Turkish Economic Review

www.kspjournals.org

Volume 7 March 2020 Issue 1

Diagnosis of the process of agrarian and rural digitalization in Bulgaria

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Abstract. Despite its big theoretical and practical importance in Bulgaria there are no comprehensive analysis of the state and evolution of digitalization in agriculture and rural areas. The goal of this study is to analyze the state, development and efficiency of digitalization in the agrarian sphere in Bulgaria, specify major trends in that area, compare the situation with other EU countries, identify main problems, and make recommendation for improving policies in the next programing period. Analysis has found out that in recent years there is considerable improvement of the access of Bulgarian households to internet as well as a significant increase in the persons using internet for relations with public institutions and trading goods and services. Nevertheless, Bulgaria is quite behind from other EU members in regards to introduction of digital technologies in the economy and society taking one of the last places in EU in terms of Integral Index for Introduction of Digital Technologies in the Economy and Society – DESI. There is a great variation on the extent of digitalization in different subsectors of agriculture, farms of different juridical type and size, and different regions of the country. Most agricultural holdings are not aware with the content of digital agriculture as 14% apply modern digital technologies. Major obstacles for introduction of digital technologies are qualification of employees, amount of required investment, unclear economic benefits, and data security. Main areas where state administration actions are required are: support of measures for supplementary training of labor, tax preferences in planning of actions and digitalization of activity, stimulation of young specialists, introduction of internationally recognized processes of standardization and certification, adaptation of legislation in the area of data protection, and securing reliable and high speed networks.

Keywords. Digitalization, Agriculture, Rural, Bulgaria, EU CAP.

JEL. Q10, O31, O33, Q01, Q16, Q18.

1. Introduction

Stimulating and sharing knowledge, innovation, digitalization and promoting their greater use" is set again as a strategic objective in the new programming period 2021-2027 of implementation of the EU (European Union) CAP (Common Agricultural Policy) (European Commission, 2018). Despite their importance, with very few exceptions (Башев, 2020; Башев и Михайлова, 2019; Николов и др., 2018; МЗХГ, 2019; Bachev, 2019, 2020), in-depth analyzes of the digitalization of the agricultural sector and in rural areas are lacking. The reason for this is the lack of enough official statistics, etc. information and sufficient public interest in the development of this important system.

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The study attempts to analyze the state, development and efficiency of digitalization in in Bulgarian agricultural and rural sector since the EU accession of the country in 2007. The aim is to specify key trends, compare with other EU countries, identify major issues, and assist public support policies in the next programming period.[1] Analysis is based on available statistical, reporting and other official information as well as a specially organized experts evaluation (2019), with 32 leading experts from the major research institutes, universities, Agricultural Advisory Service, and professional organizations of agricultural producers.

2. Diagnosis of digitalization in the Bulgarian agrarian sphere

The use of the Internet and information technology and applications is rapidly entering Bulgarian agriculture and rural areas. However, the country lacks statistics on the degree of use of computers and digital technologies in the agricultural sector, which greatly complicates the study and management of this process.

Over the last 10 years, there has been a significant improvement in the access of Bulgarian households to the Internet as a whole and in the regions with varying degrees of population density (Figure 1). It can be assumed that the general trends in the country apply to both rural households and farmers' households, which means that the use of the Internet is progressively increasing in the agricultural sector.

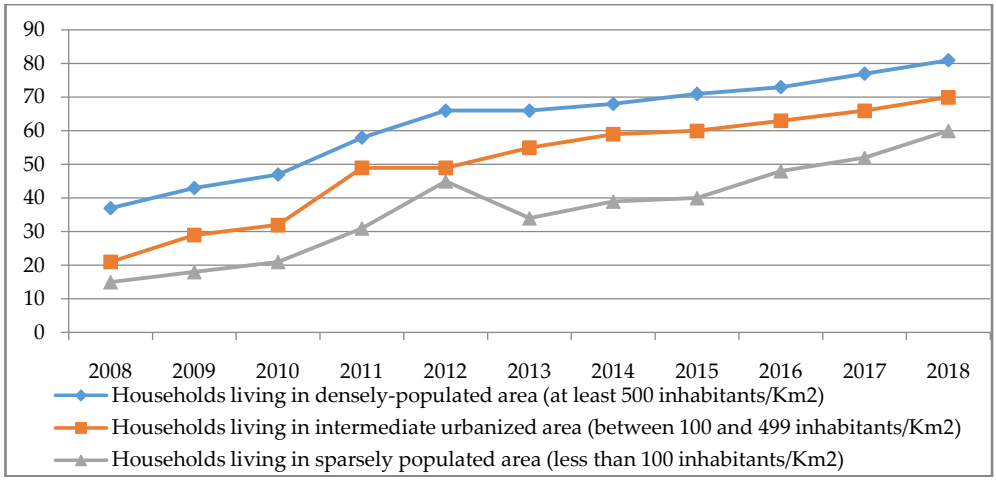

Figure 1. *Internet Access of Households in Different Regions of Bulgaria*
Source: Eurostat

However, despite the significant progress, there are still large differences in household Internet access in densely populated areas (at least 500 inhabitants/km2) and medium-urbanized populations (between 100 and 499 inhabitants/km2), and sparsely populated areas (less than 100

[1] In fact, that analisis 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).

inhabitants/m2) regions of the country - 81%, 70% and 60% of them respectively. It can be assumed that farmers living in the areas concerned use approximately the same extent of the Internet.

Bulgaria lags far behind in digitalization as a whole and in rural areas and in comparison with the European average and other EU countries (Figure 2). The country is in the group of lagging countries along with Greece, Lithuania and Latvia, ranking last in internet access in all categories of regions.

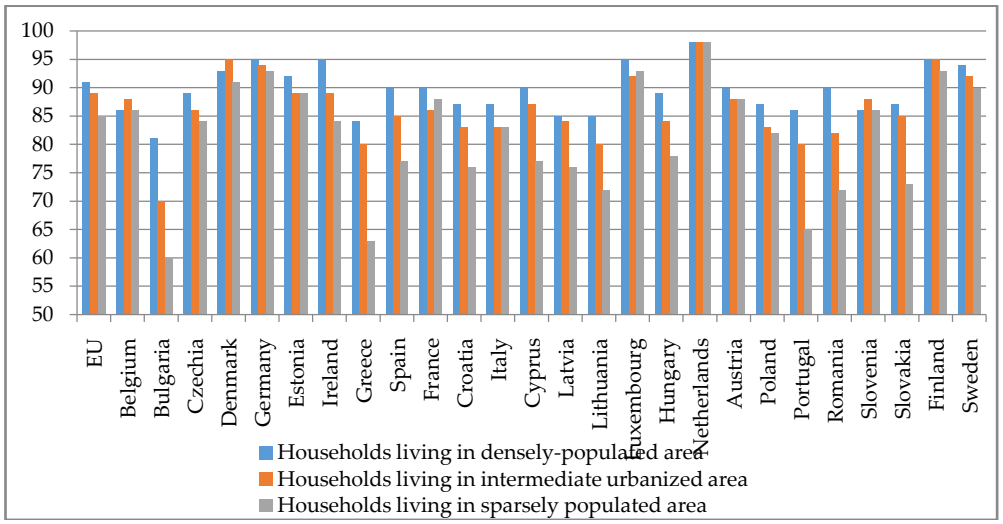

Figure 2. *Households Level of Internet Access in EU member States in 2018*
Source: Eurostat

Nevertheless, 68.5% of people aged 16-74 in the country use a variety of mobile devices to access the internet at home or at work - mobile phone or smartphone, portable computer (laptop, tablet) or other mobile device (gaming media player, e-book reader, smart watch) (Figure 3). In 2018, only 7.8% of the individuals have not used such devices to access the Internet in the last 12 months. This implies that many farmers and members of their households use this type of devices for internet access.

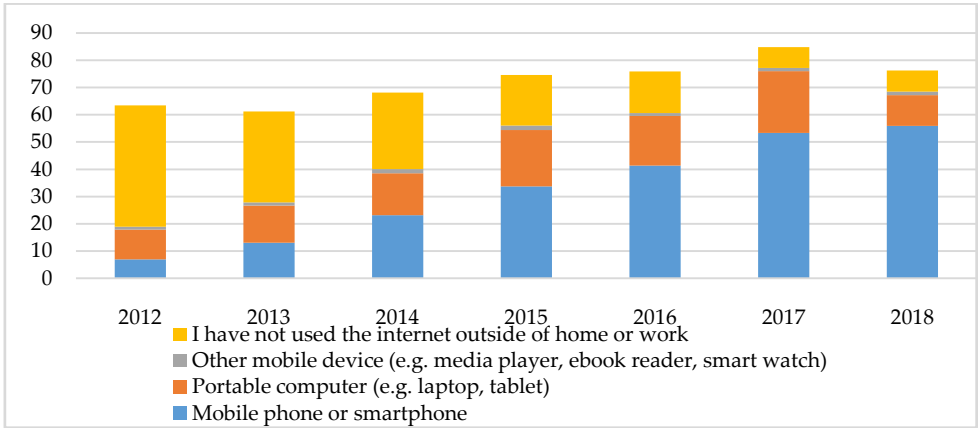

Figure 3. *Usage of Mobile Devises by Persons for Access to Internet (outside of home or office), %*
Source: National Statistical Institute

Over the last ten years, the number of people using the Internet to interact with public institutions or to order/purchase goods and services has increased significantly (Figure 4). In 2018, just over a fifth of the population have used the Internet to engage with public and private organizations in the last twelve months. Compared to other EU countries, however, the development and use of e-government and e-commerce is much smaller, with Bulgaria last (along with Romania) in this regard (Figure 5, Figure 6).

It can be assumed that the implementation of digital relations with public institutions and commercial organizations in rural areas and among farmers has a similar trend, but is less widespread.

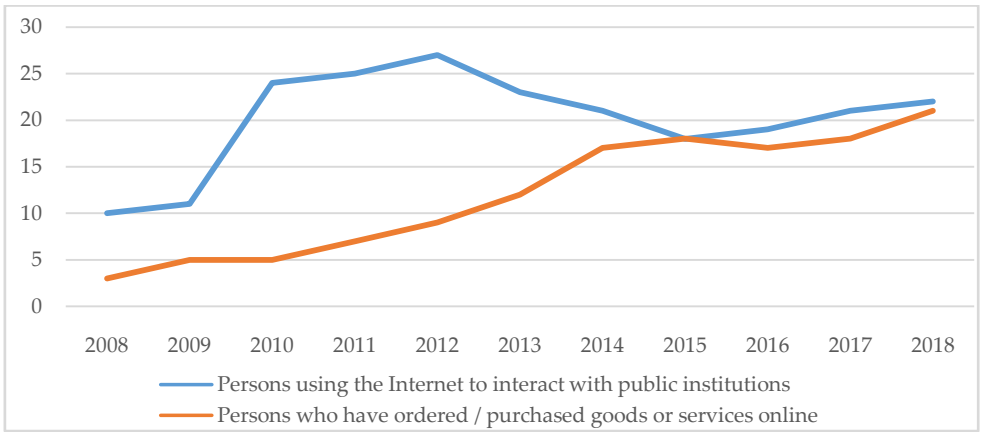

Figure 4. *Individuals Using Internet for Relations with Public Authorities and Order/purchase of Good or Services in Last 12 months*
Source: Eurostat

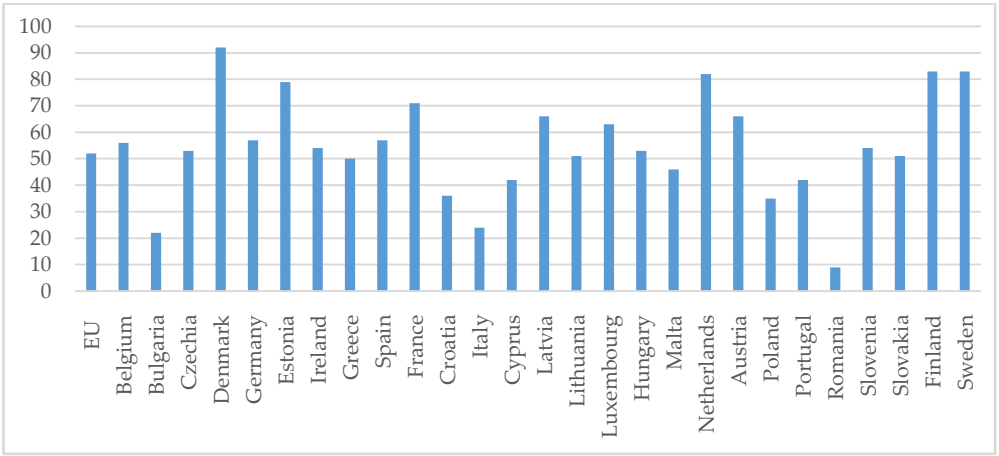

Figure 5. *Individuals using the internet for interaction with public authorities in EU countries (%)*
Source: Eurostat

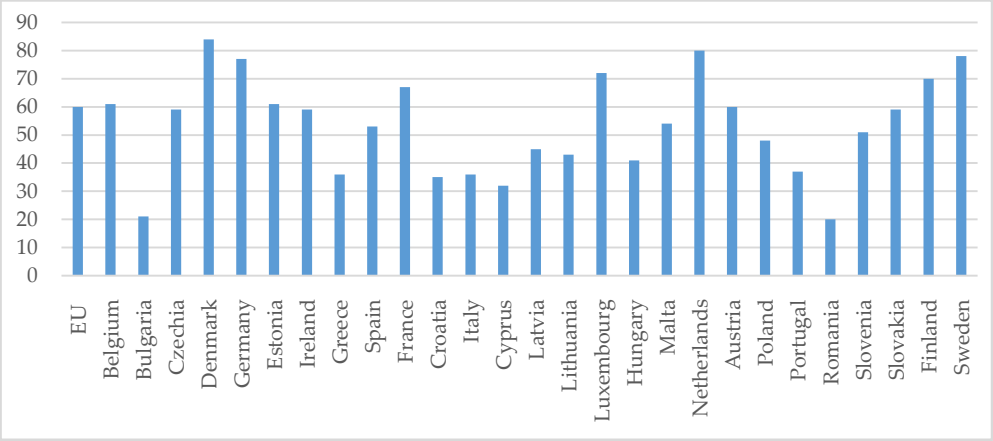

Figure 6. *Individuals using the internet for ordering goods or services in EU countries (%)*
Source: Eurostat

The National Rural Development Program 2014-2020 states that access to a standard broadband network is provided for almost all households in rural areas (99%), but in sparsely populated rural areas only 60% of households have access to a fixed broadband network (at 90% national average) (МЗХГ, 2015) Moreover, only 10% of rural households have access to next-generation networks, with broadband penetration in rural areas increasing but lagging far behind the pace in the country and other countries, with only 37 % of households in predominately rural regions having subscription to internet.

The use of the Internet by businesses and households for e-commerce, Internet banking, information and training is far from potential possibilities. By the end of June 2015, Bulgaria has coverage of a new generation of broadband access infrastructure (> 30Mbps) for 72% of the households but reaching only 2.7% in rural areas, well below the EU average.

The in-depth analysis also shows that Bulgaria lags far behind the other EU member states in terms of digital penetration into the economy and society. In recent years (2017 and 2018), the country ranks 26th in the EU in the Integrated Index of Digitalization of Economy and Society - The Digital Economy and Society Index-DESI (DESI, 2019).

In terms of DESI measurement for "Connectivity", Bulgaria ranks 25th in the EU. For some of the indicators, the country approaches the Union average (such as Total coverage of fixed broadband households, and Broadband mobile broadband) and even exceeds it by some areas (e.g. Broadband high speed broadband, and ultra-fast Broadband Internet coverage) (Table 1). However, in terms of 4G coverage and ultrafast broadband Internet access, Bulgaria is still well below EU levels.

Table 1. *Indicators for Internet Connectivity in Bulgaria, 2018*

Indicators	DESI		Ranking
	Bulgaria	EU	in EU
Fixed broadband coverage,% households	95	97	23
Fixed broadband Internet distribution,% households	59	75	26
4G network coverage,% households	72	91	28
Distribution of mobile broadband Internet access, subscriptions per 100 people	87	90	16
Next Generation Access Coverage,% VDSL, FTTP or Docsis 3.0 Households	75	80	23
Broadband Broadband Broadcast,% Subscriptions> = 30 Mbps	39	33	15
Ultra-fast broadband Internet coverage,% FTTP or Docsis 3.0 households	75	58	12
Broadband Broadband Internet Distribution,% Subscriptions> = 100 Mbps	6,5	15,4	23
Fixed Broadband Price Index, score (0 to 100)	80	87	20

Source: DESI, Report for Bulgaria, 2018

As regards to the "Human Capital" in digital technology area, Bulgaria is also making slow progress, with the overall level of skills being among the lowest in the EU (27th) and the level of all indicators below the Union average (Table 2).

Table 2. *Indicators for Human Capital in Digital Technologies in Bulgaria, 2018*

Indicators	DESI		Ranking
	Bulgaria	EU	in EU
Internet users, % of persons	62	81	27
At least basic digital skills, % of persons	29	57	27
ICT specialists, % of employees	2,7	3,7	20
Specialists in the field of science, technology, engineering and mathematics, per 1000 persons (aged 20-29)	13,9	19,1	21

Source: DESI, Report for Bulgaria, 2018

In terms of "Internet Usage", the country is among the last places in the EU (26), with major indicators showing significant differences depending on the activities carried out online. While Bulgarians intensively use the Internet for telephone and video calls and are active on social networks, they are far behind European levels in terms of e-commerce and the use of online banking (Table 3).

Table 3. *Indicators for usage of internet in Bulgaria, 2018*

Indicators	DESI		Ranking
	Bulgaria	EU	in EU
News, % of people who have used the internet in the last 3 months	74	72	20
Music, videos and games, % of people who have used the internet in the last 3 months	64	78	28
Video on demand, % of people who have used the internet in the last 3 months	8	21	23
Video calls, % of people who have used the internet in the last 3 months	85	46	1
Social networks, % of people who have used the internet in the last 3 months	79	65	5
Banking, % of people who have used the internet in the last 3 months	9	68	27
Shopping, % of people who have used the internet in the last 12 months	27	68	27

Source: DESI, Report for Bulgaria, 2018

In terms of "Introduction of Digital Technologies", the country is also one at the last places in the EU (26) and the use of digital technologies in Bulgarian enterprises is generally well below the European levels (Table 4).

It can be assumed that in the agricultural and rural enterprises the implementation of these technologies is lagging behind even more than in the cities and high-tech industries.

Table 4. *Indicators for Introduction of Digital Technologies in Bulgaria, 2018*

Indicators	DESI		Ranking in EU
	Bulgaria	EU	
Electronic information sharing,% businesses	23	34	25
Radio frequency identification, % of enterprises	9,2	4,2	1
Social media, % businesses	9	21	28
Electronic invoices ,% businesses	12	na	21
Cloud computing services, % enterprises	5,5	na	27
SMEs that sell online	7,1	17,2	28
E-commerce turnover, % of SME turnover	3,5	10,3	26
Cross-border online sales	3,4	8,4	27

Source: DESI, Report for Bulgaria, 2018

Similar is the situation with regard to the "Digital Public Services", where the country is ranked 23rd in the EU. According to many of the observed general indicators, Bulgaria is well below the Union average, and it can be assumed that the situation in the agricultural and rural areas is similar or even worse (Table 5).

Table 5. *Indicators for Introduction of Digital Technologies in Bulgaria, 2018*

Indicators	DESI		Ranking
	Bulgaria	EU	in EU
EGovernment users, % users who want to submit forms	58	58	15
Form pre-completion, score (0 to 100)	25	53	24
Completeness of online services, score (0 to 100)	72	84	26
Digital public services to business enterprises (0 to 100) - national and cross-border	89	83	11
Open data, % of maximum score	76	73	14
EHealth, % persons	10	18	23

Source: DESI, Report for Bulgaria, 2018

A MAFF survey among farmers in 2019 on digitalization of Bulgarian agriculture found out that for the question "Are you familiar with the nature of digital agriculture" the majority (49%) answered that they are not familiar, 27% are partially familiar, 19% are average familiar, and only 5% are familiar to a great extent (МЗХГ, 2019).

With regard to the question "Do you use modern digital technologies on your farm" 86% of the respondents said that they do not use modern digital technologies and the remaining 14% use digital technologies, mainly GPS navigation systems.

To the question "Do you expect digitalization to affect the number of employees on your farm?" 83% said they expect a change, 13% said they expect the number to decline and only 4% said they expect a staff increase.

To the question "Do you have a department or designated employee who is specifically responsible for digitizing on your farm?" only 8% of the respondents said that they have an employee in charge of digitization and the majority (92%) have no such an employee.

To the question "Do you plan to invest in the next five years for the development of digitalization in your farm?" 4% said they intend to invest more than 10% of their planned investment funds for digitalization, 96% said they intend to spend less than 10% of their planned funds or do not intend to spend any money at all for digitalization.

To the question "Do you intend to link your production with digitalization in the future?" 38% of respondents stated that they intend to digitize their production, 33% intend to digitize only some of the production stages, and the remaining 29% plan to introduce digital technology within the next five years.

To the question "What do you think would be the benefits for your farm with the introduction of digital technologies?" 22% cite efficiency gains, 17% cost reductions, 16% better planning and management, 14% productivity gains, 12% data acquisition and analysis, 9% competitiveness retention, 4% increase in turnover, 2% say more value added and the ability to customize products, 1% point "Time-to-market" acceleration, and 1% see no benefit in digital technology.

To the question "What do you think are the potential barriers and risks to digital adoption?" 24% of respondents indicate employee qualifications, another 24% indicate the amount of investment, 19% identify unclear economic benefits, 15% data security, 7% insufficient maturity of technologies, 5% insufficient standardization and certification, 3% insufficient capacity for recording and storing digital information, 2% lack of clear priorities by the management of the holding, and 1% cannot identify risks and obstacles to the entry of digital technologies.

To the question "In what areas is public administration action required regarding the introduction of digital technologies?" 21% of respondents indicate support for measures for further qualification of employees, another 21% indicate tax incentives for planning of measures and digitization of activity, 18% encouragement of young professionals, 11% introduction of internationally recognized standardization and certification processes, 11% adapting data protection legislation, 11% securing high-speed and high-speed networks, and 7% promoting development activity.

A representative survey of farms in the mountainous regions of the country in 2017 found that only 5% of producers actually use computer programs in agricultural management (Figure 7). However, more than half of the respondents (54.1%) express in one way or another positive attitudes towards such programs. However, there is still a significant proportion of farmers (38.3%) who lack interest in acquiring knowledge of these programs and their implementation. This requires special measures to inform and advise farmers on the benefits of such programs, as well as training them in their use.

It can be assumed that there are no significant differences in the intentions and degree of use of computer programs in agricultural management in areas other than mountainous.

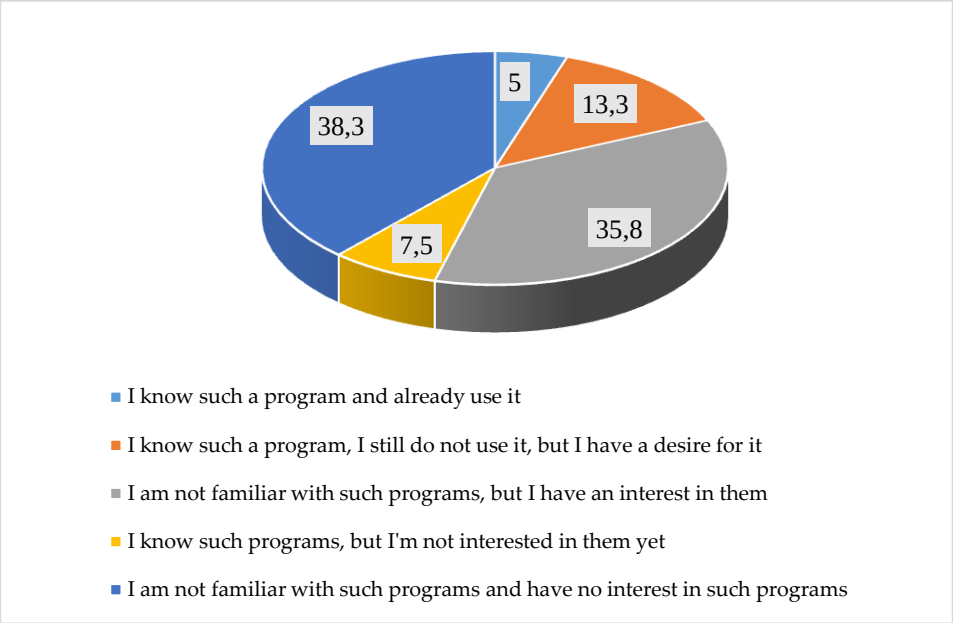

Figure 7. *Farmers Attitude in Mountainous Regions of Bulgaria to Computers Programs in Farm Management (%)*
Source: Николов Д. и др., 2018

In the last years in the EU there have been carried out numerous activities related to the digitization of agriculture and the promotion of innovation, including within the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI).

In 2016, the European Commission launched the Digital Industry Strategy for the European Industry within the Digital Single Market Package, which creates and complements the various national digitization initiatives of the economy. One of the pillars of the initiative is the establishment of a Pan-European Digital Innovation Hubs (DIHs) network. The DIHs are a one-stop shop that helps businesses become more competitive with their business/manufacturing process, products or services through the use of digital technology. The DIHs are based on technological infrastructure (competence centers) and provide access to up-to-date knowledge, expertise and technologies to support consumers through pilot projects, testing and experimentation of digital innovation. DIHs are seen as a tool to support businesses, and in particular for SMEs and the non-technology industry, in their digital transformation The goal is for all businesses in Europe, including agri-food, to have access to DIHs at a "working distance".

Under Horizon 2020 in 2019 AgroHub.BG was established in Bulgaria at the initiative of the Institute for Agro-Strategies and Innovations. The goals of this Digital Innovation Hub are: Digital transformation of Bulgarian agriculture and rural areas using digital technologies like Blockchain, Internet of Things, Artificial Intelligence and others; Increasing the role of research and digital innovation in the agri-food chain; Contributing to the spread of international practice in the field of research and digital innovative technologies in the agro-food chain, and the implementation of

this practice in the country; Contributing to accelerate the implementation of research and digital innovation by practitioners to meet the needs of Bulgarian enterprises; Providing access to up-to-date knowledge, expertise and technology to support Bulgarian enterprises with pilot projects, testing and experimentation of digital innovation; Collaboration with Bulgarian enterprises to assess digital skills needs and to provide access to these skills. AgroHub.BG's main activities include: Project development; Developing knowledge and skills; Access to finance; Maintenance of units such as Incubators and Accelerators; Testing and validation; Technical assistance for enlargement; Provision of technical infrastructure; Contract research; Strategic research and development; Lobbying; Study of ecosystems; Strategic development; Building a community.

Large-scale measures have also been taken in recent years to digitize the agricultural administration in the country. As a result, a number of information systems, databases, software products and registers have been built into the Ministry of Agriculture, Food and Forestry (MAFF) system in several main groups: Registers serving the general administration; Registers serving the specialized administration; Registers within the scope of the GIS system, etc. At the same time, the volume of documents submitted and processed electronically increases. Simultaneously, the MAFF is developing an "Information System with Electronic Registers for the Specialized Administration (EPCA)", which aims at creating a unified information system. In addition to merging electronic registers, this system will also provide consolidated data coming from different internal or external systems/registers for the purposes of specialized administration. The deadline for the creation of the EPCA was until the end of 2019. The Integrated Information System for Spatial and Registry Data for the implementation of MAFF functions is also under development. All this leads to an increase in the efficiency of the administration and an improvement in the service provided to farmers.

As part of the EU's Sixth Priority for "Promoting Social Inclusion, Poverty Reduction and Economic Development in Rural Areas, with an Emphasis on Improving Information, Communication and Communication (ICT) Access, Use and Quality in Rural Areas", in the RDP 2014-2020 EUR 30 000 000 are planned for under measure 7.3 - Support for broadband infrastructure, including its creation, improvement and expansion, passive broadband infrastructure and measures for access to solutions though broadband infrastructure and e-government. Measure 7.3 implements two objectives – of the RDP and the National eGovernment Development Plan. The sub-measure is also consistent with the National Broadband Development Strategy in Bulgaria and as such, part of its activity supports the goals of the State Agency for Electronic Governance (ДАЕУ), which is also the sole beneficiary. The goal is, by 2020, the entire rural population to be able to access the next generation with a capacity of at least 30 megabits per second. In this regard, one of the goals (concerning the development of e-government) is to establish optical connectivity to all municipal centers.

The main problems associated with sub-measure 7.3 are the lack of guarantee that after the construction of the optical infrastructure in the municipal centers, there will be interest from the operators to develop the so-called "last mile", which is fact is a necessary condition for the population to have access to next-generation broadband and to fulfil the objectives of that sub-measure. Other issues related with the sub-measure are determined by the need to notify state aid, as the infrastructure will generate revenue and possibly unbalance the principles of a level playing field between market participants in broadband services.

In 2019 The Strategy for Digitization of Agriculture and Rural Areas of the Republic of Bulgaria was adopted, which aims to turn Bulgarian agriculture and related agricultural business into a highly technological, sustainable, highly productive and attractive sphere of the global economy, which improves the living conditions of the agricultural producers, and rural areas in general. The priorities are to be defined and European and national funds earmarked for the implementation of the strategy and effective digitalization of Bulgarian agriculture in the period 2021-2027.

3. Experts assessment on the state and factors for development of the system for digitalization in agriculture and rural areas

Like most of the other EU member states, in Bulgaria there is not sufficient official (statistical, reporting, etc.) information on the state and development of agricultural digitalization. All this makes it difficult both to analyze the state and development of this important national system and to make comparative analyzes with other member states of the Union. For the purpose of this study analysis, in 2019 an expert assessment was made on the state and development of the system of knowledge, innovation and digitalization in Bulgarian agriculture, with the participation of 32 leading experts[2] from the scientific institutes of the Agricultural Academy (AA) and the Bulgarian Academy of Sciences (BAS), agrarian and other universities, National Agricultural Advisory Service (NAAS) and major professional organizations of farmers.

The majority of experts believe that the level of public spending and investments for digitalization in the agricultural sector (81.2%), for agrarian research and for the implementation of agrarian innovations (62.5% each), and for agrarian consultations and training (43.7 %) is low or very low (Figure 8). 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. At the same time, none of the experts believe that the level of expenditures and investments is high in digitalization. Therefore, public expenditure and investment for the development of these important areas of the

[2] The author is grateful to all experts for their involvement in the expertise, professional attitude and competent evaluations.

Agricultural Knowledge and Innovation System (AKIS) are to be significantly increased so that the main objectives of the CAP can be achieved in the next programming period.

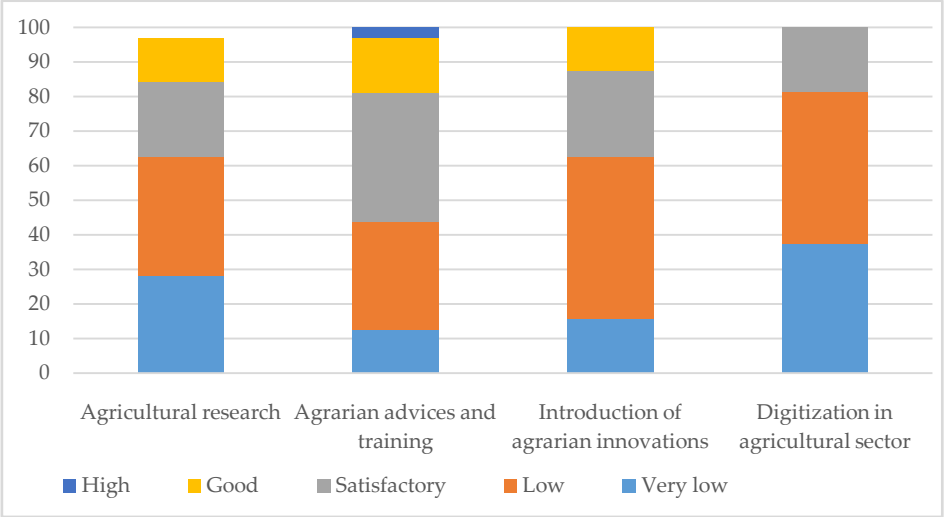

Figure 8. *Level of Public Expenditures and Investment in Agrarian Research, Agrarian Advices and Training, Introduction of Agrarian Innovation and Digitalization in Agrarian Sphere (%)*
Source: Experts assessment

A half of the experts evaluate the efficiency of public spending and investments in digitalization in the agricultural sector as low or very low (Figure 9). However, one in four panelists is of the opinion that the payback in this area is satisfactory and the remaining quarter 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 have to be expanded in order to realize the existing high potential for improving the efficiency.

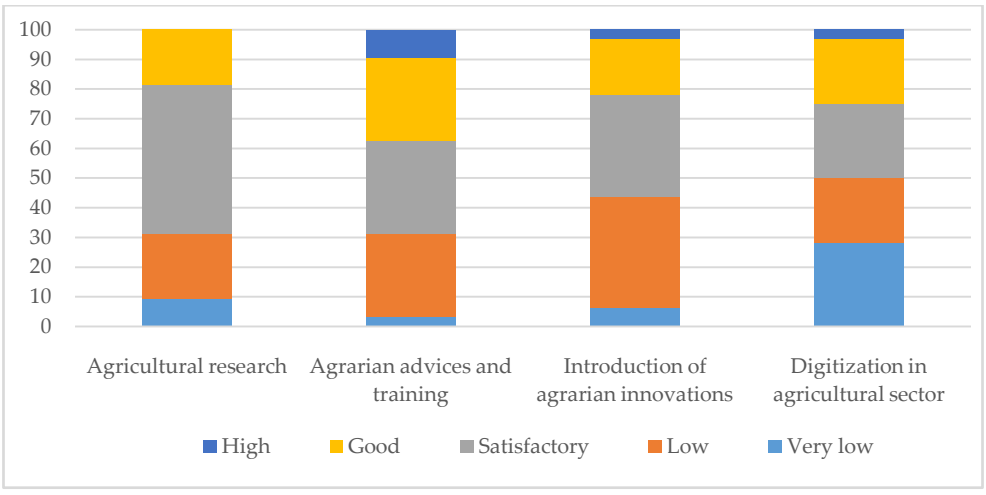

Figure 9. *Efficiency of Public Expenditures and Investment in Agrarian Research, Agrarian Advices and Training, Introduction of Agrarian Innovation and Digitalization in Agrarian Sphere (%)*
Source: Experts assessment

In terms of digital services and innovation, the universities (43.8%), and the media and Internet (40.6%) are cited by the majority of experts as most important for farmers' organizations (Figure 10). Among the most significant providers of digital information and services, according to a considerable number of experts, are private companies and consultants (31.2%), NAAS (28.1%), scientific institutes, suppliers of chemicals, technology, etc., and producer organizations (21.9% each).

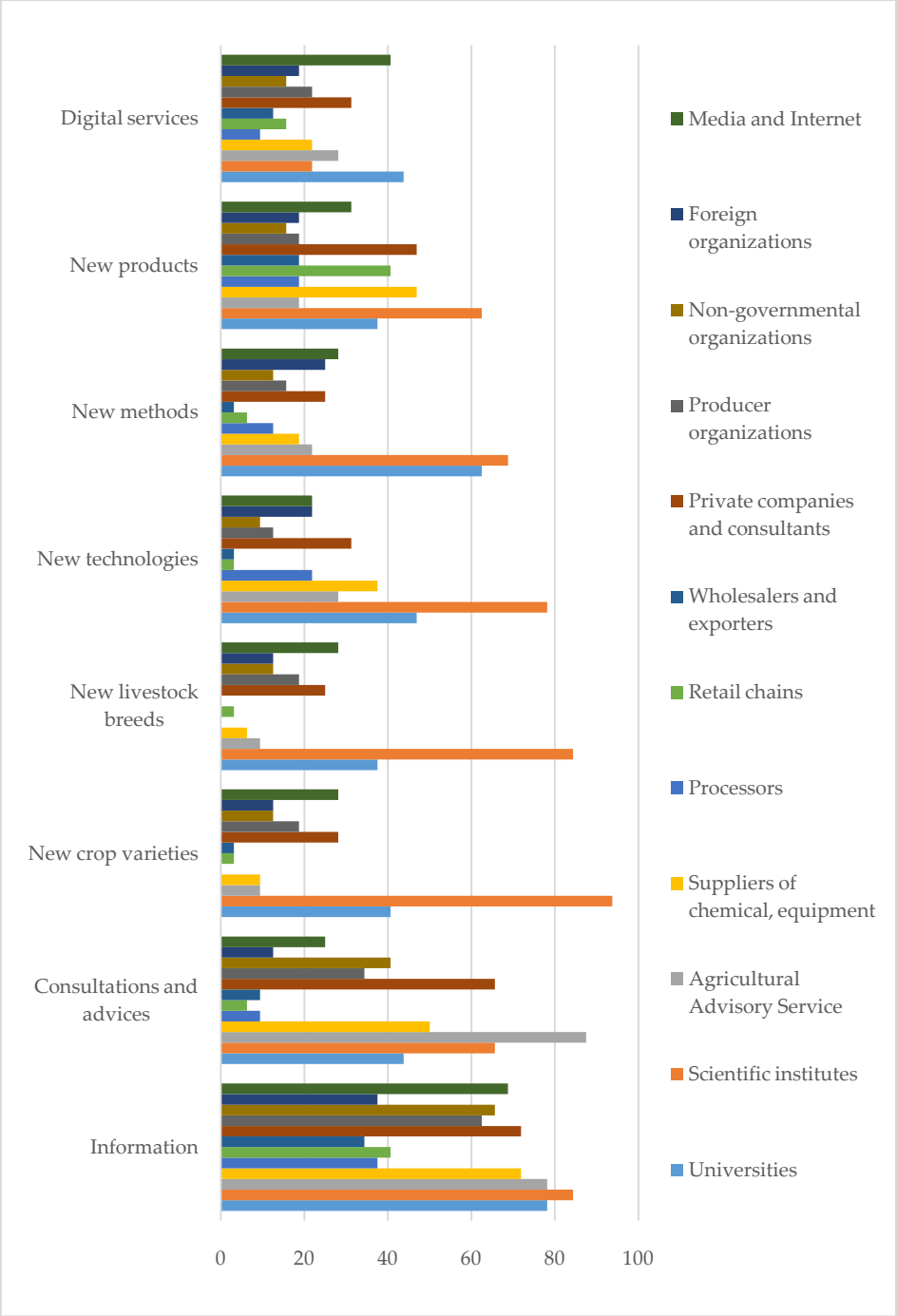

Figure 10. *Most Important Organizations Supplying Farms with Information, Consultations, Innovations and Digital Services (%)*
Source: Experts assessment

According to a large part of the panel of experts, the situation with farmers' real access to digital services, internet, software, etc. is unfavorable (Figure 11). 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.) have to be also undertaken in this important area in order to overcome the lag in the digitalization of agricultural production and rural areas in the country.

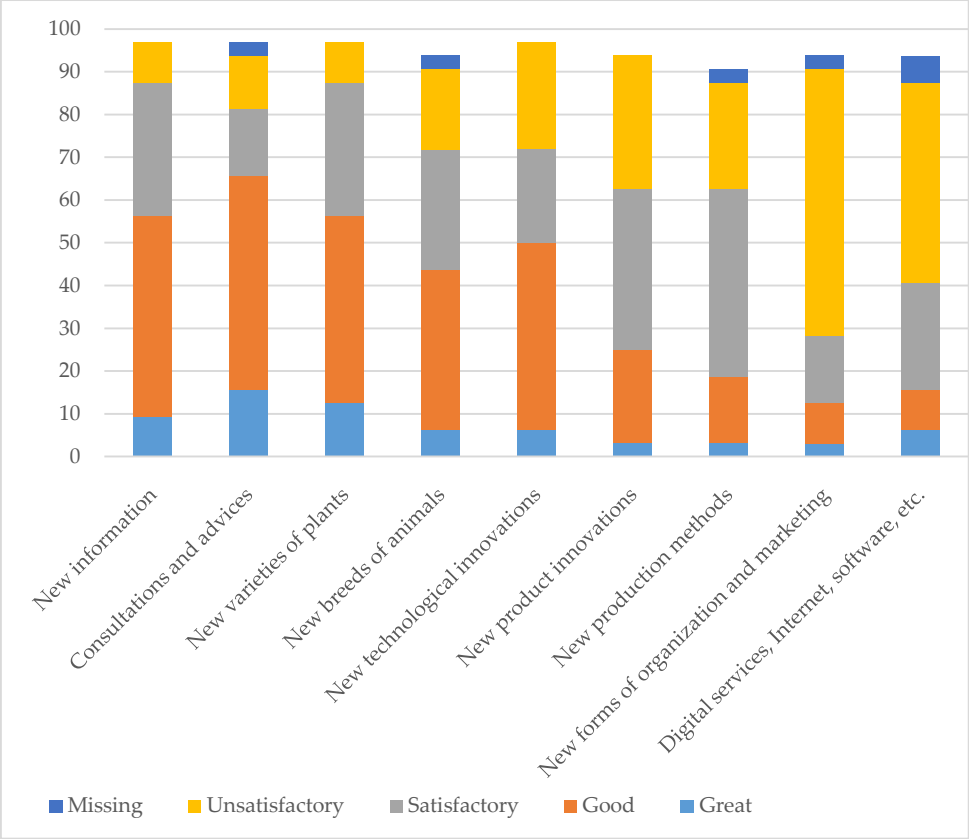

Figure 11. *Extent of Access of Farms to Information, Consultations, Innovations, and Digital Services (%)*
Source: Experts assessment

There is also a great variation in the degree of implementation of the different types of innovation in Bulgarian agriculture (Figure 12). A considerable part of the expert panel is of the opinion that the degree of introduction of whole classes of innovations such as new methods of production, new forms of organization and marketing, technologies for precision agriculture, automation of processes, including the introduction of computers, Internet, software, etc. is unsatisfactory. Therefore, adequate public measures of support, stimulation, partnership, etc. Are to be taken in order to be able to exploit the great untapped potential for organizational, technological and product renewal of the sector.

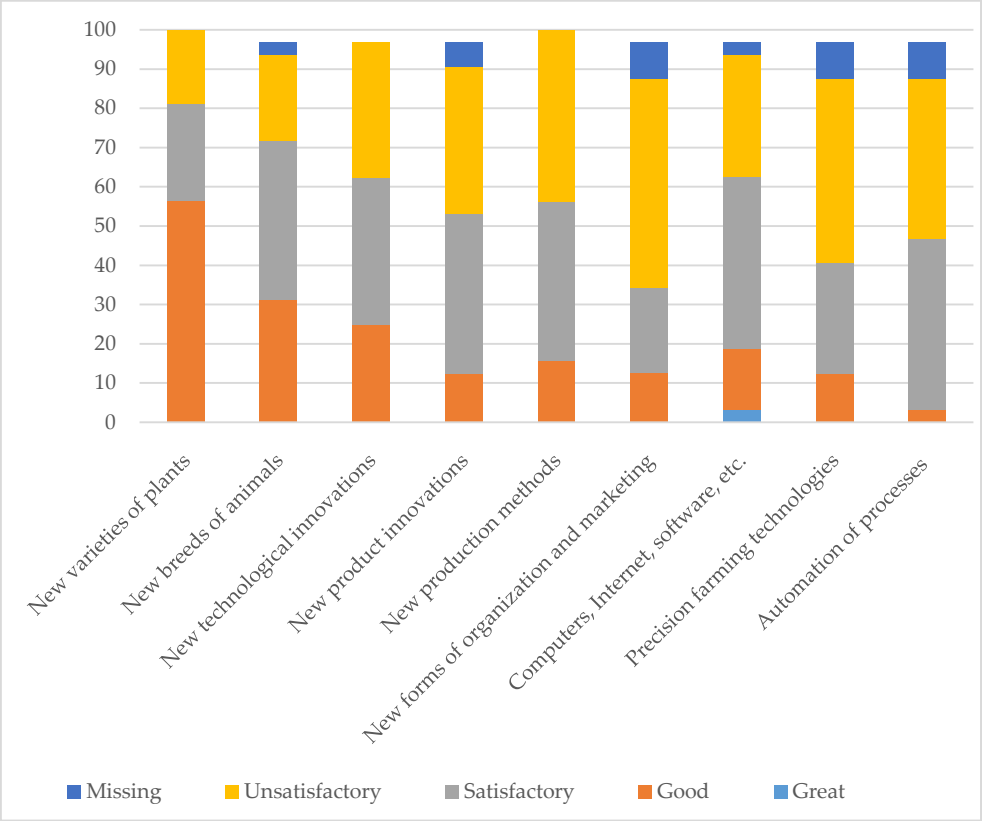

Figure 12. *Extent of Introduction of Different Type of Innovations in Bulgarian Farms (%)*
Source: Experts assessment

There is considerable differentiation in the degree of use of consultations and advices and in the introduction of innovations of different kinds in individual sub-sectors of agriculture, in farms of different legal types and sizes, and in different regions of the country (Figure 13). According to the experts' evaluation, the digital technologies, software, etc. are being applied to the greatest extent in field crops (40.6%), and a smaller proportion of them in grain and livestock production (15.6% each). Other subsectors are lagging far behind in terms of implementation of digital technologies, software, etc. The later requires the implementation of specific measures to expand digitalization in the production and management of lagging sub-sectors.

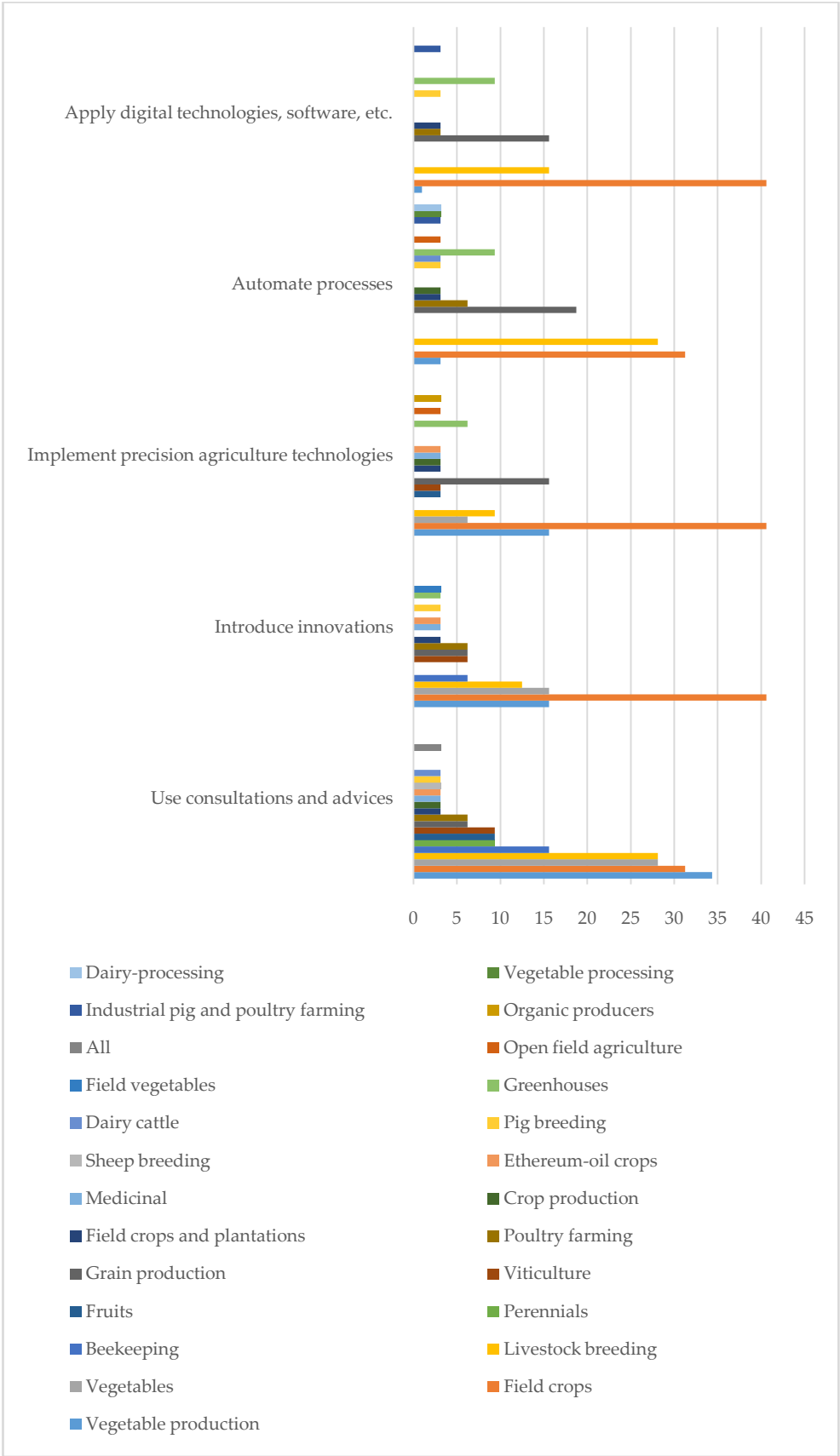

Figure 13. *Extent of Using of Advices and Consultations and Introductions of Different Type of Innovations in Individual Subsectors of Agriculture (%)*
Source: Experts assessment

There is also a great variation in the extent to which advices, consultations and innovations are introduced in farms of different types (Figure 14). Concerning the application of precision agriculture technologies, process automation and the implementation of digital technologies, software, etc., most experts believe that this is done mainly by legal entities (31.3%) and companies (21.9%), while other categories of farms are not active in these important areas. This requires the introduction of specific public measures to stimulate and support innovations in these new areas by all types of farms.

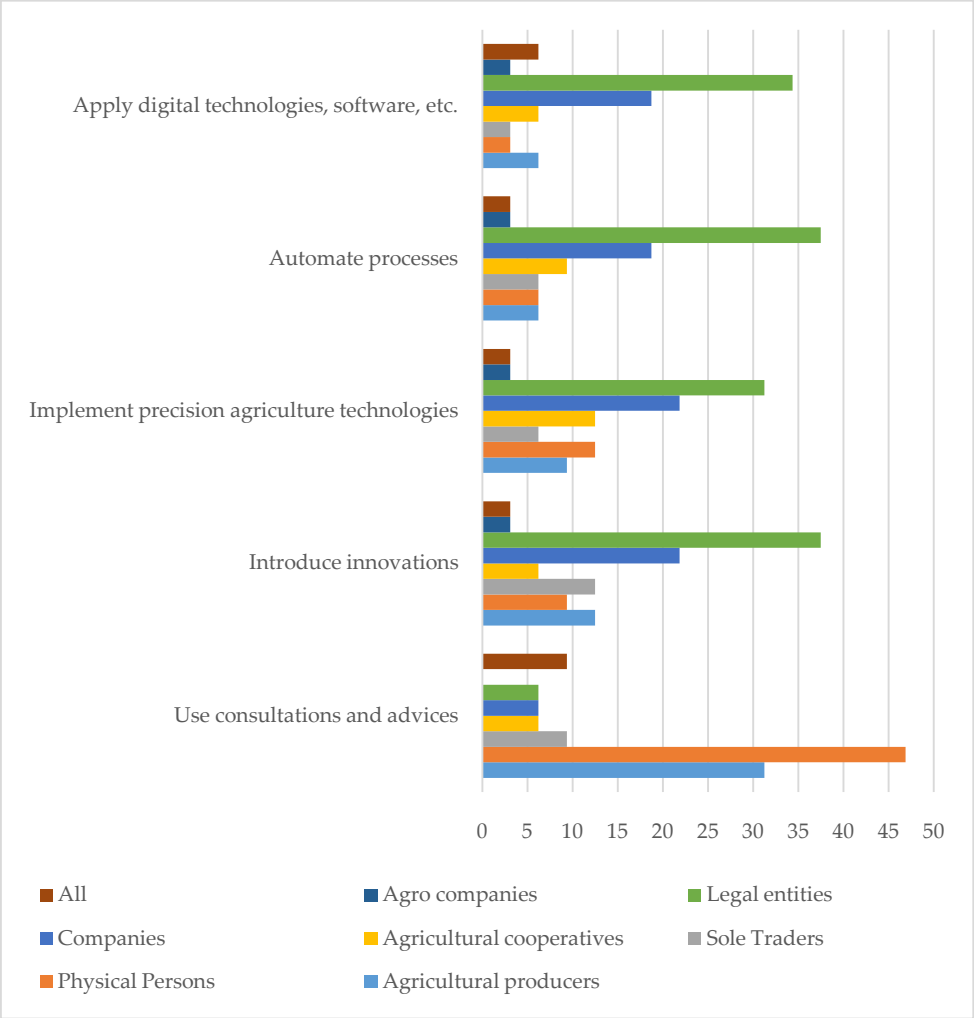

Figure 14. *Extent of Using of Advices and Consultations and Introductions of Different Type of Innovations in Farms of Different Juridical Type (%)*
Source: Experts assessment

There is also a great differentiation in the extent of using advices, consultations and introduction of innovations in farms of different sizes (Figure 15). The vast majority of experts are of the opinion that large holdings mostly innovate, apply precision agriculture 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 should be taken to extend the introduction of farm innovations of all legal types and sizes in order to reduce the wide disparities in this regard.

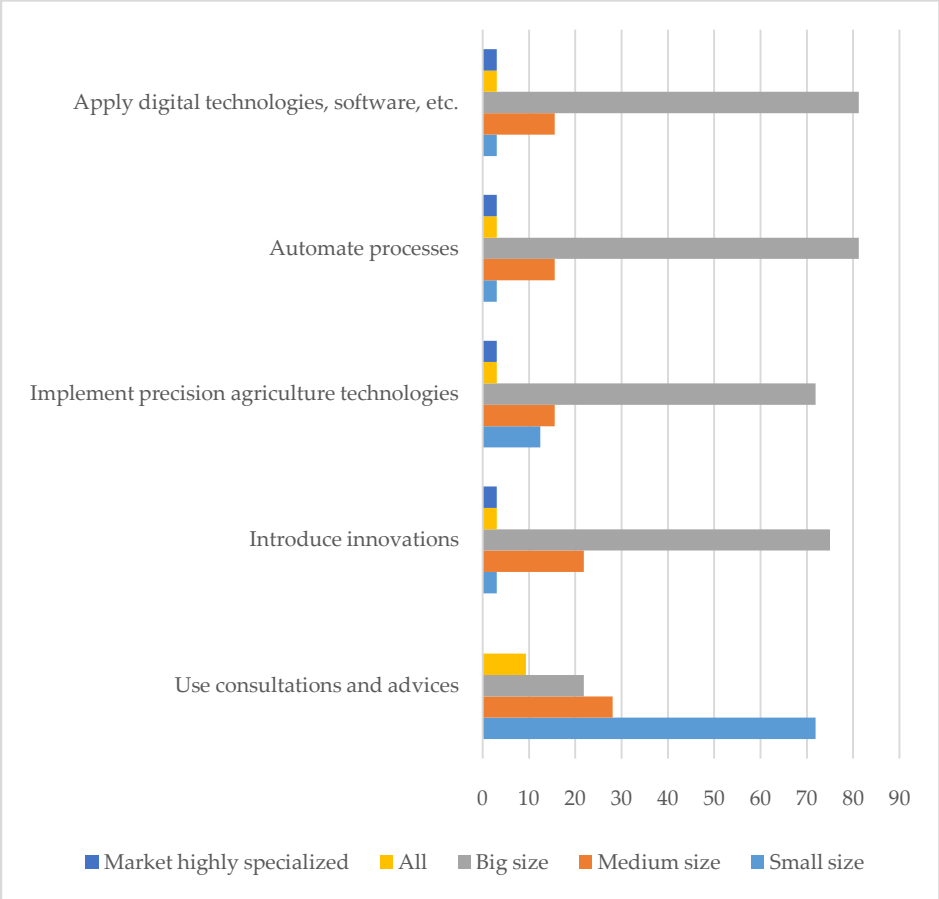

Figure 15. *Extent of Using of Advices and Consultations and Introductions of Different Type of Innovations in Farms of Different Size (%)*
Source: Experts assessment

Finally, there are differences in the degree of use of advices and consultations and the introduction of different types of innovations in different geographical regions of the country (Figure 16). 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 experts, the degree of introduction of innovations in general and the application of modern technologies for precision agriculture, process automation, digitalization, etc. in other parts of the country is small. The later requires the introduction of specific

measures for public support and partnership, for intensifying the introduction of innovations in general and in the latest trends such as advanced precision farming technologies, process automation and digitalization in other parts of the country. In this way it will be possible to overcome the great disparities in the development of the individual regions of the country.

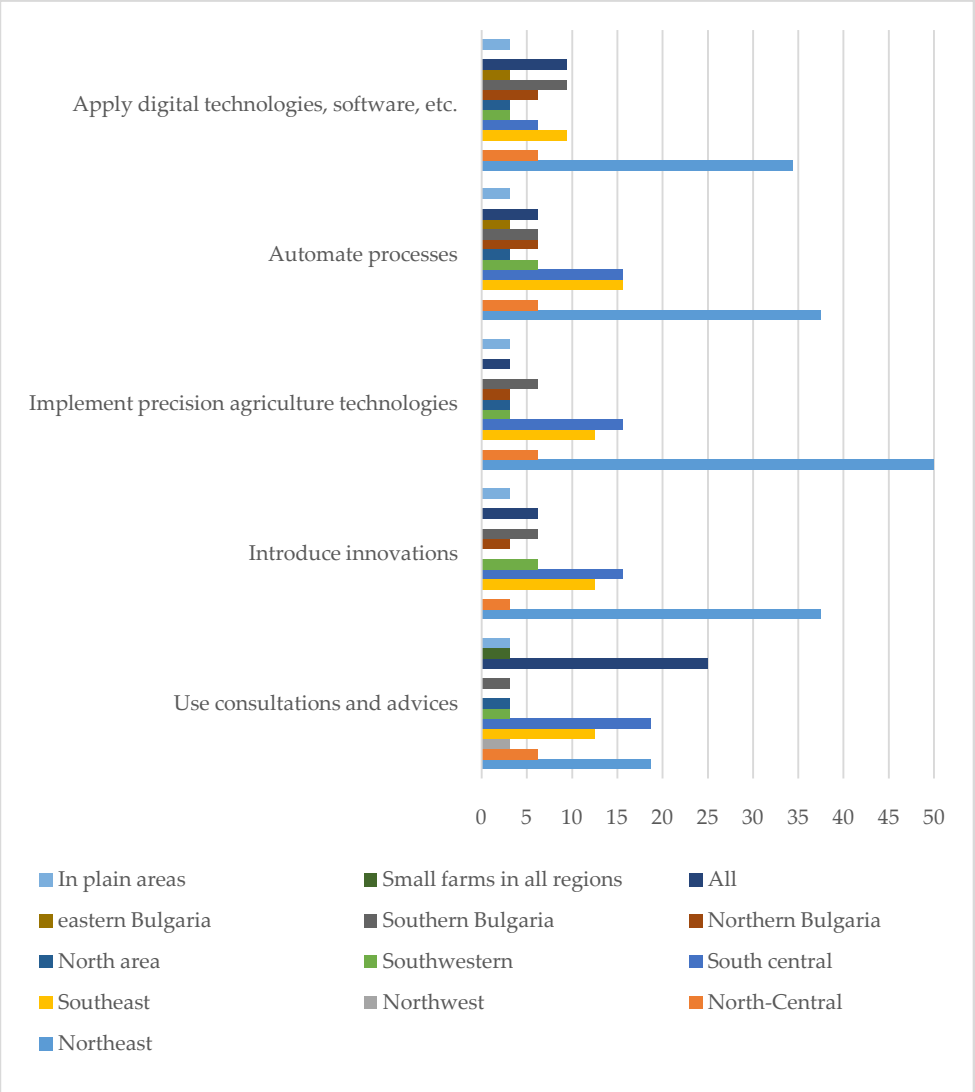

Figure 16. *Extent of Using of Advices and Consultations and Introductions of Different Type of Innovations Different Regions (%)*
Source: Experts assessment

The experts are greatly unanimous that the most significant factors (of great or very great importance) for improving the dissemination of knowledge, innovations and digitalization in agriculture and rural areas in Bulgaria at this stage are: market (consumer) demand, prices, competition, and subsidies for new investments (84.4% each), as well as the activities of the Agricultural Advisory Service (81.3%) (Figure 17). Therefore, the support for markets development, and public support (subsidies) for advices and training and private investments are to be expanded.

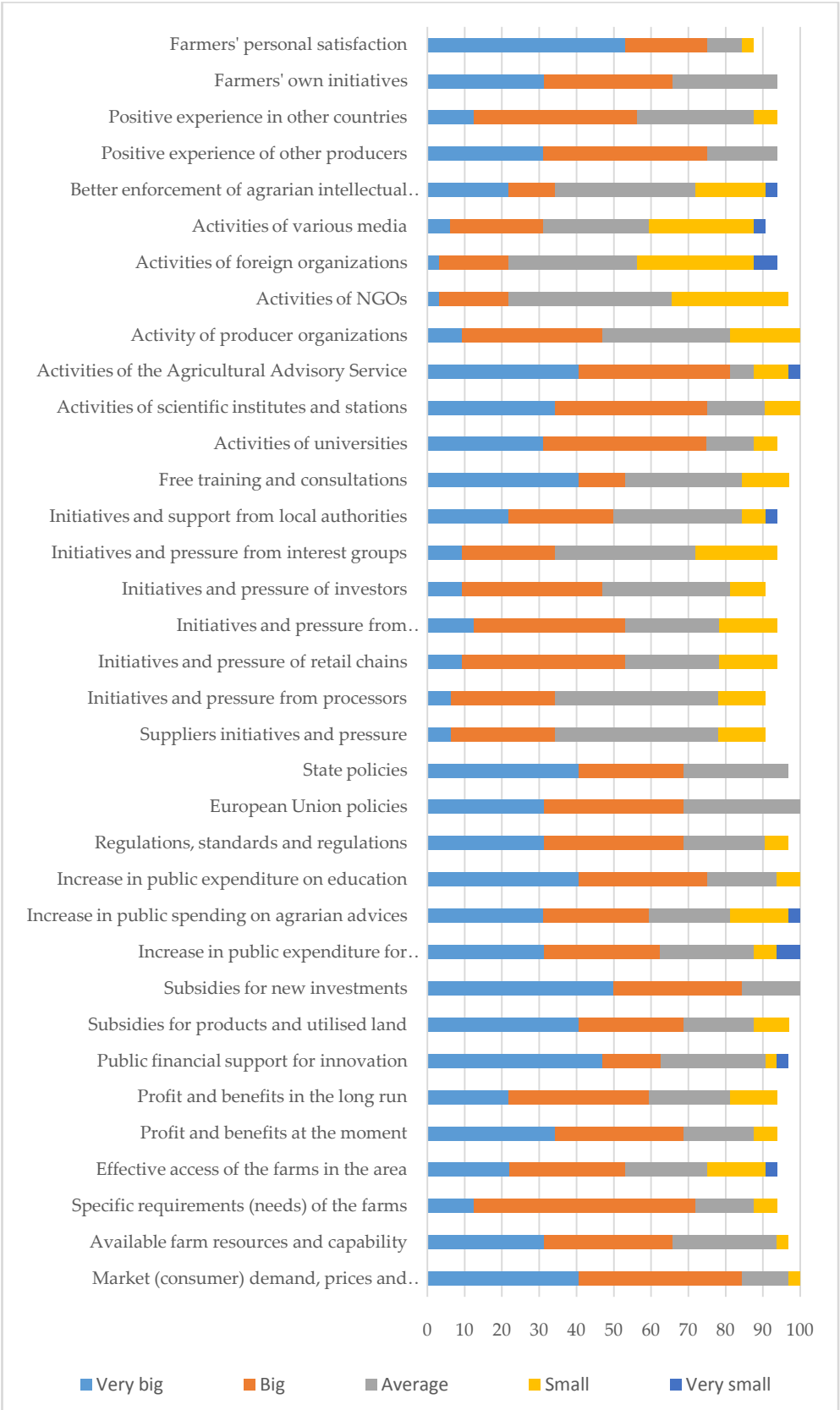

Figure 17. *Importance of Various Factors for Improving Dissemination of Knowledge, Innovation, and Digitalization of Agriculture and Rural Areas (%)*
Source: Experts assessment

Three quarters of the experts also believe that are important factors for improving dissemination of knowledge, innovations and digitalization in agriculture and rural areas are the increase in public spending on education, the activity of universities, the activities of scientific institutes and stations, the positive experience of other producers, and farmers' personal satisfaction.

A large number of experts also estimate that the specific requirements (needs) of the farms (71.9%), and the profit, and immediate benefits, the subsidies for products and utilized land, the regulations, standards and regulations, the EU policies and the 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 high rank to the available resources and capacities of the farms and farmers' own initiatives (65.6% each), as well as to the public financial support for innovations, and the growth in public expenditures for agricultural science (62.5%), the long-term profits and benefits, and the rise in public spending on agrarian advices (59.4% each), the positive experiences in other countries (56.3%), and the effective access of the farms and in the region, the initiatives and pressure of 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 situation are to be taken into account when improving the public support for the development of the knowledge sharing, innovations and digitalization system in the next programming period.

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 common objective contributes, to a large or very large extent, to the achievement of all the specific objectives of the EU CAP (Figure 18).

According to most experts, improving the dissemination of knowledge, innovations and digitalization in agriculture and rural areas contributes most to the specific objectives of the achieving sufficient agricultural incomes and sustainability (81.3%), and the enhancing market orientation and enhancement of competitiveness (78.1%).

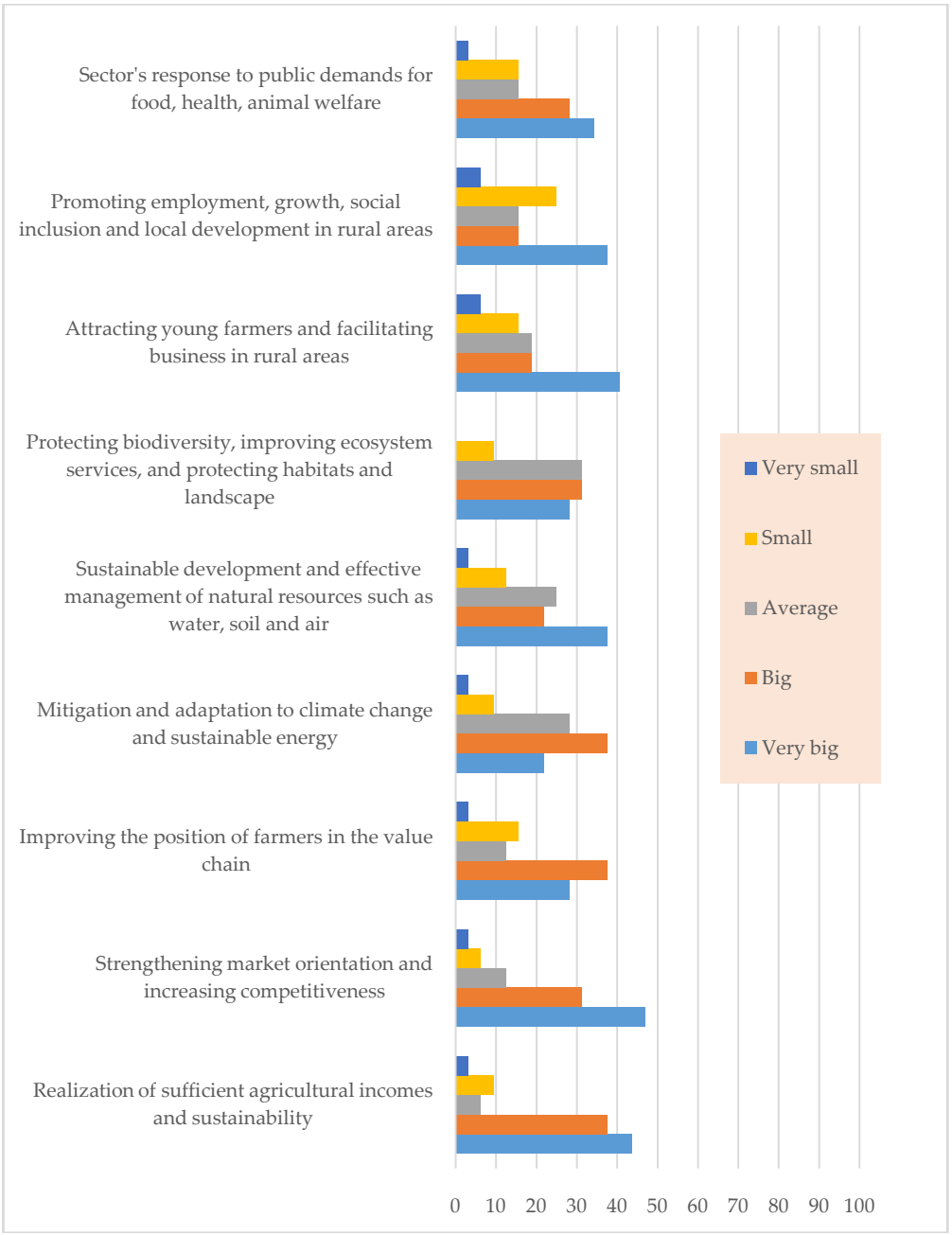

Figure 18. *Extent in which Sharing Knowledge Innovation and Digitalization in Bulgaria contributes for Realization of Different Goals of EU CAP (%)*
Source: Experts assessment

On the other hand, a comparatively smaller majority of the experts consider that improving the 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.

5. Conclusions

In recent years, there has been a significant improvement in the access of Bulgarian households to the Internet as a whole and in different regions, with large differences in access in densely populated areas and medium-urbanized and sparsely populated areas of the country. The number of people using the Internet to interact with public institutions or to order/purchase goods and services is also increasing significantly. However, compared to other EU countries, the development and use of e-government and commerce is much smaller, with Bulgaria taking the last place in this regard. The country is lagging far behind the other EU member states in terms of introduction of digital technologies in the economy and society, as in recent years the country ranking last in the EU for the integral Index for penetration of digital technologies in the economy and society.

There is a great variation in the degree of digitalization in different sub-sectors of agriculture, farms of different legal types and sizes, and in different regions of the country. Nearly half of the farmers in the country are not familiar with the content of digital agriculture, with only 14% of the farmers in the country using modern digital technologies on farms, mainly GPS navigation systems. According to the majority of Bulgarian farmers, the main obstacles and risks in the introduction of digital technologies are employees' qualifications, the size of investments, unclear economic benefits, and data security.

The main areas in needs of actions by the state administration for the introduction of digital technologies are: support for measures for further qualification of employees, tax incentives for planning measures and digitization of activities, stimulation of young professionals, introduction of internationally recognized processes of standardization and certification, adapting data protection legislation, and ensuring high-quality and high-speed networks.

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