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# MOTIVES FOR THE INTRODUCTION OF AGRICULTURAL INNOVATIONS IN SERBIA WITH PARTICULAR ACCENT ON BEEKEEPERS: THE APPLICATION OF LOGISTIC REGRESSION

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## ABSTRACT

The aim of this paper is to explore the motives of Serbian farmers for introducing innovations from the aspect of Rogers' main attributes of innovations. The outcomes of the applied method of binary logistic regression show that these agricultural producers are not so much driven by personal motives in introducing innovations, especially not by their observability and compatibility with farmers' adopted values. The findings also point out that there are impulses and desires of Serbian farmers for introducing innovations, but that the still unfavourable and uncertain market environment hinders them. Since there is no economic progress without innovations and technological progress, the state should provide them with a favourable environment by actively investing in appropriate legal, financial, rural, corporate, educational, and research infrastructure. In addition, it is necessary for farmers to adopt the principles of market orientation and entrepreneurial activities that would help them to increase their productivity, innovations and competitiveness.

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## Introduction

The capability to innovate and introduce new ideas and practices has always been one of the key factors contributing to the success of every farm production, and thus to the agricultural productiveness and competitiveness and the country's economy. Contemporary agricultural enterprises and farms that have access to necessary financial, material and intangible resources, as well as those that have a strong motivation and incentive to introduce and develop innovations belong to the group of successful innovators, especially in an appropriate supportive environmental climate and infrastructural conditions. Therefore, the capacity of every, even agricultural organization to introduce innovations depends on its ability to continuously develop new ideas, knowledge and skills, with the aim to create new products, services

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and organizational processes, as basic sources of its competitive advantage locally, nationally, regionally and globally. At the same time, the way of defining and perception of innovation determines its degree, nature and scope of application in a certain organization (Popa, Preda, & Boldea, 2010). Innovation is the use of new ideas related to products, processes and any other features of organizational activities. As such, innovation refers to the process of commercialization or the use of values, arising from a particular novel idea (Rogers, 1998).

Agricultural innovations primary relate to the need to boost the production of nourishment, crops, feed and agricultural by-products, as well as to rise the quality of agricultural goods, productivity, output efficiency, growth and to improve cultivation conditions (Van der Veen, 2010). Back in 1974, Robert E. Evenson provided a detailed classification of the agricultural areas in which agricultural innovations usually occur (Evenson, 1974):

- Crops cultivation – biological and/or genetic modifications of crops, such as the use of new breeds or more productive species, that are more renitent to certain atmospheric or land conditions; then the use of new species that thrive in various seasons or new types of farming; new agricultural production methods (for example, inoculation, replanting techniques, etc.); new techniques for turning plant products into final products (cash crops) and the like.
- Animal breeding – already mentioned biological and/or genetic modifications; new or improved modes of animal breeding and using animals for agricultural purposes in a way that raises their productivity (for example, the use of animals for obtaining their by-products such as wool, milk, traction, leather, etc.).
- Crops` and animals` growing conditions – adding compost or other types of fertilizers; increasing soil deepness; draining and watering; increased intensity of work on the ground (digging, ploughing, etc.); construction of terraces in order to avoid soil erosion; use of sun and wind renewable potentials; fodder supply or improved pasture of animals; etc.
- Agricultural machinery and equipment – more effective plows or plows that can be used on different sorts of land; harvesting machines and powdering equipment; devices that regulate water level; devices for irrigation and drainage of soil; etc.
- Practices of running agricultural business – include alters in the agricultural production technique, proprietorship and inheritance of land; the extent of the plot being cultivated; labour availability; surplus production; etc.

Robert E. Evenson and Timothy Swanson, in their unpublished paper from Internet, emphasize the importance of suitable investment in the diffusion of innovations and dynamic technological change for the introduction and growth of agricultural innovations. Ownership rights in agriculture also have an important role in this process, as they function as a mechanism for further encouragement and adaption of innovations. Finally, agricultural innovations mainly focus on the technological frontier and are

characterised by gradual adoption and diffusion. To the above list of agricultural innovations, should be added somewhat newer types of them, such as (Inter-American Institute for Cooperation on Agriculture, 2014):

- Organizational or institutional innovations – that include changes in organizational structure, agricultural activities or services; than changes in their processes and methods, as well as in their relations with other stakeholders in agriculture.
- Marketing innovations – are changes in the marketing methods, conditions and advertising of an agricultural good or service and/or changes in its target group.
- Social innovations – which are related to the evolution or major improvements of strategies, concepts, abstractions, organizational business politics, agricultural products and services with the aim of creating favourable social evolution, meeting broader social demands or serving social interests and aims.

Agricultural innovations are crucial in resolving contemporary problems, such as global population growth, security of food supply and the negative effects of climate change, contributing to increased productivity and efficiency, improving competitiveness, sustainability and all forms of equality in agriculture, and thus sustainable economic development. These innovations have their own specific features. At first, they are very complex since they often demand investments of large financial resources in labour and capital, their yields can be very uncertain, and since investments in them can pay-off in the long run. In that sense, the importance of the trial period of any agricultural innovation comes to the fore before it will be widely applied in practice. The process of their diffusion also requires significant financial resources from farmers, as well as the meeting of appropriate economic, social, cultural, ideological and psychological preconditions. Finally, they are often characterised by the impossibility of accurately identifying the time of their occurrence, which is why the moment of their emergence is usually taken as the one in which they began to be widely used in practice and incorporated into agricultural communities (Van der Veen, 2010).

Empirical literature and researchers emphasize other features of agricultural innovations such as sensitivity to environmental and climate change and their conditionality by smart technological change (Senyolo, Long, Blok, & Omta, 2018); profitability, high investment costs, compatibility with prevailing norms and values, complexity and communicability from the aspect of adaption of favourable agricultural practices (Roy, & Jaiswal, 1968). Their characteristics also include the kind of agricultural household assets, psychological characteristics of innovators and their endogenous and exogenous environment (Nguthi, 2007). Finally, agricultural innovations also depend on the properties of innovators themselves, such as prejudices and bias towards innovations, characteristics, i.e. types of innovators (Rogers, 1983), the courage, responsibility, rationality and imaginativeness of innovators, their pragmatism, openness to science, versatility and social awareness, their attitude to risk, educational level, their social networks, etc.

When it comes to the state of agricultural innovations in Serbia, the current system of knowledge and innovation is not sufficiently harmonized with the accelerated technical and technological changes. While there are difficulties in agricultural extension and farmers' access to adequate information, Serbia also lags significantly behind the European average in the quality of equipment and research techniques (Mihailović, & Cvijanović, 2016). Studying the impact of matured clusters and human capital on Serbia's country competitiveness and general capacity for adopting innovations, Domazet and Paraušić (2018) pointed to several weaknesses and problems of its science and innovation system. These problems mainly encompass: a) low level of investment in research and development (R&D) activities (below 1% of GDP); b) lack of high-quality research in practice; c) weak cooperation between the private business sector and science in terms of concretization of research conducted; d) small R&D investments in the business sector; e) phenomenon of *brain drain* and relatively poor quantity of researchers and scientists; and f) the lack of adequate infrastructure. These authors also pointed out the problems of dominance of small-scale farms and low agricultural productivity, impermanent agricultural policy and deficient financing opportunities, lack of contemporary developed technology, as well as of adequate technical assistance and analytical support. Besides, the competitiveness of domestic agricultural producers is based on low prices and exploitation of personal and natural capital, as well as the poor development of clusters, human and relating financial resources.

Despotović, Ristić and Dimitrijević (2019) also discussed the state of innovation capacities in Serbian agriculture. They emphasized that Serbia lags far behind innovative leaders and other countries of Southeast Europe in terms of agricultural productivity, as well as behind other domestic economic operations in terms of agricultural innovations. In addition, there is no sufficient investment in agricultural R&D and sciences, while insufficient agricultural innovation is one of the key factors of the lagging behind in agricultural productivity. These authors therefore conclude that the development of agricultural innovations could make a significant contribution to rising the efficiency and sustainability of the domestic agricultural sector. Finally, the Strategy of Agricultural and Rural Development of the Republic of Serbia (RS) for the period from 2014 to 2024, which recognizes the need for reducing the country's gap in technological development behind competing countries, also confirms these findings. This document especially emphasizes the importance of technological advancement, investment in new expertise and production techniques, as well as their transmission to farmers to reduce the technological backwardness of Serbian agriculture. In this sense, the Strategy recognizes the role of the state itself in terms of dealing with the effects of climate change, the introduction and improvement of modern production practices, as well as the enhancement of innovations in agriculture and related sectors.

The goal of this paper is to explore the motives for the agricultural innovation introduction in Serbia from the aspect of some Rogers' attributes. The second section of this article explains in detail the conducted research and the basic methodological steps of the applied logistic regression. The third section of the paper describes the obtained

results with their possible explanations. Finally, the last section gives a conclusion with some recommendations for encouraging and developing the policy of agricultural innovations in Serbia.

### Materials and methodology

The research of attitudes, motives and inclinations of Serbian agricultural producers towards the introduction of innovations was carried out in the period from the end of June to the beginning of August 2021. For the purpose of this analysis, a Google form survey was made, which was announced and the content of which was sent to over 400 e-mail addresses of domestic registered agricultural holdings. Only 55 individuals responded to this survey. This survey encompassed registered agricultural entrepreneurs, including vegetable and fruit growers, anglers, wine producers, beekeepers and producers of organic products, mostly from the Republic of Serbia. The aim of this research was to determine, based on the given sample, whether domestic farmers are committed to innovations, whether they apply them in practice, what were their reasons for adopting them, as well as what were the specific outcomes of their innovation ventures. The answers received from agricultural producers were assessed by categorical grades (Yes/No/I do not know).

The collected sample consisted of 51 males (92.7%) and 4 females (7.3%). In the observed sample, there were by far the most owners of agricultural farms (81.8%), and to much lesser extent members of agricultural farms (12.7%), agricultural entrepreneurs (3.6%) and owners of large agricultural companies (1.18%). Respondents were mostly engaged in beekeeping (69.1%), farming (9.1%) and fruit growing (9.1%). The following table (*Table 1*) provides a detailed overview of their received answers to the remaining questions from the survey.

**Table 1.** Proportions of the obtained responses to the questions asked

Questions	Answers		
	Yes	No	I don't know
Engagement in the organic production	29.1%	70.9%	-
Introduction and implementation of one or more agricultural innovations so far	52.7%	34.5%	12.7%
Consistency of agricultural innovation with the adopted values, beliefs, experience and needs of farmers	62.5%	14.6%	22.9%
Visibility and recognisability of agricultural innovation in the environment	53.2%	29.8%	17%
The relative advantage of agricultural innovation over the ideas and practices of competitors	50%	29.2%	20.8%
Challenge and relative complexity in applying agricultural innovation	23.4%	51.1%	25.5%
Possibility of trying and experimenting with agricultural innovation	60.9%	21.7%	17.4%

Questions	Answers		
	Yes	No	I don't know
The function of the state in further encouragement of agricultural innovations	61.1%	16.7%	22.2%
Plans related to the adoption of agricultural innovations in the future	80.4%	3.9%	15.7%

Source: Authors' calculations

Respondents listed some of the following agricultural innovations that they have introduced so far: patenting wax smelters; use of bee sms scales and innovative multifunctional beehives; digitalization of irrigation systems, and a crop protection sprinkler that controls the amount and intensity of spraying. They also practiced and introduced vacuuming machine; inter-row foil in the vineyard; elimination of the chemical agents' use; preparations and supplements, and the use of medicines of exclusively organic origin. Among other mentioned innovations, respondents pointed out: an innovative approach to defending bees from ticks without the use of chemicals; moving hive trucks, using of bee shakers and honey centrifuges; and warming and heat storage system in the spring development of bee colonies. Respondents also mentioned the production of the bee perga in virgin honeycombs without the use of a beeswax foundation sheet; special canvas pots for seedlings, modern anti-hail net and drop-by-drop irrigation system; and the use and control of bee scales remotely. Finally, they also introduced platforms for the bee colonies' migration, practiced the use of honey de-crystallization sticks, and the use of contemporary pollen collector system; application of special beekeeping techniques; new modern agricultural machinery with satellite-based guidance systems, computerized sprayers and computerized machinery for tillage; cultivation of Honey Phacelia "NS Priora"; germinator soil machine; and machines with GPS navigation.

A similar study was conducted in Cambodia in 2013, in which the method of assessing the use of *Rhizobium* by potential innovators was analysed from the aspect of Rogers' crucial factors of introducing innovations. *Rhizobium* is a root nodule bacterial symbiont of legume plants that fixes nitrogen. This land bacterium also induces natural and occasionally very useful endophytic symbioses with different cereals (Dazzo, & Ganter, 2009). This alternative ecological species is often used in sustainable and organic production in the form of efficient bio fertilizer, which is why someone can consider it a type of agricultural innovation. Everett M. Rogers in his epochal book *Diffusion of Innovations* states five key attributes of innovations that affect the rate of their adoption in practice (Rogers, 1983): a) relative advantage of innovation over the idea and practice of competitors; b) compatibility of innovation with adopted values, beliefs, needs of innovators and their previously realized ideas; c) complexity of given innovation as a degree in which it is conceived as relatively demanding to understand and apply; d) the possibility of trying and experimenting with a given innovation; and e) observability of a given innovation in the environment. Starting from the described attributes, this study

concluded that the relative advantage was the trait that most influenced the adoption of a given agricultural innovation, observability proved to be moderately significant, while other features were not significant (Farquharson et al., 2013).

In this analysis, the method of logistic regression was applied because all observed variables were categorical in their nature. In order for this statistical model to be implemented at all, it was first necessary to recode the answers of the respondents in the following manner: 1 - affirmative answer (favourable outcome of the event) and 0 - negative answer (unfavourable outcome of the event). Appropriate sample size is the first important requirement for the application of this statistical procedure. The easiest way to calculate the sample size in the context of logistic regression is based on a smaller number of binary results, i.e. a smaller proportion of positive or negative scores from a given sample (Peduzzi et al., 1996). Using this method, the data on the smallest allowed sample size for logistic regression implementation could be calculated based on the next formula (Park, 2013):

$$N = 10k/p \quad (1)$$

of which  $p$  is the smallest value of the shares of positive or negative observations in the population, while  $k$  is the allowed number of independent variables that can be employed in the analysis. Based on the presented formula, due to the relatively small sample size  $n = 55$  and the value of lower share of cases of  $p = 0.47$ , it was possible to consider the impact of only two predictors ( $k = 2.59$ ) on the choice of domestic farmers to adopt any agricultural innovation. The author of this article opted for the analyses of the predictive abilities and impact of following Rogers' predictors: a) Compatibility of innovation with the adopted values, beliefs and needs of innovators, and b) Observability of a given innovation in the environment on the outcome variable Introduction of agricultural innovations in Serbia.

Preliminary analyses indicated that all assumptions for the use of direct binary logistic regression model were satisfied, including the absence of multicollinearity between predictors. In this type of statistical model, the dependent variable appears as a binary categorical variable, commonly taking form of a binary case, which can imply success (code 1) or the failure (code 0). The odds of an observed event are defined as the quotient between the possibility of its appearance and the possibility of its non-appearance. If we mark the probability of that event appearance with the letter  $p$ , and the possibility of its non-appearance with the mathematical expression  $1 - p$ , then the odds are calculated based on the next formula (Park, 2013):

$$\text{odds of an event} = p/(1 - p) \quad (2)$$

Following two predictors were observed in this analysis: a) Compatibility of innovation with the innovator's adopted values, beliefs and needs ( $X_1$ ) and b) Observability of an

innovation in the environment ( $X_2$ ). Due to the fact that in this research the collected sample size amounted to  $n = 55$ , the influence and forecasting ability of only two predictors could be checked. In addition, as at the same time the given outcome variable  $Y$  was binary in nature, the formula of the logistic equation has taken the next form (Madžar, 2021):

$$y = P = \frac{p}{1-p} = \frac{e^{\alpha + \beta_1 x_1 + \beta_2 x_2 + \varepsilon}}{1 + e^{\alpha + \beta_1 x_1 + \beta_2 x_2 + \varepsilon}} = \frac{1}{1 + e^{-(\alpha + \beta_1 x_1 + \beta_2 x_2 + \varepsilon)}} \quad (3)$$

where  $p$  is a possibility of the event appearance,  $1 - p$  is the possibility that the observed event will not occur,  $e$  is the basis of the natural logarithm ( $e \approx 2.718$ ),  $\alpha$ ,  $\beta_1$  and  $\beta_2$  are the values of parameters, i.e. coefficients of the model, while  $\varepsilon$  is an error term.

The paper's initial hypothesis  $H_0$  is that the predictors  $x_1$  and  $x_2$  do not have predictive power and that are not able to predict the possibility of the agricultural innovations' adoption by Serbian farmers. This further means that this starting hypothesis assumes that the regressive coefficients values are  $\beta_1 = 0$  and  $\beta_2 = 0$ , i.e. that the odds can be represented by the following formula:  $odds = e^\alpha$ . In contrast, the alternative hypothesis  $H_1$  asserts that the predictors  $x_1$  and  $x_2$  have predictive power, i.e. the ability to forecast the possibility of adopting innovations in Serbia by domestic agricultural producers. This further means that the alternate hypothesis assumes that the values of the regressive coefficients are  $\beta_1 \neq 0$  and  $\beta_2 \neq 0$ , and that the odds formula has the following form:  $e^{\alpha + \beta_1 x_1 + \beta_2 x_2}$ . Based on the above, the null and alternate hypotheses take the following form (Madžar, 2021):

$$H_0: \beta_1 = 0 \text{ and } \beta_2 = 0 \Rightarrow \ln(odds) = \alpha \Rightarrow odds = e^\alpha \text{ and}$$

$$H_1: \beta_1 \neq 0 \text{ and } \beta_2 \neq 0 \Rightarrow \ln(odds) = \alpha + \beta_1 x_1 + \beta_2 x_2 \Rightarrow odds = e^{\alpha + \beta_1 x_1 + \beta_2 x_2}$$

## Results and discussions

IBM SPSS computer software was used in the implementation of this analysis. This article applied the method of direct binary logistic regression in order to determine the impact of explanatory variables Compatibility of innovation with values, beliefs and needs of innovators and Visibility of innovation in the environment on the possibility of their introducing by surveyed farmers. While this statistical method included and traced two predictors (Compatibility and Observability), it was generally a good and reliable model because it was statistically significant, correctly predicting the results of the performed analysis, Chi-square  $\chi^2 (df = 2, N = 55) = 47.775$



$Sig. = 0.000 < 0.001$ . These data further pointed to the fact that the overall model quite successfully distinguished between farmers who gave a positive and farmers who gave a negative answer related to the adoption of a certain agricultural innovation. Further results of the Hosmer and Lemeshow test also indicated the fact that it was a well-fitted model of strong predictive power, Chi-square  $\chi^2 (df = 2, N = 55) = 0.000$ ,  $Sig. = 1.000 > 0.05$ . The overall model described between 58.7% (Cox's & Snell's R Square) and 78.6% (Nagelkerke's R Square) variance of outcome variables, while at the same time it accurately classified 92.6% of observations. The sensitivity of the obtained statistical model was  $Sensitivity = 93.3\%$ , while its specificity amounted to  $Specificity = 91.7\%$ . In addition, no predictors from the model were statistically significant (Table 2). The odds ratio of an otherwise stronger, but also statistically insignificant ( $Sig. = 0.998$ ) predictor Compatibility of innovation with values, beliefs and needs of innovators was 1.535E10. On the other hand, the odds ratio of the weaker and also statistically insignificant explanatory variable ( $Sig. = 0.999$ ) related to the Observability of innovation in the environment amounted to 0.000.

**Table 2.** Coefficients of variables from the equation

		B	Standard Error	Wald.	df	Sig.	Exp(B) Odds	95% C.I. for EXP (B)	
								Lower	Upper
Step 1 <sup>a</sup>	Compatibility	23.454	11602.711	0.000	1	0.998	1.535E10	0.000	-
	Observability	-18.952	11602.711	0.000	1	0.999	0.000	0.000	-
	Constant	-2.251*	0.743	9.171	1	0.002*	0.105	-	-

Source: Authors' calculations

The analysis of independent variables indicated that none of them was statistically significant ( $Sig. (\beta_1) = 0.998$  and  $Sig. (\beta_2) = 0.999$ ), showing that none of them contributed significantly to the model, i.e. that they did not explain or influence the Serbian farmers' decision to introduce innovation (Table 2). This further meant that the initial hypothesis  $H_0$  that these predictors are not able to forecast the possibility of adopting agricultural innovations in Serbia could not be rejected. However, despite this, the analysis also showed that the coefficient of the variable Compatibility of innovation with the adopted values, beliefs and needs of innovators was positive  $\beta_1 = 23.454$ , while the coefficient of Observability of a given innovation in the environment was negative  $\beta_2 = -18.952$ . At the same time, the constant was the only statistically significant value ( $Sig. = 0.002 < 0.05$ ) and amounted to  $\alpha = -2.251$ .

Based on the obtained results, it followed that the value of the outcome variable  $Y$  could be calculated using the succeeding equation:

$$y = \frac{e^{-2.251+23.454x_1-18.952x_2+\varepsilon}}{1+e^{-2.251+23.454x_1-18.952x_2+\varepsilon}} = \frac{1}{1+e^{-(-2.251+23.454x_1-18.952x_2+\varepsilon)}} \quad (4)$$

An objective limitation of this survey relates to the relatively small sample size given that only 55 of the more than 400 asked individuals responded to this survey. Contemporary literature indicates many reasons and motives for the introduction of agricultural innovations. Nguthi (2007), in addition to personal characteristics in terms of Rogers's attributes, among the most important motives that determine their introduction states the communication process, the farm's property status, as well as the endogenous and exogenous environment. This author also cites land size, technology characteristics, health status, skills and knowledge of farmers, level of ownership and type of agricultural activities as important determinants of their adoption. In their attempt to explain the low level of adoption of seemingly useful agricultural technologies, Ruzzante, Labarta and Bilton (2021) identified differences between the characteristics of adopters and non-adopters in the developing countries. This study found a positive correlation among the level of education of farmers, household size, disposal of credit facilities, land ownership, use of extension services and organisational membership with the introduction of many contemporary technologies. Eventually, the adoption of agricultural innovations takes place under the strong influence of seemingly unobserved cultural, contextual, environmental, local, national, regional, and policy factors. However, based on the received results, it seems that farmers from Serbia are not sufficiently driven by personal reasons and motives when they introduce innovations in their practice. Namely, from the aspect of Rogers' attributes, it seems that the compatibility of the observed innovation with their adopted values, beliefs and intentions, as well as the observability of that innovation in the environment are not a good enough reason for Serbian farmers to introduce them in their practice. This further means that they most likely rely on the state when they introduce and develop their innovations, expecting initiative, more concrete support, assistance and advices from it. This explanation is supported by the fact that when asked if they think that the government can help them to introduce and expand agricultural innovations, as many as 33 respondents (61.6%) gave a positive answer, 9 people (16.7%) gave a negative answer, while 12 respondents (22.2%) did not know how to answer to this question. This trend could be a legacy of socialism, given the fact that farmers in those times largely relied and depended on subsidies, levies, soft loans and other forms of state aid. More precisely, in addition to the limitations of the agrarian policy and the economic environment, as well as the difficulties in adapting to the market economy, Serbian agriculture is burdened by the aftereffects of the socialist centrally planned economy in terms of land ownership and use (Mihailović, & Cvijanović, 2016). In addition, domestic agriculture today is burdened by the unfavourable age structure of farmers and the prevalence of small-scale farms, as well as the lack of a strategic approach to agricultural development policy. Instead of encouraging the entrepreneurial spirit, which is very important for the introduction and development of innovations, the support of the state is much more concentrated on providing incentives, causing

numerous negative effects, especially in Serbian rural areas (Aničić, & Paraušić, 2020). Without an appropriate stimulating environment, as well as without the improvement of entrepreneurship and the development of entrepreneurial spirit, there can be no increase in labour productivity, innovation, farm competitiveness and a change in the structure of production towards higher value-added products.

In addition, today the inefficient systems of transfer of knowledge and technological solutions into practice, as well as the lack of appropriate investments also present limiting factors for the growth of agricultural production, labour productivity and competitiveness. Much of agricultural production is still based on technologically low input uses and low investment in equipment, leading to lagging behind in technological progress. In such circumstances, there are not enough skills, motivation and knowledge of agricultural producers to accept innovative technological solutions. Therefore, entrepreneurial initiative, innovation and motivation of all actors in the agricultural sector are the basic preconditions for their market operations and sustainable development of agriculture (Strategy of Agriculture and Rural Development of the Republic of Serbia for the period from 2014-2024, 2014). The unexpected results of this study also show that it is possible that Serbian farmers are still not sufficiently aware and familiar with the significance of agricultural innovations for improving their business, and thus for the development of society, economy and agriculture. Besides, domestic farmers often receive information about modern technologies with restraints and rarely dare to invest their own financial resources in obtaining new knowledge and skills. Additionally, the transfer of knowledge process itself, which is carried out with the aim of promoting new products and technological solutions, can be biased, also contributing to their uncertainty (Strategy of Agriculture and Rural Development of the Republic of Serbia for the period from 2014-2024, 2014). Serbia is the country that lags behind in development in relation to almost all Central and Eastern European countries. The country is growing slowly and it could be said that it has not coped with the processes of reforms and transition well. This situation inevitably reflects on the educational structure of population, and thus on the awareness of the citizens and farmers about the importance and role of investing in innovations, R&D and education, digitalization, vocational training, agricultural extension, developing of innovative products, etc. for the success of their business operations. Perhaps, in this context, changing the awareness and mentality of domestic farmers would be for them of the greatest importance. That would help them in understanding their own mistakes, hidden problems, failures, missed opportunities, as well as the need for more marketable behaviour in order to develop their entrepreneurial and competitive spirit (Paraušić, & Cvijanović, 2014).

## Conclusions

Since this research showed that farmers from Serbia are probably not driven by personal motives and goals in developing their innovative activities, it is concluded that they in this regard most likely rely on the initiative, assistance and support from the state. They are also probably not familiar with the importance of introducing agricultural innovations for their business, and thus for the economic, agricultural and social development. It is well known that innovations are a major tool for social and economic development,

as well as agricultural innovations and investments in contemporary technology can significantly affect the efficiency of natural resources' use, economic prosperity, the upturn of agriculture, poverty alleviation and rural advancement. Therefore, without innovations and technological progress, there is no economic progress. A system without technological progress, as the theory of growth shows, tends to grow at the rate of the slowest growing production factor, and in such circumstances, there is no economic progress defined as growth in per capita income. Namely, this means if the population, i.e. the labour force is the slowest growing factor, than economic stagnation occurs in such a system. Moreover, if some other factor is the slowest growing, the system grows at the rate of growth of that factor, which is slower than the growth of the population. This further implies a drop in per capita income and economic decline with no innovations and technological advancement.

It would be natural to expect that the predictors from this study will take positive values, i.e. values that reflect the readiness of farmers to introduce innovations and for all changes that contribute to the growth of agricultural production. This follows from the fact that they are entrepreneurially oriented. Although the obtained coefficients were not statistically significant, they are very indicative, pointing out that there are impulses and desires of farmers from Serbia to introduce innovations, but also that the still unfavourable and legally uncertain environment for agricultural innovations hampers them. Although the conducted research shows that there are indications of their positive motives, these aspirations have unfortunately not been realized yet because there are other obstacles and threats from the business environment that should be removed. Besides, in order for contemporary farmers to survive in an increasingly competitive and demanding global market, it is necessary to adopt the principles of market orientation and entrepreneurial activity, as well as to abandon the socialist legacy. Entering and successfully operating in the agricultural market requires the increase of agricultural production competitiveness, which cannot only be driven by cheap inputs, but also by acquiring new knowledge, technologies and innovations. Therefore, the central government, municipalities and local town administrations should create a stimulating societal, institutional and business environment for rural development and agricultural advancement, particularly in underdeveloped regions (Aničić, Obradović, & Vukotić, 2018). Other authors such as Ševarlić, Raičević, & Glomazić (2012) also point out the importance of the government, civil society, agricultural cooperatives and business itself in the development of a sustainable economy and agriculture.

In this sense, the role of the state is expressed, which should first build the appropriate infrastructure for the agricultural innovations' advancement, by defining the necessary financial and legal framework, introducing appropriate incentives, tax reliefs, rural credits, soft loans and other forms of state aid, as well as by defining the agricultural corporate structure that would encourage their development. The state should also work on conducting intensive media campaigns and investing in extension activities in order to raise the awareness of the population and develop an appropriate mental framework for the introduction and development of agricultural innovations, and

especially for the use of contemporary agricultural technology. The state could also consider developing appropriate knowledge-intensive agricultural enterprises and institutions such as agribusiness incubators, agricultural clusters and the like. Finally, it should invest intensively and continuously in science, R&D and innovation growth in order to increase agricultural productivity and farmers' incomes in general.

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### Conflict of Interests

The author declares no conflict of interest.

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