Farmers' adaptation: what factors affecting agricultural innovations?

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Abstract

This paper addresses the question which factors influence a farmer's decision to adopt an innovation. A basic prerequisite for improving the competitiveness and sustainable development of farms is the degree of implementation of innovations in their activities. The aim of the paper is to present the results on the socio-demographic and economic profile of the innovative groups in agriculture and innovation intentions underlying factors. The results have been obtained from the achievement of the project "Agricultural Innovations Management" in the Institute of Agricultural Economics", led by Prof. Dr. D. Nikolov (IAE, 2013-2014). The research question is related to the analysis of the specifics of farmers reflects the innovative potential and demand factors influencing the behavior of innovative farmers in rural areas.

Keywords: Agricultural innovations, intentions, socio-demographic factors, economic profile, innovative groups.

Introduction

"Innovations are considered as main engine of the economic growth on the base of the economics of the knowledge" (OECD, 1997) although, according to (Dargan and Shucksmith, 2008) the social and cultural dimensions of innovations have been often underestimated. They claim that "innovation policies have been frequently examined as a main factor of competitiveness improvement for certain region". Innovations have been developed not only by scientists, they have been applied by the advisory systems in agriculture and they have been created not only in urban areas. "In the majority of researches subject of analysis are technological aspects of innovations, the development of new products. Independently of the fact that the actual innovations could be implemented only by big transnational companies, which could fund this process, current researches have revealed the fact that innovation in rural areas are possible". Many of the recent analyses have shown that innovations arise without scientific knowledge".

The opportunity for innovations implementation in small farms in rural areas has primordial significance for their development (Steiner et al., 2011). These authors analyze the farmers' innovative behavior in these areas, through the prism of the theory of regional innovation and the conceptions for the innovative environment. They examine the reflection of the specific regional environment on the innovative potential and the searching of factors, influencing the behavior of innovative farmers in rural areas. They conclude that the range of innovation potentials in the analyzed regions "are not an automatic result of this specific field, but they are connected to the organization and popularization of revealed factors for innovation activity" (Steiner et al., 2001).

European Council has underlined the importance of the participation of regional and local authorities in the elaboration and realization of EU programs results (Bachtler J., 2007). The EU policy target (encouragement of growth, innovations and competitiveness) could be accomplished only "if it is property of all stakeholders – on European, national, regional and local level" (Bachtler J., 2007). "Specific particularities and rural areas' potential for innovations deserve special attention" (Steiner et al., 2011).

In the framework of the second CAP pillar have been created new opportunities for the small farmers, in order to reach the international markets, but these opportunities are considerable challenges for them. To enable the products reaching the consumers, different stakeholders should interact in network chains, which are extremely complex systems (Ruben and Slingerland, 2006), characterized by resource and information streams on different chain

stages. While a part of agricultural producers have profited by their interaction in these value-added chains, lot of farmers, especially in Bulgaria, have obtained a decrease of incomes in result of the agricultural prices volatility. Despite this, the advantages for the farmers are not limited only to incomes increase, but also to improvement their ability to react and to adapt to different kinds of risks and market failures. (Mendoza and Thelen, 2008), so it is necessary to improve their capacity for innovation. Innovations in agriculture (including the food chains) are very important; having in view that one quarter of the population depends from this activity. The innovation is not a linear process, but a complex, dynamic and random process (Kanter, 1994). These formulations underlie the conception of agricultural innovation systems (World Bank, 2006).

There are different new approaches, used to make the agricultural value more attractive and to help the decrease of poverty in rural areas. Nevertheless, the chances for innovations diminishes when innovation approaches are attached to a particular implementation system, forced to comply with expected impacts, without taking into account the farmers' sensitivity to innovations. One of most actual debates is related to the conception of agricultural innovation systems and the advantage of scientific researches and results in agriculture. The critique could be that these results have not been transformed in tangible benefits improving the poor people's life (Clark, 2001), so there is a difference between the scientific knowledge and practice. To fill this gap and other similar gaps between participants, caused by cognitive or institutional differences, some authors underline the significance of educational platforms, covering borderline disciplines, protected spaces or niches and dialogical spaces (Leeuwis, 2004), in which the participants could communicate, study and discover new options or more effective innovations.

At the moment, Europe does not succeed to transform completely the knowledge in products, which could be proposed on the market. That is why the question "How to stimulate the innovations' generating and implementation in agriculture?" is not related only to the technical side. It is important to analyze the opinion of agricultural producers about the compatibility between the new technical decisions and the predominant management requirements and the respective social-organizational conditions (Leeuwis, 2000). This means that farmers should be in condition to determine themselves their strategic aims, to participate actively in the perfection of their own experience and knowledge within the training process.

Farmers must constantly adapt their activities and management systems, in order to maintain and increase the competitiveness and the viability of their business. The elaboration and implementation of innovations is connected to farmers' willing to change their daily routine activities. The training and the knowledge transfer between farmers for the development and implementation of innovative ideas have importance for the sustainable growth of the production of food or other agricultural products.

In the present paper is made analysis of factors affecting the innovations' implementation in farms, their social-economic profile and farmers' innovation intentions.

Methodology

The following methods have been implemented: Rogers' model for farms grouping, according the level of innovation intentions; statistic groupings; econometric modeling for establishment of quantitative relation between farms' economic potential and innovation activity level; statistical analysis and method of the survey. Data have been used from a realized survey, representative for the country, among 333 farmers. The farmers' intentions have been analyzed in the following innovation areas: agricultural machines, technique, equipment; production technologies; crop varieties; animal breeds; biological methods and preparations to fight diseases and pests; methods and medicines for animals' treatment;

irrigation methods; information technologies.

In the classical variant the Rogers' model is implemented for the analysis of factors having the strongest impact on the decision making for buying a new user's product (Yordanov, R., 2009; Rouskova, S.2012). The Rogers' model is based on the comprehension that the stages of innovation, in order to be socially accepted, are the following: awareness (people have learned about innovation, but do not have the detailed information); generation of interest (individuals are interested in the new idea and look for information); assessment (persons imagine the innovation implementation in the present moment); testing (the innovation is tested in a limited range, aiming the appraisal of the satisfaction degree from the new product); complete assimilation – full utilization of the innovation.

Taking in consideration the innovations' specificity in agriculture, farms have been divided in four main groups: innovators; early-adoption of innovations: late-adoption of innovations; inert persons.

The included in the research factors have been generally divided in motivating, demotivating and third kind of determinants, namely: social-demographic characteristics of the farm manager; economic size of the farm; production specialization; field production conditions of the farm: plains, hills and mountains; type of the implemented agricultural system: traditional or biological; duration of farms' functioning. The group of factors motivating the agricultural innovation implementation includes the following factors: *1) Production*: Receiving of higher yields; Obtaining of higher livestock productivity; *2) Economic (financial)*: Realization of higher profit; *3) Social:* Time saving; 4) *Ecological*: Lower environment pollution and nature protection.

The group of demotivating factors having negative impact on the decision taking for innovations implementation in farms are the following: *1) Financial:* Lack of necessary financial funds; *2) Market:* Lack of enough markets for agricultural innovations; Lack of necessary information for innovations in agriculture; *3) Social-psychological:* Unwillingness for risk taking at the implementation of innovations in agriculture; Attachment to old production methods and means; *4) Subjective:* Lack of necessary qualification and skills.

To establish the innovation activity level has been applied the method of average weighted values. For each farm is given a weight of 0 to 4, according to the degree of readiness to implement innovation. The farm obtains maximal value 4 when it has the firm conviction to make innovation in its production activity. Analogically, on the other pole, having weight 0, are farms which are categorically against the implementation of some kind of innovation. The intermediate values (1, 2 and 3) receive farms, having different variations of hesitation regarding the implementation of some kind of innovation. After the alignment to the classic scale of measurement, the maximal admissible value of the coefficient of innovation activity is 1 and the lowest value is 0. In correspondence to this coefficient's results, there are 3 differentiated levels of innovation activity: *low,* between 0 and 0,33; *medium,* with values from 0,34 to 0,66; *high,* the coefficient varies between 0,67 and 1.
In addition, are presented some results from n Empirical Sociological Survey,(ESS) carried out by an interdisciplinary team in 2008-2012 "Ecological culture of the agricultural producers" (Anna Mantarova, Plamena Yovchevska and all.). The data are representative for the villages in Blagoevgrad region.

Results

The purpose of the economic-statistical models elaboration is to establish the quantitative relation of the farms' economic potential from their innovation activity. According the level of farms' economic potential, evaluated through the standard production volume, the analyzed farms are separated in three groups. In each group the model of the

relation “Standard production volume and factor of real innovation activity level” has been specified. The information for the real innovation activity level is obtained after the analysis of answers of the following question from the questionnaire: “Which types of innovations have been implemented in the farm up to the present moment?” The idea is to define the degree of economic size of the farms, on the base of the obtained quantitative expression of the correlation. The specified three groups of farms are the following: the first group includes farms with standard production volume up to 4000 EUR; the second – farms with standard production volume between 4000 and 8000 EUR and the third – farms having economic potential between 8000 and 16000 EUR.

According the achieved results from the research (Fig.1), there is a prevalence of farms qualified as early-adopting agricultural innovations. These are the farms which have the awareness of the necessity of innovations implementation in agricultural production, but they did not make the decision to realize them. They are more inclined to invest in innovations if they have this opportunity than to neglect it.

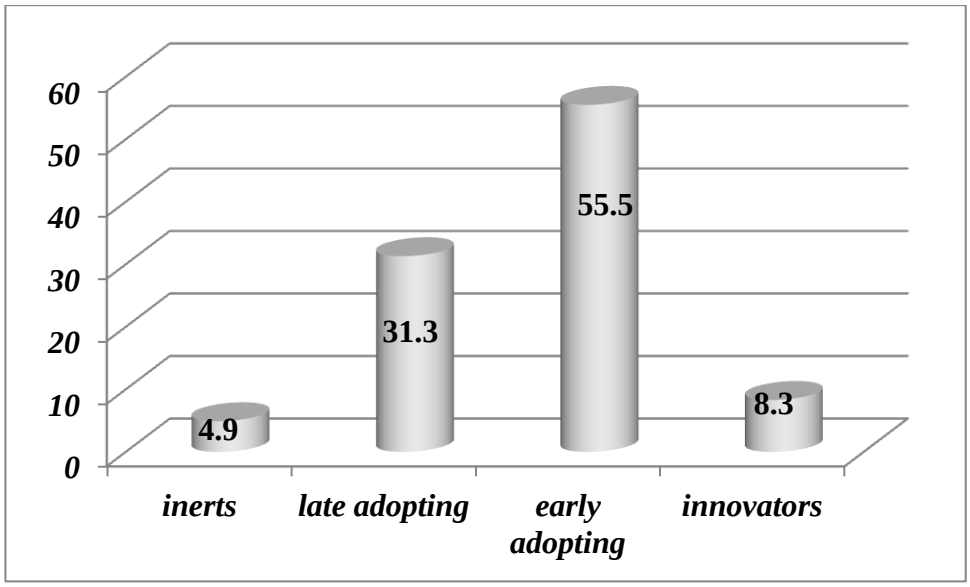

Figure 1. Main farms groups, according their intentions to innovations
Source: Own evaluations

The main reason for the insufficient determination is grounded in the lack of enough funds, which is on the first place (45,9%) among the indicated reasons for the potential refusal of innovation technologies’ use. The solution for the farmers is in the opportunities of EU structural funds.

The second place of demotivating factors in the early-adoptive farms occupies the lack of sufficient markets for innovations in agriculture (24,6%). The next places are for the unwillingness to undertake a risk of innovations implementation and the lack of necessary qualification and skills – 9,8 %. After this two factors is the “Lack of necessary information” (8,2%).

The second group of agricultural producers is of agricultural producers, late-adopting innovations. This group includes farms preferring the old traditional approaches and methods in agricultural production. They adopt hardly the new discoveries of agricultural science, techniques and technologies and do not manifest big interest to their implementation in the agricultural activity. These farmers do not deny completely innovations in agriculture, but

they would rather avoid the risk and would not invest in innovations for the agricultural practice.

Central place in the structure of demotivating factors takes also the lack of funds (54,2%). For this group of farmers the mentioned reason has bigger importance than for the early-adopting group, where this factor also has the first place.

The factor "Lack of necessary information" for the late-adopting group has less influence on the formation of negative attitude to the innovations implementation, in comparison to the early-adopting group. (2,4 times less).

The persons from this group, which still would take steps towards innovations' implementation, would rely mostly on EU structural funds - 45,7% of them have indicated these funds as a source of necessary resources for the wanted innovation acquisition.

According achieved results from the Rogers' model, there are two other groups of farmers: innovators and inert farmers. The share of innovators is 8,3% of all farmers, which means that one of every 12 persons, participated in the survey could be counted as innovator. These agricultural producers are very strongly motivated to implement innovations. They are farmers believing in advantages of innovative decisions in agricultural area and would do all the possible to adopt them in their activity. The amount of proper funds is insufficient for innovators also and they rely on the EU structural funds for the purchase of agricultural innovations – 34 % of them. This indicator makes this group almost equal to the early-adopting group. The importance of different factors for the formation of positive attitude to innovations in agriculture could be seen on Fig. 2.

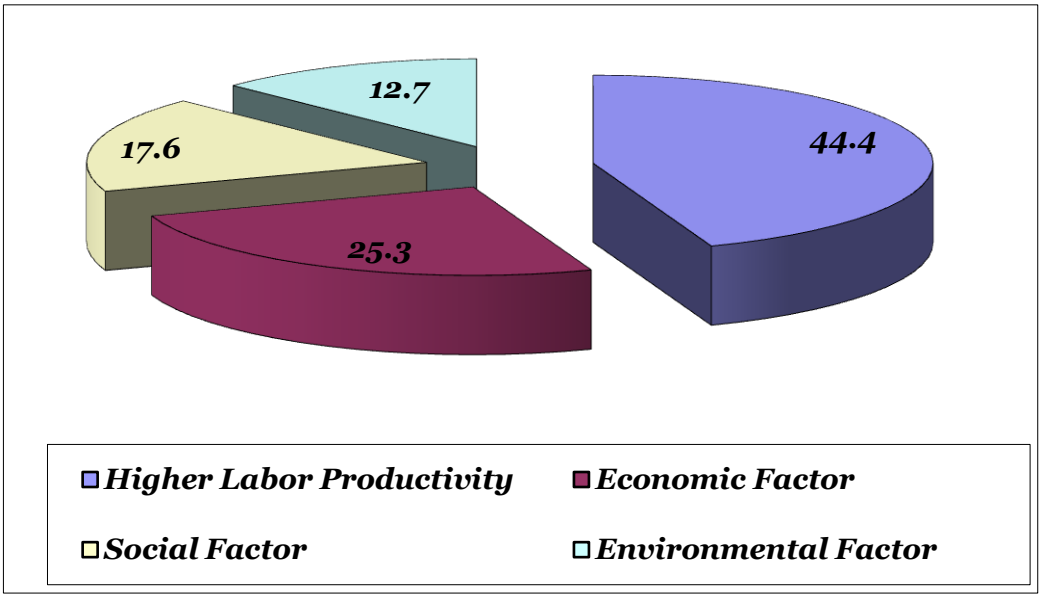

Figure 2. Structure of factors motivating the innovations' implementation
Source: Own calculations

The group of inert farmers is barely 4,9% of all analyzed persons and this is the smallest group. This fact is enough optimistic. They are farmers, for which the demotivating reasons for the decision of agricultural innovations implementation are strongly expressed. Practically, none of them has given even one reason to stimulate the willing to buy innovation for the agricultural practice. It is certain that this farmers' group would hardly change the attitude and intentions to information and market demand of innovations. Main role for the negative innovation behavior has the factor "Lack of necessary financial funds" – 60 % of inert respondents have given this answer. It is obvious that despite the primary importance of

financial resources for all the analyzed groups, in the last case they have the strongest impact (Fig. 3).

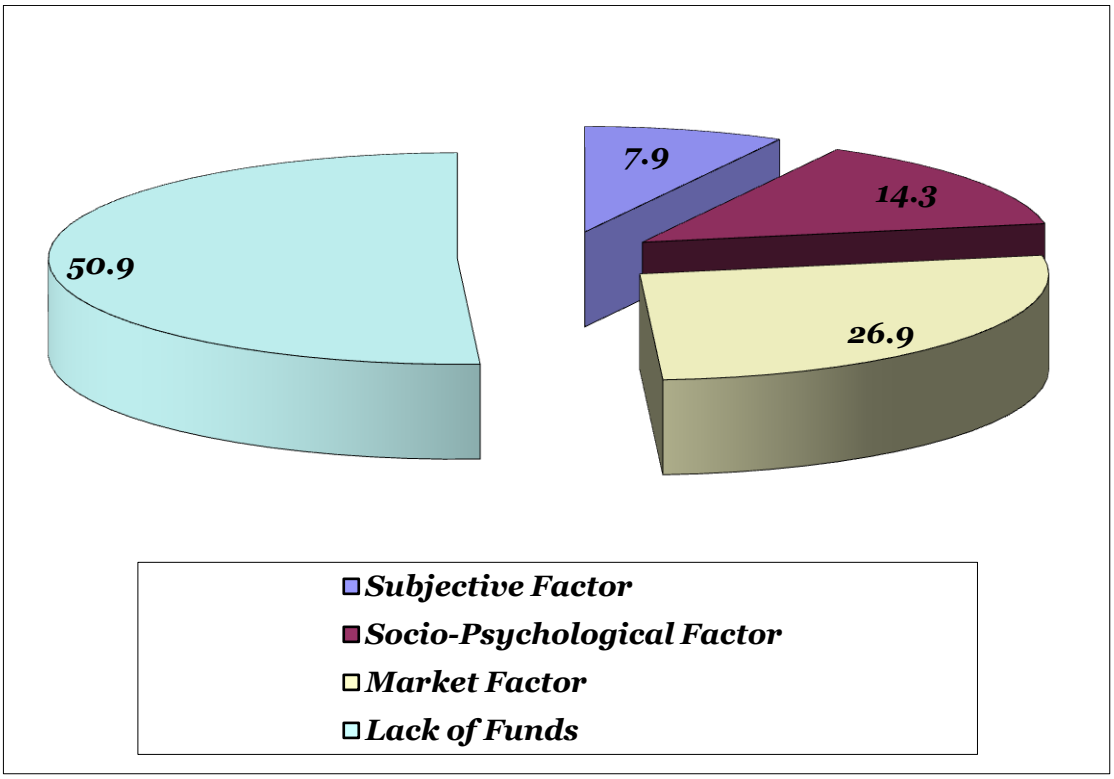

Figure 3. Structure of factors with the highest negative impact on the lack of willing to implement innovations
Source: Own calculations

The effect of examined above motivating factors, led to formation of main innovative groups, corresponds with the farms' social-demographic, physic and economic indicators. From all demographic indicators the education degree has the strongest impact on the potential orientation to innovations in agriculture (correlation coefficient 0,734 from Table 1).

Table 1.
Correlation coefficients between the level of innovation activity and the social-demographic characteristics

	Demographic characteristics		
	Age	Education degree	Sex
Correlation coefficient R	0,358	0,734	0,299

Source: Own calculations

From the persons having higher agricultural education 13,3% have high degree of innovation activity at 9,3 % average in the sample; the share of these with medium activity reaches 63,3% at average 47% in the sample. Almost twice lower is the share of agricultural specialists with higher education with low level of innovation activity (23,3%) in comparison to the share of this group in all analyzed aggregation (44,1%) (Figure 4).

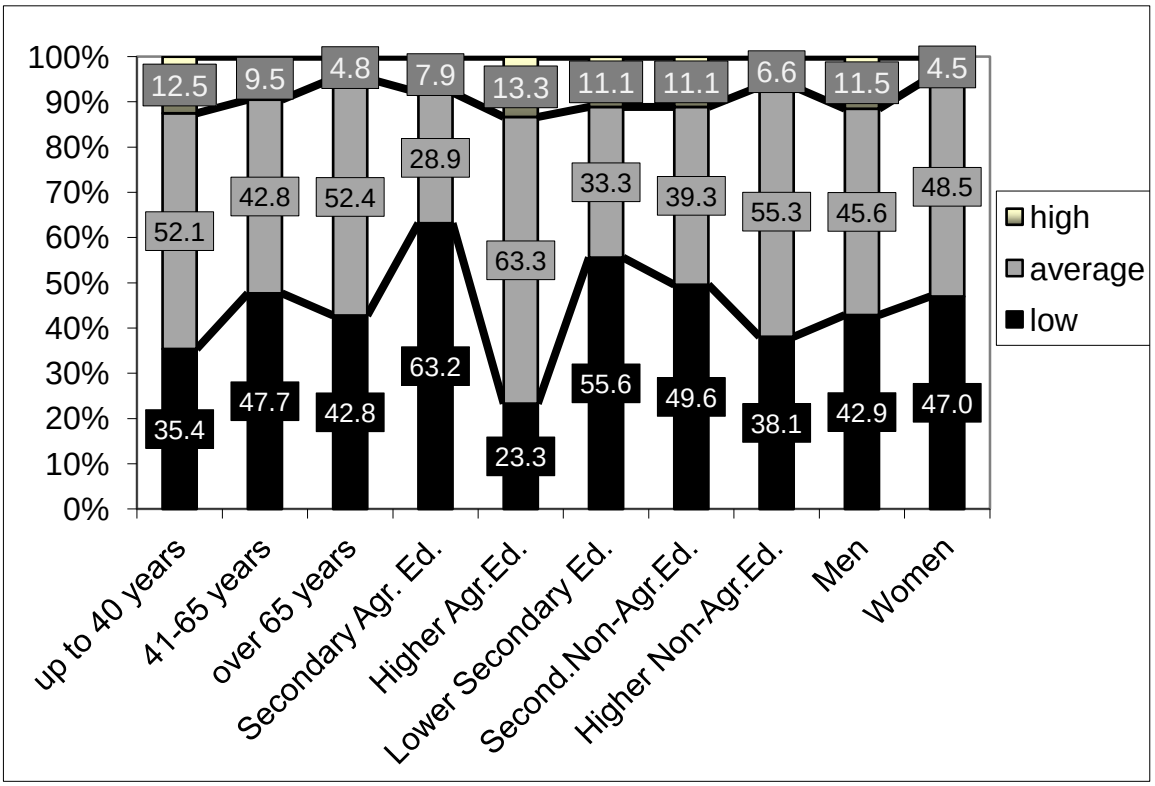

Figure 4. Level of innovation activity in farms, according their social-demographic profile
Source: Own calculations

Predictably, the younger farmers from the age group up to 40 have higher activity, over the average for the sample. For this group the relative share of farms with medium and high degree of innovation activity prevails the established values of the sample and they are respectively 52,1% and 12,5%. In other two age groups – from 41 to 65 and over 65 years some differences have been identified regarding the share of the most inclined to innovations. Completely understandable is the nearly twice lower share of farms having high innovation activity level, compared to the average for the sample. The indicated differences between age groups are not particularly important, which corresponds to the correlation coefficient (0,358) and proves the presence of moderate dependence between the innovation activity and the age. Almost the same impact power has the indicator "sex", the men have higher innovation activity.

The research has shown that some common characteristics of farms affect also the formation of respective interest to agricultural innovations. These characteristics hare classified in the following groups: production method – traditional (conventional) and predominantly traditional or organic and predominantly organic; production direction; duration of farm's functioning from its creation until the moment of survey leading. It must be noticed that according the calculated value of the correlation coefficient, which varies between 0,367 and 0,543 the impact of the four analyzed characteristics is moderate (Table 2).

Table 2
Correlation coefficient between the innovation activity level and some typological characteristics of farms

	Some typological characteristics of farms			
	Relief	Type of farm (traditional, organic)	Type of farm (per production direction)	Age of the farm
Correlation coefficient R	0,489	0,367	0,543	0,487

Source: Own calculations

The farms typology, according their production direction, has relatively bigger importance. Farms of mixed type have the highest orientation to innovations (Fig. 5).

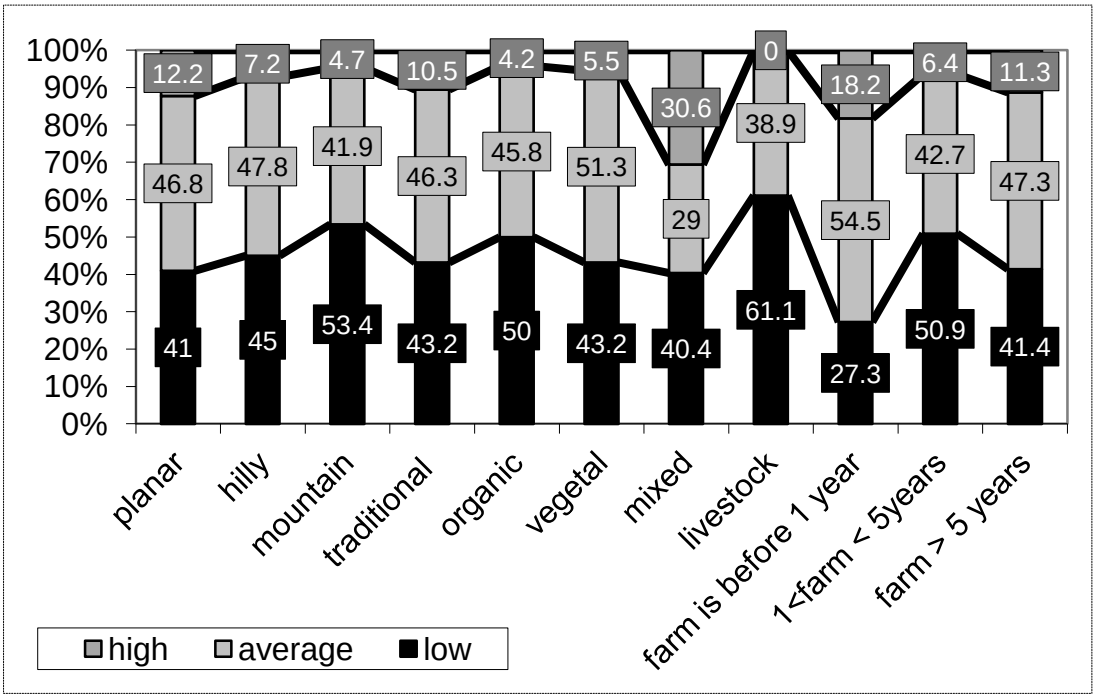

Figure 5. Level of innovation activity, according some farms' typological characteristics
Source: Own calculations

For this group the share of farms having high degree of innovation activity reaches 30,6%. Unfortunately among animal farms there is a lack of farmers with high innovation level. Farms, created recently (before 1 year) have stronger inclination to implement innovations (almost twice above the average for the sample) in comparison to other farms. The created and functioning from more longtime (between 1 and 5 years) are weakly oriented to innovations from the science, the techniques and technologies for agricultural production (barely 6,4% of them have high level of innovation activity and more than half of them manifest low level. To some degree this fact could be explained by the "young" age of farms in this group and the implementation of newer production methods, thus the need for innovations is strongly expressed. For the "older" farms (over 5 years of existence) the level of innovation activity is close to the average for the sample. It is obvious that these farms

have adopted definite labour methods and tools and they do not have the willing to change the technical and technological environment of their functioning.

Results about the quantitative assessments of the farms' economic potential in relation to the innovation activity show that on average, one farm from the group having Standard Production Capacity up to 4000 EUR will increase its economic size of 28,1% , at a condition to implement at least one innovation. For the group with size from 4000 to 8000 EUR this increase would be of 47%.

Among the groups of innovators, early-adopting and late-adopting innovations, the strongest interest is manifested toward new agricultural machinery, technique and equipment (Fig. 6).

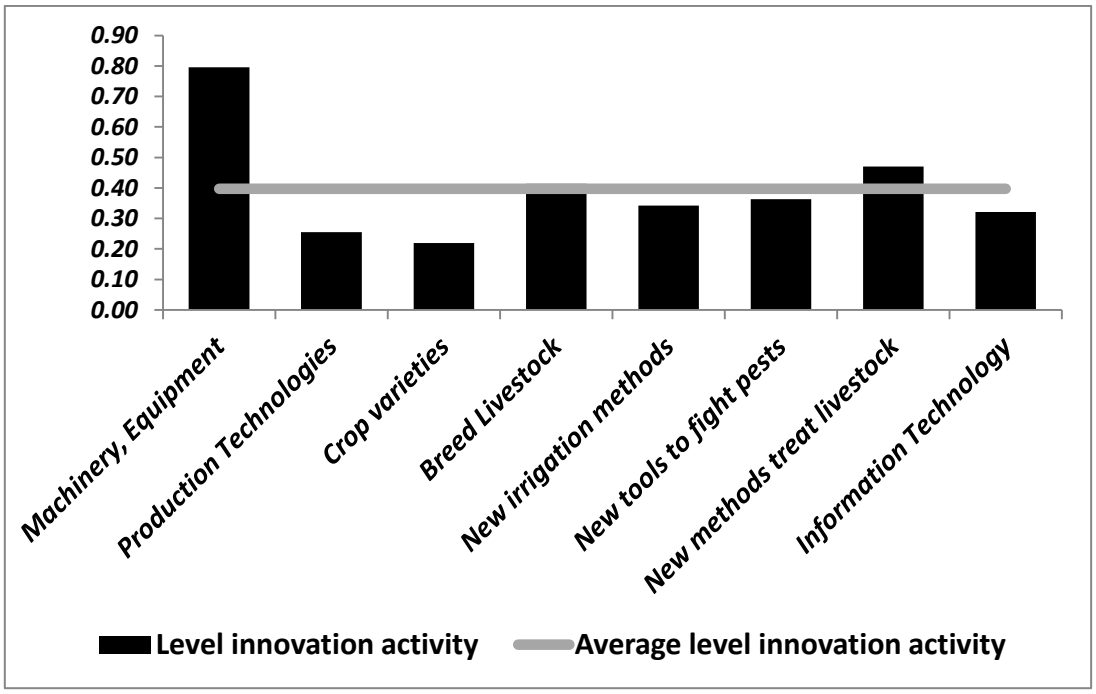

Figure 6. Level of innovation activity to different kinds of innovations
Source: Own calculations

For them the degree of innovation activity is almost twice higher than the average for all kinds of innovations. The enhanced interest to innovations in this area is determined by the low level of farms' technical equipment. Where there is technique, it is physically and morally amortized and needs qualitative renovation and enlargement of its capacity. Almost half of respondents (46,5%) have answered that the predominating age of tractors, harvesters and attached stock, owned by the farm, is over 5 years. But in the mass cases (about 77%) of farms do not possess own agricultural technique or equipment. In a lower degree, compared to the material and technical base, but also above the average level, are innovations related to the use of advanced methods and preparations for livestock treatment (17,5%) and the manifested interest to new livestock breeds (barely 2,5% over the average level).

Farmers are least oriented to approbation of new crop species in their production, almost twice lower than the average level of innovation activity. On the next place is the expressed weak innovative activity in the area of production technologies, methods and means for irrigation, pest control, information technologies, which is also under the average level.

The results of the ESS show that for 44% of the agricultural producers from the region the land is perceived as property, 28,3% define it as a source of income, almost 27% share that it is a family asset, just over 19% of the respondents define land as a valuable land resource. The lowest share of the respondents define land as a place for growing crops, just soil. These results carry valuable information revealing the caring attitude of the Bulgarian towards the main production factor in agriculture - the land. The substance of the answer to the question "What is the land for you" is a prerequisite for the successful implementation of innovative practices in the branch. The cognitive nature of the attachment of the agricultural producer to the land resource is a factor for the implementation of new technological solutions and the introduction of practices that spare the environment. Another motive testifying for the innovative thinking of the agricultural producers from the region lies within the answer to the question "For you the ecological practices are most of all:"Half of the agricultural producers reply that the ecological practices are an opportunity to conserve the environment. For almost 24% they represent an opportunity to acquire additional income. Significant information for future sustainable practices applied by the agricultural producers in Blagoevgrad region is revealed in the answer: “A possibility for entering new market niches”. Such is the opinion of almost 11% of the respondents. This is a prerequisite for a sustainable and even expanded production.

The results from the ESS show a high interest on the part of the Bulgarian farmers for the implementation of scientific developments of the agricultural science. Seven out of ten respondents affirm that they feel the need to use scientific developments in their production. Distributed on the scale, the answers have the following values: “entirely need“-28.2%; „tend to need“-42.6%; „tend to do not need “-20.3%; „do not need at all“-8.9%. The fore mentioned results show the declared willingness of the Bulgarian farmers to implement scientific results. This testifies for innovative attitudes and willingness to implement novelties from the scientific research. The declared categorical intention for adoption of scientific novelties, implementation of ecopractises, combined with the high esteem in which the Bulgarian producers hold the land as a main factor for production in the agriculture is a testimony for the readiness of the Bulgarian farmers to implement innovative solutions in the agricultural production. This is a significant factor for the successful and efficient utilization of the financial resource, allocated by the European taxpayers for the support of the environmentally friendly and innovative agricultural production.

Conclusion

The distribution of different motivating and demotivating factors and of funding sources are similar in the three groups of farmers (innovators, early-adopting and late-adopting innovations).

Priority among motivating factors are these with production-economic character (higher production results and respectively higher economic effects). The social and particularly the ecological factor are in backward position.

In the structure of demotivating factors the lack of financial resources has primordial importance, followed by the lack of enough developed markets for innovation in agriculture.

Despite the existing similarities between early- and late-adopting persons, regarding the factors for formation of attitude to the implementation of innovations in agriculture, there are differences, related to unequal financial state of agricultural producers in the two different groups.

The level of innovation activity in farms is on medium level.

The existing dependence between the innovation activity level and the main characteristics of farms, as their typological profile, economic vision and juridical state is moderate;

For the formation of the potential attitude to innovations in the sector, the most significant indicators turned out the education degree of farmers and the juridical state of farms;

The highest innovative activity have the farms with managers having higher education, of mixed type, small ones, with economic size from 2000 to 4000 EUR, they combine agricultural activity with other kind of activity out of the sector;

There is a strong dependence between the economic size and the level of their innovation activity.

The strongest interest to implementation is manifested regarding the new agricultural machinery, technique and equipment. For them the degree of innovation activity is almost twice higher than the average for all innovations.

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