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MASS APPRAISAL APPLICATION FOR LAND VALUATION USING REGRESSION MODEL: A CASE STUDY IN THE C ZONE OF NAM HOI AN PROJECT, THANG BINH DISTRICT, QUANG NAM PROVINCE, CENTRAL VIETNAM

Tran Thi Phuong[1*], Ho Viet Hoang[1], Nguyen Van Viet[1], Nguyen Bich Ngoc[1], Huynh Van Chuong[2]

[1] University of Agriculture and Forestry, Hue University, 102 Phung Hung St., Hue, Vietnam
[2] Hue University, 1 Dien Bien Phu St., Hue, Vietnam

Abstract: This study focuses on building a regression model in the series of land pricing for frontages and alleys in the C zone of Nam Hoi An project, Thang Binh district, Quang Nam province. The research applied data collection method, data processing method, regression analysis method to build a model of mass land valuation. The results of this study show that the location of the facade in the C zone of Nam Hoi An project is affected by various factors such as security, plot width, plot shape, distance to Hoi An city, traffic congestion, land use type, and road boundary. Meanwhile, the unit price of land in the alley is influenced by factors such as security, alley level, plot shape, distance to Hoi An city, road structure, traffic congestion and alley location. The biggest factor affecting frontage land price is the type of land use with regression coefficient $B_{LAND\_USE\_TYPE}$ = 14,199. In terms of unit price of alley land, that is the type of alley with regression coefficient $B_{ALLEY\_LOCATION}$ = 10,772. The results of verification of the accuracy of the land unit price from the regression model to the compensation land unit price have a negligible difference, which is completely consistent with the requirement of determining the price level close to the market price. The results of this study show the practical applicability of mass appraisal for land valuation using a regression model in land acquisition and financial management of land.

Keywords: land valuation, mass appraisal, Hoi An, regression model

1 Introduction

In Vietnam, the valuation of land to determine financial obligations related to land use and speed up land acquisition as well as site clearance is always the top concern [2]. The land valuation theory in Vietnam is specifically formulated in Land Law 2013 and Decree No. 44/2014/ND-CP on the Government's land price regulation on May 14, 2014 [18], [19]. There are 5 possible land valuation methods including: direct comparison, deduction, income, surplus, and land price adjustment [5]. These methods are basically inherited from the traditional land valuation methodology that is commonly used in the world and they are well applied in

Corresponding: tranthiphuong@huaf.edu.vn
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determining the value of each land plot [21]. However, conducting land valuation for each plot according to current valuation methods takes a lot of time, effort, and cost for appraisal [3]. This can lead to a decrease in the State Budget revenue from the collection of land use taxes or raise disagreements, even backlash from the people during the process of land acquisition, slow down the progress of the projects as well as causing difficulties and discouraging investors [4]. Today, under the modern approach, there is the method of mass land valuation based on mathematical models and computer techniques combined with databases called mass appraisal [11], [14].

Mass appraisal is the process of valuing a group of properties as of the given date and using common data, standardized method, and statistical testing [8]. Before 21st Century, relevant institutions and scholars have done fruitful work on the standard setting of real estate mass appraisal such as Standard on Mass Appraisal of real property [6], RICS Valuation-Global Standard [13], International Valuation Standards [7], Uniform Standards of Professional Appraisal Practices [17]. The development direction of mass appraisal of real estate is to model elements and find algorithms by constructing mathematical models and estimating regression functions on land values with factors as characteristics of the parcel of land [20]. The factors such as the conditions, the parameters, the correlation coefficients, the regression coefficients depend a lot on each locality, but if a standard definition is given, this method will be an effective tool in mass valuation [10].

The C zone of Nam Hoi An project is located in Thang Binh district, Quang Nam province. The land price in this area is affected by the Vinpearl project, for this reason, the market land price is quite high, which makes land users not accept the compensation price of the State-set prices [16]. Therefore, the investors and the State discussed with affected land users about the compensation price based on market land price to get agreement. This study was carried out to apply mass appraisal for land valuation using a regression model in the C zone of Nam Hoi An project not only to guarantee benefits for land users, providing compensation at market prices but also to accelerate the land acquisition and site clearance progress.

2 Materials and Methods

2.1 Data collection methods

Secondary data collection

The land price table in 2019 of Quang Nam provincial People's Committees from Department of Natural Recourse and Environment. The socio-economic development reports in 2019 are collected at the People's Committee of Thang Binh district. In addition, the research also collects additional materials such as books, magazines, etc related to the land price in the Nam Hoi An project.

Primary data collection

The study interviewed 04 staff working in the Land Fund Development Center of Thang Binh district to identify factors affecting the value of land plots in C zone of Nam Hoi An project. These staff who were chosen for the interview have to know thoroughly about the study area, have a college degree or higher and have been working in Land Fund Development Center of Thang Binh district for at least 10 years.

The study also randomly conducted face-to-face interviews with households who had acquired land in the C Zone of Nam Hoi An Project, Thang Binh District by using a Semi-structure questionnaire. The content of the questionnaires focus on factors related to land parcels such as security situation, location, shape of plot, distance to Hoi An city, traffic situation, etc. Sample size was calculated by using Cochran's formula (formula 1) [1].

$$n = \frac{pqz^2}{e^2} \qquad (1)$$

Where: e is the desired level of precision (i.e. the margin of error); p is the (estimated) proportion of the population which has the attribute in question; q is 1 – p.

In this research, p = q = 0,5, e = 0,1 and z = 1,96. Appling Cochran's formula, the determined sample size was 97. However, in order to increase of accuracy and ensure the number of sample size, the research was issued 150 questionnaires. After data cleaning, there are only 140 questionnaires are met the requirement.

2.2 Data processing method

The collected data is entered into and processed by SPSS software for data analysis to build a regression model for the mass valuation of land.

Survey samples (households) were collected from valuation certificates in the Land Fund Development Center of Thang Binh district. There are two types of real-estate in the sample: Land with and without the house. However, this research focused only on land price, therefore the value of the properties including building is estimated and deducted from the value of real-estate so that only land prices remain.

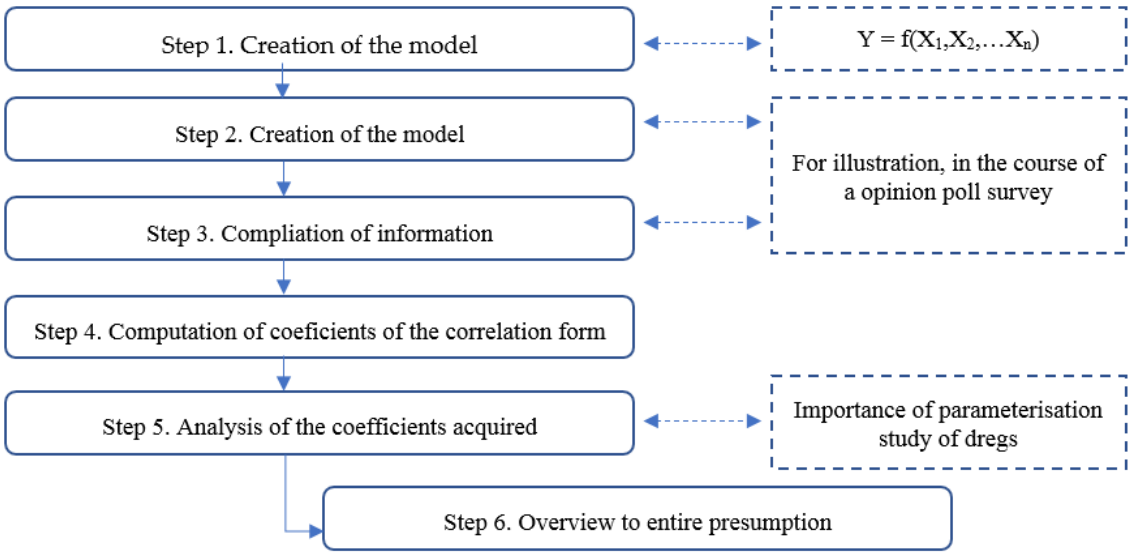

Figure 1. Flow Chart for Regression analysis

2.3 Method of Land valuation using regression model in mass appraisal

To build a mass valuation of land model for the C zone of Nam Hoi An project in Thang Binh district, the study was conducted according to the following process:

Step 1: Researching the econometric theory of Ramanathan [12], the theory of real estate market (real estate), the theory of real estate valuation, the theory of land price mathematical series and statistics as well as referring to the types of models previously studied.

Step 2: Developing a theoretical framework.

Step 3: Finding appropriate data for the model. The data used is provided by professional valuation companies, in which the unit price of land has been appraised by experts with field knowledge and experience from the field. For this reason, the study's reliability is quite high.

Step 4: Formatting variables for the model.

Step 5: Setting the model based on the theoretical framework and selected variables from the collected data.

Step 6: Estimating the model.

Step 7: Testing whether there is a hypothesis violation or not. In case of violation, resetting the model, moving back to step 5, reprocessing until the model is correct, following the assumptions and being able to explain in practice. If the models meet the statistical criteria and meet the assumptions, skip to step 8.

Step 8: Interpreting the results based on the model, from which to relate to reality.

Step 9: Forecasting the results of land prices based on the regression model obtained.

Step 10: Summarizing the interpretation results, making recommendations and solutions.

The land valuation model was applied in this study is an additive multiple regression model based on a comparative approach. This model is used to test hypotheses about the relationship between a dependent variable (UNIT_PRICE) and independent variables, Xs. Multiple regression can also be used to make predictions about the Y variable. That is why thestatistical technique is useful to determine a property's likely sales price or worth [9].

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

In which: Y is the price of land calculated on $1m^2$ of area; X_i is the factor that affects the price of land; $ß_i$ is the regression coefficients

3 Results and discussions

3.1 The study area

The C Zone of Nam Hoi An project belongs to Duy Hai and Duy Nghia communes (Duy Xuyen district) and Binh Duong commune (Thang Binh district) [15].

The adjacent faces are as follows:

– North: adjacent to Duy Nghia commune administrative area and Duy Hai resettlement area.

– South: adjacent to coastal resettlement area in Binh Duong commune.

– East sea bordering the east.

– West: adjacent to Duy Nghia and Binh Duong commune residential areas.

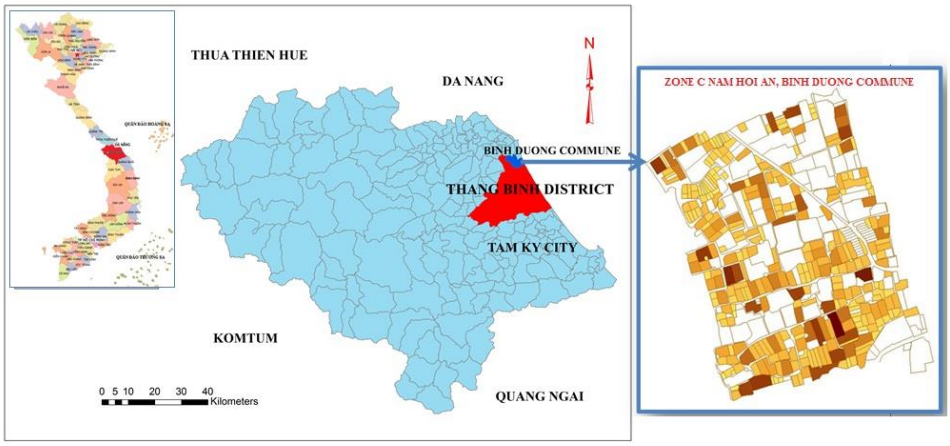

Figure 2. Location of the study area

Table 1. Current land use status of the area C of Nam Hoi An project, Thang Binh district, Quang Nam province in 2019

No	Land use purpose	Area (m^2)	Ratio (%)
1	Public building	203.026	9,4
2	Commercial	0	0,0
3	Hotel and resort	0	0,0
4	Mixed office	207.910	9,7
5	Residential	944.820	43,9
6	Green trees and water surface	404.912	18,8
7	Technical infrastructure	7.670	0,4
8	Transportation	381.790	17,8
	Total	**2.150.128**	**100,0**

The Source: [16]

Statistical results in Table 1 show that in the C Zone of Nam Hoi An project, Thang Binh district, Quang Nam province, the largest residential land area is 944,820 ha (equivalent to 43.9% of the total area). Next is greenery, transportation land, office land and public works with 404,912 ha (accounting for 18.8%), 381,790 ha (accounting for 17.8%), 207,910 ha (accounting for 9.7%) and 203,026 ha (accounting for 9.4%).

3.2 Variable description in regression model

Dependent variable

UNIT_PRICE: Unit price of land - this is a quantitative variable, the unit of calculation is thousand Dong/m^2. Land prices are calculated by subtracting the residual value of structures on land from the successful transaction price of the property. The unit price of land is calculated by dividing the land price based on the recognized land area.

Independent variables

Based on the research results of Nguyen Thi Hoa [3], Nguyen Quynh Hoa and Nguyen Hong Duong [4], John D Benjamin and C. F. Sirmans [9] and Yeh, I.C [21], A research questionnaire which contained a list of affecting factors was outlined. This questionnaire was used to interview 04 staff of Land Fund Development Center of Thang Binh district who know thoroughly about survey area in order to find out which specific factors truly affect land price there. Finally, the study identified factors affecting the value of individual land plots in the study area and coded them into Dependent variables below:

1. SECURITY: Security of the surrounding area, where the property is located, is divided into 5 levels and receives corresponding values from 1 to 5: very poor, poor, average, good, very good. The expected sign of the SECURITY variable is the (+) sign.

2. PLOT_WIDTH: The width of the plot. This is a quantitative variable, expressed in meters, and the expected sign is (+).

3. PLOT_SHAPE: The shape of the plot. This is a qualitative variable, using the identifier scale to encode this variable with the following values: get value 1 if it is final or L-shaped, value 2 if square and value 3 if parcel back hatch. The expectation sign is (+).

4. DISTANCE_CITY: Distance from real estate to the city center. This is a quantitative variable, in units of minutes. Distances (in km) are measured relatively accurately from the location of a particular property to the ancient town of Hoi An by a function in Google map. After that, this distance will be determined by the average speed of the motorbike (about 30 km/h). In fact, the further away the real estate from the center, the lower the price compared to the real estate closer to the center. The author expects the DISTANCE_CITY variable to be inversely proportional to the UNIT_PRICE variable, the expectation sign is (-).

5. STRUCTURE: Road structure. For alley land, this qualitative variable is encoded by the identification scale into 3 values: get value 3 if the alley is asphalt road; get a value of 2 if the alley is a cement or concrete road and a value of 1 if the alley is a dirt or stone road. The expectation sign is (+).

6. TRAFFIC_JAM: Traffic jam of the main road, the road leading to the property. The variable TRAFFIC_JAM is coded using the nominal scale, whereby it receives a value of 3 if it is rare, a value of 2 if occasionally and a value of 1 if traffic jams are frequent. The expectation sign is (+).

7. LAND_USE_TYPE: The main type of land use of the road where the property is located. This is a qualitative variable, whereby, this variable is coded by the identity scale with four values: get value 4 if it is business, big trade, busy; get a value of 3 if retail business; get a value of 2 if the property is for residential or residential use and get a value of 1 if the cultivation or aquaculture. The expectation sign is (+).

8. BUILDING_LINE: Building line of the road where the property is located. This is a quantitative variable in meters. This variable is only applied to properties located on the street front. The building line is determined based on the announcement of the right of way of trade - service routes in Thang Binh district. Particularly for routes where the author has not found planning information, the building line will be estimated by the distance between the two blocks. The expectation sign is (+).

9. ALLEY_LEVEL: The level of the alley. This is a qualitative variable, using the identifier scale to encode this variable with the following values: get position 1 if it is an access path with a cross-section less than 2.5 meters wide (counting the narrowest area); receive position 2 if it is an entrance with a width of 2.5 meters or more (counting the narrowest places). The expectation sign of the ALLEY_LEVEL variable is the (+) sign.

10. ALLEY_LOCATION: The alley's location where the real estate is located. This is a qualitative variable and only applied to Real Estate located in the alley. Principles to determine an alley location: Position 1 - An alley width greater than 5 m is covered with stone, asphalt or concrete or cement; Position 2 - The width of the alley from 3 m to 5 m is paved with stones,

Table 2. Variables list of the model in alleys and facades

No	Frontage land model	Model for land in the alley
1	UNIT_PRICE	UNIT_PRICE
2	SECURITY (+)	SECURITY (+)
3	PLOT_WIDTH (+)	ALLEY_LEVEL (+)
4	PLOT_SHAPE (+)	PLOT_SHAPE (+)
5	DISTANCE_CITY (-)	DISTANCE_CITY (-)
6	TRAFFIC_JAM (+)	STRUCTURE (+)
7	LAND_USE_TYPE (+)	TRAFFIC_JAM (+)
8	BUILDING_LINE (+)	ALLEY_LOCATION (+)

asphalt or concrete, cement; Position 3 - The alley width from 2 m to under 3 m is paved with stone, asphalt or concrete, cement; Position 4 - The alley width less than 2 m is paved with stone, asphalt or concrete, cement. This variable is encoded by an identifier scale into four values: getting a value of 4 if the alley has position 1, receiving a value of 3 if the alley has a position of 2, and getting a value of 2 if the alley has a position of 3 and a value 1 if the alley is located 4. The expectation sign is (+).

3.3 Building regression models for mass land prices

To clarify the relationship between the dependent variable UNIT_PRICE and the independent variables as well as to determine the degree of influence of the independent variables on the dependent variable, the research used the regression analysis method expressed as the additive multiple regression model.

Regression model of mass valuation of frontage land

The results of the regression analysis showed that all seven independent variables included in the mass pricing model for frontage land had the correct sign as expected in Table 2.

Table 3 shows that the estimated parameters of the regression model for mass pricing with land on the front are statistically significant. Specifically, the determination coefficient of adjusted R2 is 0.996, this means that the linear regression model has been built in accordance with the data set to 99.6%. In other words, 99.6% difference of the UNIT_PRICE variable can be explained by the difference in the independent variables in the model. The F value is 1917,587 with an observed significance level of Sig = 0,000 lower than 0.05, meaning the linear regression model was built in accordance with the whole. In addition, the magnification coefficient VIF of the independent variables is less than 10, indicating that the model does not have a multi-collinear phenomenon. Finally, the Sig values of the regression coefficients are greater than 0.05. Therefore, the regression model for mass pricing of facades in the front is as follows:

$$\text{UNIT\_PRICE} = 757{,}253 + 10{,}115\ \text{SECURITY} + 8{,}008\ \text{PLOT\_WIDTH} + 7{,}052\ \text{PLOT\_SHAPE} - 5{,}318\ \text{DISTANCE\_CITY} + 7{,}589\ \text{TRAFFIC\_JAM} + 14{,}199\ \text{LAND\_USE\_TYPE} + 4{,}002\ \text{BUILDING\_LINE}$$

The significance of the regression coefficient in the regression model for mass pricing with frontage land is construed as follows:

$B_{SECURITY}$ = 10,115 indicates that when regional security increases (or decreases) by 1 degree, the unit price of land will decrease (or increase) by 10,115 thousand Dong/m^2, provided that other factors remain unchanged.

B_{PLOT_WIDTH} = 8.008 indicates that when the plot's width increases (or decreases) by one level, the unit price of land will increase (or decrease) by 8,008 thousand Dong/m^2, provided that other

factors remain unchanged.

B_{PLOT_SHAPE} = 7,052 indicates that when the plot shape increases (or decreases) by one level, the unit price will increase (or decrease) by 7,052 thousand Dong/m^2 provided that other factors remain unchanged.

$B_{DISTANCE\_CITY}$ = - 5,318 indicates the distance (in km) to the center of Hoi An city increases (or decreases) the unit price of land will increase (or decrease) 5,318 thousand Dong/m^2, provided that other factors remain unchanged.

$B_{TRAFFIC\_JAM}$ = 7,589 indicates that when traffic jams increase (or decrease) by one level, the unit price of land will increase (or decrease) by 7,589 thousand Dong/m^2 provided that other factors remain unchanged.

$B_{LAND\_USE\_TYPE}$ = 14,199 indicates that when the land use type increases (or decreases) by 1 level, the unit price of land will increase (or decrease) by 14,199 thousand Dong/m^2, provided that other factors remain unchanged.

$B_{BUILDIND\_LINE}$ = 4,002 indicates that when a right of way increases (or decreases) by 1 level, the unit price of land will increase (or decrease) by 4,002 thousand Dong/m^2 provided that other factors remain unchanged.

Table 3. Regression model results for mass valuation of frontage land

Variable nam	B	Sig.	VIF
Constant	757,253	0,000	
SECURITY	10,115	0,000	1,421
PLOT_WIDTH	8,008	0,000	1,671
PLOT_SHAPE	7,052	0,000	1,254
DISTANCE_CITY	-5,318	0,000	1,595
TRAFFIC_JAM	7,589	0,000	1,639
LAND_USE_TYPE	14,199	0,000	1,408
BUILDING_LINE	4,002	0,000	1,274
R corrected = 0,996			
F statistic = 1917,587 (Sig = 0,000)			

Source: Results of data processing analysis, 2019

Regression model of mass valuation of land in the alley location

Table 4 shows that for the parcel located in the alley, all 7 independent variables have been determined to affect the value of the land plot in the alley. The sign of these independent variables is in line with the expectations of the previous study.

The adjusted coefficient of determination R2 is 0.992, which means that the linear regression model has been built in accordance with the data set to 99.2%. The F value is 998,401 with an observable significance level of Sig = 0,000, which shows that the multiple linear regression model under construction is suitable for the whole. VIF magnification coefficients for the independent variables are all below 10 and the Sig value of the regression coefficients is all lower than 0.05. Thus, the regression model of mass valuation of land in the alley meets the requirements and is shown as the following equation.

UNIT_PRICE = 311,724 + 18,886 SECURITY + 5,018 ALLEY_LEVEL + 6,975 PLOT_SHAPE – 3,002 DISTANCE_CITY + 9,869 STRUCTURE + 7,173 TRAFFIC_JAM + 10,772 ALLEY_LOCATON

The significance of the regression coefficient in the regression model for mass valuation with alley land is construed as follows:

$B_{SECURITY}$ = 18,886 indicates that when regional security increases (or decreases) by 1 degree, the unit price of land will decrease (or increase) by 18,886 thousand Dong/m^2, provided that other factors remain unchanged.

B_{ALLEY_LEVEL} = 5,018 indicates that when a plot of land alley is increased (or decreased) by

Table 4. Regression model results for mass valuation of land in the alley location

Variable	B	Sig.	VIF
Constant	311,724	0,000	
SECURITY	18,886	0,000	1,548
ALLEY_LEVEL	5,018	0,000	1,827
PLOT_SHAPE	6,975	0,000	1,204
DISTANCE_CITY	-3,002	0,000	1,705
STRUCTURE	9,869	0,000	1,673
TRAFFIC_JAM	7,173	0,000	1,812
ALLEY_LOCATION	10,722	0,000	1,654
R corrected = 0,992			
F statistic = 998,401 (Sig = 0,000)			

Source: Results of data processing analysis, 2019

one level, the land unit price will increase (or decrease) by 5,018 thousand Dong/m^2, provided that other factors remain unchanged.

B_{PLOT_SHAPE} = 6,975 indicates that when the plot size increases (or decreases) by one level, the unit price will increase (or decrease) by 6,975 thousand Dong/m^2, provided that other factors remain unchanged.

$B_{DISTANCE\_CITY}$ = - 3,002 indicates how many kilometers the distance to the center of Hoi An city increases (or decreases) the unit price of land will increase (or decrease) 3,002 thousand Dong/m^2 provided that other factors remain unchanged.

$B_{STRUCTURE}$ = 9,869 indicates that when a road structure increases (or decreases) by one level, the unit price of land will increase (or decrease) by 9,869 thousand Dong/m^2 provided that other factors remain unchanged.

$B_{TRAFFIC\_JAM}$ = 7,173 indicates that when traffic jams (or decreases) by one level, the unit price of land will increase (or decrease) by 7,173 thousand Dong/m^2 provided that other factors remain unchanged.

$B_{ALLEY\_LOCATION}$ = 10,772 indicates that when the alley location increases (or decreases) by 1 level, the unit price of land will increase (or decrease) by 10,772 thousand Dong/m^2, provided that other factors remain unchanged.

3.4 Verifying the results of mass land price determination by regression model with compensation land price

To evaluate the results of mass land valuation by the regression model, the study conducted a random selection of 03 frontage plots and 03 plots in the alleys. After that, using the unit price of land calculated from the regression model to compare with the unit price of the land parcel that has been compensated.

Frontage plots

The results in Table 5 show that the unit price calculated according to the regression model of mass valuation for land plots located on the frontage is close to the actual unit price (890 thousand Dong/m^2), which has been compensated in the area C of Nam Hoi An project. It means that this regression model is accurate enough and able to widely apply for estimating land plots located on the frontage in the survey area.

Table 5. Results of mass valuation by regression model for the land plots on the facade

Target		Plot 42	Plot 116	Plot 89
Plot information	Security	Very good	Very good	Very good
	Plot width	6,5 m	6,3 m	8 m
	Plot shape	wide back *	Square-shaped	wide back *
	Distance to the city	15 km	16 km	16 km
	Traffic jam	Rarely	Rarely	Rarely
	Land use type	Residential land	Residential land	Residential land
	Building line	10 m	10 m	10 m
Plot information encoded into the model	Security	5	5	5
	Plot width	6.5	6.3	8
	Plot shape	3	2	3
	Distance to the city	15	16	16
	Traffic jam	3	3	3
	Land use type	2	2	2
	Building line	10	10	10
Land unit price (Thousand Dong/m²)	Calculated according to the regression model	892,291	878,3194	898,985
	Reality		890	

*Notes: wide back *: Length of the front is shorter than the back*

Source: Results of data processing analysis, 2019

Plots in the alleys

The results of the land price in the alley calculated according to the regression model for the land lots of 302, 309 and 386 are 449,47 thousand Dong/m², 454,34 thousand Dong/m² and 459,50 thousand Dong/m² respectively. This calculated unit price is not much different from the actual unit price compensated in the study area (455 thousand Dong/m²).

Thus, it can be seen that the valuation result of the regression model is to ensure the practicality to apply the determination of land prices in alleys and facades in the C Zone of Nam Hoi An project, Thang Binh district.

Table 6. Results of mass valuation by regression model for the land plots in the alley

Target		Plot 302	Plot 309	Plot 386
Plot information	Security	Good	Good	Good
	Alley level	Level 2	Level 2	Level 2
	Plot shape	wide back *	wide back *	Square-shaped
	Distance to the city	15	17	16
	Structure	Cement	Soil	Cement
	Traffic jam	Occasionally	Occasionally	Occasionally
	Alley level location	Position 2	Position 2	Position 2
Plot information encoded into the model	Security	4	4	4
	Alley level	2	2	2
	Plot shape	3	3	2
	Distance to the city	15	17	16
	Structure	3	2	3
	Traffic jam	2	2	2
	Alley level location	3	3	3
Land unit price *(Thousand Dong/m²)*	Calculated according to the regression model	449,47	454,34	459,50
	Reality		455	

*Notes: wide back *: Length of the front is shorter than the back*

Source: Data processing analysis results, 2019

4 Conclusions

The research results show that the unit price of land at the front in the C zone of Nam Hoi An project, Thang Binh district is affected by security, the width of plot, the shape of plot, distance to Hoi An city, traffic congestion, land use types, and roads. Meanwhile, the unit price of land in the alley is influenced by factors including security, alley level, plot shape, distance to Hoi An city, road structure, traffic congestion and alley's location. Based on the regression coefficients, the study has identified that the most important factor influencing the frontage land unit price is the land use type ($B_{LAND\_USE\_TYPE}$ = 14,199) and in terms of the alley land unit price, that is the alley type ($B_{ALLEY\_LOCATION}$ = 10,772). From the results of the land unit price calculated using the regression model, the study has compared with the actual unit price of the land parcel that has been compensated to evaluate the accuracy of the model. The results estimated by the regression

model and the compensation land price have negligible deviations, this is completely consistent with the requirement to determine the price close to the market price in order to better serve the determination of land financial obligations of users as well as bringing better service in land acquisition and site clearance for major projects in Thang Binh district. Because of the accurate estimation, mass appraisal for land valuation using a regression in this research could be used effectively in the C zone of Nam Hoi An project and other areas which have the same survey area conditions.

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