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Serbian Academy of Sciences and Arts  
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of Agricultural Economists

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# **AGRI-FOOD SECTOR IN SERBIA**

## **STATE AND CHALLENGES**

**Edited by**

**Academician Dragan Škorić**  
**Danilo Tomić**  
**Vesna Popović**

**Belgrade, 2013**

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### *Editors*

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# **DIFFUSION OF KNOWLEDGE AND INNOVATIONS IN SERBIAN AGRICULTURE**

*Jovana Čikić, Živojin Petrović*

## **INTRODUCTION**

Since humans started to produce food, two crucial questions emerged: how to ensure continuity in the food production and how to increase yields. Answering those questions by developing (scientific) knowledge on agriculture and practicing it, men have created and still create circumstances for food sufficiency as one of the basic conditions for the survival of the societies, with no regards to the historical epoch, level of social development, type of political system etc. Today, question of food abundance is even more significant because it is influenced by issues such as fast growing population, climate changes and environmental issues in agrocomplexes, market relations between food producers and consumers, relations of power and domination among those who produce food etc.

How contemporary Serbian agriculture looks like? Actually, rural economy and Serbian economy in general are still pretty much based on agriculture. According to the 2002 census data<sup>1</sup>, every third household in Serbia is family farm<sup>2</sup>, while 60% of the rural households gain income (in whole or in part) from agriculture. On agricultural and mixed family farms live 39.5% of the total farm population, 30.6% of total rural population and 13.4% of total Serbian population. Structure of the labour force on family farms by economy sector clearly indicates the significance of agriculture in Serbian economy, as well. Almost half of the million people in Serbia or  $\frac{1}{5}$  of the total labour force is economically active in agriculture [26]. In addition, 87% of the agricultural labour force are farmers. Along with the food industry, agriculture makes 10.6% of the GDP and with the sector of raw materials

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<sup>1</sup> In the paper, authors use 2002 census data because data from the latest censuses (2011 and 2012) are still not published.

<sup>2</sup> According to the 2002 census methodology, farm is defined as a “every household which at the time of the census uses a minimum of 10 acres of arable land and a household that uses less than 10 acres of arable land, and possesses at least: cow and calf and one cow and bull, or one cow and two sheep, or five sheep or three pigs, or four sheep and pigs together, or 50 poultry or 20 bee hives” [7].

processors, it makes 40% of GDP. According to the 2012 data, 23.9% of total export was from agriculture<sup>3</sup>.

Much is expected from the Serbian agriculture. In the daily political discourse, agriculture is frequently mentioned as one of the development potentials and a path toward the rural renewal. However, current state of agriculture indicates that a great deal of Serbian farmers and their families are in unfortunate social position. Part of the answer to the question: Why? is in the partial modernization of Serbian peasant agriculture [37]. Unfortunately, the analysis of conceptual and hypothetical framework of the possibilities and obstacles in (Serbian) agricultural modernization overcomes the limits of this paper. Therefore, for this occasion, only one problem or factor of agricultural modernization has been chosen to analyse. It is a diffusion of knowledge and innovations essential for the contemporary practicing of agriculture. Such agricultural practice should be able to answer the needs and fulfil the expectations of the family farms members, but also of the state and/or society that should be investing in the agricultural development.

## **1. FAMILY FARMS – FRAMEWORK FOR RESEARCHING POSSIBILITIES AND OBSTACLES IN LABOUR MODERNIZATION IN AGRICULTURE**

In spite to the decades of repressive agrarian policy measures towards private land property and peasants, agriculture in Serbia is still based on family farms. Family farms own 84% of utilised agricultural areas [1], 91.1% of the livestock units and, according to the 2011 census, family farms participate with 57% in sales and purchase [48].

Why is labour modernization in agriculture on family farms so important? Data on labour force in Serbian agriculture give an illustrative answer to the question. First, every third resident of rural settlements in Serbia is employed. More than  $\frac{1}{3}$  (or 38%) of totally employed in Serbian rural population are farmers. If you add to this number approximately 135 000 people who can work and willing to work but are not currently employed, there are more than half a million people who

---

<sup>3</sup> Data on share of agriculture in GDP as well as share of agriculture in export available on web page of the Serbian Chamber of Commerce - Department of Agriculture [21].

live in rural settlements in Serbia and can be economically engaged in agriculture [26].

Even though it is common to think that contemporary agricultural practice doesn't require numerous labour force, the analyses of the family farms development in the EU and the analyses of the development potentials of Serbian farms show exactly the opposite. In the circumstances of the economic crisis, multifunctional agriculture can be one of the solutions for the economic activation of available rural labour force. Multifunctional agriculture is contemporary agriculture, which means that one of its basic principles is competitiveness that can be achieved only by continuous modernization of farm/agricultural practice.

Nevertheless, labour modernization on family farms overcomes modernization of agricultural production (especially, when it is understood in a productivity manner as increases of yields by unit of agricultural land and/or livestock unit or specialization of production, etc). By labour modernization on family farms, we understand planned, controlled and directed process of wider changes in a way the agricultural and non-agricultural goods and services are produced. Such process is based on a use of all available and accessible internal and external potentials for the structural strengthening and improvement of functional relations between those who are, in some way, involved in production on family farm. This means that the crucial element in labour modernization on family farms is „*adoption of new ways of doing things*“[32].

In the context of Moseley's statement and presented framework for the analysis, one of the crucial factors in labour modernization in agriculture on family farms is diffusion of knowledge and innovations. By innovation, we understood a new way of looking at the things or „*package of new social and technical arrangements and practices that implies new form of co-ordination within a network of interrelated actors*“[27]. In fact, innovations are new way of combining available elements in the family farm reproduction.

This definition of innovations (that goes beyond the necessary, but not sufficient technical and technological framework) leads to the fact that innovations are here interpreted as a trigger for the modernization of the way of thinking about farm labour and agricultural practice. In addition, the diffusion of knowledge and innovations should enable new perspectives in reflection of the role and the position of the individuals

within the labour division on family farms as well as the role and the position of the family farms within the rural community development.

How adoption and application of knowledge and innovations contribute to labour modernization on family farms? To be exact, this is the way to strengthen farm`s adaptability. Adaptation of knowledge and use of innovations not only strengthen family farm`s development potentials, but also open a new angle of perception of available resources and ways of their combining and activating. Of course, not every innovation is ideally functional. Adoption of a certain innovation involves risk. Risk is related to the compatibility of innovation with present resources and the compatibility among different innovations. However, because family farm (as a system) exists in the constantly changing conditions, learning new mechanisms of adaptation or adoption of innovations seemed to be necessary. At the same time, innovations regarded as primary external elements, if fulfil the needs, are being internalized and become an integral part of internal development potentials or sociocultural characteristics of the family farm.

There is unquestionable connection between the need to adopt and apply knowledge and innovations and characteristics of the family farm. Thus, more socially vital family farms strongly feel the need to modernize labour. Modernized labour enables family farms` reproduction (especially, economic and social reproduction) and, therefore, strengthens social vitality of family farms. Accordingly, the conditions for the intensive role of farms in rural entrepreneurship development are being created, along with the stronger bonding of the farms with the rural community. Additionally, sociocultural characteristics of socially vital family farms determine their stronger request for knowledge and innovations through the various forms of diffusion, including extension work [12].

If you want to understand the problems and necessity for the diffusion of knowledge and innovations in Serbian agriculture, you have to begin with the analysis of agricultural knowledge and innovation system<sup>4</sup> (AKIS). According to AKIS, diffusion of knowledge and innovations is a multidimensional process that includes numerous stakeholders involved

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<sup>4</sup> Labour modernization of family farms is not only about agriculture. Therefore, rural innovations mean innovations related to the improvement of the rural economy, respectively, the development of rural entrepreneurship [9], but also the improvement of the quality of life in rural communities.

in the complex network of mutual relations. Insight in basic features of the AKIS in Serbia today reveals that this system is characterised by many heterogeneous stakeholders (by the level of their institutionalization, available development potentials, power and influence). Nevertheless, there is no sufficient functional coordination between AKIS stakeholders<sup>5</sup>. Within such framework, role of the stakeholders should be analyzed, especially when speaking of the role of farmers (or family farms), extension service<sup>6</sup> and R&D organizations in agricultural sciences.

## **2. PRODUCTION OF KNOWLEDGE FOR CONTEMPORARY AGRICULTURE – THE ROLE OF R&D IN AGRICULTURAL SCIENCES IN MODERNIZATION OF SERBIAN AGRICULTURE**

In the introduction, we argue that one of the main factors of the labour modernization in agriculture is application of the results from the research in agricultural sciences, whether they solve the problems in farm reproduction, increase productivity or answer the market/consumer demands [17]. Naturally, the creation of knowledge and innovations for agricultural production improvement is a complex process influenced by various (social) factors. One of these factors is farmers` needs for certain type of knowledge and innovations. In such context, it is obvious why farmers` requires for certain type knowledge have become frequent research issue.

Extension work (as an institutional form of diffusion of knowledge and innovations) is essentially educational process with certain specifics. Based on a principle of voluntary participation and needs assessment (needs for knowledge in general, but also for a specific type of knowledge and innovations), extension work (particularly its content or knowledge and innovations that are subject of the extension work) is

---

<sup>5</sup> Petrović and Janković [37] came to the same conclusion while speaking of the necessity of the analysis of AKIS in Serbia.

<sup>6</sup> More on specifics of the agricultural extension work in Serbia see in [23], [24].

determined by characteristics, needs and potentials of farmers<sup>7</sup>. Such understanding of extension work, within the imaginary ideal conditions, results in apprehension that researches (especially experimental) in agricultural sciences should be based on the farmers' requirements for a certain type of knowledge and innovations. Nevertheless, real social circumstances deny such ideal presumptions. Direction, scope and goals of the research in agricultural sciences depend (more) on other social circumstances such as financing and available resources, characteristics of scientific and technological development policies, legislation, market characteristics (preferences of the consumers), level of development of scientific knowledge on contemporary agricultural practice and scope and possibilities of their application<sup>8</sup>.

When influences of scientific policy and influence of technical and technological development on research in agricultural sciences are being analyzed, except the research course (its goals and directions), the influence of the characteristics of the scientific organizations network must be taken into the consideration. Such characteristics are organizations' structure<sup>9</sup>, functional connections, active staff<sup>10</sup>, organization of work, finances, characteristics of the cooperation with other stakeholders in the AKIS, scientific productivity etc. According to the 2011 data, there have been 21 registered organizations for the R&D in agricultural sciences or 8.2% of the total number of R&D organizations in Serbia [46].

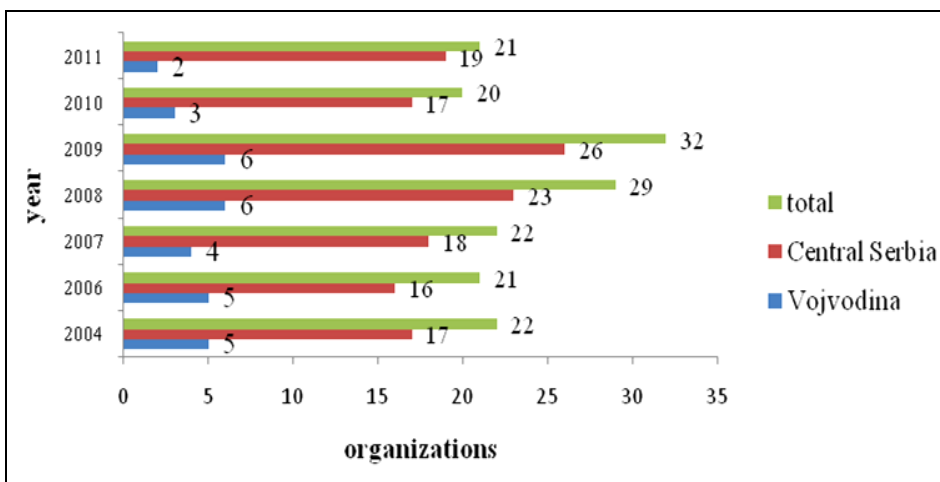
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<sup>7</sup> At the same time, factors such as sociocultural characteristics of farmers and their families, their motivation but also possibilities to practice agriculture and modernize labour etc. condition demand for agricultural extension.

<sup>8</sup> Gulan [16] emphasized that researchers in agricultural science have created approximately 1500 high-yielding plant varieties and hybrids. In our agriculture, it being used only 30% of the possibilities.

<sup>9</sup> This refers to the structure of the R&D organizations by scientific fields, disciplines and the type of the research.

<sup>10</sup> This applies to the staff structure in the R&D organizations, especially the staff structure of the researchers. Particularly, the significance of professional education of the researchers is being addressed as well as their scientific production (published papers, projects implemented, registered patents etc).



*Figure 1: R&D organizations in agricultural sciences in Serbia, by sector and scientific field*

Sources: [39], [40], [41], [42], [43], [45],[46].

Number of R&D organizations in agricultural sciences varies within the analyzed period of time (Fig. 1). Most of the organizations are located in Central Serbia. Additionally, changes in territorial distribution of research organizations can be observed. For example, in 2004, one in five R&D organizations was situated in the Autonomous Province of Vojvodina. Seven years later, in 2011, only one of ten organizations was in Vojvodina.

The most of R&D organizations in agricultural sciences are located in the capital city of Serbia, Belgrade (65% of these organizations in 2010 were located in Belgrade and even 76% of the organizations in 2011). Such territorial distribution of the R&D organizations in agricultural sciences has some advantages, but weakness too. To be precise, small spatial distance between the researches employed in the R&D organizations enables (direct) contacts and cooperation, exchange of experiences and an exchange and mutual use of scientific infrastructure. Besides, concentration of the R&D organizations in agricultural sciences in the capital city facilitates communication and cooperation with other institutions relevant for the scientific work or the creation of knowledge and innovations in agriculture. However, centralization of the R&D organizations in agricultural sciences in one location, especially in one which is not the centre of the agricultural region, cause difficulties for the



diffusion of innovations and dissemination of knowledge generated in the researches<sup>11</sup>. Locating these organizations in the large urban and non-agricultural centre also complicates direct contact of the researchers with the producers/farmers and makes difficulties for them to gain much needed research experience. To be harsh, we can ask question whether knowledge and innovations created in such manner match the real requirements in the process of labour modernization on family farms or are such innovations mainly created to fulfil scientific productivity criterion<sup>12</sup>. Moreover, concentration of the R&D organizations in one urban centre makes difficulties for the (direct) contact with the regional and spatially dispersed agricultural extension service and famers, as well.

Most of the R&D organizations in agricultural sciences are nonfinancial organizations (47.6% of the total number of these organizations, in 2011)<sup>13</sup>. Compared with the data from previous years, there is an increase in the number of R&D organizations in agricultural sciences in nonfinancial sector and a decrease in the number and ratio of organizations in the public sector and university sector. Such data indicate two major moments in the R&D, but also diffusion of knowledge and innovations in agriculture. First one relates to the fact that knowledge, information and research results (in the form of practical solutions) are commodity in agricultural input market, but also knowledge and information market, as well. Furthermore, this implies slightly uncertain position of the nonfinancial R&D organizations in agricultural sciences that are out of limited, but still regular budget financing. Such organizations are, more than the other ones, forced to struggle in the very competitive market within the conditions of the (continuing) economic crisis in Serbian society and agriculture. Such circumstances are relevant if we talk about the willingness and ability of Serbian farmers to pay for the necessary knowledge, information and

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<sup>11</sup> The importance of dissemination of knowledge reflects in legitimating the knowledge and strengthening its scientific and social confirmation and acceptance.

<sup>12</sup> Of course, by this we not intend to deny the quality of researchers in agricultural sciences or the quality of their researches and generated knowledge. By this, we are trying to draw attention to the negative consequences of the R&D organizations concentration, particularly in those sciences whose results are directly related to the production.

<sup>13</sup> According to the census methodology, „*nonfinancial sector entails enterprises and organizations with principal activity of producing goods and services for the market and selling them at economically significant prices*“ [46].

innovations, not only in terms of sale of agricultural knowledge and innovations, but also in terms of funding the researches.

Another moment, indirectly, can point out to the problem of cooperation between different types of organizations engaged in R&D in agricultural sciences. For instance, we can ask question why nonfinancial sector does not buy Serbian knowledge and innovations in agriculture from the, for example, public or university sector. The answer could be partially in the competitiveness of these organizations on the agricultural knowledge and innovations market. However, we can argue on the functionality of knowledge in Serbian agricultural knowledge market from the point of fulfilling the needs of the farmers<sup>14</sup>. Of course, knowledge market cannot be escaped. Although, it should not be forgotten that commercialization of the research results in agricultural sciences can be stimulating for entrepreneurial behaviour and targeting market niches (on national, but international, particularly regional market). Nevertheless, we should also be careful when evaluating research results from the so-called commissioned researches whose true motives (of a marketing promotion) are often hidden.

R&D organizations in agricultural sciences employed total of 2816 persons or 14.3% of total number of employees in the R&D organizations in Serbia [46]. Most of the employees are researchers (82.6%) and, as if it was expected, most of the researchers are employed in university sector<sup>15</sup>. Some important changes can be noticed in staff structure of the R&D organizations in agricultural sciences. From 2004 until 2011, total number of employees increased (for 6.3%). Number of the researchers constantly increases. According to the 2011 data, number of the researchers in the R&D organizations in agricultural sciences increased 2.3 times, comparing to the 2004 data<sup>16</sup>. Apart from this, number of employees in administration and number of so-called help staff decreased for more than a half, while number of technical associates decreased

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<sup>14</sup> This is stated in the context of the aforementioned comments on the concentration of R&D organizations in agricultural science in urban and non-agricultural centre that makes difficult for researchers to have direct access to the real situation and the farmers' needs for a specific type of knowledge.

<sup>15</sup> Most of the researchers employed in the university education are educational staff [46].

<sup>16</sup> According to the 2004 data [39], 999 researchers (37.7% of totally employed) were employed in the R&D organizations in agricultural sciences. In 2011, 2327 researchers were employed in such organizations.

almost ten times<sup>17</sup>. It can be assumed that the part of the employees in the group of technical associates have been promoted to the status of the researcher which, hence, resulted in drastic reduction of their number. These changes in staff structure should be aiming to improve work productivity in the R&D organizations and facilitate the diffusion of knowledge and innovations in agricultural practice.

Among the employed researchers in R&D organizations in agricultural sciences, most of them are Ph.D. (62.4%). From the 2004 until 2011, there have been an increase of the number of employees in all four types of the researchers (Ph.D., M.Sc., specialist and B. Sc.), mostly in the category of the B.Sc. Such change indicates the rejuvenation of the researchers.

On the key criterions in measuring researchers' productivity is a number of completed scientific works (projects and studies). Within the analyzed period (from 2004 until 2011), number of projects and studies in agricultural sciences increased, especially number of completed fundamental research. For instance, in 2004, 34 fundamental researches were completed and in 2011 even 318 researches were finished. Apart from this, number of applied and development researches have been cut in half [39; 46]. Also, number of published papers in scientific and professional publications is also contributing to the increase of productivity in agricultural sciences. Comparing to the 2004, in 2011 number of published papers has tripled – in 2004, there have been 553 published papers in agricultural sciences and in 2011 even 1629 papers. Such change is a result of a new way of evaluation of the researchers' work that undoubtedly has positive effects. Nevertheless, we can argue whether or not a new quantitative criterion for evaluation contributes to the qualitative improvement of the researchers' work. There have also been changes in the type of publications where the papers have been published. In 2011, researchers in agricultural sciences in Serbia published most of their papers in the publications abroad (68% of published papers), while in 2004 only 1/5 of total papers were published abroad.

Certainly, financial resources significantly influence results of the researches. The importance of financial investments in scientific projects

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<sup>17</sup> The base index of change in the number of employees in the administration and support staff in the 2011 is 0.414, while the base index of change in the number of professional staff in the 2011 is 0.101 (base year is 2004).

in agricultural sciences reflects in the fact that investments are not only necessary for the growth of the productivity and improvement of quality of products, but such investments pay back multiply, both economically and socially. Fuglie и Heisey [15], based on 27 studies, argue that, depending on methodological framework and scope, the funds invested in the research returns in the range of 20 to 60%. Analyzing the return of the investments in the R&D in agricultural sciences on the social level, Fuglie, Ballenger, Day, Klotz, Ollinger, Reilly, Vasavada and Yee [14] claim that most of the analyzed studies showed high return rates.

According to the 2008 data [4], global public spending for R&D in agriculture was 31.7 billion dollars and 51% of total spending are investments in highly developed and highly budgeted countries. The same authors [4] write that in the period from 2000 until 2008 there has been an increase in global spending for R&D in agricultural sciences<sup>18</sup> for 22%. Analyzing the research intensity ratio<sup>19</sup> in agricultural sciences, authors conclude that, along with the economic and social development, the ratio of the research intensity increases. With the economic development, the list of research problems in agricultural sciences expands [4]<sup>20</sup>.

On the other hand, scientific researches in Serbia in general are continually facing financial problems. According to Branković and Babin [5], value of total science budget in Serbia is low with the declining trends<sup>21</sup>. Data from the 2011 show that the total financial resources spend on the R&D in agricultural sciences in Serbia were 11.8 million EUR [46]<sup>22</sup>. In comparison with R&D organizations in other sciences, R&D organizations in agricultural sciences have the smallest budget (4.9% of total finances for all R&D organizations in Serbia in 2011).

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<sup>18</sup> According to the authors [3], the increase of the investments in R&D organizations in agricultural sciences in China, India and USA caused the increase of global public spending for the research in agricultural sciences.

<sup>19</sup> Research intensity ratio is ratio between costs of the researches in agricultural sciences and GDP in agriculture [4].

<sup>20</sup> Authors say that are not just problems relating agricultural productivity, but also issues such as impact of agricultural practice on environment, food quality, social welfare and rural development and the like [4].

<sup>21</sup> According to the authors [5], in 2000, 1.39% of the national budget was spent on the research, while in 2009, it was spent under 1% of the budget.

<sup>22</sup> Unfortunately, there is no published data adequate for the comparison of the spending on the research in agricultural sciences in temporal dimension.

Second major problem in financing Serbian R&D organizations in agricultural sciences is the structure of income. Public (both state and local government) budget accounts for more than  $\frac{2}{3}$  of the total incomes of R&D organizations in agricultural sciences in Serbia in 2011 (Tab. 1.). Even more,  $\frac{3}{4}$  of the overall budget of these organizations is university sector R&D organizations' budget. Here, we can ask question on efficiency of such model of financing and the money distribution, especially when the main task of the staff employed in the university sector is not a research, but education.

Sector	Source of financial resources							
	Own resources	State and local governments	Private and public companies	Non-profit organizations	Foreign investors	Total	Average per organization in the sector	Average per researcher in the sector
Nonfinancial sector	67 067	0	31 890	0	231 098	330 055	33 000	8 048.9
Public sector	2 620	196 718	0	0	18 499	217 837	72 612.3	1 336.4
University sector	44 408	615 798	0	0	0	660 206	82 525.7	311.0
Total	114 095	812 516	31 890	0	249 597	1 208 098	-	-
Average per organization	5 433.1	38 691.2	1 518.6	0	11 885.6	57 528.5	-	-
Average per researcher	49.0	349.2	13.7	0	107.3	519.2	-	-

*Table 1: Sources of financial resources spent for R&D in agricultural science in Serbia, in 2011 (in thousands of RSD)*

Source: [46].

On the other hand, the interesting is that  $\frac{1}{5}$  of total income of Serbian R&D organizations in agricultural sciences in 2011 comes from the foreign investors. Comparing to the R&D organizations in other sciences, R&D organizations in agricultural sciences and effects of the potential use of agricultural knowledge and innovations seem to be the most interesting for the foreign investors. R&D nonfinancial organizations in agricultural sciences in Serbia have the smallest amount of finances for the research per organization (33 million RSD in 2011 or 315000 EUR). However, such organizations are characterised by the highest average amount of finances for the research per researcher (over the 8 million RSD in 2011 or approximately 76500 EUR). Such ratio indicates different approach in financial management, partially because of different nature of such organizations and present foreign investors.

The Ministry of education, science and technological development finances the most of the scientific projects in agricultural sciences in Serbia (59.0%) because most of the financed projects are projects of R&D organizations in university sector. According to the data on the number of financed projects, from 2008 until 2011, there has been continuous decline of cooperation intensity<sup>23</sup> between economy and R&D organizations in agricultural sciences in public and university sectors. On the contrary, economy has the most frequent cooperation with the nonfinancial R&D organizations in agricultural sciences. These organizations also have the most frequent cooperation with the foreign investors. According to the 2010 data, 92.3% of all scientific projects financed from the abroad were projects of the nonfinancial R&D organizations in agricultural sciences. Such cooperation intensity is expected because foreign investors through cooperation with nonfinancial R&D organizations gain not only the opportunity to generate knowledge in agricultural science, but to have an insight in market trends (foremost, the requirements for a certain type of knowledge and innovations in agriculture which can be distributed by the very R&D nonfinancial organizations).

Along with the issue of financing R&D organizations in agricultural sciences, it is interesting to point out the changes in amount and structure of the gross domestic expenditure of these organizations. Analyzed data indicate drastic decrease of total value of gross domestic expenditure and gross investments (Tab. 2.). Gross investments in 2011 accounted only  $\frac{1}{3}$  of the gross investments in 2004 in Serbian R&D organizations in agricultural sciences.

Even more radical is decrease in gross expenditure and gross investments per researcher, which in 2011 accounted  $\frac{1}{10}$  of their values in 2004. Moreover, ratio of gross investments in gross expenditure in 2011, although significantly fluctuates, has increased, comparing to the 2004 (Tab. 2.).

<i>Year</i>	<i>Gross domestic expenditure (€)</i>	<i>Gross investments (€)</i>	<i>Gross expenditure per researcher (€)</i>	<i>Gross investments per researcher (€)</i>	<i>Ratio of gross investments in gross expenditure (%)</i>
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<sup>23</sup> According to 2008 data, the economy financed 128 projects (or 13.2%) in public sector and university sector. In 2011, economy haven't finance a single project in public and university sector of R&D organizations in agricultural science.

2004	51 812 688.6	1424.464.4	51 864.6	1 425.9	2.7
2006	87 769 810.1	2296.278,5	89 561.0	2 343.1	2.6
2007	31 522 690.6	2402.599,7	31 118.2	2 371.8	7.6
2008	41 432 279.9	3166.828,4	35 171.7	2 688.3	7.6
2009	32 960 892.7	3633.694,9	29 534.9	3 256.0	1.1
2010	14 963 014.2	838.473,9	6 491.5	363.8	5.6
2011	11 545 279.1	450.372,7	4 961.4	193.5	3.9
Total	272 006 655.2	14212.712,50	248 703.3	12 642.4	5.2
Index (2011/2004)	0.22	0.32	0.095	0.14	1.42

*Table 2: The amount of gross domestic expenditures and gross investments in R&D organizations in agricultural sciences in Serbia (2004 - 2011)*  
Sources: [39], [40], [41], [42], [43], [45],[46].

Very unfortunate is the fact that gross investments per researcher at the annual level account less than 200 EUR. Amount of gross investments per researcher is the lowest in agricultural sciences<sup>24</sup>. Also, amount of gross investments in different types of R&D organizations in agricultural sciences vary. Thus, in nonfinancial R&D organizations in agricultural sciences, average amount of gross investments per researcher accounts 6 061.14 EUR while in R&D organizations in agricultural sciences in university sector it accounts only 40.01 EUR. Presented data necessarily lead to the question of adequate expenditure management in such R&D organizations. Besides, it also signifies the necessity of systematic analysis of the R&D organizations in Serbia (in general and in agricultural sciences, as well). To make it simple, the question is on what terms R&D organizations can acquire consent for practicing the scientific research and who can be a researcher (person engaged in a research<sup>25</sup>).

### **3. AGRICULTURAL EXTENSION SERVICE IN SERBIA – CHARACTERISTICS AND POSSIBLE DEVELOPMENT PATHS**

We have already pointed out that labour modernization on family farms depends on the interest of farmers (and members of their families). It is

<sup>24</sup> The amount of gross investments per researcher at annual level in 2011 was 364.59 EUR in humanity sciences while in technical and technological sciences it was 4151 EUR.

<sup>25</sup> Mostly, this refers to the employees in university sector who are primarily engage in education. Due to changes university education in Serbia in the last few years, the question is how many teachers at universities have enough time for scientific work for which they are paid.

obvious, of course, that farmers and family farms are not independent entities. They are unavoidably included in the system of relations with other farmers, farms and households, other agricultural and rural economy stakeholders. Farmers and family farms are also in the complex relations with the environment. Their interest in labour modernization is expressed by willingness to invest in factors of modernization, including investing in required knowledge and innovations. Motivation for investment depends on sociocultural characteristics of farmers and family farms [12], characteristics of rural social structure, features of agricultural policy and policy of rural development, market characteristics etc. Due to the fact that we are analyzing impact of diffusion of knowledge and innovations on farmers' readiness to invest in knowledge, features of the AKIS, especially characteristics of the extension service (such as work organization, personnel, available equipment, funding etc.) must be taken into account as relevant factors when analyzing decision making on farms' investments.

The role and the significance of the agricultural extension service will be analyzed by the example of the agricultural extension service in Serbia. The very beginnings of the agricultural extension service in Serbia as a socially organized activity aiming towards modernization and improvement of agricultural production are dated in the second half of the 19<sup>th</sup> century<sup>26</sup> [37]. First institutions for the education of the agronomists and institutions for the diffusion of agricultural knowledge and innovations were aiming towards agricultural modernization not only to increase the productivity in order to ensure food abundance, but to strengthen the peasantry and to improve Serbian export opportunities. All measures were directed towards capital accumulation, which was essential for the development of the industrial sector.

The Second World War in which the peasantry, as it has always been, submitted one of the biggest victims has shaken newly founded agricultural extension service to the core. After the war, during the 1950s, Regional Plant Protection Stations have been founded. Agricultural stations and institutes were later developed from Plant Protection Stations. Those agricultural stations and institutes are organizational framework for the agricultural extension service in Serbia. By the 1990s,

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<sup>26</sup> In this period (1886), agricultural station in Negotin was established. Beside the intention of educating farmers how to improve viticulture (typical for the region), agricultural station was controlling quality of grapevine grafts [20]. Agricultural station is still active. Besides Negotin, agricultural stations in Kruševac and Leskovac also have long history in agricultural educating of the farmers (1900) [20].



agricultural stations and institutes have been cooperated mostly with the agricultural combines, but the breakdown of the public sector of Serbian agriculture has directed the course of the diffusion of knowledge and innovations in agriculture toward family farms<sup>27</sup>.

For a last decade and a half, Serbian agricultural extension service consists of both public and private sectors<sup>28</sup>. We are going to analyze only public agricultural extension service because it represents public endeavour to modernize agriculture. Public agricultural extension service in Serbia consists of two major organizations: Agricultural Extension Service of Autonomous Province of Vojvodina (later: AES APV) and Agricultural Extension Service of Serbia (later: AEES). The *Law on Extension Work and Professional Services in Agriculture* (2010)<sup>29</sup> which, for the first time, clearly defines extension work in agriculture and the organization of extension service regulates work of both extension services.

AES APV is under supervision of the Department of Agriculture, Water and Forestry of the Autonomous Province of Vojvodina. By the *Law on Establishing the Competence of the Autonomous Province of Vojvodina*, Department of Agriculture, Water and Forestry establish professional activities and programs for the modernization of the agriculture at the territory of Autonomous Province. In addition, Department of Agriculture, Water and Forestry of the Autonomous Province of Vojvodina is a founder and controller of the AES APV work. AES APV

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<sup>27</sup> Ministry of agriculture, forestry and water management of the Republic of Serbia since 2001 applies the concept of so-called chosen family farms in the work of public agricultural extension service. Chosen family farms are selected for a period of time during which they cooperate intensely with the extension service. The aim of the cooperation is labour modernization in agriculture, which will enable transformation of chosen family farms in exemplary farms and therefore contribute further diffusion of agricultural knowledge and innovations.

<sup>28</sup> There are two types of private agricultural extension services. First type is agricultural extension services engaged in providing professional assistance in agricultural production. The second ones are agricultural input traders who, complementary with trading, provide professional help in agricultural production.

<sup>29</sup> Before the legislation, work of the agricultural extension service was regulated by the Law on professional agricultural service (1991) which, beside positive, consisted of some problematic solutions for the important issues such as scope of the agricultural extension agent's work. Even though agricultural extension work was, by law, delegated to the agricultural stations and institutes named as Agricultural professional service [37], it was not precisely defined what are the activities of an agricultural extension agent. In practice, that has resulted in the fact that one extension agent, beside extension work, have being engaged in other activities that could have been in a collision with the extension work (e.g. control).

consists of 12 regionally established and organized units working within agricultural stations and institutes<sup>30</sup>. It employs 94 extension agents [2] that are working in seven districts of Vojvodina.

AESS activity area includes 17 districts in Central Serbia. The service consists of 22 territorially organized units. It employs 143 agricultural extension agents [33]. AESS is under supervision of the Institute for Application of Science in Agriculture. The Institute controls the work of the AESS on the behalf of the Ministry of Agriculture, Trade, Forestry and Water Management of the Republic of Serbia.

The majority of the employed extension agents<sup>31</sup> are men (59.6 %), which indirectly indicates that agriculture and agricultural extension work are still regarded as traditional male occupations. Experts on field and vegetable crops are the most numerous extension agents (29.8%) which match with the production structure on family farms. Nevertheless, considering the regional differences in the agricultural production structure, some variations in the staff structure of extension agents can be observed. Thus, among the extension agents in AES APV there is a significantly higher proportion of experts on field and vegetable crops (35.9% versus 28.7% among agents in AESS), while among the extension agents of AESS there is far more experts on horticulture and viticulture (18.8% versus 5.6% in AES APV).

Reform of the public agricultural extension service is necessary. Actually, Serbian society deals with a decade long urge for the extension service reform. Two major questions are crucial in this context: why are we still talking about the need for the extension service reform (i.e., why is reform so slow) and in which aspects of the agricultural extension work is reform required<sup>32</sup>. Naturally, talking about the need for the reform does not mean that there is no reform at all. The *Law on Extension Work and Professional Services in Agriculture* (2010) was the important step towards reform of the agricultural extension service in Serbia. Normative regulation of the questions who can be an extension agent, how and with whom extension work should be taking place, how extension work is financed etc. are significant elements in creating a

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<sup>30</sup> Since 2010, AES APV was consisted of 13 organizational units. In 2010, two regional units merged (Kovin and Vršac).

<sup>31</sup> On the importance of staff structure in extension service, see more in [44].

<sup>32</sup> This is, actually, the issue of problems in the extension service practice. Such problems should be overcome by the agricultural extension service reform.

modern agricultural extension services in Serbia. However, the question is whether the pace of changes and systematic overcoming of the problems in the extension service of Serbia are adequate considering the requirements of agricultural modernization.

Characteristics of the extension service itself, but also characteristics of the superior institutions provide answer to the question why reform of extension service in Serbia has been going so slowly. Hereby, we mean of often declarative dedication to the extension reform (within the daily political discourse) with no or partial action towards elimination of “bottlenecks” in the work of extension service because such actions can cause negative or even harsh reactions of those who work in the extension service. Actually, it seems that discontinuity in the public policy towards extension service (sometimes accompanied by insufficiently articulated reform attitude) slows down the process of transformation. However, it should be pointed out that the responsibility for slow reform must also take extension service itself. Often, agricultural extension service, while attempting to survive in the turbulent times of social transformation and crisis, preserves *status quo*.

The answer to the second question concerns the identification of the problems in the work of the extension service and identification of the necessary reform aspects. It is possible to observe at least two directions of the reform of agricultural extension service in Serbia. The first one relates to reform from within and the other one regards the reform from the outside. The reform from within includes standardization of an agricultural extension work as a profession as well as changes in the way the agricultural extension work is practiced. This mostly refers to the more intensive use of group methods in the agricultural extension work [11], planning the agricultural extension work with the family farms [31], enhancing teamwork among extension agents and extension agents and other agricultural experts etc. On the other hand, reform from the outside implicates clear definition of agricultural extension goals [24], domains of the extension practice (agricultural and rural extension), organization of the service, finances, functional and structural links with other stakeholders in the AKIS etc.

#### **4. SOCIOLOGICAL AND RELATED COMPREHENSIONS OF THE DIFFUSION OF KNOWLEDGE AND INNOVATIONS IN**

## SERBIAN AGRICULTURE – CURRENT STATE AND DEVELOPMENT PATHS OF SCIENTIFIC THOUGHT

To understand the current state and future prospects of rural sociological and related comprehensions of the diffusion of knowledge and innovations in Serbian agriculture, it should be mentioned that this issue occurs in the early works of Serbian authors who researched agriculture and rural social structure. Although primarily concerned with problems of agricultural cooperation (both in theoretical and practical manner), Avramović speaks about the differences between large and small family farms, especially from the perspective of diffusion of agricultural innovations. He concludes that process of diffusion of innovations is much easier on the larger family a farm, while on small farms diffusion of innovations is facilitated by joining the agricultural cooperation [3]. Vukosavljević[54], one of the founders of rural sociology in Serbia, while analyzing the peasants` labour and diffusion of technical knowledge in Serbian agriculture, points out that the reasons for the slower diffusion of innovations are, among others, absence of financial resources, but also reduced need for saving the labour force on family farms. Vukosavljević [54] vividly describes that peasant *“had no savings”* and, therefore, no money to buy new tools and machinery. He adds *“expensive tools are not worth on the farm if they are not used enough. When there is more labour force, it does not pay to buy all of the tools that are used sufficiently and that can make labour faster and save labour force”*. In addition, Vukosavljević points out that part of the resistance to the diffusion of technical innovations in peasant agriculture lies in the fact that innovations are way of disturbing *“previously established schedule of the labour force”* [54]. Vukosavljević concludes correctly when says that problem in search for innovations is in the fact that *“he (peasant – A/N)is always on the limit of his resources and therefore he cannot take the risk of untested innovation. Nevertheless, he is uneven. Peasants are slow but also vary fast in recruiting innovations. While objective conditions mature”* [54]. With such views, Vukosavljević confirms one of the Mandras`s rules of peasant economy (it is a family economy based on a relation between number of labour force and people who have to be fed) and Chayanov`s thesis on the impact of the family cycles on labour organization on family farm and agricultural modernization.

Work of Vojislav Đurić has been significantly marked the post-war sociological research of the diffusion of innovations. When Đurić writes

about the nature of innovations, he emphasizes its social or “*supra-individual, non-private, group character*” [13]. Accordingly, the author defines innovation as “*any socially purposeful, rational and historically appropriate instrumental or teleological value which has recent origin or recent change in its existing form, function and content or with which people have been recently reached contact and which, accordingly, has not yet been extended to saturation in social environment*”[13]. Similar to Rogers, one of the most influenced 20 century authors on diffusion of agricultural knowledge and innovations, Đurić also thinks that diffusion of innovations is “*a process of social presentation of new values in order to be adopted and used by interested social actors, accordingly with their characteristics and characteristics of the social system they live in*” [13]. Besides Đurić, Stevanović also analyzed the process of the diffusion of knowledge and innovation in agriculture in the context of agricultural industrialization. He pointed out that agricultural industrialization implies “*the use of scientific methods in production, especially to increase the scope of production, ensure the scientific labour organization, predict market trends etc.*”[49].

The recent period in the development of rural sociological comprehension of diffusion of knowledge and innovations in agriculture is marked by the work of rural sociologists from the Faculty of Agriculture, University of Novi Sad (Petrović, Janković, Čikić, Petrović). The authors have been researching needs for knowledge and difficulties in the diffusion of knowledge and innovations in Serbian agriculture and characteristics of agricultural extension work for 10 years. They have published more than 30 scientific papers. In addition, they have conducted 10 scientific projects relating agricultural extension<sup>33</sup>.

Beside rural sociologists, the other comprehension of the diffusion of knowledge and innovation in agriculture in Serbian science is agricultural economists` understanding. While researching the issues such as current state of extension service in Serbia and its development potentials [28], the role of extension in agricultural development [52; 30; 35; 51], comparing organization of extension service in different countries [29; 34], analyzing the role of web applications in extension service practice [55], agricultural economists contribute to the overall understanding of the organization and role of the extension services in the process of diffusion of knowledge and innovation in Serbian agriculture.

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<sup>33</sup> More on projects and published papers of the group of rural sociologists from Faculty of Agriculture see on [19].

## CONCLUSIONS

The analysis of the characteristics of the diffusion of knowledge and innovation process in Serbian agriculture shows that the system in which this process is being situated is marked with several problems, regarding stakeholders and their mutual relationships. If we observe only three basic stakeholders of such system (farmers, R&D organizations and agricultural extension service), it is possible to establish few important practical points in order to eliminate stakeholders' internal and relational difficulties.

First, social vitality of most of the family farms in Serbia is disturbed. Average utilized agricultural area of the single farm is 4.5 ha [1]. More than  $\frac{2}{3}$  of Serbian family farms have less than 5 ha of agricultural land<sup>34</sup>. The characteristics of the land structure clarify why four out of ten farms have no tractor<sup>35</sup> [1]. Ageing index of agricultural population is very high [8]<sup>36</sup>. Unlike the total economically active population (where 45.6% of economically active is from 20 to 39 years old), only  $\frac{1}{4}$  of agricultural population is in this age and 29.1% is 60 years old or even more. More than 70% of active agricultural population have no formal education or have only partial primary education [6]. Such characteristics of social vitality of Serbian family farms undoubtedly indicate the necessity of acquisition of agricultural knowledge and innovations, especially if farmers intend to produce food for the competitive market. Therefore, one of the first steps in agricultural modernization on family farms is enhancing farmers' awareness of the significance of investing in knowledge and information and the ways to gain such knowledge.

According to the *Innovation Union Scoreboard* [22], in the last five years Serbia have increased budget for the scientific research for 22.2%, but

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<sup>34</sup> According to the agricultural census (2012), 1.5% of the family farms in Serbia have no agricultural land. Almost half of the family farms have less than 2 ha of utilized agricultural land and 29.4% have from 2.1 until 5 ha of agricultural land [1].

<sup>35</sup> Only three out of ten farms that have less than the 5 ha have tractor. In the category of family farms that have more than 20 ha of agricultural land, every farm has two tractors, in average. On social aspects of technical base for agriculture on farms, see more in [36].

<sup>36</sup> Ageing index of agricultural population in Serbia is 1.16.

total research funds are still very limited<sup>37</sup>. Nevertheless, beside all the progress and relatively favourable characteristics of human capital in R&D sector, Serbia falls into category of modest innovators with performances under average level [22]. Besides introducing the unambiguous rules for practicing scientific work, the main problem in R&D organizations in agricultural sciences is a question of finances. Experiences from the developed countries show that investments in R&D organizations are vital for agricultural development. The issue of budgeting is accompanied with the question of the extent in which the R&D organizations in agricultural sciences have to self-provide necessary financial resources. In simple terms, the question is whether and in what scope R&D organizations in agricultural sciences are ought to be left to the market conditions. Current data indicate insufficient level of cooperation between economy and research in agricultural sciences. According to the document “*Strategy of development of the Republic of Serbia until 2020*” [47], beside increase of finances for R&D, the objective is to rearrange resource structure in order to achieve half of the overall budget from the economic sector.

Changes in R&D organizations budget structure in general (and in budget of the R&D organizations in agricultural sciences) are associated with project financing. Intensification of the cooperation with economic sector (especially with private sector) has two main benefits. First, it is a way to increase total amount of finances for the R&D. It is also mode to reform financial management in R&D organizations in a way to commit the funds for the investments (such as purchase of equipment, training etc.). Knowledge, information and innovations are commodities with a certain level of supply and demand and, therefore, price (like any other commodity present on the market). Therefore, a part of the investment in R&D in agricultural sciences should be orientated towards marketing activities and strengthening of the market recognition of research organizations.

The reform of the agricultural extension service in Serbia is a necessary step in creation of functional stakeholders within the agricultural knowledge and information system. If Serbian agricultural extension service embrace it's contemporary role of a broker [18; 25], it will not only actively be involved in a process of agricultural diffusion of

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<sup>37</sup> According to Šabić [50], only 0.3% of Serbian GDP is assign for research and development.

knowledge and innovation for improvement of agricultural production, but also it would facilitate the articulation of farmers' needs for a specific type of knowledge. In addition, if knowledge and innovation are treated as a commodity, it requires a change in extension approach. Demand-driven or farmer-driven (farmer-led<sup>38</sup>) approach raises the issue of extension work commercialization over the issue of farmer's choice of extension agents for cooperation. Demand-driven extension implies more than a knowledge and innovation transfer. This approach implies existence of open communication channels between different and often very heterogeneous stakeholders within agricultural innovation system, whereby, stakeholders' characteristics<sup>39</sup> and their relationships define characteristics of the stakeholders' network, nature of the information that are being exchanged and the very character of the communication process.

Diffusion of knowledge and innovation in agriculture should be considered as a process of creation of family farm's assets [53]. The manner this would be achieved, as well as development scope and the type of assets do not only depend on characteristics of farm's social vitality, but also on the policy of agricultural and rural development, level of stakeholder's integration within the agricultural knowledge and information system, development and availability of the institutions and organization relevant for the biological, economic and social reproduction of family farm, characteristics of the research in the agricultural sciences (and similar scientific fields), extension service etc. One of the first steps in achieving family farm's assets is the analysis of the farm's development potentials and needs for specific knowledge and innovation. Such research should be accompanied by the analysis of the willingness and ability of farmers to seek knowledge by them. However, it should not be forgotten that every stakeholder within agricultural innovation system have on disposal certain level of social power. Ability to influence is the key factor in determining stakeholders' relations with other stakeholders within the system (especially, with ones who are in position of knowledge), but also in determining the possession of required (mostly, financial) resources for work modernization. This is particularly important if the long-term objective of the work

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<sup>38</sup> The concept is used as an antonym for the concept of T&V system in agricultural extension as a typical top-down or supply-driven model.

<sup>39</sup> Stakeholders' network in AKIS consists of actors with a different level of homogeneity, organization skills, power, financial and social capital.



modernization of family farms in Serbia is enhancing rural entrepreneurship and, consequently, improvement of sustainability of local rural communities [10].

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