ATLANTIS PRESS

Advances in Economics, Business and Management Research, volume 105

1st International Scientific and Practical Conference on Digital Economy (ISCDE 2019)

The use of unmanned aerial vehicles in monitoring the implementation of the project to introduce unused agricultural land in the Penza region

Mikheev M.Yu.
Penza State Technological University
Penza, Russia
volkovange@yandex.ru

Volkov A.G.
Penza State Technological University
Penza, Russia
volkovange@yandex.ru

Kolesnikova S.V.
Пензен Penza State Technological University
Penza, Russia
volkovange@yandex.ru

***Abstract* — The article discusses the need to increase agricultural production in connection with the growth of the world's population. One of the ways to accelerate the development of agricultural production is the extensive commissioning of unused agricultural land. A project has been approved in Penza region providing for the introduction of 181 thousand hectares of such land plots for the period of 2017-2020. To control the project performance in a monitoring mode, it is recommended to use unmanned aerial vehicles (UAVs). Due to the objective difficulties facing regional agricultural producers, primarily the lack of financial resources, it is recommended to use public resources in the form of grants, subsidies, private-state investments to create UAV stations. It is also possible to attract UAVs under the guarantees of the Ministry of Agriculture of the Penza Region that are managed by the regional Ministry of Emergencies and military units.**

Keywords — agricultural land, farmland, unmanned aerial vehicles, geolocation information, GIS-technology, putting unused agricultural land into circulation, unmanned aerial vehicles station.

I. INTRODUCTION

The population of the planet is constantly growing: in 2008 there were 6.5 billion people, in 2011 - 7 billion people, according to UN forecasts, by 2050 their number will increase to 9.8 billion. Accordingly, food consumption will increase. Based on expert forecasts, agricultural production should increase by 70% by 2050 [1].

The increase in agricultural production is possible in two ways: 1) due to the increase in farmland, 2) due to the use of intensive technologies to ensure productivity growth on existing land. Most likely, these methods will be applied simultaneously. However, due to the fact that there are a few countries having agricultural land on their territory, growth will be achieved to a greater extent due to intensive factors.

First of all, the intensification is associated with the use of new equipment, computer technology using appropriate platforms and software solutions. This dramatically changes the content and structure of business processes.

For a long time, agriculture was not a business attractive for investors due to the long production cycle, subject to natural risks and large crop losses during cultivation, harvesting and storage, the inability to automate biological processes and the lack of progress in improving productivity and innovations. The use of IT in agriculture was limited to the use of computers and software mainly for financial management and tracking of commercial transactions.

Technology has evolved and a dramatic upturn in attention to the segment occurred when technology companies turned their attention to agriculture. Together with their partners, they learned to control the full cycle of plant growing or animal husbandry through smart devices that transmit and process the current parameters of each object and its environment (equipment and sensors that measure soil, plants, microclimate, animal characteristics, etc.), as well seamless communication channels between them and external partners. Thanks to the integration of objects into a single network, the exchange and management of data based on the Internet and the increased productivity of computers, the development of software and cloud platforms, it became possible to automate the maximum number of agricultural processes by creating a virtual (digital) model of the entire production cycle and interrelated links of the value chain, and with mathematical precision, plan the work schedule, take emergency measures to prevent losses in the event of a recorded threat, calculate the possible yield, production cost and profit.

II. RESEARCH METHODOLOGY

The work used materials from the sites TAdviser.ru, iot.ru, expert assessments of the state and development of agriculture digitalization in Russia and foreign countries, Rosstat data, scientific articles in specialized journals, magazines from the Web of science list, devoted to the research topic, company data manufacturers of unmanned vehicles, materials on the

official websites of the Ministry of Agriculture of the Penza Region, Office of the Federal Service for State Registration, Cadastre and Cartography of the Penza Region, Penza College of Information and Industrial Technology.

III. RESULTS OF THE RESEARCH

The active use of unmanned aerial vehicles in agriculture occurs in the USA, China, Japan, Brazil, the EU countries, and among the largest players in the world UAV market, oriented to agriculture, AeroVironment Inc, AgEagle, DJI, Yamaha, etc. can be distinguished [2].

Goldman Sachs predicts that by 2021, the agricultural sector will become the second largest in the use of drones after the defense industry [3].

The UAV market in the agricultural sector is also developing in Russia. Among the most active market participants are Unmanned Technologies (Novosibirsk), Geoscan (St. Petersburg), Autonomous Aerospace Systems - GeoService Krasnoyarsk) and ZALA AERO (Izhevsk).

The range of services provided by these companies for agriculture is quite large. For example, the company "Geoscan" offers agricultural producers assistance in the inventory of farmland, creating electronic field maps, monitoring the equipment and condition of crops, calculating NDVI and other indices, accompanying and monitoring agricultural activities [4].

Accurate (precise) agriculture is a system for optimization of links in agriculture and the resource base, based on GIS technologies. Which is:

- creation of field plans with the determination of the geographical coordinates of the boundaries of farmland (digitization);
- mapping of fields according to yield of cultivated crops;
- collection of information on soil fertility factors in individual (elementary) areas;
- optimization of soil and phytosanitary conditions of crops for the production of agrogenosis [5].

Over the course of several hours, UAVs are able to examine agricultural areas of impressive size, and the information collected using a camera and sensors allows the farmer to create electronic field maps in a 3D format and calculate the Normalized Difference Vegetation Index (NDVI) in order to efficiently fertilize crops, inventory work, protect the land, etc. Agricultural drones can perform the following types of work:

- Analysis of the soil condition. Using cameras and sensors installed on the UAV, farmers analyze the soil condition in various areas and determine which ones are more suitable for planting seeds.
- Planting seeds. At the moment, you can find startups on the market offering to set plants using special drones that shoot capsules with seeds in the soil. An example of such a startup is BioCarbon Engineering, which loudly announced itself in the spring of 2015, announcing its plans of planting up to 1 billion trees a year.
- Crop status monitoring. It is important for farmers to timely detect pests that affect the land, and take the necessary measures.
  For example, it has long been known that the first signs of plant deterioration are manifested in a change in chlorophyll - therefore, by installing infrared cameras on UAVs, farmers will be able to immediately find out about the beginning of the crop loss.
- Crop processing. Another potential area of application for UAVs in agriculture is the uniform spraying of crops with pesticides and special fertilizers. With the help of drones, farmers will be able to carry out such work remotely.
- Yield forecast. The data collected during monitoring can be used to compile analytical reports. In this case, the UAV will be used as a platform for collecting data, while the main work will rest on specialized software that processes the collected information.

"JPS Com" project, which introduces eBee unmanned aerial vehicles on the Russian market could be an example. These are ultralight aerial survey complexes (from 0.6 kg) developed by SenseFly (Switzerland).

The object was a plot of land with an area of about 0.7 km2, sown with corn and equipped with an irrigation system. Data processing and field monitoring were carried out in the PostFlight Terra 3D software package (PC), supplied with the eBee UAV, and took no more than one hour. The result was: an orthophotomap with a spatial resolution of one pixel on an area of 15 cm, a digital terrain model (DTM), a high-density point cloud in LAS format, and orthophotomosaic files for loading and displaying data in Google Earth [6].

Many experts even believe that the future of “agricultural” UAVs lies precisely with this development model: the devices themselves will become “committing”, while the main value for the market will be the specialists who are able to make the right decisions on the further development of farmland based on the results of the software [4].

In July 2017, at a meeting of the Council for Strategic Development and Priority Projects, the Russian President Vladimir Putin said that the formation of a digital economy is becoming a national security issue. “Digital economy is not a separate industry, in fact it is a way of life, a new basis for the development of the system of government, economy, business, social sphere, the whole society.

In this regard, the Government of Russia has taken measures over the past five years to implement the national project “Digital Economy”. At the end of 2016, Deputy Prime Minister Arkady Dvorkovich made an order to the Ministry of Agriculture, the Ministry of Industry and Trade and the Ministry of Communications to draw up a plan for introducing the Internet of Things technologies into the agro-industrial complex. "It is planned to develop and implement information systems and services for agrarians. To do this, you must first provide Internet access on agricultural land. In the future,

space monitoring will be conducted with the publication of the results on the Internet to evaluate land use efficiency," said M.

Abyzov, representative of the Government Commission for the Coordination of the Open Government commented on the situation [3].

The Internet Initiatives Development Fund (IIDF) has developed a roadmap that details the plan for introducing innovative technologies in the domestic agricultural sector until 2019. By this time, 30% of Russian farms, in theory, will have to actively use the technology of the "Internet of things". At the same time, the main focus is planned to be made on state regulation of "agricultural" UAVs [4].

The Ministry of Agriculture of Russia has developed a federal scientific and technical program for the development of agriculture for 2017-2025, which provides for the increase in agricultural production volumes by a quarter due to the introduction of digital farming, robotization and automation programs in the agro-industrial complex. Currently, in terms of information technology penetration into agriculture, Russia occupies 45th place in the world [7].

IV. Discussion of Results

Amid increasing intensification in most agricultural producing countries, Russia has significant reserves of unused agricultural land. According to the 2016 All-Russian Agricultural Census, the total land resources of the Russian Federation is 1712.5 million hectares, of which: forest resources - 1126.3 million hectares (65.8%), agricultural lands - 383.7 million hectares (22.4%), other lands. Moreover, the total area of farmland was 142.2 million hectares [8].

However, according to the director of the Center for Agri-Food Policy of the IPEI RANEPA of N. Shagaid, not all so-called agricultural lands meet this purpose, primarily because their use may be economically disadvantageous. Nevertheless, it is obvious that there are significant reserves for expanding the area of farmland in Russia [9].

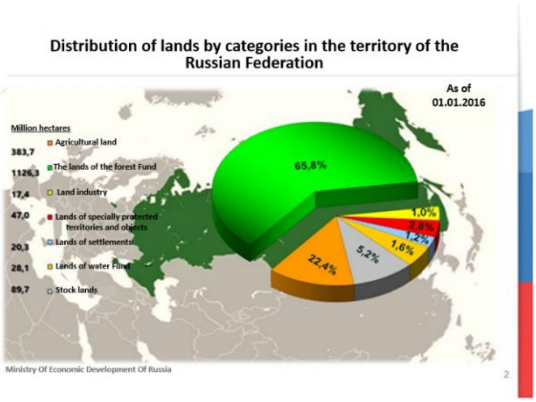

Fig. 1. Land distribution by categories in the Russian Federation (Ministry of Economic Development of Russia according to the 2016 All-Russian Agricultural Census)

The total land area within the Penza region is 4335.2 thousand hectares, agricultural land predominates (Table 1).

TABLE I. The distribution of land in the Penza region by categories, thousand hectares [10]

Categories of lands of the Penza region	2013	2016	2018
Agricultural land	3073.5	3072.9	3072.0
Land settlements	228.0	228.2	228.6
Land for industry, energy, transport, communications, broadcasting, television, computer science, land for space activities, land for defense, security and land for other special purposes	43.1	43.5	44.0
Lands of Specially Protected Areas and Objects	9.1	9.1	9.1
Forest resources	964.5	964.5	964.5
Water resources land	14.8	14.8	14.8
Land stock	2.2	2.2	2.2
Total land:	4335.2	4335.2	4335.2

In the composition of agricultural land, the area of agricultural land is over 70% (Table 2).

TABLE II. Dynamics of changes in the area of agricultural land in the Penza region, thousand hectares [10]

Indicators	2014	2015	2016	2017	2018
The total land area within the Penza region	4335.2	4335.2	4335.2	4335.2	4335.2
The area of farmland, total:	3042.2	3041.7	3041.3	3040.8	3040.6
including:					
-arable land	2258.6	2259.3	2261.9	2261.8	2261.7
-deposit	159.6	158.9	156.1	156.0	155.9
-perennial plantings	22.5	22.5	22.5	22.5	22.5
-fodder land	601.5	601.0	600.8	600.5	600.5

In the framework of the Presidential Address to the Federal Assembly of the Russian Federation of December 3, 2015, and the instructions of the Governor of the Penza Region I. Belozertsev, the Ministry of Agriculture of the Penza Region developed the Priority Project "Putting the unused agricultural land in the Penza Region into circulation", approved on November 25, 2017. The project start date is April 1, 2017, completion date is November 30, 2020 (the project curator is Deputy Prime Minister, Minister of Agriculture of the Penza Region A.V. Burlakov).

The goal of the project is to put at least 181 thousand hectares of unused agricultural land in the Penza region before November 30, 2020 into circulation.

TABLE III. PROJECT INDICATORS AND THEIR VALUES BY YEARS [11]

Indicator	Indicator type	Period, year			
		2017	*2018*	*2019*	*2020*
Total area of agricultural land put into circulation, thousand ha	main	50	95	140	181
Area of agricultural land annually put into crop rotation, thousand ha	second level	48	41	41	36
Area of agricultural land transferred for grazing as livestock, thousand hectares	second level	2	4	4	5
The number of created additional jobs, people	analytical	100	160	200	230

As indicated in the roadmap of the project, its implementation will accelerate the development of the agricultural industry of the Penza region by increasing the cultivated area of agricultural land by 166 thousand hectares, which will lead to an increase in the gross harvest of agricultural crops by 300 thousand tons. It is also planned to provide 15 thousand hectares of unused agricultural land of state, municipal and private property for rent for grazing livestock as fodder land. This will increase the number of commercial livestock of cows of specialized meat breeds in agricultural organizations, peasant (farmer) enterprises, including individual entrepreneurs, by 6.5 thousand heads. Additionally, 230 payrolls will be created. The overall economic effect of the project: due to tax increases - 9 million rubles, due to the provision of land for rent - 4.2 million rubles [11].

The project budget in the amount of 1.400 million rubles was approved, including: in 2017 - 422 million rubles, in 2018 - 358 million rubles, in 2019 - 340 million rubles, in 2020 - 280 million rubles. Sources of funding are extrabudgetary funds.

The dates of the control points for the implementation of the project were also established - November 1, 2017; November 1, 2018; November 1, 2019; and November 1, 2020 [11].

Obviously, the implementation of the project on putting the unused agricultural land into circulation will require obtaining geolocation information about the size, boundaries of land, the degree of processing. Moreover, it is advisable to receive it not once a year, but in the monitoring mode.

For this, unmanned aerial vehicles (UAVs) equipped with cameras and highly sensitive sensors can be used. UAVs are capable of several hours of work to explore agricultural areas of impressive size, and the information collected by the camera and sensors, allows the farmer to create electronic maps of fields in 3D. The data collected during monitoring can be used to compile analytical reports for project coordinators.

Monitoring of the state and use of land on the territory of the constituent entities of the Russian Federation will be carried out on the basis of the State contract with the Federal Service for State Registration, Cadastre and Cartography within the framework of the Land Code of the Russian Federation (subparagraphs 1-4 of paragraph 2 of Article 67), according to which the tasks of state monitoring lands applies:

1. Timely identification of changes in the state of the land, assessment and forecasting of these changes, development of proposals to prevent negative impacts on land, to eliminate the consequences of such effects.
2. Providing state authorities with information on the state of the environment in terms of land conditions in order to exercise the powers of these bodies in the field of land relations, including the exercise of powers on state land supervision (including for conducting an administrative survey of land relations objects).
3. Providing local governments with information about the state of the environment in terms of land conditions in order to exercise the powers of these bodies in the field of land relations, including municipal land control.
4. Providing legal entities, individual entrepreneurs, citizens with information on the state of the land environment [12].

However, such promising projects are associated with a number of objective difficulties.

As a result of the analysis of the data on the production and economic activity of agricultural enterprises in the Yaroslavl region, the authors M.A. Mayorova and M.I. Markin identified the main problems in the implementation of high-precision digital agriculture, inherent in most Russian agricultural enterprises. These include:

1) Lack of financial resources for research, development, implementation of digital farming technologies. Most of the managers of agricultural enterprises do not have their own financial capabilities and do not see the need to use borrowed funds. Since, at the moment, there is no system of farm loans for precision farming in the Russian Federation, there are no government support programs. All stages of precise farming are very costly because they involve the creation of various sensors, machines and mechanisms with electronic control for data collection and differentiated crop care.

2) The complexity of the application of high-precision technologies. In order to develop an enterprise development strategy, reorganize the system of agricultural production according to new management principles, develop programs for differentiated care of crops, based on their current state, highly qualified specialists are required who can not only develop, but also implement high-precision technologies within the framework of a specific agricultural enterprise.

3) Staff shortages. Agricultural enterprises are experiencing an urgent need not only for specialists, but also for seasonal and permanent workers of productive age.

4) Lack of high-quality, complete, reliable data for analysis. In the analysis, development and implementation of high-precision technologies, it is important to collect and accumulate detailed data on soils, the effectiveness of different doses and the timing of the application of fertilizers, ameliorants and agrochemicals, weather conditions and harvests; moreover, these data must be precisely tied to a

specific area, taking into account not only agrochemical, climatic and other indicators, but also the topography, contouring, geographical data, remoteness of sites, etc.

5) The variability of external business conditions. It is important to take into account the spatial and temporal variability of indicators of production and economic activity of agricultural enterprises.

6) The complexity of agricultural production. Industrial and economic activities in the agro-industrial complex have their own specifics and are distinguished by their variety of functional, organizational, technological, innovative features, since all processes in agriculture proceed under the influence of natural processes, where land, plants and animals are an indispensable means of production.

7) Lack of innovative infrastructure. The specifics of agricultural production associated with industry-specific features of the agricultural sector, low level of informatization of management of business entities, fragmentation of information infrastructure.

8) Weak material and technical base, technical and technological backwardness. Recently, the results of the analysis show a steady decline in the provision of agricultural enterprises with agricultural machinery.

9) The lack of incentives for R&D costs and the increase in these costs.

10) A long period for the development and implementation of innovations in the agricultural sector.

11) Natural and climatic conditions.

12) A long time lag between the invested funds and the results obtained from the introduction of innovations.

13) Low profitability of production.

14) The increase in prices for fuel, lubricants, electricity, mineral fertilizers, etc. causes an increase in the cost of mechanized work by an average of 30-45% or more and, as a result, an increase in the cost of livestock and crop production.

15) Lack of special services capable of assisting in the organization of production on new principles. The agricultural producer lacks up-to-date information on modern scientific and technical developments, innovative technologies and projects, on advanced production experience aimed at increasing the volume of production, improving its quality and reducing production costs [13].

The lack of a package of laws that fully regulate the mechanism and infrastructure of the digital economy is of a particular note. Concept of a "digital law" that was recently introduced.

In 2017, a working group was formed to coordinate regulatory work, consisting mainly of business representatives. It is headed by MTS Vice President R.S. Ibrahimov.

According to Pavel Malkov, acting director of the Department of State Administration of the Ministry of Economic Development of the Russian Federation, the Competence Center in Regulatory Control, established on the basis of Skolkovo, has two main tasks to be solved: to identify regulatory barriers to the digital economy and develop a detailed concept of priority actions. For this, 14 thematic working groups were formed, about 300 experts were involved in the work.

As part of the expert council on the development of the economy of a new technological generation under the Committee of the State Duma of the Russian Federation on economic policy, industry, innovative development and entrepreneurship, it was announced about the creation of working groups that will be involved in the legislative regulation of unmanned vehicles, big data and blockchain.

The initiator and coordinator of the working groups creation was the Autonomous Non-Profit Organization for the Promotion of Robotics and Innovative Technologies Development, "Robot Law", which brings together representatives of the Russian IT market and legal experts [14].

On August 2, 2019, the Ministry of Digital Development, Telecommunications and Mass Media of Russia summed up the results of the competition for the preparation of an indicators system for the National Index for the Development of the Digital Economy of the Russian Federation as part of the implementation of the federal project "Data Technologies". Four applications were submitted, National Institute for System Studies of Entrepreneurship Problems, NPO was announced as the winner

The system of indexes and indicators of the digital development of the regions should provide the inclusion of statistical information on the results of the development of the digital economy, designed in the regional context, including in the following areas:

- customer satisfaction with digital services,
- digitalization readiness,
- final effects of digitalization,
- aspects of regional legislation and strategic documents regarding digitalization,
- digital innovation and maturity,
- digital environment security,
- the presence and development of competencies of professional personnel and consumers in the field of digitalization,
- economic aspect of the digital environment,
- technological (technical) availability and environmental characteristics,
- sectoral focus on economic development.

The preparation of the National Digital Economy Development Index should be completed by October 15, 2019 [15].

These facts will require adequate efforts regarding the development, adoption of appropriate measures and their implementation from the regional authorities and executive bodies.

V. CONCLUSIONS

An important step towards accelerating the digitalization of agriculture at the regional level may be the allocation of the

necessary resources for the creation of unmanned aerial vehicle stations, which, in the first place, will perform the tasks of collecting and transmitting geolocation data for agricultural producers.

Most agricultural enterprises do not have the necessary financial resources. Basically, they purchase agricultural working machines with their own or borrowed funds: combines, tractors, seeders, etc. At the same time, the price of unmanned aerial vehicles is comparable to the price of such vehicles.

For example, the cost of UAVs produced by the company "Geoscan" (St. Petersburg) is in the range of 600 thousand rubles and higher. An independent power supply allows (about an hour) to fly around an area of up to 1000 hectares per session. In the Penza market, only a few individual entrepreneurs provide video filming services using quadrocopters for 2.0-5.0 thousand rubles per session [16]. There are no enterprises with the status of a legal entity and a fleet of unmanned aerial vehicles in the Penza region.

Obviously, this situation will not allow to promtly obtain geolocation data to a significant number of agricultural producers in a necessary volume.

It is no coincidence that the “garage” of quadrocopters, qualified programmers who are able to work with Big Data technologies, can afford companies of Rosneft scale. On the basis of the Ilishevsky field in Bashkiria it used the industrial Internet of things for the first time in Russia. At the same time, special sensors detect the movement of vehicles and exclude the possibility of unauthorized deviations from the route, and drones monitor the integrity of pipelines and exclude the possibility of illegal taps.

Testing of the pipeline monitoring system using autonomous drones has been singled out by Rosneft as a separate project. Within the framework of the digital cluster based on Sibintek, a separate team has been created that is engaged in the development of unmanned aerial vehicles, with a budget of several tens of millions of rubles. To process on-site monitoring materials, machine learning and computer vision technologies are used [17].

Therefore, at the regional level, it is possible to create the necessary infrastructure and similar stations for unmanned aerial vehicles only with the help of government authorities. At the same time, they can act as a customer for monitoring the use of land with subsequent processing of data, ensuring their storage, and compiling analytical reports. In the future, it is important to ensure free access to them.

It is also possible to finance such projects using public and private funds. It is possible, during the initial period, to make arrangements and use UAVs, which are managed by the regional Ministry of Emergencies and the military under the guarantees of the Ministry of Agriculture of the Penza Region.

It should also be noted that for several years the Penza College of Information and Industrial Technologies (IT College) has been recruiting for the specialty 02.25.08 “Operation of unmanned aerial systems” on a budgetary basis, where UAV operators are trained [18]. Their qualifications will help to solve some personnel problems in the region.

References

[1] IT v agropromyshlennom komplekse Rossii. TAdviser: Gosudarstvo. Biznes. IT. 14.06.2019g.

[2] Na osnove materialov s sayta iot.ru.

[3] IT v agropromyshlennom komplekse Rossii. TAdviser: Gosudarstvo. Biznes. IT. 10.07.2019g.

[4] Ivanov A. Sel'skoe khozyaystvo po-umnomu. IIoT prilozhenie k zhurnalu CONTROL ENGINEERING ROSSIYa / 06.04.2017.

[5] Abramov N.V., Semizorov S.A., Sherstobitov S.V. Zemledelie s ispol'zovaniem kosmicheskikh sistem. // Zemledelie, №6, 2015.

[6] Vasin K.V., Gerasimova S.G. Ispol'zovanie bespilotnykh letatel'nykh apparatov – novoe slovo v progressivnom zemledelii. // Geoprofi, №5, 2014.

[7] Vorotnikov I.L., Neyfel'd V.V. Effektivnost' primeneniya tsifrovykh tekhnologiy v upravlenii zemel'nymi resursami munitsipal'nykh obrazovaniy Saratovskoy oblasti. // Agrarnyy nauchnyy zhurnal, №6,2018. - www.agrojr.ru/index.php/asj/article/view/510/388.

[8] Komu prinadlezhat sel'khozzemli v Rossii? (po dannym Vserossiyskoy sel'khozperepisi 2016 goda). Argumenty i fakty, №30, 2019g., c.6-7, (www.aif.ru).

[9] Gde i kak iskat' «poteryannye» zemli? Argumenty i fakty, №30, 2019g., c.6-7, (www.aif.ru).

[10] Denisova E.S., Stupnikova M.S. Sostoyanie i ispol'zovanie osobo tsennykh produktivnykh zemel' sel'skokhozyaystvennogo naznacheniya v Penzenskoy oblasti. (Forum molodykh uchenykh. - 2019, №2(30), www.forum-nauka.ru).

[11] Pasport prioritetnogo proekta «Vvod v oborot neispol'zuemykh zemel' sel'skokhozyaystvennogo naznacheniya na territorii Penzenskoy oblasti», utverzhden Predsedatelem Pravitel'stva Penzenskoy oblasti 25.11.2017g.

[12] Rossiyskaya Federatsiya. Zakony. Zemel'nyy Kodeks Rossiyskoy Federatsii

[13] [Elektronnyy resurs]: // Informatsionnaya sistema «Konsul'tant

[14] Plyus».

[15] Mayorova M.A., Markin M.I. Tsifrovoe zemledelie v proizvodstvenno-ekonomicheskoy deyatel'nosti predpriyatiy APK. // «Teoreticheskaya ekonomika», №2, 2019 (nauchnyy elektronnyy ekonomicheskiy zhurnal) www.theoreticaleconomy.ru.

[16] Na osnove materialov s sayta www.tadviser.ru.

[17] Minkomsvyazi vybralo razrabotchika Natsional'nogo indeksa razvitiya tsifrovoy ekonomiki Rossii. TAdviser: Gosudarstvo. Biznes. IT. 06.08.2019g.

[18] Po reklamnym materialam s sayta bazar.pnz.

[19] Kak otsifrovyvaetsya «Rosneft'»: roi dronov, roboty, tsifrovye zavody i AZS. TAdviser: Gosudarstvo. Biznes. IT. 10.07.2019g.

[20] Penzenskiy kolledzh informatsionnykh i promyshlennykh tekhnologiy (IT-kolledzh): [ofitsial'nyy sayt]. - it-kolledzh.rf.