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DIGITALIZATION AND ITS IMPACT ON LAND USE IN RURAL AREAS

ЦИФРЛАНДЫРУ ЖӘНЕ ОНЫҢ АУЫЛДЫҚ АУМАҚТАРДАҒЫ ЖЕРДІ ПАЙДАЛАНУҒА ӘСЕРІ

ЦИФРОВИЗАЦИЯ И ЕЕ ВЛИЯНИЕ НА ЗЕМЛЕПОЛЬЗОВАНИЕ В СЕЛЬСКИХ ТЕРРИТОРИЯХ

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Abstract. Aim - to present the current level of information support for agricultural land use, problems and propose ways to solve them based on the use of digital technologies. *Methods* - monographic in order to study foreign experience, digital innovations in agricultural production, analytical - when analyzing the state of land assets and availability of unused agricultural land, statistical - for collecting and processing information in the context of research objects, cartographic - when considering land ownership schemes, monitoring and detecting negative changes, as well as developing predictive solutions to eliminate them. *Results* - the practice of foreign countries in using digital infrastructure in the process of forming land resources has proven the need for their use in the republic to build a model of sustainable development of rural areas. It has been determined that digitalization plays a key role in modern land management. The data content in information systems has been analyzed. It was revealed that from 2018-2021 about 208 billion tenge was allocated for digital transformation, however, despite costs, effectiveness of this program was low. It is noted

that the volume of provision of electronic public services in the online format has been brought to 90% (with a plan of 60%). The advantages and potential opportunities for introduction of geoinformation technologies in digital land use are justified. The main barrier to digital modernization of agriculture remains the poor provision of the Internet in rural areas. *Conclusions* - agricultural land sector is fully covered by digital updating based on the use of GIS technologies. The stages of creating agricultural map for diagnosing uncultivated land are displayed. However, there are a number of shortcomings in ensuring effective management of the land fund for its rational use.

Аңдатпа. *Мақсаты* - ауыл шаруашылығы жерін пайдалануды ақпараттық қамтамасыз етудің заманауи деңгейін, проблемаларды ұсыну және цифрлық технологияларды қолдану негізінде оларды шешу жолдарын ұсыну. *Әдістері* - монографиялық шетелдік тәжірибені, ауыл шаруашылығы өндірісіндегі цифрлық инновацияларды зерделеу мақсатында, аналитикалық – жер активтерінің жай-күйін және пайдаланылмайтын ауыл шаруашылығы жерлерінің болуын талдау кезінде, статистикалық – зерттеу объектілері бөлінісінде ақпаратты жинау және өңдеу үшін, картографиялық - жерге иелік ету схемаларын қарау, мониторинг жүргізу және теріс өзгерістерді анықтау кезінде, сондай-ақ оларды жоюдың болжамды шешімдерін әзірлеу. *Нәтижелері* - шет елдердің жер ресурстарын қалыптастыру процесінде цифрлық инфрақұрылымды пайдалану тәжірибесі оларды республикада ауылдық аумақтарды орнықты дамыту моделін құру үшін қолдану қажеттігін дәлелдеді. Цифрландыру қазіргі жерге орналастыруда шешуші рөл атқаратыны анықталған. Ақпараттық жүйелердегі мәліметтермен толықтығы талданған. 2018-2021 жылдар аралығында цифрлық трансформацияға шамамен 208 млрд. теңге бөлінгені анықталды, алайда шығындарға қарамастан, бұл бағдарламаның нәтижелілігі төмен болып шықты. Электрондық мемлекеттік қызметтерді онлайн-форматта көрсету мөлшері 90%-ға дейін жеткізілгені атап өтілді (жоспар бойынша 60%). Сандық жерді пайдалануда геоақпараттық технологияларды енгізудің артықшылықтары мен әлеуетті мүмкіндіктері негізделген. Ауыл шаруашылығын цифрлық жаңғыртудың негізгі кедергісі ауылдық жерлердің интернетпен қамтамасыз етілуінің әлсіздігі болып қала береді. *Қорытынды* - ауыл шаруашылығы алқаптары саласы ГАЖ-технологияларды қолдану негізінде сандық жаңартумен толық қамтылған. Өңделмеген жерлерді диагностикалау үшін ауылшаруашылық картасын жасау кезеңдері көрсетілген. Алайда, жер қорын ұтымды пайдалану мақсатында оны тиімді басқаруды қамтамасыз етудің бірқатар кемшіліктері де бар.

Аннотация. *Цель* – представить современный уровень информационного обеспечения сельскохозяйственного землепользования, проблемы и предложить пути их решения на основе применения цифровых технологий. *Методы* - монографический в целях изучения зарубежного опыта, цифровых инноваций в сельскохозяйственном производстве, аналитический – при анализе состояния земельных активов и наличия неиспользуемых сельхозземель, статистический – для сбора и обработки информации в разрезе объектов исследования, картографический – при рассмотрении схем землевладения, проведении мониторинга и обнаружении негативных изменений, а также разработке прогнозных решений для их устранения. *Результаты* – практика зарубежных стран использования цифровой инфраструктуры в процессе формирования земельных ресурсов доказала необходимость их применения в республике для построения модели устойчивого развития сельских территорий. Определено, что цифровизация играет ключевую роль в современном землеустройстве. Проанализирована наполняемость данными в информационных системах. Выявлено, что с 2018-2021гг. на цифровую трансформацию выделено около 208 млрд. тенге, однако, несмотря на затраты, результативность данной программы оказалась низкой. Отмечается, что размеры оказания электронных государственных услуг в онлайн-формате доведено до 90% (при плане 60%). Обоснованы преимущества и потенциальные возможности внедрения геоинформационных технологий в цифровом землепользовании. Основным барьером цифровой модернизации сельского хозяйства остается слабая обеспеченность интернетом сельской местности. *Выводы* - сфера сельхозугодий полностью охвачена цифровым обновлением на основе применения ГИС-технологий. Отображены этапы создания сельскохозяйственной карты для диагностирования невозделанных земель. Однако имеется ряд недостатков для обеспечения эффективного управления земельным фондом в целях его рационального использования.

Keywords: rural areas, agricultural land, land use, effective management, digitalization of land cadastral works, information technology, cadastral and interactive maps.

Түйінді сөздер: ауылдық аумақтар, ауыл шаруашылығы мақсатындағы жерлер, жерді пайдалану, тиімді басқару, жер-кадастрлық жұмыстарды цифрландыру, ақпараттық технологиялар, кадастрлық және интерактивті карталар.

Ключевые слова: сельские территории, земли сельхозназначения, землепользование, эффективное управление, цифровизация земельно-кадастровых работ, информационные технологии, кадастровая и интерактивная карты.

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Introduction

Digitalization in the Republic of Kazakhstan plays a key role in modern agricultural land use. Digitalization significantly expands the possibilities of agriculture, land monitoring, state control and land management. The Republic of Kazakhstan belongs to industrial and agricultural countries, therefore, the trend of introducing information technologies into agriculture has also affected our state. Kazakhstan embarked on digitalization in 2017. The state digitalization program was aimed at improving the standard of living of citizens through the use of innovative and digital technologies. One of the priorities of this program is the digitalization of agriculture, rational use and creation of a beneficial environmental situation.

Digitalization in agriculture is being brought to life thanks to modern technologies and methods, such as precision farming with the integration of geographic information technology, applications on mobile and stationary devices, IoT (Internet of things) and other advanced technologies. The Ministry of Digital Development of the Republic of Kazakhstan has analyzed the effectiveness of investments for the period from 2018-2021. As a result, it was revealed that about 208 billion tenge was allocated and spent on digitalization during the specified period (Digital Kazakhstan) [1]. However, they noted that despite such huge costs, the effectiveness of this program turned out to be low. However, there are also positive results. The provision of electronic public services in online format has been increased to 90% with a 60% plan (Digital Kazakhstan) [1].

It is planned to bring the implementation of the plan to 100% by the end of 2025. However, we believe that this task is somewhat ambitious, since the existing information base needs to be improved, that is, the available information is incomplete. This means that it is necessary to determine what information about land plots is needed, then collect, analyze, process it and, at the last stage, add it to the Unified State Cadastre of Real Estate information base.

In terms of digitalization of agriculture, the main problem remains the poor availability of the Internet in rural areas. The consequence of this is that today the share of agricultural producers using digital technologies in agriculture is insignificant. In addition, agricultural land is either not being used for its intended purpose or is being used inefficiently, and this is difficult to control due to the large territory, low population density and lack of necessary infrastructure for monitoring the condition and use of land with analysis and forecasting in the short and long term.

Thus, solving the problem of full-fledged digitalization of agriculture will increase the competitiveness of agricultural land use in order to realize the food security of the republic.

Literature Review

As you know, currently in the Republic of Kazakhstan, all services in the field of land cadastral works are carried out in electronic format. To do this, all information about land plots is entered into the database, concentrated in the information system "Unified State Cadastre of Real Estate". In general, the research of scientific works of foreign scientists demonstrates the effectiveness of the use of advanced information technologies in agriculture However, the analysis showed that there are still some disadvantages. This is not unique to Kazakhstan. For example, one of the disadvantages is the lack of objective cartographic data, since the available maps date back to the end of the last century. The availability of objective cartographic information plays an important role in conducting an objective assessment of soil conditions.

Thus, digitalization of agriculture provides an opportunity to increase agricultural productivity, efficiency and environmental sustainability of territories (Challenges of digital transformation in agricultural) [2]. Other scientists note that the use of information technology in agricultural activities is hampered by some problems. These include the weak infrastructure of agricultural enterprises, farmers' understanding of the needs and availability of special skills in the field of information technology, as well as public administration issues (Sabirin N.H.A., Mohd Fadhil N.F.) [3].

In addition, the introduction of digital technologies in agriculture requires large financial resources. Its implementation is hampered by a shortage of qualified personnel, and potential job cuts are expected in the future (Kirin E.) [4]. At the same time, we all know that GIS technologies are currently being actively used in agriculture. For example, in Poland, there is great interest in precision farming and smart

agriculture (Marciniak M.) [5]. They are applicable mainly to large farms. In recent years, there has been a tendency in Poland to reduce small farms and increase large ones (Support PF at Policy level in Poland…) [6]. In order to improve business processes, farmers use Global Positioning System (GPS), unmanned aerial vehicles, remote sensing of land to monitor crops, apply fertilizers, determine soil moisture, as well as information and communication technologies in the form of mobile services mKrishi, Kisan call centers, e-Choupal Internet kiosks (Singh C.) [7].

Oliver Wyman also believes that in the future farmers will be able to make profits and environmentally friendly agricultural products only through the use of sophisticated technologies such as sensors for soil moisture, temperature, fertilizer supply, robots, etc. (Wyman O.) [8]. Thus, the analysis of foreign experience allows us to conclude that agriculture will achieve the highest results only if farmers use integrated systems in their economic activities that combine equipment (machines, robots, artificial intelligence, drones, etc.) and tools for agricultural sustainability (Khan N., Ram L.R., Sargani G.R. et al.) [9]. Based on the above, it can be concluded that the use of digital technologies will improve the efficiency of agricultural land use.

Materials and methods

The research concept is based on topical issues of the system of effective agricultural land use. The theoretical basis of the research is the scientific works of domestic and foreign scientists, leading experts in the field of land resources management, their effective use, and the introduction of information technologies in the land use system. The cartographic part of the study is based on the study, evaluation and analysis of schemes of agricultural formations. To obtain statistical data, data from the analytical report on the use and distribution of lands of the Committee for Land Management of the Ministry of Agriculture of the Republic of Kazakhstan, as well as data from the land balance of territorial structures, were used. The research methodology was based on the main provisions of the scientific methodology for studying socio-economic phenomena, as well as a number of scientific theories on the use of information technology for the effective use of land resources.

When writing the article, the following methods were used: monographic – to study the foreign experience of using digital technologies in agricultural production; analytical – for analyzing the use of information technology in agriculture, as well as identifying unused agricultural land; statistical – to collect and process information in the context of research objects; cartographic – for obtaining and analyzing land use patterns in order to implement monotoring and identify negative changes and develop predictive solutions to eliminate them; abstract-logical – to identify problems and develop ways to solve them.

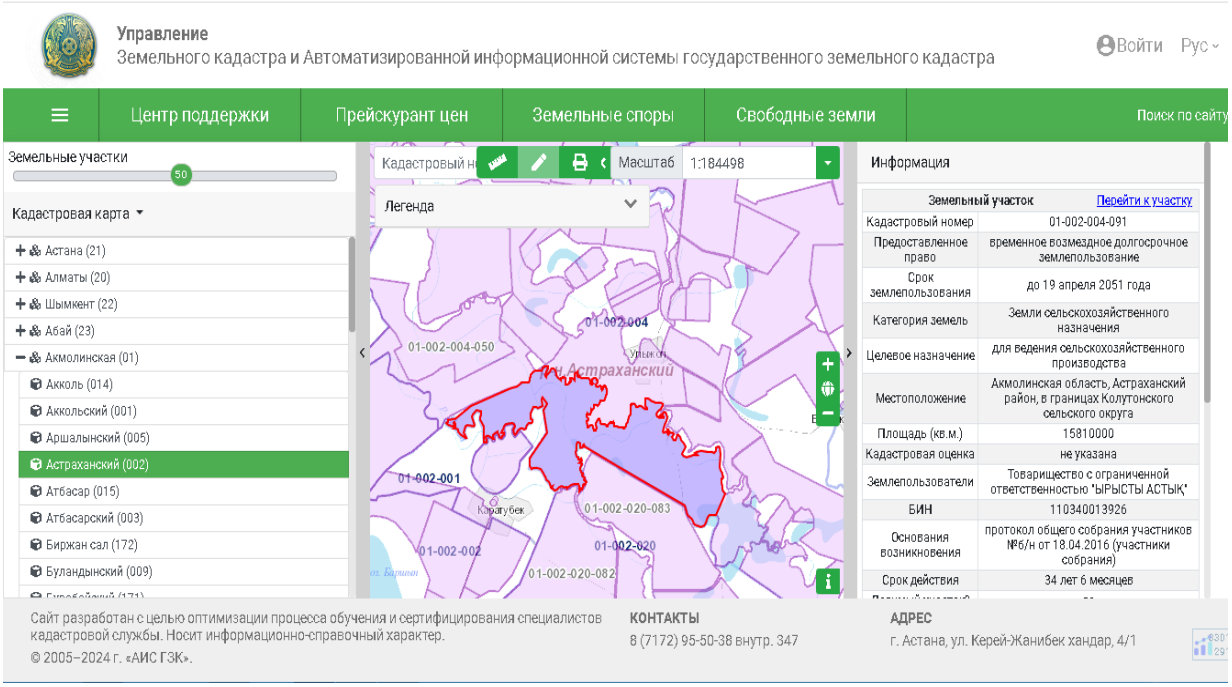
Results

To date, all the necessary information about land use has been digitized, it is concentrated in the information system "Unified State Cadastre of Real Estate". The information system "Automated information system of the State Land Cadastre" served as the basis for its creation. All types of land cadastre services in Kazakhstan are carried out in an online format. The information systems mentioned above, as well as Erokarta, were used in the research process. The study was conducted with the aim of displaying the advantages and possibilities of using geoinformation technologies in the digital land use system, as well as identifying problems in this area.

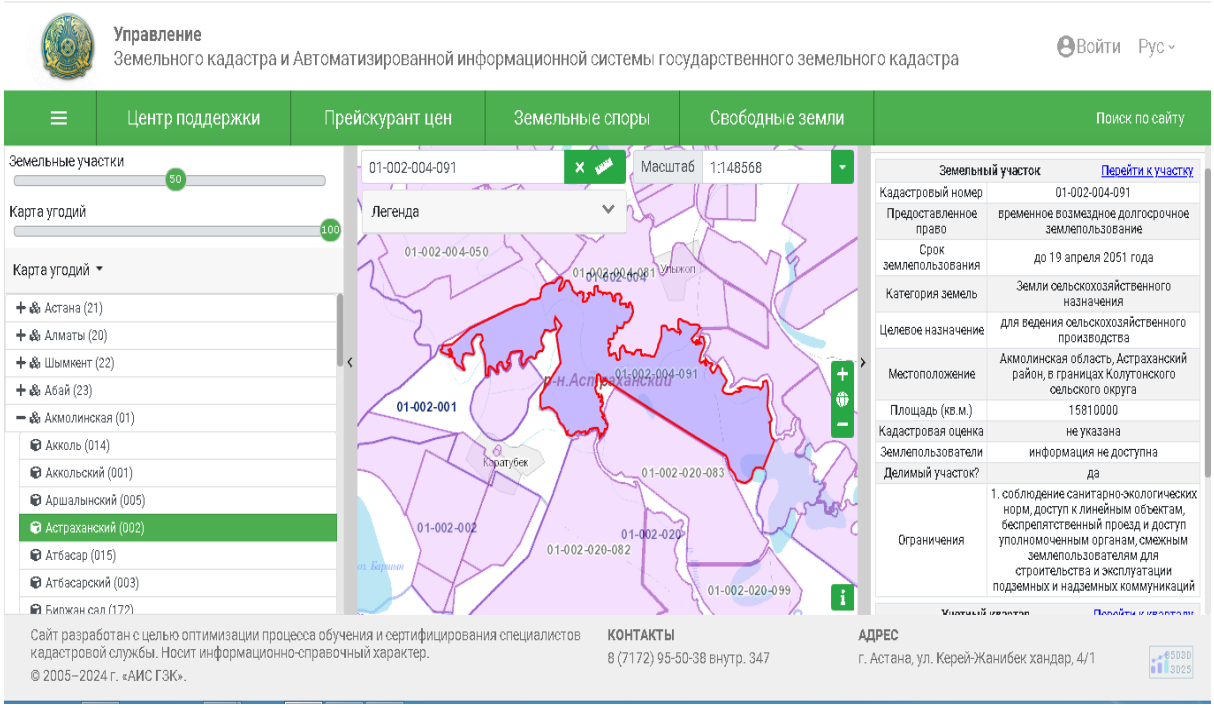
The object of the study is the land use of the Astrakhan region of the Akmola region. Let's consider the data content in the information system using the example of Yrysty Astyk LLP, with a total area of 1 581 hectares (figure 1). The system allows you to select the type of maps, it depends on the purpose of the study. We have selected 2 maps: a cadastral map and a map of agricultural land.

From figure 1A it can be seen that the following basic data is reflected on the cadastral map: the cadastral number of the land plot, the type of right and the term of land use, the category of land, the intended purpose, the location indicating the rural district, the total area, the basis of the right, the divisibility of the land plot, etc. However, as disadvantages, I would like to note the lack of areas by type of land and the cadastral value of the site. Since the system allows you to select the type of maps, an attempt was made to determine the types of agricultural land by selecting a map of land (figure 1B).

However, as can be seen from figure 1B, this map shows almost the same information as on the cadastral map, but the name of the land user and the types of land are missing. In fact, the land use scheme in the "land map" tab should reflect the boundaries and type of agricultural land, as well as information on areas by type of agricultural land. Thus, the analysis of the database occupancy of the State Agricultural Land Cadastre Automated Information System allowed us to conclude that this system requires updating and information occupancy of the existing database.



1А - cadastral map



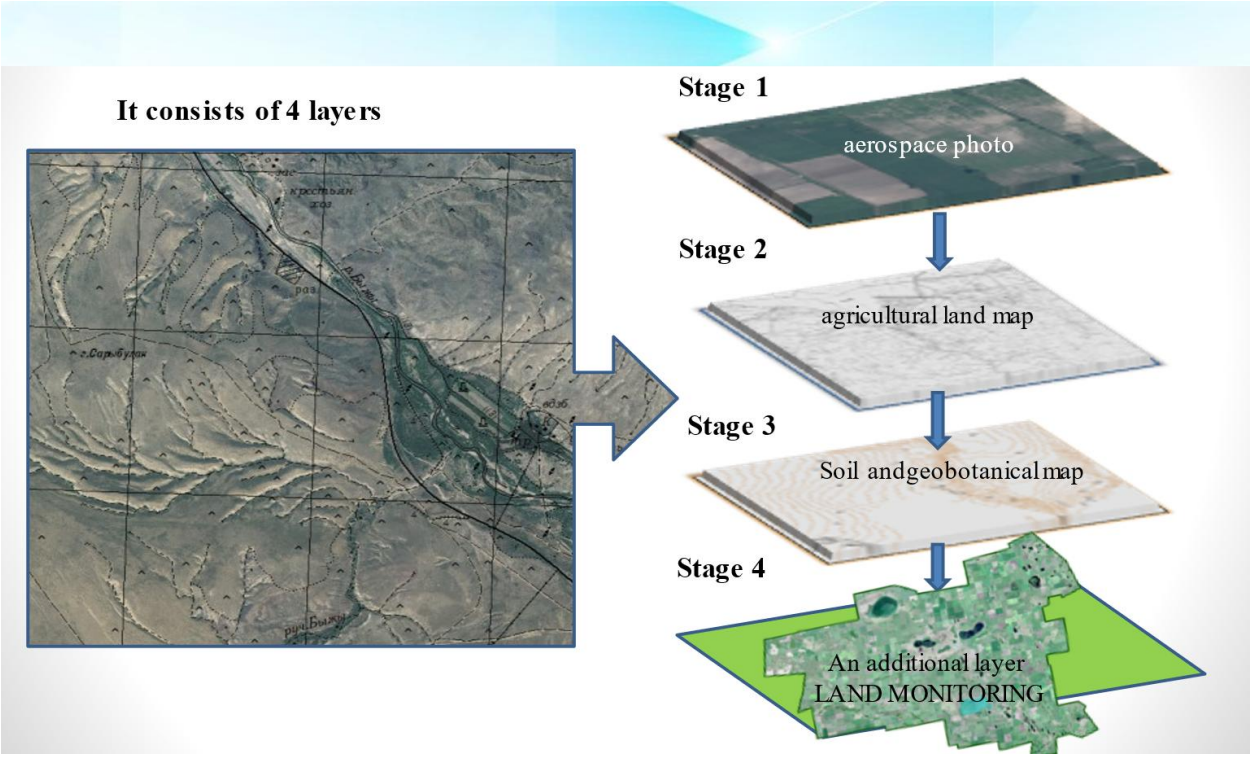
1 Б - map of agricultural land

Note: the source 1А-https://www.aisgzk.kz/aisgzk/ru/content/maps/; 1Б-https://www.aisgzk.kz/aisgzk/ru/content/maps?type=ug

Figure 1 – Land use scheme of the Limited Liability Partnership "Yrysty Astyk"

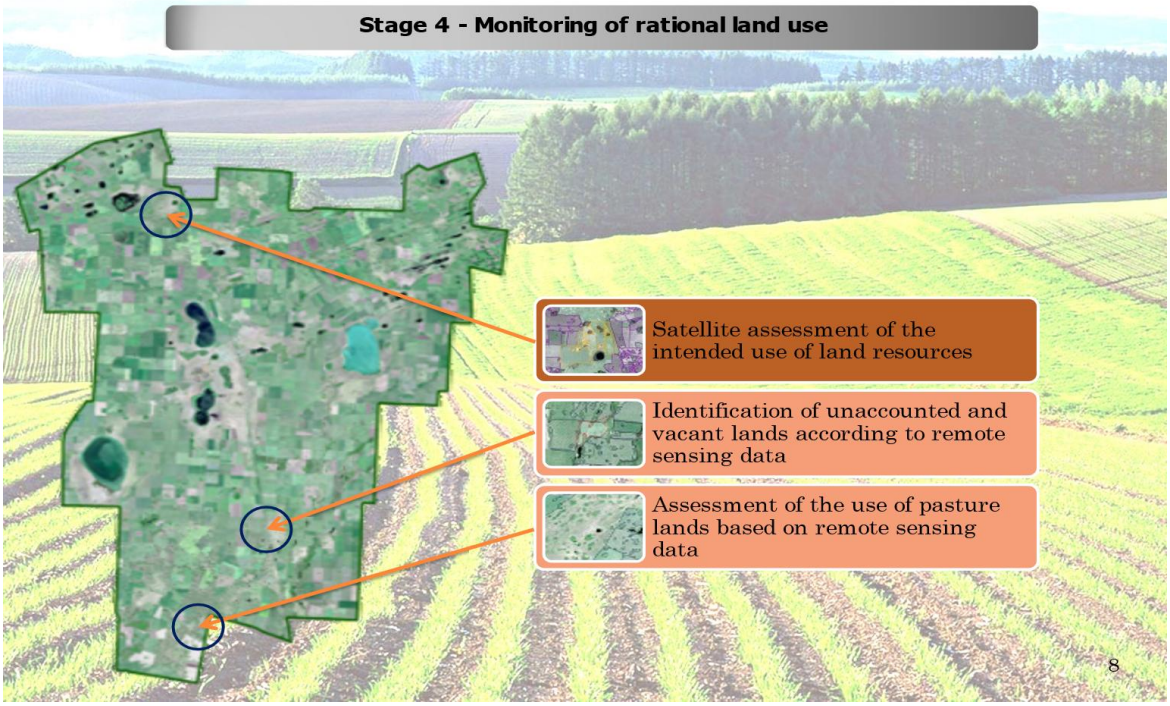
In addition, geoservice plays an important role in terms of digitalization of agriculture. Jerkarta.gharysh.kz. The prerequisite for its creation was the instruction of the President of the Republic of Kazakhstan K.-J. Tokayev on the return of lands granted in violation of land legislation, as well as unused lands. This project was launched in 2022 (“Zher Amanaty”: almost 11 million ha of land…) [10]. To achieve this task, it was necessary to create an agricultural map, which is implemented in 4 stages (figure 2).

Figure 2 shows that the final stage is the identification of unused land. Stage 4 includes 3 functions (figure 3).



Note: data of the State Corporation "Government for Citizens"

Figure 2 – The stages of creating an agricultural map

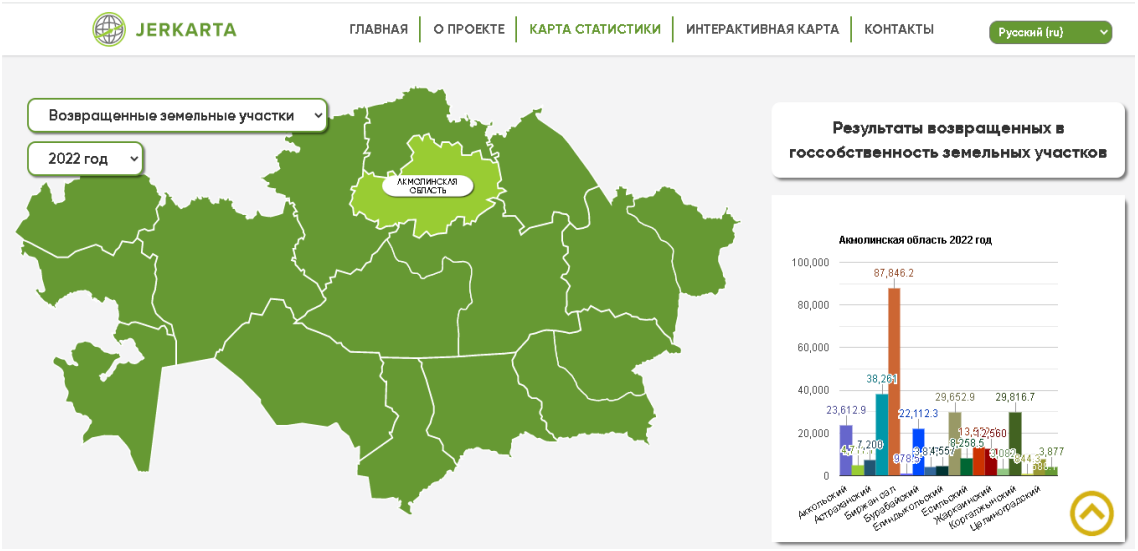


Note: data of the State Corporation "Government for Citizens "

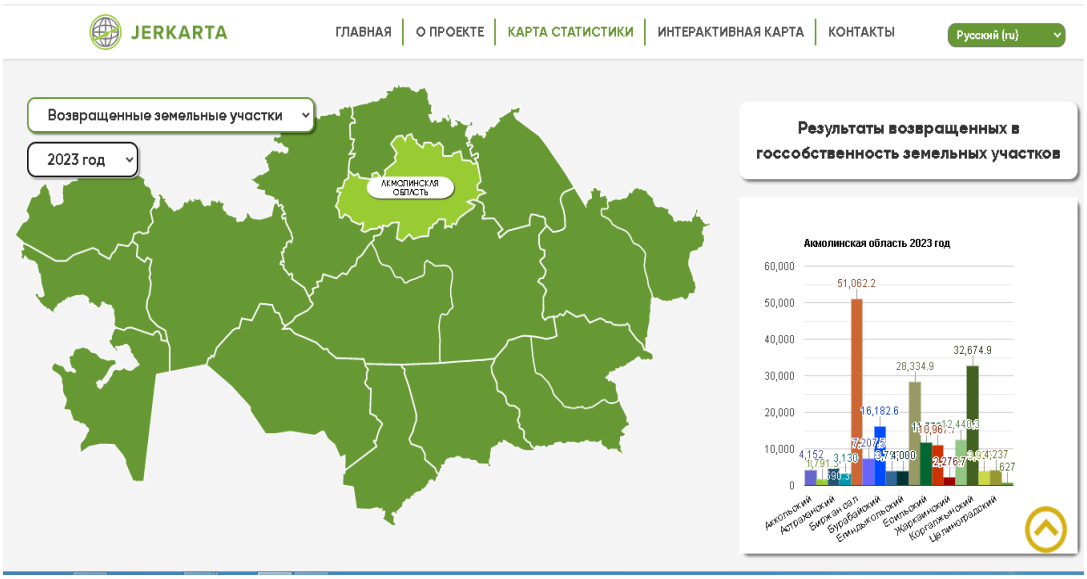
Figure 3 – Stage of identification of unused lands

The process of identifying unused land includes satellite land assessment using remote sensing.

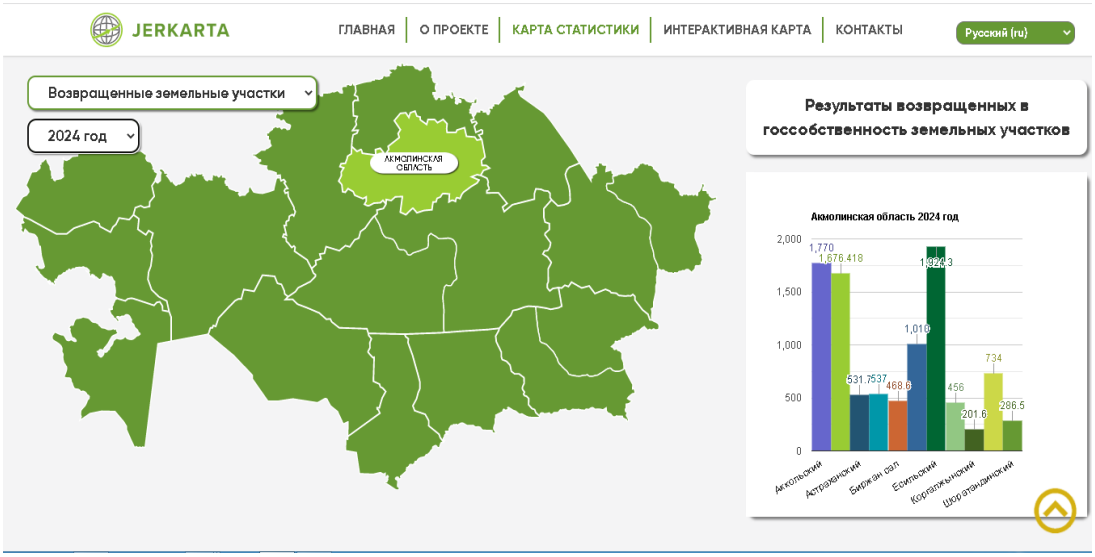
On the geoservice Jerkarta.gharysh.kz it is possible to track the number of seized lands by regions and districts (figure 4).



2022



2023



2024

Note: the source: https://jerkarta.gharysh.kz/ru/statistics

Figure 4 – Map of statistics of seized land plots for 2022-2024 in Akmola region

Figure 4 shows the scheme and diagrams for the return of unused land in the Akmola region for 3 years. The analysis showed that for the period from 2022-2024, 515.2 thousand hectares were seized in the Akmola region (table).

Table – The number of seized lands in state ownership for 2022-2024 in the Akmola region

Naming of region	Year			Total, hectares
	2022	2023	2024	
Akkolsky	23 612.9	4 152	1 770	29 534.9
Arshalynsky	4 711.1	1 791.3	1 676.4	8 178.8
Astrakhan	7 200	4 590.3	531.7	12 322
Atbasarsky	38 261	3 130	537	41 928
Birzhan sal	87 846.2	51 062.2	468.6	139 377
Bulandinsky	978.5	7 207.5	-	8 186
Burabaysky	22 112.3	16 182.6	-	38 294.9
Stepnogorsk	3 877.4	3 793.9	1 010	8 681.3
Egindykolsky	4 557	4 000	-	8 557
Yerementausky	29 652.9	28 334.9	-	57 987.8
Yesilsky	8 258.5	11 773	1 92.3	21 955.8
Zhaksynsky	13 552.1	10 967.7	-	24 519.8
Zharkainsky	12 560	2 276.7	-	14 836.7
Zerendinsky	3 082	12 440.3	456	15 978.3
Korgalzhynsky	29 816.7	32 674.9	201.6	62 693.2
Sandyktausky	844.3	3 926.4	734	5 504.7
Tselinogradsky	7 588.1	4 237		11 825.1
Shortandinsky	3 877	627	286.5	4 790.5
Total:	302 388	203 167.7	9 596.1	51 5151.8
Note: compiled by the authors based on the source https://jerkarta.gharysh.kz/ru/statistics				

Table shows that the largest amount of unused land is concentrated in Birzhan Sal, Korgalzhynsky and Yerementau districts. This is due to the low fertility of the soils, the average bonus score of which ranges from an average of 23-25 (Kurmanova G.K., Asilov B.U., Daniyarova M.T.) [11]. A more detailed view of each seized land plot is available on the interactive map of the Jerkarta geoservice.

The process of withdrawal of unused lands is carried out on the basis of state control over land use based on space monitoring of lands. The basis for this is remote sensing of the earth (Antonov S.A) [12]. The withdrawal mechanism is as follows: initially, the inspector examines the materials of space monitoring of the earth without going to the site. In case of violations, he sends a notification to the owner or land user. If the violation is not carried out within the prescribed time limits, a field visit is carried out. In this case, an order is sent to eliminate the violation for 1 year and the owner is brought to administrative responsibility. Further, in case of non-fulfillment of the order, the inspector sends the inspection materials to the State Revenue committee to impose a fine for non-use of land in a 20-fold amount. At the final stage, a control check is carried out and the materials are submitted to the court for the seizure of the land plot (All unused agricultural land…) [13].

According to the Ministry of Agriculture of the Republic of Kazakhstan, 145 million hectares of agricultural land have been digitized in the Republic, which is 77% of the total agricultural land area (Kazakhstan plans to fully complete the digitalization…) [14]. In other words, there is still no complete information about land plots in electronic format, which makes it difficult to conduct a full-fledged analysis of land use. The complete digitization of agricultural land is planned to be completed in 2025 (Kazakhstan plans to fully complete the digitalization…) [14].

Thus, it can be concluded that the use of information technology is dictated by time and is aimed at increasing the economic efficiency of agricultural production. Digitalization of agriculture is necessary for the rational use of land resources and ensuring food security of the republic.

Discussions

Today, we have a clear understanding of the need to apply information technology in agriculture. The most common type of informatization in the republic is conducting space monitoring of lands, on the basis of which the degree of contamination of crops, the specific yield of agricultural crops are determined, and unused agricultural lands are identified. The range of opportunities for digitalization is much wider, but the main deterrent is its high cost

and the lack of Internet in rural areas. Small farms cannot yet afford to use GIS technologies in full, however, it should be noted that all farms use GPS-equipped equipment.

Farmers understand that automation of agricultural processes allows them to significantly reduce the cost of fuel and lubricants, they can not worry about the depth of plowing, sowing seeds, etc. Smart farming deserves special attention. It significantly distinguishes modern agriculture from the old standards. So, if earlier the main factors were land, climate and water, today these formats have changed. Smart farming allows you to determine exactly how much moisture is needed for a particular type of plant, the amount of fertilizers, plant protection products, etc.

At the same time, the digitalization of agriculture is affected by the lack of qualified personnel, the unfavorable demographic situation, the migration of the able-bodied population, as well as the underdevelopment of rural social infrastructure (Suieubayeva S.N., Kozlova M., Ozpence O.) [15].

An analysis of the level of information technology implementation in agricultural land use has shown that, in general, a lot of work is being done in the republic to digitalize agriculture: a single database of land plots has been created, for the formation of which the state has allocated a lot of financial resources. However, the assessment of the effectiveness of investments is still low, in addition, there is no full 100% coverage of digitalization of agricultural lands.

Conclusions

1. Research has shown that digital land use makes it possible to ensure effective management of land resources based on automation and informatization of land cadastral works. Digitalization in agriculture is being brought to life thanks to modern technologies and methods, such as precision farming with the integration of geographic information technology, applications on mobile and stationary devices, IoT (Internet of things) and other advanced technologies.

2. In the period from 2018-2021, about 208 billion tenge was allocated and spent on digitalization. However, an analysis of the effectiveness of investments showed that the effectiveness of this program was low.

3. Today, the necessary information on land use is available in digital format and is concentrated in the unified information base "Unified State Cadastre of Real Estate". The information system "Automated information system of the State Land Cadastre" served as the basis for its creation. The existing database allows for online implementation of all types of land cadastral services.

4. In order to digitalize agricultural land use in the republic, a Jerkarta agricultural map has been created, which allows tracking the number of seized lands in the context of regions and districts.

5. As a result of the research, it has been revealed that the digitalization of agriculture has some disadvantages, which include the lack of objective cartographic data; poor Internet availability in rural areas; lack of necessary infrastructure for monitoring land conditions and staffing.

6. Thus, it can be concluded that the use of information technology is very relevant and is aimed at increasing the economic efficiency of agricultural production. Digitalization of agriculture is necessary for the rational use of land resources and ensuring food security of the republic.

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