Digital Technologies Use for Data Processing of Farmland Condition and Use

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Abstract. The article considers the issues of digital technologies introduction in the farmland monitoring system. United information system should connect lands database from different sources and became a platform for the analysis of land use and making effective management decisions. Authors develop an agriculture digitalization model and note a key role of primary acquisition including agriculturally used areas data. The article conducted an analysis of farmland parcel capture in the territory of the Republic of Sakha (Yakutia) of the Russian Federation. The main concern issues were highlighted and activities to remedy them were proposed for establishing a farmland informative platform.

1. Introduction
Farmers have challenges with access to different information: weather, land fertility, technologies, and others. Administrative authorities have a lack of information for making effective management decisions. Digital technologies can resolve issues. In the agriculture of Russia, the first experiences of information computer technologies and digital technologies use have been starting since 2000 in regions. At present, the Russian Federation is in “the 45th place on integrating information technologies in agriculture” [8]. Projections of digital enablement in Russian agriculture reach up to 100% on geo analysis program establishment for agriculturally used areas.

2. Background
In Russia digital enablement in agriculture has been starting since 2018 with departmental projects development. Review of the literature. On the eLIBRARY web site in searcher using the key words you can find 113 articles from 2017-2019, among them 48 articles are available. It is want to note authors like Vartanova M.L., Drobot E.V. (2018) [2], I.L. Vorotnikova, V.V. Neifeld (2018) [5], V. Korotchenya (2019) [7], T.N. Astakhova, M. O. Kolbeneva, A.A. Romanova, A.A. Shamina (2019) [1]. Using the key words UFIS AUA (United Federal Information System of agriculturally used areas) in the searcher of the eLIBRARY.RU since 2018 82 articles were published, including the articles of S. N. Volkova, D. A. Shapovalova (2018) [3], I. S. Kozubenko (2018) [6], O.A. Tkacheva (2019) [9].

3. Tasks
The goal of the study is to improve the united information space of farmlands managements.

Tasks:
1. To highlight the issues of digital enablement in land resources management at the regional level;
2. To propose activities to improve information gathering, processing, and systematization about farmland at the regional level.

4. Theoretical part
In 2017 the decree of the President of the Russian Federation [11] “About the development strategy of the information society in the Russian Federation on 2017-2030”, was issued. For the implementation of the decree the Agriculture Ministry of Russia has elaborated a number of documents: “Federal scientific and technic program of Russian agriculture development on 2017-2025”, the project “Digital transformation of Russian’s agriculture” [10], and “Digital agriculture” [4]. The Ministry has set two actions for agriculture digitalization: firstly, farm production, secondly, authorities’ plan of actions in agriculture.

In the first track project, developers propose to implement a “smart land husbandry” system, monitoring of farming operation using the Earth's remote sensing and implementation of farm production automatization complex system. The final result of “digital technology’ implementation is to reduce agricultural production costs and increase labor productivity.

In the second track, it is planned a phased transition to digital agriculture with the implementation of “Digital agriculture” national platform, “Agrodecisions” module, and “Land of knowledge” electronic educational environment. The main goal of the track is production operation planning and forecasting, timely recognition of issues, and increasing government support efficiency.

For goals and tasks implementation one of the key points is information collection, processing, systematization, and updating in agriculture – agriculture digitalization (figure 1).

![Figure 1. Chain of agriculture digitalization](image-url)
soil quality in one informational platform. The UFIS AU has four functional subsystems [6, p.6] and it has been starting to work since April 2018. More than 12 000 participants, but also departments of Agriculture Ministry, Federal Service for State Registration, Cadastre and Cartography, Federal Tax Service, RK ROSCOSMOS, RosHydroMet, Federal Forestry Agency, subjects of the Russian Federation, and municipal districts.

5. Practical relevance and implementation results
Since 2015 spatial data of municipal districts, settlements, and populated localities of Yakutia; cadastral information of property as well as land parcels; schemes of rational land use of 18 municipal and urban districts “Gorod Yakutsk” as a cartographic document in electronic form; topographic plans of 175 settlements in 28 districts are loaded in the geoinformatical informational system of the Republic.

Block for agriculturally used areas, and farmlands in other land use categories analysis were developed in 2016. In the territories of 18 districts, and Yakutsk vector layers of tillable lands, neglected fields, haylands, greenlands, perennial plantings were developed. The system automatically analyzes data.

The geoanalytical informational system shows:
1. not registered land plots in the State cadastral registration are less than 20% (marked in red);
2. partially registered lands are up to 80% (marked in orange);
3. fully completed lands are more than 80% (marked in green).

The analysis shows (figure 2) that out of a total square of tillable land 97739,68 ha only 49,6% of it is registered on the Cadastral, 6,85% is partially registered, and 43,55% are not included. The system automatically uploads on each type of farmland on the example of municipal or urban districts. Megino-Kangalasskiy district has the lowest level of tillage land registration on the Cadastral – 0%. Tattinskiy district has the highest percentage of land registration on the Cadastral – 78%. Verkhneveilyuiskiy district has the lowest level of haylage registration – 5,76% and Yakutsk has the highest percentage – 68,65%.

The subsystem of the geo analytical informational system analyzes agriculturally used areas. In the territories of 18 districts and municipality “Gorod Yakutsk” there were conducted the monitoring of tillage lands use by satellite acquisition with a resolution of 1.5 megapixels. On the basis of satellite images tilled land layer is updated. Vega-fields are highlighted on the map, which is linked to the VEGA-PRO service. You can use the link to transfer to the service and see the vegetation index dynamics of the plant cover state. The vegetation indexes allow us to monitor the planting time, ripening, and crop harvesting on the example of single fields. One of the shortcomings is a lack of information about crops on the tilled field. Based on these data it establishes a layer of tilled land use: fields which are not used marked in red - 0-20%; partially used marked in yellow - 20-80%; used marked in green - 80-100% (figure 2).

The monitoring has shown that out of a total square (103 138, 99 ha) of 18 municipal districts and municipality “Gorod Yakutsk” tillable lands 27 353,02  ha are used (26.5%), 16 829,96 ha (16,3%) are used partially, 58 294.27 ha (56,5%) is not used, and 661,74 ha (0,6%) is undetermined. Ust-Aldanskiy district has the highest level of tillage lands use (6 034.76 ha), in Megino-Kangalasskiy district (5 822,60 ha), and in Khingan district (4 421,11 ha). Amginsky district has the lowest level of tillage lands use – 11 766, 78 ha, Olyokminskiy district – 8 344,74 ha, Namskiy district – 6535,46 ha.
Figure 2. Fragment of the map of farmlands State cadastral registration.

Figure 3. Fragment of the map of farmlands use monitoring.

Agricultural commodity producers register indicating their lands in the territories of municipality “Gorod Yakutsk”, and some naslegs of Megino-Kangalasskiy district is established. Graphically, the field boundaries of each producer are marked in a certain color. For example, you can see that two fields from 11 fields of agricultural production cooperative “Olymp” are used, one field is partially used, and others are not used.

“Crop farming service” of the state-financed entity of the Republic of Sakha (Yakutia) data on user name; soil type; agricultural crops are loaded for completeness in 2018.

Therefore, three data sources are used for agriculturally used areas use analysis: the scheme of settlements lands rationally use (SSLRU), crop farming services, and Federal Service for State Registration, Cadastre, and Cartography. However, there is a discrepancy in information. For example, some tillage lands surveyed by Crop farming services are not available in the SSLRU. According to the Unified State Register of Immovable Property, there are cadastral registered parcels for haymaking, but they are not registered in the SSLRU as farmland.

Furthermore, the subsystem has the Unified State Register of Immovable Property data since 2012, and it automatically analyses of agriculturally used areas use on the examples of districts and the Republic as a whole. The informational and technological block is automated, and it fully replaces manual labor.

All municipal entities of the Republic have access to the geoanalytical informational system, they received their usernames and passwords to the system, where there is the information of municipal entities.

The Ministry of Agriculture of the Russian Federation gathers information about the farmland’s boundaries, land users, and crop cultures for content maintenance of the UFIS AUA. In those municipalities where RIZPS has been established, work has been organized to gather information about the boundaries of agriculturally used areas for the information filling which contains in the geo-analytical information system. In areas where there is no electronic mapping basis, specialists manually enter contour boundaries into the system based on satellite images and fill in information about these contours. It is necessary to send to the UFIS AUA 72047 farmland boundaries that must be sent to the UFIS AUA. As of 31 December 2017, 18,221 farmland boundaries were added to the GAIS, while 53,826 boundaries remained to be added. Kobyaiskiy and Suntarskiy districts are the leaders in boundaries completing (99.9% each). In 8 districts, the work has been organized, but it has not yet been completed: Verkhoyanskiy, Nyurbinskiy, Vilyuyskiy, Megino-Kangalasskiy, Tomponskiy, Churapchinskiy, Ust-Aldanskiy, and Amginskiy districts. The work is not organized in 8 ulus: Verkhnevilyuyskiy, Verkhnekolymskiy, Gorniy, Namskiy, Olekminskiy, Olenekeksiy, Tattinskiy, Khangalasskiy and in Yakutsk city. In this regard, local governments need to speed up work in this direction.
6. Conclusion

When creating a united information space for farmlands of the Republic of Sakha (Yakutia), a number of problems have emerged. The first problem is related to the subsystem development, with the information transfer to the UFIS AUA. We propose to integrate the UFIS AUA with the module "Geoinformation accounting and farmlands use analysis" of the geo-analytical information system (GAIS). As a result of integration, there will be a function of sending data to the UFIS AUA server.

Data from satellite images is insufficient to solve the accounting problem of the AUA and clarify land plots contours. Various interferences when shooting from space and low resolution of images lead to inaccuracies. It is necessary to confirm them with data from unmanned aerial vehicles.

It needs to develop base material on the territory of 14 districts of the Republic, and update maps on the territory of 18 municipal districts and municipality "Gorod Yakutsk".

The information system must be kept up to date. The Ministry of Agriculture of Yakutia should become a coordinator of the system. We propose to create jobs for agronomists in the districts and provide further training in this subsystem.

Over time, the information system may shift to a 3D image for a clear reflection of accounting information, such as terrain.

The introduction of digital technologies will allow you to get valid and reliable data on farmlands state and use, it also contributes to the efficient functioning of rural territories and society, and will help to make the right management decisions.

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