Governance of agricultural knowledge and innovation system (AKIS) in Bulgaria

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Abstract

Unlike in many other countries, in Bulgaria, there is no comprehensive analysis of the governance, state, efficiency and evolution of the system of Agricultural Knowledge and Innovation System (AKIS). This chapter presents the results of a large-scale study on the governance, efficiency, and development of AKIS in Bulgaria. The Governance of AKIS includes diverse governing agents, and the variety of rules, mechanisms and modes for agents, and the process of governing, and the outcome (specific order and efficiency) of the governance.

First, participants in the country's AKIS and the type of their relations are specified. Second, a diagnosis of the state and trends in AR&D is made. Third, the governance of agrarian research in Bulgaria is unpacked. Forth, the state of the system of education and training of agricultural producers in the country is analyzed. Fifth, the governance of the system of advice and consultations in agriculture is assessed. Six, results of an expert assessment on the governance of AKIS in Bulgaria are presented. Finally, the results of SWOT analysis and presented, and development strategy and intervention needs for AKIS for the next programming period are specified.

Modern scientific approaches of Comparative Data and Institutional Analysis, Gap Analysis, SWOT, Strategic Orientation, Experts Assessments, etc. are used to identify actors and relations, state and trends in development, assess Strengths, Weaknesses, Opportunities, and Threats, formulate adequate strategy, and specify overall and public intervention needs of AKIS in the country. The study is based on available data from statistical sources, official reports, fields surveys as well as assessments of a panel of leading experts in the area and stakeholders' representatives.

The study has found out that AKIS of the country consists of diverse and numerous organizations, for which activities and complex relations have no sufficient official or other reliable information. In the years of EU membership, the expenditures for ARD significantly decreased absolutely and relatively as a share in the total expenditures for R&D, which indicates diminishing importance and deteriorating financial, personnel, and material potential of the agrarian knowledge and innovation sector. Bulgarian AKIS demonstrates low resource endowment and efficiency, domination of outdated public institutions and undeveloped private sector, insufficient sharing of knowledge and innovations, slow and uneven application of modern technologies, varieties, production and management methods, digitalization, etc. in different types of farms, subsectors of agriculture and regions of the country.

The lack of full data only partially can be compensated by experts' assessments and it is necessary to carry out in-depth and representative surveys of individual components and the AKIS as a whole. Furthermore, it is necessary to institutionalize and regulate the collection of official statistics, reports, etc. information for the state and efficiency of that important system.

Key words: research, training, advisory, knowledge sharing, innovation, digitalization, agriculture, governance, modes, Bulgaria, CAP

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Introduction

"Stimulating and sharing knowledge, innovation, digitalization and promoting their greater use" is set again as one of the strategic ("horizontal") objectives in the new programming period 2021-2027 for implementation of the European Union (EU) Common Agricultural Policy (CAP) (European Commission, 2018). In many other countries, regular in-depth analyzes of the state, efficiency, and development factors of the Agricultural Knowledge and Innovation System (AKIS) are constantly made (Anandajayasekeram and Gebremedhinp, 2009; Antle et al. 2017; Chartieret et al., 2015; EIP-AGRI EU SCAR, 2012; FAO, 2019; Touzard et al., 2015; Özçatalbaş, 2017; USDA, 2019; Weißhuhn et al., 2018; World Bank, 2006; Virmani, 2013). In Bulgaria, there are only partial analyzes of the individual elements of this complex system (Башев 2020; Башев и др. 2014; Башев и Михайлова, 2019; Bachev, 2020; Bachev and Denchev, 1992; Bachev and Labonne, 2000; Bachev and Mihailova, 2019). The reason for later is the lack of enough official statistics and other information as well as "sufficient" public interest in the development of this important system.

In this chapter, an attempt is made to analyze the governance, state, efficiency, and factors for the development of the country's AKIS at the present stage of development. The goal is to specify major trends and identify main challenges and assist policies formation during the next programming period[3]. The governance of AKIS encompasses (1) the governing agents, and (2) the available rules, mechanisms and modes for agents, and (3) the process of governing, and (4) the outcome (specific order and efficiency) of governance. First, participants in the country's AKIS and the type of their relations are specified. Second, a diagnosis of the state and trends in AR&D is made. Third, the governance of agrarian research in Bulgaria is unpacked. Forth, the state of the system of education and training of agricultural producers in the country is analyzed. Fifth, the governance of the system of advice and consultations in agriculture is assessed. Six, results of an expert assessment on the governance of AKIS in Bulgaria are presented. Finally, the results of SWOT analysis and presented, and development strategy and intervention needs for AKIS for the next programming period are specified. For the analysis, a great variety of official statistical, reports, and agencies (Agricultural Academy, National Agricultural Advisory Service, etc.) data is used. In addition, an expert evaluation was made with the participation of 32 leading experts from the research institutes of the Agricultural Academy (AA) and Bulgarian Academy of Sciences (BAS), agrarian and other universities, National Agricultural Advisory Service (NAAS), and major professional organizations of agricultural producers.

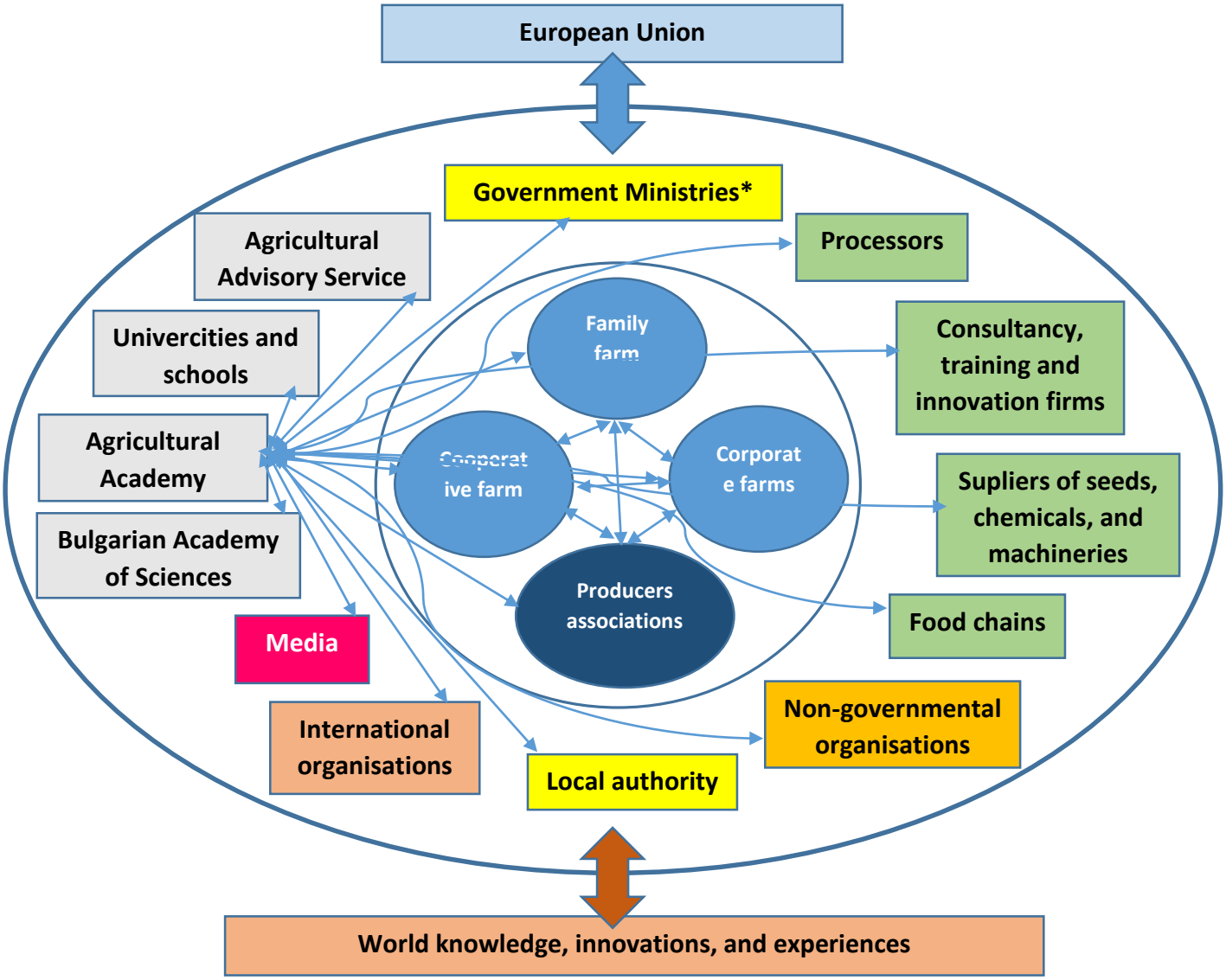
[3] In fact, that analysis is being used for identifying public intervention needs and measures in the 2021-2027 Program for Agrarian and Rural Development of Bulgaria (Иванов, Башев и др., 2020).

1. The Governance of AKIS in Bulgaria

The governance of AKIS includes: diverse governing agents and organisations (investors, research establishments, users of agrarian inovations, etc.); and the variety of available rules (e.g. system of agrarian intellectual property rights and the system of its enforcement), and private, market, collective, contractual, public, hybrid, bilateral, multilateral, national, international, multilevel, etc. mechanisms and modes for governing activity of agents; and the process of governing of AKIS; and the outcome (specific order, efficiency, impacts) of the governance.

In Bulgaria, AKIS is composed of diverse and numerous individuals and organizations involved in the process of generating, sharing, disseminating, and implementing knowledge and innovations in the sector. In addition to diverse types of farmers and agricultural farms (subsistent, semi-market, market, individual, family, cooperative, corporative, etc.), this complex system includes research institutes, universities, and schools, agricultural advisory service, private consultants, specialized consulting, training and innovation firms, professional farmers' organizations, non-governmental organizations, suppliers of machinery, chemicals and innovations, food chains, processors and exporters of agricultural produce, government agencies, local authorities, non-governmental organizations and interests groups, media of various kinds, international organizations, private individuals, etc. Figure 1 shows the main agents involved in the Agricultural Knowledge and Innovation System of Bulgaria. For greater clarity, only relationships of one organization (AA) with other organizations in this complex network of multilateral and complex relationships are highlighted.

Figure 1. Main Actors and Relationships in the National Agricultural Knowledge and Innovation System of Bulgaria



*Ministry of Agriculture and Food, Ministry of Education and Science, Ministry of Industry, etc.

Source: the author

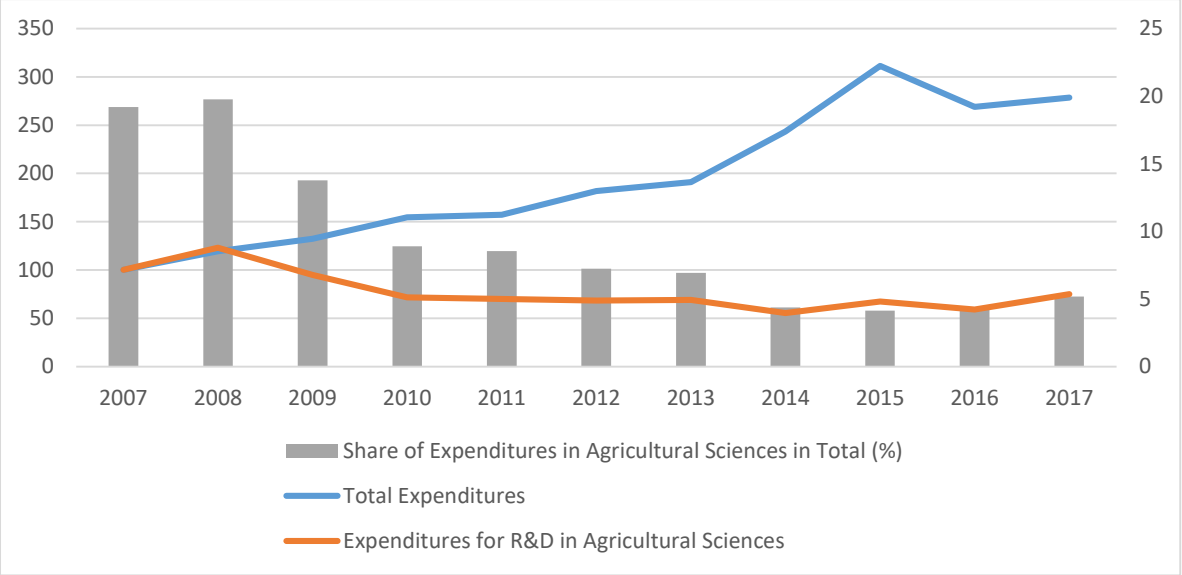
2. Diagnosis of the State and Trends in AR&D

Personnel and Expenditures for Agrarian Research and Development

Agrarian Research and Development (ARD) includes „every creative work, undertaken systematically, and aiming at increasing the body of knowledge, including knowledge about human, culture, and society, as well as utilization of that body of knowledge in new applications“ (NSI). It encompasses fundamental and applied research and experimental works. ARD in Bulgaria is mostly carried out by public organizations – research institutes and experimental stations of Agricultural Academy, some institutes of Bulgarian Academy of Sciences (Institute of Plant Physiology and Genetics, Institute of Economic Studies, etc.), some public and private universities (Agrarian University, Trasia University, Russe University, Forestry University, University of National and World Economy, High School for Agribusiness and Regional Development, etc.), and to a smaller extent by private firms and organizations, non-governmental organizations, etc. ARD in the country is funded by the state budget (e.g. National Science Fund, National Innovation Fund, state subsidies for Bulgarian Academy of Sciences and Agricultural Academy, etc.), business organizations (own and landed investments for internal R&D, purchase of intellectual property, commissioning research, sponsorship, etc.), non-governmental organizations, foreign states, international organizations (e.g. EU HORIZON 2020 Program, FAO projects, etc.), private individuals, etc.

„Expenditures for research and development activity" include the current costs and the costs for acquiring long-term material assets, for research and development (R&D) within a statistical unit, independent from the source of funding (NSI). The level of dynamics of that indicator gives insight for the state, financial and material conditions, and armament as well as for the evolution of the system for generation, sharing, and dissemination of knowledge and innovation in the agrarian sphere. In the past years, the expenditures for R&D activity in „Agricultural Sciences“ have diminished considerably both absolutely as well as a relative share in the total expenditures for R&D activity in the country (Figure 2). While the overall amount of the expenditures for R&D activity has increased almost three times after 2007, the expenditures for R&D activity in „Agricultural Sciences“ have diminished by 45% until 2014, and demonstrate a growth afterward reaching three-quarters of the initial level in 2017. Simultaneously, the share of the expenditures for R&D activity in „Agricultural Sciences“has experienced a significant drop in the total expenditures for R&D activity of the country – from around a fifth in 2008 г., to a little more than 4% during 2005-2016, and just above 5% at the end of the period. These data indicate the diminishing importance of the agrarian knowledge and innovation sector in the overall system of knowledge and innovation of the country.

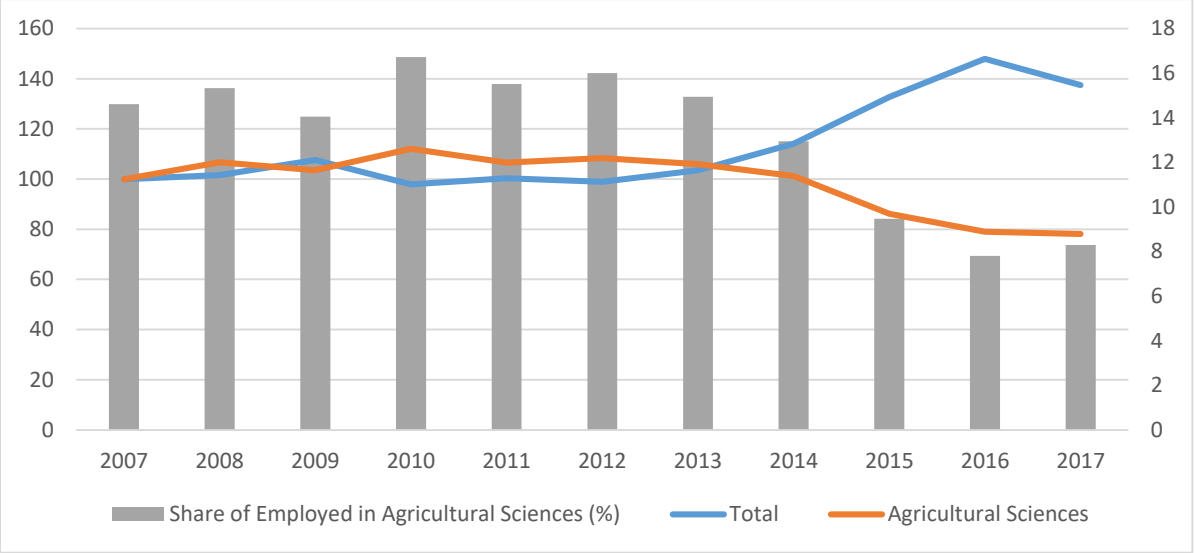
Figure 2. Evolution of Expenditures for R&D Activity Total for Bulgaria and for Agricultural Sciences (2007=100)



Source: National Statistical Institute, 2019

The indicator „Personnel employed in R&D activity" measures the human resources directly involved in R&D activity, who are responsible for the generation, application, and dissemination of the new knowledge (NSI). It comprises persons, directly carrying R&D activity and persons, directly supporting R&D activity (managers, administrators, bureaucracy, etc.). The level and dynamics of that indicator show the staff endowment of the system of R&D activity in the sector. Since 2007 personnel employed in R&D activity in the area of „Agricultural Sciences" initially augment (up to 12% in 2010), and gradually decreases afterward to 78% of the initial level in 2017 (Figure 3). That indicates the deteriorating of the staff component of R&D activity in the agrarian sphere in recent years. Simultaneously, there has been a change in the share of the involved with agricultural sciences in the total number of employed in R&D activity. Until 2012 their portion augments from 14,6% to 16%, and after that decline twice in the last two years.

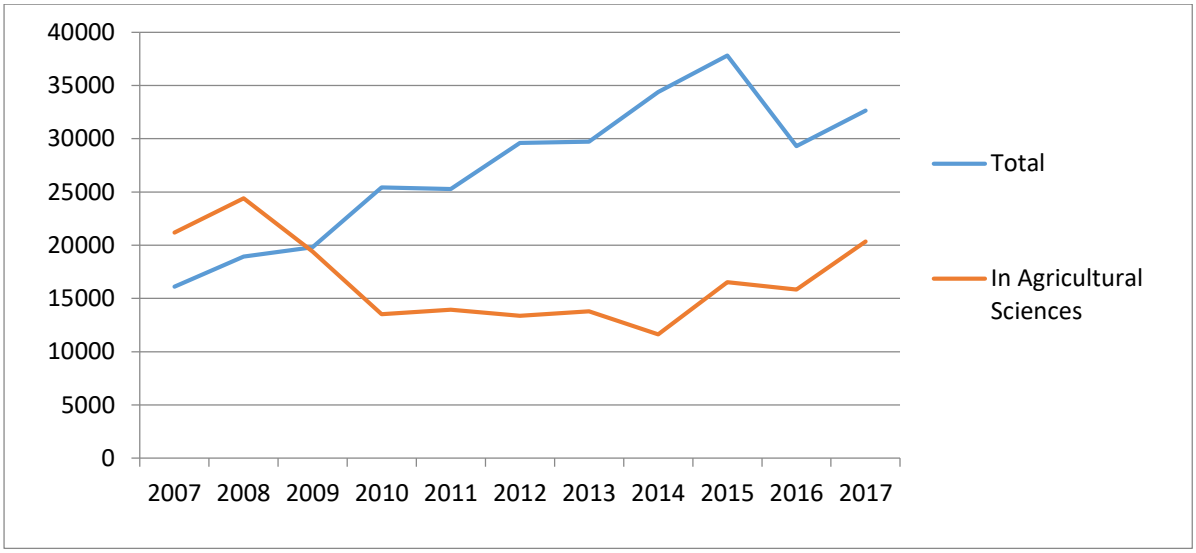
Figure 3. Evolution of Employed in R&D activity Total for Bulgaria and in Agricultural Sciences, in Full-time Equivalent (2007=100)



Source: National Statistical Institute, 2019

Along with the worsening of the personnel armament of R&D activity in agricultural sciences, there is also a decline in the material and financial endowment of the employed in R&D activity in agricultural sciences. After the accession of the country to the EU the expenditures for R&D activity per one employed in agricultural sciences fall by more than 45% by 2014 (Figure 4). Since then their amount gradually augments reaching 96% of the level at the beginning of the period. During the same period, there is a positive tendency for a rise in the average expenditures for R&D activity per one employed in R&D activity in the country. What is more, while in the first two years of the analyzed period the expenditures for R&D activity per one employed in Agricultural R&D activity considerably overpass the average in the country (with around 30%), in 2017 г. they account for merely 63,3% of the average level.

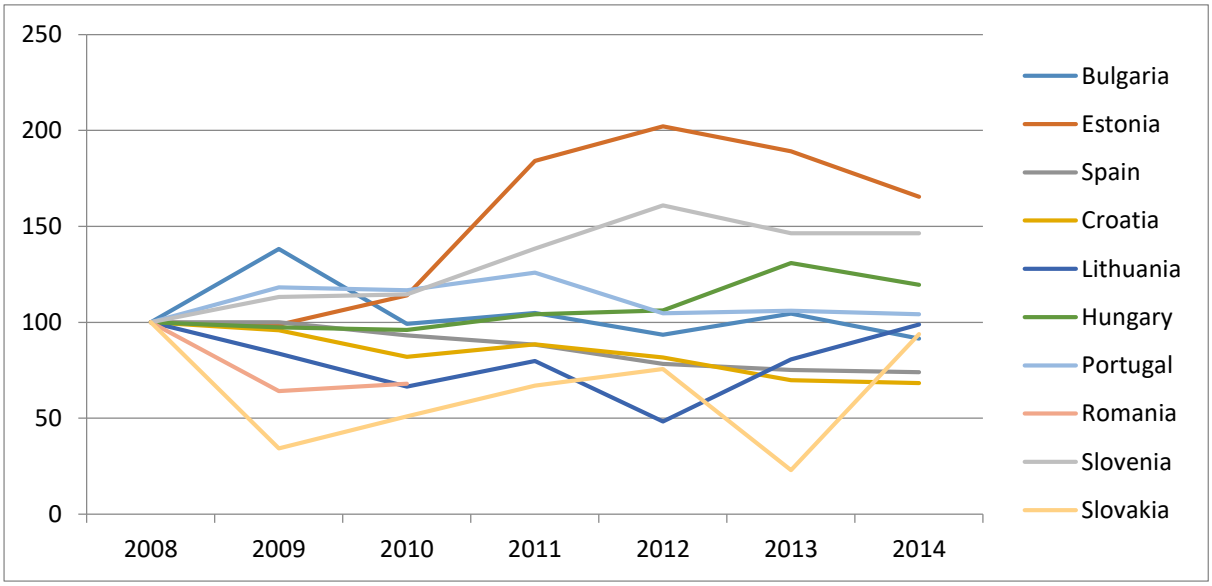
Figure 4. Amount of Expenditures per One Employed in R&D Activity Average for Bulgaria and in Agricultural Sciences (BGL)[4]



Source: National Statistical Institute, 2019

These trends in the evolution of agrarian R&D activity in Bulgaria are similar to other EU member states like Spain, Croatia, Slovakia, and Lithuania, where it has been registered diminution of expenditures for R&D activity in agriculture in the last years (Figure 5). At the same time in certain EU member states like Estonia, Hungary, Slovenia, etc. there has been significant growth in the overall expenditures for R&D activity in the sector.

Figure 5. Evolution of Intramural R&D Expenditures in Sector "Agriculture" in EU Member States (2008=100)

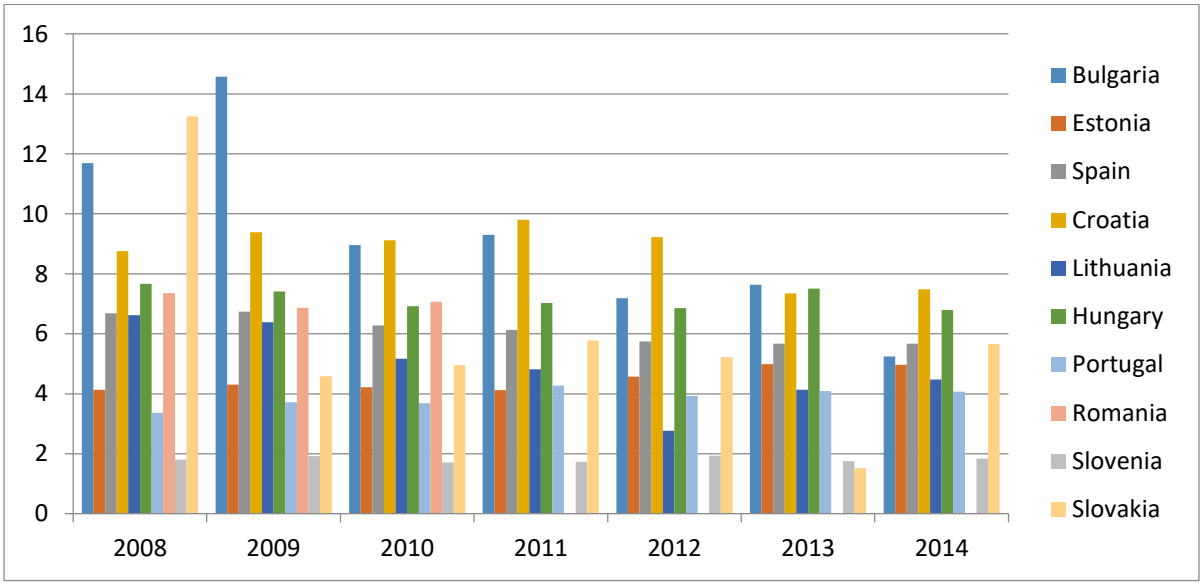


Source: Eurostat, 2019

[4] 1 Bulgarian Lev (BGL) equal 0,511292 Euro (a fixed rate applies during the period).

In many EU countries, there is a tendency for reduction of the relative share of expenditures for agrarian R&D activity in the total for the country. Nevertheless, Bulgaria is among EU countries (along with Croatia, Romania, Hungary, etc.), in which the portion of expenditures for agricultural R&D activity in the overall of the country continues to be the highest (Figure 6). On the other hand, in Slovenia the share of that type of expenditure for R&D activity is insignificant.

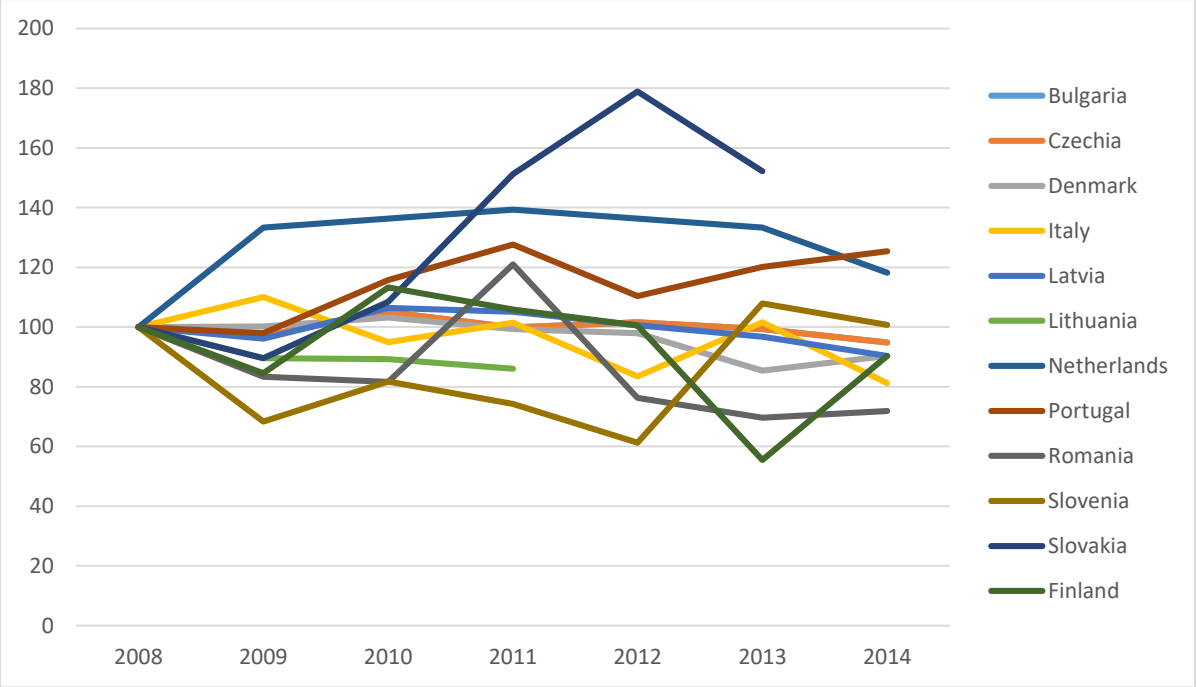
Figure 6. Share of Intramural R&D Expenditures in Sector "Agriculture" in Total in EU Member States (%)



Source: Eurostat, 2019

A common tendency in many EU countries is a diminution of the personnel and researchers in agrarian R&D activity (Figure 7). The exception is the Netherlands, Portugal, and Slovakia, where there is a considerable augmentation of cadre endowment of agricultural R&D activity.

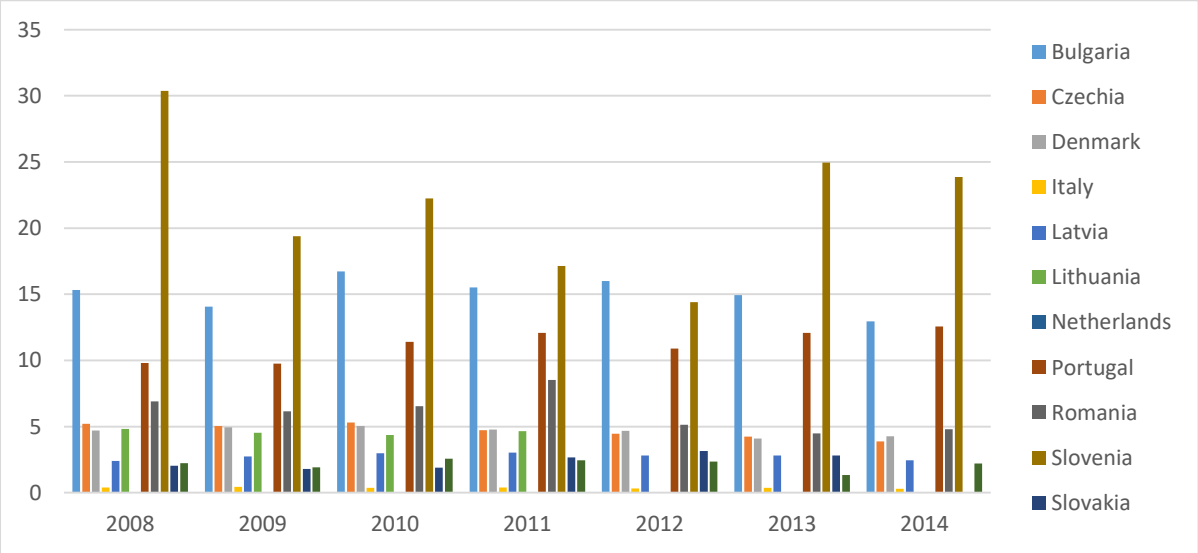
Figure 7. Evolution of R&D Personnel and Researchers (Full-time Equivalent) in "Agricultural Sciences" in EU Member States (2008=100)



Source: Eurostat, 2019

In many EU countries, there is also a reduction, to a greater or lesser extent, of the share of personnel and researchers in agricultural R&D activity in the total of the country (Figure 8). However, in Latvia, Portugal, and Slovakia there is a reverse trend of enlargement of the later proportion. Slovenia, Bulgaria, and Portugal are countries with the greatest relative share of employed in agricultural sciences in the overall employed in R&D activity.

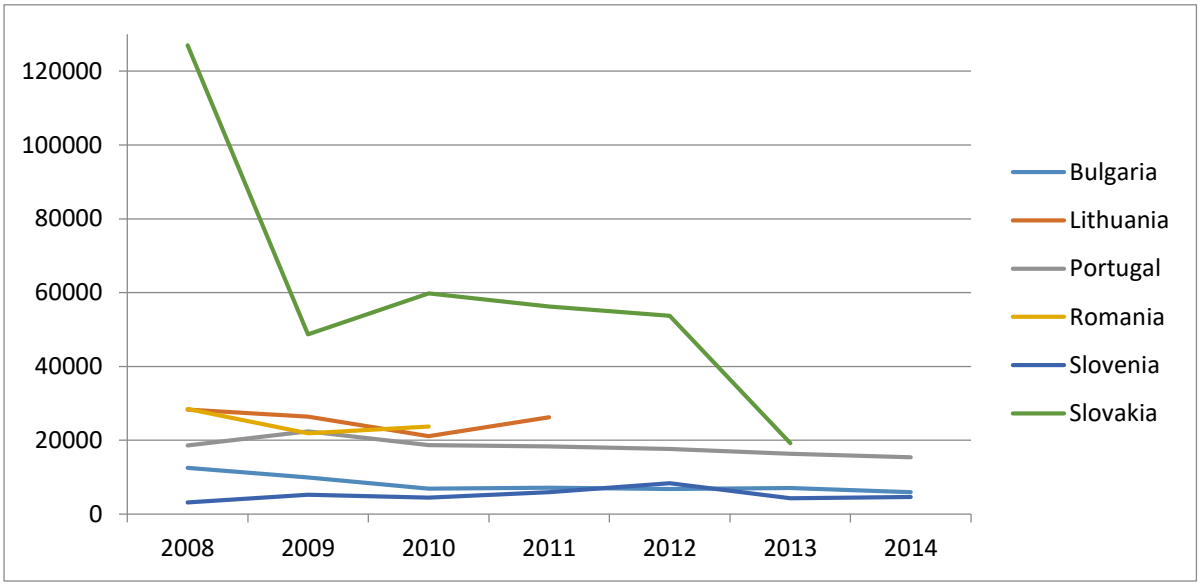
Figure 8. Share of R&D Personnel and Researchers in "Agricultural Sciences" in Total for the Country in EU Member States (%)



Source: Eurostat, 2019

In most EU member states there is a similar trend like in Bulgaria for a greater or less significant reduction of the financial endowment of employed in agrarian R&D activity (Figure 9). Despite that, however, the expenditures for R&D activity for one employed in R&D activity in sector Agricultural Sciences in Bulgaria are among the lowest in EU, similar to Slovenia. Regardless of the sensitive decline in the expenditures for one employed in agrarian R&D activity in Slovakia during the period, their amount is 2,7 folds higher than the figure in Bulgaria (2013).

Figure 9 Intramural R&D Expenditures in Sector "Agriculture" per Full-time Equivalent in Agricultural sciences in EU Member States (Euro)

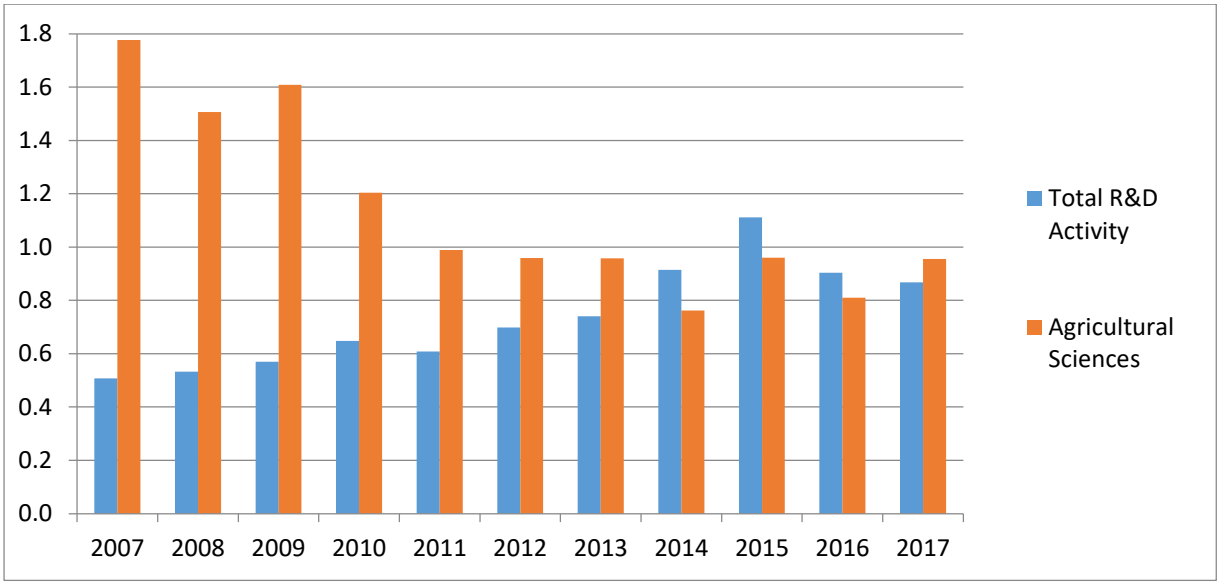


Source: Eurostat, 2019

Science Endowment of Agriculture

An important indicator for the science armament of agricultural production is the share of expenditures for agrarian R&D activity in the Gross Value Added of the sector. Since the accession of the country to the EU, there is a considerable diminution of the expenditures in R&D activity in sector Agricultural Sciences in the Gross Value Added of the sector „Agriculture, Forestry and Fishery" (Figure 10). In 2014 that indicator is 2,3 folds smaller than the 2007 level. In the last three years, there is an improvement in the level of „science armament of the sector, but levels are far below the levels for the period before 2012. The opposite is the tendency in dynamics of the indicator share of total expenditures for R&D activity in the Gross Value Added of the country. There is a positive increase of the scientific endowment as in 2015 this share doubled in comparison with the 2007 level. While at the beginning of the period the scientific endowment of the entire economy was 3,5 times lower than in the agrarian sector, it already overpasses the latter during 2014-2016. As a result of the evolution of the expenditures for R&D activity and the Gross Value Added in 2017 agriculture demonstrates again a little higher level for this indicators - 0,96% (against 0,87% before). It is obvious, that with such pace of progression of investments in R&D activity hardly can be achieved both the EU goals for the amount of investments in R&D activity at 3% of the Gross Value Added (for 2020) as well as the national objective of 1,5%.

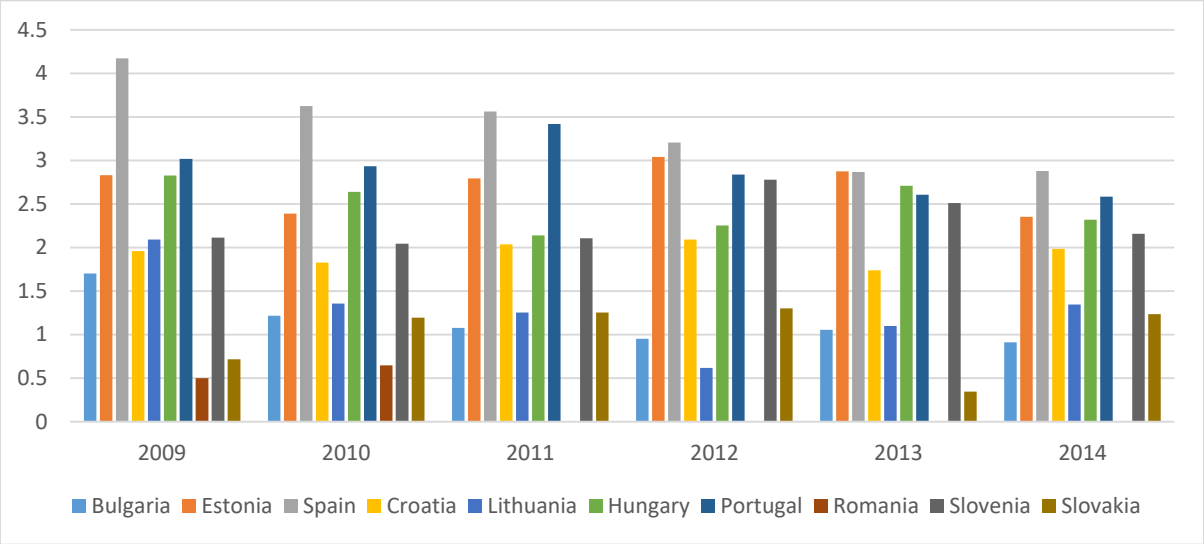
Figure 10. Share of Total and Agricultural Sciences Expenditures for R&D Activity in the Gross Value Added of Bulgaria and „Agriculture, Forestry and Fishery“ Sector (%)



Source: National Statistical Institute, 2019

The Science endowment of Bulgarian agriculture, measured through expenditures for R&D activity in Gross Value Added, is among the lowest in the EU along with Romania (Figure 11). In many member states (Estonia, Spain, Lithuania, Hungary, Portugal) the share of expenditures for agricultural R&D activity in the Gross Value Added of the sector falls during the period 2009-2014 (for which there are comparative data), but exceeds considerably that of Bulgaria during the entire period. In another group of countries like Croatia and Slovenia, the level of these indicators is stable and higher than in Bulgaria throughout the period. On the other hand, there is a significant growth of the initial level up to amounts exceeding that of Bulgaria, but inferior in comparison to other member states.

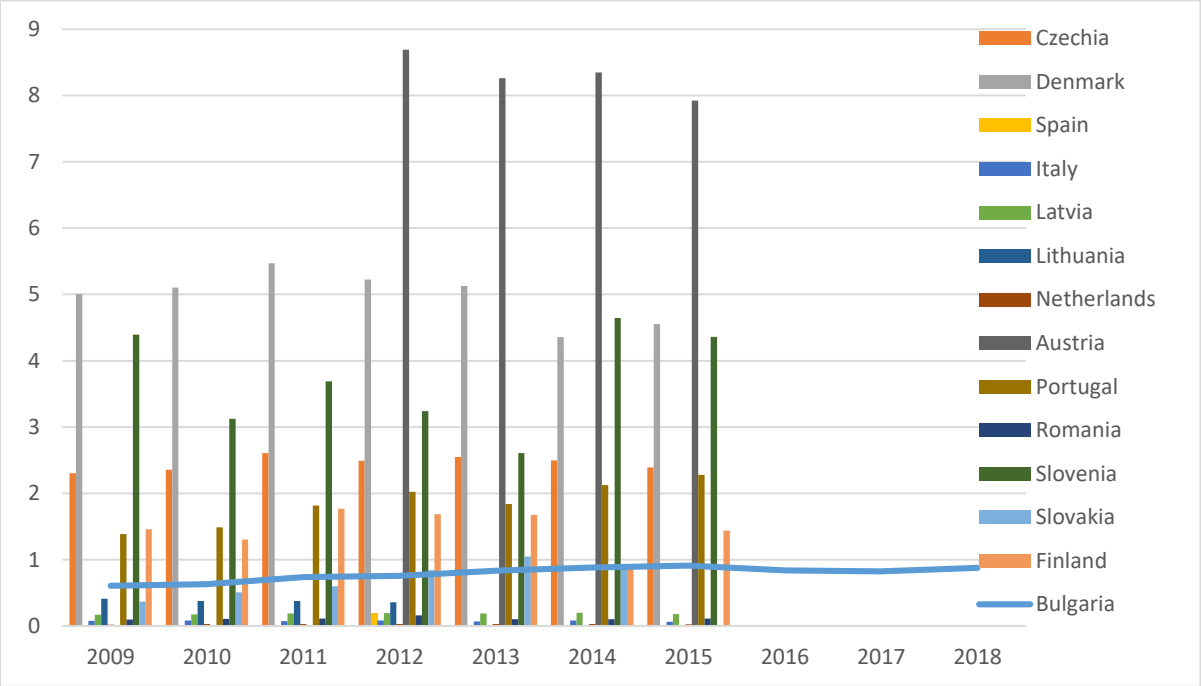
Figure 11. Share of Intramural R&D Expenditures in Sector "Agriculture" in the Gross Value Added and Income in the „Agriculture, forestry and fishing" Sector in EU Member States (%)



Sector: Eurostat, 2019

Another important indicator for the science endowment of agriculture is the share of employed in agrarian R&D activity in the totally engaged in agricultural activity. In Bulgaria, the share of employed in R&D activity in the „collective workforce" of the sector progressively grows during the period 2009-2015 г. and fluctuates insignificantly afterward. The endowment of the sector with workers in R&D activity grows due to the greater reduction of the number of employed in agriculture and working time in comparison to a diminution of the personnel and researchers in agrarian R&D activity (Figure 12).

Figure 12. Share of Employed in R&D Activity in Sector Agricultural Sciences (Full-time Equalent) in Total Workforce of Agriculture (Annual Work Units) in EU Member States (%)



Source: National Statistical Institute, Eurostat, 2019

In most EU member states during the period 2009-2016 a stable level of science endowment is observed measured by that indicator. In some countries, like Italy, Spain, Latvia, Netherlands, and Romania, the proportion of employed in agrarian R&D activity concerning the overall involved in the sector, is much lower than in Bulgaria. In Slovakia, the level of this indicator is similar to Bulgaria during the good part of the analyzed period. However, most EU member states significantly surpass Bulgaria concerning the number of employed in agrarian R&D activity „serving" the employed in agriculture. The highest endowment of workers in agrarian R&D activity is Austrian agriculture, which is 8,7 folds higher than in Bulgarian in 2016. During the analyzed period in Austria for every 100 employed in farming, there are around 8 researchers and persons in R&D activity in Agricultural Sciences, which also explains the big achievements of that country in the generation, sharing, and dissemination of knowledge and innovations.

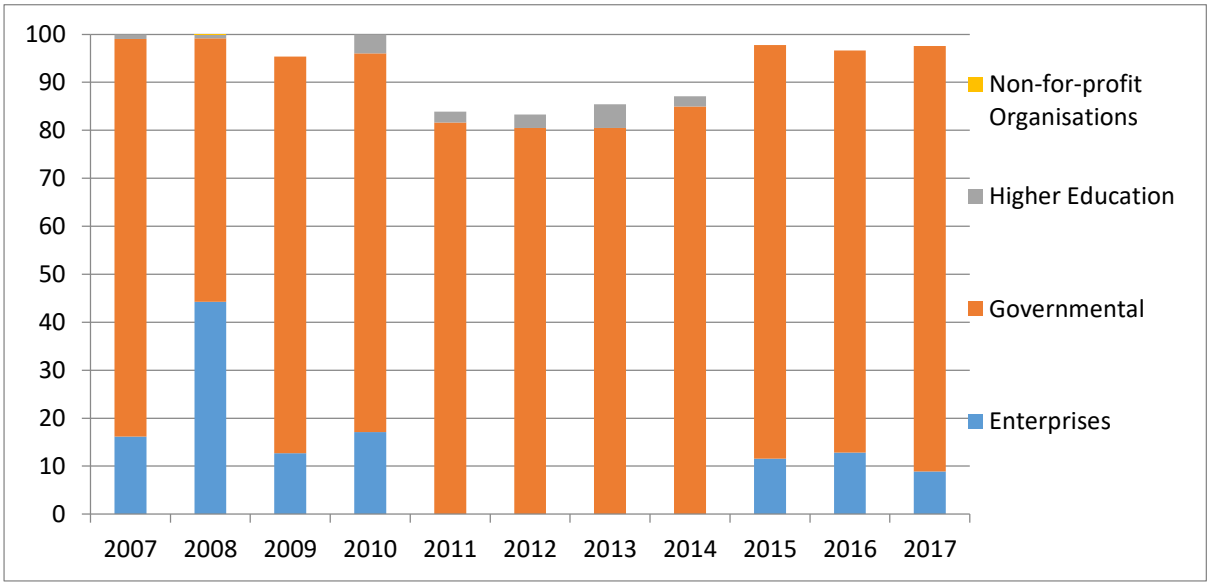
Evolution of Major Sectors of Agricultural R&D Activity

Expenditures and personnel potential (capability) of R&D activity are divided into four institutional sectors: Business Enterprise Sector, including all firms, organizations, and institutions, having the main activity of production of market goods and services (without including those, which are included in the sector „Higher Education "); Governmental Sector, including state organizations and institutions, which do not sell but provide services for satisfying individual and collective needs of society and funded mainly by the budget (without

including those, which are included in the sector „Higher Education “); Sector Higher Education, including universities, colleagues, high schools, research sectors belonging to high schools and university hospitals; Sector of Private Non-for-profit Organizations, including foundations, associations, partnerships, etc. providing non-market services.

The level, relative share, and dynamics of relevant indicators for these sectors of R&D give insight into the state, development, and importance of major sectors for carrying out agrarian R&D activity in the country. The most important sector of agricultural R&D activity in Bulgaria is the Governmental sector, in which the greatest part of the total expenditures of R&D activity in the sector is invested (Figure 13). With an exception of 2008 during the entire period after EU accession of the country, in the latter sector are allocated more than 80% of overall expenditures for agrarian R&D activity. That sector comprises mostly research and development organizations, funding their activities from the state budget by priorities determined by the state.

Figure 13. Share of Expenditures for Agricultural R&D Activity in Major Sectors of R&D Activity in Bulgaria (%)

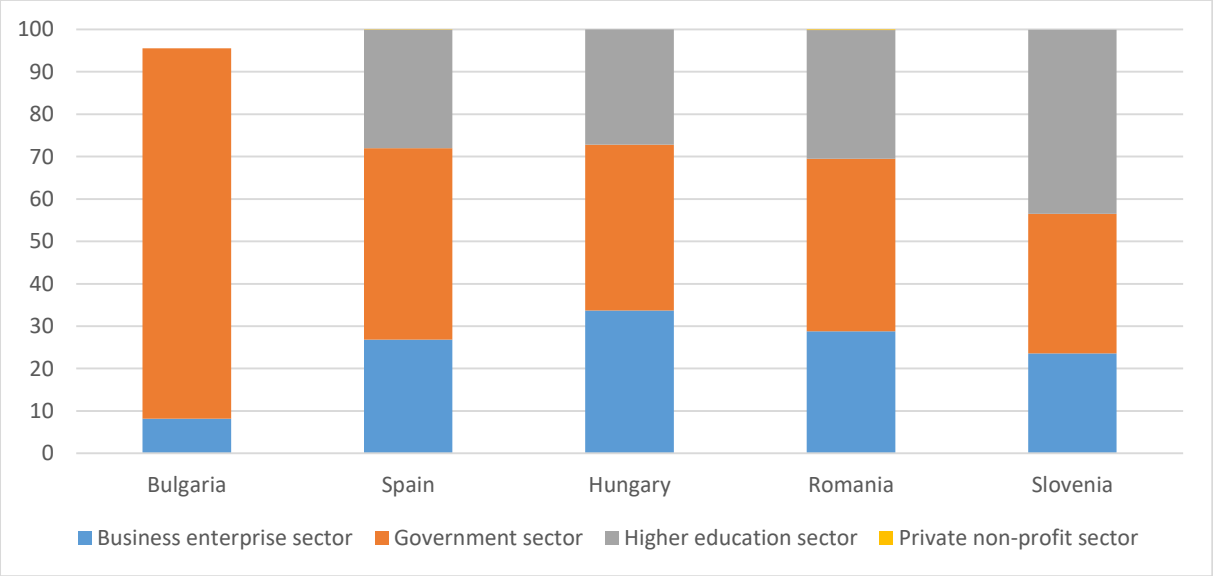


Source: National Statistical Institute, 2019

The second most important sector is that of Private Enterprises, which comprises mainly private firms and organizations managing their investments and activity for benefit of owners and according to the rules of market competition. The share of this sector in the total expenditures for agrarian R&D activity considerably varies during the period, being higher during the first four years (13-44%), after that, there are no data and in the last three years lower (9-13%). The third by volume of expenditures for agricultural R&D activity is the sector Higher Education, in which are allocated quite a different portion of the overall expenditures, varying from 0,8% up to approximately 5% in individual years, for which data are available. In the sector of Non-for-profit Organizations are reported expenditures for agricultural R&D activity only for 2008 г. and they account for a tiny portion (0,01%) of the total expenditures in the country.

Distribution of costs and organization of R&D activity in the major sectors of agrarian R&D in Bulgaria differ substantially from other EU member states (Figure 14). In most countries the governmental sector for agrarian R&D activity dominates, but in Bulgaria, its share surpasses two and more folds the portion in other member states, for which data are available. In Slovenia expenditures for agrarian R&D activity in the sector, Higher Education is the greatest (43% during the period 2008-2012), while in the rest of the countries considerable (a third in Romania, 28% in Spain, and 27% in Hungary). Unlike Bulgaria in other member states, a strong private (business) sector of agrarian R&D activity is also developing, in which are invested a significant part of the total expenditures – a little more than one third in Hungary, almost 29% in Romania, approximately 27% in Spain, and 24% in Slovenia. All these indicate unbalanced development of the main sector of agrarian R&D activity in Bulgaria in a direction different from the common trends in the EU and other developed countries. Similar to Bulgaria in the rest of the analyzed countries the share of the Private Non-profit sector in the overall amount of agrarian R&D activity is negligible.

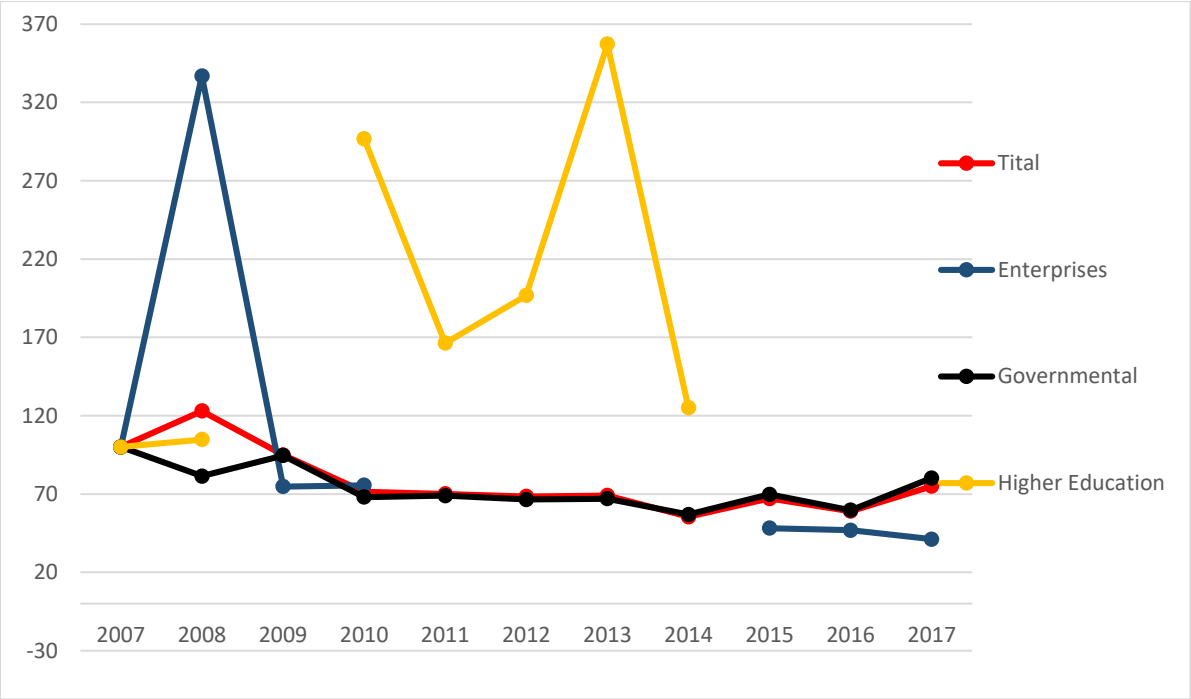
Figure 14. Share of Agricultural R&D Expenditures in Major Sectors of EU Member States for 2008-2012



Source: Chartier et al., 2015

The level of expenditures in major sectors of agrarian R&D activity in Bulgaria is with different dynamics since 2007 (Figure 15). While in the sector Higher Education there is a growth of expenditures for agrarian R&D activity, the Government and the Private sectors experience decline. Moreover, the diminution of the expenditures in the Private sector is much bigger than in the Government sector. Furthermore, since 2010 now dynamics of the expenditures for governmental R&D activity coincides with the dynamics of the total expenditures for agrarian R&D activity in the country, which confirms the leading role of that sector for R&D in agriculture.

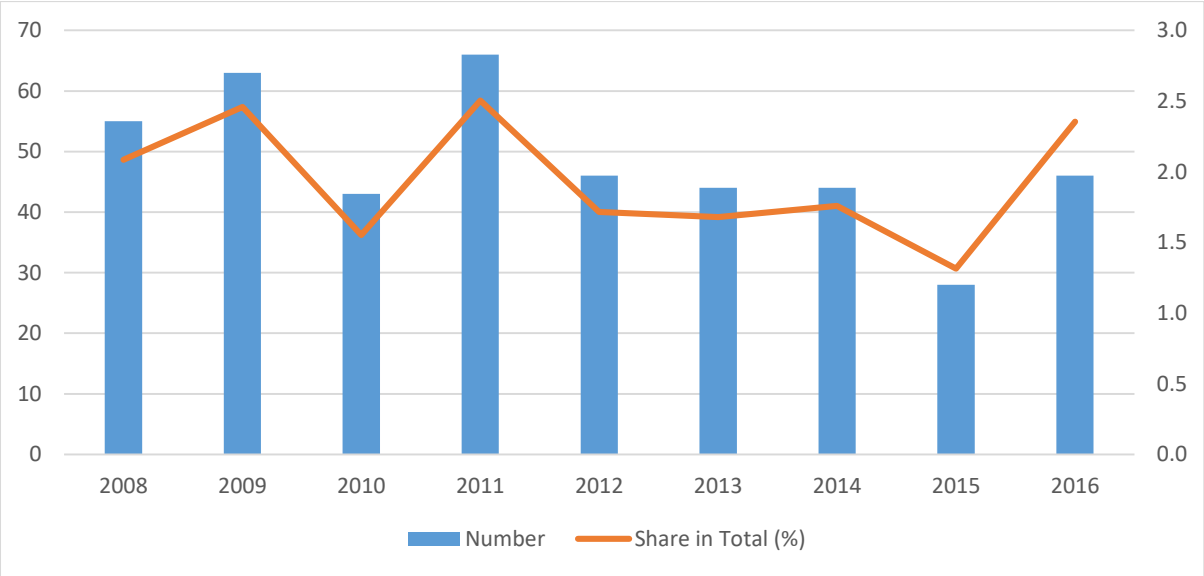
Figure 15. Evolution of Expenditures for R&D Activity in Agricultural Sciences in Different Sectors of R&D in Bulgaria (2007=100)



Source: National Statistical Institute, 2019

There is no statistical data for distribution of the number of workforce in the public (state and university) sector of agrarian R&D activity, but merely in the sector of Enterprises. In the private sector are employed a small portion of the totally involved in agrarian R&D activity in Bulgaria (Figure 16). The amount of that personnel is little, while their number and share in the overall persons and researchers, engaged in agrarian R&D activity vary considerably in individual years (from 28 to 66 persons, and between 1,3% and 2,5%).

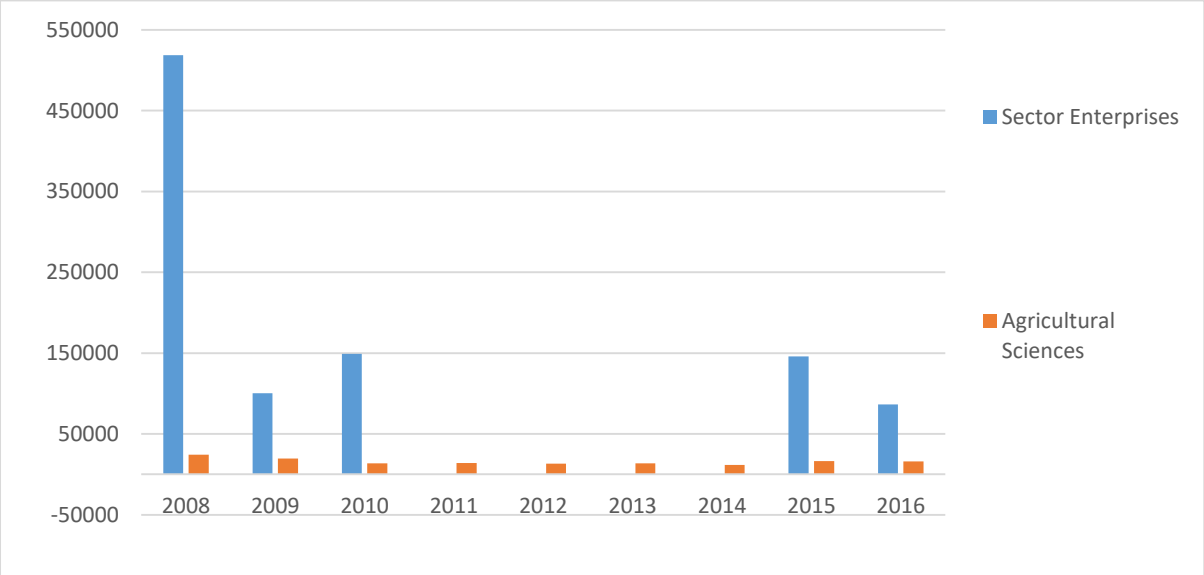
Figure 16. Number of Employed in Agricultural R&D Activity in Sector Enterprises and Share in the Total Employed in R&D Activity in Agricultural Sciences in Bulgaria



Source: National Statistical Institute, 2019

At the same time, the endowment with financial and material resources employed in agrarian R&D activity in the private sector (Enterprises) is multiple times higher than in the public sector (Figure 17). Expenditures for one employed in agrarian R&D activity in the private sector vary significantly in the individual year as their level surpasses the average for the country from 5 (2016) to 21 folds (2008). All these express the significant lag in the development of the governmental and university sectors in the financing, payment of labor, and modernization of R&D activity in Bulgarian agriculture in comparison with the business sector.

Figure 17. Expenditures for R&D Activity in Agricultural Sciences per one Employed in Sector Enterprises and Avarage for All Sectors of R&D in Bulgaria (BGL)

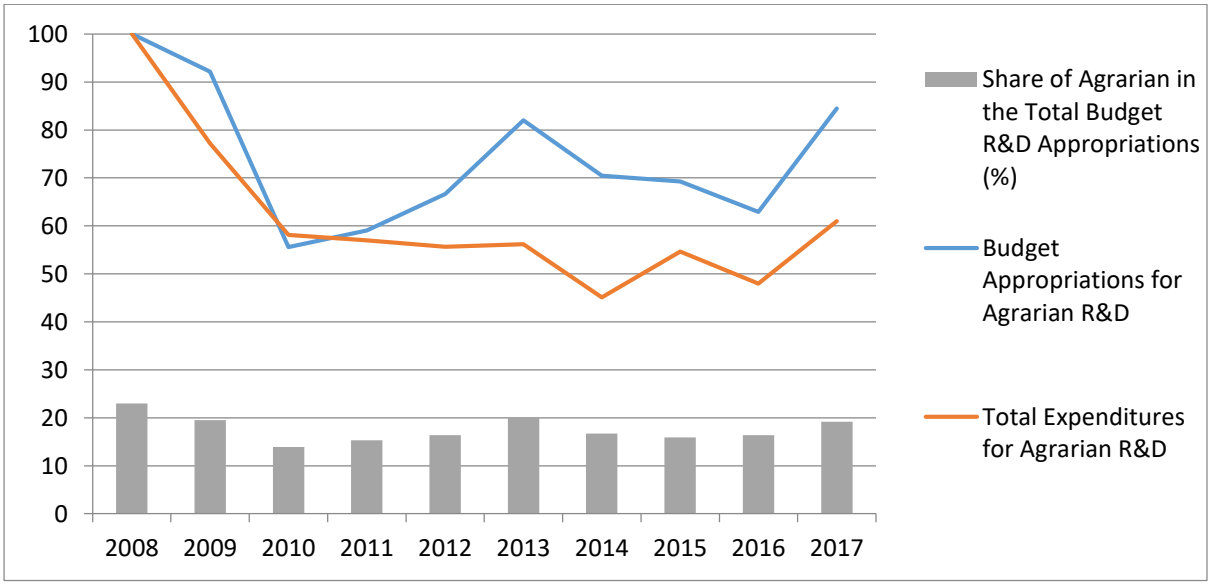


Source: National Statistical Institute, 2019

Funding of Agrarian R&D Activity

R&D activity in the agrarian sphere in Bulgaria is predominantly funded by the state budget. An approximate idea about the importance of that type of financing is given by the ratio of the amount of budget appropriations for R&D activity for „Development of Agriculture, Forestry and Fishery" to the expenditures for R&D activity in „Agricultural Sciences", averaging for the period of 2008-2017 г. at 91,8 (NSI). The pace of evolution of the amount of budget appropriations for agrarian R&D activity is similar to that of the total expenditures for agrarian R&D activity, but the decline of the 2008 level is comparatively smaller (with the exception for 2010) (Figure 18). That demonstrates that the importance of the budget financing of agrarian R&D activity relatively increases during the period. At the same time, however, there is a fall in the share of budget appropriations for R&D activity for the „Development of Agriculture, Forestry and Fishery" sector in the total budget appropriations for the development of R&D in the country. What is more, the share of agrarian funding of R&D activity from the national budget is quite fluctuating as initially dramatically falls (from 23% in 2008 to 13,9% in 2013), and after that increases a little bit (up to 19,2% in 2017). These figures give insight into the diminishing social significance of agrarian R&D activity and their unsustainable funding by the national budget.

Figure 18. Evolution of Budget Appropriations for R&D Activity for „Development of Agriculture, Forestry and Fishery ", Share in the Total Budget Appropriations for R&D Activity, and Evolution of Total Expenditures for R&D Activity in Agricultural Sciences in Bulgaria (2008=100)



Source: National Statistical Institute, 2019

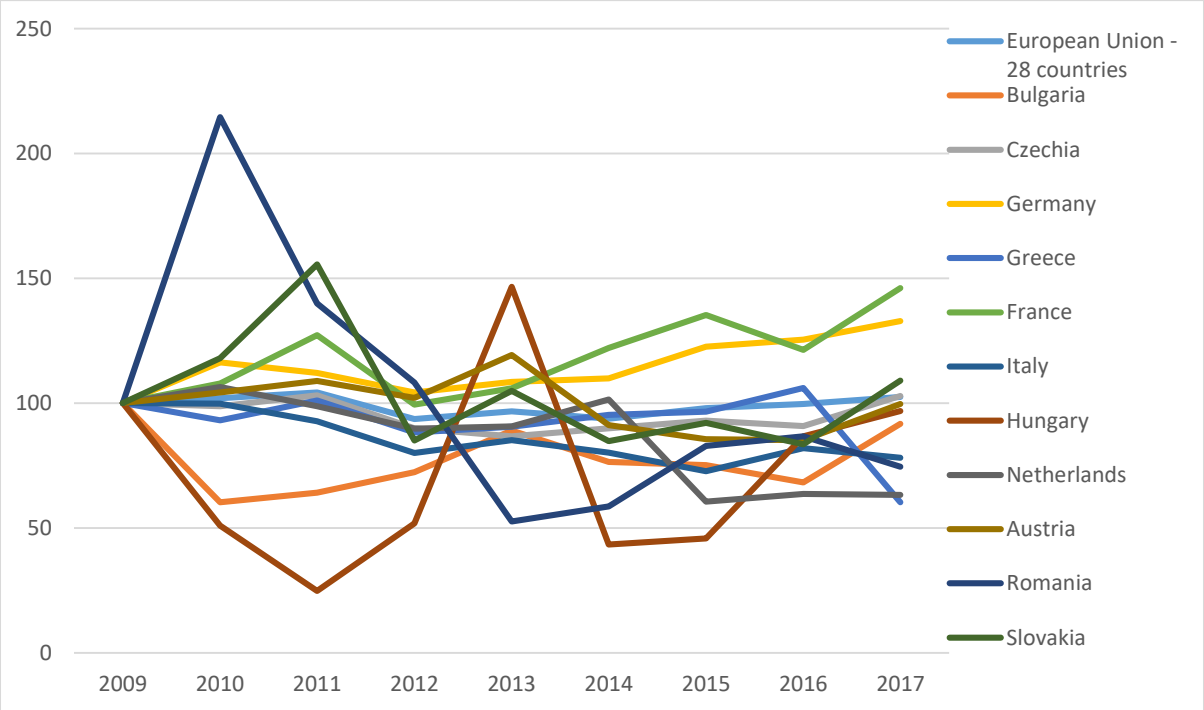
The budget financing of agrarian R&D activity in Bulgaria is mainly carried out through direct „institutional" subsidizing of Agricultural Academy and Bulgaria Academy of Sciences[5],

[5] Most Bulgarian universities get some very small budget subsidies for R&D activity.

project funding through diverse national, bilateral, etc. science programs of the National Science Fund of the Ministry of Education and Science, and projects for innovation in small and middle-size enterprises of the National Innovation Fund of the Ministry Of Economy, etc. For instance, 8% of the budget of the National Science Fund in 2017 is for „Agricultural Sciences“ – for 11 projects 45% of which for the institutes of the Agricultural Academy, 36% for the institutes of the Bulgaria Academy of Sciences, and the rest for 2 universities (MES). Implemented programs of the funding agencies aim at the achievement of the strategic priorities of the country (competitiveness, sustainable development, etc.), and they are in line with EU priorities.

Since 2009 now in the EU as a whole there are slight fluctuations in both directions in the level of budget appropriations for agrarian R&D activity (Figure 19). However, in individual member states, there are unlike changes in the financing from the national budget of R&D activity in agriculture. In Germany and France budget appropriations for agrarian R&D activity experience constant growth. In the Check Republic, budget appropriations fall a little bit and recover the initial level afterward. In Austria and Romania, there is the initial augmentation of the budget support and a subsequent drop below the initial level. In most EU member states there is a tendency for permanent reduction of the importance of the state budget in the sustentation of R&D activity of agriculture. What is more, for certain countries like Greece, Netherlands, and Italy the decline of the budget funding of agrarian R&D activity in recent years is significantly greater than in Bulgaria.

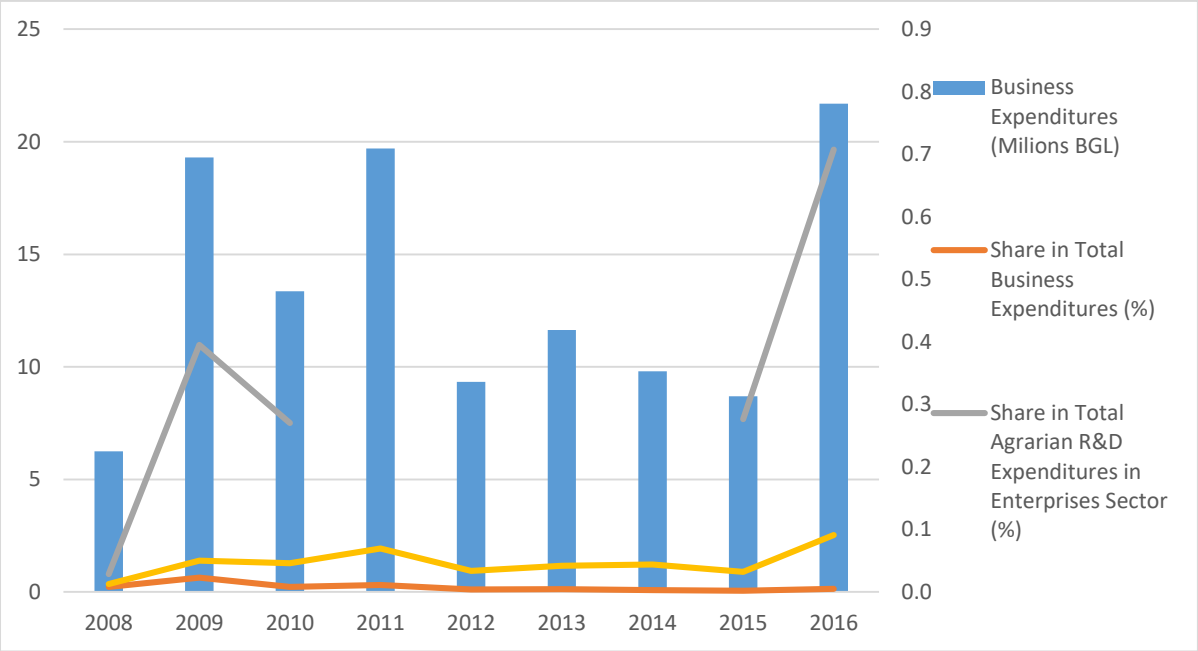
Figure 19. Evolution of Government Budget Appropriations or Outlays on R&D in Agriculture in EU Member States (2009=100)



Source: Eurostat

Private business investments in the R&D activity are „market-oriented“ and aim at satisfying some practical needs of innovation and realization of economic and other benefits (profit, improving market positions and relations with counterparts, modernization and automatization of processes, the introduction of know-how, new products and technologies, etc.). They are also a means for direct connection of interested parties and effective sharing of knowledge and innovation for the satisfaction of specific needs in the agrarian sphere. The level of business expenditures (of Enterprises) for R&D activity in the „Agriculture, Forestry and Fishery“ sector in Bulgaria varies substantially in different years (Figure 20). The share of the private sector for financing agrarian R&D activity is insignificant, as they account for a tiny portion (0,05-0,31%) of the total business investments in the R&D activity of the country. The latter demonstrates that incentives for business investments in R&D activity in agriculture are still small generally as well as in comparison with other sectors of the economy. The above is also supported by the fact that the expenditures of the enterprises for agrarian R&D still comprise a relatively little share of the total expenditures for agrarian R&D activity of the country – from 0,35% to 2,5%. That indicates besides lack of sufficient incentives (profit, other benefits) also low (staff, technical, financial, etc.) capability for private R&D activity at the contemporary stage of development of Bulgarian agriculture. However, for carrying in the sector of Enterprises agrarian R&D activity, in individual years private (business) investments in agrarian R&D activity accounts a good proportion of the overall expenditures for R&D activity of Enterprises (from 7,5% to almost 20%). The latter confirms, that when there are sufficient incentives and benefits the private sector is actively involved in funding and execution of R&D activity in the sector.

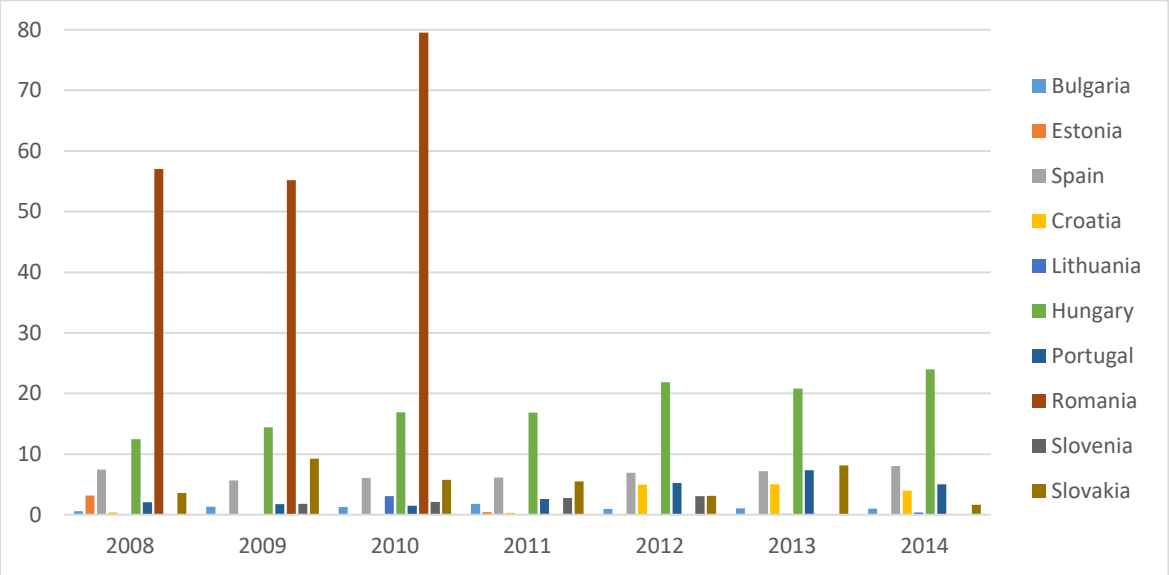
Figure 20. Amount of Expenditures for R&D Activity in Sector Enterprises in „Agriculture, Forestry and Fishery“ and Share in the Total Expenditures for R&D Activity in „Agricultural Sciences“ in Bulgaria



Source: National Statistical Institute, 2019

Bulgaria, along with Lithuania and Slovenia is among the countries of the EU with the smallest share of the business expenditures for R&D activity in „Agriculture, Forestry and Fishery“ in the total expenditures for R&D activity in the sector „Agriculture“ (Figure 21). In certain countries, like Romania and Hungary, private funding of R&D activity represents a considerable portion of the R&D activity of agriculture.

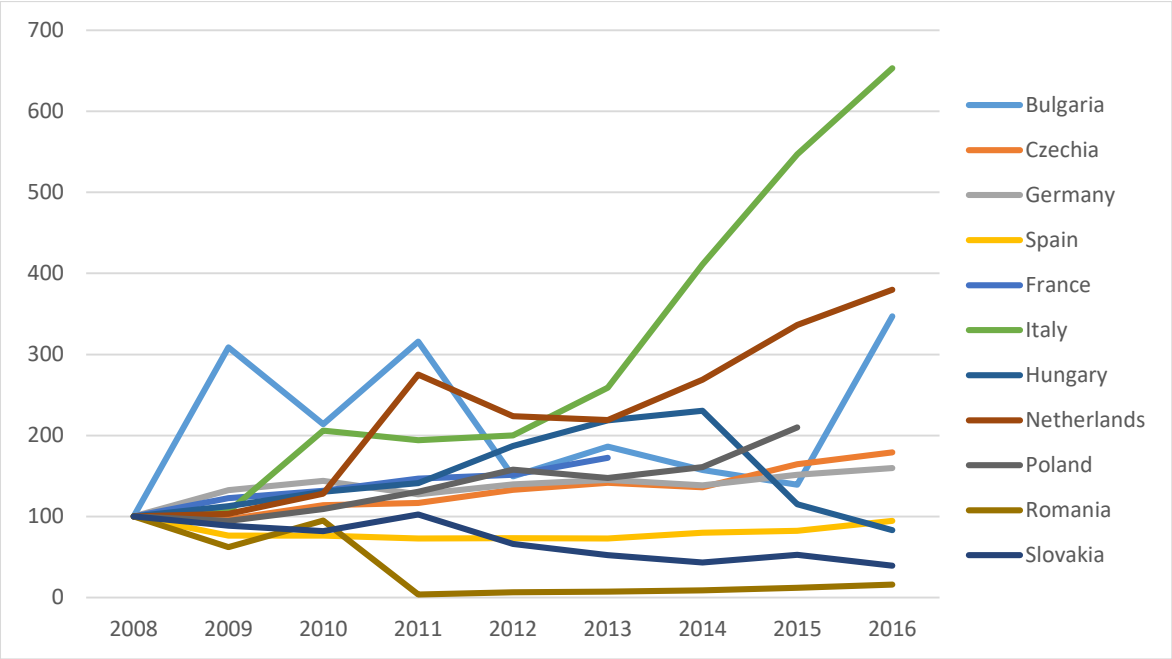
Figure 21. Share of Business Expenditures on R&D in „Agriculture, forestry and fishing“ in Total Intramural R&D Expenditures in Sector „Agriculture“ in EU Member States (%)



Source: Eurostat

In the EU member state, there are several trends in the size of business expenditures for R&D activity in agriculture during the period 2008-2016, for which data are available (Figure 22). The first groups are countries, in which the business expenditures for R&D activity in agriculture show constant (France, Check Republic, and Poland) and significant (Italy and Netherlands) growth. In other group countries (Romania and Slovakia), the amount of business investments in agrarian R&D activity demonstrate a sizable drop. In the third group of countries, the level of private expenditures for R&D is relatively stable during the analyzed period after an initial decline (Spain) or upsurge (Germany). And finally, there are countries like Bulgaria and Hungary where business expenditures in agrarian R&D of enterprises fluctuate significantly up and down in different years.

Figure 22. Evolution of Business Expenditures on R&D in „Agriculture, forestry and fishing“ in EU Member States (2008=100)



Source: Eurostat

3. The Governance of Agrarian Research in Bulgaria

Organisation of Agrarian Research

Agricultural and related research in Bulgaria is mostly carried out by public organizations – research institutes and experimental stations of the Agricultural Academy (Селскостопанска академия), some institutes of the Bulgarian Academy of Sciences (e.g. Institute of Plant Physiology and Genetics, Institute of Economic Studies, etc.), some of the public and private universities (e.g. Agrarian University in Plovdiv, Trasia University in Stara Zagora, Russe University in Russe, Forestry University in Sofia, the University of National and World Economy in Sofia, High School for Agribusiness and Regional Development in Plovdiv, etc.), and to a smaller extent by the private firms and organizations, non-governmental organizations, etc. There is no official (statistical, aggregated, etc.) information about the state and development of all components of this complex system, the relationships between different structures, and implemented specific forms of organization and cooperation in AR&D.

The Agricultural Academy (AA) is a key element of the system for creating, sharing, disseminating, and implementing knowledge and innovation in Bulgarian agriculture. Agriculture is the only branch of the economy for which an entire Academy[6] for scientific services, training, and consulting has been built and publicly funded. The analysis of the development of the staff of the Agricultural Academy, the organization and financing of its activity, its scientific and applied results, its relations with the other participants in AKIS, the main challenges to its development, etc. gives a good idea of the state of the main component of the national AKIS and the most general information about the state and trends in the development of the public sector of agricultural R&D in the country.

According to the Law, the present Agricultural Academy is a national autonomous budget organization for scientific research, for scientific-applied, innovative and educational activity in the field of agriculture and food (Decree of the Council of Ministers № 151, 25.06.2018). It consists of 29 scientific institutes and centers and 13 experimental stations (part of the State Enterprise "Research and Production Center")[7], in all main areas of agricultural research, and located in all regions of the country. The scientific institutes and centers of the Agricultural Academy are specialized or complex and carry out R&D in all main directions of agricultural research for servicing the agricultural production or its individual sub-sectors (Table 1). Experimental stations are specialized or complex for servicing agricultural production in a particular geographical area (region).

[6] The Agricultural Academy (Селскостопанска академия) was established in 1961 and have been reorganized multiple times since then.

[7] This enterprise has proved to be highly inefficient and there is the idea to (re)integrate these stations in the Research Institutes again.

Table 1. List of scientific institutes and centers of the Agricultural Academy in Bulgaria

Specialized units		Complex units
Subject principle	**Industry-product principle**	
Agrobioinstitute (Агробиоинститут) – Sofia Institute of Agricultural Economics (Институт по аграрна икономика) – Sofia Institute for Food Preservation and Quality (Институт по консервиране и качество на храните) – Plovdiv Institute of Cryobiology and Food Technology (Институт по криобиология и хранителни технологии) – Sofia Institute of Soil Science, Agrotechnology and Plant Protection "Nikola Pushkarov" (Институт по почвознание, агротехнологии и защита на растенията „Никола Пушкаров") – Sofia Institute of Plant Genetic Resources "Konstantin Malkov " (Институт по растителни генетични ресурси "Константин Малков") – Sadovo	Institute of Ornamental and Medicinal Plants (Институт по декоративни и лечебни растения) – Sofia Institute of Animal Sciences (Институт по животновъдни науки) – Kostinbrod Institute of Vegetable Crops "Maritza" (Институт по зеленчукови култури „Марица") – Plovdiv Institute of Viticulture and Enology (Институт по лозарство и винарство) – Pleven Fruit Institute (Институт по овощарство) – Plovdiv Institute of Field Crops (Институт по полски култури) – Chirpan Institute of Fisheries and Aquaculture (Институт по рибарство и аквакултури) – Plovdiv Institute of Fish Resources (Институт по рибни ресурси) – Varna Institute of Forage Crops (Институт по фуражни култури) – Pleven Corn Institute (Институт по царевицата) – Kneja Institute of Roses and Essential Oils Crops (Институт по розата и етеричномаслените култури) – Kazanlak Institute of Tobacco and Tobacco Products (Институт по тютюна и тютюневите изделия) – Markovo village, Plovdiv region Silkworm Science Center (Научен център по бубарство) – Vraza	Dobrudzha Agricultural Institute (Добруджански земеделски институт) – Geeneral Toshevo Agricultural Institute (Земеделски институт) – Stara Zagora Agricultural Institute (Земеделски институт) – Shumen Institute of Agriculture (Институт по земеделие) – Karnobat Institute of Agriculture (Институт по земеделие)– Kustendil Institute of Agriculture and Seed Science "Obraztov Chiflik" (Институт по земеделие и семезнание „Образцов чифлик") – Russe Institute of Mountain Animal Husbandry and Agriculture (Институт по планинско животновъдство и земеделие) – Troyan Agricultural Science Center (Научен център по земеделие) – Targovishte Agricultural Science Center (Научен център по земеделие) – Sredez Research Center for Animal Husbandry and Agriculture (Научен център по животновъдство и земеделие) – Smolyan

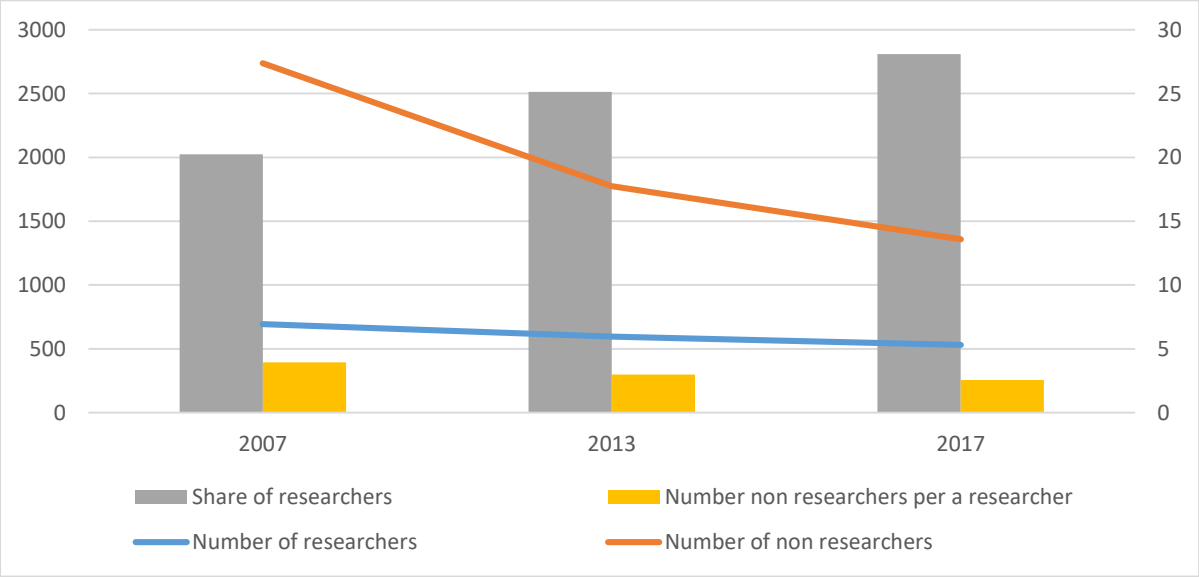
Source: author, based on official regulation (Постановление на МС № 151, 25.06.2018г.)

Some of the units of the Academy (Dobrudzha Agricultural Institute, Institute of Agriculture Karnobat, etc.) manage significant land and other resources, while the material and technical base of the majority of the units is morally and physically obsolete. The average

number of researchers in the institutes is just under 20 and at the experimental stations 2.5 (Agricultural Academy, 2018). The main part of the R&D funding is on a project basis with the Agricultural Academy and other national and international organizations, from the sale of products and services, etc. The Agricultural Academy funding[8] represents a different share of the total expenditures of the individual research units - from 20% for the Institute of Ornamental and Medicinal Plants to 94% for the Agrobioinstitute (Agricultural Academy, 2018).

In the years after the country acceded to the EU, the number of researchers and experts employed in the Agricultural Academy has been constantly decreasing due to insufficient budget funding, regulatory constraints, restructuring and layoffs, lack of acceptable pay and working conditions, insufficiently qualified candidates in some areas, etc. For ten years, the average annual staffing in the Agricultural Academy decreased by 45% to 1890, and the number of scientists by nearly 24% to 531 (Figure 23). At the same time, the structure of R&D employees has been improving as the share of scientists increased to just over 28% of the total at the end of the period. This shows that along with the reduction of the staffing of the Agricultural Academy and the agricultural R&D in the country as a whole, a progressive change has been taking place through a relative increase in the share of the active and highly qualified staff.

Figure 23. Number and ratio of scientists and other full-time staff of the Agricultural Academy in Bulgaria (number,%)

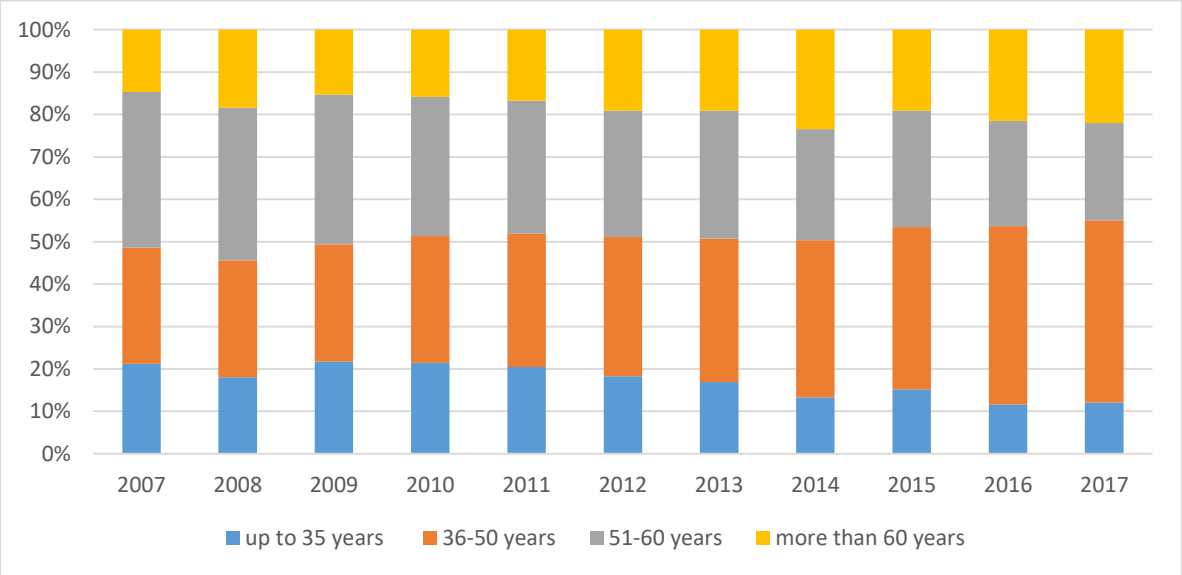


Source: Annual Reports of the Agricultural Academy

[8] The major criteria for distribution of the Agricultural Academy support between different research institutes and stations has been the number of research personnel as budget subsidies de-facto covering the salaries and mandatory social payments of researchers and support staff while (sales, competitive grants, areal-based subsidies from EU CAP, etc.) funding of other (material, supplementary activities, etc.) expenditures being the responsibility of research unites.

Throughout the period, the habilitated staff of the Academy (Professors and Associate professors) makes up a little over half of all scientists, and doctors (Ph.D.) and doctors of science (DS) are over 70% and increasing in recent years to almost 80% (in 2017). This shows that the qualification structure of staff composition is very good and adequate to meet the modern challenges of science and practice. At the same time, however, there are unfavorable trends in the development of the age structure of researchers at the Academy. Although the average age increased slightly during the period (from 48.4 in 2007 to 49 in 2017), the share of young scientists decreased relatively, at the expense of an increase in those over 60 (Figure 24). The main reason for this is the lack of enough young candidates ready to pursue a career in science, due to lower pay compared to private businesses, public institutions, or foreign academic and other organizations. If this trend continues, the Agricultural Academy will have serious problems shortly in securing the needed qualified staff to carry out its mission and research program.

Figure 24. Age structure of researchers of the Agricultural Academy in Bulgaria



Source: Annual Reports of the Agricultural Academy

Funding of Activity of the Agricultural Academy

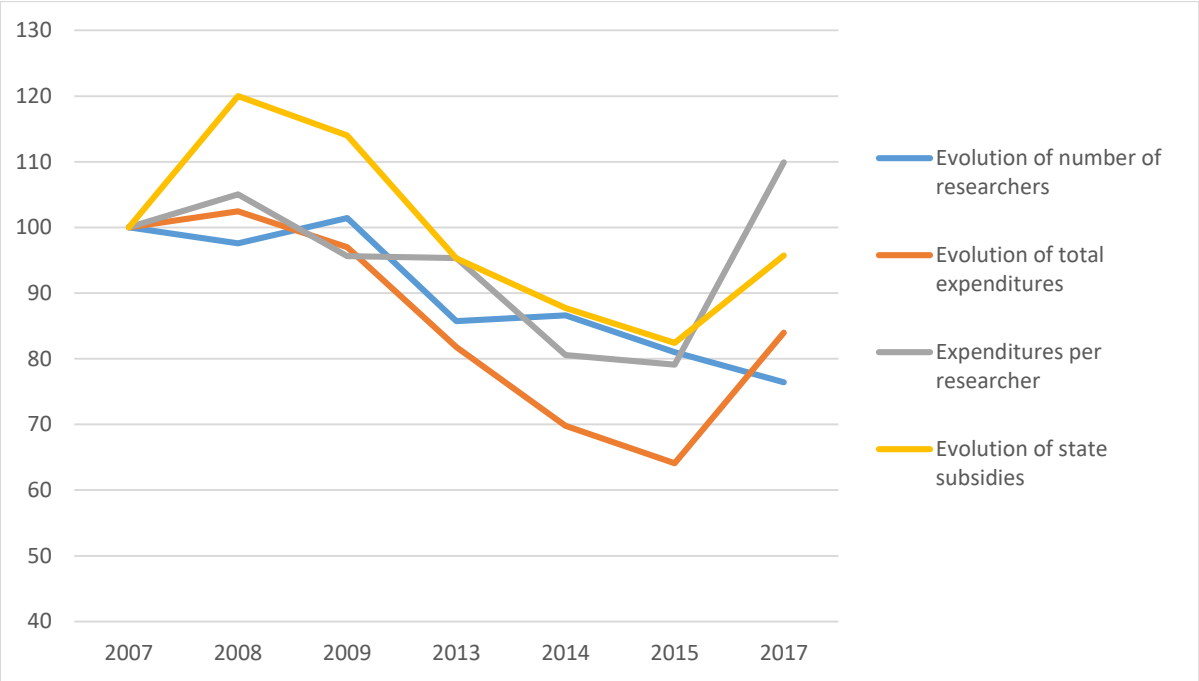
The budgetary "institutional" support of the Agricultural Academy is essential for the R&D activity of research institutes and centers (Activity 163). It is distributed mainly on a "project" basis, in which teams from the Academy units make proposals for research projects, which, after evaluation by specialized Expert Councils, are approved by the management of the Academy.

The main research priorities in the Agricultural Academy are four and are in line with the national and European priorities in this area: Sustainable development of competitive knowledge-based agriculture; Preservation of natural and genetic resources to mitigate the impact of climate change; Safe, quality and healthy agricultural raw materials and food; Improving the quality of life in rural areas through competitive agriculture and increasing

incomes. In the Agricultural Academy are carried out projects under 8 scientific programs: 1. Collection, research, storage, and management of plant genetic resources. Improving the varietal composition of the main agricultural crops and production of quality pre-basic and basic seeds and planting material. 2. Comprehensive ecological and economic assessment of soil resources and new technologies to increase soil productivity. 3. Problems related to the resilience and tolerance of agricultural crops to water deficit and extreme temperature effects of the environment. Optimization of irrigation techniques and technologies in the conditions of water deficit. 4. Technologies for organic production of plant and animal products. Development of integrated plant protection systems as a basis for safe food production and ecosystem protection. 5. New economically and energy-efficient technologies for competitive production of plant and animal products that meet EU requirements. 6. Systems for storage of the national gene pool and creation of highly productive breeds and lines of farm animals for the production of animal products, meeting EU standards. New feed sources and feed additives. 7. New methods and technologies for production and storage of safe food, beverages, and organic products. Extending the period for supplying the domestic market with fresh fruit and vegetables. 8. Assessment of the agro-ecological potential of the agricultural regions and diversification of the agricultural production. Development of organizational and economic structures in farming and their improvement. Socio-economic problems of rural development.

In addition to the direct subsidies from the state budget (until 2018 from the Ministry of Agriculture, and since then from the Ministry of Finance), the Agricultural Academy units receive budget funds for R&D from other public institutions (Ministry of Education and sciences, Ministry of Waters and Environment, etc.) mainly on a project basis. The Agricultural Academy also receives significant budgetary resources under other national and European programs - Human Resources Development, Program for Rural Development, and direct payments based on utilized agricultural area, defense and mobilization preparedness, etc. A good portion of all these funds is practically used for the maintenance of scientific units and R&D activity. For the analyzed period, there is a significant reduction in total expenditures and budget subsidies for research institutes and centers of the Academy (Figure 25). The level of expenditures in 2015 was almost 36% lower than in 2007, after which there was a significant increase in expenditures and activity below the levels at the beginning of the period. The decrease in the budget expenditures has been relatively smaller than the overall decrease in expenditures, which demonstrates the growing importance of the budget financing of the activity during the period.

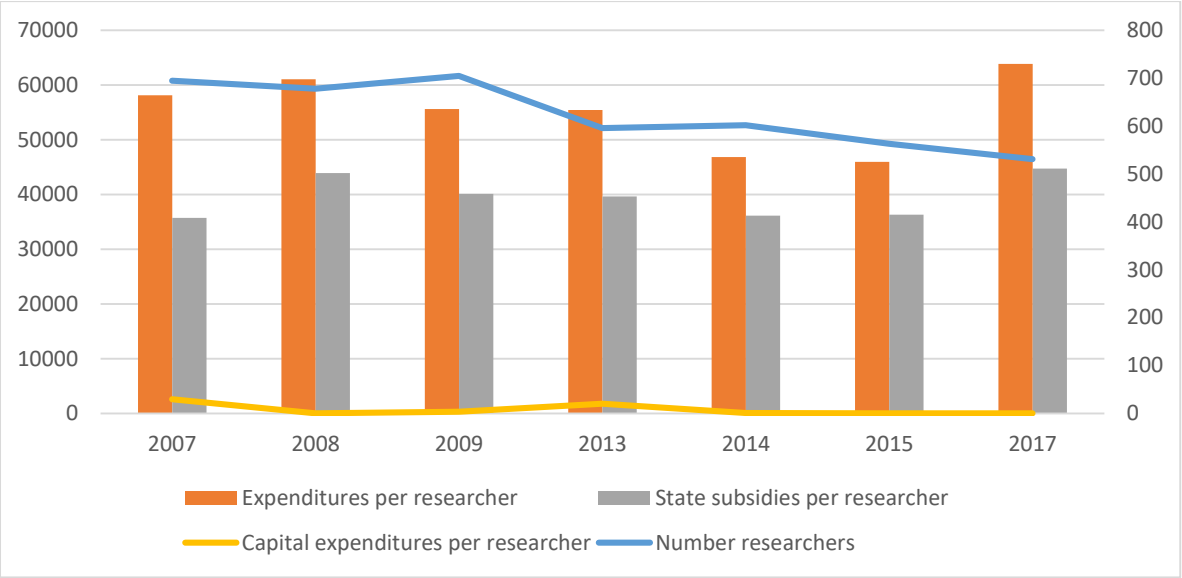
Figure 25. Evolution of the general and budgetary financial endowment of scientists of the Agricultural Academy in Bulgaria (2007=100)



Source: Annual Reports of the Agricultural Academy

Despite the reduction in the total number of scientists, the financial and material endowment per scientist decreased after 2007 by 20% (2015), after which it increased at the end of the period by almost 10% above the initial level (Figures 25 and 26). During the period, the size of the budget expenditures per one scientist fluctuates significantly in levels above the base one, and in 2017 their size is with a quarter higher than in 2007. This confirms the crucial role of the budget funding for maintaining and increasing the provision of researchers with salaries, social insurance, material resources, etc. This is accompanied by a stronger orientation of the overall R&D towards the strategic state priorities (the financing organization) rather than towards the immediate needs of the market and the end-users of knowledge and innovation. However, the capital expenditures for R&D during the period are insignificant in size, carried out only in individual years and with a decreasing amount per scientist. Their maximum share in the total costs is a little over 4% in the first two years of the period, while in the last few years it is negligible or zero. The latter deters modernization of the material and technical base and the resource endowment of scientists and reduces the efficiency of R&D.

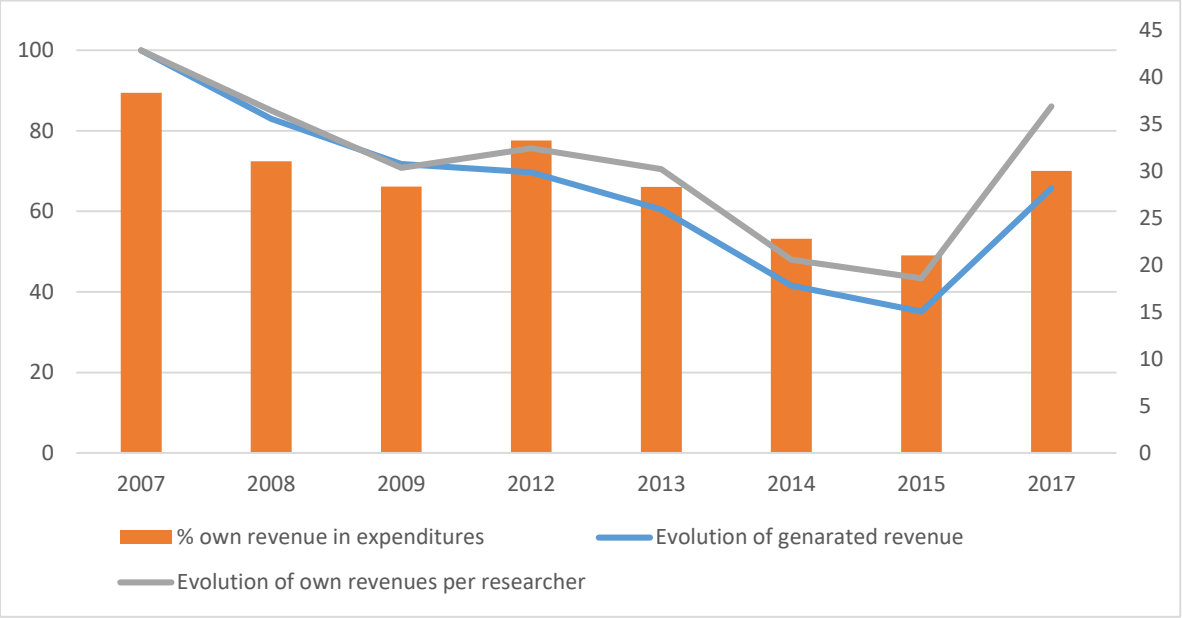
Figure 26. Evolution of the number of scientists and their financial endowment in the Agricultural Academy in Bulgaria (number, BGL)



Source: Annual Reports of the Agricultural Academy

Own generated revenues account for 21-38% of the total expenditures for research institutes and centers the Agricultural Academy in individual years, and their size varies greatly and decreases over the period (Figure 27). The sale of services, goods, and products is the main source of R&D revenue (almost 100%) and gives an idea of the degree of market orientation and commercialization of the activity, and the practical dissemination and implementation of the results of the research activity. In 2017, the own revenues (sales, rents, donations, etc.) from the country finance 30% of all R&D expenditures of the Academy. The total amount of income from own activities and the amount of income per scientist decreased significantly by 2015 (by three quarters and 57% respectively) and reached 86% of the initial level in 2017. This is an indicator that the importance of market orientation and funding in the management of the activity, and direct relations with consumers of knowledge and innovation, relatively decreased during the period.

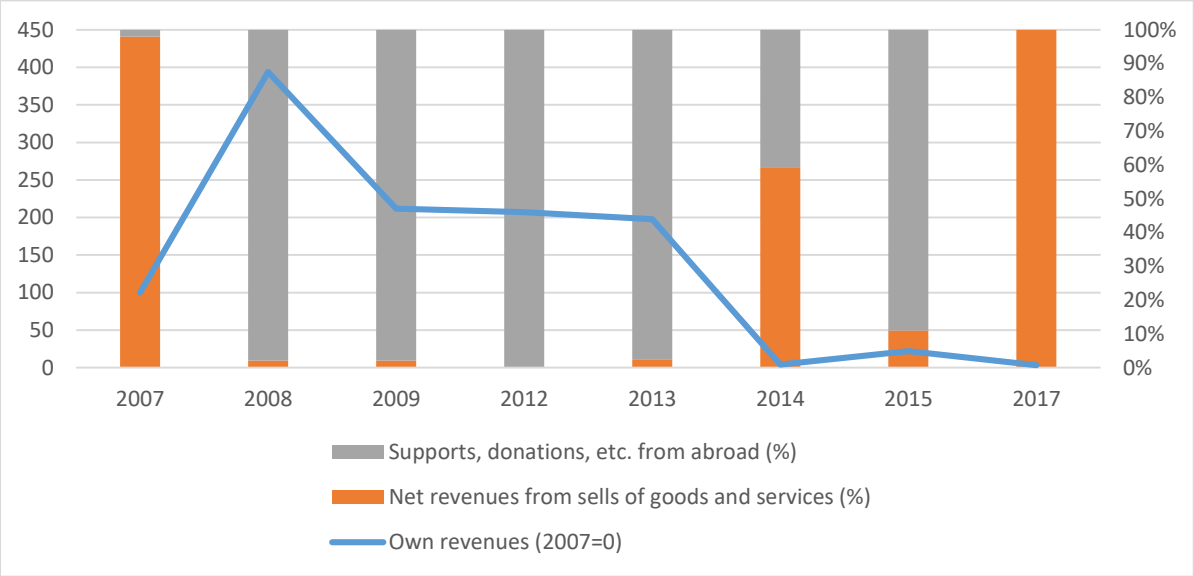
Figure 27. Amount and share of own revenues of the Agricultural Academy (2007=100)



Source: Annual Reports of the Agricultural Academy

The Agricultural Academy also receives funds from international programs and agreements, donations and grants from abroad, revenues from sales of products, goods, and services abroad, etc. In some years, their level varies widely and decreases in recent years, as they account for a different share of the total own revenues of the Academy - from 0.2% (2017) to 18% (2008) (Figure 28). The amount of this source of funding is almost entirely formed by grants, donations, and other grants received as well as sales of services, goods, and products, which have different significance in the individual years. The size, dynamics, and share of the international programs and markets for intellectual property and sharing of scientific knowledge give an idea of the degree of inclusion of the Agricultural Academy in the international division and cooperation of labor in the generation, transfer, and dissemination of knowledge and innovation.

Figure 28. Level and share of own revenues from international programs and agreements, donations and grants from abroad, and sales of products, goods and services of the Agricultural Academy in Bulgaria

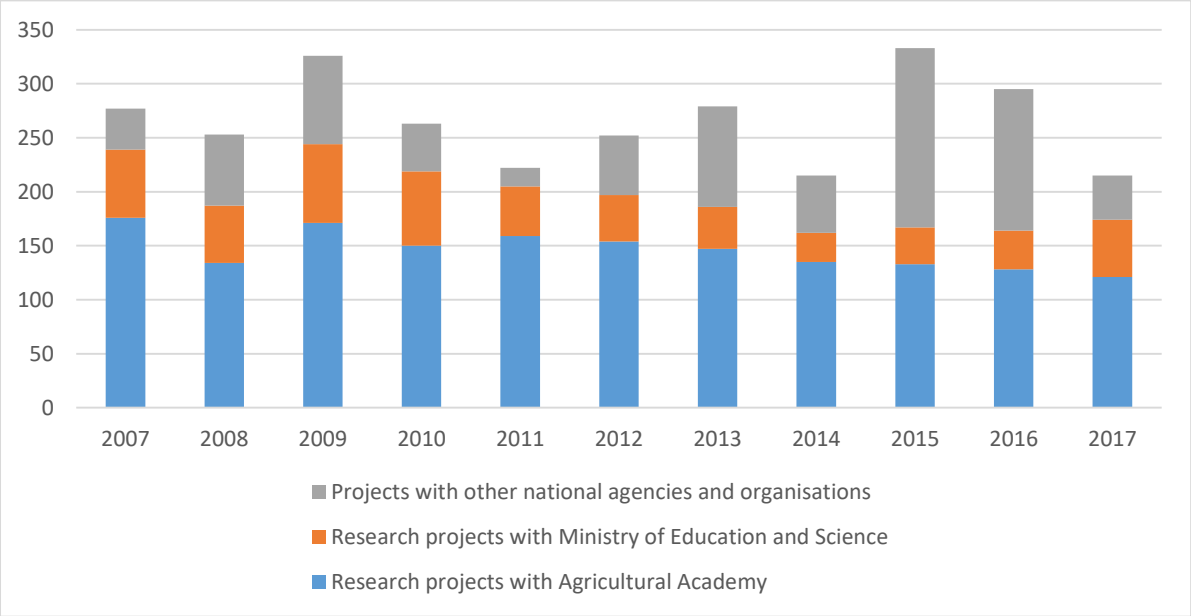


Source: Annual Reports of the Agricultural Academy

Production and Productivity of the Agricultural Academy

Research units and teams of the Agricultural Academy work on a large number of research projects funded by the Agricultural Academy, Ministry of Education and Science, and other national agencies and organizations (Figure 29). Projects are a form of organization of research and cooperation of researchers and stakeholders from different fields and disciplines, and often organizations (institutes of Agricultural Academy, Bulgarian Academy of Sciences, Medical Academy, universities, National Agricultural Advisory Service, farmers, and farmers' organizations, etc.). The total number of national projects varies from year to year, and for most of the period the share of the Agricultural Academy projects predominates. In 2015-2016, the projects funded by foreign agencies and organizations are more. The latter demonstrates higher activity in the preparation and winning of projects on a competitive basis and the efficiency of participation in the "national market" for research projects. In addition, the Agricultural Academy teams work on a significant number of bilateral and multilateral international projects, which in different years represent from 34.5% (2015) to 46.4% (2014) of the total number of projects. Moreover, most international projects are multilateral - from 27.2% (2014) to 35% (2009) of all of them. These data are an expression of the active involvement of the Agricultural Academy in international cooperation for the joint generation, transfer, and dissemination of knowledge and innovation.

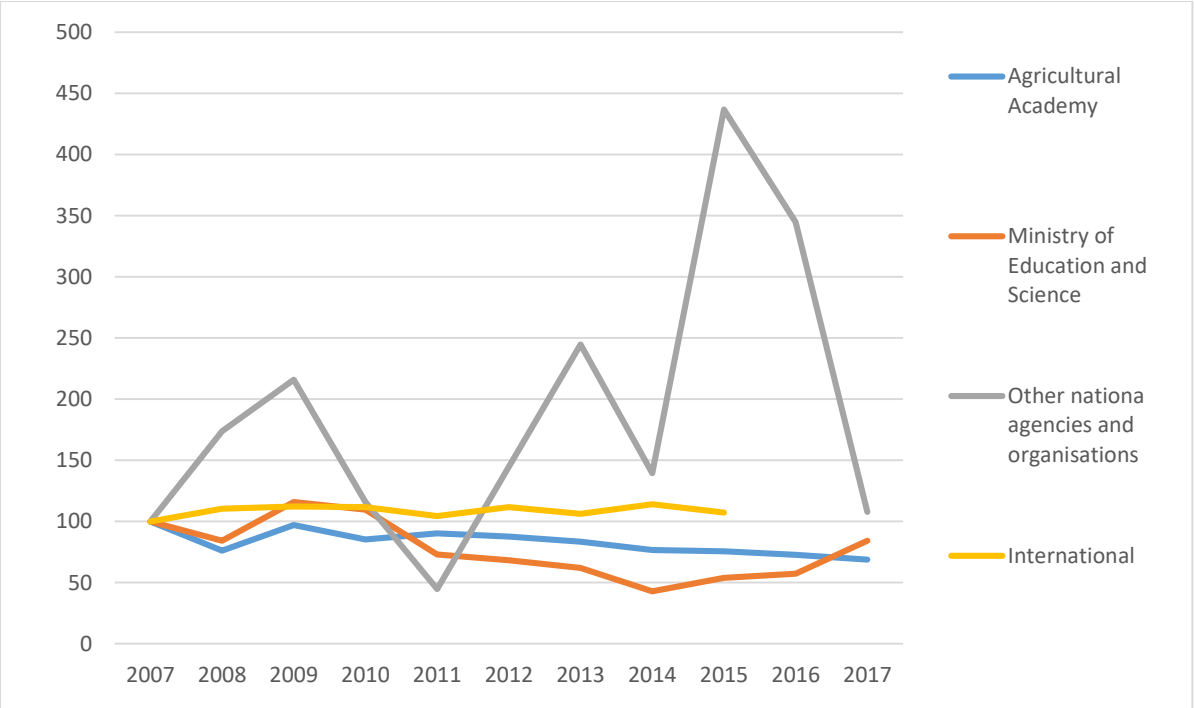
Figure 29. Number of current and completed research projects funded by the Agricultural Academy and other national agencies and organizations carried out by the units of the Agricultural Academy in Bulgaria



Source: Annual Reports of the Agricultural Academy

The number of carried-out projects funded by the Agricultural Academy and the Ministry of Education and Science decreased during the period, while the number of projects contracted with other national agencies and organizations varied widely (Figure 30). This is accompanied by an increase in the national projects implemented by one scientist from 0.4 to 0.6. The number of carried international projects throughout the period is higher than in 2007 and relatively stable, together with an increase in the number of projects (productivity) per scientist - from 0.2 to 0.3.

Figure 30. Number of research projects implemented by the Agricultural Academy in Bulgaria (2007=100)

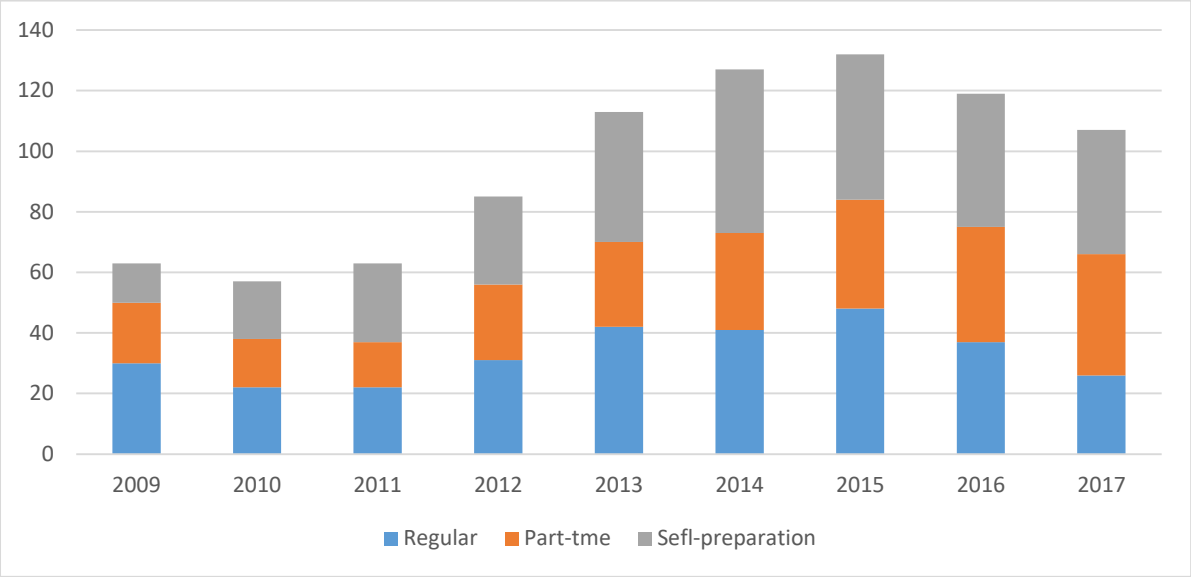


Source: Annual Reports of the Agricultural Academy

Along with the research activity, the Agricultural Academy also trains doctoral students in the field of agricultural sciences, for the needs of the Academy and other state and private organizations. Doctoral studies are on current issues of science and practice, which are integrated into the programs of scientific units, which increases both the efficiency of training and the effectiveness of the work of the Agricultural Academy.

Throughout the period there is a tendency to increase the number of successfully defended dissertations. By 2015, the total number of doctoral students is increasing, which has decreased in the last two years (Figure 31). At the same time, the relative share of full-time doctoral students decreases, and that of part-time and self-study increases. The latter groups include researchers and experts in the Agricultural Academy units and other public and private organizations. All this shows that the role of the Academy in training highly qualified specialists for the needs of scientific and other organizations in the country has been increasing.

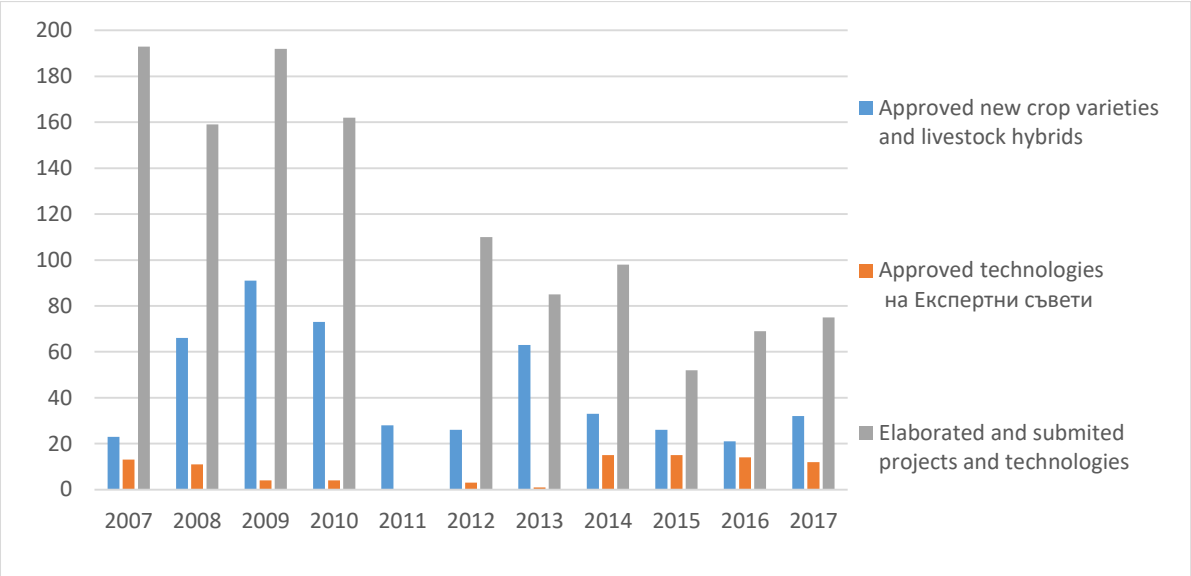
Figure 31. Number of doctoral students trained in the Agricultural Academy in Bulgaria



Source: Annual Reports of the Agricultural Academy

As a result of the R&D of the Agricultural Academy, a large number of new scientific products are created, which after approval (certification, etc.) by the relevant institutions are provided for implementation in practice through a direct transfer, contracts, and licensing agreements with the private sector and others. The number of approved new varieties and hybrids of plants, as well as animal breeds, established technologies and works, and presented projects and technologies are significant during the period (Figure 32). The variations in the amount of scientific production in the individual years arise from the nature of the R&D performance (long period of creation and formalities for approval of varieties and breeds, uncertainty, cyclicity, etc.).

Figure 32. Number of officially approved new varieties and hybrids of plants, animal breeds and works, and approved technologies from the Agricultural Academy in Bulgaria



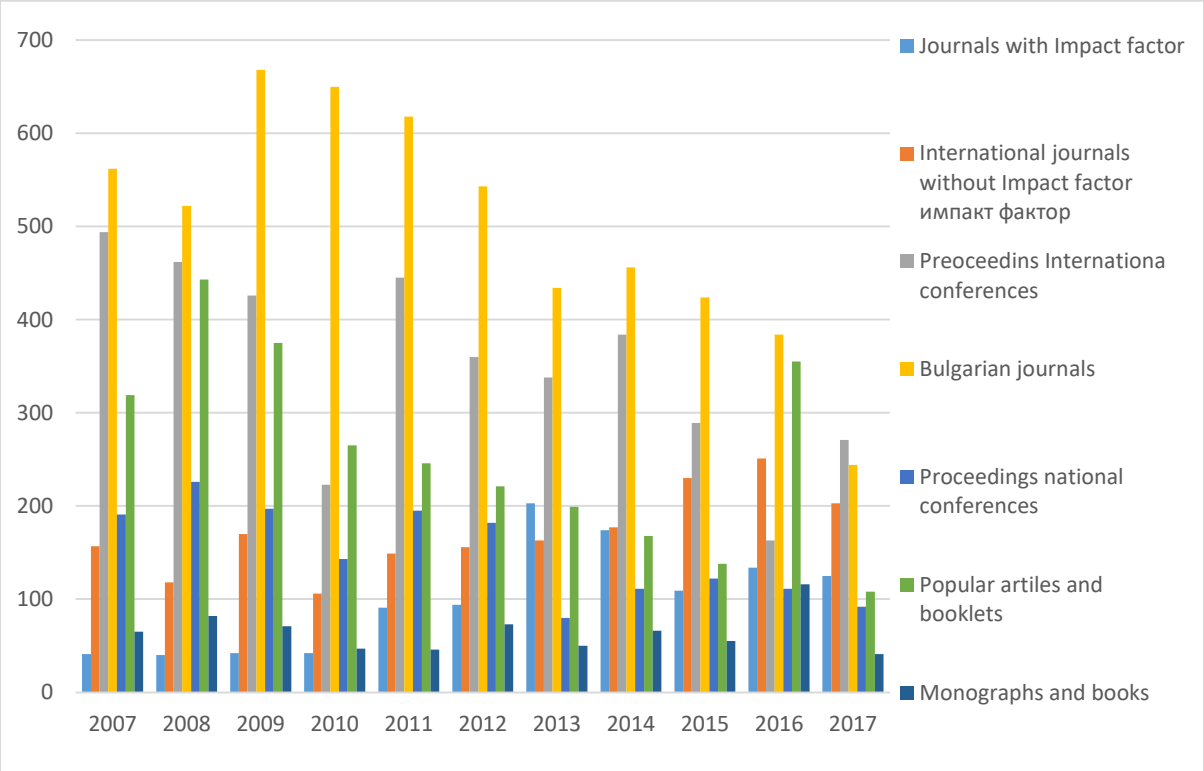
Source: Annual Reports of the Agricultural Academy

The Agricultural Academy maintains 350 certificates of protected products issued by the Patent Office, including the largest number (about 85%) of all issued and maintained certificates for plant varieties and animal breeds. Of these, the largest share is of cereals (151); beans (7); oilseeds and industrial crops (39); forages (30); vegetables (48); tobacco (22); vines (22); fruit (2); breeds of animals (14) and flowers (15). In addition, 12 technologies and instructions for production, and processing of tobacco are included; as well as oil rose picking machine; 2 useful models in cryobiology and food technologies; a device for express diagnosis of the degree of infestation of bee families with varroasis, etc. The official variety list of the country includes a total of 285 varieties of the Agricultural Academy, as in list A (cereals, fodder, oilseeds, and industrial crops, beets, potatoes, and fruit plants) are included 226 varieties, and in list B (vegetable, ornamental, medicinal and aromatic crops and vines) 59 varieties (Agrarian Report, MAF, 2018). New scientific products often outperform old ones and are quickly implemented in practice. The possibility to register rights and grant licenses creates an economic incentive to increase the efficiency and commercialization of intellectual agricultural products. However, in the country, there is no official information and reliable methods for establishing the degree of implementation of the developed new varieties and hybrids of plants, animal breeds, and technologies due to lack of effective regulations or willingness to sanction intellectual property rights, mass piracy of varieties, the impossibility of effective control and insufficient incentives and sanctions, etc. For example, in 2017, out of the total number of Agricultural Academy certificates (350), only 19.7% have concluded license agreements. All this slows down the commercialization of intellectual agricultural property and market management of R&D in the country.

Dissemination of research output of the Agricultural Academy

The Agricultural Academy and its units use a variety of forms to disseminate and share knowledge, provide scientific services, and support innovation in agriculture. Publishing in the publications of the Agricultural Academy and its units (magazines, books, collections, brochures, etc.) and other national and international academic and scientific-applied publications are the main channel for dissemination of the results of scientific and scientific-applied activities of the Academy. The number of different types of publications during the period is huge and evidence of the high productivity of researchers (Figure 33). There is a tendency to increase the number of publications in prestigious magazines with an impact factor and foreign magazines. This is an indicator of the international recognition of the Academy's R&D performance and the growing contribution to the global sharing of knowledge and scientific development.

Figure 33. Number of publications of the Agricultural Academy in scientific and popular science magazines, brochures, proceedings and books

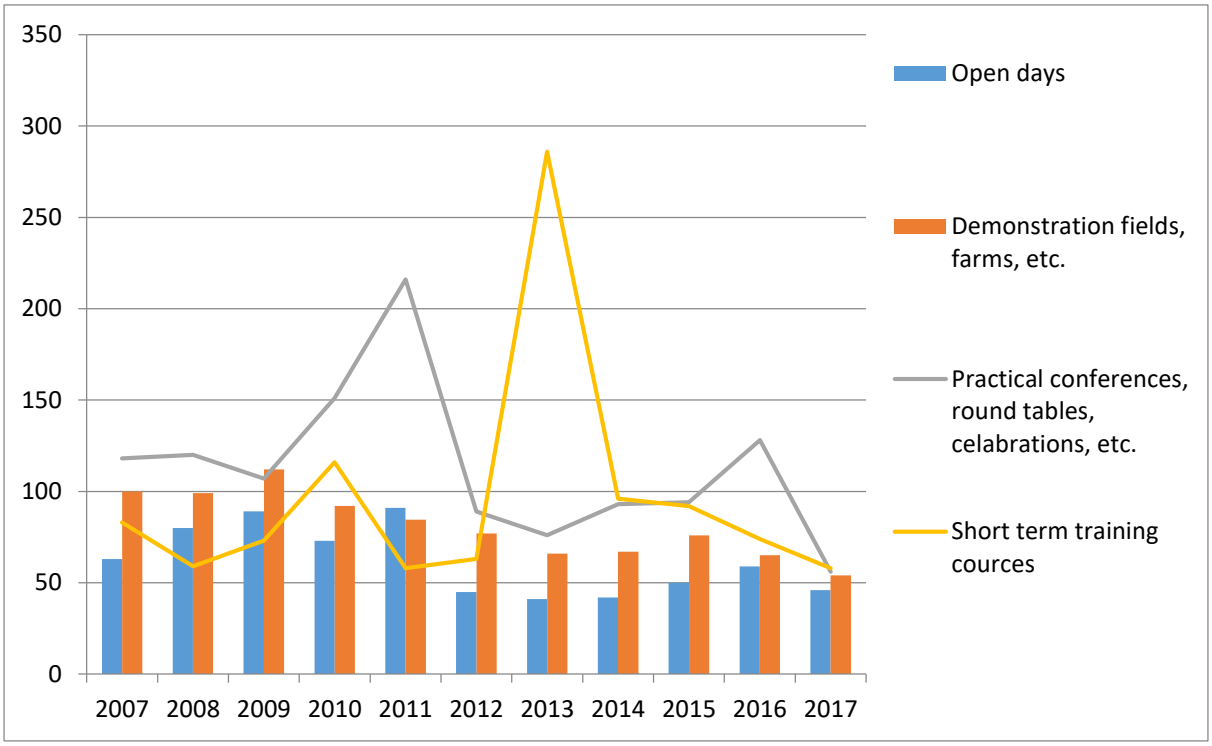


Source: Annual Reports of the Agricultural Academy

One of the most popular and widely used forms for sharing and disseminating knowledge and supporting innovation in agriculture are holding open days for farmers and stakeholders, creating demonstration fields, farms, etc., organizing scientific and practical conferences, seminars, symposia, round tables, anniversary celebrations, etc., and conducting short-term training courses. During the different years of the period, a large number of all these forms take

place in the Agricultural Academy units, with the participation of many farmers of different types and other stakeholders (Figure 34).

Figure 34. Number of created demonstration fields, open days, scientific-practical conferences and short-term courses from the Agricultural Academy in Bulgaria



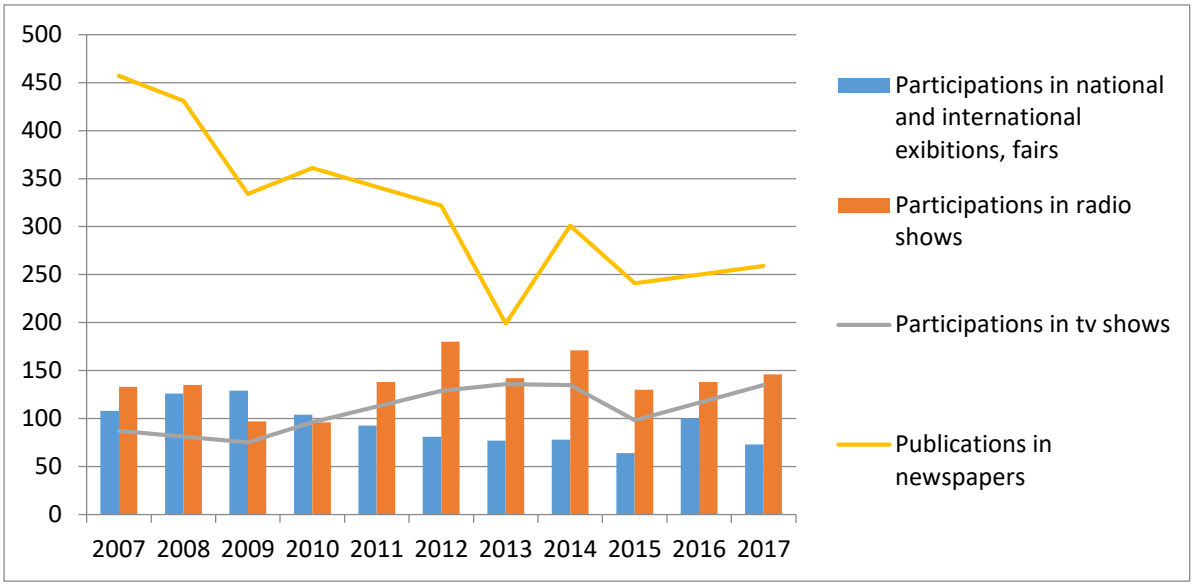
Source: Annual Reports of the Agricultural Academy

After the country acceded to the EU, the Agricultural Academy's participation in the training of farmers and specialists of various types has improved. For example, during the period 2011-2015 in the Center for Vocational Training and the scientific institutes of Agricultural Academy 2203 agricultural producers and specialists were trained, including 46% under Measure 111 in the specialties animal husbandry, plant growing, ecology, perennials, etc. (Agricultural Academy). In 2017 alone, 265 agricultural producers were trained in the courses of the Center for Vocational Training in the professional fields "Farmer", "Agroecologist", "Livestock Breeder", and "Plant Technician". The training was also conducted for over 100 people under Ordinance 2 of 23.07.2017 on the specific requirements for production, collection, transportation, and processing of raw milk, the marketing of dairy products and their official control, and for the purposes of self-control. In addition, Agricultural Academy research units and experts participate in many joint training and dissemination initiatives with other organizations such as National Agricultural Advisory Service, universities, private and professional organizations, and others.

Other effective forms for popularizing the scientific achievements of the Agricultural Academy and disseminating knowledge are participation in exhibitions and fairs at home and abroad, participation in national, regional, and local radio and television programs, as well as

publications in the press. The use of modern media such as radio and television has tended to increase over the period, enabling to reach many users at a low-cost (Figure 35).

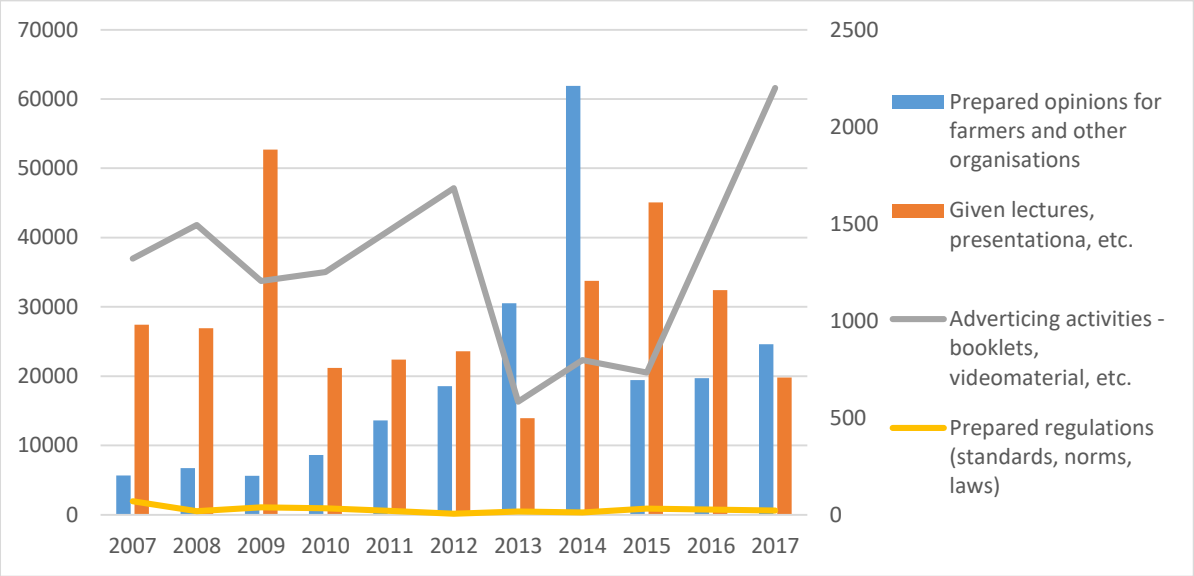
Figure 35. Number of participations in exhibitions and fairs, in radio and television broadcasts, and materials published in the press by the Agricultural Academy in Bulgaria



Source: Annual Reports of the Agricultural Academy

Also, Agricultural Academy researchers take an active part in the development of many official documents (standards, norms, laws), opinions for farmers, cooperatives and agencies, advertising materials (brochures, newsletters, leaflets, videos, etc.), and in lecturing and reporting. The growth of this type of activity shows that the diverse expertise of the Agricultural Academy is widely sought after by various agents making management decisions at different levels and all stakeholders (Figure 36).

Figure 36. Number of prepared opinions for farmers, cooperatives and agencies, developed official documents, delivered lectures, reports and advertisements from the Agricultural Academy in Bulgaria



Source: Annual Reports of the Agricultural Academy

The dynamics of all these indicators give an idea of the changing possibilities (qualification, financial and organizational capacity) for organizing and participating in such forms, the efficiency, and complementarity of the individual forms, as well as the adaptation to different needs (demand) of various participants in the system for sharing knowledge and innovations in the country. In addition to all this, the Agricultural Academy performs other important functions related to the scientific service of the industry, such as maintenance of plant and animal gene pool, performing analyzes of soil, plant and animal products, information services, independent expertise, etc. In this way, it contributes to improving the scientific and technical level in agriculture, preserving the "accumulated" biological potential, as well as disseminating knowledge and innovation in the sector.

Over the last three decades, various "reforms" of the country's agricultural research system, and in particular the Agricultural Academy, have been undertaken. However, despite certain success in some areas in recent years, still, there is not established an effective structure for the organization of R&D, and systems for public funding of activities, coordination, and evaluation of research, evaluation, and incentives for researchers and teams, as well as protection of intellectual agricultural property. Some of the research institutes and centers do not have or are on the border of the "critical" mass of human, financial and material resources necessary for effective conducting of modern research - Institute of Roses and Essential Oils Crops (6), Institute of Fisheries and Aquaculture (7), Institute of Ornamental and Medicinal Plants (9), Institute of Fish Resources (9), etc. The organizational separation of the experimental stations, on the other hand, does not allow the effective integration of their "significant" resources in the R&D coordinated by the scientific institutes and centers. All this does not allow to fully realize the great potential of the Agricultural Academy to improve the scientific and technological level of the agricultural sector in the country.

State of Agrarian Research Conducted in other Organisations

The general tendencies, efficiency, and problems in the development of agrarian research in the universities and Bulgarian Academy of Sciences are similar to those in the Agricultural Academy. Many of the universities traditionally have no strong research programs due to lack of researchers' time, financial and material resources, sufficient capacity to win and implement projects, etc. Universities receive insignificant subsidies from the Ministry of Education and Science for "internal" projects, which are usually "fundamental", small in size, and include part of the academic staff. In recent years, additional weight has been given to the distribution of the state subsidies according to science-metric indicators, on which only a few universities have comparative advantages mostly outside of “agrarian” programs. In addition, universities compete for funding from research programs of the National Science Fund of the Ministry of Education and Science and other national and international organizations, making contractual research for business and other organizations.

In 2017 the share of the budget for funding from National Science Fund projects in "Agricultural Sciences" was 17%, which is extremely insufficient (REPORT of the Commission for Monitoring, Evaluation, and Analysis of the activities of the Research Fund at the Ministry of Education and Science, 2018). Moreover, the share of public higher education institutions in the total funding of the National Science Fund was only 42%, which shows that only part of the projects in "Agricultural Sciences" are in universities.

The financing of agricultural research in the country by the European programs such as FP7, HORIZON 2020, and others is also insignificant. The total funding of Bulgarian science from these funds is significant, nevertheless among the lowest in Europe - for example, funding from HORIZON 2020 for Bulgarian organizations is "significant" (105.5 million euros), but only 0.25% of the total budget of that Program, the number of participants from Bulgaria is 0.58% of all, with only one leading organization from the country, etc. (HORIZON 2020). At the same time, in the ten most active organizations in the country for winning projects from the main EU programs such as FP7 and HORIZON 2020, there is none in the agricultural field.

The main universities in which research in the field of agriculture and food technology is carried out are the Agricultural University, Plovdiv; Thracian University, Stara Zagora; University of Forestry, Sofia; University of Food Technology, Plovdiv; and University of Ruse, Ruse.[9] In recent years, other "non-specialized" fields of agriculture universities and institutes of the Bulgarian Academy of Sciences are also quite competitive to enter the field of agricultural and related research such as bioeconomics, food security, ecology, AKIS, socio-economic and other projects. There is no aggregated information in the country about the nature and volume of agricultural research conducted by Bulgarian universities. The situation is similar to the available information on agricultural research in the institutes of the Bulgarian Academy of Sciences, given the more fundamental and multidisciplinary nature and the diverse goals of research that often go beyond the agricultural field. It is also difficult to find information on agricultural research carried out in the private sector. All this hinders the

[9] Non of them is classified as a “research” university during the 2021 multicriteria assessment by the Ministry of Education, Science, and Technologies.

analysis and management of AKIS in the country and requires the collection of similar information in the future.

The conclusion in the RDP 2014-2020 is also relevant for the agricultural universities and the Bulgarian Academy of Sciences: “the provision of consulting services and knowledge transfer in the country are not systemic. The results of research, such as innovations for introduction into agricultural holdings, are presented mainly at academic conferences or exhibitions without being promoted among potential users. The Agricultural Academy, due to its limited budget, presents results only on demonstration fields. On the other hand, research topics, although they generally cover key problems in agriculture, are not linked to the specific problems of specific farms or specific sectors”.

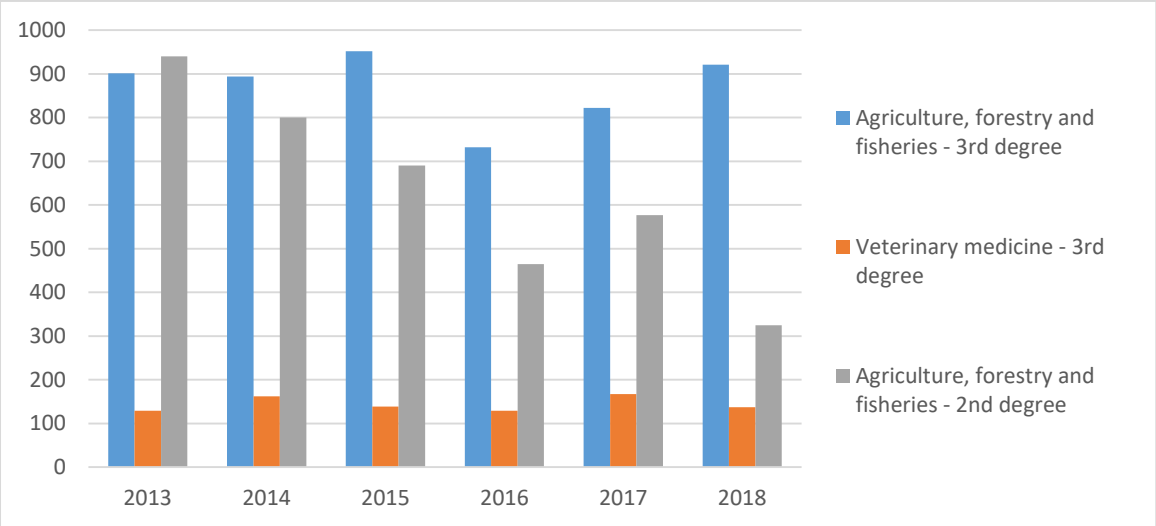
In Bulgaria, there is no summary information on the degree of implementation of different types of innovations in agriculture. There are good examples of implemented science and technology achievements in all sub-sectors. These innovations are implemented by innovative entrepreneurs who manage to study, transfer and adapt the highest achievements in the respective field, providing the necessary organization, financing, consulting, and know-how in a private way. However, the overall level of innovation implementation in the country is far below the world and EU levels, with significant differences in the technological level of the "leading" farms and the average level in most holdings of the country.

Our 2019 survey among farmers' organizations and innovative farmers found that there is not enough information about the achievements and "ready" innovations of the institutes of Agricultural Academy, Bulgarian Academy of Sciences, and universities. Moreover, the majority of the implemented innovations in the country are "imported" from abroad, due to the lack of effective solutions in the local institutes and universities for the contemporary needs and actual conditions of the Bulgarian economies.

4. System of education and training of agricultural producers

In 2014 professional education in the field of agriculture and forestry covers 92 institutions (technical schools, high schools, etc.) and more than 880 vocational training centers with licensed professions and specialties for vocational education and training in the fields of agriculture, veterinary medicine, forestry and food technologies (ПРСР 2014-2020, МЗХГ). Subsequently, some of them were closed due to the low interest in the specialties, the number of students enrolled and dropped out, etc. During the period 2013-2018 on average annually 870 persons receive a Level-3 qualification in the field of Agriculture, Forestry, and Fisheries, and 144 in Veterinary Medicine (НСИ). For the same period, 633 people also receive a Level-2 qualification in Agriculture, Forestry, and Fisheries. Agrarian graduates represent 6.14%, 1.08%, and 16.25% respectively of the total professional qualifications in the country. The number of persons acquiring in 2018 the professional qualifications Level 3 in the fields of Agriculture, Forestry and Fisheries and Veterinary Medicine is higher than the beginning of the period by 2% and 6% respectively (Figure 37), with a decrease in the total level of qualifications acquired in the country by 13% (НСИ). The number of graduates with vocational qualifications of Level 2 in general and in the field of Agriculture, Forestry, and Fisheries has been significantly reduced since 2013, as the reduction in the agrarian sphere is less than the overall graduates in that level.

Figure 37. Graduates of the II and III Levels programs for professional qualification in different fields of education (number)

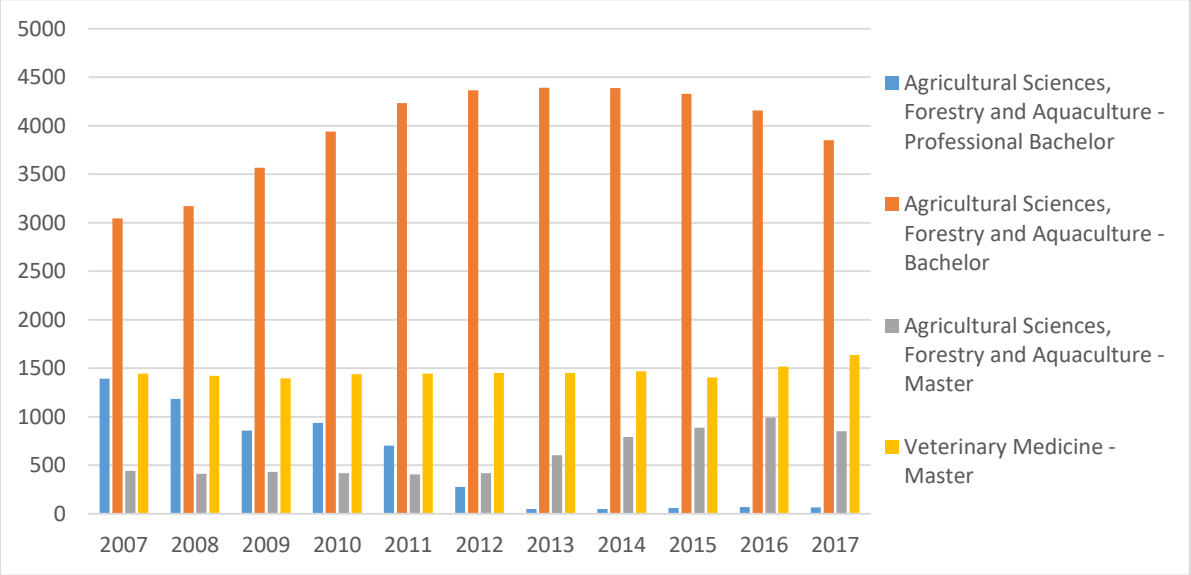


Source: NSI

The higher education in agrarian specialties is carried out at several universities offering similar qualifications and competing for a limited number of students – e.g. Agronomy and Agrarian Economics is offered in 6 universities and colleges, etc. The number of undergraduate students in Agrarian Sciences, Forestry, and Aquaculture, and Veterinary Medicine in 2017 is well above the 2007 levels for Bachelor's and Master's degrees (Figure 38). Moreover, the relative share of these two branches of agricultural education relatively increased in the total

number of students in the country during the period - for Bachelor's Degree in Agrarian Sciences, Forestry and Aquaculture from 1.89% to 2, 48%, for the Master's Degree Program in Agricultural Sciences, Forestry, and Aquaculture from 0.67% to 1.1%, while for the Master's Degree in Veterinary Medicine it is relatively stable (НСИ). This confirms the aspirations of many young people to increase their education in the agrarian sphere. However, there is no information on how many of the graduates of agricultural specialties in vocational and higher education institutions work in the agricultural sector. It is well known, for example, that a small number of university graduates work subsequently in their fields of education. Moreover, discussions regarding the (low) quality of education and the efficiency of school's adaptation to the needs of the business have been constantly on the agenda.

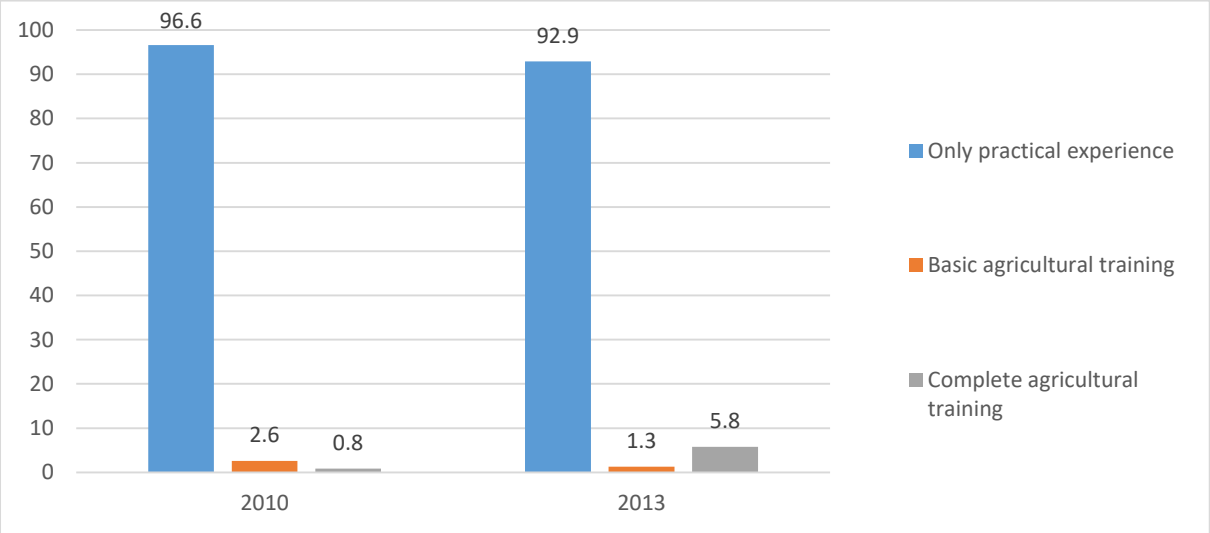
Figure 38. Number of undergraduate and graduate students and fields of education



Source: NSI

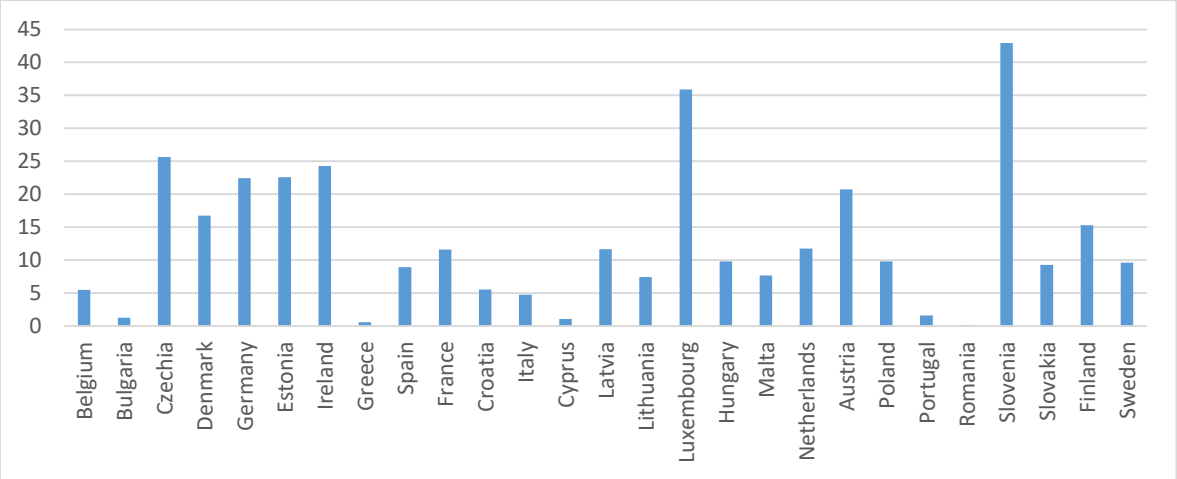
Available data on the agricultural training of the managers of agricultural farms in Bulgaria show that in the first years after the accession to the EU, only a small number of them have basic or full agricultural training, most of them being only with practical experience (Figure 39). Moreover, in 2010, only 1.3% of the farm managers had undergone some form of training in the last 12 months (Figure 40). By this indicator, Bulgaria is among the most lagging behind countries in the EU, along with Romania, Greece, and Cyprus.

Figure 39. Agricultural training of the managers of agricultural farms (%)



Source: Eurostat

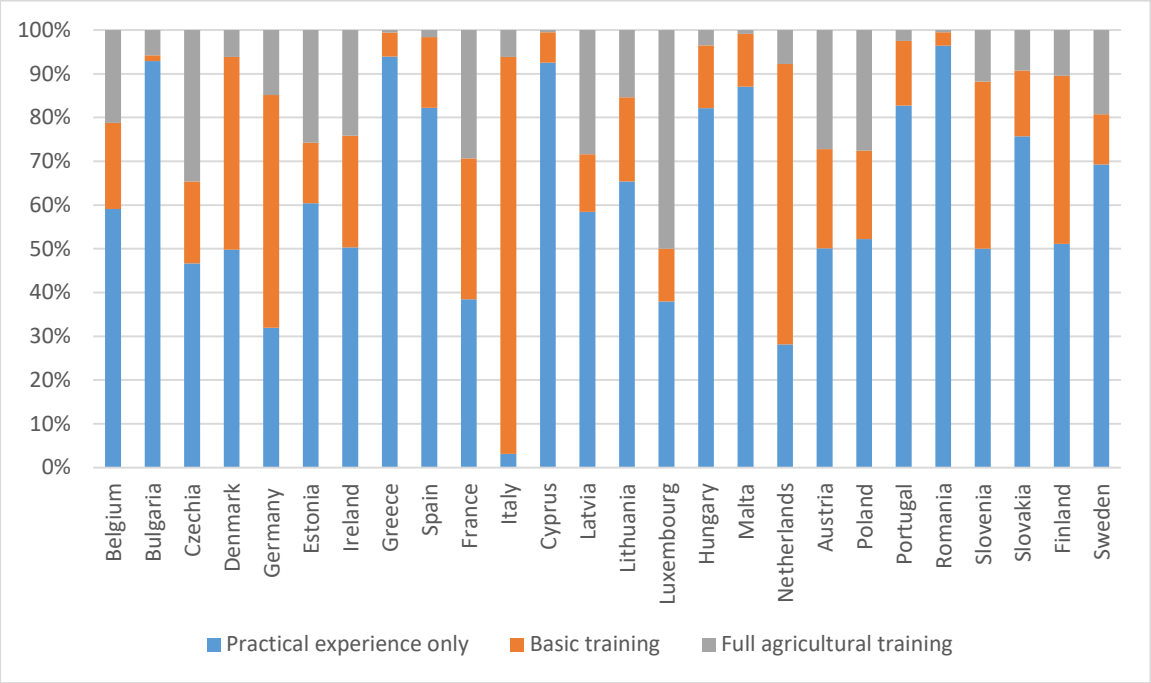
Figure 40. Share of holdings with vocational training by manager in last 12 months in EU member states in 2010 (%)



Source: Eurostat

As a result of the undertaken measures for public support during the period, 2010-2013 the share of managers having completed full agricultural training increased from 0.83% to 5.8%, while those with basic agricultural training and only practical experience decreased slightly. At the end of the First programming period for the implementation of the CAP in the country almost 93% of all farm managers are only with practical experience and without any agricultural training. The relatively small proportion of the farm managers who have completed basic or full agricultural training (7.12%) requires significant public intervention for training and consultations of agricultural producers. Except for Romania, Greece, and Cyprus, all other EU countries far outperform Bulgaria in the extent of training of farm managers (Figure 41).

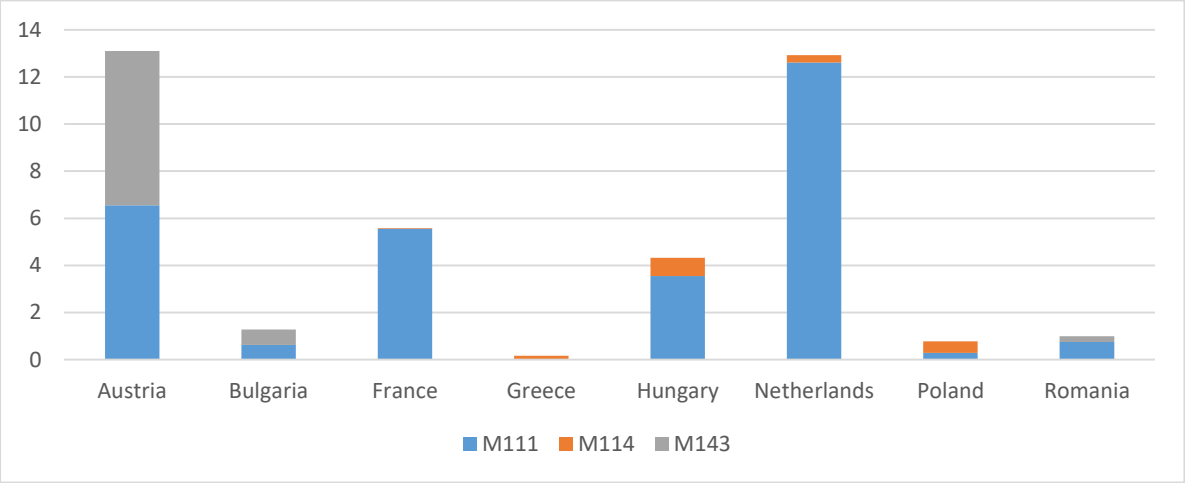
Figure 41. Agricultural training of farm managers in EU member states in 2013



Source: Eurostat

Since 2007, agricultural and rural development programs have been a major tool for public support for the training and consultations of farmers to successfully adapt to the ever-changing economic, market, institutional and natural environment. The total amount of public funds spent under the RDP 2007-2013 under Measure 111 "Vocational training, information activities and dissemination of scientific knowledge", Measure 114 "Use of advisory services by farmers and forest owners" and Measure 143 "Provision of advice and agricultural consultancy in Bulgaria and Romania" amounts to 15 236 905 Euro (MAF, 2018). It represents 1.65% of the total amount of the public expenditures under Axis 1 and 0.5% of the total budget of the program. Bulgaria is in the group of EU countries (along with Greece, Poland, and Romania), in which these three measures account for the smallest share in the total expenditures of Axis 1 and of the RDP 2007-2013 as a whole (Figure 42). Developed European countries such as Austria, Netherlands, France, etc. attach greater importance to farmers' consultations and training and devote a much larger share of the Axis 1 and RDP budgets to these activities, as the majority implement more measures related to them.

Figure 42. Share of public expenditures for Measures 111, 114 and 143 in total public expenditures for Axis 1 of Rural Development Programmes 2007-2013 in selected EU countries (June 2015)



Source: ENRD

Measure 111 represents 0.99% of the public expenditures in Axis 1 and 0.3% of the budget of the PRD. For the entire period of implementation (2008-2015), 91 contracts were concluded under the measure with various training organizations for financial assistance, totaling BGN 30 685 570. The training is provided by the AA, NAAS, universities, private and professional organizations, etc. To increase the efficiency of the RDP, vocational training was introduced as a prerequisite for the participation of farmers without agricultural education in some of the other public support measures - Measure 112 ("Setting up farms for young farmers") and Measure 214 ("Agri-environment payments"). During the implementation of the measure, the initial budget was reduced four times, which is due to greater initial interest and unrealistic planning, lack of training providers, insufficient promotion of the activity, and the reluctance of the producers to study away from the farm.

In the course of implementation of Measure 111 "Vocational training, information activities and dissemination of scientific knowledge", a total of 40 062 farmers were trained, with an average training duration of 5.1 days (Table 2). This represents almost 16% of the total number of farms in the country and just over 52% of the number of registered farmers in 2013. This is a significant success given a large number of farmers in the country and their (low) qualification level. The public cost per trained person is EUR 228.7 and one-day training EUR 44.9, which demonstrates the high efficiency of this public intervention. The over-passing of the planned indicators is high - by 158% for the indicator number of participants and by 54% for the number of training days. The participation of farmers in the training under this measure is high given the opportunity to acquire new knowledge, improve qualifications, transfer knowledge and experience, as well as the mandatory requirements for participation in other measures of the program.

Table 2. Implementation of measure 111 of the RDP 2007-2013

Area of training	Total trained participants	Number of days of training	Public funds paid, thousand EUR	Duration of training per student, days	% in total trained	% in total days	% of total cost
Administrative, management and marketing skills	5892	32020	1347	5,4	14.71	15.70	14.70
ICT in agriculture	233	1921	53	8,2	0.58	0.94	0.58
Technical knowledge and skills - new technological processes and machines, innovative practices	14898	85500	3407	5,7	37.19	41.93	37.19
New standards	170	2247	39	13,2	0.42	1.10	0.43
Quality of production	100	2163	23	21,6	0.25	1.06	0.25
Sustainable management of natural resources and environmental protection	17157	75874	3923	4,4	42.83	37.21	42.82
Others	1612	4184	369	2,6	4.02	2.05	4.03
TOTAL	40062	203909	9161	5,1	100	100	100

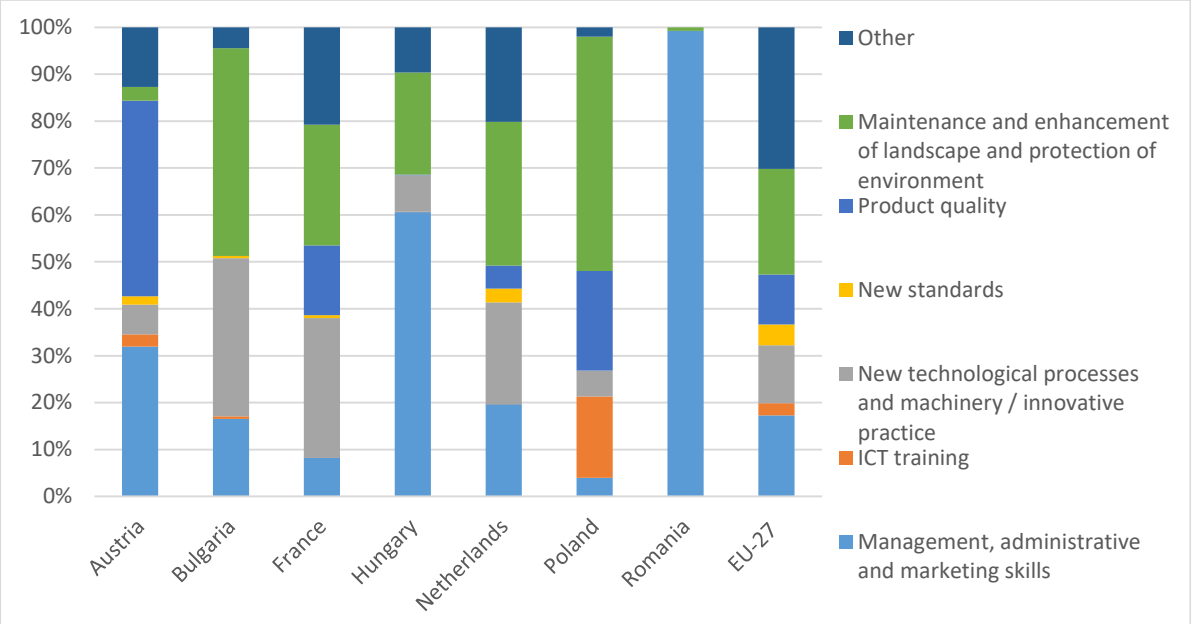
Source: Последваща оценка на ПРСР 2007-2013 г., МЗХ, 2018

A positive result in the implementation of the activities under that measure is the high participation of young people up to 40 years and women. Trainees between the ages of 18 and 40 are 60% of all trainees (МЗХ). In 2013, the number of farm managers under 40 is between 30-35000, which means that over 70% of them have received training. Women enrolled in the training are 35% of all trained, indicating that one-quarter of women managers in the country have received training during the period.

The biggest number of participants in the training and information events are in the thematic area “Sustainable management of natural resources and environmental protection” (Table 1). This area represents 42.8% of all trained persons and expenditures and 32.7% of all training days, with an average of 4.4 days of training. The second most popular topic is "Technical knowledge and skills - new technological processes and machines, innovative practices", which represents 37.2% of the number of trainees and total expenses and 41.9% of the training days, with an average length of training of 5,4 days. The third topic that farmers are most interested in is "Administrative, Management and Marketing Skills", in which 14.7%

of the participants are trained, 15.7% of the training time is engaged, with an average duration of 5.4 days. On average for the EU countries, these three thematic areas also dominate, along with "Others", but take a different relative share than in Bulgaria (Figure 43). In more developed countries such as Austria, France, and Poland, and the Union as a whole, product quality training has a significant share. In some countries in Eastern Europe, such as Romania and Hungary, the vast majority of participants in the training have preferred “Administrative, management and marketing skills”.

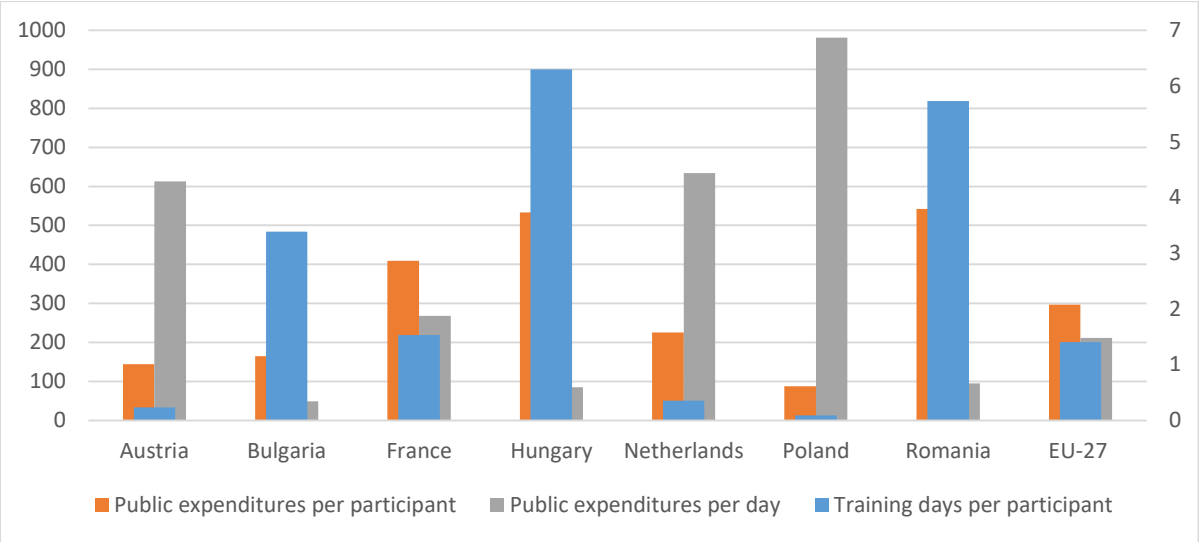
Figure 43. Measure 111 Vocational training and information actions of Rural Development Programmes 2007-2013 of selected EU countries (June 2015)



Source: ENRD

In terms of the number of training days, Bulgaria is 2.4 times above the EU average, well above that in developed countries such as Austria, the Netherlands, and Poland, and well below the duration in Hungary and Romania (Figure 44). At the same time, the public expenditures of one participant and one day of training in the country are significantly lower than the average for the Union and some of the compared countries. This is an indicator of the higher (economic) efficiency of the organization of training compared to other European countries.

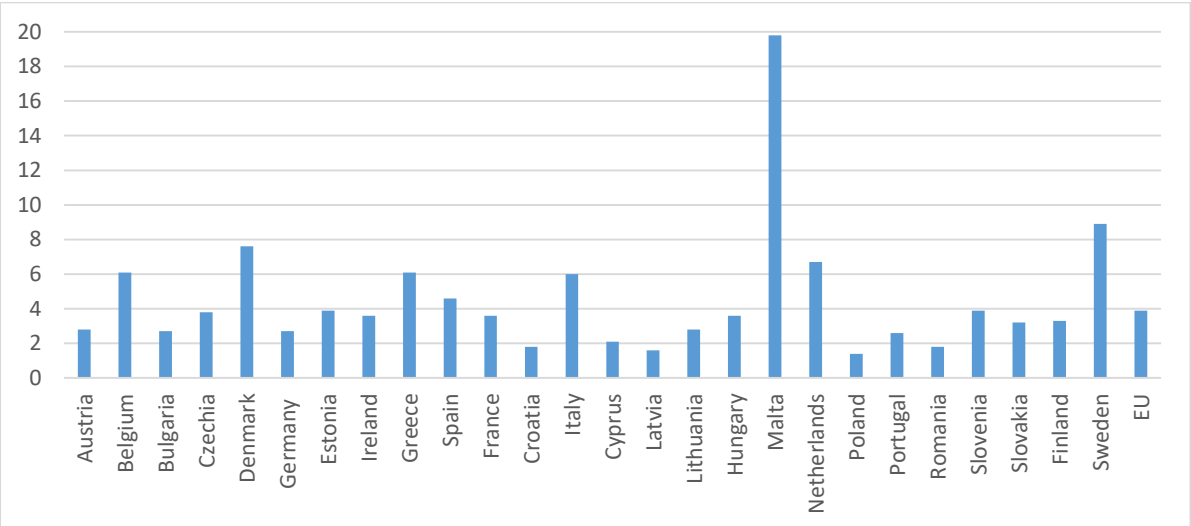
Figure 44. Number of training days received and Public Expenditure per participants and training day of Measure 111 in EU countries, June 2015 (Number, Thousand Euro)



Source: ENRD

The RDP 2014-2020 also gives a priority for the "Knowledge transfer and information actions" (Measure 1), "Consultation services, farm management, and transfer of farms" (Measure 2), and "Cooperation" (Measure 16), which respectively represent 0.87%, 0.15% and 1.12% of the total budget of public funds. Compared to the EU average and most Member States, the relative share of expenditures for co-operation, knowledge transfer, and advisory services is significantly lower in Bulgaria (Figure 45). The part of this component of the budget in the country is similar to Germany and exceeds only that of a few countries (Croatia, Latvia, Romania, and Cyprus).

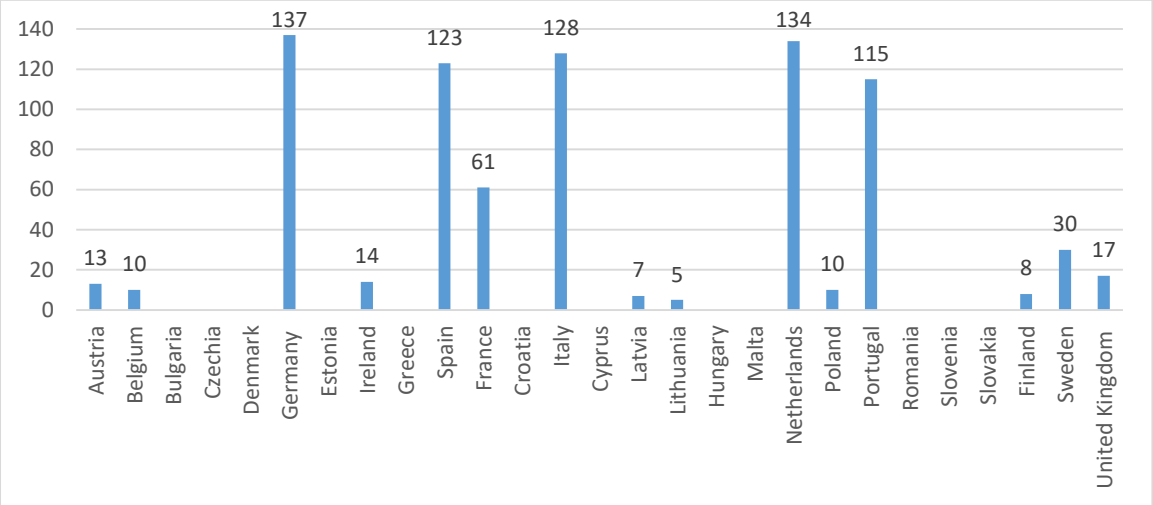
Figure 10. Percentage of expenditure under Measure 1, Measure 2 and Measure 16 in relation to the total expenditure for the RDP 2014-2020 in EU countries



Source: ENRD

The implementation of the main activities under the individual measures in the country is significantly behind in comparison with other European countries. For example, due to the delay of competitions, training has not been supported so far. There are also no funded EIP projects of stakeholder groups, researchers, consultants, and businesses within the European Innovation Platform[10]. At the same time, many of these promising forms of knowledge sharing and innovation have already been established and are successfully operating in 15 other EU countries. With the largest number of EIP operational groups in place, are the older developed member states - Germany, the Netherlands, Italy, and Spain (Figure 46).

Figure 46. Number of EIP Operational Groups in EU countries (November 2018)



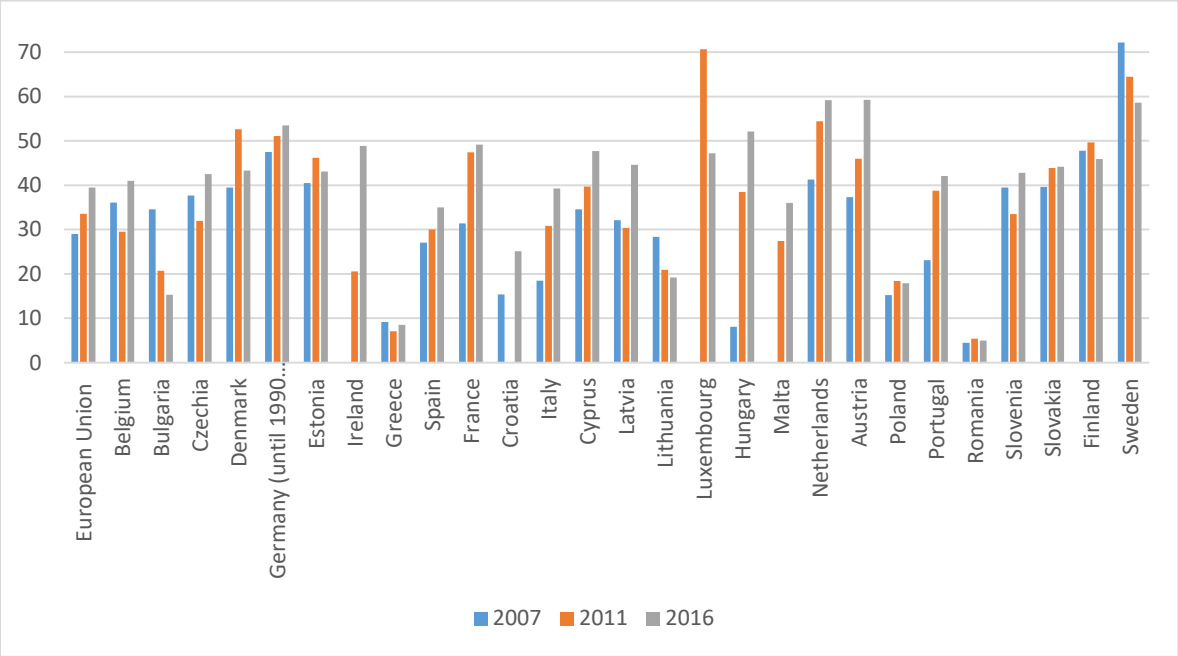
Source: DG AGRI

In Bulgaria there is no information about the total number of PhD students in the agrarian and rural sector. We can only presume that the similar trends like in Agricultural academy exist in other organizations involved in PhD training in agrarian and rural sector like public and private universities, institutes of BAS, foreign and international (like EU JRCs) organizations, etc. Nevertheless, in the country there is no any information about the number of employed in agriculture out of total completed PhD studies in the agrarian, rural and related fields.

Despite the various forms of education and training offered and the considerable amount of public money spent, the participation rate in rural areas remains weak and steadily decreasing in the years after accession of the country to the EU (Figure 47). This trend is the opposite of that in most EU Member States except Romania and Greece. In terms of formal and non-formal education and training in rural areas, Bulgaria is also much worse than most of the EU countries (Eurostat).

[10] The first call for applications for the Sub-measure 16.1. "Support for the formation and functioning of operational groups within the EIP" under measure 16 "Cooperation" of the RDP 2014-2020 was published on 17.10.2019. There have been a good number of proposals submitted and since 2020 there are dosen selected projects for funding.

Figure 47. Participation rate in education and training in rural areas in EU (%)



Source: Eurostat

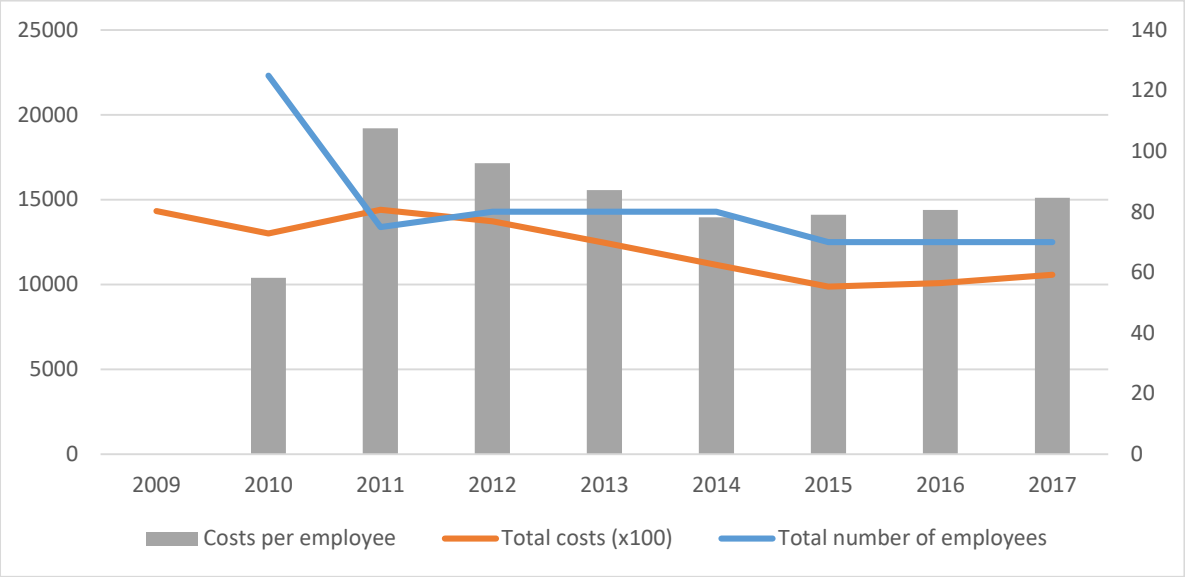
5. Governance of the system of advices and consultations in agriculture

Supporting a specialized advisory service (NAAS) and consultation services to farmers is another major priority for the state during the years following the country‘s accession to the EU. The RDP 2007-2013 includes two measures in this regard - Measure 114 "Use of advisory services by farmers and forest owners" and Measure 143 "Provision of advice and consultations advice in agriculture in Bulgaria and Romania". Measure 114 is among the measures to which there is little interest from the potential applicants. Only 96 contracts for support were concluded, with a total amount of public funds of BGN 191326, using only 36.9% of the planned expenditures (M3X). Funds spent under this measure represent only 0.004% of the total expenditures under Axis 1 of the program. Under Measure 143, as much as 0.65% of the total expenditures under Axis 1 and 0.2% of the total RDP expenditures were spent. Under this measure, the NAAS is the sole beneficiary, effectively providing a full set of advisory services to eligible persons under measures 141 ("Supporting semi-subsistence farms in the process of restructuring"), 112 ("Setting up farms for young farmers"), 142 ("Creating Producer Organizations") and 214 ("Agri-environment Payments").

The NAAS is the main participant in the training and advice system of the country. The analysis of the activity and performance of the NAAS gives a good idea of the overall development of the public system of advice and training to farmers. The NAAS employs experts organized in 3 departments at the central level ("Training, Information Activities and Analyzes", "Consulting Services for National and European Programs" and "Analytical Laboratory"), and 27 offices in each of the regions of the country. The NAAS offers a variety of consultations according to its program, including a comprehensive "package of consultation services" (from the establishment of the farm to its full servicing in agronomic, livestock, and agro-economic aspects), organizes and conducts training for farmers, disseminates useful information and good practices, and assists in the application for RDP projects. The NAAS supports the transfer and application of scientific and practical achievements in the field of agriculture and thus supports the link "research - agricultural business". All consultations provided by the NAAS are free of charge to farmers, which helps to effectively share knowledge and innovation in the sector. The target groups targeted in recent years are mainly small and medium-sized farms, start-ups and young farmers, new production (organic production, ecological, etc.), producer organizations, etc. In this way are supported the involvement of all producers in the knowledge and innovation system and the development of new forms and directions.

Funding of the activities of the NAAS is provided by budget subsidies and projects financed by various national, European, and other organizations. Following the peak of the overall expenditures of the NAAS in 2011, their size was reduced by 2015 and has increased slightly over the last two years (Figure 48). At the same time, the number of NAAS staff has been steadily declining, with a 44% decrease over the last three years compared to 2010 (70 full-time employees).

Figure 48. Number of employees and the amount of expenditures of NAAS



Source: Annual Reports, NAAS

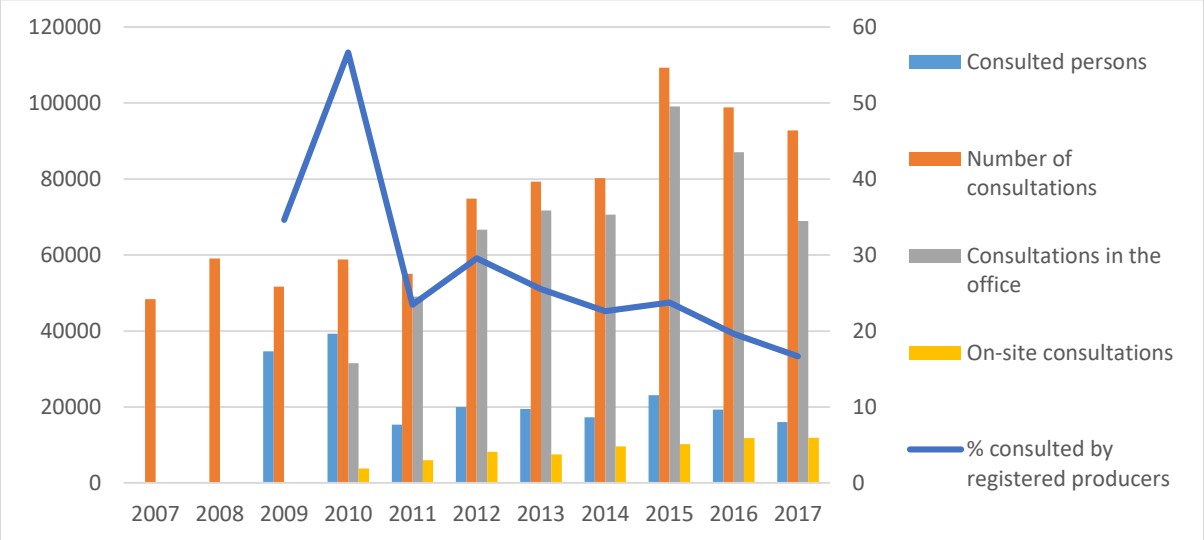
The endowment with financial and material resources per one employed follows the dynamics of total expenditures. Compared to 2009, the expenditures per employee have been significantly higher in all the years so far, with their level steadily declining until 2014 and improving slightly in recent years. Reduced public support for the NAAS's activity is indicative of the reduced financial capacity of the state, the "reduced" need for advice, new public priorities, as well as directing of the budget subsidies to other organizations and activities.

Consulting agricultural agents (potential and actual farmers, other agriculture and rural entities and organizations) is a key task of the NAAS. Since the country acceded to the EU, the number of consultations provided by the NAAS has almost doubled, reaching nearly 93,000 (Figure 49). The majority of consultations (about 90%) take place at NAAS offices, but there is a slight increase in the share of on-site consultations on the farm. The latter allows giving specific advice, depending on the specific conditions of the farm visited. Consulting agrarian agents (potential and actual farmers, other related to agriculture and rural areas persons and organizations) is a major task of the NAAS. Since the country acceded to the EU, the number of consultations provided by the NAAS has almost doubled, reaching nearly 93,000 (Figure 49). The majority of consultations (about 90%) take place at NAAS offices, but there is a slight increase in the share of on-site consultations on the farm. The latter allows giving specific advice, depending on the particular conditions of the visited farm. Compared to 2009-2010, the number of persons consulted is significantly reduced to 16,000 and varies significantly from year to year. That is a result of both the improving qualification level of farmers (the need to consult a smaller number of farmers) and the development of alternative forms of service provision (private companies, suppliers of machinery and chemicals, producer organizations, scientific institutions, etc.).

To extend and facilitate farmers' access to advisory services and reduce their costs from 2015, the NAAS is implementing a new form of “field receptions” (consultancy days) in various settlements, usually far from the regional centers. By 2017, the number of field

receptions increased to 1104, and the average number of attended persons decreased to 3.7, due to the decreased total number of participants and the increased number of receptions. This is an indicator for improving the consulting services of NAAS in all regions and settlements of the country.

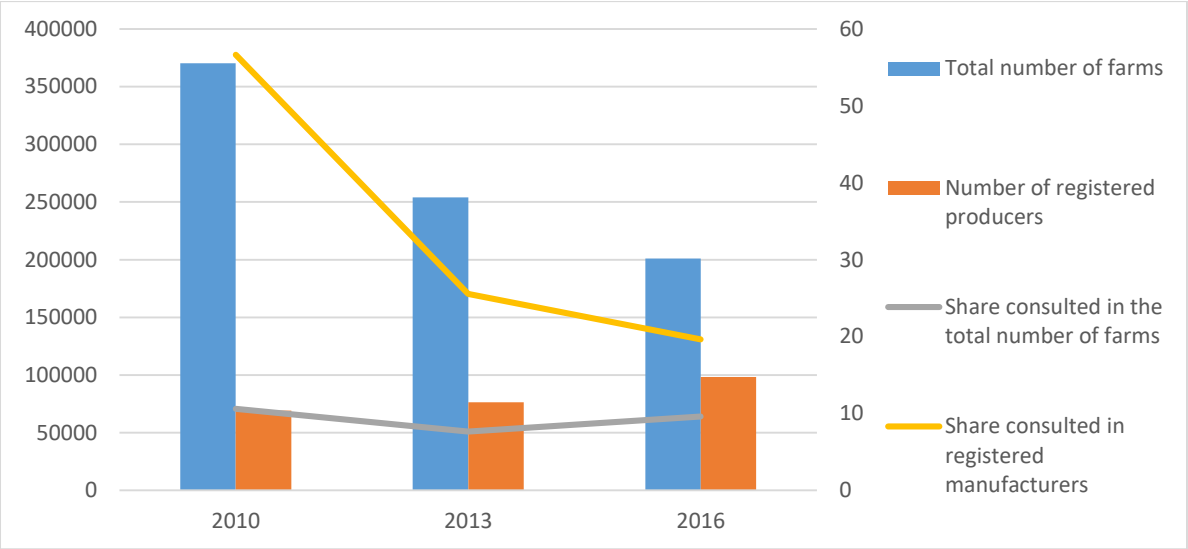
Figure 49. Number of consulted persons and conducted consultations by NAAS



Source: Annual Reports, NAAS, Agrarian Reports, MAFF

In recent years, the share of farmers consulted by the NAAS in the total number of the agricultural holdings and the registered agricultural producers has different dynamics (Figure 50). In 2010 and 2016, the number of persons consulted represented respectively slightly above and slightly below 10% of the total number of agricultural holdings in the country (compared to nearly 8% in 2013). During the same period, the proportion of the consulted persons in the number of registered agricultural producers dropped sharply from close to 57% to just under 20%. The NAAS does not limit its consultations to only certain groups of agricultural producers (registered, small, etc.), and the number of different groups is not constant - the total number of holdings is constantly decreasing, the number of registered producers is increasing, etc. Although approximate, the above proportions give an idea of the scope of agricultural producers covered by the consultancy services of NAAS. In 2017, about 17% of all registered agricultural producers were consulted and nearly 10% of the total number of farms in the country. This can be considered a great achievement given the number of farmers and the experts of NAAS.

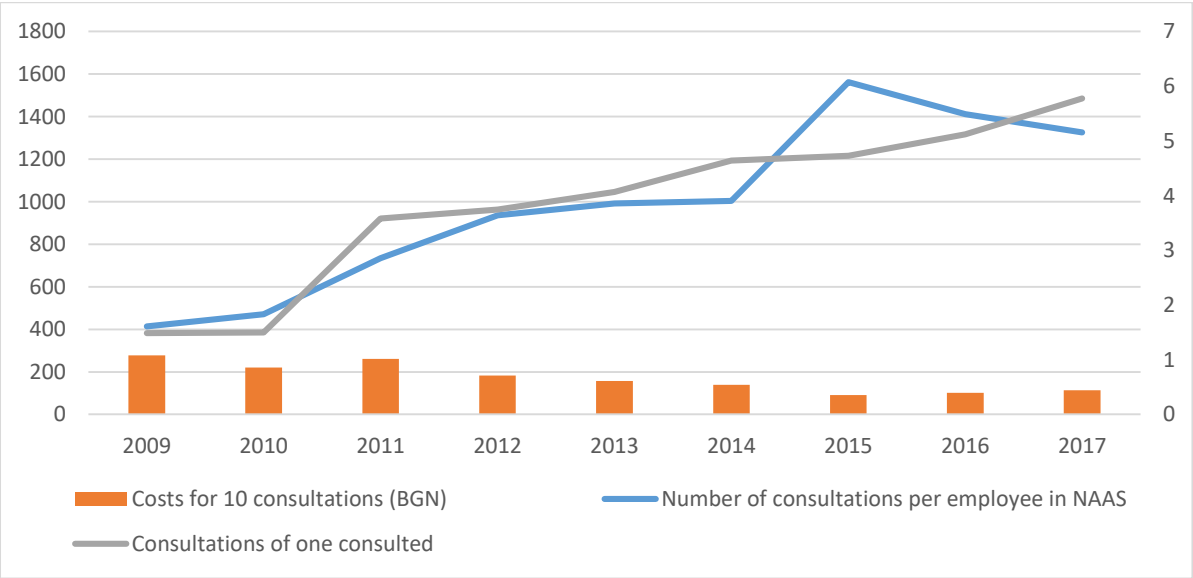
Figure 50. Share of consulted persons by NAAS in the total number of agricultural holdings and registered agricultural producers



Source: Annual Reports, NAAS, Agrostatistics, MAFF

Compared to 2009, the number of consultations per consultant increased almost 4 times to 5.8 in 2017 (Figure 51). This is a result of both a steady increase in the consulting needs of farmers as well as a longer, better, and more diverse service provided by the NAAS. As a result of the increased experience, qualification, and productivity of the NAAS staff, the cost of one consultation has been significantly reduced over the period (Figure 51). All this testifies to the continuous improvement of the organization and the increase of the efficiency of the consulting work and the activity of the NAAS.

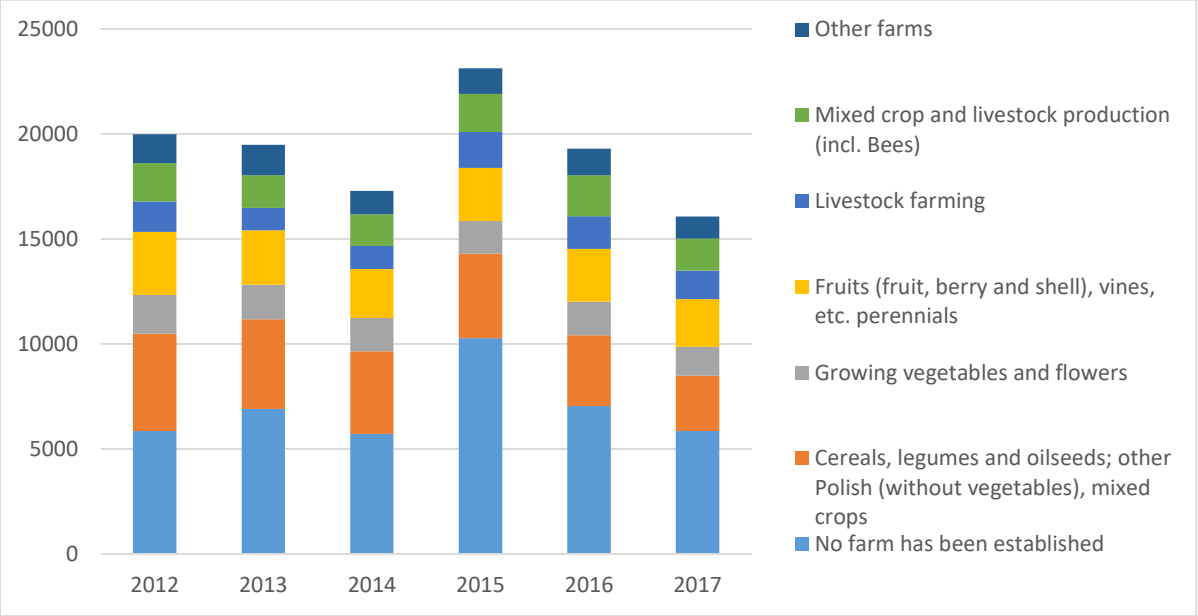
Figure 51. Number of consultations per employee at the NAAS, consultations per consulted person, and costs per one consultation



Source: Annual Reports, NAAS

The analysis of the various persons consulted according to the type of their farming in recent years shows that those who have not yet set up a farm and do not cultivate land or raise animals occupy a dominant share (Figure 52). Moreover, after 2012, the number and relative share of the potential farmers, which in 2015 increased, represent 44% of all consulted persons. The latter confirms the important role of the NAAS in advising new entrepreneurs in agriculture. Producers of cereal, beans and oilseeds, other field crops (excluding vegetables), and mixed crops are the largest group of farmers involved in the consultations of NAAS. During the analyzed period their number and relative share decreased significantly, accounting for 16% of all consulted in 2017. The second-largest among consulted by NAAS is the group of farmers specialized in fruit production (including fruit, berries, and nuts trees), vineyards, and other perennials. Their share dropped slightly until 2015, after which it again increased to 14% of all consulted persons. The consulted farmers involved in mixed crop and livestock (including bees) are the third-largest group targeted by the NAAS consultations and their relative share is relatively constant over the period (9%). The relative share of the consulted farmers specialized in growing vegetables, flowers and animals is relatively small and constant over the period.

Figure 52. Number of consulted persons by NAAS according to the type of agricultural activity performed

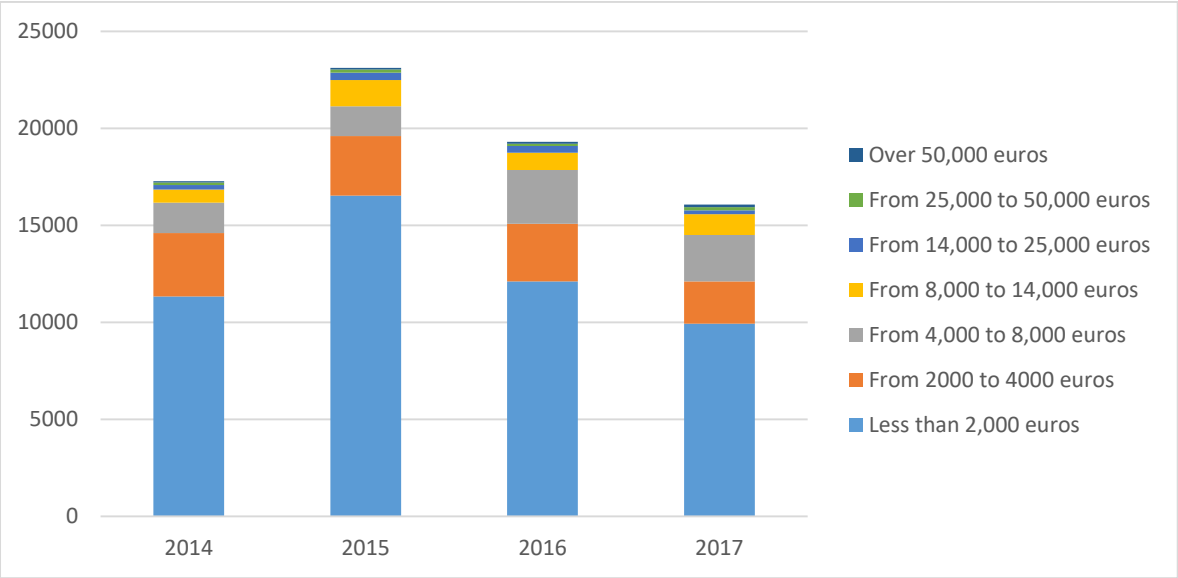


Source: Annual Reports, NAAS, Agrarian Reports, MAFF

Most of the farms consulted are small in size (Standard production volume of up to EUR 8000) - over 90% in the last few years (Figure 53). The economic size of most of these farms is very small (up to 2000 euros) and they are essential "semi-market" producers. The large-sized farms have their own specialists (agronomists, etc.) and/or the ability to hire outside private consultants and to a small extent use the services of the NAAS. The number of large farms consulted (over € 25,000) is small, but their relative share increases up to 1.8% over the

period. This proves that NAAS has the capacity and manage to serve the needs of all types of farmers.

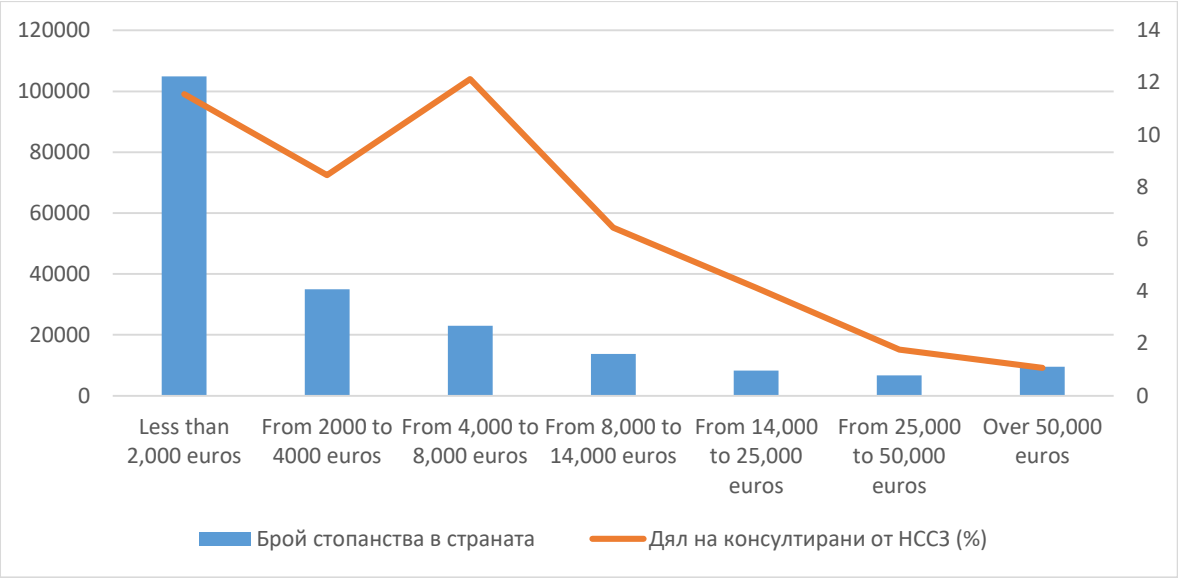
Figure 53. Number of consulted persons by NAAS according to the size of holdings in Standard Production Volume



Source: Annual Reports, NAAS, Agrarian Reports, MAFF

The farms of different size groups in the country receive to various degree consulting services from the NAAS. In 2016, the largest proportions of consulted farmers are in the total number of small market-oriented farms in the country, with a Standard production volume of EUR 4,000 to 8,000 (just over 12% of them) (Figure 54). They are followed by the small semi-subsistence farms (up to EUR 2,000) and those ranging from EUR 2,000 to 4,000, with slightly less than 12% and slightly more than 8%, respectively, receiving consultations from the NAAS.

Figure 54. Total number of holdings with different Standard production volume and the share of farmers consulted by NAAS in the respective group (2016)

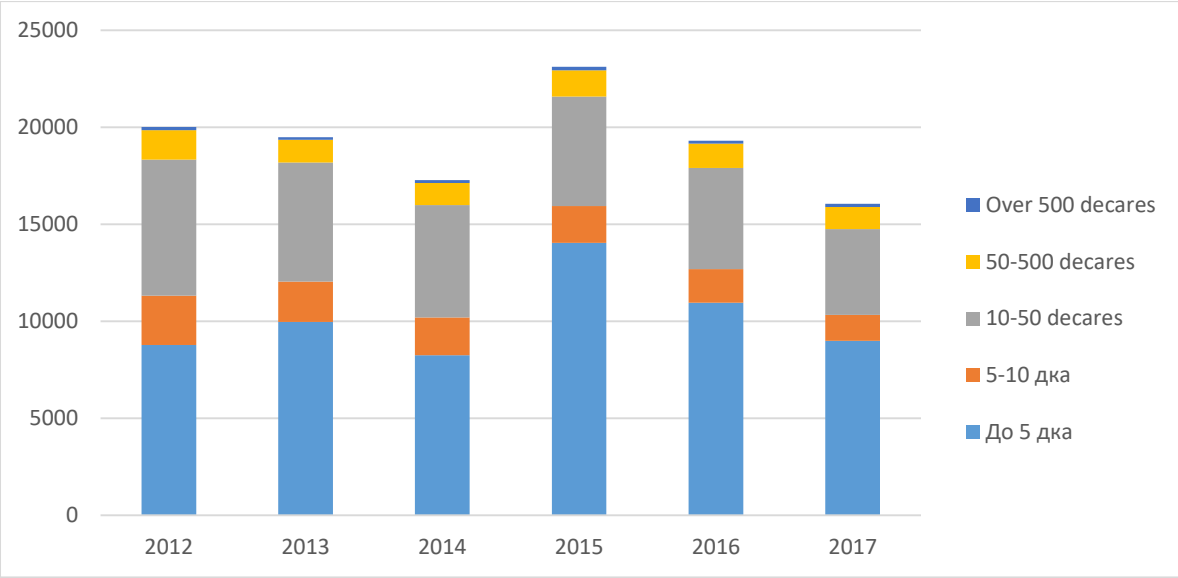


Source: Annual Reports, NAAS, Agrostatistics, MAFF

These conclusions are also confirmed by the analysis of the number of persons consulted according to the size of the cultivated land. The majority of the farms consulted manage up to 5 dka[11] of agricultural land, followed by the farm group of 10 to 50 dka (Figure 55). These groups consist mainly of small producers of crop and livestock produce. At the same time, the share of large farms with more than 500 dka is negligible during the period - between 0.7% and 1%.

[11] 1 dekar (dka) = 0.1 ha

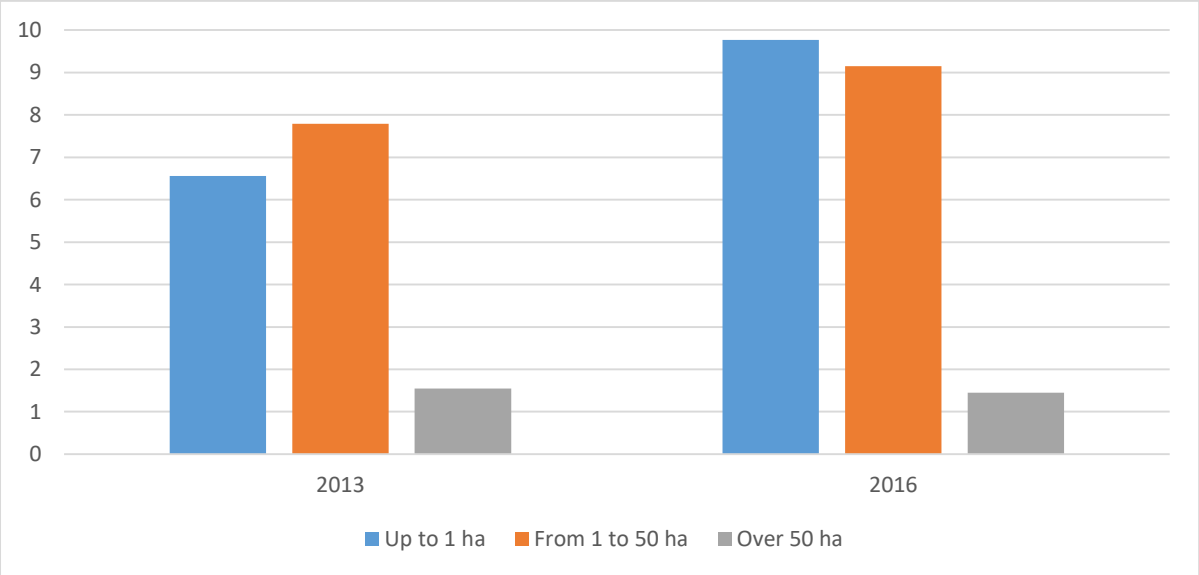
Figure 55. Number of consulted persons from NAAS according to the size of the managed land



Source: Annual Reports, NAAS, Agrarian reports, MAFF

In 2013 and 2016, a significant and growing share of all small farms in the country (up to 1 ha of utilized agricultural land) received consultations from the NAAS - 6.6% and 9.8% respectively (Figure 56). In addition, a significant and growing number of farmers from small and medium-sized holdings (from 1 to 50 ha of UAA) have been consulted by NAAS during these years - 7.8% and 9.2% respectively. In the same period, only about 1.5% of all large holdings in the country (over 50 ha) received consultations from the NAAS.

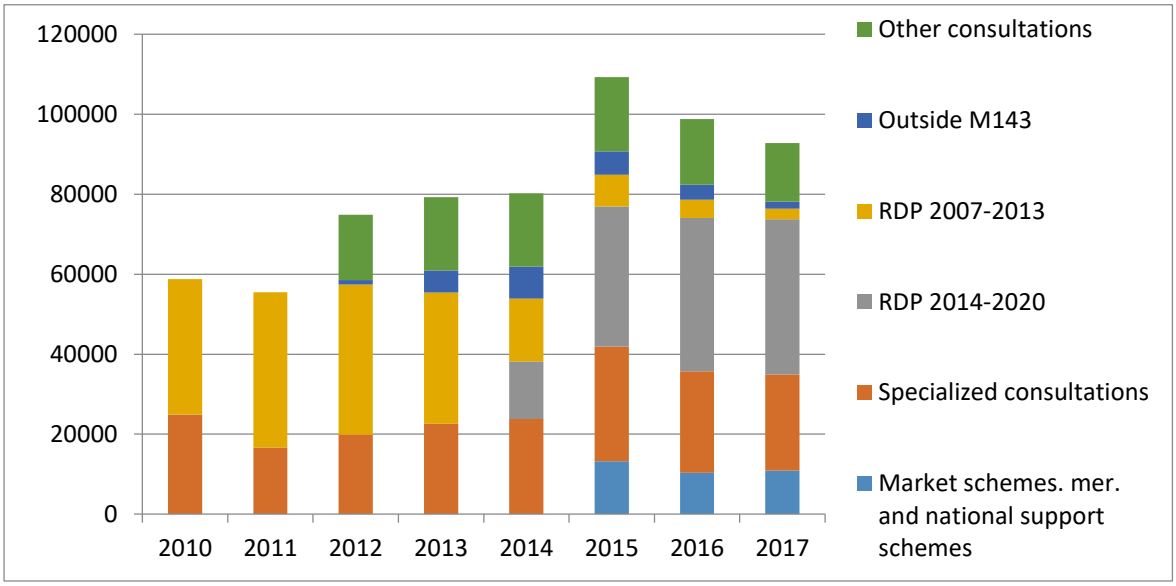
Figure 56. Share of consulted farmers by NAAS in the total number of holdings with a certain size of managed land (%)



Source: Annual Reports, NAAS, Agrostatistics, MAFF

Along with the evolution of the needs of agricultural producers, the theme (subject) of the consultations provided by the NAAS has been progressively developing. The consultations regarding the possibilities for supporting the farms with the measures of the Rural Development Programs dominate followed by the specialized consultations, other consultations, and consultations related to direct payments (Figure 57).

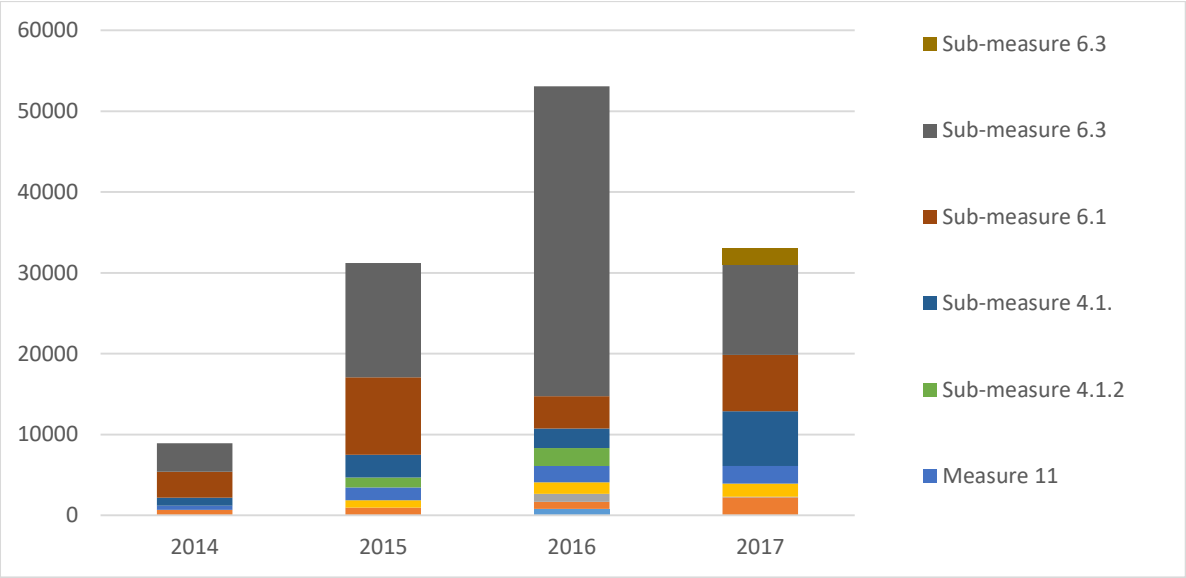
Figure 57. Number of consultations by NAAS according to their topic



Source: Annual Reports, NAAS, Annual Reports, MAFF

In the first thematic group, the most consultations in the last years have been provided for sub-measure 6.3 "Start-up aid for the development of small farms", 6.1 "Start-up aid for young farmers", sub-measure 4.1.2. "Investments in agricultural holdings" under the Thematic Sub-Program for the Development of Small Farms and the measure "Organic agriculture" (Figure 58). In the last three years, special attention has also been paid to consultations related to the National Climate Change Action Plan 2013-2020 and river basin management plans, concerning the Water Framework Directive and the Water Act.

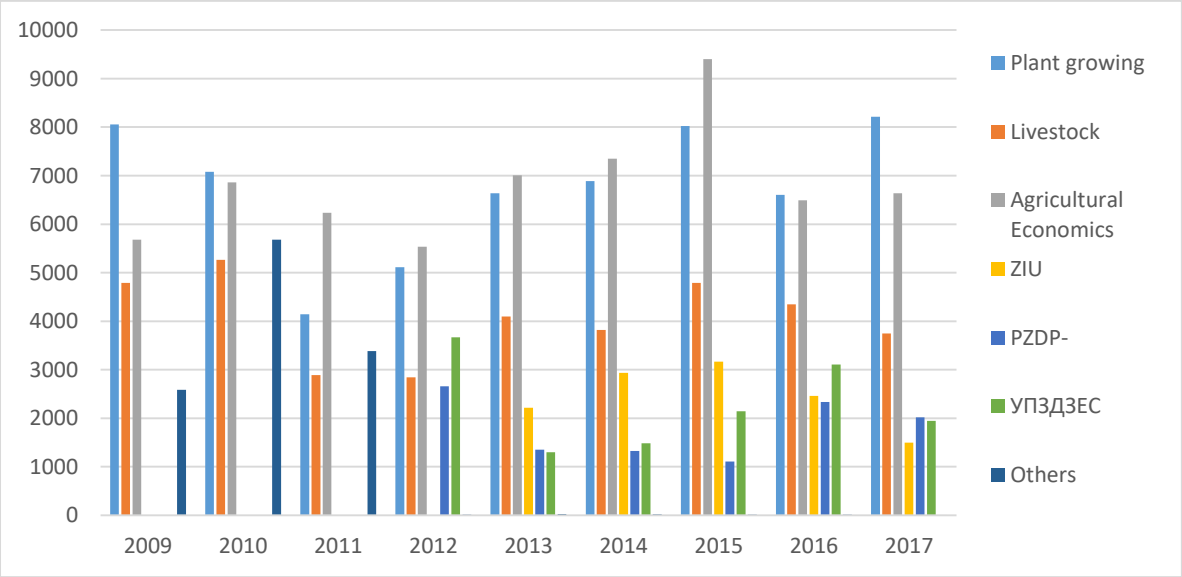
Figure 58. Number of consultations provided by NAAS related to the various measured of RDP



Source: Annual Reports, NAAS, Agrarian Reports, MAFF

In the volume of specialized consultations, those in the field of crop production and agrarian economy dominate, as their share varies in each year during the period 2009-2017 respectively from 25% to 39% and from 25.6% to 38% (Figure 59). This is undoubtedly related to the dynamically changing regulatory, market, and natural environment, which requires intensive consultations with experts. Livestock consultations are the third most important in this thematic group, with their number and relative share decreasing over the period (from 23% to 14%).

Figure 59. Number of specialized consultations by NAAS

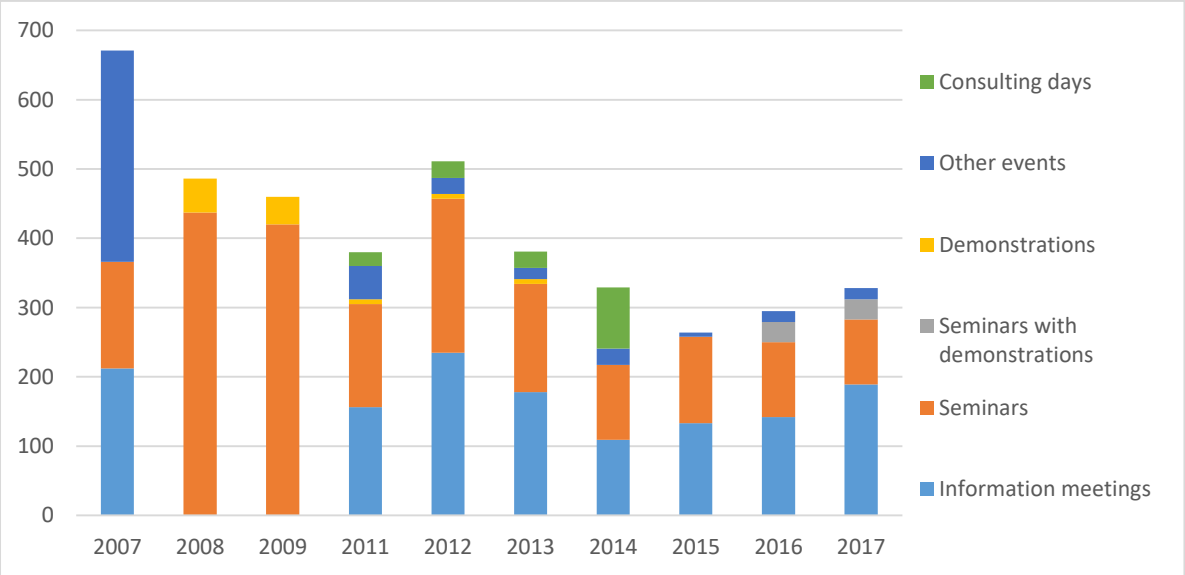


Source: Annual Reports, NAAS, Agrarian Reports, MAFF

Furthermore, NAAS also uses other effective forms of dissemination of knowledge and innovations in the sector. For the period 2007-2017 as many as 2,979 farmers and other persons were trained in the various long and short-term courses at the Center for Vocational Training at the NAAS. The training provided was funded with the European and national funds under the Operational Program "Human Resources Development" under measure 111 "Vocational training, information activities and dissemination of scientific knowledge" by the RDP or without external funding, and they are free of charge to farmers. In 2014, the NAAS completed the training under measure 111 "Vocational training, information activities and dissemination of scientific knowledge", and no courses were conducted under measure 1 "Transfer of knowledge and information actions" of the RDP 2014-2020. Therefore, in 2017, only two training courses were conducted on "Agroecology" and "Training on major environmental issues in agriculture", with a total of 41 farmers and 5 experts trained (HCC3).

In addition, NAAS organizes hundreds of different events each year related to the transfer and dissemination of knowledge and innovations - information meetings, seminars, demonstrations, consulting days, etc. (Figure 60). Information meetings have taken a major share, which has expanded in recent years. Since 2016, a combined organization of seminars with demonstrations has been implemented, which is more effective in disseminating knowledge and positive experiences than conducting it separately. A large part of the NAAS activities is organized jointly with leading AA scientific institutes, agrarian and other universities, development and other organizations, and individual experts or teams. For example, in 2017, joint activities and activities of the NAAS with universities, scientific institutes, and other organizations were one-third of the total and more than 2 600 farmers participated in them (HCC3). Collaborative events are very popular with farmers and, by their nature, are specialized one-day training.

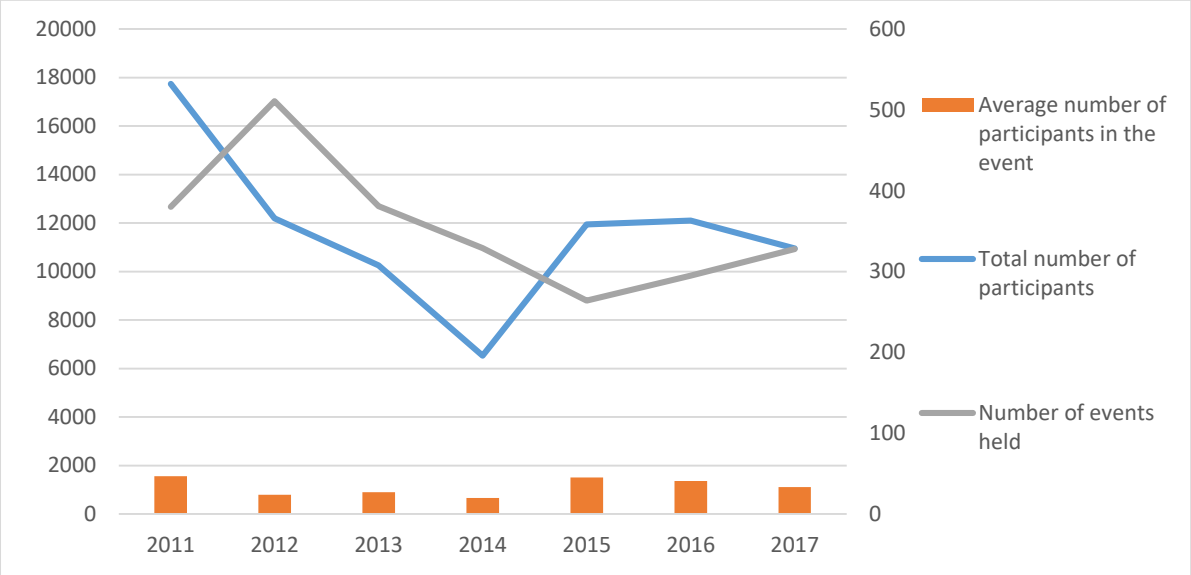
Figure 60. Number and type of events organized by NAAS



Source: Annual Reports, NAAS

In the period after 2010, the number of events conducted by the NAAS, the total number of participants in them, and the average number of participants per event varied from year to year and tend to decrease. (Figure 61). For example, in 2017, nearly 11,000 were participants in 328 events, with an average of just over 33 people per event. The reduced number of participants in a single event enables the improvement of communication and exchange of knowledge and experience between experts and farmers and between the participants themselves, a greater adaptation to the specific needs of the participants, and increased efficiency.

Figure 61. Number of events organized by NAAS and participants



Source: Annual Reports, NAAS

Since 2015, the NAAS has introduced a new form of dissemination of information to farmers through the so-called. "Farmer circles". The purpose of the 27 farming circles set up in each region is to increase the efficiency and reach more farmers through consultations, advice, dissemination, and sharing of useful information, promotion of good practices for applying and implementing RDP projects, etc. The total number of farmers participating in these circles is around 315 and varies widely in the different regions - from 6 (Blagoevgrad) to 23 (Varna). The NAAS produces and disseminates hundreds of information materials (educational leaflets, farmer calendars, brochures, etc.), the number of which is steadily decreasing (from 731 in 2009 to 143 in 2017). At the same time, the use of effective modern forms of communication such as the Internet and the media is increasing. NAAS website, which contains diverse up-to-date information about the activity, a library with useful tips in various fields, etc. Demonstrates a steady increase in visits (including from abroad). NAAS experts also make numerous media appearances, reaching numerous audiences by publishing articles, giving interviews in the national and local press, appearing in national, regional, and local radio and television broadcasts, Internet publications, etc.

The NAAS experts are also constantly participating in forums organized by other organizations in the knowledge and innovation sharing system at home and abroad. It is also

active in the preparation and participation in projects with neighboring and other European countries to improve capacity, coordination, and cooperation of activities, exchange of knowledge, experience and innovations, etc. An informal Advisory Council is also put in place to improve the service activity to farmers at each territorial office of the NAAS. This form allows for effective discussions with farmers, professional organizations, scientific institutes, and representatives of the local state structures on how to improve the activities of the respective office. All of this contributes to increasing the efficiency of the NAAS in transferring, disseminating, and sharing knowledge and innovations.

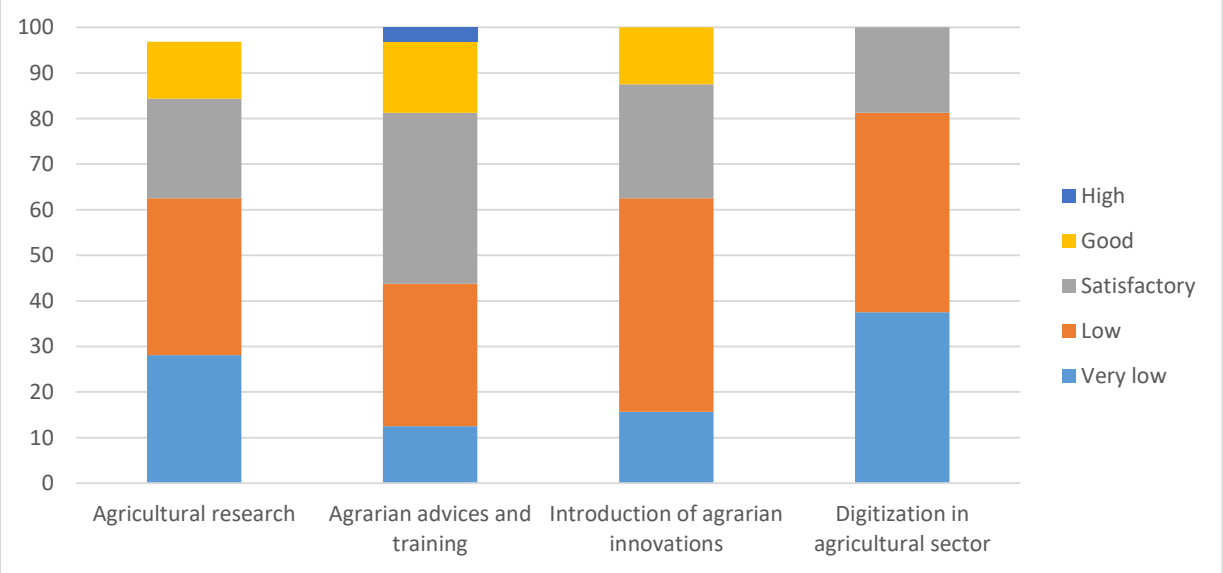
Agricultural and other universities, AA institutes and stations, producer organizations, various non-governmental organizations, etc. also provide training and provide a wide range of advice to farmers. In addition, a similar or complementary (as part of a marketing and production strategy) activity are also involved numerous organizations and individuals from the private sector - suppliers of seeds, chemicals, machinery and technologies, agricultural processors, specialized firms for training, consultations, and innovations, and the farmers themselves. In this way, farmers receive such services for free, in a "package" with the main commercial activity of suppliers and/or buyers, or share and/or trade with each other. However, in the country, there is no systematic reporting, statistical or other information on the rapidly developing and extensive university and private sector of training and consulting.

6. Epert Assessment on Governance of AKIS in Bulgaria

Level and Efficiency of Public Expenditures

The first group of questions to the experts concerns the level and efficiency of public expenditures and investments in the main components of the AKIS in the country. Most experts believe that the level of public spending and investments for digitalization in the agricultural sector (81.2%), for agricultural research, for the introduction of agrarian innovations (62.5% each), and for agricultural advice and training (43.7 %) is low or very low (Figure 62). Particularly large is the consensus among experts regarding the low level of public investment in digitalization in the agricultural sector, which is far behind the current needs of society and the industry. A relatively small number of experts consider the costs of the diverse components of the AKIS to be satisfactory, with a larger share of public expenditure and contributions to agrarian advice and training. However, none of the experts consider the level of expenditure and investment is high in agrarian research, the introduction of agrarian innovation, and digitalization in the agrarian sphere, and only a small fraction considers them to be high in agrarian advice and training. Therefore, public expenditure and investment for the development of all these important areas of the AKIS are to be significantly increased so that the main objectives of the CAP can be achieved in the next programming period.

Figure 62. Level of public expenditure and investment for agricultural research, agricultural advice and training, introduction of agricultural innovations, and digitalization in the agrarian sector (%)

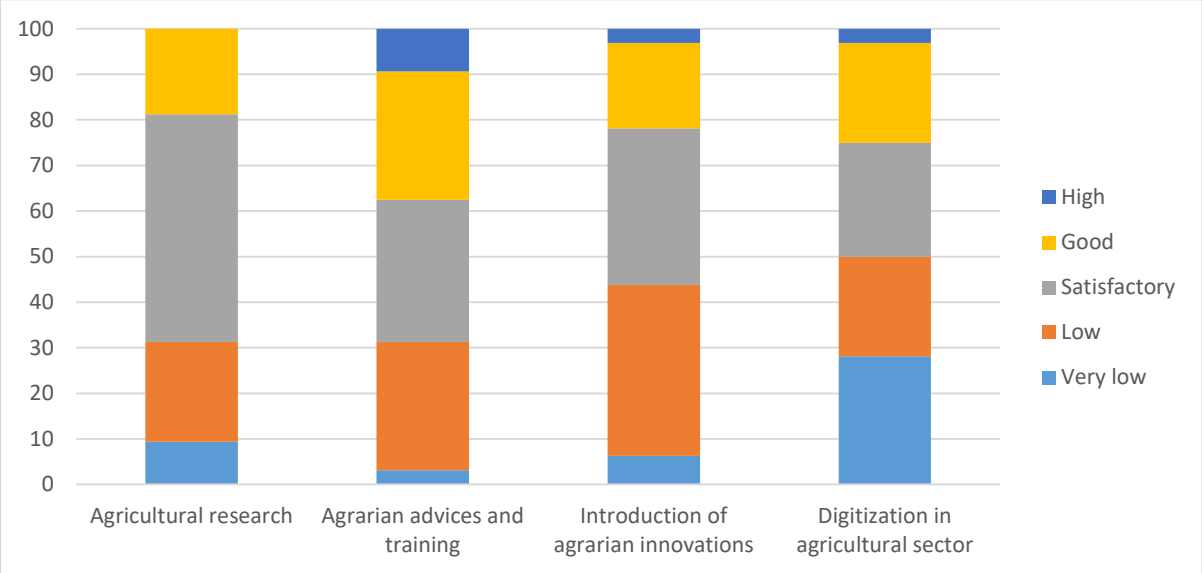


Source: Experts assessment

Every other expert estimates the efficiency of public expenditures and investments for agricultural research in the country as satisfactory, and nearly 19% of them as good (Figure 63). However, 31% of experts say that this level is low or very low. The latter shows that with a relatively low public investment in agricultural research, not bad results are achieved.

However, the efforts to increase the efficiency of the significant resources put in this important area are to continue. As far as the efficiency of public resources for agrarian advice and training is concerned, the majority of experts believe that it is good or high (37.5%). This proves that the comparatively higher level of public support in this area also gives comparatively higher efficiency. At the same time, however, for a small number of experts, the efficiency of public spending and investment in agrarian advice and training is satisfactory (31.2%) or low (28.1%). Therefore, work is to be continued to raise the efficiency of public investment in this important area.

Figure 63. Efficiency of public expenditures and investments for agrarian research, agrarian advice and training, introduction of agrarian innovations, and digitalization in the agricultural sphere (%)



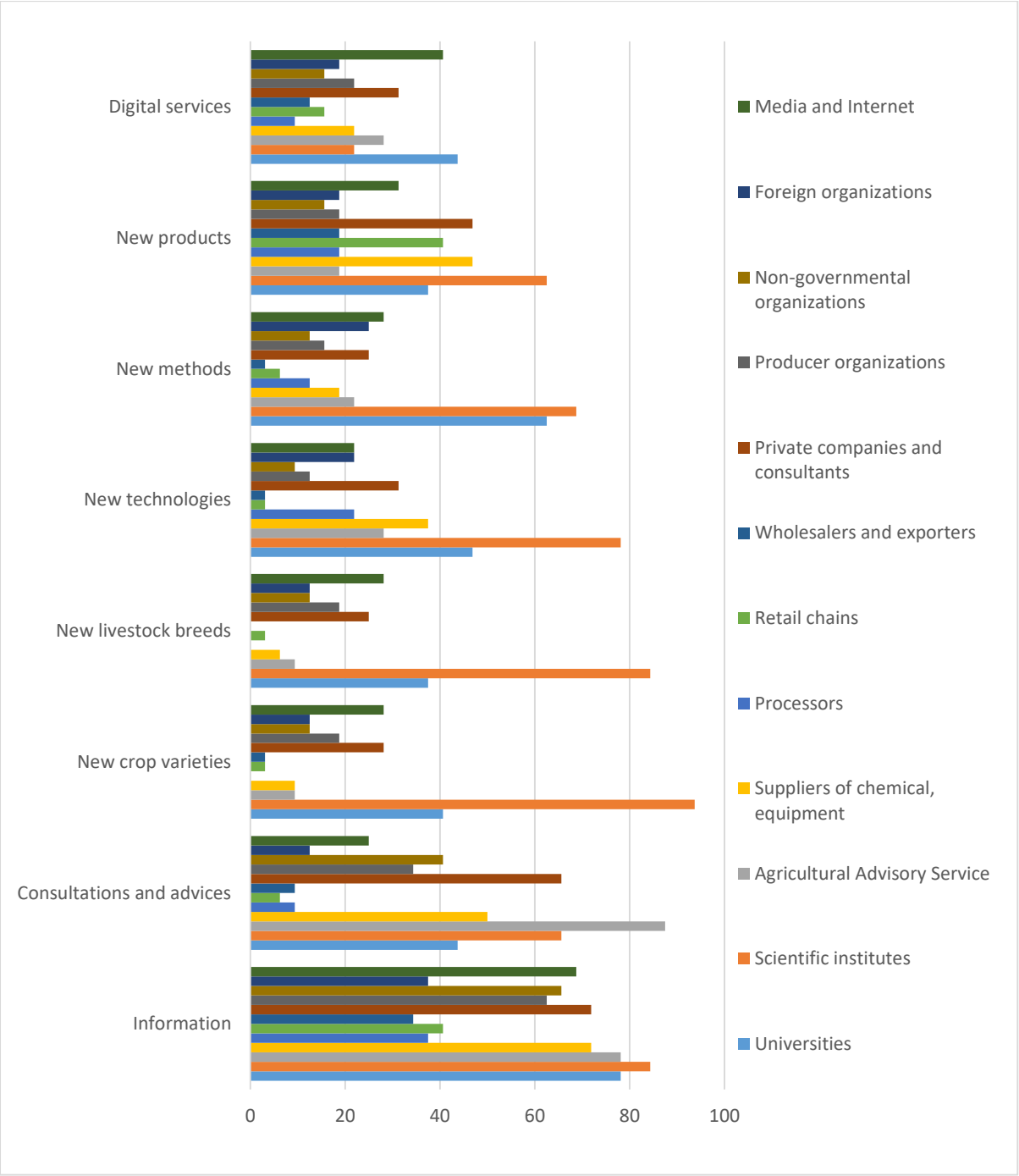
Source: Experts assessment

According to the majority of the experts (43.7%), the efficiency of public investments for the introduction of agrarian innovations is low or very high. However, a significant proportion of them rates the efficiency of this type of public support as satisfactory (34.4%). Moreover, for almost 22% of the experts, public spending and investments for the implementation of agrarian innovations are of good or high efficiency. The latter indicates that limited investment in this area is of high efficiency and is to be increased, as there is a great potential for improving efficiency through additional investment. Half of the experts evaluate the efficiency of public spending and investments for digitalization in the agricultural sector as low or very low. However, one in four panelists believes that the payback in this area is satisfactory, and for the remaining quarter, it is good or high. The latter proves that, despite the extremely low amount of public investment in this area, their social efficiency is relatively high. Therefore, investments in this area are to be expanded to realize the existing high potential for improving efficiency.

Importance of Individual Participants in AKIS

The next question for the experts is related to the identification of the most important organizations, which provide the farmers in the country with the necessary information, consultations, diverse innovations, and digital services. Experts are largely unanimous that the most important "providers" of new information to farmers are research institutes (84.4%), universities and NAAS (78.1% each), private companies and consultants (71.9%), the media, and Internet (68.8%), non-governmental organizations (65.6%) and producer organizations (62.5%) (Figure 64). A considerable number of experts also believe that important suppliers of new information to farmers are retail chains (40.6%), processors (37.5%), foreign organizations (37.5%), and wholesalers and exporters (34.4%).

Figure 64. The most important organizations providing agricultural farms with information, advice, innovations and digital services (%)



Source: Experts assessment

The experts are also almost unanimous that the NAAS is the most significant provider of consultations and advice for Bulgarian farms (87.5%) (Figure 64). Other important organizations for providing consultations and advice to producers in the sector are research institutes and private companies and consultants (65.63% each). Every second expert also believes that suppliers of chemicals, equipment, etc. are among the most active in providing the necessary consultations and advice to their actual and potential clients. For a good number

of experts, the universities (43.8%), non-governmental organizations (40.6%), producer organizations (34.4%), media, and Internet (25%) are among the most important organizations providing agricultural consultations and advice in the country. The importance of other types of organizations is less in providing farmers with consultations and advice.

Concerning new plant varieties, the vast majority of experts (93.8%) identify research institutes as the most important organizations providing this type of innovation to agricultural farms (Figure 64). Many experts also identify universities (40.6%) as major suppliers of new plant varieties to farmers. A relatively large proportion of all experts (28.1%) also consider that private companies and consultants, and the media and internet are important in providing information on/or supplying new varieties of plants. Concerning new breeds of animals, the situation is similar to that of new plant varieties, with experts ranked as the most important research institutes, followed by universities, the media and Internet, and private companies and consultants (Figure 64). A considerable number of experts (18.8%) also consider that producer organizations are among the most significant suppliers of new breeds of animals to farmers.

Regarding the provision of new technologies to the farms, research institutes are again ranked by the majority of experts (78.1%), followed by universities (46.9%), suppliers of chemicals, machinery, etc. (37.5%), private companies and consultants (31.2%), and NAAS (28.1%) (Figure 64). A considerable proportion of experts (21.9%) also place foreign organizations, the media, and the internet among the most important in providing information, assistance, or direct supply of new technologies. According to the majority of experts, the most important organizations providing new methods of production and management for farmers are research institutes (68.8%) and universities (62.5%) (Figure 64). A relatively large proportion of experts also place the media and Internet (28.1%), private companies and consultants, foreign organizations (every fourth), and the NAAS (22.9%) among the most significant organizations in providing information on /for new methods of production and management in the sector.

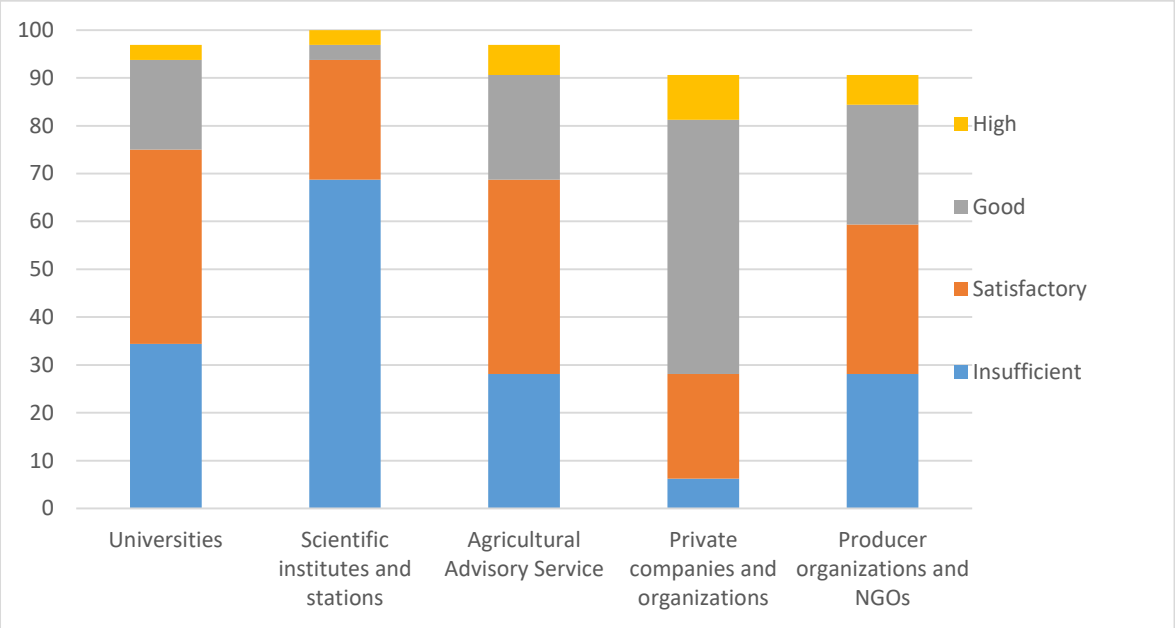
The most important for the presentation to the farmers of new products are scientific institutes (62.5%), private companies and consultants (46.9%), suppliers of chemicals, equipment, etc. (46.9%), retail chains (46.9%), and universities (37.5%), (Figure 64). A significant number of experts also put media and Internet (31.3%), NAAS, processors of farm produce, wholesalers and exporters, producer organizations, and foreign organizations (18.8% each) as important in product innovations. With regards to digital services and innovations, the universities (43.8%), and media and Internet (40.6%) are pointed by the majority of experts as most important to farmers' organizations (Figure 64). For a good number of experts, among the most significant providers of digital information and services, are also private companies and consultants (31.2%), NAAS (28.1%), scientific institutes, suppliers of chemicals, equipment, etc., and producers organizations (21.9% each).

Financial, Personnel and Material Endowment of AKIS

The next group of questions to experts relates to the endowment with financial resources, personnel, and advanced equipment for agricultural research and consultations in the major organizations in the AKIS, as well as their potential for modern research and consultations. The highest financial endowment of agricultural research and consulting is in private

companies and organizations, where, according to nearly 63% of experts, it is good or high (Figure 65). At the same time, the financial endowment of agrarian research and consultancy at scientific institutes and stations is estimated by almost 69% of experts as unsatisfactory. The latter shows that the profit-oriented private sector invests more in financial resources in these important activities compared to the public scientific institutes that dominate in the sector. Therefore, the financial support to public research institutes is to be increased to reduce the existing imbalance with the private sector. The majority of experts believe that the endowment of research and consultations with financial resources in the universities and NAAS is satisfactory (40.6%). Moreover, a considerable number of experts evaluate that these activities of the NAAS and the universities are with good or high financial endowment - 28.1% and almost 22% respectively. The financial support for agrarian research and consultations of the non-profit-making producer organizations and non-governmental organizations was rated as satisfactory (31.2%) or unsatisfactory (28.1%) by most experts.

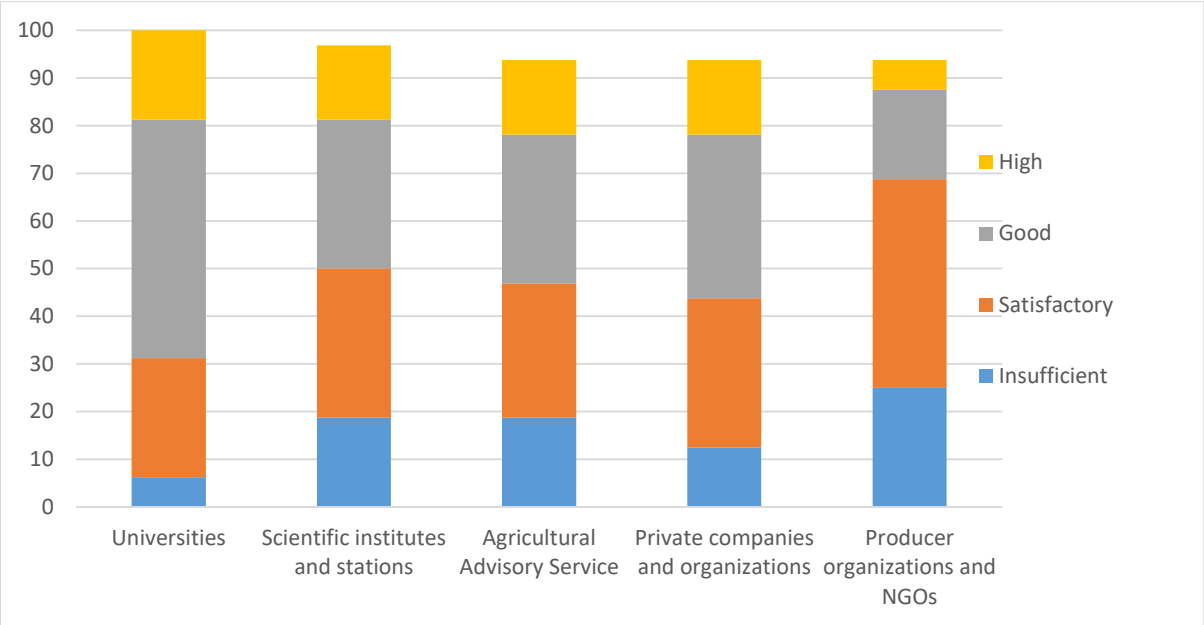
Figure 65. Financial endowment of agrarian research and consultations in the main organizations of the AKIS (%)



Source: Experts assessment

Universities are with the best staff endowment for agrarian research and consultancy, where, according to nearly 69% of experts, it is good or high (Figure 66). Every second expert also believes that staffing for research and consultations of NAAS, and private companies and organizations are good or high. At the same time, the majority of experts estimate that the staffing of agricultural research and consultancy in scientific institutes and stations is satisfactory or good (31.2% each), and that of producer organizations and non-governmental organizations as satisfactory (43.8%). This calls for urgent measures to improve the incentives to attract new staff and to improve the skills of existing staff in the state and non-governmental agrarian research and consultancy sectors.

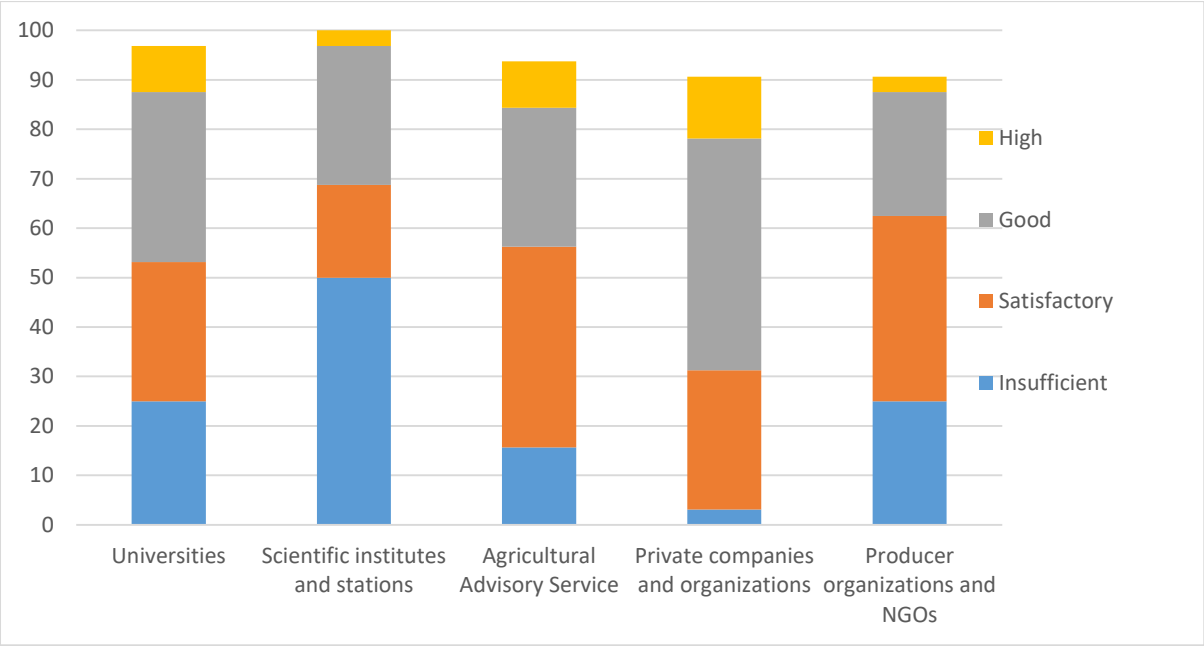
Figure 66. Staff endowment of agrarian research and consultations in major organizations of AKIS (%)



Source: Experts assessment

There is also considerable differentiation in the availability of advanced agricultural research and consulting equipment in different types of organizations (Figure 76). While in private companies and organizations it is good or high (59.4%), in scientific institutes and stations every second expert rates it as unsatisfactory, and only 31% as good or high. This proves the need to significantly modernize the equipment of the public scientific institutes that dominate the sector. The majority of experts believe that the availability of modern equipment in NAAS is satisfactory (40.6%), and not many rates it as good or high (37.5%). The material endowment of this type of activities of the producer organizations and non-governmental organizations was evaluated by the majority as satisfactory (37.5%). At the same time, however, every fourth expert thinks that it is either unsatisfactory or good. The latter indicates the different material capacities of the individual non-profit-making organization, and the need to take public action to support those lagging behind.

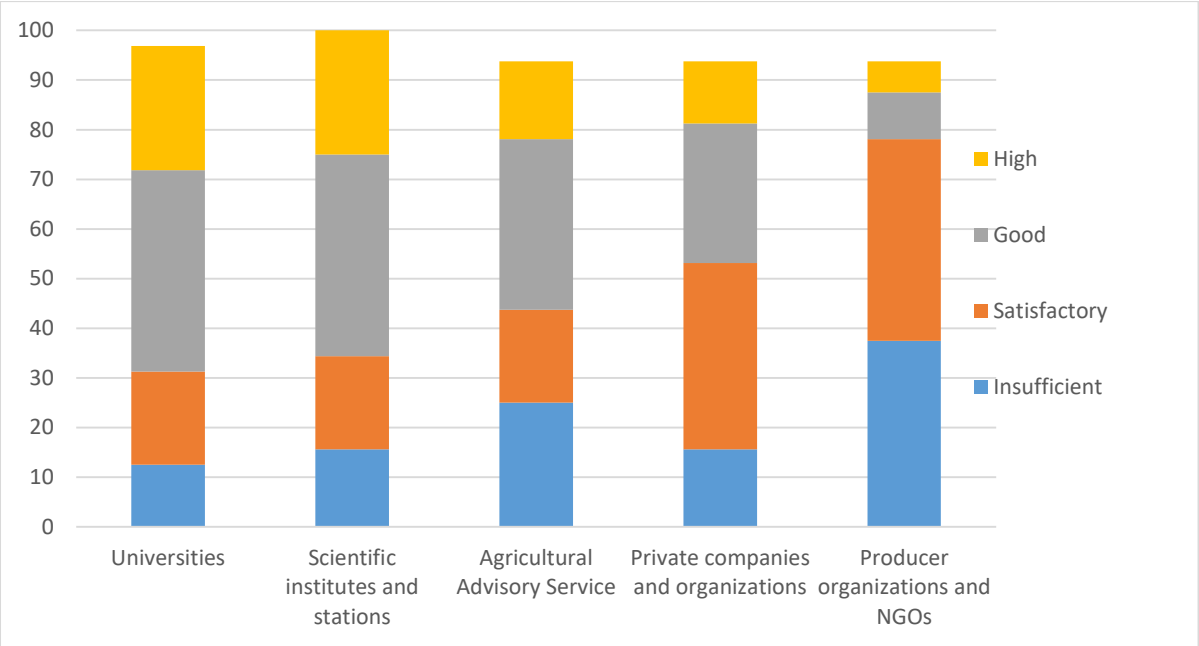
Figure 67. Endowment with modern equipment of agrarian research and consultations in major organizations of AKIS (%)



Source: Experts assessment

Despite the inadequate and quite diverse endowment with financial, human, and material resources, the public agricultural research, and consultation system demonstrates high potential for modern agricultural research and consultations. According to the majority of experts, the potential of universities, research institutes, and stations, as well as the NAAS for modern agrarian research and consultations is good or high - 65.6%, 65.6%, and 50% respectively (Figure 68). This indicates that public organizations in agricultural research and consultations will continue to dominate in the future and have to receive increasing public support. On the other hand, the potential for modern agrarian research and consultations in the private sector has been identified as satisfactory - by 37.5% of experts for private companies and organizations, and by 40.6% for producer organizations and non-governmental organizations. Along with this, however, nearly 41% of the experts believe that the potential of profit-oriented private companies and organizations for modern agricultural research and consulting is good or great. This shows that with effective public support and regulation, the role of the private sector in agricultural research and consultations will be expanded in the future and has to be a priority.

Figure 68. Potential for modern agrarian research and consultations in major organizations of AKIS (%)

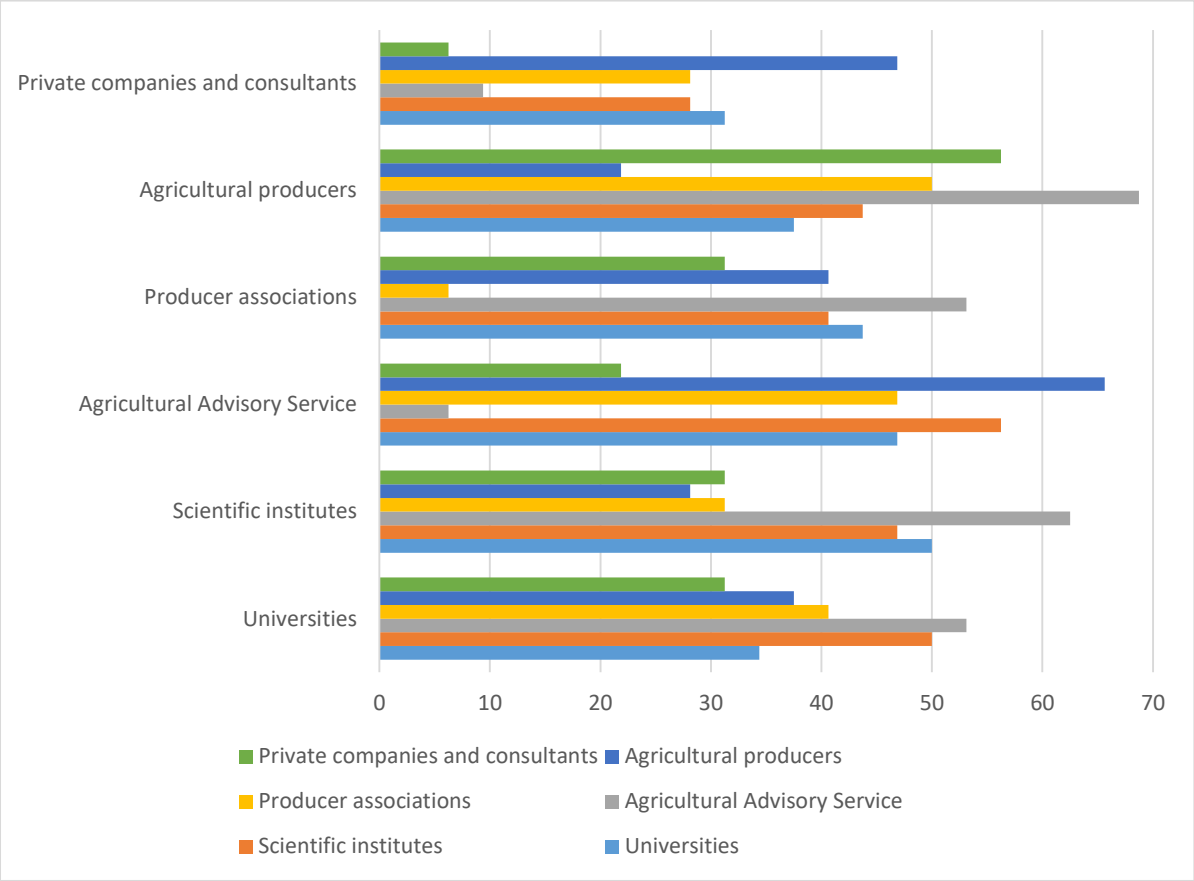


Source: Experts assessment

Efficiency of Links between Agents in AKIS

The next question to the experts is about the efficiency of the links (relations) between the main actors in the AKIS at the current stage. The majority of experts regard the links between the universities and scientific institutes, scientific institutes and NAAS, NAAS and farmers, NAAS and producer associations, producer associations and agricultural producers, private companies and consultants, and farmers as highly effective (Figure 69). At the same time, some important links for the development of the AKIS are not identified as effective by experts - between individual universities, universities with farmers and private companies and consultants, scientific institutes with farmers and private companies and consultants, NAAS with private companies and consultants, producers' associations among themselves and with private firms and consultants, between private firms and consultants, and between farmers themselves. Also, only 46.9% of the experts are convinced that the links between the scientific institutes themselves are highly effective, which is not a good indicator of the degree of integration and coordination of the activities of the various scientific institutes in the country. To improve all these critical links for the development of the AKIS, effective measures are to be taken immediately from the leadership of the public sector organizations, as well as adequate incentives for participants and public support introduced through state funding, tax relief, logistics, assistance, regulations, networking, etc.

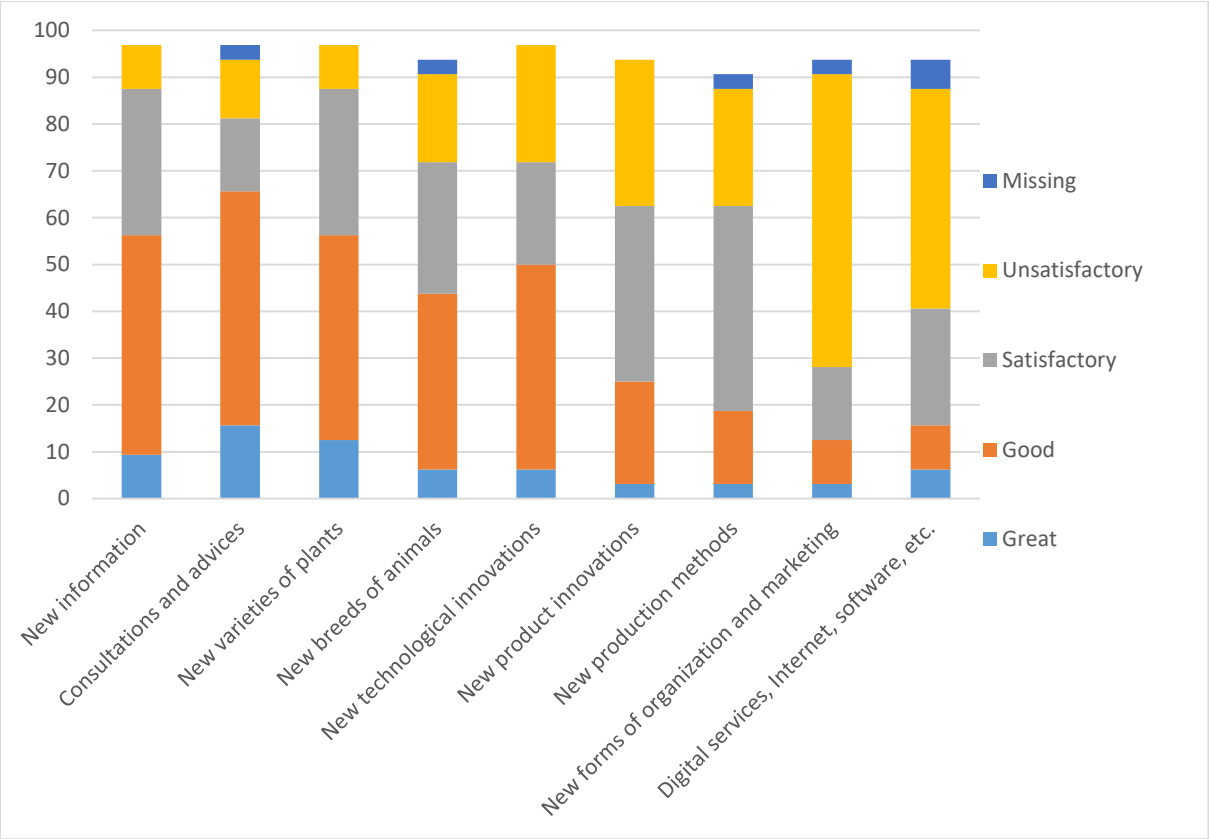
Figure 69. Efficiency of links between organizations in AKIS (%)



Source: Experts assessment

The next group of experts' assessments relates to the extent to which farmers have access to information, advice, innovations of different types and digital services, and the extent to which different types are innovations are introduced in farms. According to a large part of the panel of experts, farmers in the country have good or great access to new information (56.3%), consultations and advice (65.6%), new plant varieties (56.3%), new breeds of animals (43.8%) and new technological innovations (50%) (Figure 70). Therefore, in these areas, the existing AKIS works relatively well and serves farmers effectively. At the same time, however, the majority of experts assess that producers' access to new product innovations and new production methods is satisfactory (37.5% and 43.8% respectively) or unsatisfactory (31.3% and 25%). The most unfavorable situation is the access of farmers to new forms of organization and marketing, which is estimated by a significant number of experts as unsatisfactory (62.5%). Therefore, public measures are to be taken to support and encourage the participants in the AKIS to improve the supply and market development of diverse types of innovation in the country. The situation with the farmers' real access to digital services, the internet, software, etc. is also unfavorable. Just over 53% of the experts consider this access to be inadequate or nonexistent, with one in four assessing it as satisfactory. Cardinal public support measures (investments, training, incentives, partnerships with the private sector, etc.) are to be also undertaken in this important area to overcome the lag in the digitalization of the agricultural production and rural areas of the country.

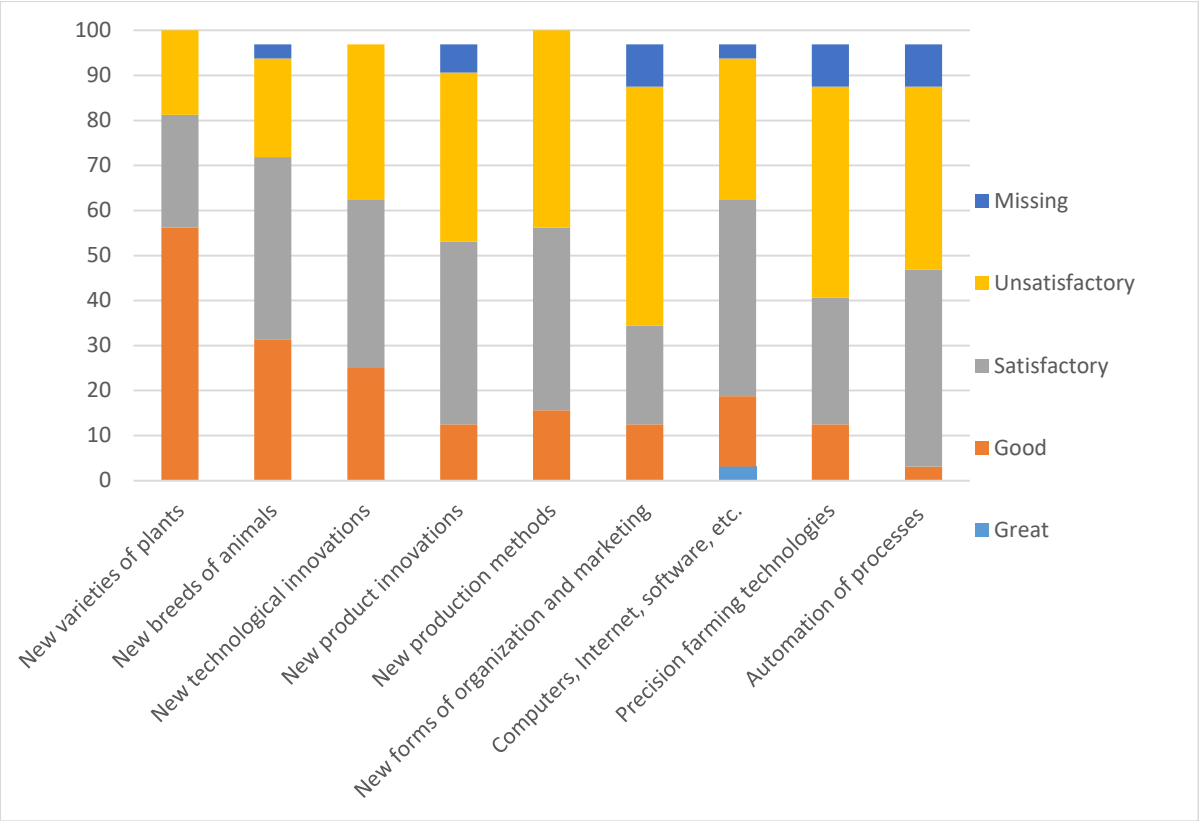
Figure 70. Extent of access of agricultural producers to information, consultations, innovations, and digital services (%)



Source: Experts assessment

There is also a great variation in the degree of the introduction of different types of innovations in Bulgarian agriculture (Figure 71). New varieties of plants are considered to be with the highest extent of introduction, where a considerable part of the experts think that it is good (56.3%). The majority of experts evaluated as satisfactory the degree of the introduction of new breeds of animals (40.6%), new technological innovations (37.5%), new product innovations (40.6%), new production methods (40.6%), computers, Internet, software, etc. (43.8%), and automation of processes (43.8%). At the same time, a considerable part of the expert panel believes that the degree of the introduction of whole classes of innovations such as new methods of production (43.8%), new forms of organization and marketing (53.1%), technologies of precision agriculture (46.9%) and process automation (40.6%) is unsatisfactory. For some types of innovation, many experts even think that such implementation is lacking - as is the case with new forms of organization and marketing, precision farming technologies, and process automation. Therefore, adequate public support, incentive, partnership, etc. measures are to be undertaken to exploit the great unrealized potential for organizational, technological, and product renewal of the industry.

Figure 71. Extent of introduction of diverse type of innovations by agricultural producers in Bulgaria (%)



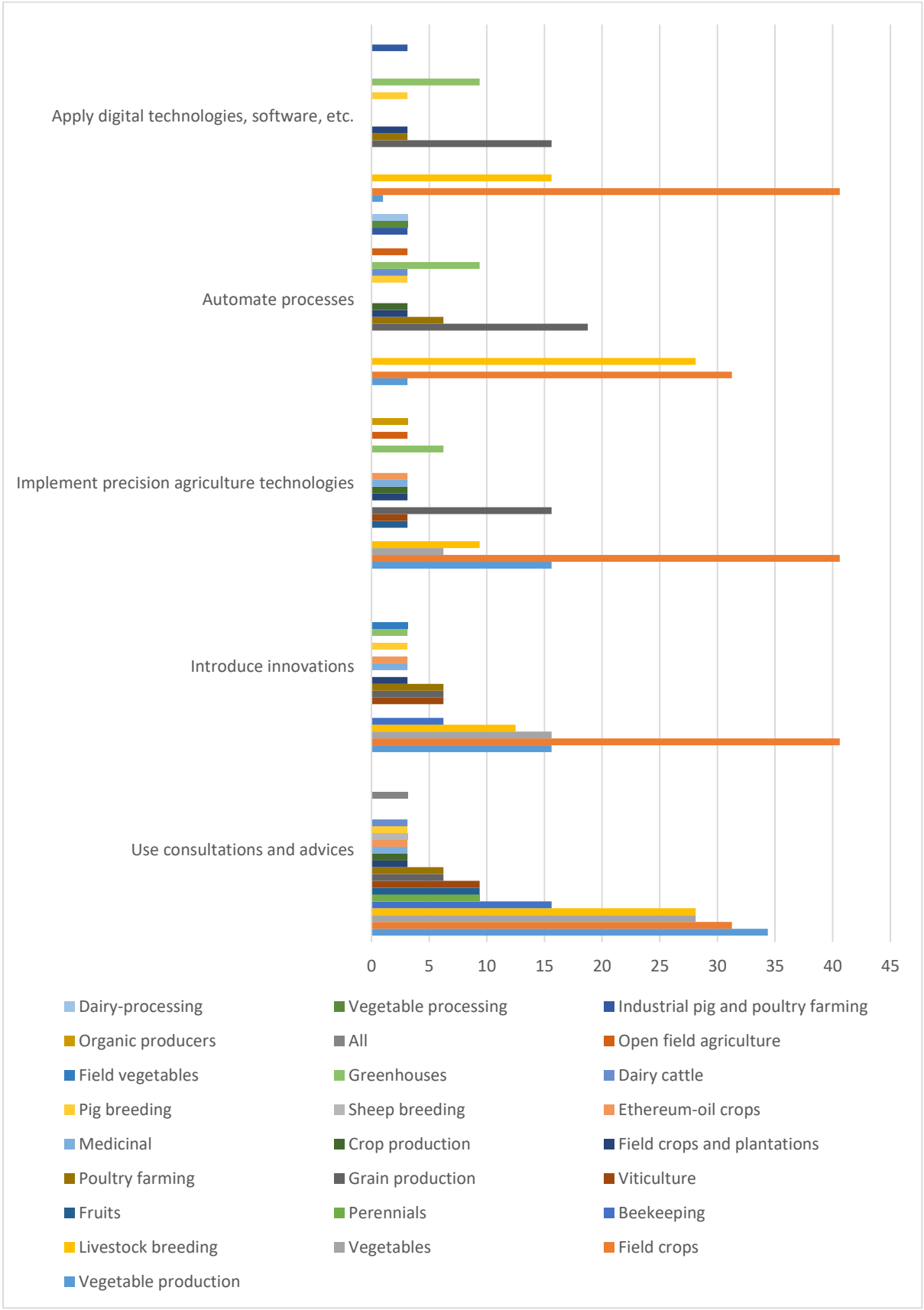
Source: Experts assessment

Extent of Utilization of Advices and Introduction of Innovations in the Sector

There is considerable differentiation in the degree of use of advice and consultations, and in the introduction of innovations of different kinds in individual sub-sectors of agriculture, in farms of different legal types and sizes, and different regions of the country. According to the experts, the widest advice and consultations are used in vegetable production (34.4%), field crops (31.3%), fruit growing (28.1%), and animal husbandry (28.1%) (Figure 72). At the same time, only a small number of experts believe that the other sub-sectors of agriculture benefit greatly from the advice and consultations provided by various public and private organizations. With regards to the introduction of innovations, the majority of experts believe that it is done in the field crops sector (40.7%), and a relatively smaller proportion in vegetable and fruit growing (15.7% each) (Figure 72). According to the experts, innovations in the rest of the agricultural sub-sectors are not very much introduced. The latter requires specific public measures and incentives to accelerate the introduction of innovations in lagging productions so that the great potential for raising the technological level of agriculture can be realized. A relatively large proportion of the experts believe that precision farming technologies are most widely applied in field crops (40.7%) and a smaller proportion of them in vegetable and grain production (15.7% each) (Figure 72). At the same time, most experts do not consider that precision agriculture technology is implemented to a large extent in other sub-sectors and

productions. A relatively large number of the experts estimate that the greatest extent the processes are automated processes in the field crops (31.3%), animal husbandry (28.1%), and grain production (18.8%) (Figure 72). Other sub-sectors and productions do not automate the processes to a great extent at this stage of development. Thus special measures of public support and stimulation of all participants in AKIS are to be taken to extend the use of technologies of precision farming and automation of processes in all types of productions. In this way, the great existing potential in this respect for raising the quality of production and labor, productivity and labor productivity, etc., could be realized. Concerning the degree of application of digital technologies, software, etc. the biggest number of experts suggest that it is done in field crops (40.6%) and a smaller proportion of them in cereals and livestock (15.6% each) (Figure 72). Other subsectors are lagging far behind in terms of implementation of digital technologies, software, etc. The latter requires the implementation of specific measures to expand digitalization of the production and management in lagging sub-sectors.

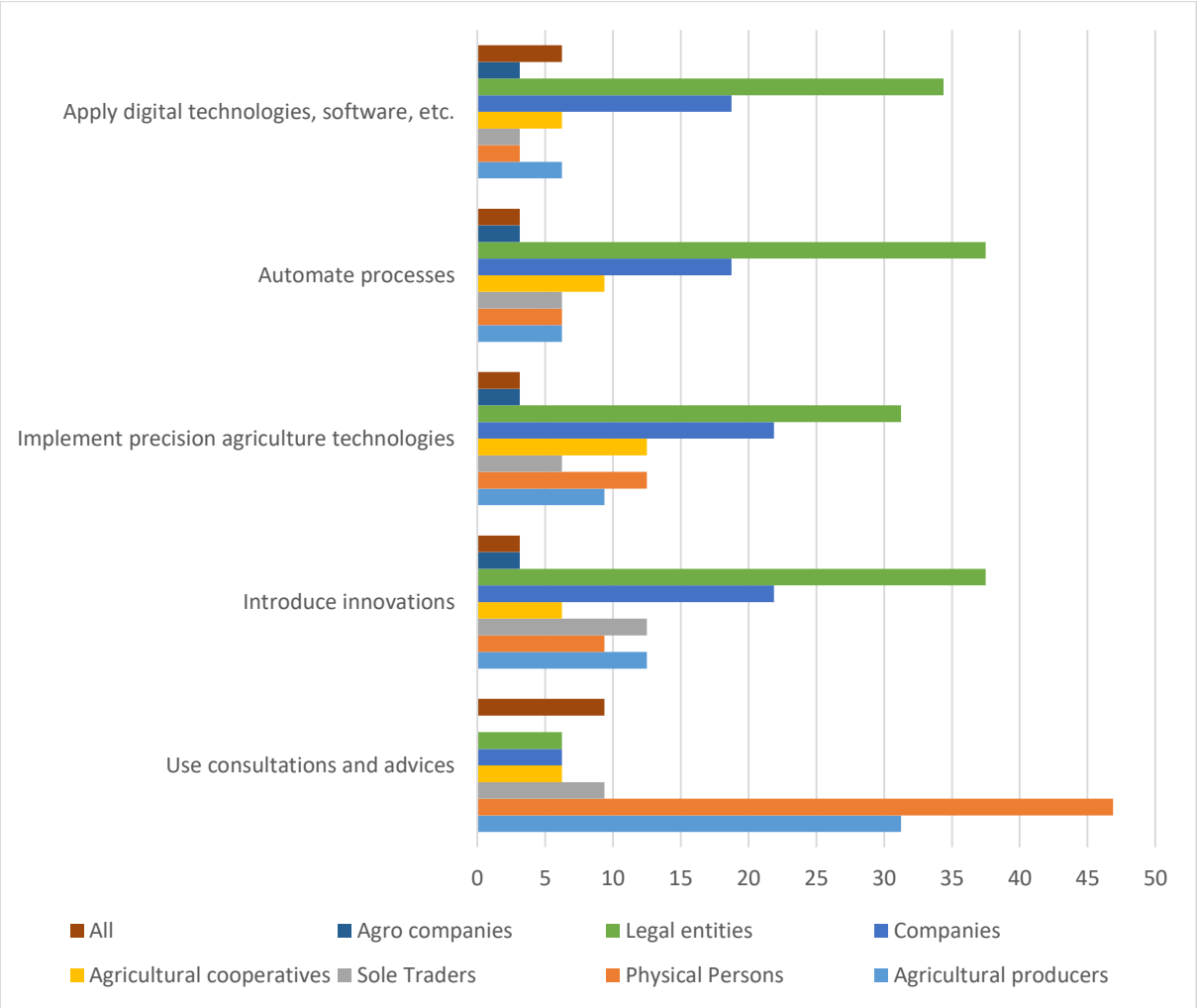
Figure 72. Extent of utilization of advices and consultations, and introduction of innovations of various type in individual subsectors of Bulgarian agriculture (%)



Source: Experts assessment

There is also a great variation in the extent to which advice, consultations, and innovations are introduced on farms of different types. According to the majority of experts, Physical Persons (48.9%) use to the greatest extent advice and consultations (Figure 73). Just over 31% of the experts also indicated that advice and consultations were widely used by agricultural producers. According to the majority of the experts' panel, other juridical types of farms make little use of the advice and consultations provided by various public and private organizations. Most experts identified as the largest adopters of innovations the legal entities of different types (37.5%), followed by the companies of different types - OOD, AD, EOOD (21.9%) (Figure 73). For other legal types of farms, only a small number of experts identify them as major innovators. Therefore, effective measures for public support introduction of innovations by other types of farmers are to be taken to elevate the overall technological level and increase the efficiency of the sector. Concerning the application of precision agriculture technologies, process automation, and the implementation of digital technologies, software, etc. most experts also believe that this is done predominantly by the legal entities (31.3%) and companies (21.9%), while other categories of holdings are not active in these important areas (Figure 73). The latter requires the introduction of specific public measures to stimulate and support innovations in these new areas by all types of farms.

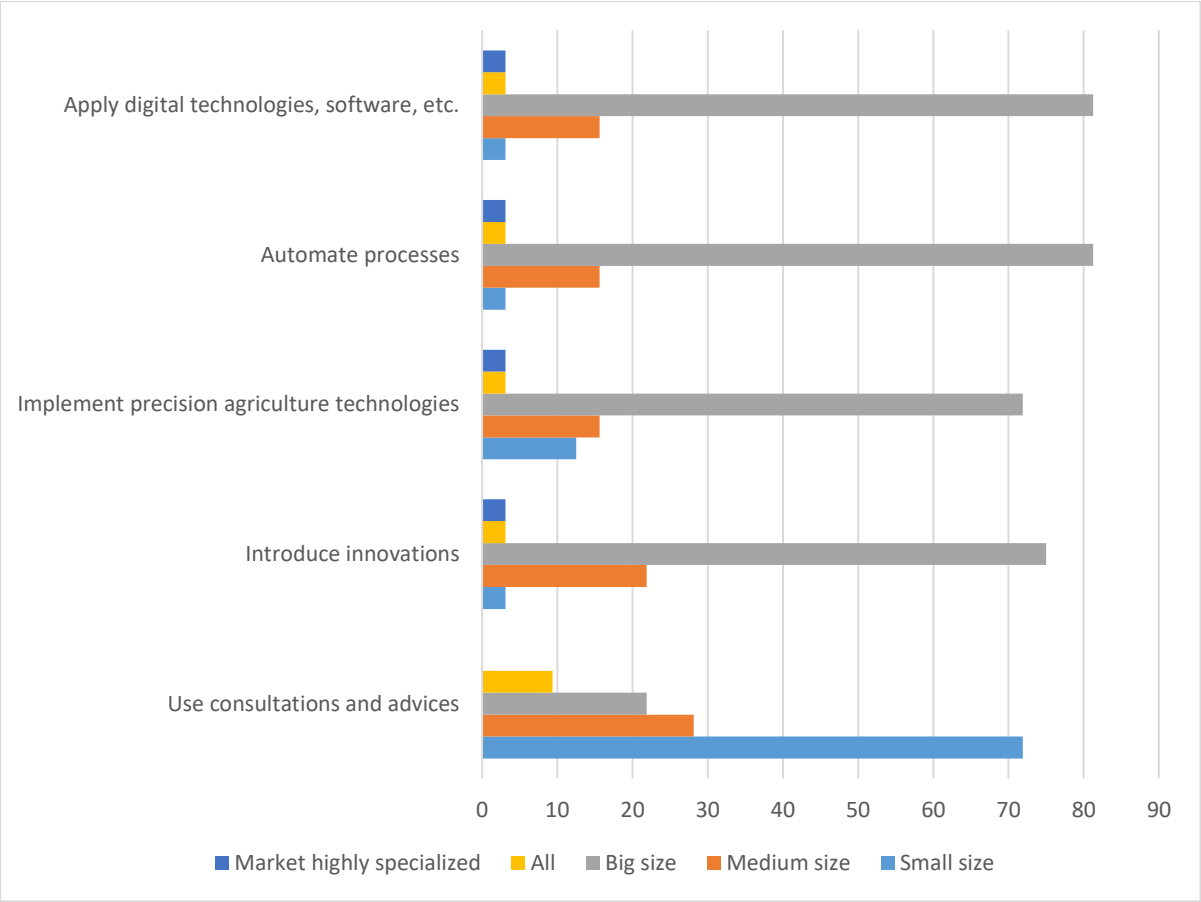
Figure 73. Extent of usage of advices, consultations, and introduction of various kind of innovations in agricultural farms od different juridical type (%)



Source: Experts assessment

There is also a great differentiation in the extent of utilization of advice and consultations, and the introduction of innovations in farms of different sizes. A significant number of experts consider that small farms use the most advice and consultations (71.9%), while other categories of producers use less "external" advice and consultations (Figure 74). On the other hand, the vast majority of the experts believe that large holdings mostly innovate, apply precision farming technologies, automate processes and apply digital technologies, software, etc. - 75%, 71,9%, 81,35, and 81,3% respectively. A relatively smaller number of the panel of experts believe that innovations generally and in the above-mentioned new areas are introduced by the medium-sized holdings. Therefore, public support and incentive measures are to be undertaken to extend the introduction of innovations in farms of all legal types and sizes to reduce the wide disparities in this regard.

Figure 74. Extent of utilization of advices and consultations and in the introduction of innovations of various type in agricultural farms of different sizes (%)

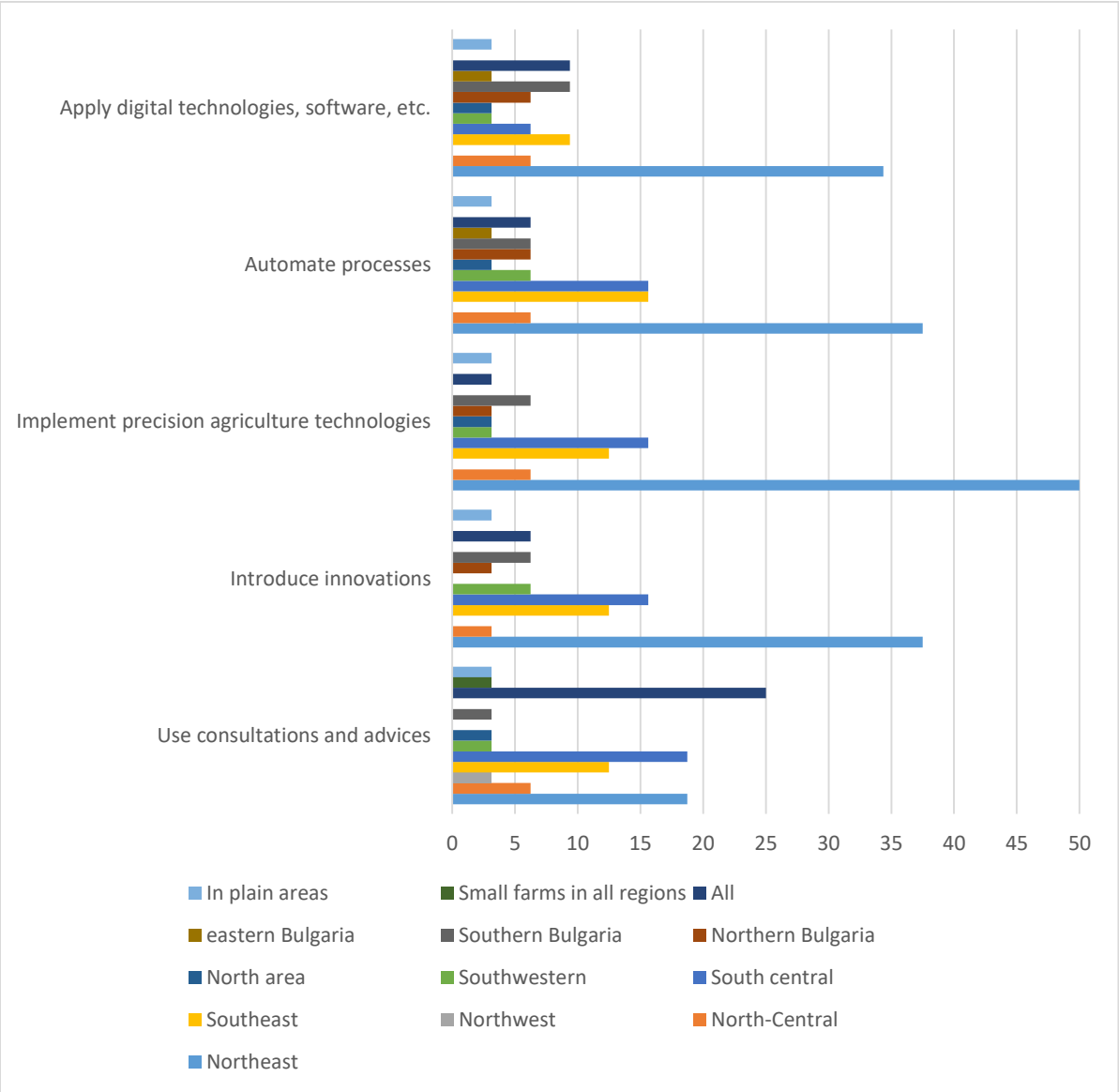


Source: Experts assessment

Finally, there are differences in the degree of use of advice and consultations, and the introduction of different types of innovation in different geographical regions of the country. According to one in four experts, advice and consultations are used evenly throughout the country (Figure 75). A considerable number of experts also point to the North-East and South-Central regions of the country (18.8% each) as the largest users of advice and consultations. According to the majority of experts, the largest adopter of innovations is the Northeast Region (37.5%), which is also a leader in the application of precision agriculture technologies (50%), process automation (37.5%), and the implementation of digital technologies, software, etc. (34.4%). A relatively smaller proportion of the experts also identify the South Central and Southeastern regions as intensive innovators (15.6% and 12.5% respectively), the application of precision agriculture technologies (15.6% and 12.5%), and process automation (15.6 each). According to the large majority of the experts, the degree of the introduction of innovations in general and in the application of modern technologies for precision agriculture, process automation, digitalization, etc. in other parts of the country is small. That requires the introduction of specific measures for public support and partnership, for intensifying the introduction of innovations in general and in the newest directions such as modern technologies of precision agriculture, automation of processes, and digitalization in other parts of the

country. In this way, it will be possible to overcome the great imbalance in the development of the individual regions of the country.

Figure 75. Extent of utilization of advices and consultations and in introduction of innovations of various type in different regions of the country (%)



Source: Experts assessment

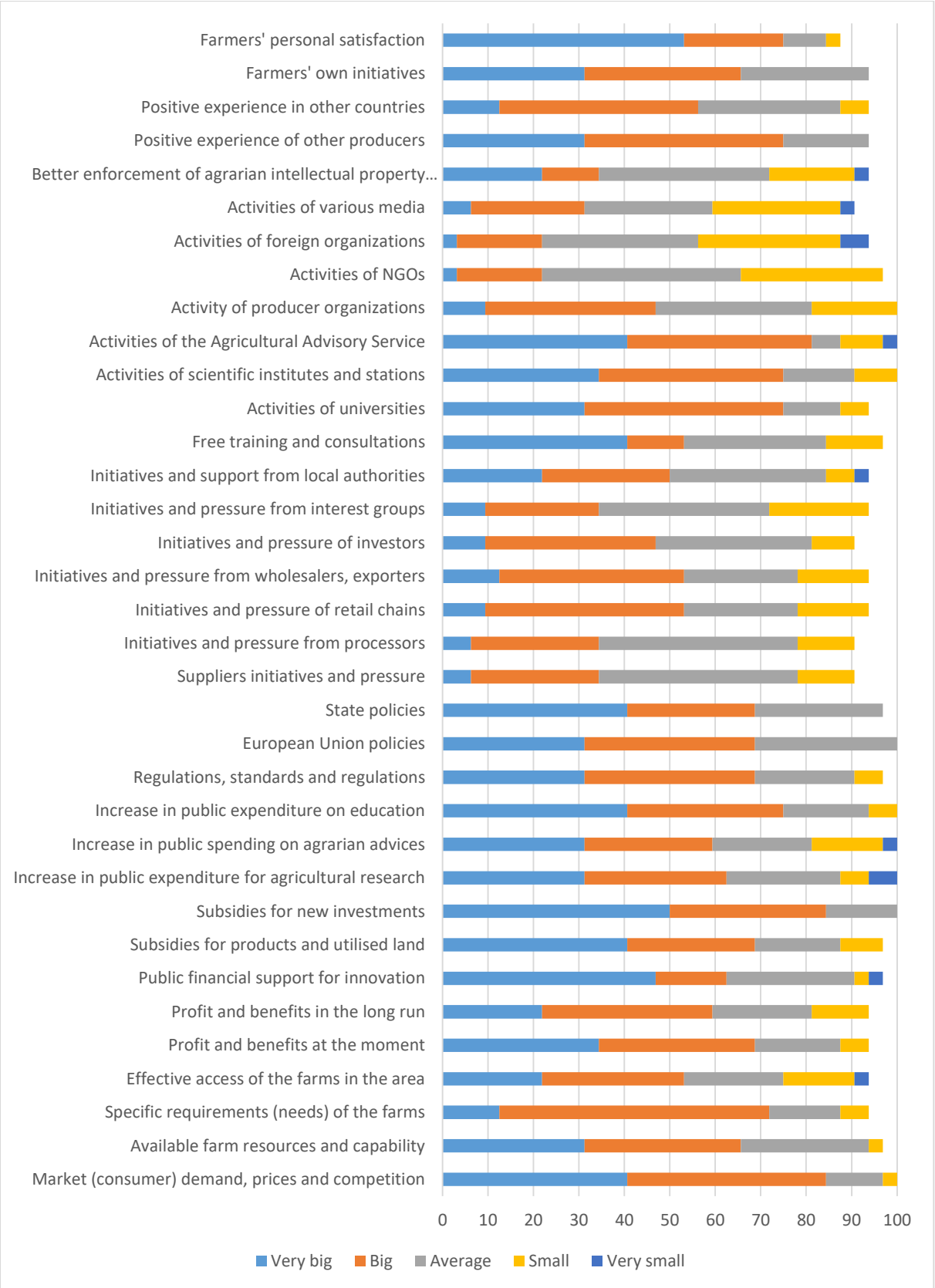
Factors and Prospects for Improving Dissemination of Knowledge and Innovations

The next question for experts is the importance of the various factors for improving the dissemination of knowledge, innovation, and digitalization in agriculture and rural areas in Bulgaria. Experts are very unanimous that the most important factors (of great or very great importance) for improving the dissemination of knowledge, innovation, and digitalization in agriculture and rural areas of the country at this stage are: market (consumers) demand, prices, competition, and subsidies for new investments (84.4% each), as well as the activity of the

National Agricultural Advisory Service (81.3%) (Figure 76). Therefore, the support for market development is to be extended as well as the public support (subsidies) for consultations and training, and the private investments in the area. Three-quarters of the experts also believe that the increase in public spending on education, the activities of universities, the activities of scientific institutes and stations, the positive experience of other producers, and farmers' personal satisfaction, are important factors for improving knowledge dissemination, innovation, and digitalization in agriculture and rural areas.

A large number of experts also estimate that the specific requirements (needs) of the farms (71.9%), and the profit and the current benefits, subsidies for products and used land, regulations, standards and regulations, EU policies and policies of the state (68.8% each) are decisive for improving the diffusion of knowledge, innovations, and digitization in agriculture and rural areas. The majority of experts also give a high rank to the available resources and capability of the farms, and the farmers' own initiatives (65.6% each), as well as to the public financial support for innovations, and the growth of public expenditure on agricultural science (62.5% each), the long-term profits and benefits, and the rise in public spending on agrarian advice (59.4% each), the positive experiences in other countries (56.3%), and the effective access of farms and in the region, the initiatives and pressure of the retail chains, the initiatives and pressure on wholesale traders and exporters, and the free training and consultancy (by 53.1%) for improving the situation in this respect. All these factors for improving the existing state are to be taken into account in the process of amelioration of the public support for the development of AKIS in the next programming period.

Figure 76. Importance of various factors for amelioration of the dissemination of knowledge, innovations and digitalization in Bulgarian agriculture and rural areas (%)



Source: Experts assessment

The final question to the panel of experts is the extent to which the achievement of the horizontal objective of dissemination of knowledge, innovations, and digitalization in agriculture and rural areas in Bulgaria contributes to the achievement of the various objectives of the EU CAP. Most experts believe that the successful achievement of the horizontal objective contributes to a large or very large extent to the achievement of all specific objectives of the EU CAP (Figure 77). According to most experts, improving the dissemination of knowledge, innovations, and digitalization of agriculture and rural areas contributes to the greatest extent to the achievement of the specific objectives of sufficient agricultural incomes and sustainability (81.3%), and enhancing market orientation and increasing competitiveness (78.1%). On the other hand, a relatively smaller majority of the experts believe that improving dissemination of knowledge, innovations, and digitalization in agriculture and rural areas contributes significantly to promoting employment, growth, social inclusion, and local rural development (53.1 %). All this proves that the effective measures are to be undertaken during the new programming period to realize the horizontal objective of the EU CAP for improvement of the dissemination of knowledge, innovations, and digitalization in agriculture and rural areas, in order also to achieve successfully the specific objectives of the Union.

Figure 77. Extent in which dissemination of knowledge, innovations and digitalization in agriculture and rural areas in Bulgarian contributes for achievement of different objectives of EU CAP (%)

Source: Experts assessment

7. SWOT analysis, development strategy and intervention needs

On the base of the diagnosis of the state and trends in development of AKIS in Bulgaria, SWOT for AKIS is formulated by the panel of experts (Table 3).

Table 3. SWOT analysis for AKIS in Bulgaria

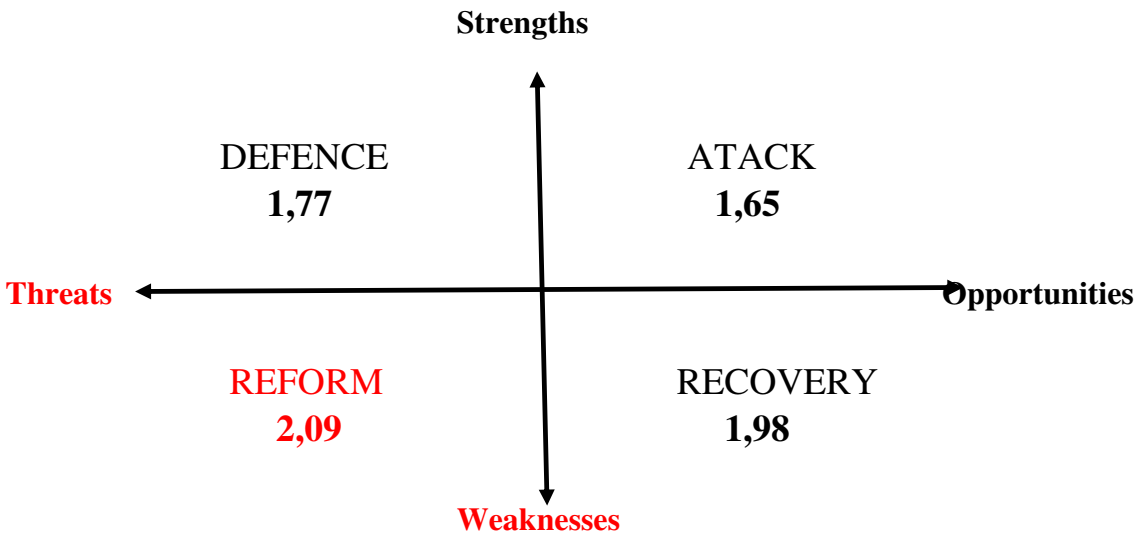
STRENGTHS	WEAKNESSES
AKIS of the country includes diverse and well-developed scientific, university, private and professional organizations	There is insufficient official or other reliable information on AKIS in the country
Agriculture is the only sector for which special service structures (Agricultural Academy and NAAS) are built and publicly funded	The share of the university and private (business) sectors of AR&D is negligible
The relative share of scientists, doctors and doctors of science in AR&D is increasing	Poor staffing and age structure of AR&D
The number of recognized new varieties and hybrids of plants and animal breeds, and approved technologies is considerable	Material endowment of AKIS lags behind world standards
Vocational education in the field of agriculture and forestry is provided in a large number of secondary and higher schools	Obsolete facilities and reduced, on the border of the "critical" mass, personnel, financial and material resources in some of the AKIS units
The number of consultations provided to farmers has increased and the subjects expanded	Low quality of education and insufficient adaptability of schools to the business needs
Availability of free and affordable support to farmers through NAAS	Most farm managers are only with practical experience and no agricultural training.
Opportunity for farmers to participate in hundreds of diverse events for transfer and dissemination of knowledge and innovation	Lack of financial resources, unwillingness to take risks and insufficient training of farmers make it difficult to innovate
Private consultancy organizations are active in preparing business plans and projects for investment measures	In many areas, a limited number of private organizations providing consultancy
	Only 5% of producers in mountainous regions use computer programs in farm management
	There is considerable variation in internet access of households in densely populated and rural areas
	Much of the links in AKIS are not efficient
	The degree of introduction of new production methods, forms of organization and marketing, precision farming technologies and process automation is unsatisfactory
	There is considerable differentiation in the use of advice and consultations and introduction of innovations in

There is a growing interest in implementation by producers for all types of innovations Numerous activities taking place related to digitization of agriculture, an important part of which is the Digital Innovation Hub Significant measures taken to digitize agricultural administration, leading to increased efficiency and improved services	different sub-sectors of agriculture, in farms of different legal types and sizes, and in different regions There is insufficient information among farmers and producers' organizations on the achievements and innovations of local institutions Few publicly supported farms introduce new technologies or product Nearly half of farmers are unaware of the nature of digital agriculture, and only 14% use modern digital technologies
OPPORTUNITIES	**THREATS**
The role of budgetary funding for AR&D is relatively increasing With sufficient incentives and benefits, the private sector is actively involved in AR&D Existence of significant public support and funding for "Transfer of Knowledge and Actions", "Consultancy Services, Farm Management and Replacement Services" and "Cooperation" Modernization of agricultural holdings is an important area of public support for Bulgarian farms. Adopted Strategy for Agriculture and Rural Digitization aiming to turn agriculture into a highly technological, sustainable, productive and attractive sphere There is great potential for increasing efficiency with adequate support and modernization of AKIS European and world AKIS offer great opportunities for rapid and efficient transfer of knowledge and innovations	Expenditures for R&D in agricultural sciences is significantly reduced in both absolute and relative terms Significant reduction in AR&D expenditure in the Gross Value Added of agriculture Share of AR&D budget expenditures in the total budget expenditures is decreasing while the share of AR&D funding from the state budget is variable The costs of innovations are high, leading to high prices for innovative technologies and products There is no effective organization of AR&D, and systems for public funding, coordination and assessment of activity, evaluation and stimulation of researchers and teams, and protection of intellectual agrarian property Most of the innovations implemented in the country are "imported" from abroad due to the lack of effective solutions in the local institutes and universities Regulatory restrictions for implementing public-private partnerships between research centers and agribusiness Bulgaria lags far behind the rest of EU in terms of the entry of digital technologies into the economy and society Implementation of measure 16.1 of the RDP 2014-2020 is lagging behind comparing to other EU states Competition with global suppliers of new knowledge and innovations in the agricultural sector is increasing

Source: the author

After SWOT is done the Expert panel gave scores indicating importance (Scale 0-3) of the major Strengths, Weaknesses, Opportunities, and Threats of AKIS in Bulgaria. On that base, a Strategic Orientation matrix has been built (Figure 76).

Figure 76. Strategic orientation for AKIS development in Bulgaria



Source: the author

The summary of experts' assessments found out that the scores in quadrant IV are the highest, which means that the Weaknesses of AKIS in the country prevent from confronting the Threats of the socio-economic, market, and natural environment. This calls for the selection of a general REFORM strategy. Moreover, the scores in Quadrant III are close to the highest one, indicating that AKIS in Bulgaria has many Weaknesses and it is not able to take advantage of the existing options of the environment. That also calls for a need to launch a global RECOVERY type strategy.

Consequently, the specific strategy for AKIS development during the next programming period is suggested and agreed upon: ***"Improving the level and forms of agriculture through stimulating knowledge sharing, innovation, and digitization".***

Seven major needs and 23 sub-needs for public intervention for the realization of the defined strategy have been specified after careful consideration (and assessment of comparative efficiency) which needs of AKIS could be effectively fulfilled by the market and private modes and where there is a strong need for public involvement during the next programming period.

Needs for public intervention in AKIS with PRD 2021-2027

I. Collecting complete and reliable information on the state and development of the System of Sharing of Knowledge and Innovations and Digitization in agriculture

a. Collecting information on the status and development of research, consultancy and innovation introducing activities of universities;

b. Collecting information on the status and development of research, consultancy and innovation introducing activities of private sector;

c. Collection of information on the digitization of agriculture and rural regions;

II. Significant modernization of the AKIS of the country

a. Significant increase in investment for R&D activity and for introduction of innovations in agriculture;

b. Support and stimulation of private investment in R&D activity and introduction of innovations in agriculture;

c. Supporting and stimulation public-private partnerships and co-operation in financing and organizing R&D activity and introduction of innovations in agriculture;

d. Improvement of the system of registration, protection and commercialization of intellectual agricultural products (new varieties, breeds, technologies, production methods, etc.);

III. Significant expansion of the AKIS of the country

a. Sustainable growth of budgetary investments in R&D activity and introduction of innovations in agriculture;

b. Improving the incentives for retaining and attracting highly qualified staff research and development activity in agriculture;

c. Improvement of the material and technical base, and the resource, financial and human endowment of the public scientific, educational and consulting organizations in the agricultural sphere;

IV. Improving the educational and qualification level of managers, specialists and workers in the agricultural sector

a. Encouragement and support of all forms of training and upgrading of the employees in the agricultural sector;

b. Encouragement and support for improving the educational and qualification level of managers and workers in agricultural holdings and rural residents;

c. Expanding the training and qualification of the AKIS participants in priority areas, including the organization of networks for sharing of knowledge and innovations;

d. Adapting the training system to the contemporary needs of farmers and businesses;

V. Promoting and supporting the various forms of dissemination of knowledge and innovations in agriculture

a. Encouraging and supporting joint initiatives of scientific, business, non-governmental and professional organizations, and farmers for dissemination of knowledge and innovations in agriculture;

b. Accelerating the setting up of operational groups of interested farmers, researchers, consultants and business (EIP) in agriculture to solving specific problems;

c. Free, easily accessible, tailored to the needs and diverse in forms and subject consultations and information for agricultural producers;

VI. Overcoming the big differences in the technological level and production efficiency in different types of farms, subsectors of agriculture and regions of the country

a. Enhanced support for sharing and transfer of knowledge and digitization in lagging areas;

b. Enhanced support and incentives for the introduction of new production methods and technologies for precision agriculture, processes automating, and implementation of digital technologies, software and other innovations in perspective areas;

VII. Supporting and stimulating the digitization of agrarian management, agricultural production and rural areas

a. Expanding the use of digital technologies in the management of the sector and in the relationships with producers;

b. Expanding access to and use of computers and digital technologies in agriculture and rural areas;

c. Supporting the introduction of digital technologies in small and medium-sized agricultural producers and their organizations;

d. Supporting innovative initiatives for the creation, adaptation and introduction of digital technologies in the management and production of small and medium-sized enterprises.

All these needs have been fully or partialy incorporated in the documents of the Strategic Plan for Agrarian and Rural Development of Bulgaria for 2021-2027 (due to be approved in 2022).

Conclusion

The country's system of governance of AKIS is composed of diverse and numerous organizations and agents, for which activities and complex relations lack sufficient official or other reliable information, deterring considerably its analyses and management. Particularly, the microanalysis of applied governing modes and driving factors for agents' choice is hard to be determined. The experts' assessment allows to fill partially that gap and give insights on the governance, state, and the main achievements and challenges to the development of this complex system. However, the lack of data can only partly be offset by the expert evaluations and it is, therefore, necessary to carry out further expert-based analyses, in-depth and representative studies of the individual components, factors, and efficiency as well as AKIS as a whole. It is also necessary to institutionalize and regulate the collection of official statistical, reporting, and other information on the status and efficiency of this important system.

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