

## AN EVALUATION FRAMEWORK OF THE CURRENT CADASTRAL SYSTEM IN UKRAINE – A CASE STUDY

Andriy Popov<sup>1</sup>✉, Pavlo Kolodiy<sup>2</sup>✉, Yurii Zadorognyy<sup>3</sup>✉

<sup>1</sup> ORCID: 0000-0001-7292-8818

<sup>2</sup> ORCID: 0000-0001-9847-9520

<sup>3</sup> ORCID: 0000-0003-3499-7753

<sup>1,3</sup> Mykolayiv National Agrarian University  
General Karpenko Street, 73, 54000, Mykolayiv, **Ukraine**

<sup>2</sup> Lviv National Environmental University  
Volodymyr the Great Street, 1, 80381, Dublyany, **Ukraine**

### ABSTRACT

**Motives:** Land is the most vital resource that meets basic human needs. There are several mechanisms for achieving the goals of sustainable administration and management of land resources, and the cadastral system is the key mechanism. In most developing countries, the procedures for monitoring the performance of cadastral systems are inadequate or non-existent. Ukraine is not an exception in this respect, and this issue is largely disregarded in the domestic literature.

**Aim:** The objective of the study was to establish an evaluation framework that relies on globally recognized best practices and their corresponding indicators. The main aim of the framework is to measure and assess the effectiveness of Ukraine's cadastral system.

**Results:** The evaluation methodology consisted of four stages: an analysis of evaluation indicators, identification of international best practices, identification of performance gaps in the cadastral system, and the development of a summary profile based on a SWOT analysis. The cadastral system was evaluated based on indicators within five domains: political, management, operational levels, external factors, and the review process.

**Keywords:** cadastral system, land cadastre, property registration, evaluation indicators, evaluation framework

### INTRODUCTION

Land plays a pivotal role as a valuable resource and a major contributor to wealth on a global scale. Land as the primary resource and production tool is even more significant for agriculture (Burns, 2007; De Soto, 2000; Diiesperov, 2010; Stupen et al., 2016). The availability

of cadastral data is crucial for effective land resource management, highlighting the vital role played by both the cadastre and the registration of legal rights on the land. Together, they contribute significantly to the progress and prosperity of society. Land data is subject to continual change and dynamism because of evolving attitudes towards land, specifically in terms

✉ popov@mnaeu.edu.ua, ✉ pavlokolodiy@gmail.com, ✉ tankist815@gmail.com

of land tenure. This is primarily driven by the growing flexibility and complexity of contemporary land ownership and land use practices.

However, as studies (Dale & McLaughlin, 1998) show, traditional cadastres (cadastral systems) are usually quite slow in their nature to respond to the ever-changing needs of society. Moreover, the information incorporated into the cadastre must be consistently updated due to the inevitable aging of cadastre databases resulting from changes occurring on the ground (Bielska et al., 2020; Buško et al., 2022; Gürsoy Sürmeneli & Alkan, 2021; Klimach et al., 2020; Szafranska et al., 2020). This requires constant expenditures to maintain the functioning of the cadastral system (Busko & Apollo, 2023; Roić et al., 2021).

The issue of a comprehensive evaluation of the effectiveness of current systems of administering and managing the state land cadastre and registering land rights (cadastral system) in promoting the development of the land market and ensuring conditions for sustainable development of the country has become relevant in Ukraine because the interaction between individuals and land has grown increasingly dynamic.

In Ukraine, the cadastral system follows a dual agency model, with different institutions overseeing land cadastre and legal registry activities. The State Service for Geodesy, Cartography, and Cadastre (StateGeoCadastre) and its local offices, subordinated to the Ministry of Agrarian Policy and Food, is chargeable for governing the State Land Cadastre. This includes tasks such as spatial registration of land plots, development of the national geospatial infrastructure, creation of index cadastral maps, and mapping activities. On the other hand, the Department of Notary and State Registration under the Ministry of Justice handles legal matters related to land registration. The State Land Cadastre (SLC) is specifically focused on land plots. Its primary purpose is to record and register the spatial attributes of each land plot, including boundary coordinates, landmarks, and land characteristics such as area and land types. This information is associated with a unique cadastral number assigned to each plot. The Department of Notary

and State Registration is responsible for managing and regularly updating the State Register of Property Rights to Immovable Property, which pertains to the registration of property rights. This property register performs duties for officially recording ownership titles (once the land plot is registered in the State Land Cadastre) and various legal rights and interests on the land. These may include mortgages, restrictions, and responsibilities, among others (Popov, 2019). These two registers serve different purposes but are interconnected and accessible to the public.

## LITERATURE REVIEW

A wide range of Ukrainian scientists is engaged in solving issues related to the management and formation of the cadastral system. Boklah (2014), Dombrovska and Tyshkovets (2019), Kuryltsiv (2012) and Perovych (2013) argue that the cadastral system is a basis for facilitating land administration. Bordiuzha (2013), Boiko et al. (2016), Kovalyshyn (2017), Martyn (2011, 2017), Tykhenko (2016), Tretiak (2012) and Tsytsyura (2016) are focused on the current situation, advantages, disadvantages and possible improvements of cadastral system functioning. Panas (2008), Perovych and Ludchak (2015), Stupen (2016) and Taratula (2017) devoted to research on foreign experience in the development of cadastral systems and their comparative analysis. Shchepak (2017) and Yasinetska et al. (2018) have addressed geoinformation technology for the cadastral system. To date, the systematic performance evaluation measures for the cadastral system remain out of focus in Ukraine. The key obstacle to creating a successful cadastral system is the lack of standardised frameworks for evaluating the effectiveness of the performance of undertaking institutions, according to Gebrewold (2016). In the Ukrainian context, there are thirteen different cadastres for natural resources, including two types of land cadastre (urban and rural), along with a unified State Register of Property Rights to Immovable Property (Popov, 2019). In such complexity cadastral system, there is a lack of a nationwide accepted methodology to effectively measure and evaluate the performance of the cadastral system.

Hence, the research objective is to find an evaluation framework that draws upon international best practices and their corresponding indicators. This framework will enable the comprehensive measurement and evaluation of the overall performance of Ukraine's cadastral system. Aligned with this objective, the research sought to address the following question: Which indicators can be used for measuring and evaluating the performance of Ukraine's cadastral system? Therefore, the research contribution is formulating a unified methodology for the many-sided evaluation of the cadastral system. Additionally, it seeks to assess the performance of Ukraine's cadastral system, providing policymakers, practitioners, and stakeholders with insights into the advancements made by cadastral system projects in reaching their desired goals. This paper mainly focuses on cadastral system evaluation because different evaluation indicators can enhance the monitoring of land administration and land management, thus reinforcing governance in this domain.

The paper is organized into four main sections. The first section provides an overview of the data collection and analysis process. The following section digs into the theoretical knowledge and background related to cadastral systems evaluation. This is followed by the results section that presents and discusses the evaluation frameworks utilized for assessing the cadastral system in Ukraine, along with the corresponding evaluation outcomes. Finally, the paper concludes by providing an answer to the research question. While this paper focuses on the specific experiences of Ukraine, it can also serve as a valuable resource for other countries developing their cadastral systems.

## **MATERIALS AND METHODS**

For this research, a comprehensive approach was employed, incorporating a desk review of international literature, a case study, and an analysis of Ukrainian documents related to the functioning of the cadastral system. The desk review primarily aims to explore and examine the available literature concerning evaluation

indicators and international best practices related to cadastral systems. The desk review was conducted to identify methodologies for measuring and evaluating the performance of the cadastral system in Ukraine. The desk review relied on secondary data sources, including journals, monographs, books, and conference proceedings, as the foundation for gathering information. Through the literature review, seven frameworks and models that are suitable and relevant for evaluating cadastral systems were identified. These represent the Cadastral template (Steudler et al., 2003), the Land Administration Evaluation Framework (Steudler, 2004), the EFQM Excellence Model (EFQM, 2012), Cadastre 2014 (Steudler, 2014) and 2034 (ICSM, 2014), the Land Administration Evaluation systems (Shibeshi et al., 2015), the Land Governance Assessment Framework (Gebrewold, 2016) and the 2030 Agenda for SDG (UN, 2015). The reason for selecting these frameworks and models is their flexible, comprehensive, reliable, and attainable nature. Steudler et al. (2004), Yilmaz et al. (2015), and Mitchell et al. (2017) have developed an evaluation framework for cadastral systems that encompasses five levels: policy level, management level, operational level, external factors, and review process. These levels are further subdivided into evaluation aspects. Best practices and corresponding indicators are developed for each evaluation aspect. This paper develops an evaluation framework for the Ukrainian cadastral system based on the above literature.

The evaluation framework developed for the Ukrainian cadastral system was applied using a case study methodology. This enabled the assessment of the system's performance. The evaluation of the different aspects is primarily rooted in the authors' extensive experience of at least sixteen years in conducting research and instructing students and practitioners in cadastre and cadastral surveying.

The third research method employed was document analysis, which involves a qualitative approach wherein documents are examined to derive meaningful insights and understanding. The basic policy (legal) documents that were analysed included

the Law “On State Land Cadastre” no. 3613-VI (dealing with the land cadastre administrating and managing), the Resolution of the Cabinet of Ministers “On the Procedure for Carrying On of the State Land Cadastre” no. 1051 (dealing with spatial registration procedure of land plots) and no. 1438 (dealing with the realisation of the pilot project on land registration by private land surveyors), the Law “On State Registration of Real Estate Rights and Their Burdens” no. 1952-IV (dealing with the registration procedure of interests to land plots). In addition, the legislation on the cadastral system, official documentation of the StateGeoCadastre and cadastral data from the Public Cadastral Map of Ukraine were analysed. All the information, discussions, and conclusions presented in this study apply to the cadastral system in Ukraine, except for the temporarily occupied territory of the Autonomous Republic of Crimea and some areas of Donetsk and Luhansk oblasts, up until the Russian invasion of Ukraine on February 24, 2022. It should be noted that during the ongoing conflict in Ukraine, the cadastral system operates under significant restrictions and limitations.

## Theoretical Background and an Evaluation Framework

In this paper, the term “cadastral system” refers to a formal subsystem within land administration. It includes the organizational system, involving various professional actors from both public and private sectors responsible for the protection of property rights. It also contains procedures, regulations, and different registers, all working in tandem to ensure the accuracy and currency of land information and its associated attributes. In short, the cadastral system of Ukraine contains two registers: SLC and Property Register (the State Register of Property Rights to Immovable Property). SLC is responsible for land plot registration (landmarks boundaries coordinates, land use, land value, land types, soils, etc.) by using unique cadastral numbers. Property Register dealing with registration of ownership and other interest to land. The integrated view of cadastre and registration

systems implies the entirety of the cadastral system, including its structure, processes, and functions. The cadastral system is centralised in the meaning of land registering and recording within the single digital public cadastral map. At the same time, the financial and technical responsibilities lie on separated institutions and ministries. The Ministry of Agrarian Policy and Food, specifically the StateGeoCadastre (a national authority) and its local offices, is responsible for managing the activities of the SLC. The Ministry of Justice, specifically the Department of Notary and State Registration, is responsible for property registration. Often this leads to discrepancy in the methodology of the cadastral system functioning.

The term “land administration system” encompasses a broader scope, which includes land use planning, valuation, taxation, and other related aspects (Bennett et al., 2012; Bogaerts & Zevenbergen, 2001; Enemark et. al., 2010; van der Molen, 2002; Williamson, 2001). Dale and McLaughlin (1988) illustrated the classical concept of land administration systems, highlighting their alignment with land policy and land tenure arrangements.

Evaluation refers to the systematic gathering and analysis of data to assess the strengths and weaknesses of programs, policies, projects, and organizations, to enhance their effectiveness (Baird, 1998). Evaluation refers to the systematic gathering and analysis of data to assess the strengths and weaknesses of programs, policies, projects, and organizations. Its purpose is to enhance their effectiveness and performance (Baird, 1998). The evaluation process can mitigate subjectivity and establish an objective foundation for investigating success and experiences by incorporating best practices and their corresponding indicators. This approach facilitates performance improvement for any given object(s) or process(es). Best practices serve as the primary objectives or desired outcomes of a well-functioning system while indicators serve as the means to measure the level of success in achieving these best practices. Furthermore, best practices and indicators serve as benchmarks for evaluation and are essential components of the evaluation system (UN-Habitat, 2003).

The framework offers an evaluation technique that assists in identifying indicators for cadastral systems that can be enhanced according to international standards (Chekole et al., 2020; EFQM, 2012; Gebrewold, 2016; ICSM, 2014; Steudler et al., 2003; Yilmaz et al., 2015). An indicator is a distinct, measurable, and observable characteristic employed to designate changes or the degree of progress made by a system in attaining a particular result. Recent studies in land management have shown an increased interest in developing evaluation frameworks to assess land administration systems. As an example, the International Federation of Surveyors (FIG, 1995) put forward a series of criteria designed to evaluate the success and effectiveness of a land administration systems. Steudler (2004) introduced a land administration evaluation framework including three organizational levels (operational, management, policy), the review process and external factors. The organizational pyramids are used to adapt and develop such evaluation frameworks and define evaluation indicators. Chimhamhiwa et al. (2009) formulated a conceptual model to measure the comprehensive performance of land administration systems by focusing on cross-organizational business processes. Bandeira et al. (2010) introduced a comparative methodology for assessing national land administration systems and applied it to evaluate the systems of Honduras and Peru as specific cases. The “Land Governance Assessment Framework” (Gebrewold, 2016) is another example of an evaluation framework. This tool is designed to evaluate the state of land governance within a specific country.

Kaufmann (2000) proposed viewing the cadastre as an “accounting system” for land issues that facilitates sustainable development. Like an accounting system in a business or organization, the cadastral system must adhere to specific rules and principles. The principles governing the cadastral system are rooted in tradition and primarily aimed at ensuring the supply of accurate and organized information regarding individual land plots. These principles serve various purposes, such as land valuation and

taxation, land-use planning, land markets, and legal, regulatory, and fiscal aspects of land administration. Therefore, the cadastral system can be regarded as an integral component of the operational level within land administration. Zhang and Tang (2017) proposed to use the multi-criteria analysis tools to evaluate the performance of the cadastral system at the operational level and systematically present an evaluation methodology (Mitchell et al., 2017; Steudler, 2004; Steudler & Williamson, 2002; Yilmaz et al., 2015) that relied on the three levels (policy, management and operational), external factors and the review process.

It is noteworthy that Rajabifard et al. (2007) created the cadastral template. Nevertheless, the template primarily serves as a standardized form that cadastral institutions complete by showcasing the emerging trends in comparative studies in cadastre, ultimately aiming to facilitate benchmarking. As of March 2022, the cadastral template, available at <http://cadastraltemplate.org>, comprises the culmination of 39 country templates that rely on six statistical indicators and two descriptive indicators. The reports from EuroGeographics, as outlined by Haldrup and Stubkjær (2013), provide an overview of the implementation of various performance indicators at a national level. These indicators encompass aspects such as the number of transactions, hours per unit of production, personnel productivity, and production backlogs. Nevertheless, certain studies are more comprehensively structured and incorporate quantitative data, as noticed by Haldrup and Stubkjær (2013).

In this paper, the authors examine peer-reviewed written works on evaluation frameworks and existing models for assessing land administration systems to develop a methodology and framework that can effectively evaluate and measure the performance of the Ukrainian cadastral system. The evaluation framework includes various aspects and indicators specifically designed for the Ukrainian cadastral system, as presented in Table 1.

**Table 1.** A framework for evaluating the cadastral system in Ukraine

Evaluation Area	Evaluation Indicators	International Best Practice
	Land policy aspects and objectives (5–20 years)	
1	2	
Policy Level	<ul style="list-style-type: none"> <li>• The presence of a governmental policy regarding the cadastral system</li> </ul>	<ul style="list-style-type: none"> <li>• The aspects of the cadastral policy are incorporated within the land policy, which includes relevant laws and regulations adapted to the specific circumstances</li> </ul>
Stakeholders: Parliament, Government	<ul style="list-style-type: none"> <li>• The cadastral policy supports: agenda 2030 for SDG; digital cadastral data lodgement portal; developing 3D digital cadastral system; digital data sharing; making and maintenance of a cadastral single map</li> </ul>	<ul style="list-style-type: none"> <li>• Policy objectives are specific, measurable, achievable, realistic, timely and continuously acknowledged</li> <li>• Cadastral policy supports and contributes to the achievement of SDGs</li> </ul>
Tasks: definition of the objectives, legal framework, long-term financial aspects, economic-social-environmental aspects (equitable, sustainable)	<ul style="list-style-type: none"> <li>• Policy objectives are SMART identified (list of objectives and tasks)</li> </ul>	<ul style="list-style-type: none"> <li>• Cadastral policy supports developing digital cadastral data lodgement portal</li> <li>• Cadastral policy guides developing 3D digital cadastral system</li> <li>• Cadastral policy supports digital data composing and sharing</li> <li>• Cadastral single map making and updating guides by policy</li> </ul>
	Historical, legal, social, cultural background	
	<ul style="list-style-type: none"> <li>• The land administration system supports the cadastral system</li> <li>• Society benefits from and acknowledges the cadastral policy</li> <li>• Transparent data access and information about the land resources, land use and land situation</li> <li>• Good governance and civic participation</li> </ul>	<ul style="list-style-type: none"> <li>• The historical background is recognized and acknowledged by the government and society</li> <li>• Administrative and political structures are suited to circumstances</li> <li>• Society recognizes the importance and advantages of implementing the cadastral policy</li> <li>• Cadastral system facilitates transparent and effective access to land-related data and information</li> <li>• Cadastral system is supported by strategic and political decisions</li> <li>• Civic participation is ensured</li> </ul>
	Land tenure and legal aspects	
	<ul style="list-style-type: none"> <li>• Land tenure aspects (recognition of informal tenure, qualified (limited) titles and flexible cadastral boundaries; humankind to land relationships is dynamic; role of the cadastral system in supporting the land management, natural resources, land market, etc.)</li> <li>• Legal aspects (institutions with clear responsibilities, protection ownership rights, existence of legal basis, system uniformity, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Legal recognition of all the details and standard procedures</li> <li>• The government recognizes the relationship between humankind and land and ensures its suitability for circumstances</li> <li>• The legal framework is well-suited to the cadastral system (e.g., by protecting ownership rights, recognition of informal tenure, qualified [limited] titles and flexible cadastral boundaries, legal reforms are on-going)</li> <li>• Cadastral system institutions have clear responsibilities and easy procedures</li> <li>• Cadastral system is well-adapted for circumstances</li> </ul>
	Financial and economic aspects	
	<ul style="list-style-type: none"> <li>• Aspects related to the land market (efficient functioning of land and property market, number of land sales, value of property market, total value of mortgages, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• The policy of the cadastral system promotes a well-functional land market and aligns with the circumstances</li> <li>• Funding supports an efficient establishment of the cadastral system</li> <li>• Reasonable direct revenue from the cadastral operations</li> </ul>

cont. Table 1

1	2
	<ul style="list-style-type: none"> <li>• Aspects related to funding (system of funding, involvement of institutions at different administrative levels)</li> <li>• Direct revenue (commercialisation of registration, land taxes, stamp duties, fees)</li> <li>• Cost recovery policy (operations)</li> </ul>
	Environmental sustainability aspects
	<ul style="list-style-type: none"> <li>• Cadastral policy ensures the sustainability of the environment</li> <li>• Defined environmental duties</li> </ul>
	<ul style="list-style-type: none"> <li>• Cadastral system includes duties such as monitoring land and natural resources, zoning restrictions, environmental protection, etc.</li> <li>• Cadastral system supports environmental sustainability issues</li> </ul>
Management Level	Strategic aspects (1–5 years)
Stakeholders: administrations responsible for the operation of the cadastral components	<ul style="list-style-type: none"> <li>• Strategic aspects and targets</li> <li>• Stakeholder-focused strategy</li> </ul>
	<ul style="list-style-type: none"> <li>• Strategies clearly defined, published and shared</li> <li>• Cadastral agencies fulfil their mission and vision by formulating a strategy centred around stakeholders' needs and interests</li> <li>• Objectives, plans, and activities are formulated and actuated to execute the strategy</li> </ul>
Tasks: definition of strategic targets, set-up of institutional and organisational structures	Institutional and organisational aspects
	<ul style="list-style-type: none"> <li>• System characteristics (cadastral departments, agencies, centralized vs. decentralized)</li> <li>• How cadastral agencies are organized themselves (legal, organizational, technical links between agencies/institutions)</li> <li>• Private sector involvement</li> <li>• Land disputes arrangements</li> <li>• Reform activities</li> </ul>
	<ul style="list-style-type: none"> <li>• The organization of the cadastral system is beneficial and well-defined</li> <li>• Institutional aspects are suited to circumstances</li> <li>• Involved institutions have well-defined roles and demonstrate effective collaboration and communication among themselves</li> <li>• Organizational aspects are structured to ensure appropriate levels of authority and jurisdiction</li> <li>• State-private partnership with well-determined limits</li> <li>• Hierarchical dispute resolution mechanisms</li> <li>• Reform projects are implemented with coordination and a clear understanding of the context</li> </ul>
	Human resources and personnel aspect
	<ul style="list-style-type: none"> <li>• Number of staff</li> <li>• Salaries</li> </ul>
	<ul style="list-style-type: none"> <li>• Adequate number of personnel in relation to a tasks</li> <li>• Salaries are suited to the circumstances</li> </ul>
	Cadastral principles
	<ul style="list-style-type: none"> <li>• Comprehensive legal status of land (the inclusion of all public responsibilities and restrictions, private rights)</li> <li>• Role of the cadastral system within the land administration system</li> <li>• Availability and suitability of cadastral data for the overall purpose</li> <li>• Cadastral survey data serves as the basis for land information systems</li> <li>• Processes related to cadastral transactions</li> </ul>
	<ul style="list-style-type: none"> <li>• Cadastral system supports sustainable development</li> <li>• The cadastral system provides a comprehensive overview of the legal status of the land</li> <li>• There is a single, fully developed and reliable cadastral system that is efficient, effective, and trustworthy</li> <li>• The cadastral surveying data undergo continuous updates to ensure standardization and suitability for a wide range of purposes</li> <li>• Cadastral data standards (data model, accuracy, etc.) are clearly defined and suitable for various applications</li> <li>• Cadastral transactions are efficient and secure</li> </ul>

cont. Table 1

1	2
Operational Level	Definition of users, services and products
Stakeholders: cadastral operational units (short-term implications)	<ul style="list-style-type: none"> <li>• List of clients (users), services and products</li> <li>• The cadastral operators possess knowledge about the clients, their desired services and products, and the feasibility of delivering those services and products</li> </ul>
	Aspects affecting the users
Tasks: to provide products, services, and interfaces (between units and the user) in an efficient, reliable, secure and complete manner	<ul style="list-style-type: none"> <li>• Data reliability (numbers of errors, title and boundary disputes)</li> <li>• Data security (duplicate storage of records, prevention unauthorised access)</li> <li>• Information accuracy on land and property registration</li> <li>• Efficiency of transactions (time and money wise)</li> <li>• Transparency, clarity and simplicity of the system</li> <li>• Efficient and effective access to cadastral data</li> <li>• Low number of disputes and errors</li> <li>• Updating process is dependable, and there is a backup procedure in place</li> <li>• Cadastral system provides accurate registration. Adequate cadastral records</li> <li>• Transactions performed in a reasonable short time and at a reasonable cost</li> <li>• Cadastral system is transparent, clear and simple</li> <li>• Accessibility to cadastral information is open, transparent and simple as possible</li> </ul>
	Aspects affecting the services and products
	<ul style="list-style-type: none"> <li>• Aspects of spatial data infrastructure (digital data modelling techniques and data format)</li> <li>• Aspects of information technology (information technology, web-enabled solutions)</li> <li>• Data integration and technical standards</li> <li>• Mapping standards</li> <li>• Complete coverage</li> <li>• Completeness of the cadastral records</li> <li>• Digital format of cadastral data and interoperable data sharing</li> <li>• Level of computerization of the cadastral system is suited for the country's capabilities</li> <li>• Cadastral system is used unique plot identifiers, linkage of data, adopted and customised international technical standards</li> <li>• Mapping data and cadastral surveying are coordinated and connected to a unique geodetic reference framework</li> <li>• Coverage of the cadastral system is 100%</li> <li>• Record of each land plot and property complete by itself</li> </ul>
External Factors	Capacity building, education
Stakeholders: academia, industry, etc.	<ul style="list-style-type: none"> <li>• A number of universities proposed education in the cadastral field</li> <li>• Number of students</li> <li>• Number of workshops proposed for continuing education</li> <li>• Number of institutions and research projects related to the functioning of the cadastral system</li> <li>• Continuing education regularly</li> <li>• Appropriate numbers of universities and students to the total population</li> <li>• The researchers are involved in the optimisation of the cadastral system</li> <li>• Good cooperation between state, academic, and private sectors</li> </ul>
Tasks: capacity building, technological supply, human resources	Technological supply
	<ul style="list-style-type: none"> <li>• Existence of local industry</li> <li>• Initiation, adoption, maintenance, and development of suitable technology</li> <li>• The technological provision is cost-effective and suitable, suited to the specific circumstances</li> <li>• New technologies are evaluated continuingly</li> </ul>
	Professional association aspects
	<ul style="list-style-type: none"> <li>• Support of the profession by the associations</li> <li>• Associations provide ethical and professional guidelines</li> <li>• The professional association plays an active role</li> <li>• The profession is organized according to circumstances</li> </ul>



cont. Table 1

1	2
Review Process	Review process
Stakeholder: cannot exactly be defined (e.g. independent land review panel)	<ul style="list-style-type: none"> <li>• Review process is defined and regular</li> <li>• Performance and reliability of the system (number of errors, time to deliver, turnover)</li> <li>• Objectives and strategies of the cadastral system are satisfied and reviewed</li> </ul>
Tasks: to review objectives and strategies, monitor user satisfaction, manage visions and reforms	<ul style="list-style-type: none"> <li>• Review process is conducted periodically and according to clear guidelines</li> <li>• Cadastral system provides timely and accurate results, with minimal errors</li> <li>• Strategic targets and objectives are adapted or achieved</li> <li>• System is effective and efficient</li> </ul>
	User satisfaction
	<ul style="list-style-type: none"> <li>• User satisfaction review is done regularly</li> <li>• Users of the cadastral system are satisfied</li> <li>• Appropriate, fast and reliable service to users</li> </ul>
	Visions and reforms
	<ul style="list-style-type: none"> <li>• Reforms and visions are managed</li> <li>• Reforms and visions are closely monitored and recognized</li> </ul>

Source: own preparation based on Chekole et al., 2020; Steudler, 2004; Yilmaz et al., 2015.

## RESULTS

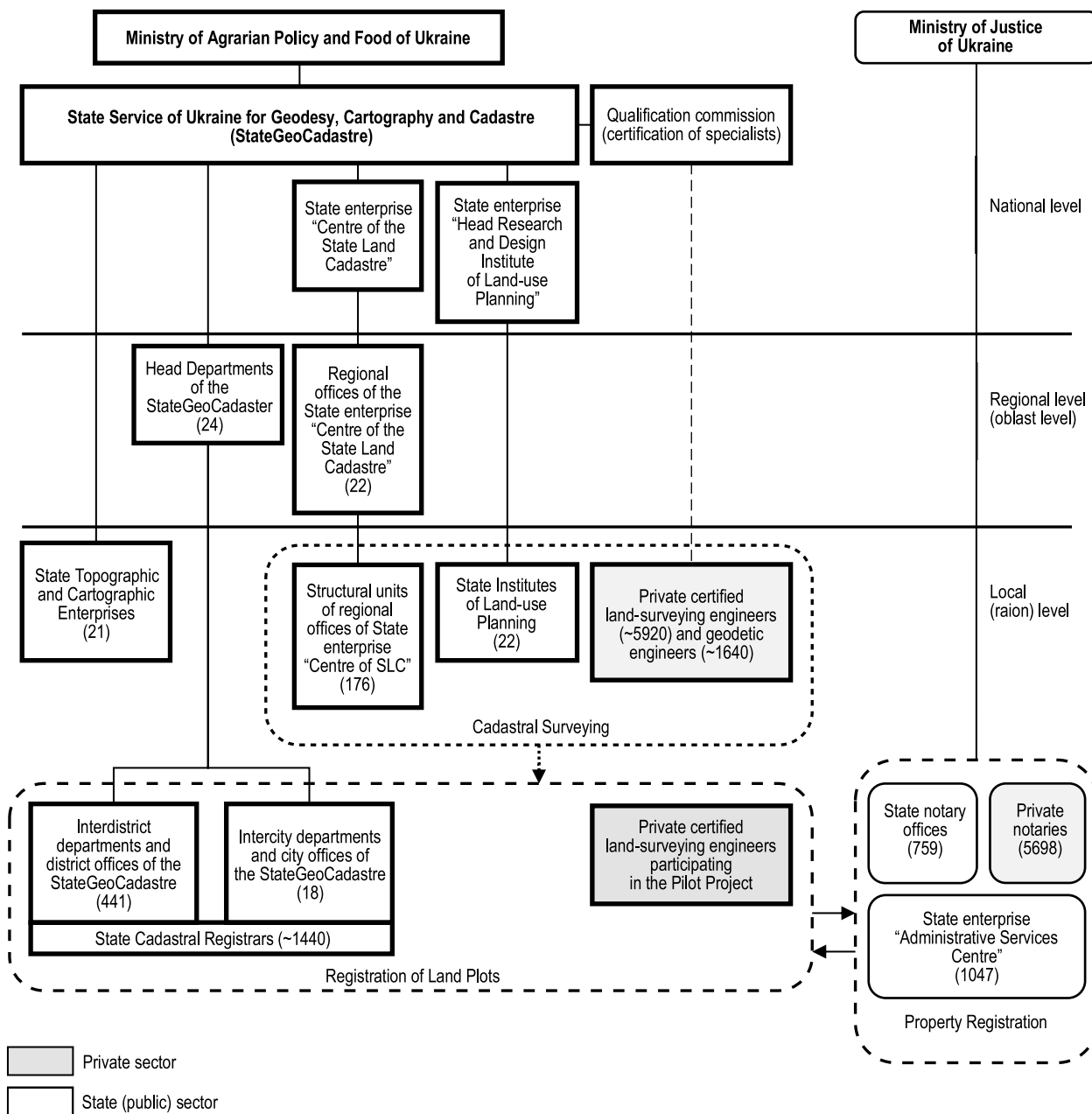
### Policy level

**Land policy aspects and objectives:** One of the criteria for evaluating the cadastral system is the presence of well-defined policy objectives for administering and managing the SLC and Property Register. The current legislative support for the activity of the cadastral system in Ukraine not only regulates its legal framework but also identifies its administering and managing procedure. The goal of the SLC's functioning is to provide information to government authorities, local self-governance bodies, legal entities, and individuals during land tenure regulations, land-use planning, land management, arrangement of rational use and land protection, land valuation and taxation, as well as establishing and managing urban cadasters and cadasters for other natural resources. According to the KMU (2015), the StateGeoCadastre is the primary authority within the executive branch and tackles responsibility for administering and controlling the SLC and the performance of more than seventy different tasks. The StateGeoCadastre's main objective is to implement the state's policies concerning topographical, geodetic, and cartographic activities, as well as land tenure regulations, land-use

planning, and state supervision in industrial agriculture to ensure adherence to land legislation. Territorial bodies of the StateGeoCadastre on the local (community) level and private businesses or persons, who are licensed (certified) by the StateGeoCadastre, are recorded spatial information about land plots into the SLC. The establishment of the electronic (digital) format of the cadastral and land-use planning documentation expanded the purpose of spatial data in land information systems. In terms of e-government, the cadastral system in Ukraine is an integral component of the national geospatial data infrastructure. This infrastructure includes identification systems for registration objects and subjects and geographic information that serves complex purposes, as outlined in VRU (2020).

The registration of property rights is done by state registration entities that have received accreditation from the Ministry of Justice. The main objective of the Property Register is to guarantee the state's objectivity, reliability and fullness of information regarding registered property rights and any other interests in land. The organisational structure of the cadastral system in Ukraine is illustrated in Fig. 1.

The matters related to cadastre are clearly stated and referenced in the Ukrainian legislation, specifically in the Land Code, Civil Code and



**Fig. 1.** The organisational structure of the cadastral system in Ukraine  
 Source: prepared by the authors.

Cadastr Law, along with relevant regulations and decrees. Nevertheless, there is no coherent state policy (program, concept) regarding the development of the SLC and Property Register, and accordingly, there is no vision of what the cadastral system should be

in the future 10–20 years. Evidence from international best practices demonstrates that the introduction of an efficient and effective cadastral system necessitates robust and affirmative political support and decision-making. The political institutions within

a country must showcase their determination and dedication to accomplishing predefined objectives.

*Performance gap:* 1) There is no concise state policy regarding the future evolution of the cadastral system; 2) The specific vision and goals of the cadastral system are not defined in a SMART manner; 3) The exact contribution of the cadastral system in facilitating the land market remains unclear; 4) No specific policy exists to guide the advancement of the cadastral system in supporting and facilitating the attainment of the Sustainable Development Goals.

**Historical, political, and social context:** Society has a strong understanding and awareness of the historical context of cadastral surveying, land cadastre, land registration, and property register. The social acceptance of these concepts is also high. Overall, the cadastral system adequately addresses the current land tenure challenges and societal needs. However, the land administration structures lack proper alignment and suitability with the political and administrative frameworks. It negatively affects the quality of development and the implementation of management decisions. The territorial bodies of the StateGeoCadastre gravitate towards a strong vertically integrated management system, which does not correspond to the decentralization course declared by the political leadership of Ukraine. As part of the implementation of the policy of openness, de-shadowing, prevention and counteraction of corruption in the field of land issues, electronic (online) services were introduced for the prompt receipt of the most requested certificates and documents from the SLC and Property Register (e.g., an extract from the State Land Cadastre about a land plot, an extract from technical documentation about the normative monetary valuation of the land plot).

*Performance gap:* 1) There is a dispersion of existing land and property data and information between different agencies; 2) Public access to the information of the SLC and the Property Register is limited; 3) The political and administrative system does not correspond to modern transformational processes; 4) There is a bureaucratic model of the apparatus of StateGeoCadastre.

**Land tenure and legal aspects:** The legal framework governing land tenure arrangements, the functioning of the SLC, and the Property Register is intricate, fragmented, and prone to conflicts. In recent times, there has been an enhancement in the level of legal certainty. However, there is still a place for improvement in terms of effectively implementing laws and legal regulations. Every year the number of norms and restrictions of public law increases, which can significantly limit the use of own land plots (real property). The land legislation recognises the concept of acquisitive prescription (adverse possession), which, as best practice shows, is one of the prerequisites for the effectiveness of the cadastral system.

*Performance gap:* 1) Integration of public law regulations and encumbrances into the SLC and Property Register is incomplete, varied, and consequently lacks transparency for the land market; 2) Land legislation does not recognise “general” boundaries of land plots; 3) There are cases of ignoring the legislation norms by the state bodies responsible for the SLC functioning.

**Financial and economic aspects:** The StateGeoCadastre is the fifth-largest state civil agency in the country, which is represented at the level of each oblast, district (raion) and/or city. In 2019, the maintenance of the StateGeoCadastre cost the taxpayers of Ukraine 1.9 billion UAH of budget funds (about 71.2 million USD), of which 1.44 billion UAH are earmarked for management and administration (VRU, 2021). The State Budget of Ukraine bears the cost of supporting the administration and functioning of the SLC, and the list of paid and free services is clearly regulated by legislation. For example, registration of land plots in the SLC and making changes to them are performed free of charge. An administrative fee is charged for correcting technical errors in the SLC data and getting information from SLC. However, the executive power bodies and local self-government bodies are used the cadastral data free of charge. State registration of land ownership is paid, in contrast to the free land registration in the SLC.

The agricultural land market in Ukraine officially began on July 1, 2021. Despite the ongoing war, the land market sector in Ukraine remains remarkably

active. Since the implementation of the land market, there have been 153,659 land transactions covering a total agricultural land area of 344,061 hectares (SGC, 2023). It is worth mentioning that over one-third of these transactions occurred during the full-scale war. As of April 2023, the average agricultural land price per hectare is UAH 39,000 or EUR 973. Since the beginning of 2023, the price of agricultural (farming) land has increased by an average of 20%. Nevertheless, the service fees acquired from land transactions are not allocated towards supporting the functioning of the cadastral system.

*Performance gap:* 1) The StateGeoCadastre and its regional offices are required to compete for funding from the State Budget of Ukraine to support the development of the SLC; 2) The Ukrainian cadastral system is not a profitable venture for the government; 3) SLC does not operate on the principle of self-sufficiency; 4) There are fundamentally different approaches to the payment of fees for land plots registration in the SLC and property rights in the Property Register; 5) The cadastral system has to struggle to get budget from the State Budget of Ukraine.

**Environmental sustainability aspects:** The cadastral system does not support environmental protection due to the lack of relevant indicators in the system.

*Performance gap:* 1) The Ukrainian legislation does not provide the recording (registering) environmental data into the SLC and Property Register; 2) Restrictions on land use are only partially and in a descriptive form integrated into the cadastral system; 3) The responsibilities are not included in the cadastral system, having the effect of a certain non-transparency.

## Management Level

**Strategic aspects:** The key responsibilities of the management level involve establishing strategic objectives by Government stakeholders with medium-term impacts of approximately 1-5 years. Despite this, the principles outlined by the FIG (1995), UNECE (1996, 2005a, 2005b), Kaufmann and Steudler (1998), Steudler

et al. (2014), and Williamson et al. (2010) regarding the establishment of a strategic Land Administration System have not yet been embraced by the Ukrainian government. Similarly, the ISO 19152:2012 Geographic Information – Land Administration-Domain Model (LADM), designed to enhance interoperability among cadastres across different nations, has not been a focal point on the government's agenda over the last five years. Hence, there is a lack of utilization of a Unified Modelling Language to describe, visualize, and document the processes within the land administration system. It is important to highlight that as of 2021, the establishment of the National Geospatial Data Infrastructure commenced, following the guidelines of the ISO 19101:2002 standard and incorporating national standards from the ISO 19100 series. The diagram in Fig. 2 illustrates the logical framework of the existing land administration system.

The Order of the StateGeoCadastre No. 343 of December 16, 2019, adopted an action plan for implementing the Strategic Action Plan “Cadastre 2.0 Transparency. Accessibility. Innovation” until 2021. That included tasks such as complete digitisation of cadastral processes and elimination of personal contact with officials, public control, reduction and simplification of cadastral procedures, creation of Service Control Departments, total disclosure of information about the land and property objects, deregulation and transfer of some powers to the local level. However, the Strategic Action Plan is still not publicly available. Few statistics are available. It is impossible to assess the implementation success of the aforesaid measures.

*Performance gap:* 1) The responsible agency for reviewing and controlling the implementation of the Strategic Action Plan was not identified; 2) Digitalisation and integration of geospatial data into digital registries are too slow; 3) In some cases, legislative norms are ignored to implement specific settings of the Strategic Action Plan; 4) The Strategic Action Plan for SLC is not transparent; 5) There is a lack of a strategy for the future adoption of the ISO 19152:2012 Geographic Information – Land Administration-Domain Model.

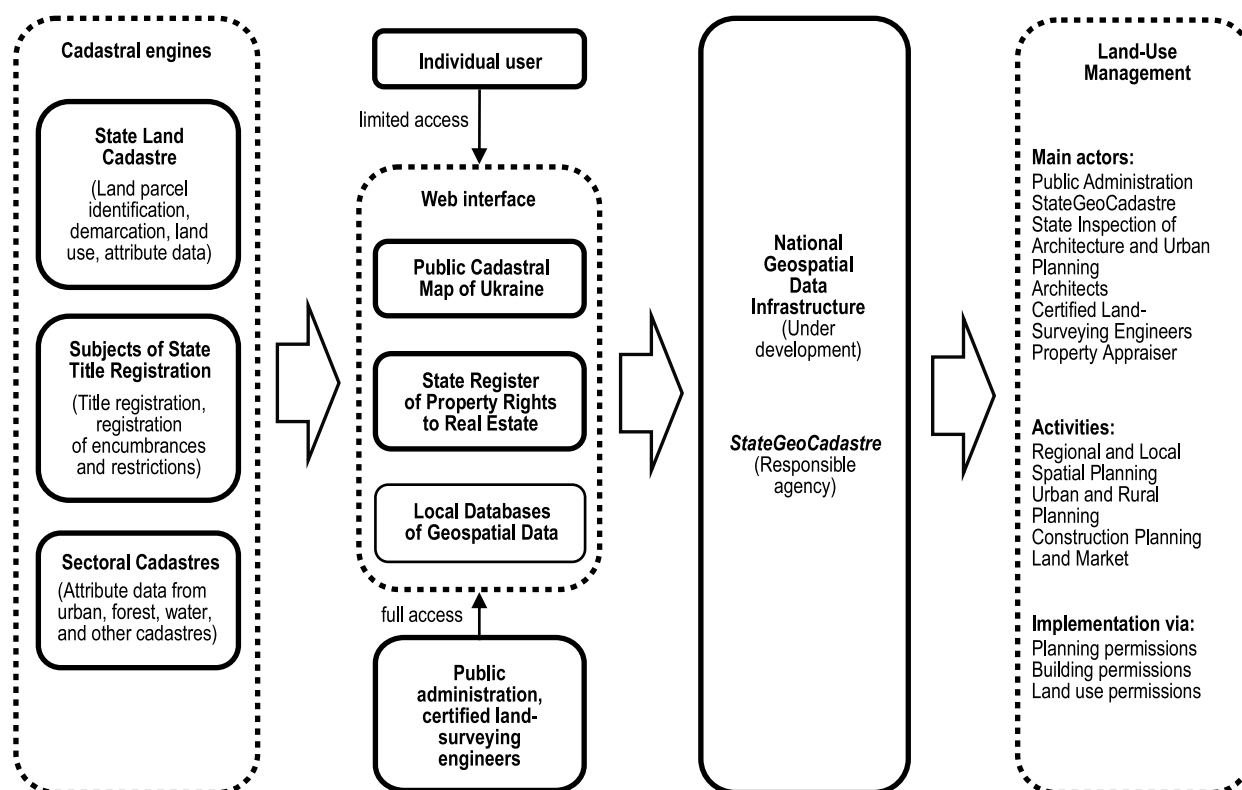


Fig. 2. The simplified land administration system in Ukraine  
Source: prepared by the authors.

**Institutional and organizational aspects:** Today, land tenure arrangements and the SLC functioning are considered one of the most corrupt spheres of state administration for the last decades. In addition, the system of bodies of the StateGeoCadaastre is treated as an attractive organisational and managerial tool for generating various methods and mechanisms of receiving corruption income (VRU, 2021). The StateGeoCadaastre is characterised by solid centralised management vertical by subordinating 47 state land-use planning, topographic and cartographic enterprises with their structural subdivisions at the national, regional (oblast), and local (raion) levels (Fig. 1). The StateGeoCadaastre has a departmental monopoly on services for state registration of newly created land plots (initial land plot registration) and other services. State property and other rights registration are carried out via local administrative service centres or notaries (Fig. 1). The central

database for information about land plots is the State Land Cadastre, which is accessible online through the Public Cadastral Map of Ukraine. Additionally, details concerning title, encumbrances and restrictions related to land plots are maintained in the Property Register.

In recent years, the engagement of the private sector has demonstrated significant benefits for the evolution of the cadastral system. Private certified land-surveying engineers and geodetic engineers have effectively adjusted technologies and processes, introducing modern capabilities, methods, and applications that have helped enhance cadastral activities. Well-defined and sustainable partnership rules strengthen the innovation potential of state-private cooperation, resulting in overall benefits for the entire cadastral system.

**Performance gap:** 1) The StateGeoCadaastre is constantly at the stage of reorganisation; 2) There is still

little desire of the StateGeoCadastre bodies to cooperate with the private sector; 3) The StateGeoCadastre holds a monopoly over services related to access to land information, initial registration of land plots, training and accreditation of land-surveying engineers and geodetic engineers, and the approval of professional qualification commission compositions; 4) Excessive technical and qualification requirements, established by StateGeoCadastre acts, complicate the integration of cadastral documentation in administrative service centres.

**Human Resources and personnel aspect:** The staff of the StateGeoCadastre and its territorial bodies is about 10,000 people, of whom 1,436 are state cadastral registrars. In 2020, the maximum number of employees of the State Geo Cadastre system was going to be reduced by 57% – to 4,317 full-time employees (Epravda, 2020). However, it was not possible to get updated information. As of 2022, 5,698 private notaries and about 4,000 state registrars, notaries and registrars in local self-government bodies perform property registration.

The salaries in the state sector are suitable and comparable to those in the private sector. However, it is not uncommon for the private sector to unofficially pay a portion of the salary “under the table” or through informal means.

**Performance gap:** 1) By increasing the number of registration offices (Administrative Services Centres), the number of state cadastral registrars remains unchanged or even decreases, which slows down the process of serving citizens; 2) There are high qualification requirements for officials of local self-government bodies and Administrative Services Centres to provide access to work with the SLC information.

**Cadastral principles:** The SLC serves as the foundation for maintaining the twelve cadastres in Ukraine. The SLC is based on six objects: land plots; land use restrictions; reclamation networks; constituent parts of reclamation networks; land within the territory of administrative-territorial units and territorial communities; land within the state border of Ukraine. During the registration

in the SLC, the first object (land plots) is assigned unique cadastral numbers and other – registration numbers. Land plots and property registration are public registries where the documentation related to land interests is maintained. There is one unique assigned property title to each land plot in Property Register after registering the physical land plot in the SLC. The cadastral system is plot-based but overlaps with five other SLC objects.

SLC is considered an entrance to property registration because holds the basic data from the input documents of the property registration. Land plots are registered in the SLC register and on the cadastral index map. State registration of land plots and property rights is mandatory during the formation of the new land plot (property) or land (property) transactions. However, land and property registration is carried out sporadically on a voluntary approach.

The cadastral plan of a land plot is compiled in digital and paper formats at a scale that ensures an accurate representation of information, and the area is recorded in the SLC with precision to four significant digits after the decimal point (KMU, 2012). The area of the land plot is indicated up to 1 square meter, considering the maximum scale error of the plan in cases where the coordinates of the boundary reference point are determined with an accuracy of up to 0.01 meters. The root-mean-square error of determining the coordinates of cadastral boundary points relative to the nearest points of the state geodetic network, densification geodetic networks, and urban geodetic networks should not exceed: in Kyiv, Sevastopol, and cities of regional subordination – 0.1 meters; in other cities and towns – 0.2 meters; in villages – 0.3 meters; outside settlements – 0.5 meters (KMU, 2019). The maximum discrepancies should not exceed double the values of permissible root-mean-square errors, and their number should not exceed 10% of the total number of control measurements.

The legal timeline for land plots and property registration is not more than one month without cadastral surveying. However, in real life, registration can take several months because of tenure

uncertainties (e.g., data discrepancy between SLC and Property Register, double land registration, land plots overlapping, etc.). Few statistics are available on land disputes. It is known about the technical errors in the SLC data. A commonly encountered issue is overlapping land plots and discrepancies between the boundaries (shape and size) stated in the legal document and the actual boundaries of the land plot (Popov et al., 2019).

In theory, the land plots should cover the entire territory without any gaps or overlaps. Roads, shelterbelts, forests, rivers, and lakes are designated as single land plots with assigned landowners or land users. As of March 2023, about 72% of the country's territory (43.6 ml hectares) is registered in the SLC (SGC, 2023) and covered by digital cadastral maps of land parcels. No administrative-territorial units have a fully completed (digital) cadastral map at 100%. Officially marked administrative boundaries of 21,702 settlements are registered in the SLC, which is 76.7% of the 28,299 settlements in Ukraine (SGC, 2020) (excluding the Autonomous Republic of Crimea and the temporarily occupied territories of the Donetsk and Luhansk regions). The Public Cadastral Map of Ukraine, accessible to the public online, presents little information regarding registered land plots and SLC objects. Cadastral maps and data are maintained both in physical paper format and digitally within the State Fund of Land-use Planning Documentation. Additionally, they are securely stored on the servers of the StateGeoCadastre, ensuring accessibility and preservation for efficient land management.

The cadastral system does not provide a comprehensive representation of the legal status of the land (property) since it does not incorporate information regarding zoning or other public rights limitations and restrictions. Legal data is stored in Property Register. Consequently, this situation has resulted in a growing lack of transparency within the land market, particularly in the agricultural land sector. The Public Cadastral Map of Ukraine has errors of both technical (overlapping of land plots and their location) and legal nature. The digital format of cadastral data makes it possible to structure it into layers developing their usability, adaptability, and flexibility.

*Performance gap:* 1) The cadastral system is dual. There are two different registers; 2) SLC does not register (contain) information about real property objects (buildings); 3) The software which would allow keeping the SCL completely accordingly to the cadastral legislation was not developed yet; 4) The information of the SLC and Property Register is not entirely publicly available; 5) There is no legal procedure for assigning registration numbers to SLC objects and the cadastral number assigned to land plots does not follow the current legislation; 6) The cadastral system does not include public law responsibilities and restrictions; 7) Information about the property rights to land plots registered before 2013 was not fully transferred (integrated) from SLC to Property Register; 8) A complete and comprehensive cadastral index map is currently unavailable; 9) Cadastral surveys can use at least five different coordinate systems: UCS-2000, CS-42, CS-63, local coordinate systems, and nominal coordinate systems; 10) There are cases of noncompliance between the boundaries of land plots specified in the legal document and physically fixed boundaries; 11) Legislatively fixed principles of SLC functioning are mostly declarative; 12) There are no clear standards for the preparation of cadastral documentation.

## **Operational Level**

### ***Definition of users, services, and products:***

The overall focus of the cadastral system is to offer user services, and significant efforts have been dedicated to its improvement over the past three years. The responsibility to provide cadastral surveying has predominantly been entrusted to the private sector, while the local level StateGeoCadastre authorities handle land plot registration and oversee their immediate supervisory duties.

Creating a properly operational (agricultural) land market holds significant importance in the present time. However, the existing cadastral system is not focused on the market of real property and land plots. Both the StateGeoCadastre and the Department of Notary and State Registration recognize the importance of prioritizing the welfare of citizens,

certified land surveyors, and notaries as the primary beneficiaries. Nevertheless, prioritizing the clear definition of users, services, and products was not a top concern.

*Performance gap:* There is no unified, comprehensive, and user-friendly service available.

**Aspects affecting the users (clients):** Data security is effectively managed through regulations and stringent checks on data backup procedures. The ongoing updating of cadastral databases is carried out through clearly defined notification procedures implemented by the central database. Despite the StateGeoCadastre's monopoly and the centralized model of collecting cadastral information, accessing data is challenging, particularly when the extensive data coverage is required for large areas.

The registration procedure for land plots and property is quite simple, clear, and understandable. However, leasing hundreds or even thousands of land plots entail significant financial expenses (around 11.20 USD/ha) and time investment (three months or longer) for registering lease rights (Popov et al., 2019).

The reliability of the cadastral system for land market operations is relatively low. There is a significant occurrence of title (property) and boundary disputes, with the number of land disputes being exponentially higher compared to disputes in other industries, with a ratio of ten thousand to one. Namely, for every ten thousand land disputes there is one dispute in other sectors of the economy taken all together (Havrylenko, 2019). In 2017, the courts registered 1.905 administrative land disputes, 10.621 civil land disputes and 5.379 economic land disputes (SY, 2018). As practice shows, one of the most widespread land disputes is disputes over the shared boundary of neighbouring land plots (overlapping of land plot boundaries). A common problem is the double registration of land lease contracts, which often is used to grab other people's property. On average, there are 35 errors in the SLC database per thousand registered landowners and land users in cities; in rural areas – 15 errors (SY, 2018).

The Public Cadastral Map of Ukraine is constantly being improved, which allows better access to various

data. The system offers straightforward access to information, although it may not be comprehensive. Internet-based solutions are increasingly employed to enhance user access and improve overall usability. Therefore, the number of electronic cadastral services provided by the StateGeoCadastre and Department of Notary and State Registration is gradually increasing.

*Performance gap:* 1) Certain cadastral information is enclosed and scattered among different agencies and databases; 2) Cadastral databases are incomplete; 3) The occurrence of errors, as well as the frequency of title and boundary disputes, is significantly high; 4) Registration of lease rights for agricultural enterprises is time-consuming.

**Aspects affecting the services and products:** The integration of data and information within the cadastral system domain is good. There are unique land plots (cadastral numbers) and SLC objects (register numbers) identifiers. Consequently, all plot-related information can be associated with the specific land plot by ensuring a robust linkage. The completeness of the land records is commendable, as all data is consistently and comprehensively gathered.

Cadastral data is presented in digital form using XML technology, which ensures shared data exchange. The use of XML format (exchange file) made it possible to improve the quality of the cadastral documents, such as completeness, ease of use and functional convenience. Modern information and communication technology are increasingly integrated into the cadastral system.

Cadastral surveying and data mapping are harmonized and interconnected with the Unified State Geodetic Reference Coordinate System UCS-2000. The data coverage in cadastral mapping is limited due to the sporadic approach taken towards the registration of land plots and properties. The last update of orthophoto plans was in 2007–2011. Spatial data infrastructure aspects were not given significant priority during the past ten years of the cadastral system's operation. The Ukrainian government formulated spatial data infrastructure legislation in 2020, which came into force in 2021.

*Performance gap:* 1) The cadastral system is incomplete with 71% coverage of the country territory;



2) The record of each individual land plot is incomplete by itself; 3) The Public Cadastral Map of Ukraine is not displayed all cadastral data; 4) Orthophoto plans are not updated.

## External Factors

External factors exert influence on all three organizational levels (Steudler et al., 2004). These external factors should encompass various functional areas such as research and education institutions, innovative technology, or industries involved in the operations of the cadastral system directly or indirectly. The cadastral system operates within an ideological context that includes these external sectors, as outlined by Steudler (2004).

**Capacity building, and education:** Numerous workshops and seminars are currently being arranged to provide ongoing training and education for cadastral specialists in both the public and private sectors. The educational capacity in the speciality 193 “Geodesy and land-use planning” is deemed sufficient, with fifty-one universities providing programs related to land surveying, mapping, cadastre, and land-use planning. However, there has been a steady decrease in the number of students pursuing this field.

**Performance gap:** The partnership between the state and private cadastral activities and academia is not close.

**Technological supply:** Geodetic equipment is almost not produced in Ukraine. Nevertheless, the private sector exhibits considerable strength in providing the local market with geodetic tools and GIS products required for the cadastral surveying and cadastral system.

**Professional association aspects:** Multiple professional associations, including the “Association of Land-use Planning Specialists of Ukraine”, “Land Association of Ukraine”, “All-Ukrainian Union of Certified Land-Surveying Engineers”, “Ukrainian Society of Geodesy and Cartography”, “All-Ukrainian Union of Certified Geodetic Engineers”, and “Union of Surveyors and Cartographers”, actively advocate (lobbying) for the progress and promotion of professional interests. The interactions between the state and

these professional associations are accomplished and appropriate. There are specific requirements in place that limit membership in professional associations.

## Review Process Aspects

It is crucial for any system that it is regularly being reviewed and adjusted if necessary. Following international best practices, it is recommended to establish an independent commission, either temporary or permanent (governmental, parliamentary, or public), to assess the state of the cadastral system. This commission would be responsible for overseeing and supervising the entire cadastral system.

**Review Process:** Within the framework of the “Supporting Reforms in Agriculture and Land Relations in Ukraine” project, supported by the World Bank, a monitoring initiative was conducted to assess land tenure issues in Ukraine from 2013 to 2017. The monitoring process used 65 indicators aligned with the practices of developed countries and the recommendations of the World Bank (SY, 2018). The analysis of the functioning of the SLC and Property Register was a part of the monitoring. The results of monitoring are publicly available in the form of yearbooks. However, after the completion of such a project, monitoring or other comprehensive analysis of land tenure issues was not carried out at the national level.

It should be noted that the analysis based on World Bank indicators had a statistical nature regarding land transactions, completeness of official registration, normative monetary valuation of land plots, the number of registrars, and land disputes. Conducting such an analysis is essential for upholding the principles of transparency and accountability in the cadastral system. However, the evaluation framework proposed in the article is primarily focused on establishing qualitative indicators of the cadastral system rather than quantitative ones. Through the integration of both quantitative and qualitative indicators, various stakeholders can achieve a well-rounded understanding of how the cadastral system’s performance. This comprehensive assessment helps identify areas that require improvement, showcases successful practices,

**Table 2.** The SWOT evaluation matrix of the cadastral system in Ukraine

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• The sole national agency entrusted with the responsibility for the national infrastructure of geospatial data</li> <li>• Central databases of SLC and Property Register are accessible via the Internet</li> <li>• A unified and standardized data format for defining and exchanging digital information</li> <li>• The registration procedure of land and property and functions of system users are clearly defined</li> <li>• A relatively swift and cost-effective process for registering land plots and properties</li> <li>• A land transaction registration process that is relatively fast and cost-effective</li> <li>• Concept of one-stop-shopping</li> <li>• Active involvement of the private sector</li> <li>• Good collaboration between the private and public sectors</li> <li>• There is professional associations</li> <li>• Implementation of pilot projects by the StateGeoCadastre</li> </ul>	<ul style="list-style-type: none"> <li>• No clear state policy regarding the future development of the cadastral system</li> <li>• No regular and comprehensive review panel (monitoring) of the “Cadastre 2.0” strategy</li> <li>• No systematic procedure for regular monitoring and evaluation to assess the effectiveness of the cadastral system</li> <li>• Need to enhance and strengthen the regulatory standards for cadastral documentation</li> <li>• Registration of land plots and property and other rights is carried out by two different agencies</li> <li>• Cadastral surveying is conducted on many local coordinate systems</li> <li>• No comprehensive and complete cadastral map thus far</li> <li>• Weak collaboration between the academic, private, public, and sectors</li> <li>• Competition between different interest groups (land-surveying engineers and geodetic engineers, cadastral and property registrars) rather than cooperation</li> <li>• The territorial bodies of the StateGeoCadastre have monopoly access to cadastre information yet</li> <li>• Limited integration between SLC and Property databases</li> <li>• Double registration of lease rights for one land plot</li> <li>• Technical errors in SLC database</li> <li>• Most of the SLC objects that should be contained in the SLC database are missing</li> <li>• There are signs of bureaucracy</li> <li>• The legislation on the cadastral system is, in most cases, not in line with new technology</li> <li>• The slow development of the cadastral system due to systems problems and resource issues</li> <li>• No regular customer satisfaction surveys</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Development of a clear state policy regarding the cadastral system strategy</li> <li>• Strengthen political and legal support</li> <li>• Engagement of the private sector can be expanded to foster a mutually beneficial partnership between the state and private sectors</li> <li>• The establishment of a national geospatial data infrastructure has the potential to improve the acquisition and distribution of cadastral data for promoting good governance</li> <li>• It is a good time to initiate the establishment of a unified electronic 3D Property Cadastre</li> <li>• Decentralisation of management and regulatory powers</li> <li>• A more resolute dedication to good governance and adherence to the rule of law</li> <li>• Rapid infrastructure and technological development</li> <li>• Recognizing the significance of the cadastral system in socio-economic progress for allocating the necessary resources to cadastral agencies to ensure their technological advancement</li> <li>• Improving the security and guarantee of land rights</li> <li>• Increasing user (customer) support</li> <li>• Involvement of community and civic organizations</li> </ul>	<ul style="list-style-type: none"> <li>• Losing political support</li> <li>• Incapacity to unite divergent interest groups</li> <li>• Cost of data acquisition, implementation, and integration of new technology</li> <li>• Continued tensions between StateGeoCadastre, Department of Notary and State Registration and private sector</li> <li>• Lack of funding</li> <li>• Dependency on imported technologies</li> </ul>

Source: prepared by the authors.

and guides strategic decision-making. Ultimately, this approach ensures that the cadastral system not only meets technical requirements but also aligns with user expectations and contributes to achieving sustainable development principles.

*Performance gap:* 1) A regular and comprehensive review process for evaluating the performance and advancement of the cadastral system, along with the status of its objectives and strategy, is absent; 2) There is no land accounting in the country.

*User satisfaction:* StateGeoCadastre and the Department of Notary and State Registration appeared to be taking a market-oriented approach focusing on identifying and satisfying consumer needs and desires. The cadastral system has the ability to swiftly and flexibly adapt to necessary changes. However, this stands in contrast to the conventional approach to public administration, which tends to be slow. Currently, there is no monitoring of user satisfaction with the cadastral system. Nonetheless, the majority of users appear to be content with the services offered.

*Performance gap:* 1) There is no regular monitoring of the satisfaction of cadastral system users; 2) Users can be served more efficiently in the Internet age; 3) The costs associated with land transactions and cadastral surveying are frequently perceived as being high.

*Visions and reforms:* Employees of the State-GeoCadastre and Department of Notary and State Registration are generally open and willing to receive new knowledge and adopt new visions from other countries. The participation of the private sector in the cadastral system presents a continuous challenge to exploring new concepts and envisions for its development, which ultimately benefits the entire system.

*Performance gap:* The visions and requirements for reform are not closely observed and recognized.

## SWOT ANALYSIS

The SWOT analysis is a strategic planning technique employed to assess an organization's strengths, weaknesses, opportunities, and threats, as outlined by Hill and Westbrook (1997). According

to Gürel and Tat (2017), these factors represent the most influential parameters in determining the future prospects of the cadastral system. Identifying strengths and weaknesses gives valuable advice on improvement for the cadastral system, and threats and opportunities will hint at possible development concerning long-term strategies and plans. Using the SWOT matrix (Table 2) to analyse the present state of Ukraine's existing cadastral system will aid in the development of strategic planning.

## CONCLUSIONS

The purpose of this research was to create an evaluation framework that utilizes international best practices, publications from International Scientific Indexing journals, and cadastral models to measure and evaluate the performance of the cadastral system in Ukraine. Building upon previous findings, a comprehensive collection of evaluation indicators has been identified to measure the extent to which best practices align with the criteria across various evaluation areas and aspects of the cadastral system. Consequently, a comprehensive evaluation framework has been formulated, encompassing best practices and their corresponding evaluation indicators for all eighteen aspects within the five designated evaluation areas (refer to Table 1). The significant contribution of this paper is to raise awareness regarding the importance of establishing a nationally recognized methodology for conducting regular performance evaluations of a country's cadastral system. The significance of the evaluation framework presented in this paper is further reinforced by the fact that it is the inaugural framework of its kind in the Ukrainian cadastral field.

The paper highlights the importance of connecting the evaluation of the Ukrainian cadastral system to broader economic and social concerns. The evaluation framework should consider a comprehensive range of factors, including political, institutional, legal, economic, environmental, social, and technical aspects, alongside the influence of partnerships between state and private sectors. Implementing such an evaluation framework will establish a foundation

for a more comprehensive and standardized approach. The analysis of strengths, weaknesses, opportunities, and threats of the cadastral system (as depicted in Table 2) is explored in the context of strategic planning development. The suggested evaluation framework has the potential to serve as a robust tool for strategic sustainability planning and management drawing upon the analysis of the current situation. The results of this research will allow decision-makers at various levels of policymaking to effectively monitor, evaluate, and review the cadastral system performance's strengths and weaknesses in response to changes in technology, organisational capacity, and access to geospatial information. Therefore, drawing from the achieved results, the researchers propose the following recommendations:

1. The presence of a comprehensive cadastral policy is crucial for the successful implementation of the cadastral system in Ukraine. At the heart of this policy should lie political willingness and commitment, addressing institutional and legal matters, as well as sustainability considerations including economic, social, and environmental aspects, along with technical standards. The next stage has tended to be the integration of this policy into legislative programmes.
2. Given the lack of a clear vision for the future evolution of the cadastral system, the implementation of the ISO 19152 – Land Administration Domain Model is being suggested as an alternative approach. It will be crucial for a cadastral system's development as it provides a standardized framework for consistent data representation, enhancing interoperability and facilitating efficient data exchange among diverse land information systems. By aligning with LADM, Ukraine can establish a robust foundation for modernized and integrated land administration practices, supporting accurate land management, transactions, and decision-making.
3. In order to choose the most suitable cadastral system for Ukraine, the involvement of policy and decision-makers, academia, and professionals through state-private partnerships is crucial. Their

support plays a vital role in developing sound cadastral policies and establishing an appropriate cadastral system, as well as a comprehensive land administration system overall.

4. The private sector's involvement in the cadastral system is already evident. However, the private sector can further contribute to the implementation of the cadastral system policy, despite the government's ultimate responsibility for it. Hence, it is crucial to ensure the sustainability of the cadastral system through effective state-private partnerships and collaboration with end customers.
5. Cadastral institutions and organizations, both individually and as part of the overall cadastral system, should implement a regular review process to evaluate and monitor the performance of their operations. This includes assessing their organizational excellence and finding ways to measure it effectively. Moreover, organizations involved in cadastral system implementations should prioritize customer satisfaction surveys as a means to gauge their accomplishments.
6. The institutions and organizations responsible for the implementation of the cadastral system should adopt the suggested evaluation framework as a standard reference point. It is recommended to conduct regular review processes and issue annual reports to assess their progress. The application of the proposed evaluation framework will bring meaningful transformations in various economic and social aspects supporting the country's sustainable development goals.

Unfortunately, land continues to be a key factor in conflicts and wars. The presence of a robust cadastral system, along with its evaluation framework, can contribute to post-war and post-conflict mitigation. Future research could focus on examining the policies and strategies employed by the cadastral system to address the diverse objectives and requirements found in various environments and contexts, such as urban and rural areas.

**Author contributions:** authors have given approval to the final version of the article. Authors

contributed to this work as follows: Conceptualization, A.P., P.K.; methodology, A.P.; validation, A.P., P.K.; formal analysis, A.P.; investigation, A.P., P.K., Y.Z.; resources, A.P., P.K., Y.Z.; data curation, A.P., P.K.; writing original draft preparation, A.P., Y.Z.; writing review and editing, A.P., P.K., Y.Z.; visualization, A.P., Y.Z.; supervision, A.P., P.K.

**Note:** the results of this study were presented in another form, such as a poster at a conference.

## REFERENCES

- Baird, M. (1998). *The role of evaluation*. In K. Mackay (Ed.), *Public Sector Performance – the Critical Role of Evaluation. Selected Proceedings from a World Bank Seminar* (pp. 7–12). World Bank Operations Evaluation Department, Evaluation Capacity Development, Washington DC.
- Bandeira, P., Sumpsi, J. M., & Falconi, C. (2010). Evaluating land administration systems: a comparative method with an application to Peru and Honduras. *Land Use Policy*, 27(2), 351–363. <https://doi.org/10.1016/j.landusepol.2009.04.005>
- Bennett, R., Rajabifard, A., Williamson, I., & Wallace, J. (2012). On the need for national land administration infrastructures. *Land Use Policy*, 20(1), 208–219. <https://doi.org/10.1016/j.landusepol.2011.06.008>
- Bielska, A. Wendland, A., & Delnicki, M. (2020). Possibilities for the Development of Building Plots with an Unfavorable Structure in the Context of Spatial Justice: A Case Study of Poland. *Sustainability*, 12(6), 2472. <https://doi.org/10.3390/su12062472>
- Bogaerts, T., & Zevenbergen, J. (2001). Cadastral systems – alternatives. *Computers, Environment, and Urban Systems*, 25(4–5), 325–337. [https://doi.org/10.1016/S0198-9715\(00\)00051-X](https://doi.org/10.1016/S0198-9715(00)00051-X)
- Boiko, O. H., Kushniruk, T. M., & Dodurych, V. V. (2016). Kadastrovyi oblik zemelnykh resursiv Ukrainy [Cadastral accounting of land resources of Ukraine]. *Visnyk Natsionalnoho universytetu vodnoho hospodarstva ta pryrodokorystuvannia. Tekhnichni nauky*, 3, 164–172.
- Boklah, V. A. (2014). Zemelno-kadastrova systema yak instrument derzhavnoho upravlinnia zemelnymy resursamy v Ukraini [The land cadastral system as a tool for state management of land resources in Ukraine]. *Derzhava ta rehiony. Serii: Derzhavne upravlinnia*, 2, 3–7.
- Bordiuzha, A. S. (2013). Suchasnyi stan zemelnoi informatsiinoi systemy Ukrainy. *Zbalansovane pryrodokorystuvannia*, 1, 76–82.
- Burns, T. (2007). *Land administration reform: indicators of success and future challenges*. Agriculture and Rural Development Discussion Paper, no. 37 Washington, D.C.: World Bank Group.
- Busko, M., & Apollo, M. (2023). Public Administration and Landowners Facing Real Estate Cadastre Modernization: A Win-Lose or Win-Win Situation? *Resources*, 12(6), 73. <https://doi.org/10.3390/resources12060073>
- Busko, M., Zyga, J., Hudecová, E., Kysel, P., Balawejder, M., & Apollo, M. (2022). Active Collection of Data in the Real Estate Cadastre in Systems with a Different Pedigree and a Different Way of Building Development: Learning from Poland and Slovakia. *Sustainability*, 14(22), 15046. <https://doi.org/10.3390/su142215046>
- Chekole, S. D., Vries, W. T. de, & Shibeshi, G. B. (2020). An Evaluation Framework for Urban Cadastral System Policy in Ethiopia. *Land*, 9(2), 60. <https://doi.org/10.3390/land9020060>
- Chimhamhiwa, D., Molen, P. van der, Mutanga, O., & Rugege, D. (2009). Towards a framework for measuring end to end performance of land administration business processes – A case study. *Computers, Environment and Urban Systems*, 33(4), 293–301. <https://doi.org/10.1016/j.compenvurbsys.2009.04.001>
- Dale, P. F., & McLaughlin, J. D. (1998). *Land Information Management: An Introduction with Special Reference to Cadastral Problems in Third World Countries*. Oxford University Press.
- Diiesperov, V. S. (2010). Zemlia yak holovnyi pryrodnyi resurs silskykh terytorii i krainy [Land as the main natural resource of rural areas and the country]. *Ekonomika APK*, 9, 102–109.
- Dombrovska, O., & Tyshkovets, V. (2019). Znachennia zemelno-kadastrovykh danykh v systemi administruvannia zemelnykh resursiv [Significance of land cadastral data in the system of land administration]. *Skhidna Yevropa: ekonomika, biznes ta upravlinnia*, 2, 242–249.
- Enemark, S., Williamson, I., & Wallace, J. (2010). Building modern land administration systems in developed economies. *Journal of Spatial Science*, 50(2), 51–68. <https://doi.org/10.1080/14498596.2005.9635049>
- Epravda. (2020, December 9). Kabmin na 57% skorotyv hranychnu chyselnist spivrobotnykiv Derzh-

- heokadastru [The Cabinet of Ministers reduced the maximum number of employees of the StateGeoCadastre by 57%]. <https://www.epravda.com.ua/news/2020/12/9/669001/>
- European Foundation Quality Management. (2012). *European Foundation Quality Management (EFQM) Excellence Model*. <https://www.efqm.org/>
- FIG. (1995). *Statement on the Cadastre*. Report Prepared for the International Federation of Surveyors by Commission 7 (Cadastre and Land Management), FIG Publication No. 11. <https://www.fig.net/resources/publications/figpub/pub11/FIG%20Statement%20on%20the%20Cadastre.pdf>
- Gebrewold, Z. H. (2016). *Land Governance Assessment Framework (LGAF) Implementation in Ethiopia*. Final Country Report. <http://documents.worldbank.org/curated/en/747201504859857290/Land-Governance-Assessment-Framework-LGAF-implementation-in-Ethiopia-final-country-report>
- Gürel, E., & Tat, M. (2017). SWOT analysis: A Theoretical Review. *The Journal of International Social Research*, 10, 994–1006.
- Gürsoy Sürmeneli, H., & Alkan, M. (2021). Towards Standardisation of Turkish Cadastral System Using LADM with 3D Cadastre. *Survey Review*, 53(381), 543–558. <https://doi.org/10.1080/00396265.2020.1855700>
- Haldrup, K., & Stubkjær, E. (2013). Indicator scarcity on cadastre and land registration in cross-country information sources. *Land Use Policy*, 30(1), 652–664. <https://doi.org/10.1016/j.landusepol.2012.05.005>
- Havrylenko, R. (2019). *Abetka zemlevlasnyka. Perspektyvy ukrainskoi zemli [Alphabet of the landowner. Prospects of the Ukrainian land]*. <https://ngp-ua.info/2019/12/42887>
- Hill, T., & Westbrook, R. (1997). SWOT analysis: it's time for a product recall. *Long Range Planning*, 30(1), 46–52. [https://doi.org/10.1016/S0024-6301\(96\)00095-7](https://doi.org/10.1016/S0024-6301(96)00095-7)
- Intergovernmental Committee on Surveying and Mapping. (2014). *Cadastre 2034 – Powering Land & Real Property. Cadastral Reform and Innovation for Australia – A National Strategy*. Intergovernmental Committee of Surveying and Mapping, Canberra, Australia. [https://www.icsm.gov.au/sites/default/files/Cadastre2034\\_0.pdf](https://www.icsm.gov.au/sites/default/files/Cadastre2034_0.pdf)
- Kabinet Ministriv Ukrainy. (2012). *Pro zatverdzhennia Poriadku vedennia Derzhavnoho zemelnoho kadastru*: Postanova Kabinetu Ministriv Ukrainy [On the Procedure for Carrying On of the State Land Cadastre, Resolution of the Cabinet of Ministers of Ukraine] vid 14.01.2015, No. 15. <https://zakon.rada.gov.ua/laws/show/1051-2012-%D0%BF#Text>
- Kabinet Ministriv Ukrainy. (2015). *Pro Derzhavnu sluzhbu Ukrainy z pytan heodezii, kartohrafii ta kadastru*: Postanova Kabinetu Ministriv Ukrainy [On the State Service of Ukraine for Geodesy, Cartography and Cadastre, Resolution of the Cabinet of Ministers of Ukraine] vid 14.01.2015, No. 15. <https://zakon.rada.gov.ua/laws/show/15-2015-%D0%BF#Text>
- Kabinet Ministriv Ukrainy. (2019). *Pro zatverdzhennia Poriadku provedennia inventaryzatsii zemel ta vyznannia takymy, shcho vtratyly chynnist, deiakykh postanov Kabinetu Ministriv Ukrainy*: Postanova Kabinetu Ministriv Ukrainy [On the approval of the Procedure for carrying out land inventory, Resolution of the Cabinet of Ministers of Ukraine] vid 14.01.2015, No. 15. <https://zakon.rada.gov.ua/laws/show/1051-2012-%D0%BF#Text>
- Kaufmann, J., & Steudler, D. (1998). *Cadastre 2014. A Vision for a Future Cadastral System*. FIG – Commission 7 Working Group (1994–1998) “Vision Cadastre”.
- Kaufmann, J. (2000). *Future Cadastres: The Bookkeeping Systems for Land Administration supporting Sustainable Development*. Paper presented at the 1st International Seminar on Cadastral System, Land Administration and Sustainable Development in Bogotá, Colombia, 3–5 May.
- Klimach, A., Dawidowicz, A., Dudzińska, M., & Żróbek, R. (2020). An Evaluation of the Informative Usefulness of the Land Administration System for the Agricultural Land Sales Control System in Poland. *Journal of Spatial Science*, 65(3), 419–443. <https://doi.org/10.1080/14498596.2018.1557571>
- Kovalyshyn, O. (2017). Improvement of data formation in the mode of land use and land plots in the new registration forms of the state land cadastre. *Land Management, Cadastre and Land Monitoring*, 2, 37–43.
- Kuryltsiv, R. M. (2012). Formation of land administration system in Ukraine. *Scientific Bulletin of UNFU*, 22(12), 277–282.
- Martyn, A. (2011). Problemy derzhavnoho zemelnoho kadastru [Problems of the state land cadastre]. *Zemleustrii i kadastr*, 2, 12–36.
- Martyn, A. (2017). *Derzhavnyi zemelnyi kadastr: kudy ydemo?* [State land cadastre: where are we going?].

- <https://agravery.com/uk/posts/author/show?slug=derzavniy-zemelnyj-kadastr-kudi-jdemo>
- Mitchell, D., Grant, D., Roberge, D., Bhatta, G. P., & Caceres, C. (2017, September). An evaluation framework for earthquake-responsive land administration. *Land Use Policy*, 67, 239–252. <https://doi.org/10.1016/j.landusepol.2017.05.020>
- Molen, P. van der (2002). The dynamic aspect of land administration: An often-forgotten component in system design. *Computers, Environment, Urban Systems*, 26(5), 361–381. [https://doi.org/10.1016/S0198-9715\(02\)00009-1](https://doi.org/10.1016/S0198-9715(02)00009-1)
- Panas, R. M. (2008). Porivnialna otsinka zemelnykh kadastriv zarubizhnykh krain i Ukrainy [Comparative assessment of land cadastres of foreign countries and Ukraine]. *Geodesy, Cartography and Aerial Photography*, 70, 68–75.
- Perovych, I. (2013). Kadastr yak osnova administruvannya zemelnykh resursiv [Cadastr as the basis of land administration]. *Suchasni dosiahnennia heodezychnoi nauky ta vyrobnytstva*, 2(26), 110–112.
- Perovych, L., & Ludchak, O. (2015). Kadastrova systema Ukrainy v konteksti svitovoho rozvytku [Cadastral system of Ukraine in the context of global development]. *Suchasni dosiahnennia heodezychnoi nauky ta vyrobnytstva*, 1(29), 15–19.
- Popov, A. (2019). Land cadastre development in Ukraine: issues to be addressed. *Geodesy and Cartography*, 45(3), 126–136. <https://doi.org/10.3846/gac.2019.7121>
- Popov, A., Koshkalda, I., Kniaz, O., & Trehub, O. (2019). Land fragmentation of agricultural enterprises in the context of administration of land. *Economic Annals-XXI*, 176(3–4), 80–90. <https://doi.org/10.21003/ea.V176-08>
- Rajabifard, A., Williamson, I., Steudler, D., Binns, A., & King, M., (2007). Assessing the worldwide comparison of cadastral systems. *Land Use Policy*, 24(1), 275–288. <https://doi.org/10.1016/j.landusepol.2005.11.005>
- Roić, M., Križanović, J., & Pivac, D. (2021). An Approach to Resolve Inconsistencies of Data in the Cadastre. *Land*, 10(1), 70. <https://doi.org/10.3390/land10010070>
- Shchepak, V. V. (2017). Heoinformatsiini tehnolohii ta kadastruvi systemy [Geoinformation technologies and cadastral systems]. *Biznes Inform*, 5, 108–112.
- Shibeshi, G. B., Fuchs, H., & Mansberger, R. (2015, April). Lessons from Systematic Evaluation of Land Administration Systems. The Case of Amhara National Regional State of Ethiopia. *World Development*, 68, 282–295. <https://doi.org/10.1016/j.worlddev.2014.12.006>
- Soto, H. de (2000). *The mystery of capital: why capital triumphs in the west and fails everywhere else*. Bantam Press.
- StateGeoCadastr (2020, January 1). *About a condition of the establishment of borders of settlements*. <https://land.gov.ua/vstanovlennia-mezh-naselenykh-punktiv/>
- StateGeoCadastr (2021, July 1). *Monitorynh zemelnykh vidnosyn* [Monitoring of land relations]. <https://land.gov.ua/monitorynh-zemelnykh-vidnosyn/>
- StateGeoCadastr. (2023, May 5). *The State Service for Geodesy, Cartography, and Cadastre – Official Website*. <https://land.gov.ua/>
- Statistical Yearbook. (2018). *Monitoring of land relations in Ukraine 2016–2017*. <http://land.gov.ua/wp-content/uploads/2018/10/monitoring.pdf>
- Steudler, D. A. (2004). *Framework for the Evaluation of Land Administration Systems* [Ph.D. Thesis]. The University of Melbourne, Parkville, VIC, Australia.
- Steudler, D. (Ed.). (2014). *Cadastr 2014 and Beyond*. No. 61. FIG: Copenhagen, Denmark.
- Steudler, D., & Williamson, I. P. (2002). *A framework for benchmarking land administration systems*. Proceedings of FIG XXII International Congress. Washington DC.
- Steudler, D., Williamson, I. P., & Rajabifard, A. (2003). The Development of a Cadastral Template. *Journal of Geospatial Engineering*, 5(1), 39–47.
- Steudler, D., Rajabifard, A., & Williamson, I. P. (2004). Evaluation of land administration systems. *Land Use Policy*, 21(4), 371–380. <https://doi.org/10.1016/j.landusepol.2003.05.001>
- Stupen, M. (2016). Svitovi dosvid funktsionuvannya kadastruvykh system u konteksti ratsionalnoho zemlekorystuvannya [World experience in the functioning of cadastral systems in the context of rational land use]. *Investytsiyyi: Praktyka ta Dosvid*, 17, 22–26.
- Stupen, M. H., Duma, Yu. I., & Kok, Z. S. (2016). Zemlia – osnovnyi resurs silskoho hospodarstva Zakarpattia [Land – the main resources of agriculture in Transcarpathia]. *Zbalansovane pryrodokorystuvannya*, 3, 152–156.
- Szafarska, B., Busko, M., Kovalyshyn, O., & Kolodiy, P. (2020). Building a Spatial Information System to Support the Development of Agriculture in Poland

- and Ukraine. *Agronomy*, 10(12), 1884. <https://doi.org/10.3390/agronomy10121884>
- Taratula, R. (2017). Zarubizhnyi dosvid rozvytku zemelno-kadastrykh system [Foreign experience in the development of land cadastral systems]. *Agrosvit*, 7, 17–21.
- Tretiak, A. M. (2012). Problemy rozvytku derzhavnoho zemelnoho kadastru v Ukraini yak systemy fiksatsii zemelnykh aktyviv [The problem of the development of the state land cadastre in Ukraine as a system for fixing land assets]. *Zemleustrii, kadastr i monitoringh zemel*, 1–2, 28–35.
- Tsytsyura, Y. G. (2016). Publichna kadastrava karta Ukrainy: Otsinka adaptyvnosti ta stratehiia udoskonalennia [Public Cadastral Map of Ukraine: Adaptability Assessment and Improvement Strategy]. *Silke hospodarstvo ta lisivnytstvo*, 3, 6–14.
- Tykhenko, O. (2016). Problemy vedennia obliku yakosti zemel u systemi derzhavnoho zemelnoho kadastru Ukrainy [Problems of keeping records of land quality in the system of the state land cadastre of Ukraine]. *Zemleustrii, kadastr i monitoringh zemel*, 3, 34–39.
- UN. (2015). *Sustainable Development Goals*. <https://www.un.org/sustainabledevelopment/poverty/>
- UNECE. (1996). *Land Administration Guidelines with Special Reference to Countries in Transition*. UNECE, Geneva. <https://unece.org/info/Housing-and-Land-Management/pub/2870>
- UNECE. (2005a). *Land Administration in the Unece Region. Development Trends and Main Principles*. Geneva, 2005. <https://unece.org/info/Housing-and-Land-Management/pub/2846>
- UNECE. (2005b). *Guidelines on Real Property Units and Identifiers*. Geneva, 2005. <https://unece.org/info/Housing-and-Land-Management/pub/2849>
- UN-Habitat. (2003). *Monitoring and Evaluation Guide*. The United Nations Human Settlements Programme (UN-Habitat), Nairobi, Kenya.
- Verkhovna Rada Ukrainy. (2012). Pro Derzhavnyi zemelnyi kadastr: Zakon Ukrainy [Law of Ukraine On State Land Cadastre] vid 13.04.2020, No. 554–IX. <https://zakon.rada.gov.ua/laws/show/3613-17#Text>
- Verkhovna Rada Ukrainy. (2020). Pro natsionalnu infrastrukturu heoprostorovykh danykh: Zakon Ukrainy [Law of Ukraine On National Infrastructure of Geospatial Data] vid 13.04.2020, No. 554–IX. <https://zakon.rada.gov.ua/laws/show/554-20#Text>
- Verkhovna Rada Ukrainy. (2021). The explanatory note to the draft Law of Ukraine “On Amendments to the Land Code of Ukraine and Other Legislative Acts Concerning Improvement of the Management and Deregulation System in the Sphere of Land Relations”. <https://zakon.rada.gov.ua/laws/show/1423-20/card4#History>
- Williamson, I. P. (2001). Land Administration “Best Practice” Providing the Infrastructure for Land Policy Implementation. *Land Use Policy*, 18(4), 297–307. [https://doi.org/10.1016/S0264-8377\(01\)00021-7](https://doi.org/10.1016/S0264-8377(01)00021-7)
- Williamson, I., Enemark, S., Wallace, J., & Rajabifard, A. (2010). *Land administration for sustainable development*. ESRI Press Academic.
- Yasinetska, I. A., Petrishche, O. I., & Kovtyniak, I. P. (2018). Derzhavnyi zemelnyi kadastr yak informatsiina baza [State land cadastre as an information base]. *Ekonomika ta suspilstvo*, 14, 680–685.
- Yilmaz, A., Çğadas, V., & Demir, H. (2015, March). An evaluation framework for land readjustment practices. *Land Use Policy*, 44, 153–168. <https://doi.org/10.1016/j.landusepol.2014.12.004>
- Zanuda, A. (2019, November 11). Zemlia Ukrainy: skilky yii, komu nalezhyt i khto na nii pratsiuie [The land of Ukraine: how much it is, who owns it and who works on it]. <https://www.bbc.com/ukrainian/features-50223336>
- Zhang, H., & Tang, C. (2017). A performance assessment model for cadastral survey system evaluation. In T. Yomralioglu, & J. McLaughlin (Eds.), *Cadastr: Geo-Information Innovations in Land Administration* (pp. 33–45). Springer, Cham. [https://doi.org/10.1007/978-3-319-51216-7\\_4](https://doi.org/10.1007/978-3-319-51216-7_4)

#### Abbreviations

- EFQM – European Foundation Quality Management  
KMU – Kabinet Ministriv Ukrainy  
SDG – Sustainable Development Goals  
SGC – StateGeoCadastre  
SY – Statistical Yearbook  
VRU – Verkhovna Rada Ukrainy