Use of information technology in spreading new knowledge in agriculture

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Abstract. Popularization of scientific and technological achievements, advanced experience and new knowledge in the agribusiness, especially in current conditions, can be considered as a mechanism that contributes to the receipt by agricultural producers of relevant, high-quality and reliable information on issues of interest and problems in the field of agriculture. The article presents the results of popularization of scientific resources using the database (DB) called “Users of scientific and engineering products in the agribusiness.” The database is maintained to collect information about users by category of organizations, user distribution by federal district, and on the preference of issues of interest to them in subject areas in order to further improve the provision of scientific and engineering information for users in the area of technical and engineering education. The results of the database are used in proposals for adjusting the subjects in the preparation of analytical materials on the engineering and technological support of the crop and livestock product manufacture and processing.

1. Introduction
The “popularization of science” term appeared in Russia in the late 17th and early 18th centuries. At the same time, the first scientific publications appeared, the authors of which sought to present complex scientific materials in the most understandable and accessible form for a wide range of people. If science is a sphere of human activity, and its function is the development of objective knowledge about reality and the theory of systematization and a form of social consciousness [1], then the popularization of science is the process of disseminating scientific knowledge in a current and accessible form for a wide range of people having a certain level of preparedness for information.

As the experience of leading foreign countries shows, scientific and information support and the popularization of new knowledge of the agricultural sector and related industries is an effective factor in the intensive development and increase in the efficiency of agriculture [2].

2. Problem Statement
Among the shortcomings of scientific and information support for the agricultural industry, the imperfection of the system for the dissemination and popularization of scientific knowledge, an insufficient level of accessibility of agricultural producers, scientific organizations and educational
systems to information resources, and low rates of introduction of information technology are noted. The information provided on the Internet is not always up-to-date and reliable.

In order to comprehensively solve the existing problems of scientific and engineering support of the agribusiness, it is necessary to create conditions for the formation of competitive scientific and/or scientific and engineering results, as well as the transfer of scientific results and knowledge into production with their subsequent involvement in economic circulation and application.

The aim of the study is to analyze the use of information technology in the popularization and dissemination of new knowledge.

3. Materials and Methods
During the research, information was used from the publications of the Ministry of Agriculture of Russia, from journals, and from those sites where research results and information about the use of information technology and modern methods in the dissemination of new knowledge were presented. The research was performed using analytical, comparative and information-logical methods of analysis of the initial information.

4. Results
To ensure a high-quality process of disseminating knowledge, the interest in this of certain subjects, as government, scientists, business, and society, is necessary [3].

New knowledge, like other resources, must be managed, that is, they must be planned, organized and coordinated, their use must be motivated, as well as information processes must be taken into account, controlled, analyzed and regulated at all levels of management. In turn, this necessitates the creation of an information infrastructure that ensures the introduction of up-to-date information technology in the agricultural sector of the economy.

The Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025 (FSTP) [4] and the State Program for the Development of Agriculture and Regulation of Agricultural Products, Raw Materials and Food Markets [5] provide for the creation and implementation in the agribusiness of the technology based on the latest scientific achievements as well as advanced experience. The spread and popularization of new knowledge contributes to the acceleration of the practical use of scientific and technological achievements.

In this country, many farmers have long been using marketing research methods while widely applying various strategic mechanisms for the development of scientific products, databases and databanks, and Internet technologies [6]. The exhibition and fair activities are developing as well.

The popularization of scientific and engineering achievements contributes not only to potential technological independence, but also to a decrease in the level of import dependence through the introduction of innovative developments, ensuring the availability of high-quality and competitive agricultural products of domestic production in the Russian market, as well as the possibility of introducing an agricultural education system as a driver for the development of the agribusiness.

In order to ensure the marketing research to popularize scientific and engineering achievements, best practices and new knowledge, templates and implementers can be used that are presented on various Internet sites [7] and in databases [8], as well as in various online services [9], which are freely available and allow solving typical mathematical problems of research and operations, such as problems of linear, nonlinear and integer programming, problems of optimizing the network schedule of work, game theory and the theory of queuing. We would like to draw your attention to the www.atozmath.com site developed by Piyush N Shah [10] and the www.ampl.com optimization modeling systems site [11]. The tables presented on them are convenient for studying algorithms and solving educational problems in mathematics, statistics and the study of operations where there are multiple online calculators and an optimization modeling system based on the AMPL algebraic modeling language.

One of such developed computer programs has become the “System for determining the information needs of agribusiness organizations” (registration No. 2016614169 dated 04/18/2016.)
The software is designed to collect, to process and to provide data on the information needs of agribusiness organizations. Functionality of the program are as follows: conducting an interactive survey of agribusiness information resource users; analysis of the data obtained during an interactive survey (17 fields of the questionnaire); formation of a database of the agribusiness information resource users; database export; automated selection (based on the analysis of the questionnaire) and provision of information publications for the user; providing data on the trend in the demand for information in the agribusiness; preparing an information report containing diagrams and tables on the information needs of organizations along with the analysis of data by federal district, type of organizations, area of their activities, subject, and type of scientific and information products. The software generates output data in the following formats: .html, .pdf, .csv, .xml, .png, .jpg, and .svg. It can be used as a decision support system (DSS) when planning the improvement of the policy of information bodies to meet the demand for information products and services, which makes it possible to increase the efficiency of scientific information, as well as of methodological, information and consulting support of the agribusiness [12].

5. Discussion

In order to study the information needs of agribusiness specialists, Rosinformagrotekh uses a number of marketing mechanisms, such as a questionnaire posted on the Rosinformagrotekh website, HTML electronic questionnaires at congress and exhibition events along with a set of subject questions according to the event areas, consulting support as “request-response” written and telephone conversations. The collected information is generated in the “Users of scientific and engineering products in the agribusiness” database (registration certificate No. 12357 dated April 27, 2009, made by Informregister Scientific and Technical Center.)

The purpose of maintaining the “Users of scientific and engineering products in the agribusiness” database is to accumulate and systematize information about users of information materials, assess the user degree of satisfaction and develop recommendations for conducting marketing policy and proposals.

The database has a large data bank, it is constantly operating and is being upgrading in accordance with the goals and realities of the time. The database is an irreplaceable assistant in the surveys. It can be practiced by any companies.

Let us describe the construction of the conceptual model of the “Users of scientific and engineering products in the agribusiness” database while having analyzed the information of users (respondents) and problems to be solved and promising thereby revealing subject preference [14].

Database information objects (stored forms) are as follows:

Form 1 is input and accumulation of information about users (respondents).

Form 1 fields are the date of initial registration; dates of re-registrations; category of organization (governing body, scientific institution, educational institution, additional education, information and consulting center, enterprise, organization, private entrepreneur, machine testing stations, intermediaries, libraries, etc.); name of the organization or personal full name; address; index; telephone; email address; TIN; Tax Registration Reason Code; contact person; subject area; note.

Form 2 is input and accumulation of information about scientific products.

Form 2 fields are the date of release of scientific products; printing order number; publication order number; group of information materials (reference book, catalog, analytical review, brochure, recommendations, book, etc.); the year of publishing; calculation price; quantity in stock.

Form 3 is preliminary extract of scientific publications for the user (consists of related information of forms 1 and 2.)

Annual monitoring of the database reveals the main trends and leading subject areas in the industry, as well as typical patterns of user behavior, which, in turn, helps many governing bodies and managers to make timely appropriate decisions.

The performed analysis of information and consulting services allows revealing the number of users of scientific information by federal district (table 1); category of information users (table 2);
subject area of information materials (table 3), which serves for further drawing up a subject plan of research, development and technological work (R&D) and prospects for the use of information materials.

**Table 1.** Percentage of users of scientific information by federal district for 2016-2020.

| Federal district                      | 2016 | 2017 | 2018 | 2019 | 2020 | Average |
|---------------------------------------|------|------|------|------|------|---------|
| Central Federal District              | 34   | 41   | 38   | 46   | 42   | 40.2    |
| Volga Federal District                | 20   | 19   | 18   | 11   | 10   | 15.6    |
| Southern Federal District             | 10   | 8    | 12   | 7    | 13   | 10      |
| Northwestern Federal District         | 7    | 8    | 7    | 10   | 8    |          |
| Siberian Federal District             | 6    | 7    | 7    | 10   | 6    | 7       |
| Ural federal district                 | 4    | 4    | 4    | 3    | 5    | 4       |
| North Caucasian Federal District      | 5    | 3    | 3    | 7    | 4    | 4       |
| Far Eastern Federal District          | 4    | 1    | 1    | 1    | 3    | 2       |
| Republic of Crimea                    | 3    | 1    | 2    | 1    | 1    | 2       |
| CIS                                   | 4    | 7    | 6    | 5    | 4    | 5       |
| Foreign countries                     | 3    | 1    | 2    | 1    | 2    | 2       |

The obtained values made it possible to identify the number of users of scientific information by federal district, where the largest number of users is clearly traced in the Central Federal District (about 40%). The Volga and Southern Federal Districts take the second and third places respectively in terms of the number of users (7% to 20%) followed by the North-Western and Siberian Federal Districts (6% to 10%), Ural and North Caucasian Federal Districts (3% to 7%), Far Eastern Federal District and the Republic of Crimea (1% to 3%) that are less active in attending exhibition events due to remoteness and financial costs.

**Table 2.** Percentage of categories of users of scientific information for 2016-2020.

| Categories of organizations                               | 2016 | 2017 | 2018 | 2019 | 2020 | Average |
|-----------------------------------------------------------|------|------|------|------|------|---------|
| Enterprises (agricultural enterprises, cooperatives, farms, etc.) | 11   | 23   | 19   | 47   | 42   | 28      |
| Educational institutions (Universities and Additional vocational Education Institutions) | 17   | 16   | 24   | 8    | 13   | 15      |
| Organizations (design offices, machine test stations, business structures, etc.) | 18   | 18   | 10   | 11   | 15   | 14      |
| Individual entrepreneurs                                  | 15   | 12   | 11   | 8    | 10   | 11      |
| Research institutions                                    | 9    | 8    | 16   | 8    | 5    | 9       |
| Agribusiness governing bodies                            | 13   | 8    | 5    | 6    | 3    | 7       |
| Media                                                     | 7    | 4    | 8    | 3    | 5    | 5       |
| Libraries                                                 | 6    | 7    | 3    | 4    | 3    | 4       |
| Information and Consulting Centers                       | 4    | 3    | 4    | 5    | 4    | 4       |

By 2020, the largest indicator (11% to 42%) of users of scientific information on agriculture fell on enterprises (agricultural enterprises, cooperatives, farms, etc.), which are committed to qualitative changes in politics and economics, a return to private peasant forms of farming. The business owners are interested in government support issues related to land allotment, registration and liquidation, lending, accounting, etc.
Educational institutions (8% to 24%), such as universities and additional vocational education institutions, etc., and organizations, such as design offices, machine testing stations, business structures, etc., (10% to 18%) took the 2nd position in the category of users. Diverse information on agriculture is of interest to educational structures and agricultural organizations.

Individual entrepreneurs (8% to 15%), research institutes (5% to 16%) and governing bodies (3% 13%) are interested in the development of crop and livestock production, as well as processing branches of the agribusiness.

Mass media (3% to 8%), libraries (3% to 7%) and information and consulting centers (3% to 5%) use Internet information to a greater extent in their intellectual development; they are less interested in information presented at exhibitions.

Table 3. Percentage of subject areas of information materials.

| Subject areas                                      | 2016 | 2017 | 2018 | 2019 | 2020 | Average |
|---------------------------------------------------|------|------|------|------|------|---------|
| Technological and engineering support for the production of crop products | 35   | 32   | 38   | 45   | 49   | 40      |
| Technological and engineering support for the production of livestock products | 20   | 15   | 18   | 15   | 19   | 17      |
| General issues in the field of agriculture and others | 16   | 19   | 16   | 15   | 10   | 15      |
| Technological and engineering support for the processing of agricultural products | 12   | 12   | 8    | 8    | 9    | 10      |
| Development of peasant (farming) households       | 6    | 11   | 6    | 7    | 7    | 7       |
| Economic issues                                   | 7    | 8    | 8    | 6    | 4    | 6       |
| Compound feed production                          | 4    | 3    | 6    | 4    | 2    | 4       |

As the analysis showed, the users of scientific information showed particular interest in the following subject areas in 2020.

Engineering and technological support of crop production amounts to 49%, including gardening and nursery; sheltered ground; open ground (production of vegetables and potatoes); breeding and seed production; intelligent plant protection systems and differential fertilization; seed treatment; land reclamation. Scientific and informational materials on resource-saving technology of cultivation of winter durum wheat, beets, potatoes, mustard, millet, rye, spring vetch, beans, grain sorghum, rape and rapeseed, lentils, vetch, and chickpea are in demand. There is an increased interest in analytical information on plant protection with the introduction of biological products and fertilizers.

Engineering and technological support of livestock production amounted to 19%, at the same time, some of the specialists were interested in techniques for animal husbandry in small forms of farming (5%); upgrading, reconstruction and construction of livestock farms (4%); engineering and technical support of dairy farms (3%); development of the poultry industry (3%); on-farm aquaculture (2%); others (2%).

General agricultural issues amount to 10%. In recent years, political issues and various economic fluctuations in Russia (imposition of sanctions and embargoes) have made it possible to obtain loans
and subsidies and to get an opportunity to develop farms, therefore, specialists are interested in information on the development of small businesses, sustainable development of rural areas, innovative developments, including those on the transition of the agribusiness to the principles of the best available technology and resource conservation in the agricultural service.

Technological and engineering support for the processing of agricultural products amounts to 9%. The specialists are interested in the development of the best available technology when making food products, as well as in the dairy production processes and equipment.

Development of peasant (farmer) households amounts to 7%. One of the most pressing subject for farmers and their associations, as well as for investors and specialists of agricultural organizations is organizational, legal and economic issues, mechanisms for creating farms and their effective functioning, insurance, etc.

Economic issues in the agricultural sector amount to 4%. In a market economy, issues related to the economy and organization of agricultural production, planning, the use of flowcharts for crop production, issues of chemicalization, land reclamation, livestock raising, rationing, wages, leasing, financing, insurance, etc., find their relevance.

The main categories of information users are enterprises and organizations of small and medium-sized businesses (42%). First of all, this is due to import substitution, where, at the first stage, it is important to solve all business processes, as well as it is willingness to replace imported market brands with domestic ones. Educational institutions (15%) and organizations (14%) use information publications for writing scientific and engineering reports, for preparing materials for conducting classes and replenishing library stock, etc. Individual entrepreneurs, agricultural producers (11%) and research institutes are interested in the use of intensive technology for the production of vegetables, biological methods of plant protection, intensive development of horticulture and production of high quality feed; in the advanced technology for drying and storing grain; in equipment and application of technology in modern grain cleaning and grain cleaning and drying facilities, etc.

The assessment of their own capabilities in import substitution is higher among entrepreneurs of the Central (42%), Southern (13%), and Volga (10%) federal districts. To a greater extent, these districts are interested in information on the technological support of crop and fodder production. In the Northwestern Federal District, specialists are interested in more information on the development of animal husbandry and fodder production

6. Conclusion
Based on the results of the marketing activities performed, it is possible to present a list of subject areas for the most outstanding results by federal district and category of users of scientific information and subject areas identified in order to further present relevant information.

Monitoring the information needs of agribusiness specialists and establishing feedback with them along with further entering information into the database allow identifying the categories of users, as well as preferences, relevance and shortcomings of the information provided. Therefore, in helping to improve the effectiveness of the implementation of priority areas of the agricultural sector, the use of new mechanisms for the popularization of scientific information and exchange of experience, the introduction of innovative technologies, the creation of the most favorable conditions for a personalized exchange of knowledge, a tool for attracting investors and assessing the real situation in the market connect international and domestic markets, consumer demand and offer, and promote investment in projects of Russian organizations.

References
[1] Popularization of science on the Internet: content, forms, and development trends Retrieved from: https://vestnik.journ.msu.ru/books/2013/2/populyarizatsiya-nauki-v-internete-soderzhanie-formy-tendentsii-razvitiya/
[2] Mishurov N P, Kondratieva O V, Fedorov A D, Slinko O V and Vogytuyk V A 2021 Foreign experience in spreading new knowledge in agriculture. Machinery and equipment for rural
Specificity of science popularization in Russia Retrieved from: https://cyberleninka.ru/article/n/spetsifa-populyarizatsii-nauki-v-rossii

Federal scientific and technical program for the development of agriculture for 2017-2025. Retrieved from: https://base.garant.ru/71755402/

State program for the development of agriculture and regulation of markets for agricultural products, raw materials and food for 2013-2020 Retrieved from: https://base.garant.ru

Fedorov A D, Kondratieva O V and Slinko O V 2020 Process of digital transformation of agrarian economy: Advances in Economics, Business and Management Research. Proc. of the Int. Conf. on Policies and Economics Measures for Agricultural Development (AgroDevEco 2020) Voronezh 164-169.

Questionnaire specialist Retrieved from: https://anketolog.ru/primery-anket

Podyablonsky P A, Mishurov N P and Chavykin Yu I 2020 Databases for R&D reporting Information. Bulletin of the Ministry of Agriculture of the Russian Federation 10 42-44

Volovikov S A 2020 Online services for solving typical problems of operations research. Proc. of the Int. Scientific and Practical Conference “Mathematics and Informatics in Education and Business” Moscow 117-122

AtoZmath.com web-site Retrieved from: http://atozmath.com/

AMPL Retrieved from: https://ampl.com/cgi-bin/ampl/amplcgi

Questionnaire for the study of information needs Retrieved from: http://opros.rosinformagrotech.ru/opros.php