Assessing land values and proximity using hedonic model-a case study of green town gujrat, pakistan

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Abstract

This paper evaluates the impact of proximity on land and property values in the urban area of Gujrat City, in Pakistan. Property and land values are a dynamic phenomenon spatially and economically. Generally, land is an element of property and property values are considered bearing multiple characteristics for the price evaluation and assessment, and there is no perfect method to estimate these values. The property attributes and neighborhood services have positive impact on land and property values due to their association with amenities for a settlement area. The greater the neighborhood amenities more the utilities, therefore higher the property values. However, amongst all these defined methods, the Hedonic Price Model is considered the best model that includes the locational, structural, neighborhood and community attributes, that are considered in this case study. The impact of these services is evaluated by measurement of this potential. Moreover, Hedonic Pricing Model, the most suitable method used in research studies, is used the (Geographical Information System) GIS for spatial modeling of proximity and Multi Linear Regression as a statistical tool for measurement and checking the impact of each individual variable on total property value. The study area selection was taken due to the suitability of hedonic variables. The regression analysis results reflected that hedonic variables including the land and property with large structure, similar community characteristics, neighborhood attributes and accessibility to the roads and streets network due to the locational aspect, have positive impact on the values of the property. The regression model summery shows the potential of each hedonic variable of total price of the property and suitability of the model by values of R, R2 and adjusted R2, where the values of R is 0.92 and R2 is 0.85. The assessment result from hedonic regression of the study will provide tools for sustainable urban infrastructure and development. Furthermore, suggestions are made on the bases of these results. It is expected that the research on such burning issue may provide best land allocation plan to urban designers, urban managers and also provide spatial tool for sustainable urban development.

1. INTRODUCTION

Proximity is valuable and associated with walkability. Walkability is a basic element for proximity for a sustainable city thinking (Rafiemanzelat, Emadi, & Kamali, 2017). Thinking is important for developing model (Gonzalez, 2017). Meanwhile in a sustainable city the residential communities are basic units for living (Liang, Liu, Qiu, Jing, & Fang, 2018). Walkability is related to accessibility that is one of the key measure for effective urban planning (Verma, Verma, Rahul, Khurana, & Rai, 2019), and have positive impact on real estate/property marketing (Cordera, Coppola, dell'Olio, & Ibeas, 2019). For a sustainable city, walkability provides foundation for proximity and this impact is associated with psychological, environmental and socio-economic issues (Bhattacharyya & Mitra, 2013). Equal access to neighborhood amenities/services and locational facilities is one of the significant element for effective urban policy (Bem, Ucieklak-Jeż, & Siedlecki, 2016). Surrounding support facilities in geographical studies are closely associated with the real estate market (Liang et al., 2018). The understanding of these impacts is appropriate for land use planning (Su, Pi, Xie, Cai, & Weng, 2017). The proximity is linked with land value that is determined by the land characteristics of that area. Proximity to the environmental attributes including the access to roads, marketing area and parks have an influence on property values (Bolitzer & Netusil, 2000).

Transportation costs, minimum distance to neighborhood services and streets networking relating to location of property are discussing in the concept of accessibility (Belmeziti, Cherqui, & Kaufmann, 2018). Domestic facilities including mobility, health, education, and sustainability have fruitful effects on society for urban development (Glumac, Herrera-Gomez, & Licheron, 2019). These domestic facilities are the basic units for an urban areas (Liang et al., 2018). Normally, increasing accessibility is targeted to the public transport investment which will increase land values located near to the roads (Mulley, Ma, Clifton, Yen, & Burke, 2016). Assessing the value of local areas including economic, environmental, entrepreneurial and social dimensions of sustainability are the key factors for development (Nakamura, 2019). The known homebuyers for surrounding amenities and neighbourhood characteristics are necessary for effective urban planning (El Garouani, Mulla, El Garouani, & Knight, 2017). The estimation and monitoring of land values has a very long history since the work of Von Thunen in 1826 and Hurd in 1903 (Black & Machin, 2011). Land near the road has highly accessibility and proximity to the environmental attributes. This study provides a thematic assessment of land values by providing the results of study area in forms of the Hedonic Regression Model summary, Analysis of Variance (ANOVA) and coefficient regressions. The ANOVA analysis is a technique used for testing the hypothesis estimation of various parameters, or functions of the parameters involved in statistical modeling (Molugaram & Rao, 2017).

Globally, affordable housing and sustainability attainment has received attention of policy makers in the recent decades (Adabre & Chan, 2019). In the world housing price has increased in recent years very rapidly due to economic reforms in the globe, usually due to increase the value of land (Li & Wu, 2014). A land has high values, when located near the park, business centre or area where a community has similar characteristics. The most suitable model used for such assessment of property is the Hedonic Model, that is adopted by the work of Rosen in 1974 (Kim & Kim, 2016).

However, the relationship between land price and property values is still disputed (Wen & Goodman, 2013).

The current study investigates how proximity to hedonic variables has an influence on land values, finding the effect of proximity to road and other hedonic variables measurement in urban area. In urban environment, the distantial attenuation is a significant characteristic for pattering the urban land (Liu, Zheng, Turkstra, & Huang, 2010). Rapidly growing population often leads to conflicts between proposed land uses models, however information on the monetary value of environmental amenities provided help to decision makers and decision-makers account this information to ensure the quality of life in an urban region (Dahal et al., 2019). Quality of life in urban areas is most important issue now-a-days (Rosu, Corodescu, & Blageanu, 2015). The growing populations and associated urbanization compete with environmental services and neighborhood characteristics for industrial development, and residential zones (Dahal, Grala, Gordon, Petrolia, & Munn, 2018). Where, the conversion of rural land into urban land is called urbanization or urban expansion that is growing rapidly (Tong, Yuan, Wang, & Wu, 2019) and the same critical situation was observed in the study area and results were obtained.

2. LITERATURE REVIEW

The real estate dealers differentiates between size of built structures, developed and undeveloped land and land uses (Jurado, 2018), which have influence on decisions of landowners like, what to build and how to build (Wenner, 2018). Now a days rapid urban expansion of built up environment is the major cause of land use changes (Chen, Chen, Xu, & Tian, 2016). On the other hand, growth presents crucial challenges for planners, elected officials, and natural resource managers because, in addition to many benefits, urban development can increase stress on the landscape (Halder, 2018) and compromise environmental quality and community resilience (Dahal et al., 2018). The analysis of land use change with temporal and spatial characteristics is an important phenomenon to understand the urbanization (Zhang, Kang, Wang, & Sun, 2010). The results show a significant effect of hedonic measurement on property values. For an urban area that is already existing, there is a strong need to prevent the urban sprawl for land use development in future (Korthals Altes & K., 2019).

The association between neighbourhood characteristics including the location of house (Safarabadi, Moayedfar, & Varesi, 2015), easy access to major road, presence of a market, park, hospital and major surrounding of a house/ property determine its values (Sadayuki, 2018), and this relationship is well documented (Eisenberg, Vanderbom, & Vasudevan, 2017). The previous studies provide evidence that the locational factors are one of the most dominant factor which determine property values (Aziz, Anwar, & Dawood, 2019). Most of the scientific research on housing valuation is more concerned with marketing sectors (Gibb, 2012). The impact of proximity and hedonic measurement on property and land values is still unknown, and there is no perfect method to determine this effect precisely. Some researchers also use the geographically weighted regression (GWR) model (Wen, Xiao, Hui, & Zhang, 2018). But amongst all, the Hedonic Model is significant (Zabel, 2015). Studies founded that accessibility and neighborhood facilities effect the land values positively (Mulley & Tsai, 2016).

The neighbourhood provides platform for regular walking in context of accessibility, in living environment (Ghani, Rachele, Loh, Washington, & Turrell, 2018). That is why, known homebuyers preferences about the neighborhood facilities are very effective for urban planning and sustainability (Belcher & Chisholm, 2018). When a buyers purchase a property, he/she will weigh all of the components of a property which varying both over time and across location (Bourassa, Hoesli, Scognamiglio, & Zhang, 2011).

By 2030< about 60% of the population will be living in urban areas (Narducci, Quintas-Soriano, Castro, Som-Castellano, & Brandt, 2019). Much development has been made in the cities, gradually, which poses challenges for the sustainable urban development (Bolunda & Hunhammar, 1999). The rapid and irregular expansion of the land built-up is a major challenge of land use particularly in urban areas (Chen et al., 2016). The natural land is gradually being transformed into manmade topographies (Kong & Nakagoshi, 2006). Sustainable urban land use policy is a critical component of sustainable land use (Lu & Ke, 2018). For sustainable land management (SLM), particularly in its planning stage, it is important to involve the local urban people in decision making process and urban policies (Wang & Aenis, 2019). Understanding of the neighborhood services is important for urban decision making processes to sustain the ecosystem services among the population (Narducci et al., 2019).

For achieving sustainable urbanization, understanding the spatiotemporal heterogeneity of the property and its formulation, is necessary (Yuan, Wu, Wei, & Wang, 2018). Inexpensive informal house in developing countries and booming housing market ignore the concept of sustainability (He, Wang, Webster, & Chau, 2019). The impact of accessibility is valuable for policy making and urban planning (Contesse, van Vliet, & Lenhart, 2018). It is essential to analyze this policy in the framework of sustainable urbanization to evaluate the effectiveness of policy making process (Lu & Ke, 2018).

The empirical literature found the environmental attributes of the hedonic model also have the negative impact on property values including the traffic noise and air pollution in the urban areas (Salukvadze, Gugushvili, & Salukvadze, 2019). However, due to flexibility in the hedonic model one can change and fix the variables of the model during a research. Following variables were found in the literature which has both positive as well as negative effects on property values using the Hedonic Model.

Table 1: Description of Hedonic Variables

Structural: large Area/Size of house, Numbers of bedrooms +ve
Neighborhoods: Easy access to school, Mosque, Neighborhood quality. Air quality/Garden +ve. Traffic noise –ve
Community: Similar financial status, Job status +ve
Locational: Location adjacent to the road market/Shopping centre. +ve

Based on the above variables the data were collected from individual's property owners and the above structural, locational, environmental and community attribute are further divided into qualitative and quantitative values in the table below.

Qualitative	Quantitative
Area/Size of house/property, Age of house, Same Financial and job status, Traffic noise, Neighborhood quality. Air quality/Garden	Location adjacent to the road, near to the market/Shopping center, park, mosque, school, Numbers of bedrooms, garage

One of the most important model for land allocation is the time required to reach at work (Pan, Deal, Chen, & Hewings, 2018). In scientific literature, a new and emerging aspect also has been included that is, the allocation of the employee's residencies near the factory area. Some researchers also focusing the land values and school education preferences (Feng & Lu, 2013).However, these aspects has not been included in this research.

3. MATERIALS AND METHODS

Following methods has been adopted which are elaborated in the research framework:

Figure 1: Frame work of Methodology
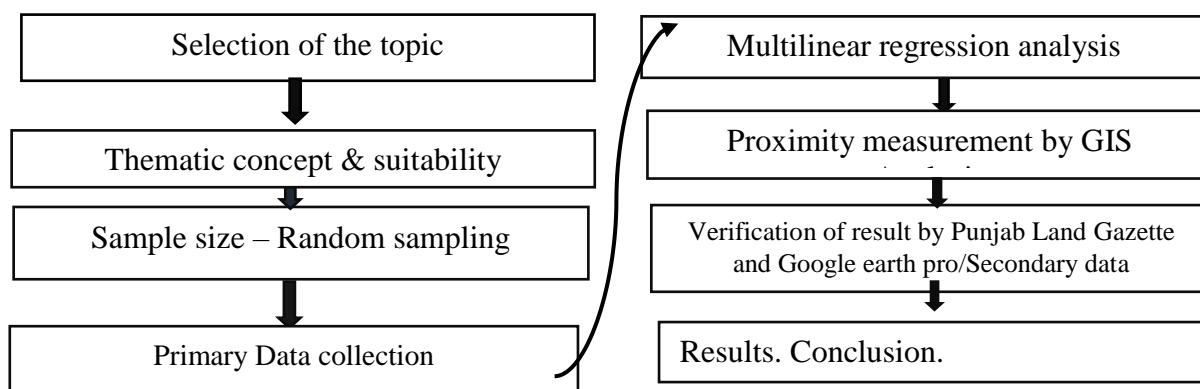
The hedonic measurements provide critical data according to the likes and dislike of an individual The hedonic measurements provide critical data according to the likes and dislike of an individual seller as well as buyer (Jaeger & Cardello, 2009). However, in 1974 the Rosen was the first man who introduced the model for the property assessment with different characteristics using the regression techniques. As every house and property has a heterogeneous nature and a set of characteristics so the Multi-linear Regression (MLR) was used, keeping the land value as a dependent variable and hedonic variables as independent. The hedonic model derives an equation of the price assessment given below:

$$P_{RS}{}^1 = (S, C, L, N) \ \dots\dots\dots\dots\dots\dots\dots \ (1)$$

Adopted: (Delmelle & Duncan, 2012)

Where P_{RS} is the single dependent variable, while Structural variable including, numbers of stories, numbers of bedrooms, number of bathrooms, Community variable including, job and cost status, and locational variables counted the location of land/property with respect to the road. By keeping the concept of the above equation the Hedonic models drive the following:

$$P_{RS} = \sum Xs + \beta_c X_c + \beta_L X_L + \beta_e X_e \ \dots\dots\dots \ (2)$$

Adopted: (Delmelle & Duncan, 2012)

Where P_{RS} = Hedonic Price (Predicated). $\sum$ = Sum of all variables, Xs= Vector for the structural attribute. X_n = Vector for neighborhood attribute. X_c = Vector for community attribute. $X_{L=}$ Vector for the locational attribute. The data having heterogeneous nature, so every variable is treated individually and has positive as well as negative effects on land values. The study sums up the results through regression analysis using R that is coefficient of determination or R square shows percentage variation in dependent explained by all the independent variables together. The results show a strong correlation among used hedonic variables.

3.1 Statistical Data Analysis

Multiple Linear Regression Technique is considered as a formal way for analysis in hedonic measurements for analysis of large data set (Selim, 2009). This technique was run through Statistical Package for the Social Sciences (SPSS). Regression coefficients values in table 1 including R and R^2 were used for the numerical indexes used to quantify and investigate the parameters having interaction among them. The evaluated data was analyzed using the analysis of variance (ANOVA, $p<05$). The independent factors including structural, locational, neighborhood and community variable were selected to examine their effect on total property values independently and they were represented in coefficient table no 3. The significant values of each variable were determined through p value less than 0.05 initially. The values obtained after analysis of R and R^2 explained the overall results of analytical applied model. Coefficient of correlation shows the relationship among variables having values between -1 to +1 where near to +1 shows all variables are moving in unison. But the study number of independent variables that is why the results could be more reliable if express in form of R square values for multi liner regression analysis as done in the study.

3.2 Spatial Analysis

GIS (Geographical Information System) were used as spatial analyses for proximity measurement. The Hedonic Model variables were linked with GIS to make it a spatial hedonic model (Latinopoulos, 2018). For GIS measurement, Google earth pro were used to draw the map of study area roads and streets-networking to have

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[1] Total sales value of property including the land price.

proximity measurement. Previous studies also use spatial analysis and GIS for landscape assessment in urban areas (Eleni Mougiakou & Photis, 2014).

3.3 Study area

The green town is situated in Gujrat City, Pakistan adjacent to the Grand Trunk road (G.T road). The total population of the town is 2196 (Punjab, 2017). The figure 1 shows the study area. This area is bounded by roads including the three-sided by Grand Trunk road, green town road and Shadiwal road and 4th side is adjacent to open and agricultural area. The proximity to the road provides the best way of the suitability for hedonic analysis. The result of the current study will be very effective for research and planning for urban area.

4. RESULTS AND DISCUSSION

Table 2: Hedonic Regression

R	R square	Adjusted R Square	Std. error of the Estimate
0.922[a]	0.850	0.827	1067816.965[2]

The above table-2 shows the regression results of the hedonic variables, where coefficient of correlation R = 0.922 shows a strong relationship between dependent and independent variables. Coefficient of determination, R-square value of 0.850 showing the variables are unison. The value of coefficient of determination shows 85 percentages suitability of the model. However, every variable has an individual effect on total result is shown as coefficient in the below table.

Figure 2: Green Town Gujrat, Pakistan.

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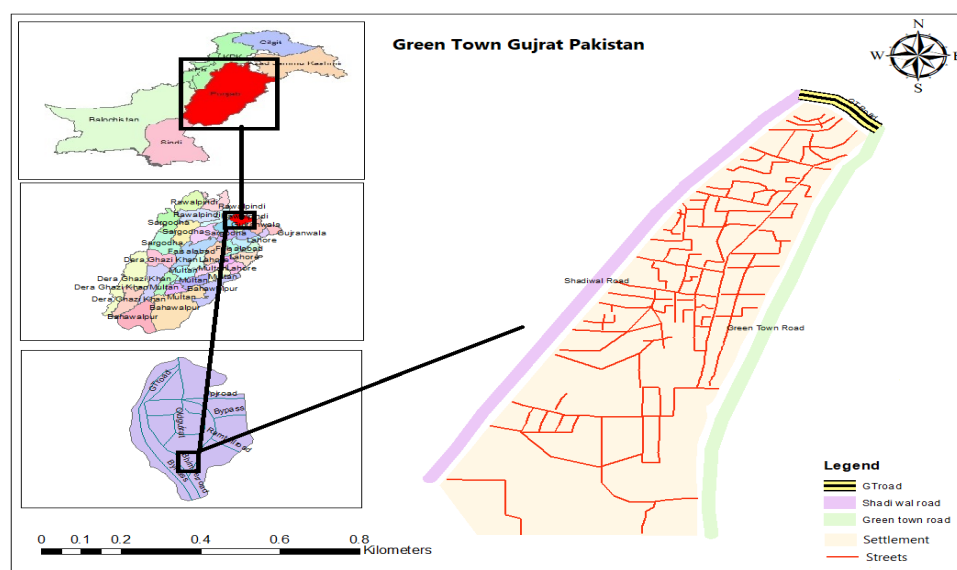
[2] High value for standard error due to varying price and heterogeneity in houses/property characteristics, especially the structure of houses and area characteristics and mixing of the settlement with an agricultural area.

Table 3: ANOVA Analysis

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	5.537E+14	13	4.259E+13	37.353	0.000b
Residual	9.806E+13	86	1.140E+12	***3	***
Total	6.518E+14	99	***	***	***

The above table 3 ANOVA (analysis of variance) shows the value of F that is 37.353 is high than the value of significant that is zero in regression analysis. Df value 13 meanings that total 13 variables were used in regression analysis. On the base of above result in the overall regression model is significant. The suitability analysis of the model can be represented by the significant value of 0.000.

Table-4: Hedonic Regression Coefficients

Variables	β-Beta values	T-statistics	Significant value
Location	-0.277	-2.720	0.008
Access	0.096	1.789	0.077
Size	0.297	4.788	0.000
Stories	0.215	3.255	0.002
Rooms	0.319	3.284	0.002
Bathrooms	0.061	0.591	0.558
Covered area	0.030	0.618	0.538
Land price	-0.114	1.963	0.053
Land Nature	-0.115	-2.444	0.017
Hospital-distance	0.001	0.010	0.992
Market-distance	0.030	-0.367	0.714

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[3] ***=Values are not available in Regression Analysis Result in SPSS.

| Community-financial status | 0.043 | 0.587 | 0.559 |
| Community-job | -0.013 | -0.202 | 0.841 |

The above table 4 shows the regression coefficient for each variable, at 95% confidence interval. All variables are statistically significant shows the significant values less than zero. The values of T-statistics are calculated by the ratio of standard error to measure the coefficient variables. The negative values of the locational variable (location of houses) shows the heterogeneity in the area characteristics location-wise. Land price has variations due to the location of houses like a land near to the road has high prices then the land adjacent to the agricultural area. Similarly, due to variation in community socio-economic status and characteristics the values are negative as few people are businessman and majority are involved in agricultural activities.

Figure 3 shows the land values based upon the data provided by land record authority Punjab Pakistan and display proximity measurement to the road through map in figure no 2. The result shows that the land located to the roadside or within the walking distance with respect to the road have high price ranging from 100000 to 500000,[4] per marla (26 sq.m) in residential and commercial area respectively. However, the land located away from the road or a distance from the road has 50% less price.

Figure 3: The proximity map for road and land values.

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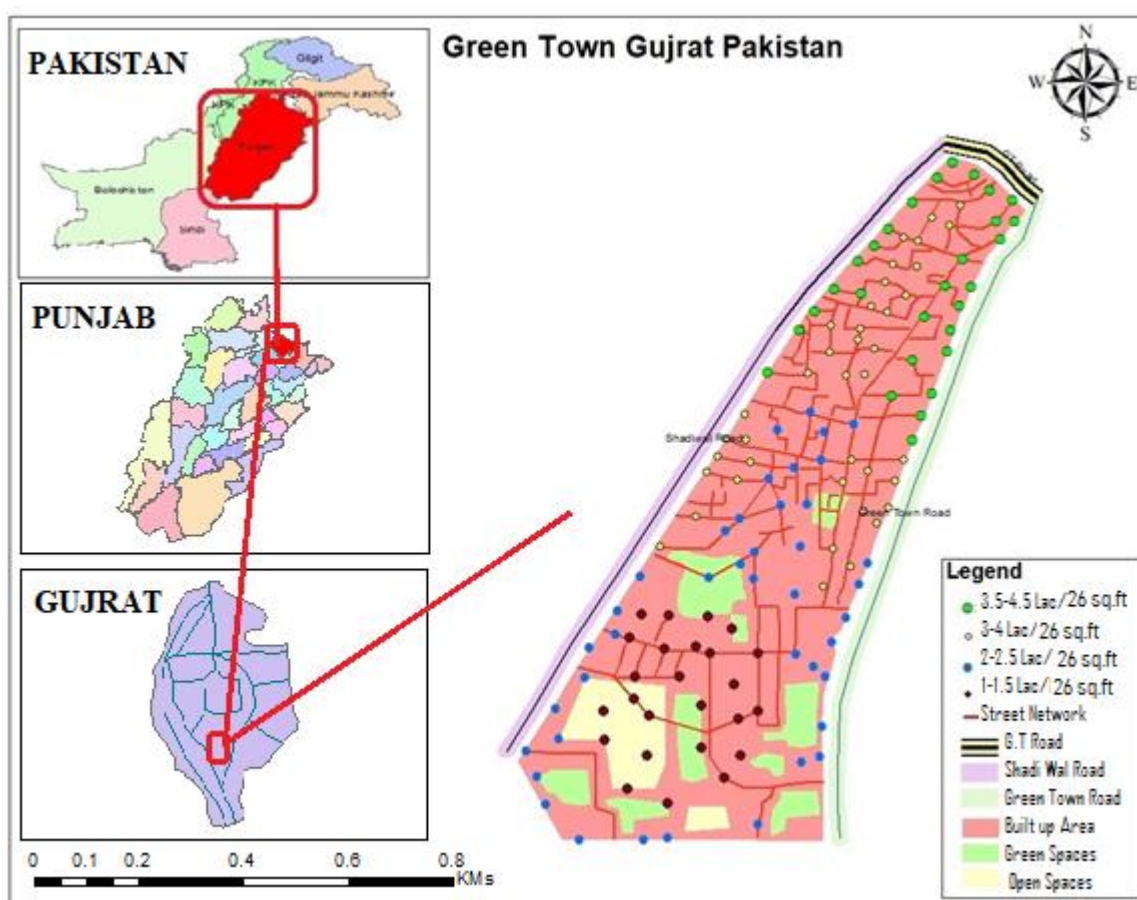
[4] 1 US$= 142 Pakistan Rupees. Dated 04-April-2019 (Pakistan, 2019).

Figure 4: Normal p-p plots of green town from regression results.

The results of the above figure 4 show the proximity effect on property values on land in the urban area of Gujrat. People preference for proximity found positive in economical context, and the people pay more for these proximity effects. After analysis, it is observed that the easy access to the road, the location of the property near to a shopping center, hospital, and community center will decrease the transportation cost due to accessibility at walking distance.

5. CONCLUSION

The characteristics of property and land determine its price. These characteristics vary for every property and land from location to location. The perfect method to measure this cost and property values is not defined especially in developing countries where there is heterogeneity in areas characteristics and land-values. However, people preferences and people perception about an area is a forceful element which plays a vital role in the sales and purchase decisions. It is also concluded that the people preference is also set by community characteristics socially as well as economically. For example, the people want to purchase a land or property where the local community has similar social, financial and job status. Finally, the result of this study based upon the current scenario of the area. The results describe the urban mechanism which will be very helpful for urban planning for land and property allocation plan for the government and concerned authorities.

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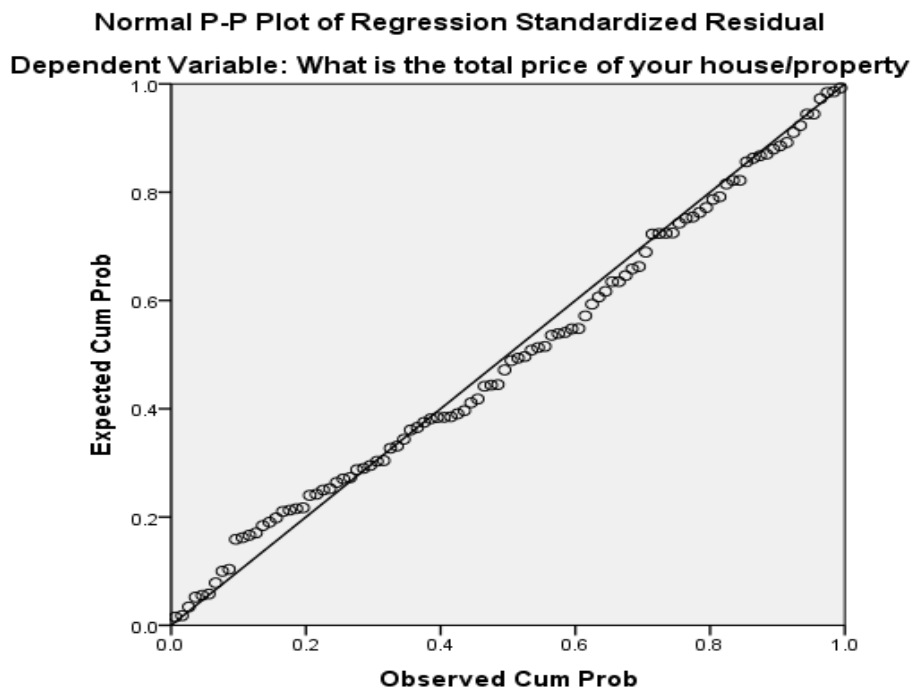
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APPENDICES

Figure 1: Normal P-P Plots of Green town from regression results.

Figure 2: Scatter plots of Green town form regression result.