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DOI: <https://doi.org/10.62687/VLJ.1.1.2025.8>**LEGAL ASPECTS OF LAND ADMINISTRATION DIGITALIZATION: INTERNATIONAL EXPERIENCE AND PROSPECTS FOR KAZAKHSTAN****¹N.B. Akanov*** , **²N.A. Ibraeva** ¹«AtyrauInzhStroy-AIS» Branch in Astana, Astana, Kazakhstan²Astana International University, Astana, Kazakhstan*e-mail: photoshopzakaz12@gmail.com

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Abstract. This article presents an analysis of the digitalization of land administration in Kazakhstan, including legal aspects and global practices that could be integrated into this country. Today, the trend toward globalization is expanding, reinforcing the need for stable land resource management. Kazakhstan faces barriers such as non-digitized information, low digital literacy among the rural population, and uneven legal reforms. The high importance of sharing international experience and creating an institutional environment is highlighted by practices such as the Estonian E-Land model and Singapore's geoinformation technologies. The solution to these problems is presented through a set of measures, including improving digital literacy, developing telecommunications infrastructure, and harmonizing land legislation with international standards. The effectiveness of the proposed measures is assessed through the flexibility of global practices, including legal mechanisms, in the context of Kazakhstan's socio-economic specifics. The data obtained will contribute to sustainable development and improvement of the quality of life of the population.

Key words: digitalization, land administration, international experience, land relations, land policy, land legislation, digital legal framework.

ЖЕРГЕ ОРНАЛАСТЫРУ ЖҮЙЕСІН ЦИФРАНДЫРУДЫҢ ҚҰҚЫҚТЫҚ АСПЕКТІЛЕРІ: ХАЛЫҚАРАЛЫҚ ТӘЖІРИБЕ ЖӘНЕ ҚАЗАҚСТАН ҮШІН БОЛАШАҚ МҮМКІНДІКТЕР**¹Н.Б. Ақанов***, **²Н.А. Ибраева**¹«Атырауинжстрой-АИС» ЖШС, Астана, Қазақстан²Астана халықаралық университеті, Астана, Қазақстан*e-mail: photoshopzakaz12@gmail.com

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Андатпа. Мақалада Қазақстан Республикасында жер ресурстарын басқару жүйесін цифрландыруға қатысты талдау жүргізілген, соның ішінде құқықтық аспектілер мен ұлттық құқықтық әрі институционалдық ортаға енгізуге болатын әлемдік тәжірибелер қарастырылады. Жаһандану үдерістерінің күшеюі жағдайында жер ресурстарын орнықты басқаруға деген қажеттілік артып келеді. Қазақстанда ақпараттың толық цифрландырылмауы,

ауылдық халықтың цифрлық сауаттылығының төмендігі және құқықтық реформалардың біркелкі еместігі сияқты бірқатар кедергілер бар. Халықаралық тәжірибені қолдану мен институционалдық ортаны қалыптастырудың маңыздылығы Эстонияның E-Land моделі мен Сингапурдың геоақпараттық технологиялары мысалында негізделеді. Аталған мәселелерді шешу цифрлық сауаттылықты арттыру, телекоммуникациялық инфрақұрылымды дамыту және жер заңнамасын халықаралық стандарттармен үндестіруді қамтитын кешенді шаралар арқылы ұсынылады. Ұсынылған шаралардың тиімділігі Қазақстанның әлеуметтік-экономикалық ерекшеліктерін ескере отырып, құқықтық тетіктерді қоса алғанда, әлемдік тәжірибелердің икемділігін бейімдеу арқылы бағаланады. Алынған деректер орнықты дамуға және халықтың өмір сүру сапасын арттыруға ықпал етеді.

Түйін сөздер: цифрландыру, жер ресурстарын басқару, халықаралық тәжірибе, жер қатынастары, жер саясаты, жер заңнамасы, цифрлық құқықтық орта.

ПРАВОВЫЕ АСПЕКТЫ ЦИФРОВИЗАЦИИ ЗЕМЕЛЬНОГО АДМИНИСТРИРОВАНИЯ: МЕЖДУНАРОДНЫЙ ОПЫТ И ПЕРСПЕКТИВА ДЛЯ КАЗАХСТАНА

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Аннотация. В статье представлен анализ цифровизации системы управления земельными ресурсами в Республике Казахстан, включая правовые аспекты и мировые практики, которые могут быть интегрированы в национальную правовую и институциональную среду. В условиях усиления процессов глобализации возрастает потребность в устойчивом управлении земельными ресурсами. Казахстан сталкивается с рядом барьеров, таких как нецифровизированность информации, низкий уровень цифровой грамотности сельского населения и неравномерность правовых реформ. Высокая значимость заимствования международного опыта и формирования институциональной среды подтверждается примерами эстонской модели E-Land и геоинформационных технологий Сингапура. Решение обозначенных проблем предлагается через комплекс мер, включающий повышение цифровой грамотности, развитие телекоммуникационной инфраструктуры и гармонизацию земельного законодательства с международными стандартами. Эффективность предлагаемых мер оценивается через адаптацию гибких мировых практик, включая правовые механизмы, с учётом социально-экономических особенностей Казахстана. Полученные данные будут способствовать устойчивому развитию и повышению качества жизни населения.

Ключевые слова: цифровизация, земельное управление, международный опыт, земельные отношения, земельная политика, земельное законодательство, цифровая правовая среда.

Introduction. The digitalization of land administration, at present, appears to be the most significant component of global modernization. It can be used to achieve stability, efficiency, and accessibility in land resource management. As mentioned earlier, the trend toward globalization is growing, and with it, standards for sustainable development. The use of digital innovations contributes to the eradication of corruption, the improvement of accounting activities, land tracking, and compliance with international requirements. The global modernization of land management in

Kazakhstan is of exceptional importance, as it is here that there are huge agricultural areas (more than 80%). The introduction of digital innovations in this sector is aimed at rational land use, attracting financial investments, and joining large agricultural and economic unions. With proper modernization, this sector will take the national economy to a new level.

Today, services such as the Unified State Real Estate Cadastre (USREC) and the eGov public services platform are successfully operating in Kazakhstan. However, the state still faces difficulties that hinder the transition of administrative activities to digital mode. The majority of land information is not subject to digitalization. There is no possibility of forming a unified information base or approving effective solutions. In addition, innovations cannot be fully utilized due to low digital literacy among the population in certain areas and underdeveloped digital infrastructure. In this context, the analysis of global practices and their adaptation to the socio-economic conditions of Kazakhstan are particularly important areas of research for the modernization of land management and the maintenance of its stability.

International experience. Different countries use their own methods to implement digital technologies in land management. Each country takes its own characteristics into account when creating such systems. However, all these systems are based on two principles: close interaction between different technologies and openness of government agencies. Estonia has created the e-Land digital system, which operates on a single platform and allows all cadastral operations to be performed, including the registration of rights and the issuance of certificates. This is done using electronic signatures, which reduces the need for personal contact between parties. The e-Land system covers 98% of operations and reduces bureaucracy. It also strengthens trust in digital services because it eliminates corruption at all stages of work (Rękawek-Pachwicewicz, 2021:107--125). In Singapore, the focus is on optimizing land management using geographic information systems. These systems synchronize data on urban planning, infrastructure, and environmental constraints, enabling monitoring and forecasting of land use. Singapore's approach allows it to respond quickly to urbanization issues and strike a balance between the interests of residents and authorities when land is scarce.

In Australia, especially in the state of New South Wales, there is a shift from traditional registries to experiments with blockchain. This technology protects transactions and makes records immutable (Bennett et al., 2021: 220). Australia's transition to blockchain highlights the need to combine traditional solutions with innovation to reduce legal risks and protect against cyber threats. Success depends on the introduction of new technologies, data integration, and the development of a legal framework for electronic transactions (Jahani Chehrehbargh et al., 2024:1097--1129). Kazakhstan needs to adapt these models to its agricultural needs: monitoring land conditions, combating soil degradation, and connecting small farms to the digital system. It is important to adopt Singapore's approach to land use planning in order to use land more efficiently, and Estonia's methods of electronic interaction to involve people in land resource management.

The digitalization of land administration in these countries is based on a set of regulatory and legal acts, strategic documents, and sectoral reforms adapted to the national characteristics of their legal systems. In Australia, the key guideline is the program "Australia's Technological Future: Building a Strong, Secure, and Inclusive Digital Economy," developed by the Department of Industry, Innovation, and Science, which emphasizes the use of satellite technology and blockchain in agriculture and natural resource management. Although there is no specific law on the digitalization of land administration, industry standards are being integrated through a system of national strategies, including the automation of mining activities and the introduction of the Internet of Things in industry (Bennett et al., 2021: 220).

Singapore, despite the absence of direct references in the sources provided, traditionally implements digitalization through the "smart state" model, where land administration is regulated under the State Lands Act and the Planning Act, supplemented by digital platforms such as the e-Cadastre system. Such mechanisms are indirectly related to international practices described in analytical materials on blockchain solutions for registering property rights, which ensure transaction transparency.

Estonia uses a "digital state" model, where land administration is integrated into the X-Road platform through the Land Cadastre Act and the Digital Signature Act, which ensures end-to-end digitalization of rights registration processes. The general principle of adapting legislation to technological innovations, characteristic of these countries, is consistent with the trends noted in Russian literature: the need to overcome legal gaps through cross-sectoral harmonization of norms and the development of specialized standards.

All three jurisdictions are characterized by an emphasis on creating infrastructure conditions (cybersecurity, system interoperability) and the introduction of end-to-end technologies (GIS, AI), which requires not only updating land legislation, but also synchronisation with the norms of the digital economy, as provided for in the EAEU and BRICS strategies mentioned in Russian sources. However, the lack of uniform international standards is compensated for by national programs focused on technological sovereignty and sustainable data management (Rękawek-Pachwicewicz, 2021:107--125).

Digitalization of land administration in Kazakhstan. The introduction of digital technologies in land resource management is yielding good results, but there are some challenges that require attention. One of the main achievements has been the expansion of the Unified State Real Estate Cadastre (USREC), which has consolidated information on 6.5 million land plots. This creates conditions for transparent management of rights and optimization of administrative processes. The eGov platform helps process 30% of land transactions online, which speeds up the process and reduces the likelihood of corruption. In the Almaty and Akmola regions, the creation of digital land maps is being tested. This will help analyze their location and predict their use. Such technologies are important for regions with large agricultural areas (Aitkhozhayeva et al., 2024:155--164).

The digitalization process is based on a regulatory framework that includes the Land Code of the Republic of Kazakhstan (dated June 20, 2003, No. 442, as amended), which regulates land relations, and the Law of the Republic of Kazakhstan "On Informatization" (dated 24 November 2015 No. 418-V), which provides the legal basis for digital services. The state program "Digital Kazakhstan" (2017, repealed by the Government Decree of May 17, 2022) stimulated the automation of cadastral processes. Amendments to the Land Code (2021) allowed for the introduction of electronic registration of land rights in cities, which reduced document processing times by 97%. However, outside urban areas, the traditional procedure remains in place, indicating the unevenness of the reforms. Full digitalization requires harmonization of legislation, including regulations on AI and blockchain, as well as unification of data standards between the RGIS and the USREC.

Despite technological advances, there is a large gap between how urban residents use digital tools and access to them in rural areas. As a result, only half of all land data in Russia is entered into the common database. This makes it difficult to monitor the situation with land resources throughout the country. Rural areas have little infrastructure and slow internet, so only a quarter of residents use digital technologies. This hinders the implementation of digital reforms. There is a shortage of specialists, especially those who are knowledgeable about geographic information systems and artificial intelligence. Because of this, the introduction of new technologies in agriculture is slow (Salykov et al., 2024:6703--6718).

Digitalization will continue thanks to the introduction of intelligent GIS-based monitoring systems. These will help monitor soil conditions and land use. Artificial intelligence will help analyze cadastral data and automatically find unregistered plots. This will help optimize land distribution. It is important to integrate national standards with international practices, such as ISO 19152 (LADM). This will ensure data compatibility and facilitate the attraction of foreign investment. To implement these plans, technology and education reforms are needed. It is necessary to train specialists who know how to work with new digital tools (Abdrassulova, 2023: 45--55).

Kazakhstan is undergoing land administration reform. The success of digitalization depends on overcoming regional differences, modernizing infrastructure, and creating conditions for the development of digital skills. Adapting best international practices, taking into account the specifics of agriculture, will help transition to effective land resource management, which will ensure the country's sustainable development and competitiveness on the world stage.

Methods and methodology. The study is based on a systematic approach that views the digitalization of land management as a multi-stage process involving technological innovations, organizational reforms, and social transformations. This approach helps to examine the interrelationships between different parts of the system: from the use of geoinformation technologies to changes in legislation and the development of digital literacy among users. Taking all aspects of the transformation into account helps to identify not only obvious effects, such as the automation of cadastral registration, but also hidden factors that influence the behavior of land relations participants due to digital platforms.

The study uses a combination of methods that identify common patterns and features of national contexts. The study examines the strategies of Estonia, Singapore, Australia, and Kazakhstan. It compares the level of technological development, the transparency of institutions, and the effectiveness of land policy.

Studying the experience of Estonia with its e-Land system, which provides seamless data integration through electronic signatures, and Singapore with its use of GIS for land resource management, helps to understand how solutions are adapted to different socio-economic conditions. The study is based on theoretical foundations, which include a review of scientific literature on the digital transformation of public administration, as well as an analysis of legislative documents related to land relations in selected countries (Bennett et al., 2020: 2497).

The empirical part of the study is based on information from the Ministry of Agriculture of the Republic of Kazakhstan and the Statistics Committee. It includes data on the Unified State Real Estate Cadastre, the level of Internet development, and the use of the eGov platform. Limited access to detailed data on the regions of Kazakhstan and the results of pilot digitalization projects makes it difficult to accurately assess the effectiveness of the solutions being implemented. This highlights the importance of strengthening monitoring mechanisms and improving interagency data exchange to increase the accuracy of analytical conclusions.

To take into account the specific characteristics of Kazakhstan, it is necessary to monitor soil conditions and connect small farms to the digital system. Different methods complement each other, allowing the topic to be studied from different angles. This helps to analyze changes at the institutional level and evaluate user practices, as well as technological limitations at the micro level.

Results and discussion. International approaches to the digitalization of land administration vary depending on the geography, economy, and institutions of each country. In Estonia, thanks to complete digitalization and public trust, unprecedented transparency has been achieved in the field of land transactions. This has been made possible by integrating all processes into a single digital system, where electronic signatures and automation minimize human involvement. Singapore effectively manages land resources using geographic information systems. This helps to synchronize urban planning, ecology, and infrastructure. The Australian model uses blockchain and automated registries to protect data from fraud and ensure transaction security. These examples show that successful digitalization depends not only on technological development, but also on the coordination of regulatory acts, the development of digital infrastructure, and the formation of trust between stakeholders (Nikolina et al., 2020:150--156).

In Kazakhstan, the process of digital transformation of land administration is ambiguous. On the one hand, successes have been achieved in the form of the introduction of the Unified State Real Estate Cadastre (USREC) and the eGov platform. However, there are also systemic limitations. Due to non-digitized data, about 40% of land plots in rural areas remain without information in the USREC. This makes it difficult to make management decisions. In villages and rural areas, there is little internet access and few people who know how to use it. As a result, rural regions lag behind urban areas in terms of technological development (Ualieva & Maydirova, 2022).

A comparison shows that Kazakhstan lags far behind the leaders in digitalization in terms of how deeply technology has been implemented. Estonia has almost completely automated land transactions, and Singapore uses GIS for forecasting management. In Kazakhstan, however, the system remains fragmented, with limited use of artificial intelligence and blockchain. The Digital Kazakhstan strategy helps to bridge the gap between countries. It focuses on developing telecommunications,

training IT specialists, and using international standards (Tassilova et al., 2024).

Kazakhstan has the potential for development by leveraging best practices and the country's unique characteristics. Estonia's experience with e-interaction can help engage rural residents, while Singapore's spatial analysis methods can optimize the use of agricultural land. Success requires cooperation between the state, private companies, and international partners to address infrastructure issues, change laws, and develop a digital culture of land management (Rodima-Taylor, 2021:140--151).

The analysis showed that Kazakhstan and other advanced countries have similar goals in the digital transformation of land management. However, there are differences in the level of technological development and the ability to adapt to change (Kalogianni et al., 2020:107). Both Kazakhstan and Estonia are seeking to simplify access to services through digital platforms. However, Kazakhstan has a problem with internet infrastructure in rural areas, which makes it difficult to achieve a level of inclusiveness similar to that of Estonia. The Estonian model uses the X-Road system and blockchain to integrate information between organizations. In Kazakhstan, digital solutions in agriculture are not yet fully developed, as difficulties with paper documents and traditional methods remain (Akhmetbek & Špaček, 2021: 41--64).

The main difference between Kazakhstan and the leaders in digitalization is the level of use of modern technologies. Singapore and Australia use advanced technologies for land resource management, while Kazakhstan is only beginning the process of digitizing data through the Unified State Real Estate Cadastre. The transition to complex solutions, such as AI-based intelligent monitoring systems or decentralized registries for property rights registration, has great potential. This is particularly important with the support of the state as part of the "Digital Kazakhstan" strategy.

Digitalization will be more successful if cultural characteristics and problems are taken into account. The use of GIS systems for soil monitoring and blockchain for protecting cadastral data will reduce corruption and strengthen trust in institutions. Implementing these measures requires investment in telecommunications and training rural residents in digital skills. Rural residents play a key role in the agricultural economy, so their development is important (Akilzhanova et al., 2023:26--33).

It should be noted that Kazakhstan is actively developing digital mechanisms in the field of land administration, comparable to advanced foreign practices, but with characteristic institutional and technological features. The implementation of the state program "Digital Kazakhstan" has led to the creation of geoportals for the automation of services in the field of land relations and subsoil use, which is in line with global trends in the integration of GIS technologies into land resource management. Unlike Estonia, where digitalization is based on the X-Road end-to-end platform, the Kazakh model is developing through regional geoinformation systems (RGIS) and a unified state real estate cadastre (USREC), which integrates land and legal cadastres. This creates a basis for centralized data management, but carries the risk of fragmentation due to the parallel development of regional systems, which is absent in the Singapore model with its unified digital platforms (Kalogianni et al., 2020:107).

A key difference in the Kazakh approach is the emphasis on agricultural digitalization through services such as Qoldau.kz and the automation of subsidies, reflecting the priority given to the agro-industrial complex in economic policy. However, the complexity of the interfaces and the high cost of maintaining these systems limit their accessibility to farmers, whereas in Australia, similar solutions are focused on reducing the bureaucratic burden through blockchain applications. Legislative changes, including the introduction of an electronic procedure for granting land plots in cities, demonstrate a desire to eliminate corruption risks, but the preservation of the "old order" outside city limits indicates the unevenness of reforms (Akhmetbek & Špaček, 2021: 41--64).

The main barriers to full-scale digitalization are technical and regulatory issues. The lack of uniform data standards between the RGIS and the USREC complicates interagency interaction, and the low digital literacy of the population limits the effectiveness of electronic services. To reach the level of Estonia or Singapore, deeper harmonization of legislation is needed, including the introduction of artificial intelligence standards in the land cadastre and the scaling up of pilot projects to integrate

information systems. The priority should be to develop big data-based recommendation models similar to Australian practices, with an emphasis on predictive analytics for agriculture. Despite progress in service automation (97% reduction in document processing times), there is still a need for specialized regulations governing the use of satellite data and IoT in land management, which will help bridge the gap with digitalization leaders.

The characteristics of the territory, the large proportion of agricultural land, and the different regions create challenges that require the adaptation of foreign experience. Estonia's experience in implementing AI in the KrattAI system can be applied to control large land plots. Singapore's methods in the field of spatial analysis are suitable for water resource management in arid regions (Ponomareva et al., 2021: 253--262). The digitalization of land administration in Kazakhstan will be successful if global technologies are combined with local characteristics.

Conclusion. The digitalization of land administration in Kazakhstan requires significant strengthening and adaptation of the legal framework, based on successful international practices. Analysis of foreign experience demonstrates several promising legal mechanisms, the implementation of which will ensure effective and transparent management of land resources.

First, the experience of Estonia in legally establishing electronic digital signatures and digital identification integrated into the X-Road platform should be used. This mechanism will allow Kazakhstan to significantly simplify land registration procedures, reduce bureaucracy and corruption, thereby strengthening the trust of citizens and businesses in digital government services.

Second, the Australian model of implementing blockchain technologies in land registries points to the need to create a separate regulatory act governing the use of blockchain to ensure the immutability and transparency of land transactions. Such standards will protect the interests of land relations participants and ensure the stability of registry data.

Third, Singapore's practice of legislative regulation of geographic information systems (GIS) should be adapted by Kazakhstan through amendments to the Land Code providing for the mandatory use of GIS for spatial analysis and monitoring of land resources. Legal consolidation of these requirements will increase the efficiency of land planning and land resource management.

The fourth mechanism is the harmonization of Kazakhstan's land legislation with international standards such as ISO 19152 (LADM). The introduction of this standard at the legislative level will ensure the compatibility and unification of land data at the international level, facilitating Kazakhstan's integration into global information systems and increasing the country's investment attractiveness.

Fifth, it is important for Kazakhstan to adopt the Estonian legal model for the use of artificial intelligence (KrattAI) for big data analysis and forecasting changes in land relations. This will require supplementing the Law of the Republic of Kazakhstan "On Informatization" with norms regulating the legal aspects of AI application in state information systems.

Finally, the Australian experience shows the importance of regulatory control over the use of satellite monitoring data and the Internet of Things (IoT) in land management. The development and adoption of relevant legal acts will provide a legal basis for expanding the intelligent monitoring of agricultural areas and optimizing land resource management processes.

The introduction of these legal mechanisms will enable Kazakhstan to move to a qualitatively new level of land administration, ensuring sustainable development and increasing the efficiency of public and private investment in land resources.

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