

Agroecological risks of the digital economy

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Abstract. The article is dedicated to the study of risks and building a digital profile, both at the level of economic entities and at the regional level. The factors that determine eight types of risks inherent in agricultural organizations in the context of digital transformation are analyzed. A hypothesis is put forward that the digital profile makes it possible to assess the readiness of companies for further digitalization and to highlight areas of increased risk that require attention from the state. Our calculations can be used in the future to assess the sustainability of agricultural organizations, both in Russia and abroad.

1 Introduction

The last decades have been characterized by the active use of digital technologies in all areas of human life, including the agro-industrial complex. The growing value of information, on the one hand, and the risks associated with consumption of natural resources, determine the need to study the possible mutual influence of agroecological risks on the digital economy. The quality and level of digitalization entering into the agro-industrial complex are studied by scientists from different countries [1-6]. African scientists have studied the impact of the climate change risk on the condition and further development of rural households. They identified six archetypal climate risk profiles, considering their various components. Archetypes show the variability of climatic risks depending on the strategy of obtaining financial resources and the availability of capital [7]. The study of the sustainability of the New Zealand dairy complex in order to minimize exposure to risks depending on agroecological, social and economic factors is provided in the paper of N.A. Cradock-Henry [8].

Italian scientists have investigated the digital, socio-economic and environmental impacts of the agriculture digitalization. Their offered taxonomy will help predict negative outcomes in order to reduce the unintended impact of digitalization. They refer the potential dependence of farms on digital service providers, and the possible increase in electricity consumption by digital tools to the potential digitalization risks. Also, the risks of reducing digitalization arise in the case of uneven ownership of electronic skills among rural workers

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and the lack of IT infrastructure in rural areas. The possibility of serious problems with confidentiality, data ownership and use exacerbates social asymmetries [9].

Article is dedicated to study of research trends and opportunities related to digitalization of agriculture [10]. According to the authors, it is necessary to develop IoT devices that consider the advanced encryption algorithms in order to increase the security of the collected data. Big data technologies can be viewed as a solution for various applications and used in decision-making and extraction of new ideas and knowledge for agriculture.

Spanish scientists B. Garske, A. Bau and F. Ekarth also speak about development of IT infrastructure, a legal framework that clarifies the issues of data protection and security and the availability of technologies for small and medium-sized farms as a prerequisite for development of agriculture digitalization. They also note that development of digitalization itself generates risks of growth in electricity consumption, environmental risks due to increased pressure on renewable energy sources and on measures to compensate for the remaining inevitable emissions [3].

Domestic scientist E.A. Bubenok notes the insufficient level of digitalization of agriculture, linking this with the lack of scientific and practical knowledge about innovative modern technologies and methodology, a high level of production costs. As a result, only a small number of agricultural producers have the ability to use IT equipment and platforms. At the same time, she notes a change in the very paradigm of creating and developing a successful agribusiness through use of digital platforms as the cores of global digital information ecosystems [9].

The vision of extremely positive effects of digitalization is noted in the work of T.M. Yarkova. So she points out that the expected positive effect of digitalization for the Russian agricultural economy is enormous and is not associated with any risks and threats. It is possible to minimize possible risks and threats of various origins by revising the existing specialization in all territories of the country. As noted, the medium term is aimed at a significant effect from introduction of digitalization elements in the economy of the agro-industrial complex, which consists in increasing labor productivity more than three times, reducing the cost of production and sales by 20-25 %, expanding the boundaries of agricultural business and increasing profits from agricultural production [4].

Paper [11] highlights the risks associated with the digital transformation of the agri-food sector in the countries of the Middle East and North Africa. The most significant potential risks are: displacement of the workforce (digital technologies may displace agricultural labor with labor-saving technologies), different potential for digitalization depending on the size of the company, rejection or low level of adoption of digital technologies due to fear of losing competitiveness and growing lagging behind other countries, reducing privacy and security, generating new flows of resource use and waste, including greenhouse gases associated with increased energy use.

Despite the lot of studies conducted to examine the impact and risks of digitalization on agriculture, there is insufficient empirical evidence to assess the risks posed by this digitalization.

This article develops the concept of studying the risks of digitalization in the agro-industrial complex [12] and reveals the methodology for assessing their impact on the sustainability of companies, forming a digital profile of both individual districts and the region as a whole.

2 Materials and Methods

In the process of study, general and particular methods of scientific study were used [13], such as observation, analysis and synthesis, deduction and induction, which made it possible to identify the risks affecting the economic activity of economic subjects.

To implement the offered algorithm for assessing the impact of agrarian risks of the digital economy (ARTsE) on economic activity, an assessment method (MOARTsE) was offered, and it justifying the need to collect initial information for analysis using questionnaires. The best option for collecting is filling out by experts (managers and specialists of economic entities, as well as third-party specialists) the questionnaires for all 8 units (K_{Te} — process [14] , K_{Pe} — social [15] , K_{Ei} - environmental (Fig. 1), K_{Sa} — sanitary, K_{En} — economic, K_{Po} — political, K_{In} — infrastructural, K_{Ma} — psychological and management). The number of questionnaires is limited only by the number of possible experts who have expressed a desire to participate in the survey. The criteria for scoring internal risk assessment of the MOARTsE analysis for the "Ecology" unit are shown in Fig. 1.

Since there is information about typical representatives of the general population (managers, specialists and outside experts), the quota method of spontaneous sampling based on the "snowball" principle was preferred. To assess the districts of the Novosibirsk region (30), these are the heads and specialists of the administrations of the districts and the region, and for the assessment of organizations (selectively from more than 390 thousand), these are the heads and specialists of enterprises and experts from the district administration, who agreed to take the survey, and also recommended new respondents matching the sample parameters.

Depending on the situation, the survey can be conducted both in the form of a questionnaire and an interview, both in a contact and remote format. Given the unfavorable epidemiological situation, the survey was carried out mainly remotely by telephone, while it is necessary to use all the advantages and reduce the disadvantages of this method.

E1-1. Presence of factors for introduction of innovations over the past 5 years	0-0.4 – introduction of new methods of caring for crops and/or livestock ("precision farming", "precision animal husbandry"); 0.4-0.7 – partial mastering of the above technologies; 0.7-1 – work in this direction is not being carried out
E1-2. Innovations related to soil improvement	0-0.4 – introduction of proprietary technologies and developments in soil cultivation, use of biotechnological methods to improve the properties of plants; 0.4-0.7 – application of advanced experience; 0.7-1 – no innovations related to soil improvement
E1-3. Using intelligent technology to manage land and biological resources	0-0.4 – the farm regularly uses technical means, navigation, geoinformation and telecommunication technologies, which allow registering, processing and applying information linked to coordinates in order to optimize agro-technological solutions in agriculture; 0.4-0.7 – the technology is under development, but not yet applied; 0.7-1 – work in this direction is not being carried out
E1-4. Application of specialized software products	0-0.4 – software product used to control technological processes (land and process resources); 0.4-0.7 – software product used in the farm management system; 0.7-1 – specialized products have not been purchased for 5 years;
E1-5. Use of manned (unmanned) aircraft and space vehicles	0-0.4 – fully mastered and applied technology for remote monitoring of the agro-ecological state of soil and crops, observation of herds of animals; 0.4-0.7 – partially mastered, but not yet applied technology; 0.7-1 – work in this direction is not being carried out.

Fig. 1. Criteria for scoring internal risk assessment of MOARTsE analysis for the Ecology unit

3 Results and Discussion

According to the offered algorithm, possible ARTsE were estimated for the districts of the Novosibirsk region (NSO) using the MOARTsE analysis. Based on the results of the scoring MOARTsE analysis, graphic models of the digital profile of the districts and the Novosibirsk region as a whole were built (Fig. 2).

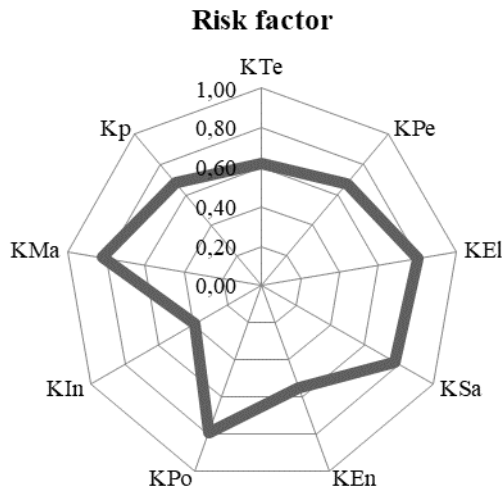


Fig. 2. ARTsE digital profile for the Novosibirsk region.

Digital profiles of districts and the region (Fig. 2) allow to identify the relative impact of the consequences of the potential impacts of the risks of each analytical unit. It was found that infrastructure risk is of the least importance, which indicates the significant potential of economic entities in all districts of the Novosibirsk region to transform into a digital economy and improve financial stability.

Errors made in making managerial decisions (on the inclusion of the agricultural insurance system in the "single subsidy") led to an increase in psychological and managerial risk and a massive refusal of agricultural organizations from agricultural insurance, which affected the growth of environmental and sanitary risks, especially in the field of crop production and a little less in animal husbandry. This can explain the high level of these three types of digital risks.

Regarding the analyzed risks, special attention shall be paid to agro-ecological and sanitary risks, which are specific to the agricultural sector and require special measures to compensate them.

Agriculture refers to a high-risk sector of the national economy, since it largely depends on the conditions and final results of agricultural activities, which are characterized by random factors, most often environmental and sanitary ones. Therefore, use of agricultural insurance programs takes a decisive place in the management of agricultural risks and minimization of unforeseen losses. The stability and efficiency of agricultural insurance systems has been proven by its many years of experience in the global insurance market. The very idea of agricultural insurance is not new for the Russian Federation, and the state has adopted a number of legislative and organizational and economic measures, but today the system of domestic agricultural insurance with state support, due to errors in making managerial decisions, does not correspond to the tasks set and requires improvement.

4 Conclusion

Digitalization that has affected all sectors of economic activity, including agriculture, carries not only benefits, but also risks. The study made it possible to identify and differentiate the risks affecting the sustainability of agricultural enterprises. We have established a high level of influence of such types of risks as: political, sanitary,

environmental and psychological and managerial (more than 0.8). The low value of infrastructural risk indicates a high degree of readiness of enterprises for digitalization. Use of MOARTsE analysis makes it possible to form a digital profile of both individual companies and regions as a whole. On its basis, it is possible to develop measures to reduce risks, including programs of state support for agricultural producers. The versatility of the analysis methodology reveals a wide range of areas of its application. The performed analysis gave us grounds to single out the risks that reveal industry specificity — these are sanitary and agroecological, and also to assume that the leveling of the influence of these risks lies in the field of agricultural insurance. We believe that our study shall be further developed. Namely, the risks arising from the digitalization of agriculture itself require a quantitative and qualitative assessment.

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