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CHANGE IN THE FUNCTIONAL STRUCTURE OF AGRICULTURAL CONSULTING IN THE CONDITIONS OF TRANSITION TO THE DIGITAL AGRARIAN ECONOMY

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Abstract

Agroconsulting plays an important role in helping farmers to sustainably develop and modernize agricultural production. Nevertheless, the classic set of services provided has become less and less satisfying the needs of consumers and almost everywhere falls below their expectations. At the same time, the development of digitalization processes in industries is uneven; differentiation in the use of innovative solutions in agricultural production among large, medium and small forms of business is increasing. The proposed hypothesis consists in that global digital trends require a significant expansion of the scientific and production infrastructure, transformation of the functions of the elements of the institutional system, leading to a change in their significance. To disclose this hypothesis, this paper examines the impact of digital trends on changing small farm advisory practices. The analysis of the current level of development of agricultural consulting in the Russian Federation; the structure of users and their requests is investigated; the data obtained are compared with the indicators of the use of digital technologies in agriculture. It is proposed to improve the efficiency of consulting services by including "digital" components in the classic set of functions.

Key words**:** *agriculture, consulting, digital economy, system, model, economic efficiency*

INTRODUCTION

The agricultural consulting system is the most important connecting element of the innovation system, bringing modern development trends to the attention of agricultural producers. It is the specialists of the consulting services (CS) who know the peculiarities of agricultural production and work directly with farmers. They provide them practical assistance in mastering advanced production experience, helping to increase their financial stability and modernization of production through the introduction of innovative developments.

At the same time, the international community was highlighted the continued effectiveness and importance of advisory services [14, 18]. One of the strategic priorities of the European Union is to provide farmers with timely access to knowledge and information, as well as training and education. Achievement of these objectives should be facilitated by policy programs in which agricultural research and extension services play a key role.

The European Commission, through the Horizon H2020 program, is successfully promoting cross-cutting instruments such as the Farm Advisory System and the European Innovation Partnership [28]. The Regulation of the European Parliament and of the Council No. 1306/2013 noted the importance of agricultural consulting in the modernization of farms, increasing their competitiveness, adapting to climate change, sectoral integration, introducing innovations and applying new knowledge. During the 41st Session of the UN FAO Regional Conference, countries in Europe and Central Asia encouraged the organization to continue its efforts to share knowledge on policies and best practices, in particular with a focus on smallholders and family farmers, and to build a regional platform for knowledge sharing and supporting the implementation of national e-agriculture strategies for Europe and Central Asia. The importance of ensuring family

farms have access to innovative technologies through not only financial mechanisms, but also the provision of information and advisory services, was noted in the UN FAO report "The future of food and agriculture: alternative paths to 2050" (The future of food and agriculture: Alternative pathways to 2050) [11]. At the same time, economists note that the return on agricultural production in richer countries is almost twice as high as in poorer countries. Earlier this pattern was identified by Lio M. and Liu M. [21], studying the impact of information and communication technologies on agricultural production using data for 81 countries for the period 1995-2000 [6]. They argued that developing regions with small farms, low levels of infrastructure development and insufficient investment in human capital incur higher transaction costs for providing the necessary advice and services. As a result, low levels of agricultural advice and warning systems lead to a cycle of inefficient production.

In general, the agricultural consulting system remains active and at the same time the least costly mechanism for the transfer of innovative solutions to agricultural production. Understanding the peculiarities of agro-industrial production, a variety of innovative opportunities and the possession of methods of consulting activities presuppose the use of various adapted forms of knowledge transfer. Therefore, the transition of developing countries to a digital agricultural economy should be accompanied by the continuous active work of the agricultural consulting system.

For a long time, the consulting centers performed a set of classical functions and met the information needs of rural producers [4, 7, 8]. But with the development of economic relations, technological breakthroughs, and the emergence of new challenges and threats, the requirements of farmers to the list and volume of consulting services began to grow [26, 39]. The current procedure for completing the portfolio of CS proposals began to not fully meet the expectations of consumers, which in many respects was the reason for the lack of demand for consulting services on the part of representatives of the real sector of the economy [2, 6, 33]. The changed socio-economic conditions came into conflict with the outdated concept of modernization of the agricultural production management system. Global digitalization processes require a significant expansion of the composition of the research and production infrastructure, changes in the functions of the elements of the institutional system, which leads to a change in the weight of their importance. All of this requires a change in consulting practice, going beyond the usual disciplinary knowledge and the classic set of suggestions for consultants. In response to modern challenges and the dynamics of the digital trend, the vector of consulting services development should be aimed at expanding the disciplinary experience of consultants and changing consulting practices, which will create new opportunities for the development of agricultural consulting.

The purpose of this study is to substantiate promising directions for improving the functional structure of the Russian agricultural consulting system based on an analysis of trends and features of its development in the context of the transition to a digital agricultural economy.

MATERIALS AND METHODS

The methodological basis of the research: the work of Russian and foreign economists in the field of research on the innovative development of the agri-food complex based on information infrastructure.

To determine the nature of the existing agricultural consulting system in Russia, we conducted a retrospective analysis.

It is believed that the first surge of interest in the formation of a system of consulting services for agricultural production in Russia occurred in the mid-nineties of the last century, when an agreement between the Ministry of Finance of the Russian Federation and the World Bank on the allocation of a loan for the creation of the ARIS project (Agriculture Reform Implementation Support) was signed. However, in reality, the history of

this issue goes back more than 120 years. Back in 1765, the Imperial Free Economic Society was organized in Russia, the purpose of which was to train local peasants in advanced farming skills [41]. Graduates of the school were allocated land for the organization of educational facilities, at the expense of society, books were purchased for them, agricultural schools and libraries, experimental farms and stations were opened, where tests of modern agricultural technology were carried out at that time [22]. It was the members of this society who were the initiators and main organizers of the first All-Russian Exhibition of Agricultural Products in 1850.

In 1913, the Institute of Local Social Agronomy was created, which in its essence laid the foundation for a centralized agricultural consulting system in Russia. Its staff included 9,000 consultant agronomists, serving both individual owners and rural communities in general. Two years later, the League of Agrarian Reforms appeared, among the leading specialists of which were well-known Russian scientists: N.P. Oganovsky, S.L. Maslov, A.V. Chayanov, N.P. Makarov and others. In 1924 A.V. Chayanov published a work on the organization of an agricultural consulting service "Basic ideas and methods of work of public agronomy". For the first time, they paid attention to the difference in the sources of information necessary for making an optimal management decision. In his writings, he revealed the significant potential of informatization, considering it as a structure that ensures an increase in the volume of production without increasing costs and contributes to an increase in the rate of development of agriculture based on the use of new scientific discoveries and advanced knowledge about market opportunities [3].

Research in the development of agricultural consulting, theoretical and methodological substantiation of the role of consulting services in agricultural production, analysis and characteristics of classical functions began to be carried out on a large scale since the early 1960s and are still relevant [34, 16, 1, 23]. Van den Ban paid a lot of attention to the differentiation in thinking among farm managers who were ready to embrace innovation and traditional peasants [38]. In his research, he notes that "It is the most highly educated producers who make the most use of the consulting service" [39, 40]. E. John Russell and A. Fisher adhered to a similar point of view. They repeatedly emphasized the importance of international exchange of information in the field of agriculture and viewed advisory services as a source of knowledge and experience, acquisition of practical skills for more efficient use of resources to increase production productivity and improve living standards [36, 42]. In the works of V.G. Savenko, M.Ya. Veselovsky, I.S. Sandu, G.M. Demishkevich, the main approaches to the organization of activities are clarified and the principles and methods of consulting are disclosed [7].

For a long period of time, the agricultural consulting system, fulfilling a set of classical functions, satisfied the information needs of rural producers, but as economic relations developed, their requirements for the list and volume of agricultural consulting services began to increase. Rural producers around the world have begun to move away from the traditional forms of regional agricultural advisory services, increasingly searching for information on the Internet. The outdated functions of consulting services began to be replaced by new ones, connected, first of all, with the formation of a database of innovative developments, products and services that are significant for the subject area, the provision of marketing services for the determination and selection of the most promising options for technical and technological support of production, as well as on the formation of a regional package of orders for applied scientific research in the field of agriculture.

To date, few works have studied the processes associated with the change in consulting practice caused by the transformation of the socio-economic space and the development of digitalization processes. Some elements of the analysis of new styles and methods of consulting services functioning can be found in the works of R. Birner, K. Davis, J. Pender, and others. The study of the processes of qualitative change in the practice of

consulting the farming sector was carried out by a group of Australian scientists R. Nettle, A. Crawford, P. Brightling [26]. The criteria for evaluating the effectiveness of the work of consulting services are presented in the works of Semina L.A., Sandu I.S. [35].

Considering the high importance of the conducting information infrastructure in agriculture, both in Russia and in the EU countries, it is surprising that the scientific community has a small amount of analytical information on the development and effectiveness of the agricultural consulting system in these countries. Farmers' opinions on the results of using advisory services are rarely studied. In Russia, in particular, it is difficult to find indicators reflecting the effectiveness of the work of consulting services in agricultural production at the regional or municipal level. First, the financial performance of each individual farm is a trade secret. Secondly, the coverage of indicators provided by federal and regional statistics services does not correspond to the dynamics of the development of innovative technologies in real sectors of the economy. Thirdly, the data of the statistical survey in agriculture become available with a long time lag. This significantly complicates a deeper study. As a result, the author relies mainly on the data submitted until 2016 published by the national statistical offices, as well as on the results of surveys conducted in 2018 by the Kuban State Agrarian University on the use of digital technologies in agriculture in Russia and the Federal Center for Agricultural Consulting and Retraining of the Russian agro-industrial complex on the effectiveness work of the agricultural consulting system.

The research was based on data from the Federal State Statistics Service (Rosstat), Eurostat, World Bank Group, MARS, FAO, as well as analytical materials from the Ministry of Agriculture of the Russian Federation and reports on the work of regional consulting services of the agro-industrial complex. To compare Russian and foreign experience and assess the qualitative development of the national agricultural consulting system, the results of reports compiled at the request of the European Commission were used: "Agricultural Knowledge and Information System (AKIS)" (Service of agricultural knowledge and information systems), "Farm Advisory System (FAS)" (National Farmers Advisory System).

When working with statistical data sets, methods of economic and mathematical analysis were used, which made it possible to study the structure of users of agricultural consulting services and their requests, to determine the economic efficiency of the introduction of innovations by individual categories of farms with the participation of consulting services.

The methodological base was formed by the methods of systemic, comparative and factor analysis. This made it possible to compare the data obtained with the indicators of the use of digital technologies in agriculture, to determine the most popular areas of consulting for different groups of agricultural producers.

The results obtained and the conclusions drawn on their basis will serve as the basis for developing recommendations for improving the functional structure of the agricultural consulting system, taking into account the growing influence of the digitalization trend.

RESULTS AND DISCUSSIONS

The development of a system for the dissemination of agricultural knowledge is one of the most important tasks of innovative agri-food policies in developed and developing countries. Russia is no exception. A characteristic feature of the Russian agro-food complex is the predominance in its structure of small producers, whose economic activities are concentrated in rural areas. Agricultural production is less a place of work than a way of life for most farmers. But in the mass consciousness of rural residents, "traditionalist" values still prevail - adherence to the usual, fear of change, paternalistic expectations. The conservative mentality of the bulk of the rural population, the irrationality of social institutions, hinder the change of priorities in the value system of the rural population from maintaining a stable existence to focusing on accelerated

development and renewal of society, and will largely hinder the positive perception of innovations. A high proportion of the influence of informal institutional factors, the isolation of most agricultural producers from research organizations and enterprises that sell high-tech products impose their own restrictions on the process of spreading innovations in the agri-food complex and necessitate such a structure as a system of agricultural consulting. Agroconsulting remains today the most important element of the institutional system, contributing to the acceleration of the transfer of intersectoral innovative technologies in agriculture. The agricultural consulting system has the ability to directly interact with scientific organizations, governing bodies and business entities, covering the macro-, meso- and micro-levels of management.

The Russian system of agricultural consulting is a set of interrelated structural elements, which are based on consulting organizations at the regional and district levels [32, 4, 25]. They are closest to agricultural producers and directly work with them, providing practical assistance in the development of advanced production experience, innovative developments, as well as in the adoption and implementation of managerial, organizational, economic and technical decisions. In 2018, in 62 out of 85 constituent entities of the Russian Federation, 87 organizations provided consulting services in the field of agro-industrial complex and rural development at the regional level and 190 at the district level. In 2018, 554 consultants worked in district structures, on average 3 consultants per center [30].

With all the variety of forms of agricultural consulting system organization, the Ministry of Agriculture of the Russian Federation has chosen to form a vertically hierarchical one, in which most services are structural subdivisions of sectoral governing bodies or created on the basis of large regional multidisciplinary universities. This scheme has become more and more susceptible to criticism by agricultural producers, since it is considered poorly adaptable to external factors. Since the beginning of the 2000s, foreign governments began to abandon the division into federal and regional consulting services in favor of commercial consulting, working according to individual customer schemes with a wide range of services provided. In most EU countries, agricultural advisory services are predominantly provided by commercial organizations. Flexible policy of budgetary co-financing of consulting services removes part of the financial burden from farms.

Table 1. Main characteristics of agricultural consulting systems in Europe and the Russian Federation

Country	Subsidizing contracts for the payment of consulting services %	Share of expenses for consulting services in % of income
Hungary	80%	1.11%
Italy	80%	0.80%
Lithuania	80%	2.19%
Belgium	80%	1%
Finland	80%	0.28%
Estonia	75%	0.51%
Luxembourg	70%	0.41%
Latvia	70%	0.41%
Sweden	70%	0.58%
Czech Republic	68%	1.10%
Germany	60%	0.81%
Netherlands	50%	2.22%
Denmark	0	2.02%
Russian Federation	0	>3%

Source: Compiled by the author based on data [10].

Table 1 shows the amount of subsidies for contracts for payment of consulting services and the share of expenses for consulting services to income in Europe and the Russian Federation.

Table 1 shows that in Germany government subsidies for contracts for the payment of commercial services in the field of agricultural consulting amounted to about 60%, while the share of farmers' expenses does not exceed 0.81% of the total profit. In Finland, Lithuania, Hungary, Belgium and Italy, the state compensated up to 80% of the costs of agricultural producers for consulting services. The share of own expenses of farmers in the listed countries for agricultural consulting services ranged from 2.19% to 0.8% of their annual income [12]. In Russia, consulting activities in most constituent entities are supported from regional budgets, therefore basic consulting services are free for agricultural producers. Russian regional consulting centers provide individual or group services to customers on a wide range of issues within their competence: they conduct field research, training events, seminars, exhibitions and specialized conferences. However, consulting services in the field of economics and organization of production, software development, geoanalytics are paid. As a result, the costs of these services have a high specific weight relative to their income.

The results of the research projects "Evaluation of the Implementation of the Farm Advisory System" and "Prospects for Farmers' Support: Advisory Services in European AKIS", published by the European Commission, show that consulting services are increasingly in demand in the EU countries in recent years. The latter are associated with the search for additional sources of increasing production efficiency through the use of resource-saving technologies (renewable energy sources (40.1% of requests), ecology and environmental protection (33.1%), diversification of production (27.8 %). The demand for software maintenance services among farmers in European countries, as well as services in the field of rural development, is, on average, three times higher than the Russian level. Such a structure of requests points on the vector of farmers' strategic planning with focus on long-term development, while a characteristic feature of Russian agricultural producers is an orientation towards achieving short-term goals.

Analyzing the structure of services of Russian regional agricultural consulting centers, the following can be noted. The provision of professional assistance in the field of crop and livestock production, as in all countries, is in stable demand among consumers. The structure of other directions of inquiries of clients of consulting services from 2002 to 2018 has changed significantly. Answers to questions related to software and informatization, despite their relatively high cost in comparison with other paid services of CS, have become more in demand (from 0.3% to 6%). Also, a positive trend in the number of consulting services provided was noted in the field of economics and organization of production (from 9 to 13%). However, in recent years, farmers have become more selective about the sources of information, seeking to independently apply new knowledge in business planning and production design. In the structure of consulting services provided by agricultural consulting organizations, accounting services from 2002 to 2016 first increased from 8 to 11%, then in 2018 they decreased to 7.6%. The issues of legal support remained at the level of 5% [8]. The share of consulting services in the field of marketing fell from 10% to 1.7%, mechanization from 9% to 4.1%, land relations - from 5% to 1%.

The study of the experience of the most effective consulting services of the Russian Federation regions shows that the implementation of the consultants' proposals can contribute to a multiple reduction in the risks of making erroneous management decisions and form an increase in the sustainability of the development of farms. Regulatory information on the ratio of supply and demand in the market, prices for food products provides an opportunity already at the planning stage not only to rationally distribute the totality of labor and material and

technical resources, but also to adequately correlate the position of the organization in relation to its main competitors.

Figure 1 shows the dynamics of the share of various categories of recipients of services of regional and municipal consulting services for 2012 – 2018.

Analysis of the structure of users of services of agricultural consulting organizations in the regions of the Russian Federation shows the predominance of small forms of farming. In 2016, compared to 2012, the share of peasant-farm households (PFH) in the structure of consumers of services increased from 31% to 45% [31]. By 2018, the share of PFH decreased to 35.5%, while the total share of small enterprises in the structure of service recipients was 53.7%.

The number of hits from representatives of large agricultural organizations in 2016 decreased (the share was 23%) with a noticeable increase to 30.7% in 2018.

Small farmers are little able to effectively use modern equipment and technologies. A small seasonal profit and a low level of capital concentration do not allow to ensure the acquisition of a complex of innovative developments and to employ several highly qualified specialists (agronomists, livestock specialists, accountants, lawyers, programmers, etc.) [17, 19].

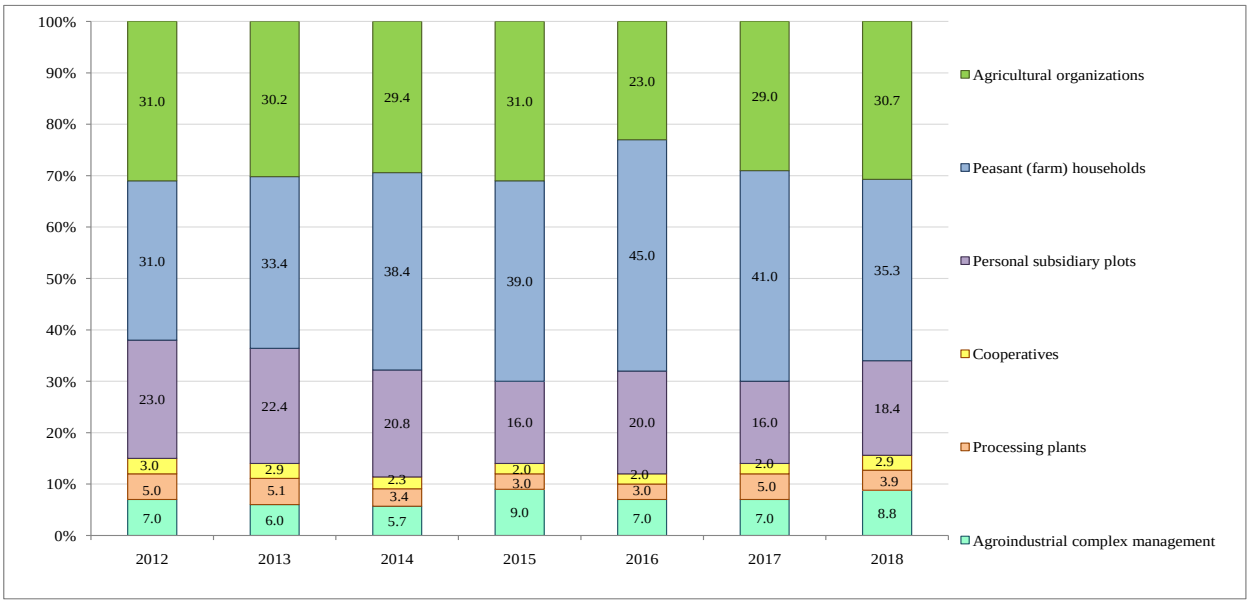

Fig.1. The structure of recipients of services of regional and municipal consulting services for 2012 - 2018, in %.
Source: [30, 31].

Figure 2 shows how much the share of small farms that used innovative technologies in 2018 is less than large agricultural organizations. Every year, the differentiation in the use of innovative solutions in agricultural production among large, medium and small forms of farming is increasing. The largest share among the introduced innovative technologies was the system of wastewater disposal and treatment of industrial effluents, as well as the construction of treatment facilities at livestock farms. This is largely due to the need to comply with the standards in accordance with changes in legislation in order to implement the Decree of the President of the Russian Federation dated 05/07/2018 No. 204 "On national goals and strategic objectives for the development of the Russian Federation for the period up to 2024" in terms of ecology [5]. Already in 2018, more than 15% of agricultural organizations implemented the system of precise driving and diagnostic quality control of technological processes. Among small farmers, the most popular are biological methods of protecting plants from pests and diseases, individual feeding systems for livestock, a system of drainage and treatment of industrial effluents.

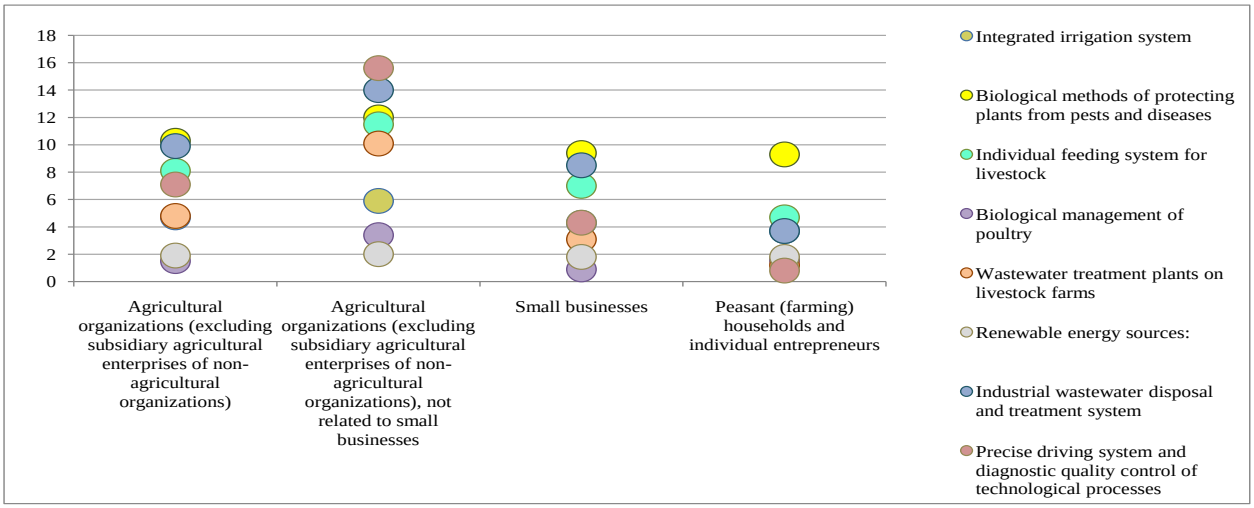

Fig. 2. The share of agricultural organizations, peasant (farmer) households and individual entrepreneurs using innovative technologies in 2018, in %
Source: [20, 27].

Systems of precise driving and diagnostic quality control of technological processes are used by only 4.3% of small enterprises and 0.8% of PFH.

The analysis of innovative activity indicators in the agri-food complex of Russia shows that the rate of introduction of new technologies in agricultural production does not correspond to world standards. According to federal statistical observation, the share of innovative goods, works and services produced by Russian agricultural organizations in 2017 amounted to 1.7% of the total, the intensity of expenditures on technological innovation reached only 0.7% [15]. In 2019, the indicators increased slightly. The share of innovatively active agricultural organizations in the total number was 5.8%, the share of innovative goods, works and services produced by them was 2.36% of the total [13].

Table 2 presents the results of the implementation of innovations by individual categories of farms with the participation of Russian agricultural consulting services in 2016. The generalization of data on innovations introduced by agricultural producers directly with the help of consulting services and the resulting economic effect indicates the significant potential of agricultural consulting.

Table 2. The results of the introduction of innovations by individual categories of farms with the participation of consulting services of the agro-industrial complex in 2016

Industries and areas of innovation	Service recipients							Innovation efficiency	
	Agricultural organizations		PFH		Personal subsidiary plots		Others	Expected economic effect, thousand rubles	The resulting economic effect, thousand rubles
	units	in the number of farms	units	in the number of farms	units	in the number of farms			
Introduced innovations in crop production	119	17,633	52	78	23	260	2	243,701	221,944
Implemented innovations in animal husbandry	139	116	58	56	30	59	20	906,946	371,917
Introduced innovations in the field of economics and organization of production	47	35	28	24	12	36	4	60,870	30,371.1
Number of innovation and investment projects *(developed/mastered)*	240	121	251	112	221	178	26	1,101,895	558,704

Source: Compiled by the author based on data [31].

Analysis of the results of innovative activities of services by recipients of services showed that in 2016 the percentage of development was about 80 points. In agricultural organizations, every second innovation and investment project in the field of organizing production, crop production and animal husbandry was mastered.

One of the main directions of innovative development of agriculture and its subsectors is the large-scale implementation of digital technologies. In 2019, the Ministry of Agriculture of the Russian Federation proposed a departmental project "Digital Agriculture" [9]. The goal of the project is to transform agriculture through the introduction of digital technologies and platform solutions to ensure a technological breakthrough in the agro-industrial complex and achieve a 2-fold increase in productivity in digital agricultural enterprises by 2024. In accordance with the objectives of the project, the share of specialists from agricultural enterprises who have undergone retraining and have competencies in the field of the digital economy to work with digital products and technologies,% (of the total number of specialists employed in agricultural enterprises) should be 50% by 2024.

In the same year, the Center for Forecasting and Monitoring the Scientific and Technical Development of the Agro-Industrial Complex in the field of precision agriculture, automation and robotization [37] conducted a survey of more than 80 farmers and heads of agricultural enterprises, as well as experts in the field of management and development of the agro-industrial complex According to the survey results, the requirements for the qualifications of employees in agricultural enterprises vary depending on their size. Thus, 46% of respondents noted that they accept workers mainly with secondary vocational education (not excluding higher education), 22% want to have employees only with higher education, and 32% (mainly small enterprises and peasant (farm)) do not impose requirements at all on the level of education of their employees. At the same time, 73% of representatives of small businesses have already realized the need to use digital technologies to improve the efficiency of production and management, but more than half of agricultural producers believe that the share of economic entities that have introduced elements of digital technologies into production will not reach 50% declared in the Project by 2024.

According to the respondents, the acceleration of the digitalization of the agricultural industry will be facilitated by subsidies and preferential loans for the acquisition of elements of digital technologies, as well as an increase in the share of IT specialists in the total number of employees. But according to the Analytical Center of the Ministry of Agriculture of the Russian Federation, today there is an acute shortage of IT specialists in the industry (the number of people employed in agriculture is 4,706 thousand people (6.5%), of which ~ 113 thousand people are in IT). The shortage of IT specialists in the Russian agro-industrial complex is at least 90 thousand people [24]. One of the main reasons for the shortage of personnel for the transition to the digital economy of the agro-industrial complex is the lag of the teacher training system behind the modern requirements of educational standards, which contributes to the reproduction of competencies inherent in the analogue economy in subsequent generations of workers. The growing level of technological equipment of modern industrial complexes, as well as the ever higher expectations that the digital economy places on them, require not only retraining of agricultural workers in new high-margin segments (organic farming, production of specific non-mass agricultural products), but also more in-depth non-agricultural training [2]. To eliminate personnel imbalances in the short term, consulting services can be assigned an intermediary function to find partners for IT outsourcing and other services in the field of agricultural production. When clients contact them, they can recommend both their own personnel and external specialists, using crowdsourcing technologies [33]. In the future, as a solution to the problem, it is necessary to create a system for training specialists for agricultural enterprises in the

field of digital agriculture and retraining specialists for agricultural enterprises on the basis of educational and experimental farms of the Ministry of Agriculture of the Russian Federation, consulting services of the agro-industrial complex and commercial enterprises. The expediency of creating such centers of competence was noted by 98% of the respondents. The need to adapt as quickly as possible to digitalization conditions transforms the classic set of functions of consulting services, including "digital" components. Figure 3 shows the classic, innovative and digital directions of work of the consulting services of the Russian agro-industrial complex.

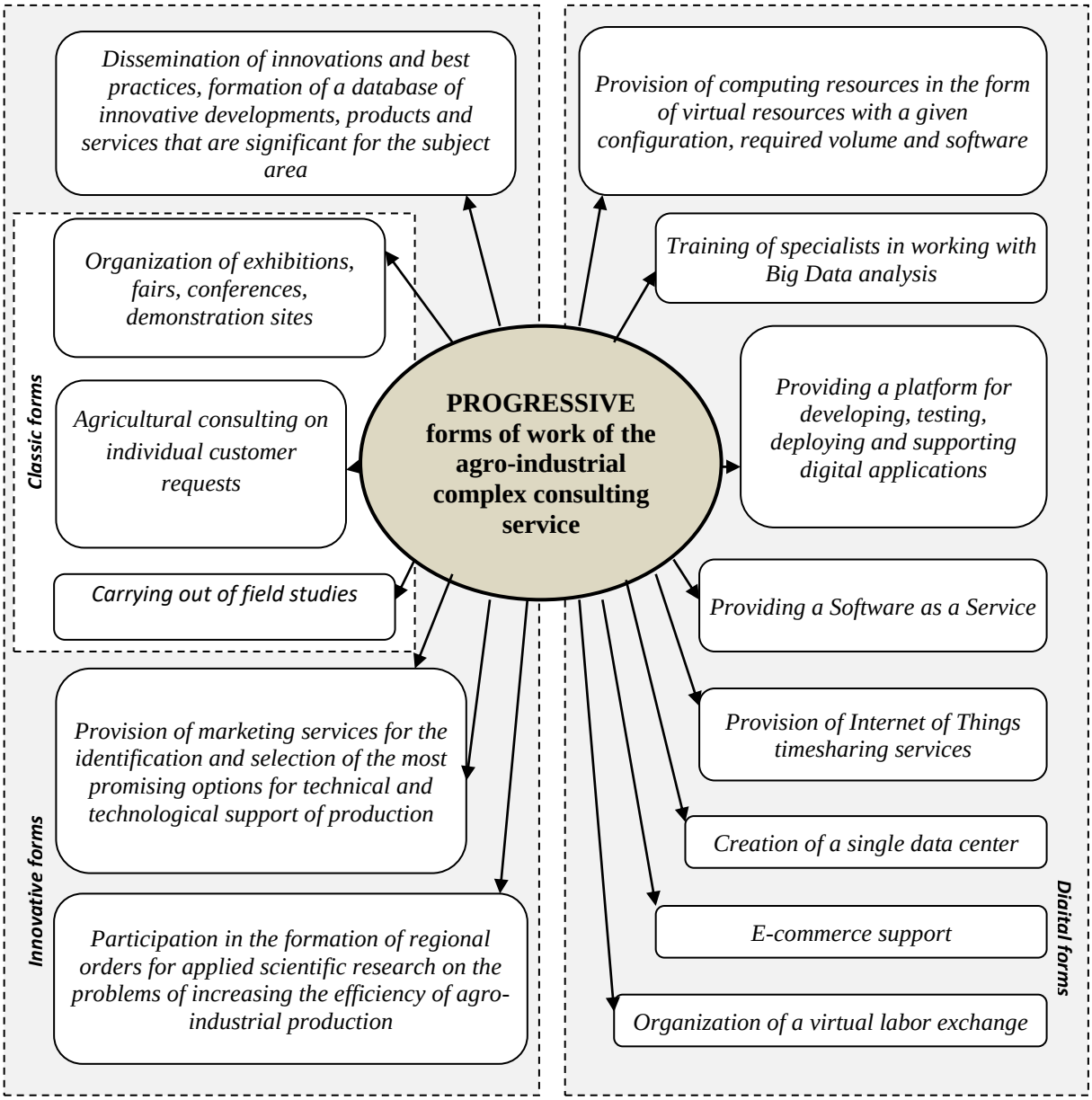

Fig.3. Progressive forms of work of consulting services of the agro-industrial complex of the Russian Federation
Source: [2, 17, 33].

The classic forms of consulting services work successfully with innovative directions that took shape 15 years ago. Until now, the most effective way for the dissemination of promising varieties of agricultural crops, breeds of productive animals, machinery and equipment is the organization of demonstration objects (fields and farms) by employees of consulting services. According to the annual reports on monitoring the provision of consulting assistance to agricultural producers and the rural population

of the Russian Federation, 78 exhibitions were held in 2014, and in 2016 their number increased to 407 (187 regional and 220 district levels), 356 demonstration objects were organized (104 regional, 93 district and 159 under agreements with agricultural organizations), as well as 315 "Field days". Maunder also believes that extensive advisory methods without demonstrations and field practice have very little effect and should therefore be retained as a classic feature set [1]. Thus, while acquiring new functions, consulting services retain their basic functional structure due to the predominance of biological processes in agriculture and the associated risks and uncertainties. For example, most IT startups avoid field trials by using “fast” data collection and analysis techniques to get to market as quickly as possible. However, farmers cannot afford to make a mistake when introducing new technology, in this regard, the organization of demonstration sites, experimental stations by specialists, as well as conducting thematic seminars will remain in demand, both on the part of farmers and commercial enterprises.

Agriculture is becoming an object of research with a large set of digital data. According to the forecast prepared by the Higher School of Economics, by 2030 the global market for self-driving vehicles based on micro-geolocation will grow 70 times and will amount to 157.5 billion dollars. The use of GPS/GLONASS sensors and RFID-tags (Radio Frequency IDentification), which carry out radio frequency identification for the logistics of agricultural production, will increase by 1.7 times, the market of integrated control and accounting systems in agriculture, combined with telematics systems, will grow by 1.73 times, and aerospace services, including geolocation, remote sensing and hydrometeorological information, 1.72 times [29]. This will contribute to an increase in interest in remote informing about the state of farmland and in a decision support system for farmers through online services. Therefore, we believe that the distribution of software, both highly specialized and general purpose, should be among the functions of the next generation of consulting services.

As part of the planned activities of the Departmental Project "Digital Agriculture", the Ministry of Agriculture of the Russian Federation has compiled a Catalog of digital solutions for the analysis, study and subsequent scaling of the most successful cases in the field of big data and artificial intelligence, the Internet of things, robotization of processes and various specialized services (digital platforms and systems). The catalog contains digital developments in the field of the agro-industrial complex, as well as companies that implement them in practice. Specialists of consulting services are able to adapt one or another innovative development to the specific conditions of the farm, draw up a business plan and help make a rational management decision. In addition, the replication of innovative developments remains one of the basic functions of agricultural consulting. Activities to promote innovation among agricultural producers are fully subsidized by the state.

In accordance with the informatization plan of the Ministry of Agriculture of the Russian Federation, back in 2016, the Federal Network for the Exchange of Knowledge and Technologies in the Field of Agriculture was launched, developed to provide consultants of the agricultural consulting system with competent information to improve the quality of the consulting services provided. The information platform is a repository of industry data on innovations, technologies, business; statistical materials; regularly updated industry directories; technological solutions (tools for collecting and processing information, contact center solutions integrated with a CRM (Customer Relationship Management) solution). The communication platform provides an opportunity for agricultural consulting to interact with the industry community. Consulting platform is an integrated web-based solution for providing a wide range of paid consulting services. Thus, by providing agricultural producers with access to state automated information systems, platforms for developing, deploying and supporting digital applications, distributing the necessary

software for this and training specialists in working with the Internet of Things and big data analysis technologies, consulting services are developing new areas of activity, laying the digital vector of development. We believe that a promising direction for the development of agricultural consulting is the creation of platforms for testing the best foreign practices in the use of digital technologies in the field of agriculture. This will facilitate their natural transfer and adaptation to specific Russian conditions.

The expansion of end-to-end digitalization of agriculture is also associated with the creation of optimal product chains that unite, in addition to producers and consumers of agricultural products, trade and processing enterprises, building logistic transportation schemes, fixing price information, coordinating the work of tax, customs and other authorities in the field of agriculture. The activity of agricultural consulting services improves the institutional structure of regional agrosystems, the model of cooperation of its subjects, contributing not only to reducing the cost of production, but also speeding up the process of its implementation. After assessing the volume and structure of demand, the farmer independently interacts with the end consumer, reducing the number of links in the value added chain. The transition to direct supplies of products helps to reduce the level of prices for basic foodstuffs, will create preconditions for increasing the volume of lending to the industry, and will contribute to its investment attractiveness from private capital.

CONCLUSIONS

The study touches upon the problem of the disproportion between the possibilities of the dynamically developing digital technologies in the world and their insufficient use in solving urgent problems of agriculture. This digital divide can be explained by the peculiarity of agricultural production, lack of government funding for the industry, the predominance of small forms of farming in the agri-food complex, and a high proportion of the influence of informal institutional factors. A uniform standard set of measures to overcome the digital inequality is of little use for different regional agricultural systems. Therefore, the modernization of agriculture based on digital technologies requires a balanced approach, including a set of universal tools to support the modernization of agricultural production and a set of differentiated mechanisms for approbation and implementation of IT technologies, adapted to the conditions of the intra-industry environment.

The agricultural consulting system is one of the most important mechanisms for a balanced ecosystem of innovative development of the agri-food complex based on the use of digital technologies. But the current order of completing the portfolio of offerings of consulting services does not fully meet the expectations of consumers. This is largely the reason for the decrease in the demand for agricultural consulting on the part of representatives of the real sector of the economy.

The changed socio-economic conditions came into conflict with the outdated concept of modernization of agricultural production, which requires changes in consulting practice, going beyond the usual disciplinary knowledge and the classic set of consultants' proposals.

The digitalisation phenomenon is redefining the concept of consulting services by adding "digital" components to the classic feature set. In this regard, we propose several directions for improving the functional structure of the Russian agricultural consulting system that meets the trends of the digital economy.

This is assisting small and medium-sized businesses in the form of providing them with access to state automated information systems, supporting e-commerce, forming a package of orders for conducting the most popular applied scientific research, providing training for specialists of agricultural enterprises and expanding the disciplinary experience of the consultants themselves in the direction of working with the Internet. things, big data analysis technologies, spatial sensing materials and geoanalytic products.

REFERENCES

[1]Bareiss, G., Hruschka, E., Rheinwald, H., 1962, Probleme des Beispielbetriebes. Ullmer Verlag, Stuttgart, 1962. 133 p.

[2]Bylina, S., Kadomtseva, M., Osovin, M., 2018, Informatization of the agri-food complex and rural territories of Russia: opportunities and limitations. 2018. 228 p.

[3]Chayanov, A., 1924, The main ideas and methods of work of Public Agronomy. - 3rd ed., People's Commissariat for Land "New Village" (Osnovnyye idei i metody raboty Obshchestvennoy Agronomii. – 3rd ed., Narkomzem «Novaya derevnya»), Moscow, 132 p. (In Russian)

[4]Concept for the development of the agricultural consulting system for the period up to 2015 (Kontseptsiya razvitiya sistemy sel'skokhozyaystvennogo konsul'tirovaniya na period do 2015 goda), Moskva, 2009. 66 p. (In Russian)

[5]Decree of the President of the Russian Federation of 07.05.2018 No. 204 "On national goals and strategic objectives of the development of the Russian Federation for the period up to 2024" http://www.kremlin.ru/acts/bank/43027/page/1, Accessed on March 01, 2021.

[6]Deichmann, U., Goyal, A., Mishra, D., 2016, Will Digital Technologies Transform Agriculturein Developing Countries? World Development Report Team & Development Research Group Environment and Energy Team. 2016. 28 p.

[7]Demishkevich, G., Sandu, I., 2013, Organizational and economic aspects of the development of innovation and consulting activities in the agro-industrial complex of Russia, VNIIESH, Moscow, 148 p. (In Russian)

[8]Demishkevich, G., 2009, Formation and development of the agricultural consulting system, (Formirovaniye i razvitiye sistemy sel'skokhozyaystvennogo konsul'tirovaniya), FGU RCSK, Moskva, 2009. 296 p. (In Russian)

[9]Departmental project "Digital Agriculture": official publication (Vedomstvennyy proyekt «Tsifrovoye sel'skoye khozyaystvo»: ofitsial'noye izdaniye), «Rosinformagrotch», Moscow, 2019, 48 p. http://mcx.ru/upload/iblock/900/900863fae06c026826a9ee43e124d058.pdf (In Russian).

[10]Evaluation of the Implementation of the Farm Advisory System. Final Report – Evaluation Part. Belgium. 2009. p.183.

[11]FAO, 2018, The future of food and agriculture – Alternative pathways to 2050. Rome. 224 p. Accessed on March 03, 2021.

[12]FAS implementation in the EU Setting-up, farm advisory bodies and rural development support, JRC Scientific and Technical Reports. 2016. https://www.europarl.europa.eu/RegData/etudes/STUD/2016/573448/IPOL_STU(2016)573448_EN.pdf, Accessed on January 21, 2021.

[13]Federal statistical observation data according to form No. 4-innovation "Information on the organization's innovative activity" https://fedstat.ru/form/10206, Accessed on March 31, 2021.

[14]Ferroni, M., Zhou, Y., 2012, Achievements and Challenges in Agricultural Extension in India, Global J. Emerg. Market Econom., 2012, 4 (3):319-346.

[15]Gohberg, L., Ditkovskij, K., Evnevich, E., 2021, The science. Technologies. Innovation: 2021: A Brief Statistical Compendium. (Nauka. Tekhnologii. Innovatsii: 2021: kratkiy statisticheskiy sbornik). NSU «High school of economy», Moskva, 2021. 92 p. (In Russian).

[16]Jones, A., 1963, The agricultural economist and his tools. Extension work. Proceedings of the 1 lth International Conference of Agricultural Economists Cuernavava. Oxford Univ. Press, London, 1963. pp.135-155.

[17]Kadomtseva, M., Osovin, M., 2019, Prospects for the development of a national agricultural consulting system in the context of the transition to a digital agricultural economy, Bulletin of NGIEI, 2019, 2 (93): 83-95.

[18]Kansiime, M., Asten, P., Sneyers, K., 2018, Farm diversity and resource use efficiency: Targeting agricultural policy interventions in East Africa farming systems, NJAS - Wageningen J. Life Sci., 2018, 85:32-41.

[19]Korolkova, A., Kuzmin, V., Marinchenko, T., Goryacheva, A., 2019, Support and stimulation of demand for innovative products and technologies in the agro-industrial complex: scientific analytical overview, «Rosinformagrotch», Moscow, 2019. 232 p.

[20]Kozubenko, I., 2018, Introduce digital technologies, Inform. bul. Ministry of Agriculture of Russia (Vvodim tsifrovyye tekhnologii, Inform. byul. Minsel'khoza Rossii, 2018, 7:13-16. (In Russian)

[21]Lio, M., Liu, M.C., 2006, ICT and agricultural productivity: evidence from cross-country data, Agricultural Economics, 2006, 34 (3):221-228.

[22]Lukichyov P., 2016, Imperial Free Economic Society and its role in the development of agriculture in Russia (to the 250th anniversary of IFES) / Bulletin of S.-PbSAU, 2016, 42:283-289. [Лукичёв П.М., 2016, Императорское вольное экономическое общество и его роль в развитии сельского хозяйства России (к 250-летию ИВЭО) / Известия С.-ПбГАУ, 2016, № 42:283-289.]

[23]Maunder, A., 1973, Agricultural Extension. A reference manual (Abridged version). Rome: Food and Agriculture Organisation of the United Nations. 1973. 103 p.

[24]Ministry of Agriculture of the Russian Federation. Department of digital development and management of state information resources of the agro-industrial complex. Analytical Center of the Ministry of Agriculture, 2019. https://rupto.ru/content/uploadfiles/presentations/motorin-20092018.pdf

[25]Nechaev, V., Sandu, I., Demishkevich, G., 2014, Organization of consulting activities in APK

(Organizatsiya konsul'tatsionnoy deyatel'nosti v APK), Lan', S.-Petersburg, 2014. 320 p. (In Russian)

[26]Nettle, R., Crawford, A., Brightling, P., 2018, How private-sector farm advisors change their practices: An Australian case study, J. Rural Studies, 2018, 58:20-27.

[27]Petrikov, A., 2018, The use of innovative technologies by various categories of farms and the improvement of scientific and technological policy in the agriculture sector, Agro-industrial complex: economics, management, 2018, 9:4-11.

[28]PRO-AKIS, 2012, Prospects for farmers' support: Advisory services in European AKIS. EU's Seventh Framework Programme for Research EU) No 1306/2013 Of the european parliament and of the council of 17 December 2013 on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008 https://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:32013R1306&from=en, Accessed on March 26, 2021.

[29] Prospect of scientific and technical development of the agro-industrial complex of the Russian Federation for the period up to 2030 (Prognoz nauchno-tekhnicheskogo razvitiya agropromyshlennogo kompleksa Rossiy-skoy Federatsii na period do 2030 goda) (In Russian). http://www.mcx.ru/documents/file_document/v7_show/37653.156.htm. Accessed on February 10, 2021.

[30]Report on the results of monitoring the development of the agricultural consulting system in Russia. http://mcx-consult.ru/page0125022010, Accessed on January 17, 2021.

[31]Report on monitoring the provision of consulting assistance to agricultural producers and rural population in the Russian Federation in 2016. http://mcx-consult.ru/otchety-ob-okazanii-konsultatsionnoy-pomoshchi-selskokhozyaystvennym-tovaroproizvoditelyam-i-selskomu-naseleniyu-v-rossiyskoy-federatsii, Accessed on January 29, 2021.

[32]Ruposhev, A., 2011, Information and consulting support of innovative activities of the crop sector of the agro-industrial complex, V Int. Scientific-Practical conference, «Rosinformagrotch», Moscow, 2011, pp. 231-239.

[33]Sandu, I., Savenko, V., Sokolov, K., 2017, Crowdsourcing as a tool for developing the activities of information and consulting services, Fundamental and applied research of the cooperative sector of the economy, 2017,6:78-80.

[34]Sharma, S., 1960, A comparative study of the training of agricultural advisory personnel in the Netherlands and India. Thesis Agric. Univ. Wageningen, 1960. 183 p.

[35]Syomina, L., Sandu, I., Demishkevich, G., 2017, The effectiveness of the functioning of consulting organizations in the agro-industrial complex: issues of theory and practice // Scientific electronic publication / Barnaul, 2017, http://elibrary.asu.ru/xmlui/bitstream/handle/asu/3477/read.7book?sequence=1&isAllowed=y. Accessed on February 28, 2021. [Сёмина Л.А., Санду И.С., Демишкевич Г.М. , 2017, Эффективность функционирования консультационных организаций в АПК: вопросы теории и практики // Научное электронное издание / Барнаул, 2017]

[36]Thornton, H., 1966, «Edward John Russell. 1872-1965». Biographical Memoirs of Fellows of the Royal Society, 1966, 12:456-477. http://www.plantphysiol.org/content/plantphysiol/19/3/391.full.pdf. Accessed on February 28, 2021.

[37]Truflyak, E., Klejmer, A., Kurchenko, N., 2019, Results of the survey in the direction of the departmental project "Digital Agriculture"(Rezul'taty anketirovaniya po napravleniyu vedomstvennogo proyekta «Tsifrovoye sel'skoye khozyaystvo»), KubGAU, Krasnodar, 2019. 27 p. (In Russian).

[38]Van den Ban, A. W., 1961, Research in the field of advisory work, Neth. J. Agr. Sci., 1961, 9 (2):122-133.

[39]Van den Ban, A.W., Koshelev, V.M., 1998, Information and consulting service of the agro-industrial complex and its relationship with organizations of rural producers, Information bulletin (Informatsionno - konsul'tatsionnaya sluzhba APK i yeye svyaz' s organizatsiyami sel'skikh tovaroproizvoditeley, Informatsionnyy byulleten)' IKS, MSHP RF, 9-10/98, Moskva, Informagrotech. (In Russian).

[40]Van den Ban A. W., Hawkins H. S., 1996, Agricultural Extension, 1996, 294 p.

[41]Veselovskij B., 1915, Imperial Free Economic Society and Zemstvo Institutions, Bulletin of Agriculture (Imperatorskoye Vol'noye Ekonomicheskoye Obshchestvo i zemskiye uchrezhdeniya, Vestnik sel'skogo khozyaystva), 1915, № 51-52. (In Russian).

[42]Vigier, G., 1971, Management-Information-Systeme. Informations systeme in Wirtschaft und Verwaltung, New York, 1971, 680 p.