

**Agricultural Communication**

# Development of Technology Transfer in Agriculture During the COVID-19 Pandemic in Russia

Nadezhda Viktorovna Ukolova,<sup>1</sup> Juliya Anatolyevna Shikhanova,<sup>2</sup> Lyudmila Nikolaevna Pototskaya,<sup>1</sup> Nadezda Alexandrovna Novikova<sup>1</sup> and Elena Vasiliyevna Vasiliyeva<sup>1</sup>

<sup>1</sup>Saratov State Agrarian University, Saratov, Russia

<sup>2</sup>Moscow University for Industry and Finance "Synergy", Moscow, Russia

## ABSTRACT

In an ever-changing environment, strategic decisions are made when implementing changes in the technology transfer process. Currently, it is important to implement effective measures to stimulate the development of technology transfer in the agro-industrial complex in modern conditions; to develop ways to stimulate the demand of agricultural enterprises for modern technologies, including by optimizing prices for them. Insufficient demand for innovative technologies also arises due to possible risks. In this regard, it is necessary to develop ways to reduce risks in the process of technology transfer in agriculture. The authors investigate the impact of the COVID-19 pandemic on technology transfer and the way the coronavirus forced people to change their habits and isolate themselves from each other. During this period of time, the role of digital technologies has increased and technology transfer has come to help build new ties between inventors and consumers of scientific achievements. The authors tried to consider the scenario of technology transfer development in agriculture by proposing an algorithm for implementing the technology transfer process in the country's agriculture. Methods of benchmarking, comparative analysis and a systematic approach were used to process information obtained from electronic databases, online publications, the legal reference system, and Internet information resources. As indicated in the article, an important task today is to organize effective interaction between participants in the technology transfer process, including in the virtual space on the Internet sites. For the effective functioning of the technology transfer market in agriculture and its infrastructure, it is necessary to regularly monitor the market situation in order to meet the interests of both buyers and sellers as much as possible.

**KEY WORDS:** CORONAVIRUS, DIGITAL ECONOMY, ISOLATION, PANDEMIC, TECHNOLOGY TRANSFER ALGORITHM.

## INTRODUCTION

The first wave of the COVID-19 pandemic showed that the development of science, innovation and digital technologies is not just an abstractly declared political priority in the countries that are long-standing technological leaders. People around the world, who previously got used to the achievements of science and technology and no longer noticed their advantages, today, in isolation, personally feel their importance for each person. As the history of global economic crises or epidemics shows, each of them "clears" the field and opens up new opportunities for long-term innovative growth. It is important today to lay the foundation for the advanced development of science and

innovation, to increase its contribution to economic growth and the well-being of citizens, to increase the efficiency and achieve a new quality of the economy and the agricultural sector through the introduction of digital technologies, to ensure equal and effective opportunities for realizing the creative and entrepreneurial potential of citizens in the digital environment (Kostin and Khomchenko 2021).

And this conductor will be a technology transfer that will unite science and the real sector of the economy, and its most important segment is agriculture. The emergence and spread of COVID-19 contribute to changing of both the social and the economic life of mankind. The positive consequences of the pandemic may include the acceleration of the introduction of digital technologies that provide wide information access to users through the use of innovative tools. Within the restrictions imposed by governments, entrepreneurs and ordinary consumers are actively developing digital solutions

**Article Information:**\*Corresponding Author: [ukolovang@sgau.ru](mailto:ukolovang@sgau.ru)

Received 19/08/2021 Accepted after revision 25/12/2021

Published: 31<sup>st</sup> December 2021 Pp- 1544-1549

This is an open access article under Creative Commons License,

Published by Society for Science & Nature, Bhopal India.

Available at: <https://bbrc.in/> DOI: <http://dx.doi.org/10.21786/bbrc/14.4.27>

to continue their activities in a remote format (Accounts Chamber of the Russian Federation 2020).

Digitalization contributes to the transition to the online environment of all branches of the agro-industrial complex, allows people to make online purchases, exchange information about innovations. This trend is developing due to the urgent need and to the created material base for the widespread use of digital technologies (Accounts Chamber of the Russian Federation 2020). In addition, the active study of the functioning of the transfer mechanism in the context of a pandemic continues. Solovyova (2019) investigated the conditions of interaction between the institutional structures of the Russian Federation and a number of other countries based on the analysis of indicators of innovative development. She justified the need to reduce the raw material orientation of economic development and increase the share of exported products of innovative developments (Solovyova 2019). Researchers Kostin and Khomchenko (2021) proposed a systematized concept of technology transfer, the impact of the pandemic on the development of technology transfer in different countries and regions was analyzed on a qualitative and quantitative level (Kostin and Khomchenko 2021).

The purpose of the study is to build an algorithm for the implementation of the technology transfer process in agriculture, taking into account the likely scenario of the development of the transfer in a pandemic. In accordance with the purpose of the study, the following main tasks are to be solved: to generalize and to systematize theoretical provisions on the formation and development of technology transfer mechanisms; to clarify the factors of the coronavirus pandemic affecting the effectiveness of technology transfer; to analyze the indicators of the functioning of technology transfer in the field of intellectual property in a number of countries during the pandemic; to formulate the stages of the implementation of the technology transfer process in agriculture in the conditions of the coronavirus pandemic and in the post-pandemic period; to scientifically substantiate the recommendations of the effective functioning of the technology transfer market in agriculture (Solovyova 2019; Kostin and Khomchenko 2021). The working hypothesis to substantiate the scenario for the development of technology transfer in agriculture in the context of the coronavirus pandemic is based on the development of an algorithm for the transfer implementation process.

## MATERIAL AND METHODS

The methodological basis of scientific research consists of methods of analysis and synthesis of economic information, the method of deduction and induction, the causal method and other methods of data processing – they were used in the study and assessment of the current state of innovative development of the analyzed countries in order to identify trends and patterns of technology transfer development. Indicators of the functioning of technology transfer in the field of intellectual property for 2017-2019 in a number of countries (China, USA, Japan, Germany, France, Russia) were selected as the information base of the study according to the principle of priority of innovative economic

development (World Intellectual Property Organization 2019; World Intellectual Property Organization 2020; World Intellectual Property Organization 2021).

Methods of benchmarking, comparative analysis and a systematic approach were used to process information obtained from electronic databases, online publications, the legal reference system, and Internet information resources. To test the hypothesis, methods of generalization and synthesis were used in order to increase the efficiency of the transmission mechanism, to identify the connections between its elements. To develop an algorithm for technology transfer, methods of constructing graphic images were used. The selected methods allow us to evaluate the transfer of technologies, and to develop mechanisms for implementing and improving the efficiency of this process.

## RESULTS AND DISCUSSION

The principles of technology transfer organization are disclosed in the works of many scientists. The works of various authors are devoted to the mechanisms of transfer of intellectual property from the university environment to the real sector of the economy. The methodological and scientific-practical basis for studying the mechanisms of technology transfer were monographs, scientific articles and other scientific works of authoritative scientists-economists and researchers. In the work of the above-mentioned authors, the significance and principles of the organization of technology transfer are revealed, recommendations for stimulating technology transfer are indicated, ways of organizing the activities of technology transfer centers are proposed, as well as mechanisms for the formation of additional subjects of innovation infrastructure (Schumpeter 1982; Butler 2011; Nishizawa 2011; Somaya 2011; Shore and McLauchlan 2012; Luksha and Yanovsky 2012; Correa 2013; Gaponenko 2013; Stolyarov, Sazhina and Kudina 2014; Rossinskaya and Pleshko 2014; Cardamone 2015; Litvinov 2015; Rozhdestvensky 2015; Ruposov 2016; Ugnich 2016; Likholetov and Terebova 2017; Allard 2017; Falko 2017; Porter 2017; Gerasimenko 2018; Kashirin 2018; Gavrilyuk, Voronov and Leontiev 2018; Ukolova et al. 2020). Solovyova (2019) analyzed the indicators of innovative development of a number of countries and, based on the generalization of the experience of functioning, made a conclusion about the need for innovative export orientation (Solovyova 2019). Russian researchers Kostin and Khomchenko (2021) systematized the concept of technology transfer in the context of a pandemic (Kostin and Khomchenko 2021).

Reports of foreign and Russian scientists explore different points of view on the implementation of technology transfer, but it is worth noting the lack of a priority algorithm for its implementation in agriculture. This circumstance required the need for further development of implementation mechanisms and ways to improve the efficiency of technology transfer, as well as the development of practical recommendations for improving existing forms of technology transfer in Russia's agriculture. The slowdown in economic growth around the world was observed in

2019, and at the beginning of 2020 it has increased due to the coronavirus pandemic (Solovyova 2019).

The large-scale decline in economic activity due to the closure of many leading economies affected all countries, disrupting the usual way of life. Conferences, seminars, and exhibitions of scientific achievements were suspended. The gap between developers and consumers of scientific

achievements leads to missed opportunities for farmers. Regulators and governments were forced to urgently apply a wide range of support measures, to carry out these activities online. At the same time, the root causes of the current crisis lie outside the economic or financial sphere, which makes it unlike the previous ones. This crisis caused fear, fright, a threat to their lives. And this imposed a certain communication between people. This is confirmed by the data presented in Table 1 (Solovyova 2019).

**Table 1. The answers to the question How do you assess the threat from the new coronavirus and the response to it?**

Reaction to the coronavirus is hypertrophied and seems more dangerous than the virus itself	369 (43%)
Threat of the virus is still underestimated in the world — this explains the pandemic nature of the spread of the disease	277 (32%)
Response to the coronavirus is adequate to the threat posed by the COVID-19 pandemic	211 (25%)

**Table 2. Indicators of the functioning of technology transfer in the field of intellectual property for 2017-2019**

Indicators	Russia	USA	Germany	France	China	Japan
	2019 (World Intellectual Property Organization, 2021)					
number of patent applications for inventions	35 511	621 453	67 434	15 869	1 400 661	307 969
number of applications for utility models	10 136	-	11 668	454	2 268 190	5 241
number of applications for the creation of industrial designs	10 928	49 848	44 097	37 404	711 617	32 176
	2018 (World Intellectual Property Organization, 2020)					
number of patent applications for inventions	37 957	597 141	67 898	16 222	1 542 002	313 567
number of applications for utility models	9 747	-	12 307	608	2 072 311	5 388
number of applications for the creation of industrial designs	8 943	47 137	44 460	12 495	708 799	31 468
	2017 (World Intellectual Property Organization, 2019)					
number of patent applications for inventions	36 883	606 956	67 712	16 247	1 381 594	318 479
number of applications for utility models	10 643	-	13 301	428	1 687 593	6 105
number of applications for the creation of industrial designs	7 390	45 881	45 803	12 132	628 658	32 457

The uncertainty is supplemented by the fact that traditional relations in the economy and in society are fundamentally changing, the nature of labour relations is beginning to change, the remote access mode is being practiced more and more. As of mid-2021, the probability of a third wave of the pandemic is quite high, while its duration and scale are still unclear, and the prospects for further development of the countries' economies are becoming less certain, and

the scale and mechanisms for stabilizing the situation are becoming more diverse and non-standard (Solovyova 2019; Ukolova et al. 2020).

As it has been repeatedly stated in the media, digitalization in the post-quarantine world will gain unprecedented momentum. "The pandemic is likely to accelerate the digital revolution, all its components: 5G communications,

enterprise robotics, artificial intelligence and e-government technologies, digital commerce and payments," says Jeffrey Sachs. And here it is impossible to do without the help of the state, its support. The state is more interested in the development of technology transfer than anyone else. In the leading countries of the world, such as the United States, China, Japan, and the European Union, technology transfer is the basis for building the economy of the future, based on the active use of artificial intelligence, robotics, information and communication technologies, reducing the intensity of human labour use and, as a result, increasing the productivity and efficiency of economic entities of national economies as a whole. Here it is worth mentioning the statement of Virginia Marie "Jinni" Rometti "The only way to survive is continuous transformation" (Golovanov 2020).

In the conditions of a pandemic, it is impossible to draw an unambiguous conclusion about the increase in the participation of information resources in creating the value of high-tech products, the introduction of innovations based on the accumulation of additive technologies (Table 2).

Analyzing the impact of the COVID-19 pandemic on technology transfer, we can note:

- in RF on indicator 'the number of Russian patent applications for inventions' in 2019 we come across a decrease of 6.4% compared to 2018 and 3.7% compared to 2017;

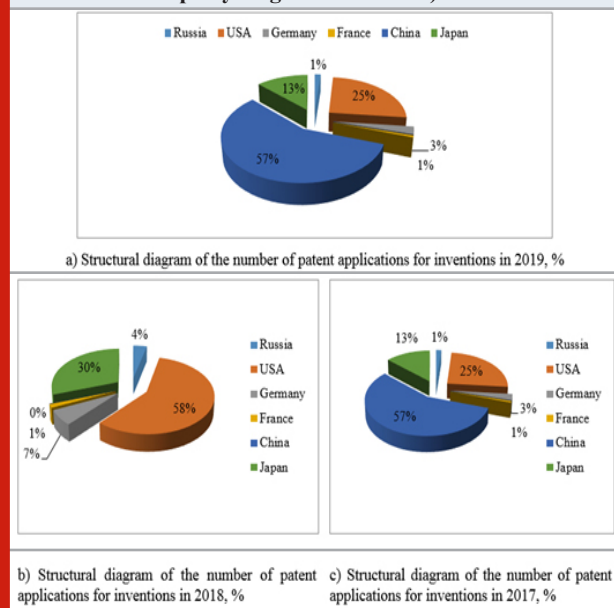
- indicator 'the number of applications for utility models' in 2019 revealed an increase of 4% compared to 2018 and a decrease of 4.8% compared to 2017; the indicator of the number of applications for the establishment of industrial designs has increased by 22.2% and 37.8% to 2018 and 2017, respectively.

According to studies of US indicators, it was found that the number of patent applications for inventions in 2019 increased by 4.1% and 2.4% compared to the data of 2018-2017. According to the indicator 'number of applications for utility models', there is no data, the increase in the indicator- 'number of applications for the creation of industrial designs' was 5.8% and 8.6%, respectively, compared to the data of 2018 and 2017. The change in the studied indicators in Germany revealed a negative trend: in 2019, the number of patent applications for inventions decreased by 0.7% and 0.4% compared to 2018 and 2017. The number of applications for utility models decreased by 5.2% and 12.3% relative to the study period. According to the number of applications for the creation of industrial designs, the decrease was 0.8% and 3.7%. In France, the situation is ambiguous regarding the change in innovation activity in 2019: the number of patent applications for inventions decreased by 2.2% and 2.3% compared to 2018 and 2017. In terms of the number of applications for utility models, a decrease of 25.3% compared to the data of 2018 and an increase of 6.1% compared to 2017; the number of applications for the creation of industrial designs increased almost 3 times compared to the study period (Porter 2017;

Gerasimenko 2018; Kashirin 2018; Gavriilyuk, Voronov and Leontiev 2018; Ukolova et al. 2020).

In China, the indicators are consistently high, however, according to the indicator, the number of domestic patent applications for inventions decreased by 9.2% compared to 2018 and a slight increase (1.4%) compared to 2017 data. According to the indicator, the number of applications for utility models in 2019 showed an increase of 9.5% compared to 2018 and by 34.4% compared to 2017. The number of applications for the creation of industrial designs increased by 0.4% and 13.2% compared to the data of 2018 and 2017, respectively. The study of changes in Japan's indicators revealed: a decrease in the number of domestic patent applications for inventions in 2019 by 1.8% and 3.3% compared to the data of 2018-2017. According to the indicator-the number of applications for utility models fell by 2.7% and 14.2%, the change in the indicator – the number of applications for the creation of industrial designs, respectively, by 2.2% (an increase compared to 2018) and 0.9% (a decrease compared to 2017). Information about the changes taking place during the pandemic is shown in Figure 1.

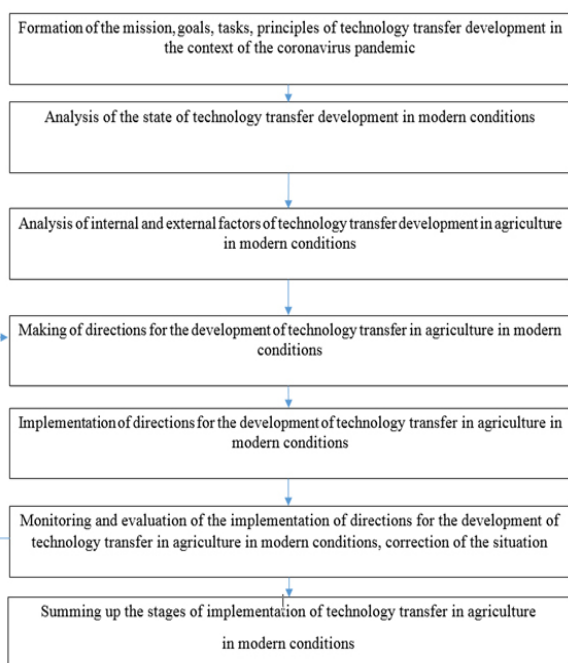
**Figure 1: Comparative indicators of technology transfer during the COVID-19 pandemic and before its onset (World Intellectual Property Organization 2021)**



The change in the share of the number of patent applications for inventions of the countries selected by us as analyzed allowed us to establish that China occupies a leading position in 2019 and in 2017, the second place in 2019 and in 2017 belongs to the United States (25%), in 2018 the United States was the leader (58%). Japan is on the 3rd place in 2019 and in 2017 (13%), in 2018 an increase of up to 30% was noted. In 2019, Germany accounts for 3%, Russia and France for 1% each. In 2018, Germany accounted for 7%, Russia-4%. In 2017 Germany accounted for 3%, Russia-1%.

Thus, in the conditions of the COVID-19 pandemic, the formation of intensive market interaction of economic entities of the United States was noted, in other countries (Russia, Germany, France, Japan, China), a slight decrease in innovation activity was recorded. It is important to implement measures to expand intra- and interregional cooperation in the field of technology transfer in agriculture in order to expand the customer base (potential buyers of innovative technologies from other regions). An important task in modern conditions is the organization of effective interaction between participants in the technology transfer process, including in the virtual space on the Internet (Figure 2). At the first stage, described in this algorithm, the mission, goals, tasks, and principles for the development of technology transfer in agriculture in the conditions of the coronavirus pandemic and in the post-pandemic period are formulated.

**Figure 2: Algorithm for implementing the technology transfer process in agriculture**



At the second stage, the state of development of technology transfer in agriculture in modern conditions is analyzed. Special attention is paid to the period of the pandemic and the peculiarities of the development of technology transfer in this period of time. At the third stage, the internal and external factors of the development of technology transfer in agriculture in modern conditions are analyzed. At the same time, special attention is also paid to the period of the pandemic and the influence of external (including international) factors. At the fourth stage, the development of directions for the development of technology transfer in agriculture in modern conditions is carried out, taking into account risks and uncertainties. At the fifth stage, the directions for the development of technology transfer in the agricultural sector of the economy are being implemented, taking into account the influence of external and internal environmental factors, possible risks and uncertainties.

Next the implementation of the directions of technology transfer development in agriculture in modern conditions is monitored and evaluated, and the situation is adjusted. After that, the directions of development of technology transfer in agriculture are adjusted and their implementation is carried out. At the last stage, the results of the stages of the implementation of technology transfer in agriculture in modern conditions are summarized. The generalization of the research results of foreign and domestic scientists on the consideration of the principles of the organization and mechanisms of technology transfer served as the basis for the development of an algorithm (Kashirin 2018; Gavrilyuk, Voronov and Leontiev 2018; Ukolova et al. 2020).

This has helped with the implementation of the technology transfer process universal for the agricultural production industry. The algorithm is based on the development and implementation of effective development directions formed taking into account the current state of agricultural production changing under the influence of external and internal factors. An analysis of the current state of the innovation environment and the functioning of the transfer mechanism of a set of leading countries (China, the United States, Japan, Germany, France) allowed us to conclude that the positive dynamics due to the impact of the COVID-19 pandemic was noted only for the United States. In other countries, including Russia, there was a slight slowdown in innovation activity, probably caused by an increase in the influence of uncertainty and risk factors in new, non-standard conditions for market conditions (Ukolova et al. 2020).

## CONCLUSION

The findings of the present study conclude about the impact of the COVID-19 pandemic on the slowdown or progressive development of the transfer mechanism can be made at the end of 2021, when it is possible to evaluate the extraordinary ways developed by countries to overcome the negative consequences of the pandemic, due to the individual characteristics of the functioning of the countries under consideration. The optimal technology transfer mechanism considered by us for application in the field of agricultural production should be built taking into account changing market conditions, the consequences caused by the COVID-19 pandemic, natural and climatic factors (fundamental for agricultural production) and the experience of countries that have overcome the impact of the pandemic (the United States) in modern economic conditions.

## ACKNOWLEDGEMENTS

The reported study was funded by RFBR, project number 20-010-00324.

## REFERENCES

- Accounts Chamber of the Russian Federation. (2020) Digital technologies and cybersecurity in the context of the COVID-19 spread. Accounts Chamber of the Russian Federation. Available at: <https://ach.gov.ru/upload/pdf/Covid-19-digital.pdf> (Accessed on: July 1, 2021)

- Allard, G., and Allard, S. (2017). Information behaviour in the technology transfer process. *Proceedings of the Association for Information Science and Technology*, Vol. 54(1), pp. 614–616.
- Butler, J.S., and Gibson, D.V. (2011). *Global perspectives on technology transfer and commercialization: building innovative ecosystems*. Cheltenham: Edward Elgar Publishing.
- Cardamone, P., Pupo, V., and Ricotta, F. (2015). University technology transfer and manufacturing innovation: the case of Italy. *Review of Policy Research*, Vol. 32(3), pp. 297–322.
- Correa, C.M. (2013). Innovation and technology transfer of environmentally sound technologies: the need to engage in a substantive debate. *Review of European, Comparative & International Environmental Law*, Vol. 22(1), pp. 54–61.
- Falko, S.G. (2017). Innovations in project management. *Innovations in management*, Vol. 4(14), pp. 2-3.
- Gaponenko, N.V. (2013). The concept of sectoral innovation systems for the modernization of the economy and increasing competitiveness: methodological problems and experience of use in Russia. *Innovations*, Vol. 10, pp. 32-40.
- Gavrilyuk, A.V. (2018). Transfer of innovations in the digital economy. In: Kudina, M.V.; Voronov, A.S. *Digital economy as a strategic trend of innovative development*. Moscow: KDU.
- Gerasimenko, V.V. (2018). Labyrinths of Eurasian integration: finding ways to a single market. *Scientific Research of the Faculty of Economics. Electronic Journal of the Faculty of Economics of the Lomonosov Moscow State University*, Vol. 9(2), pp. 27-41.
- Golovanov, G. (2020). Jinni Rometty: It's time to stop hiring people judging by their diploma. *Hightech+*, 2020. Available at: <https://hightech.plus/2020/10/06/dzhinni-rometti-pora-perestat-nanimat-lyudei-na-osnove-ih-diploma> (Accessed: September, 26, 2021)
- Kashirin, V.V., and Sysoev, A.P. (2018). Some issues of innovative development of the Russian economy. *Society and Economy*, Vol. 2, pp. 25-35.
- Kostin K.B. and Khomchenko E.A. (2021). The current state of international technology transfer in the world economy. *Economic relations*. 11(2): 411–424.
- Kudina, M.V., Sazhina, M.A., Stolyarov, I.I., et al. (2014). *Innovative economy: a scientific and methodological manual*. Moscow: Forum Publishing House: INFRA-M.
- Litvinov, V.V., and Kharchenko, V.S. (2015). Experience of interaction between universities and industry in the field of IT technology transfer in Western Europe. *Mathematical machines and systems*, Vol. 1, pp. 111-123.
- Luksha, O.P., Yanovsky, A.E., Pilnov, G.B., et al. (2012). The Russian network of technology transfer as an integral part of the national innovation system: methodology, practice, prospects. Moscow: Artifex.
- Nishizawa, A. (2011). From triple-helix model to eco-system building model. *International Journal of Technoentrepreneurship*, Vol. 2(3–4), pp. 304–323.
- Porter, M. (2017). *Competitive strategy: methods of analyzing industries and competitors*. Moscow: Alpina Publisher, (7).
- Rossinskaya, M.V., and Pleshko, M.S. (2014). Effective directions of commercialization of scientific developments and technology transfer in Russian universities. *Property relations in the Russian Federation*, Vol. 9(156), pp. 34-37.
- Rozhdestvensky, I.V., Rozhdestvensky, O.I., and Tarshin, A.Yu. (2015). Model of an effective system of technological transfer in universities and scientific organizations of the Russian Federation. *Innovations*, Vol. 11(205), pp. 106-109.
- Ruposov. V.L., Konyukhov, V.Yu., et al. (2016). Analysis of the creation and implementation of innovative projects in higher education. *Innovations*, Vol. 7(213), pp. 20-23.
- Schumpeter, J. (1982) *Theory of economic development*. Moscow: Progress, 455.
- Shore, C., and Mclauchlan, L. (2012). Third mission activities, commercialization and academic entrepreneurs. *Social Anthropology*, Vol. 20(3), pp. 267–286.
- Solovyova, and Yu.V. (2019). Technology transfer in Russia: current state and prospects of development. *Innovation*, 5: 46–53.
- Somaya, D., Kim, Y., and Vonortas, N.S. (2011). Exclusivity in licensing alliances: using hostages to support technology commercialization. *Strategic Management Journal*, Vol. 32(2), pp. 159–186.
- Terebova, S.V. (2017). *Mechanisms for increasing the innovative activity of industrial enterprises: problems of development and implementation: monograph*. Vologda: FSBI ISERT RAS.
- Ugnich, E.A. (2016). Development of the sphere of high technologies: the role of the venture ecosystem. *State management. Electronic bulletin*, Vol. 54, pp. 161-185.
- Ukolova, N.V., Monakhov, S.V., Shikhanova, et al. (2020) Technology transfer in agriculture: introduction to the theory and improvement of the mechanism. Saratov: Amirit.
- World Intellectual Property Organization. (2019) *WIPO IP in facts and figures 2018*. World Intellectual Property Organization. Available at: [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_943\\_2018.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_943_2018.pdf). (Accessed on: July 1, 2021)
- World Intellectual Property Organization. (2020) *WIPO IP in facts and figures 2019*. World Intellectual Property Organization. Available at: [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_943\\_2019.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_943_2019.pdf). (Accessed on: July 1, 2021)
- World Intellectual Property Organization. (2021) *WIPO IP in facts and figures 2020*. World Intellectual Property Organization. Available at: [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_943\\_2020.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_943_2020.pdf). (Accessed on: July 1, 2021)