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Geographic Information into Land Administration in Vietnam Land Use

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Abstract

Land use administration takes place as a dominant element, evidencing the correspondence between land and other economic sectors. Nowadays, the computerizing the land information system is increasing tendency, a prosperous state in the management of State management agencies as well as business or citizen. Geographic information system (GIS) has been extensive application in the stewardship of natural resources, waste, and traffic. The article presents a summary of the GIS application in Vietnam, dissociates the current situation of GIS application in land use administration, and worthwhile studies for policymakers in Vietnam. The article's limitation only shows GIS application into land use management, not into technical technology.

Keywords: Geographic information system - GIS, Land administration system - LAS, Integrated real estate information system - IREIS

1. Introduction

A geographic information system (GIS) is an information system that uses input data and analytical operations to produce an output geographically of the geospatial database for acquisition, storage, management, processing, analyzing, and displaying of spatial information. GIS assists in land use, natural resources, environment, traffic planning and administration. That is an obliging tool in urban sustainable development. GIS is a large data system in computers, accommodates AM/FM (Automated Mapping/Facilities Mapping) and mapping functions. GIS and its applications which combine GIS with GPS (Global Positioning System), are evolving rapidly, locating restaurants, hotels, and navigating, embedding into handheld devices (such as PDA - Personal Digital Assistant), laptops, smartphones and applying on website maps (such as Google Map, Map Quest, ...). It gives free access to geographical data, especially, geospatial image, Earth's surface changes over the years.

2. Geographic information system's application

2.1. Advantages of Geographic information system

Firstly, GIS has outstanding technology. GIS is a system consisting of computers and peripheral devices used to code, save, access, process, analyze, display, and export data. The GIS database contains data of objects, activities, and events distributed in space and time. Therefore, GIS is a technology that combines multitudinous types of technology (computer graphics, computer maps, space...). In particular, with its analytical ability, GIS is an advantageous software and applied in many ministries and sectors in Vietnam. Integrated with cloud computing, big data, artificial intelligence, and smart devices, GIS is created diverse applications in urban management, disease management; supported to make decisions in planning and sustainable development in the context of climate change (Đinh Hồng Phong, 2005)

Second, GIS data be applied to numerous fields on the same technological platform. Vietnamese provinces and cities use GIS to standardize and update information in industries and local land management. Ho Chi Minh City Department of Science and Technology operates a GIS database with a thematic database, remote sensing images and LiDAR (Light Detection and Ranging) data, which according to VN-2000 updated from 2010 to 2017, sensing images data from 2008 to 2011 and natural resources environment data since 2005. GIS database of Ho Chi Minh City is ongoing collected and updated.

Third, shared GIS data can be applied flexibly between industries and fields. Urban development is also strongly influenced by the laws of the market economy. In a short time, the transformation of urban land and the diversity of construction works put pressure on urban planners and managers. With the current development needs and future development trends, GIS applications is an extreme desideratum in smart city evolution, flexibly handling problems in many fields such as urban management, administration of industrial area, business documentation, commercial strategy, petroleum industry policy, population policy, disease control, environment and climate change, land policy, wildlife areas, waste management and pollution

2.2. Geographic information system's application in Vietnam

In Vietnam, GIS has been built to store, manage, access, process, analyze and provide the necessary information in many areas of public services. There are divided into three groups: (1) Simulated inventory applications. GIS is applied to the statistics of research subjects in a selected area (such as in forest, hydrology and land use administration); (2) Analytical applications. The GIS interface with the remote sensing satellite image system and digital map technology to serve decisions, accurate and analyzed information. (3) Management applications. A completely and continuously updated data has been established. Some examples of GIS applications such as: in the Environment (location, properties of forest trees, soil erosion process, air and water pollution, ...), in Hydrometeorology (a quick response system, serving to combat natural disasters such as flash floods in downstream areas, identify storm centers, predict flows, determine flood levels, etc.), GIS applications in Agriculture, land management (Harvest monitoring, land management system, soil research, irrigation plan, water testing,..), GIS application in Financial Services (determining branches) new bank, insurance and risk assessment tools, geology, property values,..), GIS application in Health (fastest route between current location of ambulance and patient) emergency personnel, disease research tools, schedules, infection maps, ...), GIS application for local authorities (search and management of land plots, replacing the current paperwork. , home maintenance, traffic, emergency situations, ..), GIS application in the Retail market (competitive supermarket location, asset management, finding the shortest delivery route,...), GIS application in

Traffic (location application in maritime transport, and Electronic charts, traffic flow maps, GIS applications for electricity, water, gas, telephone services...

Ho Chi Minh City (HCMC), the economic center and most populous city of Vietnam face a strong structural change since its market liberalization in the late 1980s. Big challenges occur in the form of uncontrolled urban sprawl due to rapid population growth with the encroachment of agricultural land, which leads to environmental and climatic issues like urban heat island effects, air pollution, and flooding events. Remote Sensing and Geographic Information Systems (GIS) provide new computer-based technologies for urban planners which can greatly ease the monitoring of agricultural loss as well as improve decision making for future land management (Mathias Schaefer, Nguyen XuanThinh, 2019) In Ho Chi Minh City, GIS is applied in economic management such as environmental resources industry, bus system, HCMC Planning Information, Covid-19 epidemic map, traffic map. A group of scientists from the Institute of Oceanography and the HCMC Geographic Resources Institute has researched and built a simulation model for quick warning of oil spills in the southern waters of Vietnam. The model allows determining the scope and path of the oil spill. (Nguyễn Quỳnh, 2021). HCMC University of Agriculture and Forestry and HCMC University of Technology have researched and applied Landsat 8 OLI, a satellite to image a drought map of the coastal areas in Ben Tre province. Its image is functional information over a large spatial scale and time series for forecasting land-use change in the future. Vietnam Posts and Telecommunications Group built a land management information system VNPT iLIS, with spatial databases (borderland groups, traffic, place names, cadastral, land plot, land occupier, current land use status, etc). This system can be deployed at land management, such as sub-departments, land registration offices, land fund development centers, etc, to perform land registration, grant land use right certificates, land use planning, land price. Some other applications such as GIS application in risk management and disaster reduction; Global Positioning System - GPS; Develop and evaluate the effectiveness of the route of domestic waste transportation in Da Nang city; 3D GIS technology; Telemetry application to monitor forest changes in Lam Dong (Cổng thông tin điện tử Bộ Giao thông vận tải, 2020)

2.3. Geographic information system's application in land use administration policy in Vietnam

Nowadays, applying modern technology with using remote sensing images and specialized software such as ENVI, GIS... in data processing, makes land management convenient and accurate. The Ministry of Natural Resources and Environment and the Vietnamese provinces have used GIS to analyze and zoning landforms, control land resources by mapping and classifying land. Each land type is represented by a specified color and background. The Attached distributing soil map shows out information such as location, area, etc. The information in map form helps the managers easy to analyze the changes in natural and human impacts. GIS technology is useful for land use planning. The data on land use, collected from the spatial observations processed in the GIS, is mapped and analyzed into input data which is output to the master plan map for Urban and Rural Locality Planning, Master Planning for Social Economics, and Rural Development Planning.

GIS is also an effective land management tool in urban development, economic development, investment management, and real estate business. GIS supervises the registration in separation and consolidation of land and then connects with the Department of Taxation to fulfill financial obligations on land such as registration fee, payment of land use fee, payment of land rent. GIS also supports land managers in the acquisition and clearance of land for real estate investment projects.

Specifically, GIS in Vietnam has been prioritized for investment in development and upgrading with great attention to information systems such as: Geographical Information System of Ho Chi Minh City- SAGOGIS; Information system on the current state of technology and environment of Dong Nai province – DONAGIS; Geographic information system for management of Ben Tre

province - BETEGIS; Quang Nam – QANAGIS; Geographic information system for agricultural management of Da Nang city – DANAGIS; Geographical information system for economic development in Binh Duong province - BIDOGIS. Plan to use satellite images to survey and map land use status systematically according to regulations of the total land inventory in the cadastral branch as well as to monitor and update changes in land use continuously in short-term cycles, is being periodically implemented by the Center for Remote Sensing – Ministry of Natural Resources and Environment

2.4. Limitations of geographic information system

Since the 90s, in Vietnam, GIS has been applied in some sectors such as natural resources and environment sector, agriculture and rural sector, transportation sector. However, the application of GIS is still not synchronized and appropriate. Some fields have actively approached but others have not because of funding not enough. The system is updated regularly in a short time but not maintained in long term because of scarcity in condition to upgrade hardware and software. Many urban planning or management organizations also invest in the basic system of database and application of GIS, but that can not be synchronized and is unsustainable. However, specialized databases and management systems do not have the connection and sharing of information and data in a synchronous and unified planning and construction manner. The database of land use has been completed but only used in closed documents. Many types of research and topics about GIS technology have been carried out widely but the applicability is limited.

3. Experience in establishing GIS systems in land management

3.1. Experience in building GIS systems in land management

In Kenya

An example of land ownership and an agricultural starting point similar to Vietnam is Kenya. Kenya is a country with a history of colonization and late independence among African countries, so its land ownership is state ownership according to old agricultural manners, which makes agricultural productivity low. The trend of applying science to land management in Kenya has facilitated the development and increased agricultural productivity. Most African governments have implemented land reform in the form of individualization of property rights through ownership registration schemes (private ownership or private lease on state-owned land). When implementing the application of land management by computerization, there are actually two models in Kenya: a geographically located land management model (LADM - Land Administration Domain Model) and a land management model based on land use. (STDM - Social Tenure Domain Model). Initially, the LADM model was officially implemented and the land administration in Kenya focused on investing in formal land title management with an interest in STDM.

LADM, is one of the standards specified in ISO issued in Switzerland in 2012 (ISO, 2012). It is a standardized model of land management. LADM provides an interface that allows the central land management agency to design the system, develop the system and implement the system as well as exchange data and manage data and land. (P. van Oosterom, C.H.J. Lemmen, 2015)

Besides LADM, STDM is a model of land management for the poor and informal property rights owners (outside the formal land tenure system). STDM allows a person who has “own” land to manually update the location to the system, which means that the software handles access to informal landowners (usually reclaimed, land). The software recognizes a wide range of rights and allows property rights to be extended to more people, including the urban and rural poor. This

creates an optimal solution for land management in Kenya in particular and African countries in general. (Augustinus, 2010)

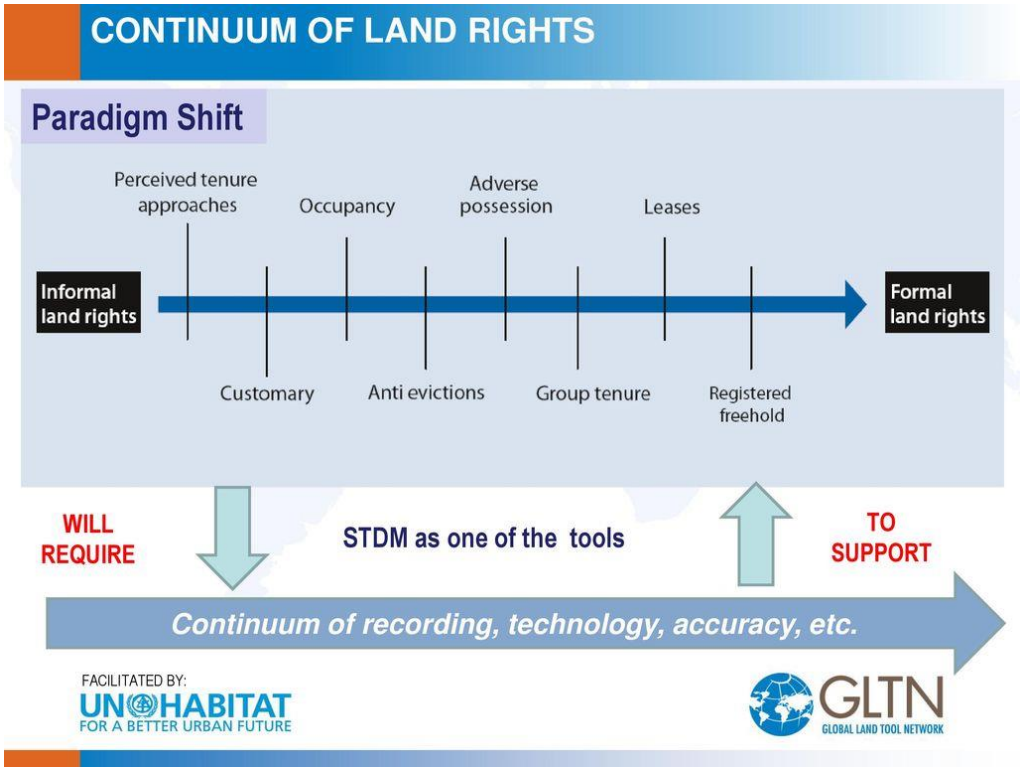

Figure 1: Continuum of land rights (Augustinus, 2010)

Experience drawn from Kenya's land management in GIS application is to build up both formal (LADM) and informal (STDM) models at the same time. These two models make good work of both land management according to central planning and updating information from the community.

In Poland

Application of GIS in Poland for land management through the creation of an integrated urban information system. This land management system includes sub-components such as: Integrated Real Estate Information System (IREIS), Geographic information system (GIS), Identification of Degraded Urban Areas (GIS – IDUA) includes detailed economic, political, social, and environmental information.

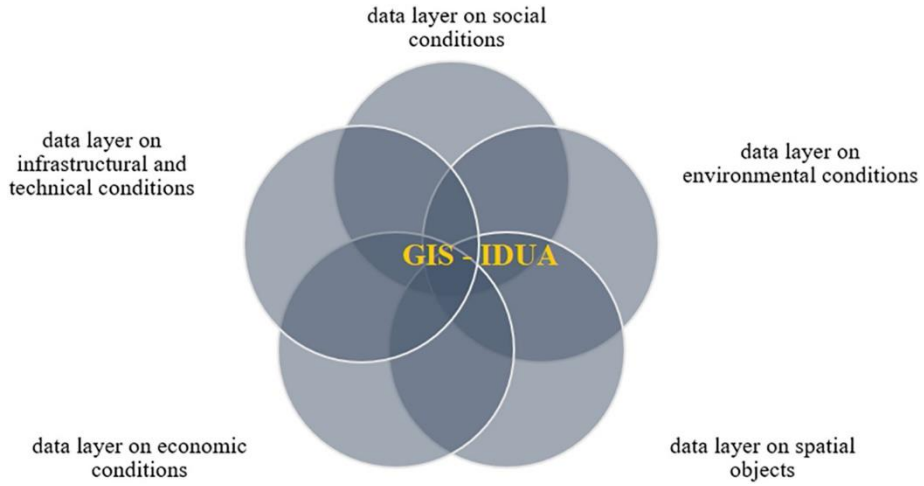

Figure 2: Data layers in the GIS-IDUA concept. (Zysk, 2020)

Type of cartographic material	Responsible entity
Basic map	Main Office of Geodesy and Cartography/
Cadastral map	Main Office of Geodesy and Cartography
Local zoning plan Reference drawings for the local zoning plan	Town Hall/Municipal office
Orthophotomap	Center for Geodesic and Cartographic Documentation
Topographical map	Center for Geodesic and Cartographic Documentation
BDOT (Topographical Features Database 10 k)	Center for Geodesic and Cartographic Documentation

Table 1: Cartographic materials for the identification of degraded areas (Zysk, 2020)

The GIS database model in Poland is stratified and decentralized according to the management level as described in Table 1, from the city council to the cadastral management centers. After assigning tasks to each level of management, they will proceed to plan the implementation plan for each stage. Phase 1 (from 2013 to 2015), phase 2 (from 2015 to 2018). The information was collected in phase 1 included information such as: land registration, fiscal register, topographic feature database, geoportal, population register, business register, register of agricultural producers, farms and requests for payment, land use plans, notary system, register of monuments, central register of nature protection. Stage 2, collect the following accumulated information: detailed location, street, specific address, real estate value, land unit price (Register of places, streets and addresses, Register of real estate prices and values.

Data/ Source	**Detail GIS- IDUA**
1. Social data	

Population register/databases in the relevant departments of municipal offices (e.g. Registry Office, Civic Affairs Department)	Registered and deregistered residents per address point, with a breakdown into pre-working age, working-age, and post-working age
Unemployment system/District Employment Agency (Labor Office)	Total number of registered unemployed persons, including the unemployment period (long-term unemployment) and education (lower-secondary and lower) per address point
Social Welfare System/Municipal Welfare Center	Number of persons receiving welfare benefits, with detailed information about the type of awarded benefits: alcoholism, chronic or debilitating illness, disability, domestic abuse, parental support, deprivation, unemployment (per address point)
Database of the State Election Commission	Voter turnout in presidential elections, Voter turnout in parliamentary elections, Voter turnout in local elections
Databases in the relevant departments of municipal offices	Number of places in special needs kindergartens with an indication of children attending special needs kindergarten by residence address and age (or age groups: 0–3 and 4–5 years)
Crime Register/Police	Number of domestic abuse files (per address point)
Business Register/National Court Registry/databases in the relevant departments of municipal offices	Number of non-governmental organizations (NGOs) (societies, foundations, social organizations) (per address point), Number of social integration events and fairs per year
Unemployment System/District Employment Agency; databases in the relevant departments of municipal offices/population census of Statistics Polan	Birth rate per 1000 in town/city, Migration rate per 1000; rate of migration across domestic and national boundaries
2. Economic data	
Business Register/courts; Population data/databases of Statistics Poland/database of the Social Insurance Institution (SII)	List of registered businesses in the REGON register, including newly registered businesses (per address point), Number of businesses per number of employed persons, Number of self-employed per 1000, Number of businesses per category
3. Spatial and functional data	
Cadaster/Main Office of Geodesic and Cartographic Documentation	Land area
Population data – Statistics Poland; Population Register/Cadaster	Average floor area per person in square meters and housing unit area in square meters,
Land Use Plans and other cartographic materials in databases in the relevant departments of municipal offices	Average distance to selected local facilities (culture, sport, recreation, transport, etc.) or public facilities, Number of commercial premises for lease
Register of Vehicles/Transportation departments in county offices	Number of registered vehicles, Number of parking spaces (distance from town/city center), Availability of public transport to the

	town/city center, Number of public playgrounds and family recreation facilities,
4. Environmental data	
Central Register of Nature Protection/Chief Inspectorate of Environmental Protection	Daily average PM10 and PM2.5 emissions
	Types of nature protection
5. Technical/infrastructure data	
Geodesic Register of Utility Networks	Length of district heating networks. Length of district water supply and sewerage networks. Technical condition of electrical, gas, water and heating networks, Infrastructure description (sidewalks and lighting)
	Length of cycling lanes, assessment of pedestrian walkways
Cadaster; Databases in the relevant departments of municipal offices	Number of occupied residential buildings constructed before 1989/total number of occupied residential buildings
	Housing conditions (housing development). Number of apartments
	Number of council housing units, including the number of rooms
	Housing development standard, Number of welfare housing units in council housing, including floor area m^2

Table 2: An analysis of the applicability of the Polish LAS (IREIS) for the identification of degraded areas in the social context (Zysk, 2020)

Poland developed the stages to collect input information for the data system. Phase 1 and phase 2 are the data collection phase. The cumulated data was the differences between regions, find solutions, find out the causes of underdevelopment of an area to facilitate that area in the future.

4. Some proposals for the implementation of GIS application in land management in Vietnam

The application of GIS in urban management must be systematic and synchronous. The application should have unified institutions and apply sanctions. In fact, in the last 20 years, Vietnam has had the development of GIS but its application to urban planning and management is still inadequate and difficult. Therefore, it is necessary to properly identify the importance and development trends and have appropriate development policies so that GIS can maximize its effectiveness in land management and urban management, contributing to the development of GIS's future smart city development. Since then, the State needs to issue decrees and circulars guiding the application of GIS to urban development management, which requires many policies and synchronous mechanisms such as strengthening synchronous capacity from the central government to the locality; appropriate hardware and software investment; unify the set of information indicators; update information on a quarterly and annual basis; maintaining the investment mechanism for the annual upgrading work; multi-level information exchange according to specific management objectives.

GIS technology applied in the field of natural resources and environment is an important part of the economy, especially, applications in land management and the system of connecting fields and industries of the construction process and smart city development in Vietnam today. Some application proposals related to land management, real estate investment and business that can be applied in Vietnam today are as follows:

Firstly, the application of GIS technology helps managers identify areas and localities that are hot spots in land development and management by relying on fluctuations in data of purchase, sale, transfer, separation and consolidation of land plots. From there, managers will have management policies and legal documents issued in accordance with the situation of civil transactions on land, development policies corresponding to each changing area.

Second, the combination of land price data set by the State, market land prices and land management data to assess areas where land prices rise or fall, with large fluctuations in land use rights transaction values to have timely policies and sanctions.

Thirdly, the data on the licensing of investment and construction projects makes the construction investment of an area, an area abnormal or normal. It is shown visually through remote sensing images of GIS technology. Seeing this helps the land use planning work to be reasonable, appropriate and synchronous among urban areas.

Finally, GIS technologies applied in the fields of transportation, environment, healthcare, retail, public utilities, etc. are applications that support land management in terms of synchronous development of the area. In particular, the synchronous construction of GIS technology in all fields will stimulate businesses, business investors, and real estate investors to conduct feasibility studies to invest in project development, infrastructure development, and investment urban floor... is a factor to build a smart city and improve the quality of urban life.

In addition to the current difficulties, GIS is still developing more and more widely in Vietnam. With the attention and investment in research and development, it is certain that in the coming decades, Vietnam will have great effects on the use of GIS technology in the fields of socio-economic development in general. , in land management in particular.

CONCLUSION

Through the process of searching and collecting data on the history of GIS formation in the World, Vietnam, and Ho Chi Minh City, the study presents a geographical information system that was formed not far away, but in everyday life, due to the human need to use time more sparingly, to manage things better. Before that necessary need, people came up with the idea of building a geographic information system (GIS), so GIS was formed very early, right when people knew how to expand their residential areas, know how to communicate. Traders had to think about finding the shortest way, they had to think about finding the most convenient way. However, it was not until the early years of the twentieth century that GIS technology was officially formed and developed more and more modernly and widely, due to the increasing demand of people, the growing physical conditions of the society. The more developed, science and technology is more and more modern, and it also promises a more open future. In addition, the process of learning about the history of GIS formation in the World, Vietnam, and Ho Chi Minh City, shows that the process of formation and development of GIS in Vietnam is still slow and has not been widely applied by the public this technology. In particular, the importance of GIS application in land management contributes significantly to the planning of land policies in each region, contributes to the development of economic development strategies and is a tool for stabilizing and managing land real estate market management.

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