

Development prospects of agrarian science and education in the formation of digital economy

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Abstract— The article substantiates the importance of the development of agrarian science and education in the conditions of innovative development and digitalization of the economy sectors in agro-industrial complex. The problems of the digital economy in the agro-industrial complex are identified. Priorities in the development of modern agricultural science and education, the competitiveness of modern scholars and university professors are justified. Priority areas in scientific research of engineering and technology in agriculture, organization and agribusiness management based on digitalization are defined. At the same time, special attention is paid to the organic agriculture development and the functioning of the food market for agricultural organic products. It is proved that the digital economy contributes to the formation of an innovative information space. Production relations are changing; progressive changes are taking place in the structure of the economy and in all levels of education (general, secondary and higher). The emerging information society is changing the model of the school teacher, the university lecturer and the student model. The article identifies the priorities of e-learning and its most significant components. Relevance and effectiveness of the e-learning implementation in higher and postgraduate education is shown.

Keywords—*digital economy, digital technologies, innovations, agrarian science, education, competitiveness.*

I. INTRODUCTION

Digital economy means business activity, where digital technologies are the key factor for development. As practice shows, the processing and analysis of a large amount of information flows based on the digital technologies' implementation allows: to ensure the acceleration of economic growth; increase the effectiveness of various activities; resource potential rational use of enterprises and organizations in various fields of activity.

Problems of the digital economy in the agroindustry sector (according to the Analytical Center of the Ministry of Agriculture of Russia) - low penetration of digital technologies in rural areas and agricultural production (less than 10% of digitalization), poor coverage of data networks; lack and incomplete information about existing and innovative digital technologies; inadequate regulatory support in the data aggregation and the digital technologies' implementation for the needs of agriculture, providing the population with food and increasing exports of agricultural products and food; the lack of programs for

the introduction of the digital economy, subsidizing production costs for the digitization of the agro-industrial complex for small and medium-sized agricultural commodity producers, especially personal subsidiary farms; the lack of legal bases for interaction and collection of information on the management of agricultural activities by household farms and the associated limited opportunity to support their activities; - low margins (developing segment) of the industry - unattractiveness for a technological and infrastructure investor. The solution of these problems is impossible without the development of relevant areas of science and education.

In this article, the authors put forward and justify the hypothesis: Digital economy is a concrete way to realize the main advantages of innovative transformations at the present stage of agricultural development in Russia ensured by the development of science and education.

In the course of scientific discussions held in recent years in the Russian Federation, scientists and agricultural experts concluded that the promising direction of agricultural development for most regions of the country is the production of organic agricultural products [1], that requires the use of modern biotechnology agricultural technologies, based on the synthesis of the latest achievements of biological and engineering sciences, digital technologies.

An analysis of the available literature in the theory, methodology and practice of the problem led to the conclusion that the theoretical and methodological basis of organic agriculture is a new direction in interdisciplinary research using digital technologies, which requires the development of new areas of education.

II. RESEARCH METHODS

The research applied methods: monographic, dialectic, expert assessments, economic and mathematical modeling, comparative and factor analysis, system-functional, design-calculated, logical-structural analysis and synthesis, applied economical and statistical, empirical methods, including content analysis, methods of matrix modeling, algorithmization, clustering, rating.

III. THE RESULTS OF THE STUDY

The results of the study showed that the development of global climate, soil and macroeconomic processes requires the digitization of their consideration in solving problems of land use. The priority areas of scientific

research in agricultural engineering and technology are trends in precision farming, the compilation of digital maps and yield planning, differential fertilization, monitoring of the crops state using remote sensing, monitoring crop quality, differential spraying, local soil sampling in the coordinate system. Research is also continuing in the following directions: defining field boundaries using satellite navigation systems, sowing differentiated by area, Big Data, differentiated tillage, differentiated growth regulators, parallel driving systems, artificial intelligence for agriculture, unmanned tractors (combines), mapping of soil electrical conductivity. The implementation of the state program “Digital economy” (dated July 28, 2017) covers three closely related levels:

- markets and sectors of the economy engaged in the interaction of specific business agents (suppliers and consumers of goods, works and services);
- platforms and technologies that form the necessary conditions for the successful development of organizations and enterprises;
- environment and the creation of favorable conditions for the functioning of the digital economy, in particular, regulation, information infrastructure, personnel and information security [2,3].

The development of organic agriculture involves the study of the functioning of the agricultural organic products` food market. [6,7,8]. Conducted research in this area revealed the following patterns. The use of functional dependencies in the analysis of the agricultural organic products` food market and its dynamics, although it enhances the scientific nature of the study, however, do not take into account that the economic processes most often show the correlation nature of the relationship between performance indicators and factor characteristics. В этой связи применен метод кластеризации. Modern data mining technologies (Data Mining) are based on collecting the necessary information and conducting its subsequent research based on discriminant analysis algorithms. In our case, this corresponds to the division of areas potentially suitable for the production of agricultural organic food products into groups (clusters) [7]. The coefficients on the basis of which the analysis was conducted, for convenience, were divided into four groups:

- 1 - indicators expressing entrepreneurial activity;
- 2 - indicators expressing consumer activity of the population;
- 3 - the condition of agricultural land, including the coefficients of land conservation (by the share of reduction of sown areas in the regions) and soil fertility (by the content of potassium in the soil, phosphorus and acidity);
- 4 - man-made state of the region’s territories (environmental friendliness), including coefficients expressing: the ratio of the number of births and deaths, the level of environmental friendliness of the territories by emissions of pollutants into the atmosphere, the level of technogenic pollution (radioactive impact, the level of agricultural production losses).

In the discriminant analysis, each subject is mapped to a vector, the components of which are the corresponding coefficients. The use of such vectors allows us to introduce the concept of distance, which, in turn, makes it possible to measure the degree of closeness between subjects according to the degree of their suitability for the production of the above-named production.

For example, if there are a large number of components, you can use the so-called cosine distance using the formula

$$C_{jk} = \frac{\sum_n^{29} X_n^j \cdot X_n^k}{|X_j| \cdot |X_k|}$$

where $|X_j|$ - vector length (norm) \vec{X}_j .

Based on the collected data, the calculation of the matrix of coefficients was carried out. Each of the 29 coefficients presented in the matrix reflects the status of a specific indicator in all regions. However, the use of all 29

component vectors $|X_j|$ is not very convenient, precisely because of their large number. In this regard, aggregation (averaging) of coefficients over their various groups was carried out. (Table 1, last line). In this case, the geometric mean of the coefficients will be used (equal to the degree 1 / N of their product), for the corresponding groups.

TABLE I. AGGREGATION OF COEFFICIENTS

SUBJECT	Кпр	Кр	Ккоп	К	Км	Кзс	Кэ
Kurgan	0,72	0,6	0,55	0	0,7	0,1	0,8
Sverdlovsk	0,79	0,7	0,70	0	0,84	0,6	0,6
Chelyabinsk	0,76	0,8	0,78	0	0,8	0,1	0,6
Tyumen	0,85	0,7	0,56	0	0,78	0,0	1,1
Max / Min values	0,85	0,8 2	0,55	0 0	0,84	0,0 9	1,1 2
Coefficient groups	Production	Realization	Production-Sales (correlation coefficient)	Consumption	Material wealth	Land	Environmental friendliness

The aggregated coefficients presented in table. 1 is convenient to renormalize. For this, the coefficients for which the optimal value is large (or close to 1) will be divided by this maximum value, and in cases where the optimal value of the coefficient is zero, the corresponding minimum value in the table. 1 will be divided by the value of the corresponding coefficient. In each of these options, the value of the renormalized coefficient corresponding to the “ideal” subject will be equal to 1. In total, we proposed 116 values of coefficients (29 * 4 subjects), combined into 4 groups according to the principle of their uniformity and compatibility by the nature of their impact on a specific indicator. This allows us to distribute them more objectively into subgroups with the selection of the most significant and similar in nature to the impact on the resulting (complex) indicator. Before we conduct the discriminant analysis itself, we will display the results obtained on a graph (Fig. 1).

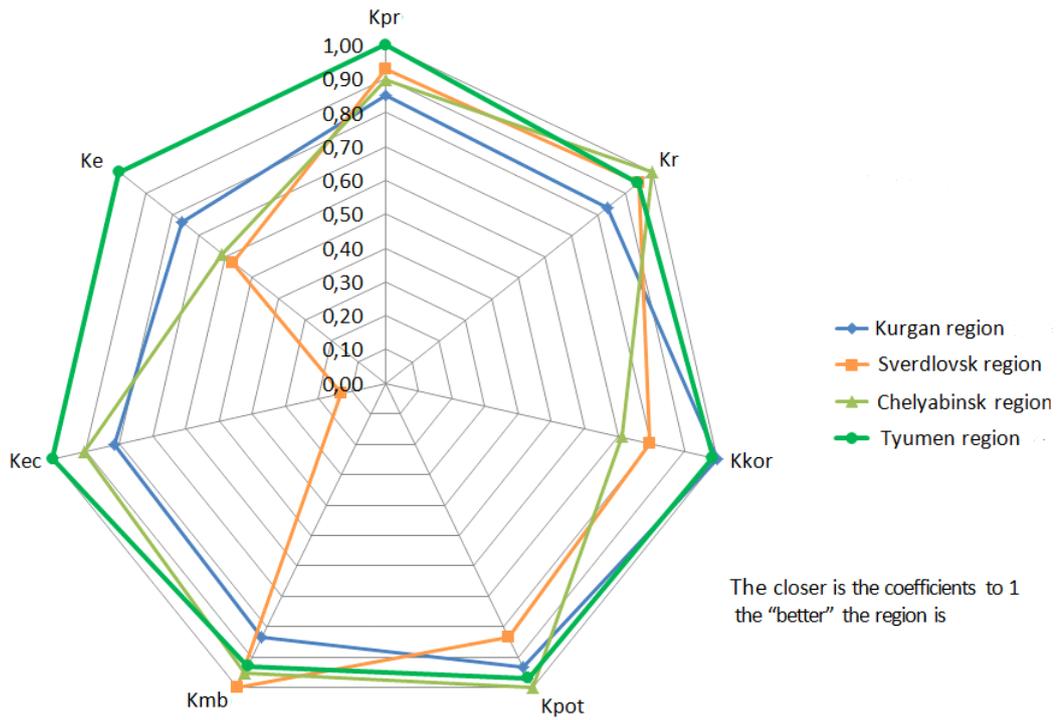


Fig. 1. The values of the coefficients, determining the suitability of the subject to the production of agricultural organic products. The “ideal” values of the coefficients are 1

Fig. 2 illustrates the distance (the absolute value of the difference of the integral coefficients of the subjects presented in the last column of Table 4). The smaller the

distance, the closer the subjects are to each other (in terms of suitability for the production of agricultural food organic products).

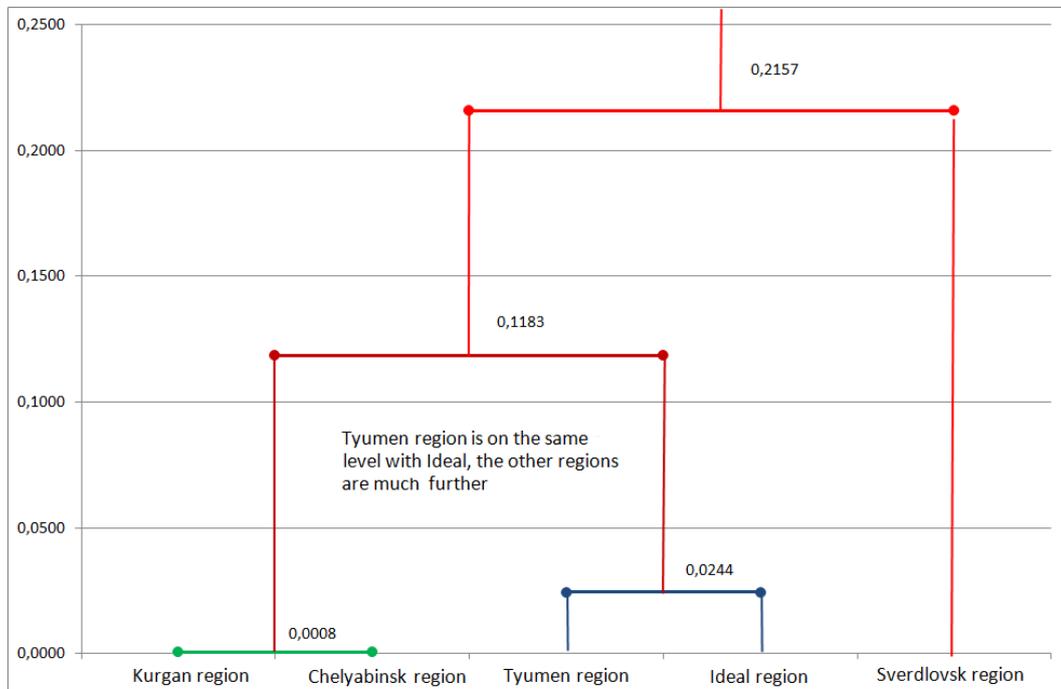


Fig. 2. Hierarchy (grouping) of regions - subjects according to their proximity

Based on this methodological approach, it is possible to choose the region that is most suitable for the production of

agricultural organic food products. This problem is solved on the basis of the mathematical apparatus of discriminant

analysis. If we proceed from the new paradigm of the modern economic system, which is distinguished by exogeneity (independence of perception) and increased irrationality (emotionality), then the paradigmatic approach to the development of the organic food market theory will also focus it on the interdisciplinary level, from the point of view of which this theory is enriched by interrelation with other theories. These include and substantiated in the author's interdisciplinary-diffuse model of development of the market theory: the theory of benefits, the theory of economic happiness, the theory of value, the theory of entrepreneurship, the theory of marketing, institutional theory, the theory of dysfunction, the theory of diffusion of theories. Diffusion of theories, as the process of penetration of well-known theoretical propositions into the theory of the development of the organic products food market, occurs on the basis of the objectives of each theory connected with the theory of this market through an institutional mechanism.

Digital economy contributes to the formation of an innovative information space. Production relations are changing, progressive changes are taking place in the structure of the economy and in all levels of education (general, secondary and higher).

In this respect, e-learning is a priority, due to the fact that information is generated systematically, purposefully, through the joint efforts of professors, teachers and students. In this case, a transformation and a change in the paradigm of education itself takes place. It moves from the classical subject-object model of knowledge acquisition to the model of «counter questions – answers», it becomes more practical and socially oriented. At the same time, the leading role is assigned to interactive and project methods of teaching, the volumes of the material being mastered by the students increase, the terms of its acquisition are reduced; individual educational trajectories appear, supported by the possibility of academic mobility.

An information society is being formed that also changes the student's model. The student is required to be motivated to continue learning (the concept of Life-long Learning, declaring the need and the possibility of learning throughout life), to be able to learn new information systematically in accordance with certain tasks. [10]. At the same time, a specialist should not only have knowledge of IT, but also be able to work in a team, be adaptive to innovative processes, have conscious goals and values.

According to the Ministry of Education and Science of Russia, the share of specialists in information and communication technologies is 3.9% of the total number of graduates of higher education levels and 6.6% of graduates of secondary professional education. At the same time, the share of specialists in information and consulting technologies in Russia is 1.5%, while in Finland 6.6%, Sweden - 6.2%, Estonia 5.3%, Great Britain - 5.1% in percentage of total employment in the economy. [11, c. 69 - 72].

In recent years, the global e-education market has noticeably intensified, there is a growth in almost all countries of the world. Foreign portals of mass open online courses from leading lecturers of the world's best universities have appeared on the Internet.

At present, there are educational programs in Russia and abroad, the implementation of which takes place exclusively

with the use of e-learning. This means a clear expansion of the consumer audience.

The growth rate of the e-learning market in the world refutes earlier predictions. The highest growth rates are observed in the countries of the Asian region (from 39% per year in Malaysia, up to 44% in Vietnam); India, China, Thailand are practically not inferior (30-35% per year); in Africa, the growth rate of the e-education market exceeds 15%, and in the Middle East - about 8% per year. In advanced economies, growth is not high: about 4% in North America, about 6% in Western Europe, with an aggregate share of these e-learning markets around 70% [10].

E-learning involves an asynchronous educational process using an electronic information-learning environment, includes electronic information and educational resources, information technology, telecommunication technologies and the corresponding technical and technological means.

The most significant components of e-learning, determining its effectiveness, are:

- reasonable presentation of electronic content;
- use of interactive learning elements;
- the organization of the interaction of students in the process of mastering the course;
- automated verification of training and control tasks;
- support of students and their motivation to achieve high results;

The e-course provides the function of learning management and in certain conditions can be used for training without the direct participation of the teacher - remotely, which is especially important for distance learning, postgraduate and doctoral studies.

Under the conditions of toughening competition in world markets, accelerating the processes of digitalization of the economy, the role of post-graduate continuing education is increasing. There are new increased requirements for communications, computing power, information systems and services. By 2025, about 40% of the country's population - not only large centers, but also residents of rural areas and small cities should acquire digital skills. As the transition to the digital economy proceeds, many traditional areas of activity and professions are transforming. It is planned to increase the share of business entities that use the national payment system in 2018 to 25%, 2020 - 50%, 2024 - 90% [5]. The market will demand multi-skilled specialists of a wide profile who successfully master programming by information and communication technologies, robots, etc. So, for example, there will appear operators for managing vehicles and payment terminals for services, designers (developers) of various target program products, highly qualified specialists - turners, millers, mechanics, welders working on machine tools with numerical program control, robots for performing warehouse operations and other upgraded functions. The formation of the digital economy makes radically new demands on educational activities. The realities of modernity dictate the need for continuous study throughout the entire work activity in full accordance with the forecasts of the scientific and technological development of society. The development strategy of the information society, the key priorities for the formation of the digital

economy (until 2030) cover all areas of the country's social and economic activities, taking into account the specifics of their functioning, in particular the agricultural sector of the economy.

IV. CONCLUSION

The formation of the digital economy, the development of science makes innovative demands on educational activities. The priority directions for the development of universities are: large-scale retraining of various categories of personnel for special advanced software products; organization of personnel reserve training, advanced to higher and responsible positions, appropriate retraining of the teaching staff of the university, training of teachers in the advanced high-tech organizations in their field. A modern university teacher, in addition to deep scientific training, should have a wide range of knowledge in the field of pedagogy, mathematics, in accordance with the requirements of the digital era; own information technology and communication tools, computer programs, organization of the educational process in order to constantly anticipate emerging requirements and comply with the innovative status.

The introduction of e-learning in the system of higher and postgraduate education will allow:

- ensuring the availability of professional education in the framework of the implementation of the state program “Development of Education” for 2013–2020;
 - with limited mobility of the population in education;
 - increasing the accessibility of education, the degree of flexibility of the educational process, the ability to take into account the interests of employers quickly;
 - continuous staff training (Life-long Learning) on an individual training schedule;
- control over the results of training due to access to the student's electronic portfolio by the employer.

Thus, the digital model sets new standards for the development of science and education, including the agrarian sector of the economy.

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