

# Methodology for assessing agricultural risks of the digital economy

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**Abstract.** In recent years, there has been increasing interest in the introduction of digital technologies in various areas of life and activity, including the agro-industrial complex. However, few studies pay attention to the issue of risk assessment that accompanies this process. It is not known how to methodically competently and quickly analyze possible risks and assess the prospects of the organization for transformation into the digital economy. The aim of the work is to develop an effective methodology for assessing agricultural risks and on their basis to determine the prospects of organizations in the direction of digital transformation. To explore the possibilities of digitalization, we use hierarchical and digital analysis, as well as operations of mathematical logic and set theory. The results of the study indicate that the evaluation method can be divided into 8 blocks, and its algorithm consists of five stages. The proposed methodology will contribute to the formation of more effective organizational and economic regulators for the transformation of economic entities into a digital economy through a preventive assessment of agricultural risks and, taking them into account, the readiness for digitalization of state authorities, economic entities and the population.

## 1 Introduction

The driving force of modern economic development is the trend towards the introduction of digital technologies in various areas of life and activity, including the agro-industrial complex. The formulation of the concept of agricultural risks of the digital economy (ARDE) justifies the need to develop an appropriate methodological approach to assessing possible risks of economic entities at various levels and their impact on the readiness of agricultural organizations for digital transformation.

The study by Georgios Bartsas and Kostas Komnitsas [1] applied a holistic methodology that integrates life-cycle analysis to assess environmental risks along with local farm and regional surveys using a multi-criteria environment of an analytical hierarchical process designed to identify the most sustainable agricultural management practices at the regional level. The proposed methodology has significant potential as a

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valuable multi-criteria tool that can be easily adapted at the regional level to assist decision makers, such as farmers and their associations, policy makers, local and regional authorities, in effectively exploring a range of alternative farm management practices and thus identifying ways to achieve sustainability. The disadvantage of the applied hierarchical analysis is the assessment of only one environmental risk without taking into account the possibilities of digitalization.

In an attempt to classify farms and markets in different groups based on their metrics, Jerome N. Barons co-authors [2] used factor analysis for mixed data and hierarchical clustering. Hierarchical analysis allowed us to distinguish four groups based on metrics and characteristics of nodes, which in a broad sense can be described as: 1) small and yard farms (LPH and KFH), 2) industrial farms( SHO), 3) markets and 4) a single external market with extreme values. The characteristics and patterns of the proposed network can be used to create dynamic models. The disadvantage of the method used is the lack of consideration of possible risks, except for sanitary, and the prospects for digitalization of farms.

Sebastian N. Avondo and co-authors [3] used a multidimensional spatial structure as a digital analysis to study the potential of combining with a simulated multi-site and multi-environment bot designed to insure against minor, moderate, and severe environmental risk in the form of drought. Like previous researchers, they limited themselves to one type of environmental risk – drought.

Srijit Aravindakshan and co-authors [4] used panel observational data and modeled the trajectories of farm typologies, as well as the impact of multi-level socio-environmental factors, using multidimensional statistics combined with panel data models that operationalize the conceptual framework. Their research, in addition to environmental risks, took into account sociological risks, but also limited itself to these two. Of particular interest is the use of multidimensional statistics, which allowed the development of panel predictive models.

Hierarchical regression analysis conducted by Nalini Junko Negi and co-authors [5] to study the relationship between individual and social factors, as well as with depressive factors of work, showed that work-related discrimination is uniquely associated with depressive symptoms, regardless of the influence of occupational risks and stressors. The study shows the importance of social risks without taking into account the rest.

Lyudmila Vladimirovna Sakharova, Mikhail Borisovich Stryukov, and Gurrú Igorevich Akperov [6] used regression analysis and nonlinear optimization methods modified on the basis of fuzzy set theory to predict the total expected crop yield. The advantage of this technique is the use of operations of mathematical logic and set theory, and the disadvantage is limited only to crop production and the exclusion of possible risks.

In the work of Tian Jie and Xu Jinxuan [7], a mathematical model with incomplete information of a dynamic game was constructed, aimed at reducing moral (psychological) risk when designing an insurance mechanism by analyzing the maximization of utility for farmers and the logic of farmers ' thinking when considering risks. To improve the insurance contract and reduce psychological risk, a retrospective premium payment model was adopted, which will contribute to the healthy development of agricultural insurance policies in China. The application of mathematical logic of operations in agricultural insurance is of interest, however, it is limited to the sphere of social and psychological and managerial risks.

Developed by V. A. Kuzmin and co-authors [8], an intelligent system for assessing the environmental safety of irrigated agricultural land and risks, built using the mathematical apparatus of fuzzy logic, made it possible to formulate recommendations on a set of necessary measures to prevent damage and minimize losses, as well as to assess the effectiveness of their implementation in each specific case. The proposed model is limited

to an assessment of the environmental safety of irrigated land, i.e., an assessment of environmental risks.

## 2 Materials and method

As the main research methods, a combination of methods of hierarchical and digital analysis, operations of mathematical logic and set theory was used.

The hierarchical analysis used by Elena Maslyukova in studying the features of agricultural risk assessment and management [9] allowed us to rank the causes of inefficient development of economic entities of the agro-industrial complex of the region, the main of which were identified as low-effective marketing, control and accounting of reserves and resources. However, the studies did not consider the possible risks of using digital technology.

In the method of digital analysis proposed by Inna Manzhosova [10] to assess the transformation processes in the agro-industrial complex during the transition to the digital economy, the characteristics of its analytical blocks are developed. The main disadvantage of the proposed methodology is the lack of accounting for the impact of agricultural risks in all analytical blocks. In order to increase the effectiveness of this methodology, it should be modernized by adding mechanisms for accounting for agricultural risks of the digital economy to its blocks. In addition, you should also change the number and sequence of blocks, as well as adjust their content. The result of this transformation is shown in Table 1. The proposed methodology for assessing agricultural risks of the digital economy can be briefly called MAARDE (Methodology for Assessing Agricultural Risks of the Digital Economy).

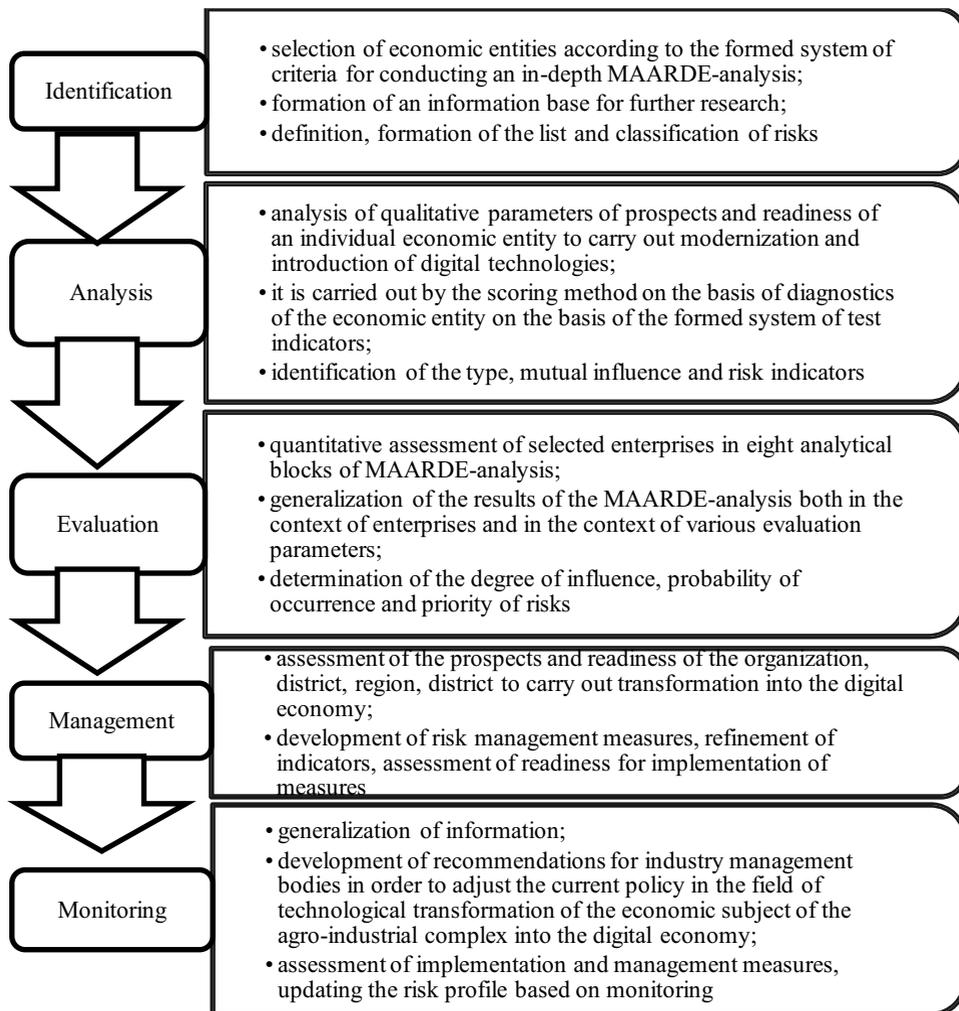
**Table 1.** Characteristics of MAARDE-analysis blocks.

The analysis unit		Specifications
Te	Technology	Analyzes and evaluates the availability, condition, sufficiency and adequacy of digital tools and technologies for the implementation of the ARDE concept, perceived production and technological, resource and organizational and economic deficits, as well as possible technological risks
Pe	Personnel	Establishes the degree of qualification of employees of an economic entity and the possibility of its adaptation to work with digital technical means and technologies, taking into account possible social risks
El	Ecology	Analyzes the natural and climatic and technogenic state of the environment, bioresources and the potential for environmental risks
Sa	Sanitation (	Analyzes the sanitary and epidemiological state of the economic entity and the region, assesses the prospects for increasing the national genetic resources of animals and plants, taking into account possible sanitary risks
En	Economy (	Determines the level of innovation activity of economic entities, differentiating developed and ready-to-implement innovations in the field of intelligent agriculture, precision animal husbandry, breeding, genomics, urbanized farms, etc., as well as possible economic risks
Po	Politics	The author assesses the regulatory and institutional conditions for ensuring the legislative status and legitimation of digital technologies in the industrial and public spheres, the possibilities for reducing the imbalance in foreign trade in agricultural goods, reducing differences in the standard of living of urban and rural residents, as well as possible political risks.

In	Infrastructure	Defines the degree and specific conditions for the formation of a network structure of specialized infrastructure facilities engaged in the development, implementation and support of innodiversification digital developments and technologies, taking into account possible social, technological and economic risks.
Ma	Management	Assesses the effectiveness of the management decision-making system in economic entities, as well as for individual business processes occurring in them, taking into account possible psychological risks

### 3 Research results

With the merge operation set theory table 1 and algorithm of the mechanism of risk management in economic subjects of AIC [11], it is possible to obtain the analytical algorithm of action for the micro - and meso-levels of the proposed methodology MAARDE-analysis (Fig. 1).



**Fig. 1.** Algorithm of the mechanism of introduction of digital technologies of economic entities.

The frequency and order of use of analytical blocks is determined by the intensity of information requests from the main user groups, but the final assessment is carried out exclusively depending on the results obtained from each block.

Information databases and knowledge for digital analysis are filled from possible, available internal and external sources of information.

To assess the indicators of digital analysis, a three-level scale can be applied to the tasks of agricultural risk analysis, which was proposed by Inna Manzhosova [10], which allows identifying the level of deviation of a particular parameter from the optimal value and, consequently, determining the degree of readiness for transformation into a digital economy, taking into account the coefficients of agricultural risks ( $K_r$ ), which can make an unambiguous conclusion about the prospects of an economic entity for digitalization (Table 2).

**Table 2.** Scale for assessing risk factors of MAARDE-analysis.

Scale	A	B	C
Qualitative value of the risk coefficient $K_r$	Effective value (minimum risk)	Limit value (acceptable risk)	Critical value (unacceptable risk)
Quantitative value of the risk coefficient $K_r$	0-0,4 (0 to 40%)	>0.4-<0.7 (41 to 69%)	0.7-1 (from 70 to 100%)
Type of digitalization	Intensive	Transitional	Extensive
Type of transformation (by types of risk management functions)	Innovator	Follower	Observer
Prospects for digital transformation	Full readiness	Potential readiness	Complete unavailability

In the second step of the qualitative analysis (Fig. 1) a scoring internal evaluation of digital analysis as a diagnostic of agricultural organizations in the context of analytical units (Table 1). For each test the proposed system of indicators, which allows to assess the potential risks and make conclusion about readiness of economic entities to implement digital technology on a larger scale and to reveal its strengths and weaknesses. The main advantages of scoring agricultural risks include the ability to conduct a rapid assessment in the presence of a representative of an economic entity and assess its chances of receiving state support or investment for digitalization of an organization, district or region, as well as to minimize the risk of inefficient use of transferred resources.

The second stage of analytical actions is carried out using the structured method of assessment in the format of interviewing (Fig. 7) specialists of the diagnosed business entity, as a result of which points are awarded (Table 2) depending on the facts of certain events directly or indirectly related to digital transformation. Scores for scoring models are calculated using the logistic regression tool and for risk assessment can vary from 0 to 1 or as a percentage from 0 to 100% (Table 2). It should be noted that the selection of economic entities for all stages of the assessment should be based on indicators of the scale and sustainability of the organizations' work. The process of digitalization is practically inaccessible for unstable enterprises, so for MAARDE-analysis it is advisable to select the most successfully functioning economic entities that are the flagships of the agro-industrial complex. These organizations are of the greatest interest primarily because they have sufficient financial, material and human resources to implement digital technologies.

The scoring system for internal evaluation of digital analysis as a diagnostic of the economic entity APK offers 8 basic analytic units (table. 1). As per the studies made earlier [11, 12] noted the priority the impact of technological risks on the transformation of the economic actors in the digital economy, then the analysis should begin with a process unit.

The criteria for scoring internal risk assessment of the MOARCE analysis for the Technology block are shown in Figure 2. The other 7 blocks have a similar structure.

The second most important evaluation criterion is human resources capable of managing digital equipment using digital technologies, which are characterized by social risks [13]. A specific feature of the agro-industrial complex is the increased riskiness of agriculture, which is characterized by increased environmental and sanitary risks. The economic block is characterized by the presence of innovative, competitive and marketing risks [11]. The Politics block is characterized by the presence of country, innodiversification risks, as well as the risk of cybersecurity. The process of digital transformation of economic entities of the agro-industrial complex is impossible without the formed innovative infrastructure of the digital economy [14], which is characterized by a complex of risks. The criteria for scoring internal risk assessment of the MAARDE-analysis for the "Infrastructure" block, as well as the "Management" block, are characterized by a complex of risks.

At the third stage of the MAARDE-analysis mechanism (Fig. 1), a process of quantitative internal assessment is carried out in order to develop indicators in the system of state regulation to control and motivate the planning of the strategy for the digital transformation of the agro-industrial complex. The third block of analytical measures includes quantitative criteria for assessing agricultural risks of the digital economy, which are determined for an economic entity of any level (organization, district, region). Insufficient, at the current moment of development, the level of digital technologies in the economy limits the possibilities of digitalization of economic entities, with the exception of the largest agricultural holdings, which are able to show technological and innovative activity and can subsequently become initiators of further transformation of technologies in the agro-industrial complex.

The quantitative assessment criteria are presented in Appendix 3, and the scale for assessing the risk coefficients of the MAARDE-analysis is shown in Table 2. The risk value for each indicator of any block is indicated by an expert, and if there are several expert assessments, it is calculated as an arithmetic mean. The integral risk coefficient for each analytical block is calculated taking into account their weight (Table 3) according to the formula [15]:

$$R_i = \sum_{i=0}^n (\gamma_i * A_i) + \sum_{i=0}^m (\gamma_i * B_i) + \sum_{i=0}^k (\gamma_i * C_i), \quad (1)$$

where  $i$  – is the number of the indicator in the analytical block;

$n$ ,  $m$  and  $k$  – are the number of indicators whose value for an economic entity has an effective, borderline and unsatisfactory value;

$\gamma_i$  – is a potential function of the weight of the indicator,

$A_i$ ,  $B_i$  and  $C_i$  – is the risk coefficient, the value of which for an economic entity has an effective, borderline and unsatisfactory value.

**Table 3.** Scale for assessing risk factors of MAARDE-analysis.

Indicator number in the block	The unit designation							
	1.Te	2.Pe	3.El	4.Co	5.En	6.Po	7.In	8.Me
1	0.12	0.20	0.13	0.22	0.20	0.22	0.20	0.18
2	0.12	0.20	0.12	0.22	0.20	0.24	0.16	0.14
3	0.16	0.12	0.14	0.16	0.20	0.26	0.12	0.18
4	0.20	0.13	0.20	0.20	0.20	0.14	0.12	0.18
5	0.20	0.15	0.21	0.20	0.20	0.14	0.20	0.18
6	0.20	0.20	0.20				0.20	0.14
For the block	0.14	0.14	0.14	0.14	0.12	0.12	0.10	0.10

The generalized integral coefficient of agricultural risk of the digital economy ( $K_p$ ), substituting the result of calculating the integral risk coefficients for analytical blocks (1), can be determined by the formula:

$$K_p = \sum_{j=0}^8 (\gamma_i * R_j) \quad (2)$$

Substituting formula (1) into expression (2), we obtain the dependence of the generalized integral coefficient of agricultural risk of the digital economy ( $K_p$ ) on the initial risk indicators for each parameter:

$$K_p = \sum_{j=1}^8 [\gamma_j * \sum_{i=0}^{n_j} (\gamma_{i,j} * A_{i,j}) + \sum_{i=0}^{m_j} (\gamma_{i,j} * B_{i,j}) + \sum_{i=0}^{k_j} (\gamma_{i,j} * C_{i,j})], \quad (3)$$

where  $j$  – number of the analytical block;

$n_j$ ,  $m_j$  and  $k_j$  – the number of indicators in the  $j$ –volume of the analytical block, the value of which for an economic entity has an effective, borderline and unsatisfactory value;

$\gamma_{i,j}$  – potential indicator weight function,

$A_{i,j}$ ,  $B_{i,j}$  and  $C_{i,j}$  – risk coefficient, the value of which for an economic entity has an effective, borderline and unsatisfactory value.

Analysis of expression (3) showed that at the preliminary step, the indicators of each analytical block are ranked in ascending order  $R_{i,j}$ , followed by classification into three qualitative groups that characterize their effective, borderline and unsatisfactory values by the number of indicators included in the group. This allows us to identify in each analytical block the number of indicators that have a positive, neutral or negative impact on the risk coefficient of the block itself, which can be used to make a preliminary analysis of the magnitude and nature of the risk of the digitization process of the entire analytical block (Table 2).

At the second step, using the numbers of indicators determined at the preliminary step, the values of integral risk coefficients for analytical blocks are calculated according to the formula (1). The analytical blocks are ranked in ascending order  $R_j$ , followed by classification into three qualitative groups that characterize their effective, borderline and unsatisfactory values by the number of indicators included in the group. This allows us to identify the number of analytical blocks that have a positive, neutral or negative impact on the risk coefficient of the organization, which can be used to make a preliminary analysis of the magnitude and nature of the risk of the digitalization process of an economic entity (Table 2).

In the third step, using the integrated risk ratios of the analytical units identified in the second step, calculated the generalized integral coefficient of the agricultural risk of the digital economy of the business entity ( $K_p$ ) by the formula (2). Generalized integral coefficient of the agricultural risk allows you to make a clear final conclusion about the magnitude and nature of risk of the process of digitalization of business entity (PL.2).

Therefore, the analysis can determine not only the magnitude of the risk of the process of digitalization of a business entity, but also to rank the risks according to their degree of influence and the significance of the indicators characterizing them. This makes it possible to identify positive and negative characteristics of an economic entity and identify promising areas for its digitalization.

To determine the generalized integral coefficient of agricultural risk of the digital economy of an economic entity ( $K_p$ ) without detailing intermediate data, it is advisable to apply the formula (3). The calculation results represent information about the course of transformation processes, and also reflect trends that are observed in the agro-industrial complex and are transmitted to interested parties for making management decisions at the fourth stage of the algorithm of the mechanism for implementing digital technologies of economic entities (Fig.1). At the fourth step, decision makers assess the prospects and readiness of an economic entity (organization, district, region) to carry out transformation

into a digital economy, as well as develop risk management measures, clarify indicators, and assess readiness to implement the proposed measures.

## 4 Discussion of research results

If there is a lack of information, efforts should be focused on improving the accuracy of data and developing models for forecasting them. Only 22 % of top corporate executives who participated in the 22nd annual survey [16] consider the information they provide about likely risks to be complete enough to make long-term decisions.

It should be noted that this trend of leading corporations has not changed over the past 10 years, despite the growth of the data set, is a serious concern. Reliable data is essential when making management decisions, taking into account risks, in the context of digitalization. Therefore, the risk management function is much more effective in increasing the level of readiness of innovators for digitalization.

More than 2,000 CEOs, top managers, Board members, and risk management, compliance, and internal audit experts participated in the PWC surveys [16]. PWC specialists analyzed the features of digital risk management with them.

As a result of the analysis, behavioral models were identified that contribute to the increase in the effectiveness of digital risk management functions. It is established that in organizations (from the group of minimal transformational risk) that have high competencies in the field of digital technologies, they receive a greater return from their initiatives in the field of digitalization. Organizations in this group perform better digital risk management and achieve better results in gaining customer experience and revenue growth relative to their targets.

Experts in the field of risk management provide advice on transformation into the digital economy, without slowing down the pace of ongoing business operations. As practice shows, risk management functions not only do not slow down large-scale digital initiatives, but also become important partners that help corporations achieve or even exceed their goals. In a number of companies in the transition group, risk management functions are already being transformed to this level. In other organizations that are included in the group of critical transformational risk (Table 2), these processes are in their infancy and need to initiate this process.

The methodology can be used to monitor economic entities at any level (organization, district, region, district) to assess the risks and readiness of transformation in the digital economy, as well as in a comparative analysis between several organizations, districts, regions and districts. At the fifth step of the algorithm of the mechanism for implementing digital technologies of economic entities, information obtained at previous stages is summarized and recommendations are developed for industry management bodies in order to adjust the current policy in the field of technological transformation of an economic entity of the agro-industrial complex into a digital economy, as well as to assess the implementation of management measures and update the risk profile based on monitoring.

## 5 Conclusion

Analysis of the concepts and main types of agricultural risks showed that agricultural producers, by analogy with economic entities of other sectors of the national economy, are influenced by both production and market risks. Currently, not only agricultural producers, but also the state should have a direct impact on reducing the level of agricultural risks, which will help attract private investment in the industry.

The following distinctive features contribute to the positive effect of using the proposed MAARDE-analysis technique:

- the analysis is carried out in the context of eight analytical blocks, which characterize the risks that most strongly affect the process of transformation of economic entities into the digital economy (Te – technological; Re – social; El – environmental; Co – sanitary; En – ‘economic; Po – political; In – infrastructure; Me – management). By analyzing these risks, it is possible to identify groups of threats that hinder transformation into the digital economy, and formulate a number of measures to compensate for them;
- each of the analytical blocks has developed its own system of qualitative and quantitative indicators by logically combining the features of the risks of the digital economy with agricultural risks using set theory operations. Therefore, they take into account the existing trends and patterns of development of the digital economy, adapted to the specifics of economic entities of the agro-industrial complex;
- the results of the analysis represent information about the course of transformation processes, as well as reflect the trends that are observed in the agro-industrial complex and are transmitted to interested parties;
- the methodology can be used to monitor economic entities at any level (organization, district, region, district) to assess the risks and readiness of transformation into the digital economy, as well as in a comparative analysis between several organizations, districts, regions and districts;

The methodology allows using not only statistical information, but also accounting data from internal sources, as well as data obtained as a result of expert analysis or self-diagnosis of organizations. Complexity in the combination of input data formation contributes to obtaining correct and high-quality information at the output of the analysis process about the parameters of the technical and economic state of the economic entity.

The proposed methodology makes it possible to form more effective organizational and economic regulators of the process of transformation of economic entities into a digital economy through a preventive assessment of agricultural risks and, taking them into account, the readiness for digitalization of state authorities, economic entities and the population.

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## References

1. G. Bartzasa, K. Komnitsas, *Information Processing in Agriculture* **7(2)**, 223-232 (2020) DOI: <https://doi.org/10.1016/j.inpa.2019.09.005>
2. J.N. Baron, M.N. Aznar, M. Monterubbianesi, B. Martínez-López, *PLoS ONE* **15(6)**, e0234489 (2020) DOI: <https://doi.org/10.1371/journal.pone.0234489>
3. S.N. Awondo, G. Kostandini, P. Setimela, O. Erenstein, *Journal of Agricultural Economics* **71(1)**, 239-259 (2019) DOI: <https://doi.org/10.1111/1477-9552.12344>
4. S. Aravindakshan, T.J. Krupnikb, J.C.J. Groota, et al., *Agricultural Systems* **177**, 102695 (2020) DOI: <https://doi.org/10.1016/j.agsy.2019.102695>
5. N. Junko Negi, J.E. Swanberg, J. Miller Clouser et al., *Cultural Diversity and Ethnic Minority Psychology* **26(1)**, 54–60 (2020) DOI: <https://doi.org/10.1037/cdp0000276>

6. L.V. Sakharova, M.B. Stryukov, G.I. Akperov, *13th International Conference on Theory and Application of Fuzzy Systems and Soft Computing — ICAFS-2018. ICAFS 2018. Advances in Intelligent Systems and Computing*, Springer, Cham (2019) DOI: [https://doi.org/10.1007/978-3-030-04164-9\\_104](https://doi.org/10.1007/978-3-030-04164-9_104)
7. Tian Ze and Xu Jinxuan, *Proceedings of 2019 China international conference on insurance and risk management (CICIRM-2019)*, 474-487 (2019)
8. V.A. Kuzmin, K.E. Tokarev, A.Yu. Rudenko, T.V. Pleshchenko, *IOP Conf. Series: Earth and Environmental Science* **577**, 012008 (2020) DOI: <https://iopscience.iop.org/article/10.1088/1755-1315/577/1/012008>
9. E. Maslyukova, *Russian Journal of Entrepreneurship* **18(16)**, 2345-2354 (2017) doi: 10.18334/rp.18.16.38227
10. I. Manzhosova, *Moscow Economic Journal* **3(8)** (2018) <https://qe.su/otraslevaya-i-regionalnaya-ekonomika/moskovskij-ekonomicheskij-zhurnal-3-2018-8/?print=print>
11. M. Chernyakov, M. Chernyakova, *Financial economics* **6**, 384-389 (2018)
12. M. Chernyakov, M. Chernyakova, *Journal of Corporate Finance Research* **12(4)**, 99–109 (2018) DOI: 10.17323/j.jcfr.2073-0438.12.4.2018.99-109
13. M.K. Chernyakov, M.M. Chernyakova, K.C. Akberov, *Advances in Economics, Business and Management Research. Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth: 1 intern. sci. conf. (MTDE 2019)* **81**, 373-378 (2019) DOI: 10.2991 / mtde-19.2019.71
14. V.Volodin, N. Nagkina, *Izvestia of Higher educational institutions. Volga region. Economic Sciences* **2(8)**, 3-12 (2018) DOI: 10.21685/2309-2874-2018-2-1
15. M. Chernyakov, M. Chernyakova, *Regulation of the digital economy of agriculture (NSTU, Novosibirsk, 2019)* [https://www.elibrary.ru/author\\_items.asp?authorid=473456](https://www.elibrary.ru/author_items.asp?authorid=473456)
16. *Being a Smarter risk taker through digital transformation. PWC research from the series "Looking at risks"* (2019) <https://www.pwc.ru/ru/publications/risk-study.html>