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Comparative Performance Analysis of Türkiye's Land Management System Using SWOT Analysis Method

* Dr. **Hicret Gürsoy Sürmeneli**
Department of Civil Engineering, Faculty of Engineering, Atatürk University, Erzurum,Türkiye
E-mail: hicretg@atauni.edu.tr

Abstract
With sustainability and digitalization, countries are urgently conducting technical studies as well as legal and economic studies in land management. In this study, land management models developed by 12 countries with different land management systems were analyzed according to the qualitative research method. The data obtained by the selected countries have been examined under these headings: land management, registered data, legal side, technical institutions, digitalization studies and technical models. Comparison tables of the countries were created under the determined headings. In addition, a comparison table was created by examining the land management data models developed by the countries. The performance analysis of the land management studies in Türkiye (In terms of Planning, Cadastre, Land Infrastructure, Real Estate Valuation) has been made by using the SWOT Analysis method of evaluation of these countries. The strengths and weaknesses of Türkiye's land management system were evaluated as a result of the analysis.
Keywords: SWOT Analysis; Land Management System; Cadastre; Land Administration Models.

1. Introduction

Nowadays, sustainable land management is of great importance for conserving natural resources and improving people's quality of life by balancing environmental, economic and social factors. In this context, a land management system includes the process of identifying, registering and disseminating information about the land, its value and its use while implementing land management policies. Sustainable land management strategies include health, education, nutrition, transportation, economy, planning, land registration and real estate valuation. Especially the sustainability of scarce land resources directly affects other strategies such as health, nutrition and economy. From this perspective, land registration and real estate valuation form the basis of sustainable land management strategies. Land registration is the legal process of registering, documenting and utilizing the rights, restrictions and responsibilities of land. This process includes steps such as collecting, storing, analyzing and presenting data on land use. Real estate valuation is the process of determining the economic value of the registered real estate and including it in planning. Proper real estate valuation ensures the efficient use of resources and positively affects land policies, the economy and, accordingly, planning processes.

Due to limited land resources, the above and below the surface of the land need to be planned and managed together. In this respect, the need for sustainable land management is increasing. The data required for land management can be obtained through accurate land registration and real estate valuation. Since these data are obtained through cadastral systems, the need for a multidimensional cadastre that represents the real world is increasing. For a sustainable cadastral system, it should be digital and multidimensional, created by national/international standards. To establish a sustainable system, legal and institutional arrangements should be made in addition to technical procedures and these three components, technical, legal and institutional, should be integrated. In this context, countries are carrying out legal, technical and institutional studies and improvements in cadastral systems to create sustainable land management (Aien, 2013; Guo et al., 2013; Paulsson, 2007; Papaefthymia et. al., 2007; Sahojaei et.al., 2016; Kitsakis et al. , 2016; Kalagianni et al., 2017; Rajabifard et.al., 2018). The studies and improvements can be listed as legal requirements, 3D/4D real estate registration, data models, database systems, technologies for visualization and service operations. At this point, some countries such as Austria and the Netherlands have partially made these improvements and transitioned to a sustainable land management system. In Türkiye, standard development and implementation studies are being carried out for the transition to a multidimensional cadastral system.

The main purpose of this study is to examine the studies carried out by 12 countries (USA, Australia (Queensland and Victoria), Israel, Canada (Quebec), Netherlands, Norway, Sweden, Switzerland, China, Greece, Austria, Croatia, Norway, Sweden, Switzerland, China, Greece, Greece, Austria, Switzerland) selected from different regions in the field of sustainable land management and to determine the status of Türkiye among these countries. By using the SWOT analysis method, Türkiye's strengths and weaknesses in terms of sustainable land management and the opportunities and threats it faces will be revealed. The study aims to analyze the situation and provide guidance for Türkiye to develop sustainable land management strategies and become more competitive in the international arena. In addition, a comparative analysis of sustainable land management practices of different countries will contribute to academic studies. Since the scope of sustainable land management is very wide, this study is limited to the evaluation of studies on cadastre and real estate valuation. This study aims to contribute to the process of raising awareness and

developing strategies for sustainable land management both in academic circles and among policymakers and practitioners.

2. Background of Turkish Land Mangement

In Türkiye, which has a well-established land management system, real estate and property rights are guaranteed by the state. The smallest part of land management is the parcel. Different legislative arrangements and organizational structures have been formed from past to present (Sürmeneli & Alkan, 2021). As a result of all these developments, it has completely taken the form of a property cadastre (also referred to as legal cadastre or border cadastre). In this context, the boundaries of real estate on the land and the rights on it are determined and transferred to the map, and modern land registries envisaged by the Turkish Civil Code are created (DPT, 2001). The most comprehensive right a person can have is the property right. According to Article 35 of the Turkish Civil Code, the property right is defined as "Everyone has the right to property and inheritance. These rights can only be limited by law for the public interest. The exercise of the property right cannot be contrary to the general public." It is clearly stated that private property or the right of use may be interfered with in case of public interest. In addition, the vertical boundary of ownership is defined as "The ownership of land includes all layers above and below the land as long as it is beneficial for its use. Plants, facilities and resources on the land are also included within the limits of the scope of ownership" (Article 718 of the Civil Code). As can be understood from this statement, there is not enough detail on vertical rights and boundaries. There are several rights determined in our constitution regarding the determination of vertical rights and boundaries. Easement rights are classified as real easement rights and personal easement rights. Easement in kind is a type of right that restricts the rights of a real estate in favour of another real estate and determines the limits on how those rights can be used. Types of easements in real: Right of passage, right of overlay (construction), right of resource and other easements. Personal easement rights are rights that allow someone other than the owner of the real estate to benefit from some of the property rights. The difference between personal property rights and real property rights is that personal property rights are not rights granted by one real estate to another, but rights granted by one real estate to a person. Types of personal easement rights: Right of usufruct, Right of occupancy, Right of construction, Right of resource and other easements.

In Türkiye, cadastral works are carried out by the "General Directorate of Land Registry and Cadastre (GDLRC)", whose foundation dates back to 1847 and whose current structure was determined by Law No. 2997 in 1936. The provincial organization of the General Directorate of Land Registry and Cadastre (GDLRC), which operates under the Ministry of Environment, Urbanization and Climate Change, consists of regional directorates, cadastre directorates and title deed directorates (Sürmeneli & Alkan, 2021). Many projects on digitalization, standardization, data service and sharing are being carried out within the ministry and directorates. These projects are:

- Land Registry Cadastre Information System (TAKBIS)
- Spatial Real Estate System (MEGSIS)
- Land Registry Archive Information System (TARBIS)
- Land Registry and Cadastre Modernization Project (TKMP)
- Türkiye National Geographic Information System Project (TUCBS)
- TUSAGA-ACTIVE (Cors-TR)
- Map Information Bank Project (HBB)
- Agricultural Reform Implementation Project (ARIP)
- Completion of facility cadastre
- 2/B cadastre
- 3D Urban Models and Cadastral study pilot application
- Updating and digitizing civil administrative boundaries (MIDAS)

The common feature of the projects is that they are created in a sensitive, digital common database and developed by national and international standards. The General Directorate of Land Registry and Cadastre, which has a well-established institutional structure, has established the infrastructure of the spatial information system by specifying the boundaries of immovable properties on land and cadastral maps based on the cadastral and topographical cadastral map of the country according to the country coordinate system with the Law No. 3402. In addition, cadastral systems and cadastral data have been improved through many projects. Since the current system is based on two-dimensional parcels, it cannot be adequately associated with physical objects in the real world, and therefore incomplete information about the third dimension is presented. There are two main reasons for this situation. The first is that the space where the rights are applied cannot be registered and represented independently of the parcel. The second is that the information below the surface of the parcel is inaccessible and the information above the parcel is insufficient. These obstacles in the current system also fail to fulfil the main purpose of cadastre, which is to reflect the physical world. Because in the current cadastral system, 3D spatial data related to the space where the rights are applied are not included in the cadastral records. In addition, since the data of the objects located under the parcel are not available in the cadastral system, the relationship between these objects and the parcels cannot be analyzed.

Another obstacle is that although it is known who owns which apartment in the building in the registration of independent sections located on the parcel, the data on how the ownership units are located in the structure is not available in the cadastral system. To overcome these deficiencies, 3D city models and the Cadastre project have been developed. The CityGML model has been adapted to ensure that the data to be produced within the scope of the project is in a common standard.

3. Material and Methods

In this study, qualitative and quantitative mixed research method was used. With the method used, the regulations on cadastre and real estate valuation within the scope of land management systems of 12 different countries around the world on sustainable land management were examined. The data were analyzed under 8 headings. A qualitative research method was used in the search for answers to the 3Ws (How, Why, What) questions in law and legislation analysis. Qualitative methods will facilitate a better understanding of the advantages and disadvantages of existing cadastral systems in terms of managing layered AQS. The focus of qualitative methods is on the measurement and quantification (more or less, larger or smaller, often or rarely, similar or different) of the phenomena that researchers are investigating (Polat et. al., 2017). In this research context, quantitative methods can be used to answer research questions. For example, how many AQS should there be in a 4D cadastral data model? How many objects should be registered? How many attributes should describe a cadastral object?

Within the scope of the study, the land management systems of each country were examined under the headings determined through sources such as academic papers, official reports, web pages, policy documents and publications of international organizations in the existing literature. An in-depth analysis was conducted focusing on the countries' land management systems, governance structures, legislation and policies, cadastral objects recorded, 3D represented objects, data models developed and other relevant factors. The data obtained were compared with Türkiye's land management performance using the SWOT analysis method. SWOT analysis is an effective tool to identify Türkiye's strengths, weaknesses, opportunities and threats in land management. The methodology and methods are designed to allow the study to produce reliable and comprehensive results. The qualitative research method and SWOT analysis form the basic analytical framework of the study, aiming to provide an in-depth assessment of Türkiye's land management performance.

4. Results

Within the frame of this study, legal regulations, technical studies and solution proposals developed by 12 countries to improve their cadastral systems and 3D/4D cadastre were analyzed. Countries with different cadastral systems and different laws have developed different methods for registration and mapping for 3D applications. When the legal structures of the countries examined are analyzed, it is seen that the USA, Australia and Canada have regulations with detailed explanations on how to measure and register a parcel in 3D. There are also regulations in these countries that define the boundaries of the property above or below the land surface with 3D coordinates. The Netherlands, on the other hand, amended its Civil Code and Cadastral Code in 2007, redefining ownership over land and paving the way for 3D objects defined by law to be registered independently of the parcel. Austria has focused on transferring its cadastral maps to digital form, while in Greece, digital Hellenic cadastral work is underway. In China, there is no integrated cadastral system and it is divided into urban and rural cadastres. In the Netherlands and Switzerland, there is a separate Line cadastre for the registration of underground networks. In Norway, the registration of underground structures is not compulsory but optional. On the other hand, the states of Victoria and Queensland in Australia show great interest in the field of 3D Cadastre, with long-standing legislative work on 3D real estate and research on the establishment of 3D cadastral systems following the legislation (FGDC, 2008; ePlanVictoria, 2010; Vučić et.al., 2016; Van Oosterom, 2018).

Implementation projects are being carried out in the Netherlands, Israel, Switzerland and China. Pilot projects were carried out in the Netherlands and Israel to test the proposed systems on 3D use cases. Country profiles have been published in line with the models developed for 3D Cadastre. In Switzerland, studies have been carried out to convert the existing cadastral database into 3D. A comprehensive plan was prepared for the Swiss Cadastre, covering the steps of transition to 3D cadastre. In China, 3/4 dimensional cadastral studies have gained momentum with pilot projects that have started to be implemented in some urban centres. The legal remedies in Sweden and Norway are more aimed at improving the existing system rather than being innovative. In both countries, subsurface structures are not required to be registered in the cadastre unless they cause a loss of value to the structure above the surface. The legal arrangements are more oriented towards compensating for the damage to the above-ground structure caused by the subsurface structure (Van Oosterom, 2018).

Within the scope of the study, cadastral studies of many countries and 3D cadastral concepts are summarized and presented in a table. Each country uses different terminology to define 3D objects. However, when the objects defined in 3D are analyzed, it is seen that they have many similar characteristics. Based on variations in the structure of cadastral systems, types of recorded objects and other issues, it can be seen that the implemented solutions are not significantly different, although different aspects of 3D features are taken into account. With the

creation of 3D cadastral legislation, the introduction of a 3D cadastral system and the definition of 3D terminology, it seems that the management of 3D real estate in 3D space will be easier. Examples from Sweden and Australia (Queensland, Victoria) in particular show that such regulations have facilitated the management of real estate and significantly clarified the complex HLCs applied to the land. However, considering the scope and limits of 3D LUCs, 3D Public Law Regulations, modification of cadastral surveying procedures and modification of data recording to incorporate 3D features of immovable properties will facilitate the transition from the current 2D cadastral system to a 3D cadastral system.

Table 1. Cadastral studies carried out by countries within the scope of sustainable land management

Countries	General information	Registration status of 3D objects	Rights registered as 3D	The legal definition of 3D objects and cadastral parcel type	What are 3D objects	Definition of 3D objects cadastral map	Models and studies developed on 3D cadastre
USA	-State jurisdiction -Traditional legal system (Independent of surface to real estate ownership have, has) -Land recording and cadastral maps -Property registration local governments and at state government level	-Distinguishing 3D units in a building separate real estate (apartments) can be done. -Parcels can be defined in 3D with height information -The legal framework allows creating volumetric parcels	-Common property rights (private and common parts) -Rights in buildings -Minering and oil rights -Grazing and fishing rights	-Laws support registration for 3D Buildings. -There is legal legislation for creating 3D volumetric parcels.	-Apartments and commercial buildings -Mine and oil objects -Tunnels and Bridges -3D Easements, Leases, Contracts	2D (3D Representation is provided via 2D elevation data)	US Federal Geographic Data Committee (FGDC) Standard Reference Data Model
Australia Queensland	-Common Law -Torrens Title registration system -Paper title not provided to owners -Point of truth for title is Title Office record, and for dimensions are the paper cadastral plan -Digital cadastral database (DCDB) is a representation only and not the point of truth -Private cadastral surveyors survey land and are legally responsible for accuracy of plan data, State liable for Title -Both Titles Office and Directorate of Survey is within Department of Natural Resources and Mines, but separate offices -DCDB holds 2D with footprint of 3D -All cadastral representation, including valuation, topographic data, imagery etc. Are open source and is dissemina free of charge	-Building units have been registered under Building Units and Group Titles Act (1980) and Body Corporate and Community Management Act (1997) -2D and 3D Title registered under Land Title Act (1994) for freehold land and Land Act (1994) for crown and non-freehold land, the Surveying and Mapping Infrastructure Act (2003) guides surveyors and geodetic infrastructure, the Surveyors Act (2009) safeguards the public by guiding the surveyors	- All rights on 3D are registered, any RRR on 2D is possible to be registered in 3D	- Separation between 3D Building Format Plan and 3D Volumetric Format plan - Any 3D object can be registered if it can be mathematically defined - Separate legislation exists for 3D Buildings - 3D Volume covered under directives	- 3D Easements, Leases, Covenants - 3D Roads - Air spaces - 3D Ambulatory boundaries - Water Spaces - Underground space (with or without construction) - Restriction easements (so others cannot obstruct view) - Mining rights - Limitations (above or below a certain height) - Apartments and Common Property - Tunnels, Utilities (network and individual infrastructure) - Carbon abatement zones - Commercial spaces - Car parks - Bridges (pylons and bridge spaces) - Sports spaces (stadium, locker spaces)	- 2D Footprint with 3D Isometric View - Different plan types for 2D, 3D Buildings, and 3D Volumes - Different lot numbering system for 3D - 3D Volumetric plans required to show connection to elevation geodetic control point - Any type of 3D geometry permitted if it canbe mathematically defined	-Harmonized data model HDM -ePlan Queensland 3D -LegalProperty Object -ICSM 2034 Cadastre vision

Australia victoria	-Common law, -Torrens land registration system -Parcel register and index "digital cadastral map base" exist -Title register is digital but copies of title is printed in hard copy	-Various 3D (objects) RRRs are registered. -Utility networks are not included in the register -Land Use Victoria is responsible for the title (including cadastral plans) registration, and maintenance of index "digital cadastral mapbase"	Various 3D RRRs are registered but are represented in 2D diagrams	-Is defined by the type of 3D RRRs and the boundaries that delineate the RRR	-Apartment unit and their accessories, -common property, -depth limitation and airspace	-2D	-Harmonized data model HDM -ePlanVictoria 2B -LegalProperty Object -3D Cadastral Model -ICSM 2034 Cadastre vision
Israel	-Common law system -Torrens title system -Registration of land rights is carried out according to the 1969 land law. -2003 legislation for the preparation of spatial plots	-Underground and surface rights are registered -2B parcels (Legal legislation has been developed for 3D parcel definition)	-Land registration -Apartment and commercial areas -Independent sections -RRRs registered structures	-Legislation was prepared for the creation of sub-parcels	-Sub-parcels -Apartment rights -Public networks such as tunnels and pipelines -Underground and airspace	- 2D	-3D Cadastre R&D Project -3D cadastral profile developed according to LADM
Canada Quebec	-Civil code jurisdiction -Deeds registration - land register and cadastre map exist -Cadastre reform proposes updated, complete, accurate, digital and online land register and cadastre map.	-Mainly 2D land parcels. -Overlapping properties distinctly indicated on the 2D cadastre plan (with tags) and then refer to subdivision plans, mainly for condominium units. -Registration does not include 3D information but PC plans are available and altitude, height and volume are provided. -Easements are not represented on the 2D cadastral plan. -State Resources and distribution networks recorded in distinct registers (not cadastre), no a map is available. -Real property cadastre managed by Government.	-Co-ownership rights (private and common parts) are described by altitude and height information in the PC-Plans.	-The concept of 3D legal object does not exist in the documentation even though it is possible to register 3D objects (see PCplans)	-Apartments and commercial buildings, -Underground infrastructure objects as tunnels, subways, -Utility networks -Mining objects	-2D plan with Text that refer to complementary PCplans. PC-plans show vertical profiles and subdivision plans each floor. Altitude, height And volume is indicated on the PC-plans.	-

Netherlands	-Civil Law jurisdiction -Deed registration system -Archive of deeds, parcel-property register and index "cadastral map" are maintained from the Agency for Cadastre and Public Registers -The public registers are kept in an analogue form, notaries and Kadaster are working in a digital form.	-2D registration with the first one fully 3D registration in 2016. No legal framework for 3D descriptions of parcels -2D registration under/above ground utilities' recording to cadastre - Agency for Cadastre and Public Registers "Cadastre" are responsible for the maintenance of the archive of deeds, parcel-property register and index "cadastral map"	Accepted 3D pdf format as a part of the deed - 2016	3D parcels can be considered the legal volumes formed with real rights and that can overlap with several ground parcels	-Apartments -offices -commercial buildings, -infrastructure objects -tunnels -bridges	-2D (some 3D)	-Conceptual Models: -Full 3D Cadastral method -MixedCadastre Method -Adding 3D labels to existing Cadastral Records -Logical Models: -Spatial Data Model -Administrative Data Model -Historical Data Model Full 3D Cadastral method -Historical Data Model
Norway	-Civil Law jurisdiction -Underground structures are not registered -Telecommunications, electricity and water lines are not recorded -Cadastral maps are digital	-Cadastral records are 2D and do not contain temporal information. -According to the decision of the commission established after 1995: -3D building ownership can only be created by dividing the parcel in the vertical direction. -The parties are the ones who decide whether the 3D structure property will be used or not. Registration of the 3D structure is not mandatory but optional -3D building ownership cannot be established for a part of the building	2D real estate rights are registered	-There is no registration for underground structures. It is determined only when the underground structure causes economic damage to the aboveground structure in order to compensate for the damage.	-Parcels -Addresses -Buildings -Underground parks -Shopping malls -Tunnels -Structures built on columns.	-2D	-Working group for the creation of 3D property units
Sweden	-Civil Law jurisdiction -Titles registration system - unified land registry and cadastral map - Digital - Complex RRRs on real property	-3D Cadastre legislation since 2004 – Condominium legislation established since 2009 2D representation of 3D objects to cadastral map - 2D registration - under/above ground utilities' recording to cadastre	No difference with 2D real property – No limitations in 3D RRRs	3D property is defined as a property unit which in its entirety is delimited both horizontally and vertically	-Apartments -offices -commercial premises, etc. -infrastructure objects, e.g. tunnels or other large underground facilities, etc.	2D(Special symbology of 3D property units).	-DM.01. -Core cadastral domain model -Creation of the concept of 3D Ownership
Switzerland	-Civil law and Land Registry law -Digital form	-A working group has been established on how to represent	-No difference with 2D real estate	-3D property is represented by special symbols developed	-Apartments -Offices -Commercial buildings	2D	-Line Cadastre -Catalogue on how to represent

	-The establishment of the independent data definition language INTERLIS for the cadastral system has made it possible to exchange data freely and easily between different systems.	the 3rd dimension in cadastre. -Line cadastre, where infrastructure services are shown, is considered an independent cadastre. -As of 2008, the cadastral system consists of 17 information layers.	- No limitations on 3D HSKs		-Tunnels and larger underground objects -Public infrastructure servises.		some objects in 3D
China	-Civil law jurisdiction -Dual cadastre system -Real property title registration system -Land register and cadastre map exist -Digital form in certain cities -Unified cadastre registration under construction, the initial operational status will be achieved by 2018	-2D registration -under/above ground utilities' recording to Cadastre not fulfilled -Not unified registries -Each registry is maintained by responsible institution	3D cadastre in pilot projects	Real property unit	-Apartment - Commercial buildings - Underground facilities	-2D	-2D
Greece	-Civil Law jurisdiction -Transition from Deeds to Titles registration system - unified land registry and cadastral map (after completion of Hellenic Cadastre project) - Digital (in regions where Hellenic Cadastre is completed)	-2D representation of 3D objects to cadastral map using tags and separate thematic layers -projections of servitudes on surface parcels registered -Hellenic Cadastre and thematic cadastres exist	No rights registered in 3D.	N/A (Does not apply)	-Horizontal ownership/ condominium -Vertical ownership -Mines -SRPO -Infrastructures/ utilities	2D (Special layer for mines and SRPO used.)	-
Austria	-Civil law jurisdiction -National cadastre system - Digital cadastral map and land register - Geometrical basis for condominium stored in land register but not connected to cadastral maps	- 2D registration only - Condominium registration as shared ownership of land - Easements are usually not represented geometrically	No rights registered in 3D.	N/A (Does not apply)	-Tunnels -Condominiums -Wine cellars	2D	-Publishing declaration determine the need for 3D Cadastre
Türkiye	-Civil law -Property rights are under state guarantee -Land Registry Law -Cadastral Law -Land registration system -The vast majority of cadastral maps are in digital form -All cadastre has been completed throughout the country	-2D recording is made -Real Estates, their additions and rights on them are recorded -There is a condominium registration -Registration is mandatory	-Land, land buildings, independent sections and additions are registered -RRRs on registered objects are recorded -Registered RRRs are represented as 2B	-3D objects subject to registration are recorded with easements -3D RRRs type, scope and application are defined in the Civil Code and Cadastre Law -Although it is possible to register some	- Buildings and their additions -Parcels -Easements -Condominium -High voltage lines -Oil and Natural Gas pipes -Pylon locations -Water channels	-2D	-Starting the 3D City models and Cadastre project - Türkiye National Geographic Information Systems Project (TUCBS) - Land Registry Cadastre Information

	-Underground structures are not registered -Cable, water, sewer and telecommunication lines are not recorded -Condominium.	-3D objects are registered as easements -Easements are represented in 2D on the cadastral map -3D related information is available in architectural plans.		3D objects, there are no necessary explanations for all 3D objects in the law.			System (TAKBİS)
Croatia	- Civil Law jurisdiction - Title, based registration system - Cadastre maps exist in digital form	- use of 3D models in 3D objects' registration (2D models with tags - 2.5D) - under/above ground utilities' recording to Cadastre - Real property cadastre and thematic utility cadastre are maintained by State Geodetic Administration - Land book maintained by local courts (Ministry of Justice)	Various 3D RRRs are registered but are represented in 2D diagrams.	Rights referring to use of limited space will be registered in land book on a 2D parcel registered in the cadastre and in the land book.	-Apartments -Office spaces buildings and other structures -utility lines with associated facilities -traffic infrastructure -water and related objects	2D	-Croatian Infrastructure Cadastre -Croatian Land Management System (records Cadastral objects) -3D cadastral Profile was developed according to LADM.

4.1. SWOT analysis for land management in Türkiye

SWOT analysis stands out as a thinking model and analysis technique that is frequently used in the strategy development process. With the help of this technique, key points are identified through information gathering, interpretation and delimitation of data. The term "SWOT" stands for "Strengths", "Weaknesses", "Opportunities" and "Threats", which represent the four steps of the analysis. SWOT analysis provides a solid basis for strategic decisions (Polat et.al., 2017). SWOT analysis identifies the strengths of the system or organization under study by assessing its unique characteristics, resources and capabilities. The lack or inadequacy of these characteristics or capabilities constitutes the weaknesses of the analysis. What may be a weakness for one system may be perceived as a strength for another and vice versa. Therefore, when conducting a SWOT analysis of a system or organization, its unique factors should be explored. These analyses are called internal analyses to identify the strengths and weaknesses within the system, while external analyses are conducted to identify the opportunities and threats faced by the system or organization. For the continuity of the system and the success of the strategic plan, it is necessary to examine and clarify the threats and opportunities in detail. The general purpose of SWOT analysis is to make a comprehensive situation assessment.

In this study, some criteria should be determined for SWOT analysis. These criteria are the titles created in Table 1 based on the criteria determined in Cadastre 2014 and 2034 visions (Van Oostereom, 2018) . Countries are analyzed and summarized according to the determined headings. The general evaluation for Türkiye is also given in Table 1. In the SWOT analysis made according to the criteria determined, Türkiye's land administration and cadastral system were analyzed according to internal and external factors and presented in Table 2. In the evaluation of SWOT analysis, reports and surveys conducted by experts, activity reports of institutions, academic studies and directives were examined.

Table 2. Evaluation of land management in Türkiye according to SWOT analysis

	STRENGTHS	WEAKNESSES
Internal Factors	- Registration of ownership and assurance of property rights with the Turkish Civil Code - Development of the Cadastral Law, Land Registry, Regulation on Sharing of Land Registry and Cadastral Data, legislation on the protection of underground and surface resources, and the Regulation on the Production of Large-Scale Maps and Map Information. - Existence of the sole responsible institution regarding land registry and cadastre activities - Existence of a strong corporate budget - Existence of deep-rooted corporate experience - A common organizational structure - Possibility to carry out land registry and cadastre transactions from abroad - Providing consultancy services to foreign countries with professional and technical knowledge - Completion and development of TAKBİS, MEGSİS, TUCBS, HBB, TUSAGA-ACTIVE, 3D City Models and Cadastre projects - Completing the transition to TAKBİS throughout the country - Determination of projects and data standards for the creation of 3D cadastral infrastructure - Existence of a strong archive structure - Access to information about parcels via e-government - Development of e-government and online transactions - Online and offline data sharing	- Long-standing cadastral cases - Existence of broad and complex laws, circulars and regulations - Object-oriented cadastre is not fully defined and there are no clear definitions in the legislation regarding 3D/4D cadastre. - Second cadastral ban - Keeping underground objects independent of the cadastre - Failure to register underground RRRs - Continuation of 2D Cadastre - Failure to digitize the cadastre completely - Lack of a significant legal framework for cadastral activities at the global level - Lack of qualified and expert personnel - Deficiencies in vocational retraining - Lack of an effective human resources policy - Use of different measurement, datum and coordinate systems - Failure to complete 2D cadastral measurements and records - Continuation of 100% parcel based cadastre - Problems encountered in the identification, delimitation and allocation of lands that have lost their summer, pasture, winter and forest qualities.
	OPPORTUNİTİES	**THREATS**
External Factors	- Development of international land management standards and regulation of country legislation accordingly - The assumption that the world's national resources are international public goods - International manifestos and declarations, adoption of Cadastre 2014 and 2034 Vision - Adoption of INSPIRE Directives - ISO19512 Land Administration Domain Model - Widespread use of CityGML and BIM - Studies on harmonizing the legislation with international standards - Improving cooperation with non-governmental organizations, public and private sectors - Increase in educated and young human resources - Instructions in the EU harmonization process - Existence of international standardization activities such as ISO and OGC - More opportunity to use foreign financing loans - Development of state automation projects - Giving importance to studies on sustainability and land management in State Development plans- Dissemination of database-based management information system - Improving measurement techniques in technical and technological terms - Increasing need for spatial information management system	- Intensity of the jurisdiction's workload and prolongation of property cases - Lack of lawyers and experts specialized in land administration and Cadastre - Existence of country-specific legal rules - Regional development level and land understanding - Lack of legal and technical infrastructure for sustainable and integrated land management - Existence and hierarchy of different laws restricting land administration and cadastral activities - Carrying out land-related activities by different institutions - Collaboration and data sharing between institutions at global and national levels lack of sharing - Lack of an effective national land management Policy - Failure to ensure political and economic stability in the region and the world - The existence of natural disasters and their impact on the Institution's budget - Increase in vertical architecture in urban areas - High cost of collecting three-dimensional data - Need for outsourced software regarding software management - Risks in data sharing in the digital environment and inadequacy of legal legislation

	- Development of satellite and mobile technologies and the ability to collect spatial data regardless of distance - Technological developments in 3D data collection and imaging - The power of the private sector - Data management and data security with relational database - Development of blockchain systems - Increasing widespread cross-sector relations with information and communication technology	

4. Discussions and Conclusions

The Cadastral 2014 and 2034 visions emphasize the need to fully represent the true shape of the world in terms of land management and to legally and technically represent the rights, restrictions and responsibilities of land. Based on this context, many studies have been carried out in the legal and technical fields to improve land management. To evaluate the studies, research questions were determined to cover all the articles of Cadastre 2014 and 2034 visions. In line with the determined questions, the land management systems of the countries given in Table 1 were evaluated in legal, technical and academic terms. For the selected countries, attention was paid to the fact that they are from different continents and have different land management systems and that document access was open. Quantitative and Qualitative analysis methods were used to analyze the laws, regulations, institutional reports and resources, projects developed and academic studies conducted in the countries.

Although countries have different land management systems, their common features are the improvement of cadastral systems for sustainable land management and the transition to 3D Cadastre. When Table 1 is evaluated, especially in Austria and the Netherlands, studies are being carried out for the registration and representation of objects independent of the parcel. There are applications for this change especially in the legal legislation. They have carried out important studies both legally and technically in terms of registering underground objects, developing a common standard and integrating them into the cadastral system. Switzerland has created an information system for land management and developed a data description language. Definitions have been made using different symbols for 3D representation. Countries such as Israel, Greece and Austria are carrying out serious studies to improve their cadastral systems and convert them into digital form. China is working on obtaining 3D/4D data from the land using developing technology. Türkiye has a well-established and institutionalized structure in land management.

Cadastral maps were created in digital form in the country coordinate system. Significant improvements have been made in the cadastral system with the national standards and projects developed. Having a well-established and systematic cadastral system facilitates Türkiye's transition to a sustainable and multi-dimensional cadastral system compared to other countries. However, the slow institutional structure and existing laws slow down this transition process. The SWOT analysis identified the strengths, weaknesses, opportunities and threats of land administration in Türkiye. As seen in Table 2, Türkiye in particular has a well-established institutional framework for land management. This institutional framework provides a great advantage in the management and organization of land management. Again, the constitutional guarantee of property rights and existing legal regulations ensure sustainability. The projects developed within the scope of land management, e-government applications and the digitalization of the cadastral system are among the biggest advantages. To overcome the inadequacy of the common national standard, new standards are being developed. The new standards have been prepared in international form to be compatible with Europe.

When the studies are evaluated, it is observed that countries that reform legal regulations can transform faster. To have a common language for sustainable land management, it is necessary to adopt international standards. The existing land management system also needs to be improved and digitized as soon as possible. In addition, the most important issue is to identify both underground and above-ground RRRs in the system. In this study, cadastral systems, which are the cornerstone of sustainable land management, were analyzed with the vision of cadastre 2014 and 2034. Thus, it is aimed to contribute to decision-makers and academic studies by revealing the current situation of the countries and the position of Türkiye.

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Conflict of Interests

The Author(s) declare(s) that there is no conflict of interest.

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