years for the indicated low levels of development of the determinants of the innovation capacity of agricultural producers. But it should be noted that the majority of them are internal to the holdings and are the result of the insufficient efforts of the agricultural producers themselves and of their management skills.

In this regard, the summarized results about the importance for the future development of innovations and of the agricultural holdings themselves, which the agricultural producers attribute to the various determinants, are interesting. It is significant that all three groups of farms, according to their size, consider the determinants important for development, with the ratings given being significantly higher than the ratings for their levels. This can also be seen in Table 2, which shows the importance of the determinants for different types of innovation, according to the average ratings of small farm owners

**Table 2.** The importance of determinants for different types of innovation (average for small producers)

Determinants of innovation capacity (i)	Significance of the determinants for the relevant innovation (t <sub>ij</sub> )				
	T1	T2	T3	T4	T5
Clearly defined company goals and innovative strategies	4.0	4.2	3.2	3.0	4.5
Entrepreneurial capabilities of management	5.2	4.8	3.0	3.4	5.0
Share of personnel with higher education	4.2	4.0	2.5	3.0	4.0
Share of personnel with technical education (secondary and higher)	2.2	4.2	2.0	1.5	3.5
Staff experience	3.8	3.2	2.5	2.5	3.0
Company culture promoting the search for and the introduction of novelties	4.5	4.0	3.2	3.0	4.0
Level of production base	3,5	4.0	2.2	2.0	3.4

Degree of development of innovation activity	3.6	3.8	2.5	1.5	3.5
Financial possibilities of the agricultural producer	4.5	6.0	3.4	3.0	5.0
Extent of use of ICT	2.2	3.4	4.0	3.5	3.6
Possibilities of the agricultural producer to market the results of the introduced new technologies	5.2	4.0	2.0	3.2	4.5

It is significant that the small farmers evaluate as relatively more significant precisely those determinants, the level of which is low in their holdings. This assessment is a reason for optimistic expectations because it may indicate that they will put more effort into the future development of these determinants.

The following table shows the weighted estimates of the influence of the determinants on the innovative capacity of agricultural producers, i.e. the estimates of the levels of the determinants adjusted by their importance.

**Table 3.** Weighted estimates of the influence of determinants on the innovative capacity of farmers

Determinants of innovation capacity (i)	Weighted estimates of the influence of determinants (O <sub>i</sub> )		
	Small farms	Medium-sized farms	Large scale farms
Clearly defined company goals and innovative strategies	7.56	9.4	10.7
Entrepreneurial capabilities of management	15.0	17.0	17.4
Share of personnel with higher education	7.08	13.4	12.0
Share of personnel with technical education (secondary and higher)	6.7	7.0	7.2
Staff experience	12	12.6	10.8
Company culture promoting the search for and the introduction of novelties	8.23	10.8	13.2

Level of production base	7.25	6.6	9.2
Degree of development of innovation activity	5.96	10.0	10.6
Financial possibilities of the agricultural producer	6.13	10.2	13.4
Extent of use of ICT	7.35	15.0	14.8
Possibilities of the agricultural producer to market the results of the introduced new technologies	6.80	7.8	14.6

According to the responses given by the respondents, the determinants “Share of personnel with technical education” and “Level of production base” have the lowest impact on innovation capacity. This is clearly one of the features of agriculture. In industrial enterprises, it is the technical staff who are the main initiators and implementers of innovations, and the level of the production base to a significant extent is the condition for their implementation. In agriculture, the main innovations are related to the introduction of new agricultural crops and the transfer of already proven techniques, which do not require a great technical qualification.

The values of the calculated indicators for the innovation capacity of farmers with different farm sizes are shown in Table 4.

**Table 4.** Innovation capacity of agricultural producers with different farm sizes

Farm Size	Innovation capacity
1. Small farms	8.19
2. Medium-sized farms	10.89
3. Large scale farms	12.17
<b>Total for the sample of farms</b>	<b>9.62</b>

The obtained results give reason to assume that the main hypothesis of the study has been proven, i.e. the level of innovation capacity in agriculture is low, and it is the lowest among small producers. Moreover, the comparison of the obtained values for this indicator with its theoretical maximum (49) shows the weed condition in agriculture.

Of course, it should be emphasized that the studied sample is not representative of Bulgarian agriculture. Nevertheless, the obtained results are indicative of the

innovative capabilities of agricultural producers. Based on them, various comparisons can be made and analyzes relevant to theory and business practice can be carried out.

The results indicated here are the basis for future research related to the evaluation and comparative analysis of the innovation capacity of farmers from different regions of the country, with an analysis of the dependence between the level of innovation capacity of farms and their innovation activity, etc.

### **Conclusion**

Bulgarian agriculture, which is traditionally one of the leading sectors of the economy, lags behind in its development compared to world trends. This is mainly due to the low innovation activity of agricultural producers. At the same time, agriculture has the potential to increase its efficiency, reduce its impact on climate and nature, while increasing its resilience to environmental shocks. More and more farmers are realizing the importance of innovation and making efforts to improve innovation capacity.

In this regard, the results obtained from the study and partially presented here can be useful for clarifying the real state of innovation capacity and its determinants in agriculture. They also provide guidelines in which farm owners can make efforts to improve their innovation activity, as well as priorities for state support.

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### **NOTES**

1. OECD DAC Network on Development Evaluation (2010), <http://www.oecd.org/dac/evaluation/dcdndep/41612905.pdf>.
2. OECD and Eurostat. 1997. Oslo Manual – Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, Paris.

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