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BUILDING TOOL FOR CALCULATING LAND PRICE OF TAN PHU DISTRICT, HO CHI MINH CITY

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ABSTRACT

Land price is a very important information to many fields and objects that is related in our society. Tan Phu District, Ho Chi Minh City where has a very complex process of urban development so land price is extremely nescessary to invest and manage. The development of GIS technology and its application have promoted many strengths in land management including land price. Aiming to manage land price and real estate market effectively, the study had sucessfully defined a formula for calculating land price with a set of weight values of indicators that impacted to land price in the study area by AHP; moreover; defining the distances of the market and State land price and setting a tool for calculating land price on Web base for study area by using integration of GIS and WebGIS. The results had effectively supported for the locality in managing and using land price data, as well as setting a background to look up all information relating to land price conveniently and reliably for investors and citizens when they need to determine the minimum value in real estate trades. This is a basic for Ho Chi Minh City to build successfully an E-government and smart city which is suitable to a trend of the context of the 4.0 industrial revolution which is processing strongly all over the world.

Keywords: Land price, land price calculation formula, land price calculation tool, WebGIS

1. INTRODUCTION

Information has played a very important role to many fields and objects which are related in our society, land prices and differences of State prices and market prices always create many challenges as well as make strong impacts on many aspects of life and socio-economic in Ho Chi Minh City. Tan Phu District, a place is received a lot of interests to develop from both enterprises and Gorvernmental sectors with the large-scale policies of planning and investment in local and neiboring areas, so those makes land prices always to fluctuate strongly (Thanh Tran Thi Ngoc, 2009). In addition, the current real estate market develops very fast and lacks transparency; the land information system is incomplete as well as has not fully promoted its potential in management and exploitation Therefore, land price information and database become extremely necessary .

Nowaday, the development of applying GIS technology has brought many strengths in land management, including the issues of land prices. In order to manage land prices well, it is necessary to have a tool which helps calculating and looking up land prices effectively, as well as clarifying information, minimizing negative impacts and supporting effectively the management of real estate market (Toan Le Nguyen, 2013).

The study had carried to find out the interval between market and State land prices. Basing the these results to build a formula and a tool for calculating land price on Web-based for Tan Phu district in order to support effectively the management of land prices and real estate market. This is the premise to successfully build e-government and smart city with the general trend of nation and world in the context of The Fourth Industrial Revolution is booming strongly now.

2. METHODOLOGY

During the implementation process, research has used many methods: Documents and data collection; Field investigation; experts interview; Analysis, statistics and synthesis; Integrating of GIS and WebGIS; and Analytic Hierarchy Process Group Decision Making (AHP-GDM), two main methods are as below:

- *Method of integrating GIS and WebGIS:* applying MicroStation SE, AutoCad, ArcGIS 10.5, Google Map, PostgreSQL, Boostrap and JavaScript programming language to build land price database and tool to calculate land price on Web base.

- *The method for Analytic Hierarchy Process Group Decision Making (AHP-GDM):* is used in environment of group decision to calculate the weight of factors that affect to land price (Vinh Tran Thi Thanh, 2013).

3. RESULTS AND DISCUSSION

3.1. Applying AHP-GDM to calculate the effected weights

Identify the factors which affect to land price: Including 4 main elements, each element can have many small constituents (Hung Tran Thanh, 2012):

- *Land parcel:* frontage width (CRMT), legal, business capacity (KNKD), current land use (SDĐ_HT), planning land use (SDĐ_QH);

- *Transportation:* planning the boundaries of roadway, road cover, flooding, hierarchy of urban roads (PC_ĐĐT) including: trading and service (TMDV), district center (TT_Quận) and other roads;

- *Urban subdivision (PKĐT)*

- *Distance to the center of infrastructure (KC_CSHT).*

Decentralize affected factors to land price into 3 levels (1,2,3) to calculate the global weight by hierarchical tree with total weight (W) is the multiplication of component weight.

Table 1: The weight of affected factors to land price

Level 1 factor	W1	Level 2 factor	W2	Level 3 factor	W3	TSTC (W)
Parcel	0,3841	Frontage width	0,3297			0,0713
		Legal	0,1560			0,0423
		Business capacity	0,2214			0,0937
		Current land use	0,1970			0,0813
		Planning land use	0,0959			0,0954
Transportation	0,2490	Roadway	0,4132			0,1029
		Road cover	0,2464			0,0613
		Flooding	0,2283			0,0569
		Urban subdivision	0,1121	Trading and service	0,6159	0,0172
				District center	0,2771	0,0077
				Other roads	0,1071	0,0030
Distance to the center of infrastructure	0,2448					0,2448
Urban subdivision	0,1221					0,1221

Calculate weights by using AHP-GDM and assign values to each level, then calculate the coefficient for each parcel by multiplying the weight with the assigned value. (Table 2)

Table 2: Decentralize the factors and assigned values

Criteria	Hierarchy	Weight	Assigned value
Frontage width	≥3m	7,13	1
	<3m		0
Legal	Enough	4,23	2
	Not enough		1
	None		0
Business capacity	Very convenient	9,37	3
	Convenient		2
	Less convenient		1
	Inconvenient		0
Current land use	Residential land	8,13	1
	Non-residential land		0
Planning land use	Mixed land	9,54	2
	Residential land		1
	Other land		0
Roadway	>20m	10,29	2
	7 – 20m		1
	<7m		0
Road cover	Asphalt	6,13	2
	Concrete		1
	Gravel, soil, stone		0
Flooding	Non-flooded	5,69	1
	Flooded		0
Trading and service	Belong to commercial - service road	1,72	1
	Not belong to commercial - service road		0
District center	Belong to the central road	0,77	1
	Not belong to the central road		0
Other roads	Belong to other road	0,30	1
	Belong to commercial - service or central road		0
Distance to the center of infrastructure	≤300m	24,48	3
	300 – 500m		2
	500 – 1000m		1
	≥1000m		0
Urban subdivision	Central area	12,21	2
	Urban district		1
	Suburban district		0

3.2. Building formula to calculate land price

Identify the coefficient of difference between state and market land price (Ki)

The survey results of 25 streets in Tan Phu District showed that the difference between these two types of prices in local area was not according to general regulations. The State land prices have low differences and relatively equal among areas, while the market land price fluctuate strongly along the route due to the influence of the surrounding positioning poles. This fact showed that the State land price was listed in 2014 remains many unreasonable points.

Chart 1: The difference between State land price and market land price

(Source: Survey and synthesis)

Zoning land value in the case study area into 3 sub- regions (corresponding to 3 regions of value: ≥ 80, 50 - 80 and <50) to calculate the reliability of the data set (unit of million VND).

Table 3. Results of calculating the reliability of areas

Unit: Thousand VND/m^2

Sub-Area	Standard Deviation	Error range	Confidence Interval		Difference coefficient K_i (times)
			Lower bound	Upper bound	
1	22.912,7815	11.595,4673	102.671,1994	125.862,1340	10,0492
2	7.836,9880	2.956,1289	56.414,2414	62.326,4993	6,2810
3	5.025,2225	1.769,0110	41.424,5374	44.962,5593	6,1713

Building formula to calculate land price

According to Phe Hoang Huu and Patrick Wakely (2000), land prices change according to two trends: global and local. Global change will be associated with current state of the economy, the position of the whole region or inflation; land prices increase or decrease depends on the financial capacity to invest into the real estate market, investors' expectations or the money devaluation. In contrast, the local change is due to the change of one of the positional factors that constitute the land price of each land value region. Accordingly, among the four main groups of positional factors that constitude the land price (land parcel, transportation, distance to the center of infrastructure and urban subdivision), factor distance to the center of infrastructure and factor urban subdivision are usually stable because these two factors are associated with planning projects and economic development of the Government. Therefore, the change of land price will depend on the other two groups of factors, so the formula to calculate land prices is determined as follows:

$$P = P_{NN} * (1 + H)$$

With: $H = H_{TĐ}*K_i + H_{GT}*K_i + H_{KC\_CSHT} + H_{PKĐT}$

In which:
- P_{NN} : *is the State land price*
- H : *is the total coefficient which is create by the weights multiply with the assigned value of factors*
- $H_{TĐ}$: *is the coefficient of land parcel group*
- H_{GT} : *is the coefficient of transportation group*
- H_{KC_CSHT} : *is the coefficient of the group of distance to the infrastructure*
- $H_{PKĐT}$: *is the coeficient of urban subdivision group*
- Ki : *is the deviation coefficient between the State land price and the market land price for each region*

3.3. Apply WebGIS in building tools to calculate land price

- Build database PostgreSQL/ PostGIS according to Diagram 1.
- Display map layers on Geoserver according to Diagram 2.

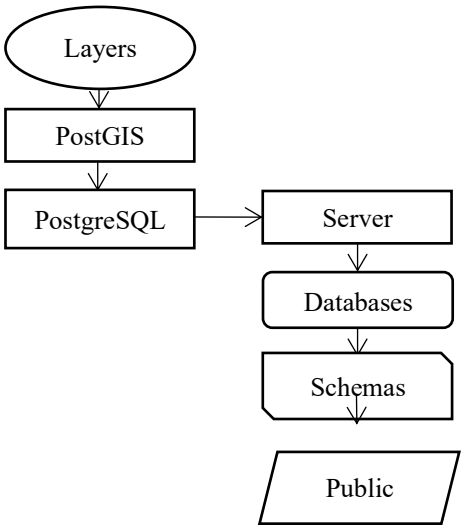

Diagram 1: Process to build database

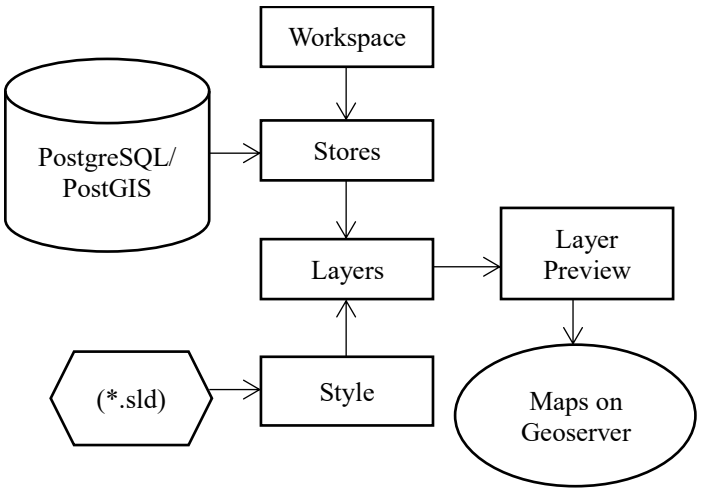

Diagram 2: Process to display maps on Geoserver

<u>Building tool for calculating land price on Web base</u>

- Interface of the website is displayed on Leaflet platform, with main function is calculating land prices.
- *Actions:* click on each parcel on the map to display the interface of land price information and press button ***"Tính"*** for system to calculate land price and show the results.

The system will automatically get information from the map, then combine with the function that automatically calculates the frontage width and the distance to the center of infrastructure to add the formula and shows the results of land prices.

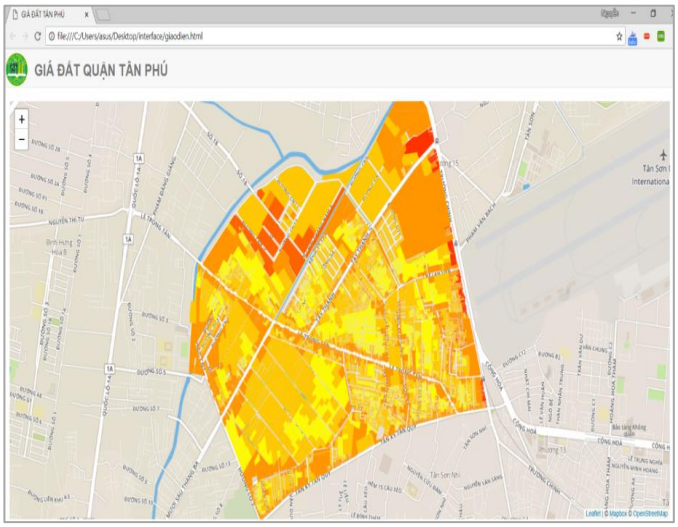

Figure 1. Home page

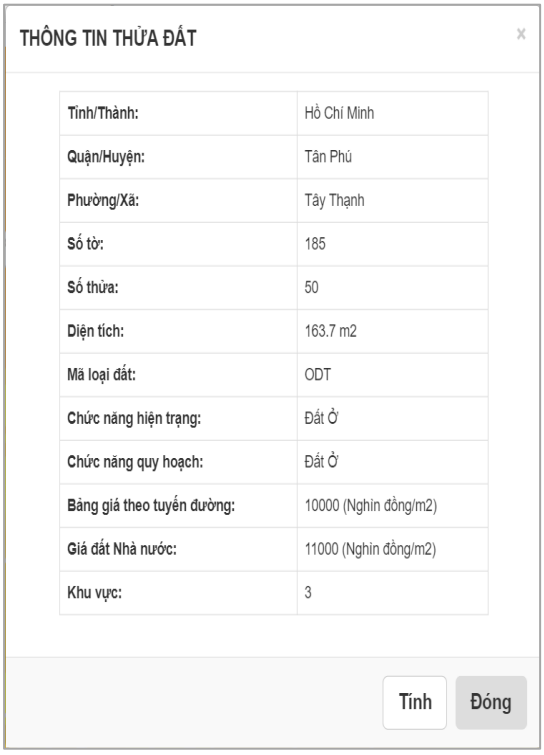

Figure 2. Interface to display parcel information

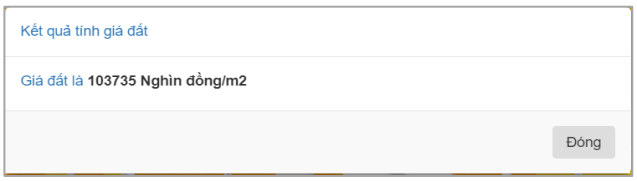

Figure 3. Interface to display the calculated result of land price

Test the tool's efficient and evaluate

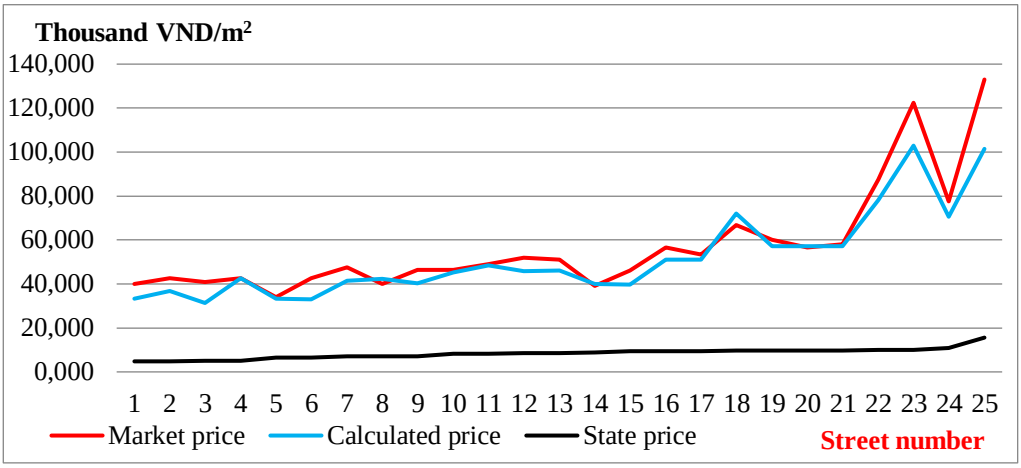

Chart 2. The difference between calculated price with market price and State price

According to the results of land price calculation on 25 streets that surveyed, the interval between market and calculated price is no longer as high as the State price (with the average difference is 91.79%). This is an appropriate price which ensures the interests of both State and citizens. This result showed that the appropriate level and the computability of the tool is quite high.

4. CONCLUSION

Tan Phu district is an area where the urban development process has carried on quite complicated. So land prices here always fluctuate strongly and bring many negative affect to the development process of real estate market. Therefore, an effective system to support calculating, searching and managing land prices is very neccessary.

The method of hierarchical analysis (AHP-GDM) in environment of group decision is an effective method for quantifying the relevant factors such as: economic and social,... The research results have identified a set of weights and the affect values of the land price impact indicators in locality, which is a most important part in building the formula to calculate land price.

Nowadays, GIS and WebGIS are the popular technologies which are the means to connect users with the specialized information that requires a lot of expertise knowledge. Applying WebGIS has helped the land price calculation formula to be more complete, it is possible to calculate the criteria which the normal way is difficult to collect. Therefore, the study had successfully built a tool which support to calculate the land prices that reaches a reasonable error range (with the average difference is 91.79%).

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