

Improving the database on land use planning in Vung Tau city, Ba Ria - Vung Tau province

Linh D. T. Truong

Faculty of Land and Real Estate Management, Nong Lam University, Ho Chi Minh City, Vietnam

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*Corresponding author

Truong Do Thuy Linh
Email:
truongdothuylinh@hcmuaf.edu.vn

ABSTRACT

Vung Tau city is an area where management of land use planning (LUP) and urban planning is quite complicated and has been successful in building LUP database. However, this database still has limitations that must be addressed, including (1) lack of data layer on current land use for building LUP database, (2) incompleting LUP attribute database, (3) lack of metadata, (4) no connection between LUP database and digital legal materials and (5) no overlay cadastral database to data layer of current land use and LUP database. To solve these problems, this research used many methods such as documents and data collection, inheritance, expert interview, data processing and analysis, mapping, GIS application, and IT applications. The results of this study showed that the structure of cadastral database of 8 wards was successfully converted from existing structure (according to Circular 17/2010/TT-BTNMT) to the standard structure (according to Circular 75/2015/TT-BTNMT). The 2019 land inventory data was standardized and data layer of current land use for whole city was built. In addition, the LUP database (period 2010 - 2020) for Vung Tau was improved, including: supplementing attribute information, completing metadata, connecting LUP database with relevant digital legal records, overlaying cadastral database with LUP database and data layer of current land use. Briefly, our results could be a foundation to help Vung Tau manage land sustainably, contribute to successfully building national land database and meet the exploitation requirements of LUP information in accordance with the orientation of Ministry of Natural Resources and Environment for study area.

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1. Introduction

Vung Tau city, Ba Ria - Vung Tau (BR-VT) province is an area where many projects are being implemented, so the demand for information about land and construction of people is extremely large. However, Vung Tau still does not have a complete land use database. Firstly, the operating cadastral database was built according to the old regulations in Circular No. 17/2010/TT-BTNMT and Circular No. 04/2013/TT-BTNMT. Next, the database of land use planning (LUP) has just been tested and showed many shortcomings, such as: (1) lack

of data layer on current land use for building LUP database, (2) incompleting LUP attribute database, (3) lack of metadata, (4) no connection between LUP database and digital legal materials, (5) no overlay the cadastral database to data layer of current land use and LUP database. To exploit LUP database more effectively, it is very necessary to keep on improving LUP database in accordance with the active regulations for Vung Tau. It will be a useful tool in the land management of locality and the process of capturing LUP information of citizens, as well as meeting the requirement of exploiting LUP database in accordance with the orientation of MONRE.

2. Materials and Methods

Vung Tau archived full legal documents on the formulation of LUP (2010 - 2020) and adjustment of LUP (2016 - 2020). The works and projects in LUP (2010 - 2020) and LUP adjustment (2016 - 2020) are presented quite specific and exactly (PC of BR-VT, 2014 & 2019).

Vung Tau already had a testing LUP database (2010 - 2020), which was one of products from scientific project was approved in 2021 (Truong, 2021). By using VBDLIS, study built a testing LUP database (2010 - 2020) for Vung Tau in accordance with MONRE regulations (MONRE, 2017 & 2018) with 6 data layers contains information about LUP, LUP adjustment and corresponding projects (QuyHoachS-DDCapHuyen, CongTrinhDuAnCapHuyen, DieuChinh_QuyHoachSDDCapHuyen, DieuChinh_CongTrinhDuAnCapHuyen, DoiTuongThaiThamVan and YkienThamVan). Results of building testing LUP database on VBDLIS include (1) successfully built spatial database of LUP and adjusted LUP for whole city, (2) automatically imported LUP attribute data for whole city and (3) supplementing all data that have not been automatically imported for Ward 8, Vung Tau city with specific results (Table 1).

Table 1. Statistics on number of data records managed on land use planning (LUP) database (Unit: record)

No.	Data content	Vung Tau city	Ward 8
1	LUP	22,294	168
2	LUP project	164	8
3	LUP adjustment	14,650	700
4	LUP adjustment project	570	36

Source: Truong (2021).

2.1. Data collection and evaluation

With many methods (Vu, 2007) such as collecting documents and data (secondary and primary), select research site, inheritance, expert interview, data processing analysis, the study has collected full necessary documents and data for improving LUP database (period 2010 - 2020) of Vung Tau (LUP maps, LUP options and LUP database; cadastral database; 2019 land inventory data and other relevant documents and

data). Results of analyzing and evaluating input data showed that data quality basically meets requirements of improving LUP database:

(1) Cadastral database is basically managed in accordance with regulations on management, exploitation, usage and updating cadastral databases (Table 2). However, this database was built before 2015 (Circular No. 17/2010/TT-BTNMT), and it is no longer consistent with land data standard in Circular 75/2015/TT-BTNMT. It has caused many difficulties for process of synchronizing databases at all levels and cannot be integrated into national land database (Truong, 2018), including LUP database. To help LUP database meet the requirements of MONRE, it is necessary to convert data structure of current cadastral database from existing structure to the standard one (MONRE, 2015).

Table 2. Statistics on number of data records managed on cadastral database

No.	Data content	No. of record
1	Land manager, land user and owner of property on land	102,139
2	Parcel	101,686
3	Property on land	72,529
4	Land use right certificate	98,050
5	Land use change registration	152,317
6	Records are conducted by electronic ISO process	116,486

Source: Land registration office of BR - VT province.

(2) The data source on current land use was dataset of 2019 land inventory and current land use map (PC of BR - VT, 2020). This dataset was basically complete, accurate, clear and consistent with MONRE regulations (MONRE, 2018) as shown in Table 3. However, land decamation layer on spatial data is incorrect (located at level 10 instead of level 5). Therefore, converting current land use data to the data standard of land inventory and statistics has been done previously (MONRE, 2015 & 2018). To successfully build data layer of current land use, it is necessary to carefully review and standardize this data source.

(3) Legal documents of LUP created a good support for process of digitizing records and connecting digital records into LUP database. The works and projects in LUP (2010 -2020) and LUP adjustment (2016 - 2020) are presented quite specific and exactly. They help process of supplementing content of LUP database to be more ad-

vantageous; and help all kinds of user easily exploit, access and look up information from this database (Truong, 2021).

Table 3. Statistics on number of data records in 2019 land inventory dataset

No.	Data content	No. of record
1	Area	17,747
2	Object code	17,747
3	Previous period's object code	6,594
4	Land type code	17,747
5	Previous period's land type code	6,594

Source: Land registration office of BR - VT province.

(4) LUP database just stopped at testing phase and remained many limitations such as: (1) lack of data layer on the current land use; (2) attribute database was incomplete because VBDLIS did not automatically import all input data into LUP database; (3) not connect LUP database with digital legal documents; (4) lack of metadata; (5) has not overlaid cadastral database to data layer of current land use and LUP database because the structure of cadastral database was incorrect with the active land data standard (MONRE, 2015). This problem has caused a lot of difficulties in land management of the locality and the process of capturing LUP information of citizens. To improve LUP database for Vung Tau, it is very essential to overcome the above limitations.

2.2. Improving LUP database (period 2010 - 2020)

With GIS application method (Le, 2007), ArcGIS Desktop 10.1 was used to extract and review existing cadastral spatial data to well support a process of transforming this data into new structure (MONRE, 2015). MicroStation was used to review and standardize 2019 current land use map in accordance with prescribed standards (MONRE, 2018) for building data layer of current land use.

With method of applying Information Technology (Le, 2007), Microsoft SQL Server DBMS and ViLIS 2.0 were used to extract cadastral database and synthesize data for assessing the state of cadastral database. Many modules of VBDLIS were used to improve LUP database as: (1) LISEditorTC in converting cadastral spatial data, exporting electronic cadas-

tral books and registration information; (2) VBDLIS.ConvertData in converting cadastral attribute data and connecting cadastral database to VBDLIS system; (3) QuyHoachKHSDD Desktop in building data layer of current land use, supplementing content of LUP database, completing metadata content, connecting LUP database with digital legal records, overlaying cadastral database with LUP database and data layer of current land use for whole city.

From results of the data input assessment, LUP database (2010 - 2020) was completed as shown in Figure 1.

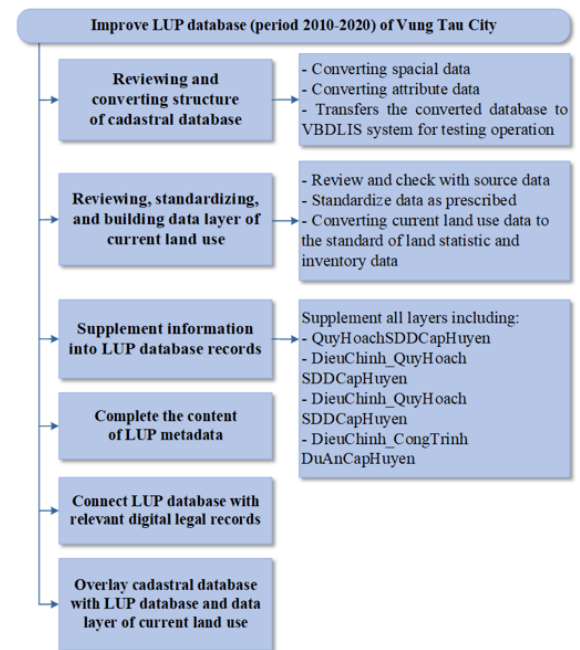


Figure 1. Process of improving the database on land use planning (LUP).

3. Results and Discussion

3.1. Cadastral database structure conversion

Process of converting cadastral database structure is carried out sequentially for each ward by 2 steps: converting spacial data as shown in Figure 2 and converting attribute data as shown in Figure 3.

By LISEditorTC Module of VBDLIS, cadastral spatial database of 8 wards has successfully been converted (Table 4). Result has created a

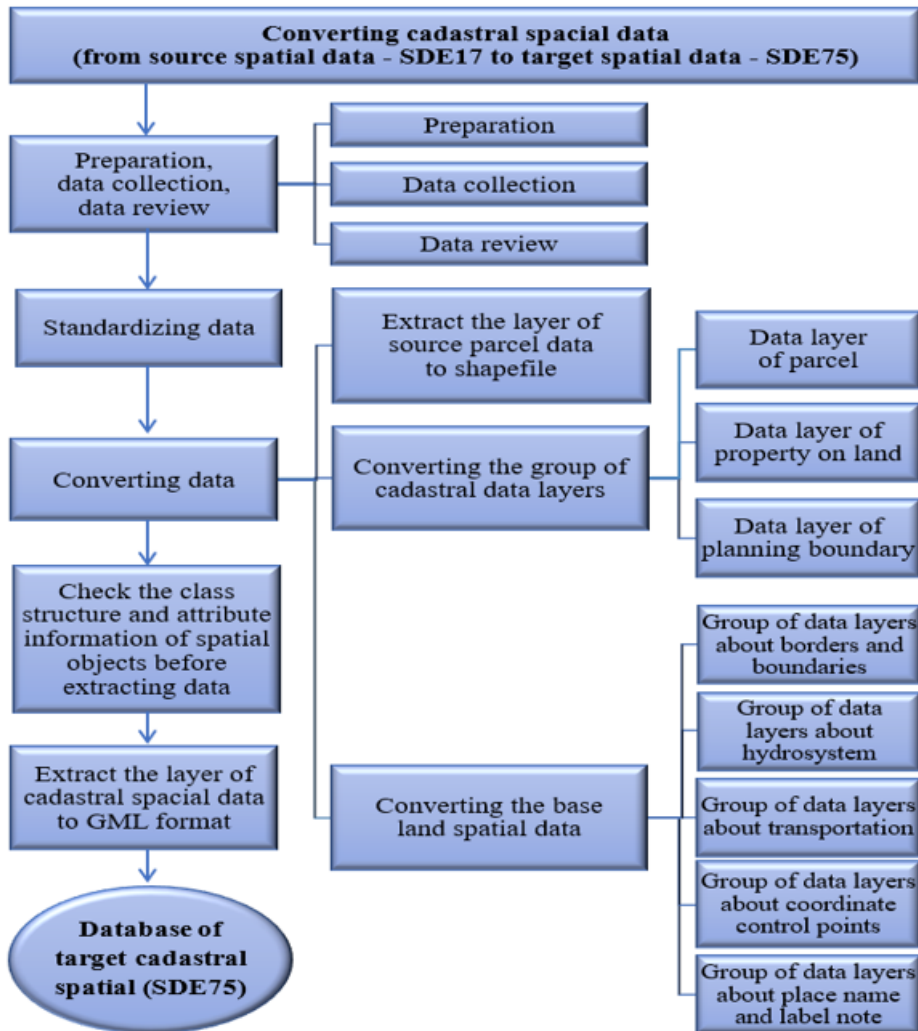


Figure 2. Process of converting cadastral spacial data.

SDE17: Existing cadastral spatial database was built according to Circular 17/2010/TT-BTNMT.

SDE75: New cadastral spatial database, which was converted to legal data standards in Circular 75/2015/TT-BTNMT.

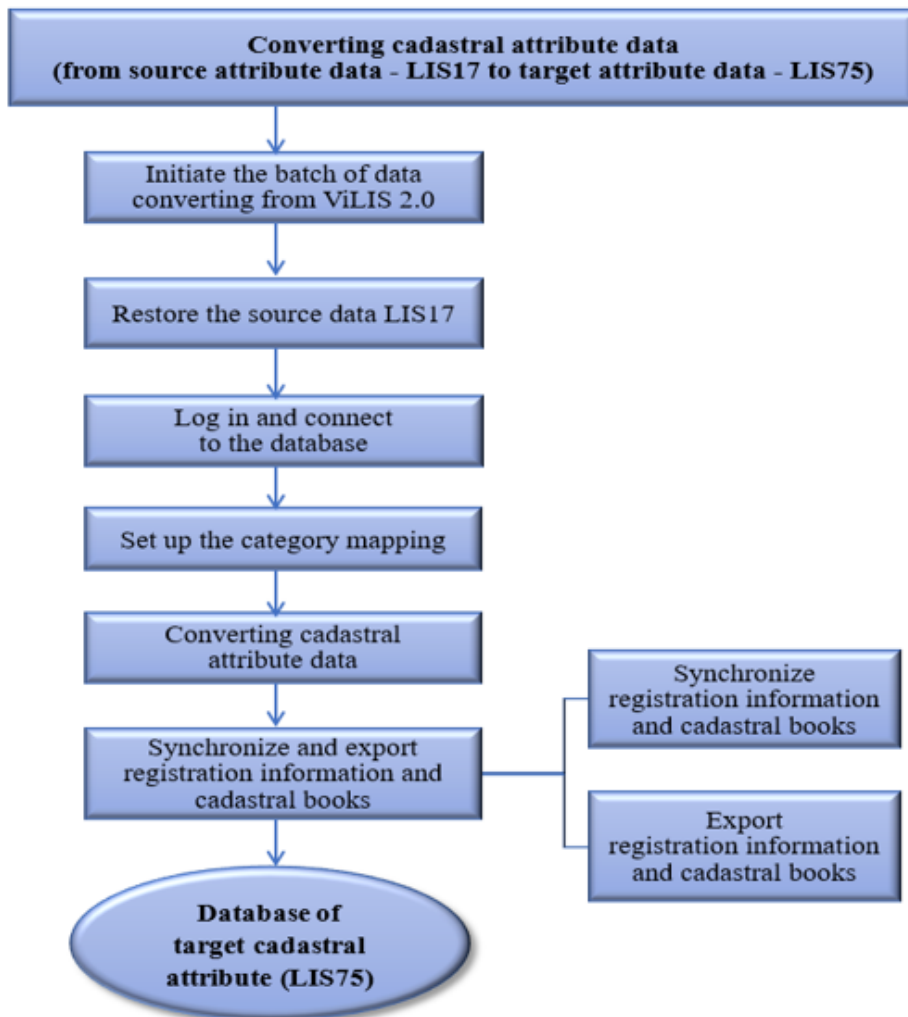


Figure 3. Process of converting cadastral attribute data.

LIS17: Existing cadastral attribute database was built according to Circular 17/2010/TT-BTNMT.

LIS75: New cadastral attribute database, which was converted to legal land data standards in Circular 75/2015/TT-BTNMT.

Table 5. Results of converting cadastral attribute data

No.	Administration unit	Parcel data (record)	Data on registration application (record)	Digital cadastral book (file)	Registration information in *.xml format (file)
1	Ward 8	6,325	6,307	6,240	1
2	Ward 9	3,577	3,592	3,575	1
3	Ward 10	6,467	7,004	6,472	1
4	Ward 11	4,941	4,851	4,938	1
5	Ward 12	13,565	13,549	13,563	1
6	Nguyen An Ninh	3,658	4,026	4,035	1
7	Rach Dua	5,949	5,940	5,947	1
8	Thong Nhat	4,037	4,059	4,037	1
	Total	48,519	49,328	48,807	8

Table 4. Results of converting cadastral spatial data

No.	Administration unit	Base land spatial data (record)	Cadastral spatial data (record)	Digital cadastral book (file)	Registration information in *.xml format (file)	Cadastral spatial data in *.gml format (file)
1	Ward 8	549	10,046	10,046	13	13
2	Ward 9	631	4,996	4,996	13	13
3	Ward 10	632	9,407	9,407	13	13
4	Ward 11	1,094	11,385	11,385	13	13
5	Ward 12	2,063	17,691	17,691	13	13
6	Nguyen An Ninh	379	5,029	5,029	13	13
7	Rach Dua	555	9,180	9,180	13	13
8	Thong Nhat	985	12,937	12,937	13	13
	Total	6,888	80,671	80,671	104	104

cadastral spacial database which is accurate, synchronous, adaptable with legal standard and well supports the process of improving LUP database.

The conversion process of cadastral attribute data (from LIS17 to LIS75) is conducted by data conversion tool of VBDLIS. This work requires to be carried out carefully and in the right order to ensure high accuracy and reliability in mapping process of each record (Table 5).

Then, study transfers converted database to VBDLIS system for testing operation via <https://dt.mplis.gov.vn> (Figure 4) to serve multiple purposes in land management. Because all land information will be updated fast, easy and timely as well as securely stored for minimizing possibility of data leakage, due to less affection from objective factors. Database security will be much higher than traditional method. Achieved results will support locality in managing, exploiting, using and sharing of cadastral database in an effective way; and facilitating process of improving LUP database, successfully building land database for BR - VT and nationwide.

3.2. Building the data layer of current land use

The current land use data plays an important role in data building for many purposes such as: (1) generalize results of land statistics and inventory on map; (2) basic documents for territorial and land management; (3) priority documents on serving formulation of LUP and inspection of approved LUP implementation process. To successfully improve and operate LUP database, it is very crucial to build a data layer of current land use (Figure 5).

By VBDLIS, data layer of current land use has successfully built with sufficient data (spatial and attributes) and in accordance with data standard, ensures the accuracy and necessary quality. The results serve well the process of integrating and improving LUP database at locality (specifically in Table 6; Figure 6):

3.3. Inserting data into the LUP database

From existing LUP database, to improve and exploit LUP database effectively, study supplement necessary contents into all records that were not automatically imported by VBDLIS (Truong, 2021) (Figure 7).

After all, LUP database contains full informa-

tion (spatial and attribute) in accordance with approved map and LUP with high accuracy and consists of 4 data classes as shown in Table 7.

3.4. Completing the content of LUP metadata

The LUP metadata helps to describe the most complete and detailed description of data and quality of data which is contained in LUP database, served effectively for process of exploiting, operated and shared LUP database. Study has supplemented 65 records of metadata for LUP data (Figure 8), ensured to describe completely about LUP data as regulation, and contributed to improving legality and quality of LUP database.

3.5. Connecting LUP database with relevant digital legal records

Connecting LUP database with relevant digital legal records to support users to look up 3 blocks of LUP information simultaneously (spatial, attributes, original record image). All digital legal records related to formulation and management of LUP have been successfully connected to LUP database (Figure 9).

The results support users to look up information comprehensively, help to strengthen legal value of LUP database and increases user's trust in the information which accessed from database, reduce time of searching related information, improve the rigor, and ensure the publicity and transparency in process of implementing LUP at locality.

3.6. Overlay cadastral database with LUP database and data layer of current land use

Overlaying cadastral database with LUP database and data layer of current land use helps users look up LUP information comprehensively (cadastral, land use status, LUP) and the management of LUP be more quickly, accurately, conveniently and transparently (Figure 10).

Except LUP information, users also look up more information about cadastral and current land use of parcel affected by LUP option (username, land parcel ID, address, area, current land use); help to exploit and query LUP information more comprehensively, meet the need of diversity objects in land transactions and looking

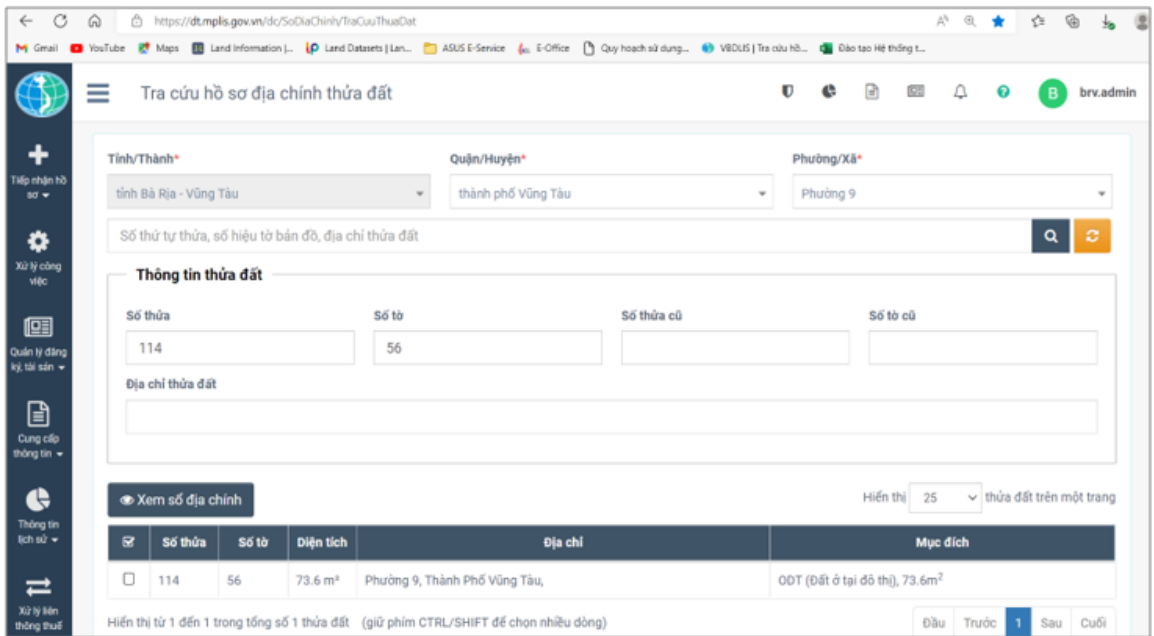


Figure 4. Result of importing the completed cadastral database to VBDLIS system.

Source: <https://dt.mplis.gov.vn/>.

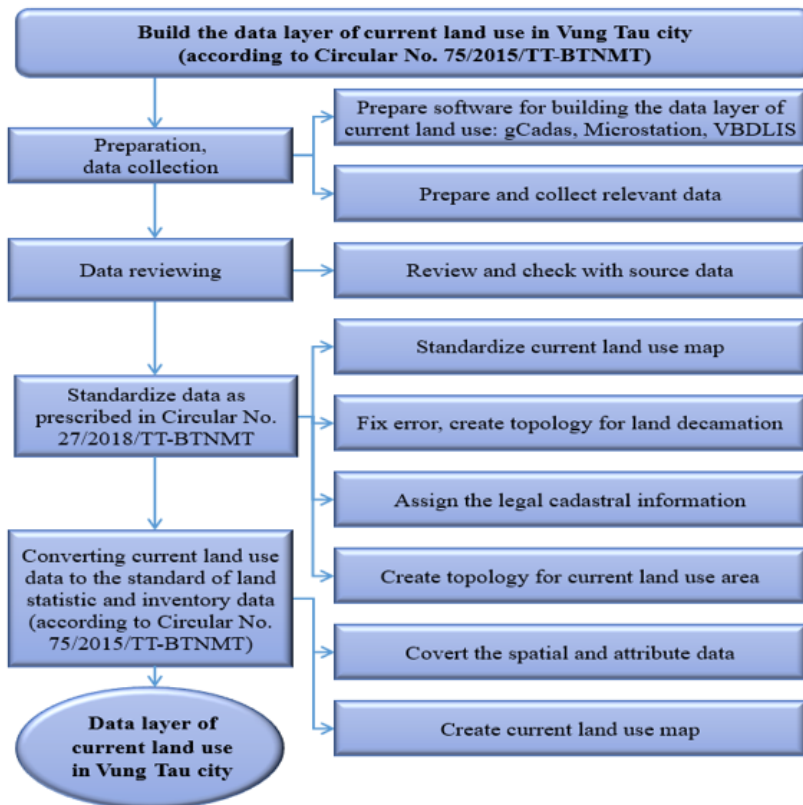


Figure 5. Process of building data layer of current land use.

Table 6. Result of building data layer of current land use

No.	Administration unit	No. of land demarcation	Area (ha)
1	Ward 1	511	178.18
2	Ward 2	536	293.68
3	Ward 3	818	90.04
4	Ward 4	400	80.92
5	Ward 5	1,345	399.81
6	Ward 7	440	162.49
7	Ward 8	613	198.93
8	Ward 9	213	329.57
9	Ward 10	1,053	404.03
10	Ward 11	1,528	1,040.19
11	Ward 12	3,600	3,708.93
12	Nguyen An Ninh	642	480.07
13	Rach Dua	744	610.65
14	Thang Nhat	1,540	859.76
15	Thang Nhi	654	273.46
16	Thang Tam	581	249.92
17	Long Son	2,535	5,728.97
Total		17,747	15,089.60

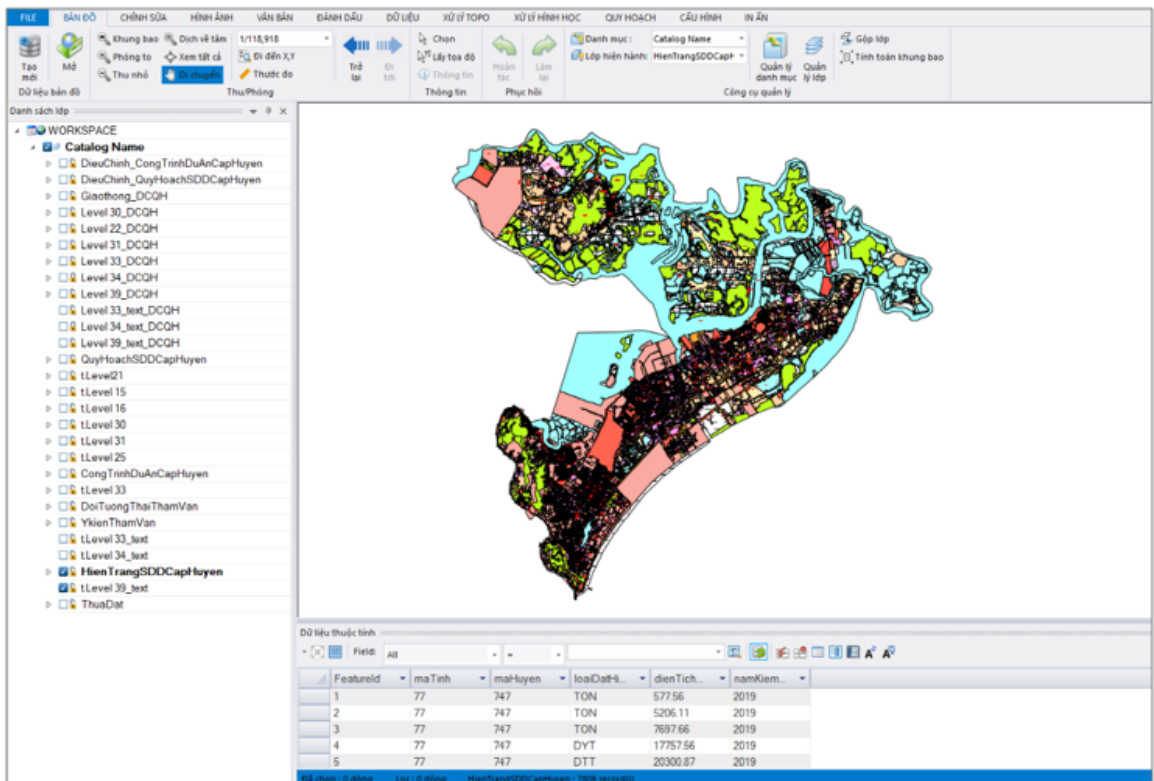


Figure 6. Results of building and overlaying data layer of current land use.

Table 7. Results of inserting data into the land use planning (LUP) database

No.	Name of data layer	No. of record
1	QuyHoachSDDCapHuyen layer	2,760
2	CongTrinhDuAnCapHuyen layer	37,580
3	DieuChinhQuyHoachSDDCapHuyen layer	4,054
4	DieuChinhCongTrinhDuAnCapHuyen layer	2,887
Total		47,281

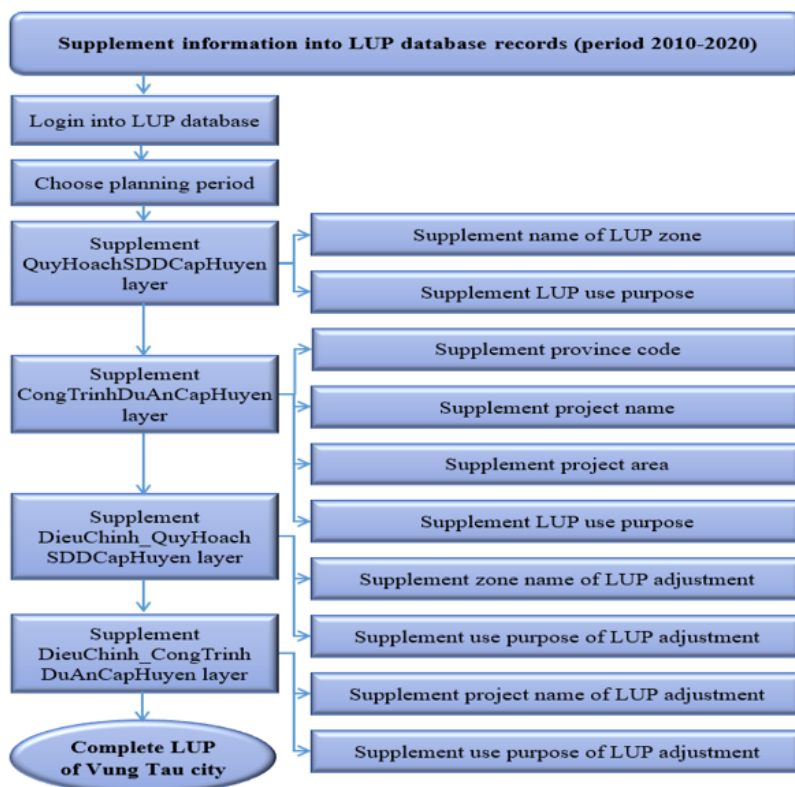


Figure 7. Process of supplementing information into land use planning (LUP) database.

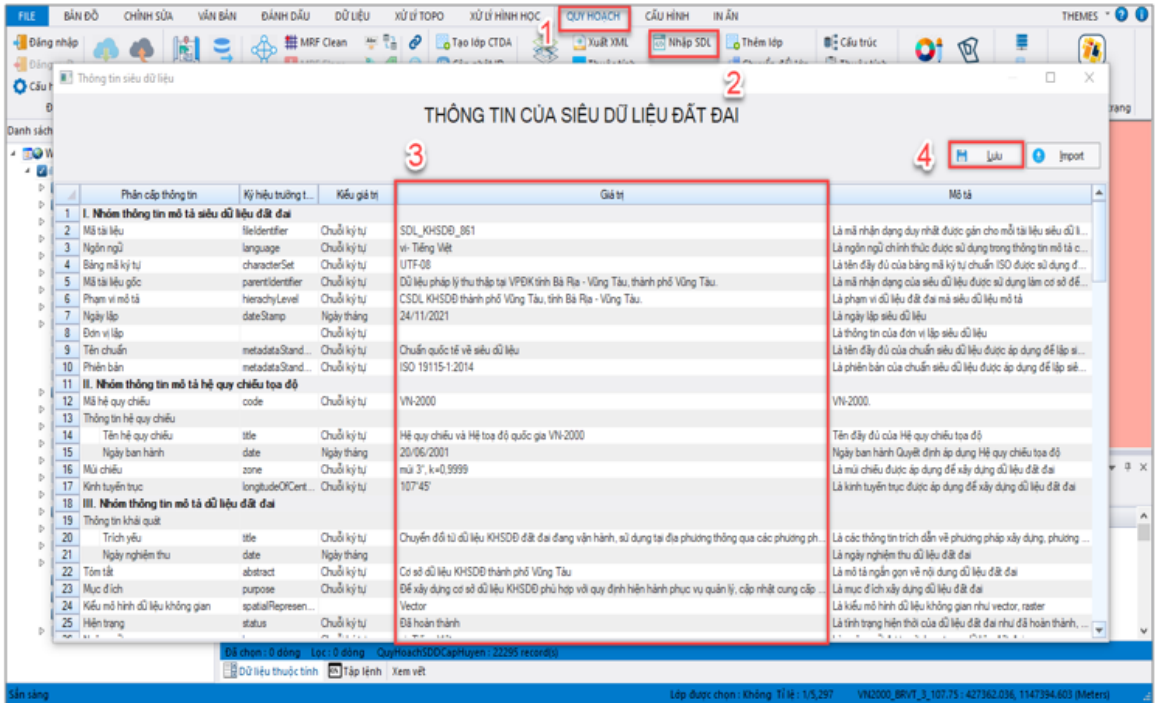


Figure 8. Results of completing the content of land use planning (LUP) metadata.

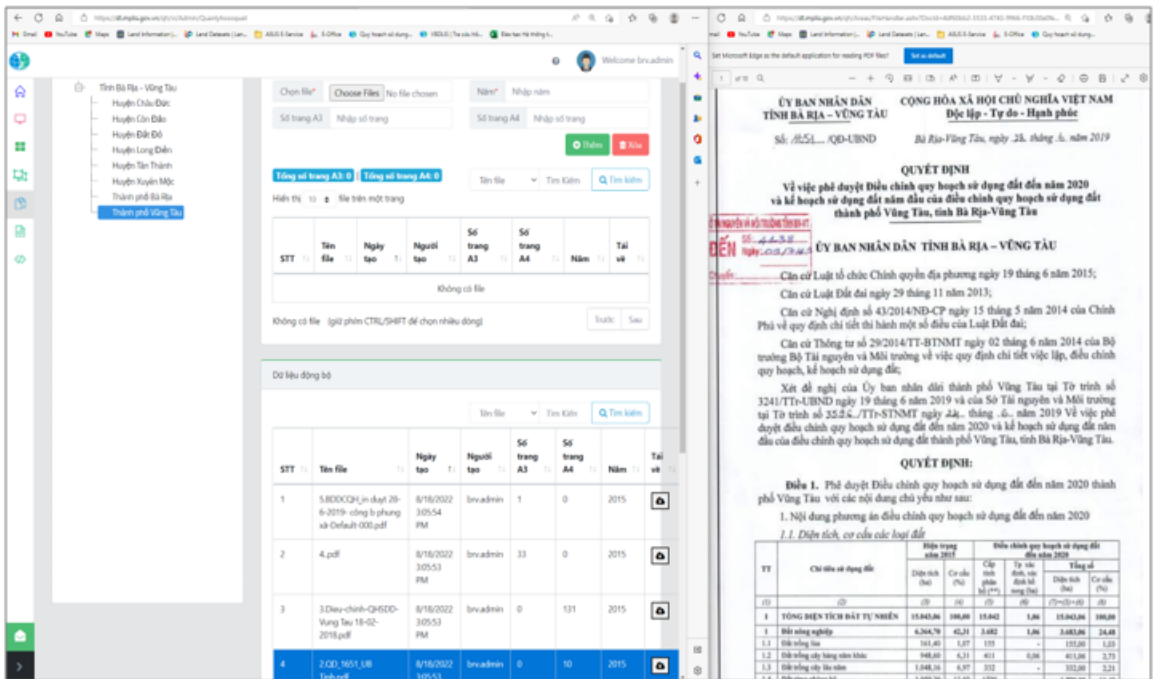


Figure 9. Result of connecting land use planning (LUP) database with relevant digital legal records.

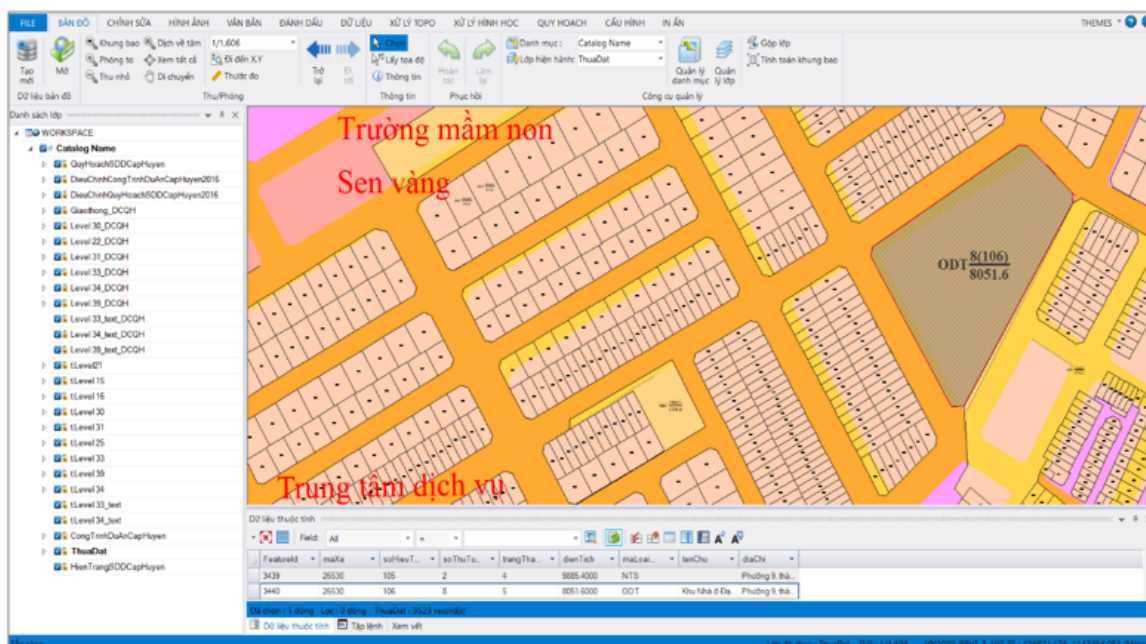


Figure 10. Result of overlaying cadastral database with land use planning (LUP) database and data layer of current land use.

up LUP information; and contribute to improving the publicity, transparency and reliability of citizens on decisions of local authority.

3.7. Discussion

From 1993 to 2021, in Vietnam, there were many studies around application of science and technology in formulating and managing LUP. That is scientific basis for perfecting policies and serving process of LUP modernization. However, those researches stop at applying information technology into some phases of data calculation and map digitization, there is no synchronous solution for database establishment and exploitation. The promulgation of standards for land databases, including standard for LUP databases (TCVN 13343:2021) mainly serves the goal of building a national land database (MOST, 2021). Many experimental studies on building district-level LUP database were carried out based on LUP options of respective period, but were incomplete, did not meet current data standards and existed many inadequacies in terms of content, data standards, infrastructure for management, exploitation and sharing database (Tran & Le, 2010; Doan et al., 2017; Nguyen et al., 2019). Researches on innovation and improvement of

LUP processes, complete software to support development of LUP plans, GIS application and multi-criteria analysis methods to support selection of optimal LUP option (Nguyen et al., 2006; Nguyen, 2019; Pham, 2020)... have also been implemented in many places. However, these studies mainly focused on construction of a set of land use indicators in LUP at all levels and development of a set of economic, social and environmental criteria to evaluate effectiveness of LUP option for each level.

Up to 2021, "Research to design the model of LUP database at district level which is associated with the community consultation factor in Vung Tau city, BR - VT Province" (Truong, 2021) was the first work in Vietnam that addresses the issue of building LUP database in accordance with national database standards and mentioning to community consultation factors in LUP. Author analyzed the importance of community consultation in State management in Vietnam (especially in land management and LUP); and designed database model of LUP, which was associated with the community consultation factor, for Vung Tau in accordance with land data standards of Circular 75/2015/TT-BTNMT; successfully built a set of LUP database structure (with 22 spatial data tables on ArcGIS and 8

attribute data tables associated with the community consultation factor, on Microsoft SQL Sever), which was in high-precision and in line with data standards of MONRE and designed database model. By VBDLIS, study successfully build LUP database (period 2010 - 2020) for Vung Tau with 6 data layers: LUP data layer (15,060 records), project layer (163 records), adjustment LUP layer (12,002 records), adjustment project layer (570 records), and 2 data layers of community consultation. Results showed that the corrected model and completed database structure set were the basic for successfully building and effectively exploiting LUP database. This was the premise to implement land manage in accordance with approval LUP and improve land use efficiency in locality. However, this study needs to be further improved because the results obtained are only at experimental stage. This test LUP database of Vung Tau still has many limitations, has not fully met regulations of MONRE and actual exploitation needs in locality.

Together with priority development strategy of Viet Nam to be perfect and modernize land management industry with main goal is to build a complete national land use database (TECOVCP, 2022), it is very necessary to study and improve LUP database in accordance with national land data standards and associated with community consultation to improve the feasibility and effectiveness of LUP option. Closely linking LUP with community consultation factors will create conditions for citizens to boldly participate in contributing more ideas to process of making and managing LUP; help to increase the publicity, transparency and feasibility of LUP option; successfully building a modern, effective and efficient electronic land management system.

In general, results of this study have addressed the remaining problems in test LUP database of Vung Tau, proved the correctness and urgency in policy and orientation of MONRE on building a synchronous and unified national land database, which based on completing component databases (including cadastral database, land inventory and statistics database, LUP database and land price database, ...), (MONRE, 2015 & 2017). It creates a good condition to establish successfully land database and support process of administrative reform through online public services on land. It will help to meet the requirement of exploiting information from land and LUP in accordance with

orientation of MONRE for the study area. These results can become useful references for further studies and be a basis for duplicating the model to other localities which have similar conditions.

To exploit the improvement of LUP database effectively and meet requirements of integrating and building land database in accordance with current regulations and directions for sustainable land use and management (TECOVCP, 2022), it is necessary to implement relevant further studies, including:

(1) Build models that help manage, operate, share and integrate LUP database into land database (MONRE, 2017) in the study area as LUP information system, provincial land information system, LUP database management, user management, exploiting and operating LUP database, sharing LUP database and integrating LUP database into land database.

(2) Supply classes of approved LUP (period 2020 - 2030), including mention to community consultation factor in LUP.

(3) Evaluate the status of community consultation in process of making and implementing LUP plan (period 2020 - 2030) in Vung Tau.

(4) Deploy to collect comments of local community and developing tools to collect, synthesize and process community consultation information to complete data layer of community consultation in making and managing LUP (period 2020 - 2030).

(6) Keep researching to establish land database model based on building and completing the remaining component databases for Vung Tau includes cadastral database, database of land statistic and inventory, land price database, land resource database... (MONRE, 2015).

4. Conclusions

The study has succeeded in addressing limitations of LUP database (2010 - 2020) for Vung Tau, as: (1) converting data structure of cadastral database; (2) building data layer of current land use; (3) supplementing 47,281 missing records of approved LUP into LUP database; (4) supplementing 65 metadata records; (5) connecting digital legal file to LUP database; (6) overlaying cadastral database with LUP database and data layer of current land use. Obtained results help Vung Tau to get completed LUP database in both structure and content according to the current

regulations, which helps process of exploiting and querrying LUP information to be more comprehensively, meets the needs of users in land transaction and looking up information... This is an important premise to build a land database for the locality and synchronize with land database at all levels. LUP database is a useful tool to support locality in managing and implementing LUP option, towards sustainable land management. The method of exploiting LUP database on network environment of VBDLIS system helps to improve the publicity and transparency of LUP plan and create good condition for citizens in grasping information when needed. It creates a favorable and healthy environment of real estate investment, improves people's living standards and contributes to the development of real estate market and local economy.

Conflict of interest

The author has no conflicts of interest to declare.

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