Modelling the *Kampungkota*: A quantitative approach in defining Indonesian informal settlements

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Abstract. Bandung City is home to 2.5 million inhabitants, some of which are living in slums and squatter. However, the terms conveying this type of housing is not adequate to describe that of Indonesian called as *kampungkota*. Several studies suggest various variables in constituting *kampungkota* qualitatively. This study delves to define *kampungkota* in a quantitative manner, using the characteristics of slums and squatter. The samples for this study are 151 villages (*kelurahan*) in Bandung City. Ordinary Least Squares, Geographically Weighted Regression, and Spatial Cluster and Outlier Analysis are employed. It is suggested that *kampungkota* may have distinguished variables regarding to its location. As *kampungkota* may be smaller than administrative area of *kelurahan*, it can develop beyond the jurisdiction of *kelurahan*, as indicated by the clustering pattern of *kampungkota*. *Keywords: kampongkota, informal urbanism, housing system, Indonesia.*

1. Introduction to *kampungkota* in Indonesia

Slums and squatter has been issues of housing in Indonesia. Cities are not merely consisted of slum area but also planned residential area, trading and services centers, offices, and other tertiary sectors. However, the particular social values and the dynamics of local neighborhoods have contributed in generating *kampungkota*. This term refers to a specific neighborhood which at some extent has unique social values amidst the heterogeneity of urban dwellers. The definition is not settled though, as there is not suitable word in English; several *kampungkota* are built upon legal property and some are not considered slums (Obermayr, 2017). This condition is exacerbated as legal framework in Indonesia only recognized the management of slums (*permukiman kumuh*).

The continuing struggles in constituting the definition of *kampungkota* motivates further studies to gather evidentiary supports thoroughly in order to better grasp what the term actually is. Hence, this study aims to investigate the characteristics of *kampungkota* as the common issue in Indonesian cities. Quantitative methods are employed in this study, in which analyses are done using GIS. Taking case in Bandung as both the third most inhabited cities with population around 2.5 million citizens and the second highest population living in slum (Tarigan et al, 2015), this study should suggest more suitable definition of *kampungkota*. In bigger picture, this study should encourage the studies in informal urbanism, which is sometimes having less quantitative data. Also, this study should identify basic model of how *kampungkota* will manifest in urban perspective of Indonesia.

2. Previous studies pertained to *kampungkota*

The emergence of slums and squatter has been widely witnessed in mostly developing countries, including in Bangladesh (Paul, 2006), Albania (Pojani, 2013), The Philippines, and Vietnam (Minnery et al., 2013). However, the terms of 'slums' and 'squatter' is too vague to discern, leading to the use of more comprehensive term which is called "marginalized settlements" (Obermayr, 2017). Several evidences found by Obermayr (2017) suggest that the dwellers of squatter could be lower and middle class and most of them have legal ownership of their properties, while a large part of them don't have clear ownership over their property (Özdemirli, 2014). Another findings by Pugh (2000) suggests that squatters typically do not only have low access to water, but also possess high risk of mortality, particularly the children.

The vulnerability of slums' dwellers and squatters' inhabitants encourages various global initiatives to upgrade the livability in slums and squatters throughout the world. Kool et al. (1989) conclude that vast implementation of slums upgrading—particularly done in low to moderate standards—diminishes the needs of displacement. Milone (1993) investigated the implementation of *Kampung* Improvement Program in small and medium-sized cities in Java, Indonesia and found that improving the accessibility of water supply and sanitary facilities correlates with higher livability. However, Minnery et al (2013) suggest that security of tenure, government and regulation setting, public participation, up-scaling and extension program, and the connections between slum upgrading and sustainable livelihoods in implementing effectual slum upgrading programs and integrating them into urban planning.

A comprehensive study by Obermayr (2017) identifies two polarized types of Indonesian squatter; the first is located in inner-city which could be either *kampungkota* with improved infrastructure or *kampungkota* with insufficient infrastructures while the second is located in the periurban area. *Kampungkota* in peri-urban area may be constructed illegally which characteristics are more rural (Obermayr, 2017). These lead to the recognition that some characteristics of both slums and squatters can be used in indicating which neighborhood is actually *kampungkota*. These characteristics may include the land use surrounding kampungkota, the number of poor people living there, and number of slum housing.

3. Methodology

This study employs three quantitative methods, which are Ordinary Least Squares (OLS) linear regression, Geographically Weighted Regression (GWR), and Clusters and Outliers Analysis (COA). Clusters and Outliers Analysis (COA) is a method which identifies the clusters of objects having similarities not only in value but also in geographical proximity (ESRI, 2012). Also, this analysis recognizes the outliers that having no similarity with surrounding or similar objects. Both clustering objects and outliers can be defined by looking the *z*-score, *p*-value, and Moran's Index (Moran's I).

OLS linear regression generates predictions or models a dependent variable in terms of its relationships to a set of explanatory variables. However, if any misspecification resulted by trying to model nonstationary variables using OLS, then GWR may be used to improve predictions and to better understand the nonstationarity (regional variation) inherent in explanatory variables (ESRI, 2012). GWR models spatially varying relationships, whose coefficients are functions of spatial location (Fotheringham et al, 2002; Chi et al, 2013) give a general form of a basic GWR model as:

$$y_i = \beta_{ik} x_{ik} + \varepsilon_{ik} \quad (1)$$

where y_i is the dependent variable at location i; x_{ik} is the k-th independent variable at location i; β_{ik} is the local regression coefficient for the k-th independent variable at location i; and ε_i is the random error at location i.

Firstly, ratio of slum area in *kelurahan* in Bandung City are analyzed using COA. This will reveal the likeliness of *kelurahan* having high ratio of slum area to cluster with another *kelurahan* which has

relatively similar condition. Secondly, GWR is employed to explore what factors influencing the *kampungkota*. Several variables used in GWR will be described in Table 1.

3.1. Variables

The objects to analyze in this study are the possible clusters of *kelurahan* (This term is equivalent to "village". There is also *kecamatan* which is equal to "subdistricts". *Kelurahan* is hierarchically lower than *kecamatan*) which have significant relationship in term of ratio of slum area in each *kelurahan* and the relationship between the area of slum in each *kelurahan* and its predictor variables. The predictors are selected after the reiterations of GWR using various variables inputted to reach the highest possible value of R-square and the lowest value of Akaike Information of Criterion (AIC). R-square indicates how accurate the model is while AIC looks for the model having a good fit to the actual condition but minimum parameters.

The data used in this study are gained from *Potensi Desa* 2014. There is also the calculation of land use ratio compared to the area of *kelurahan* whose data are attained from the land use map of Bandung in 2015, with scale 1:5000. The area of slum in each *kelurahan* in Bandung City is collected by the Mayor Decree 648/2015 about The Location of Slums Area in Bandung City.

Table 1. Variables used in GWR

Variable	Definition
AS	The area of slum in *kelurahan* (m^2)
RHDRA	Ratio of high density residential area in *kelurahan* (m^2)
RMDRA	Ratio of medium density residential area in *kelurahan* (m^2)
RCA	Ratio of commercial area in *kelurahan* (m^2)
PD	Population density in *kelurahan* (persons/km^2)
NSH	Number of slum housing in *kelurahan* (unit)
SKTM	Number of Identification Letter of Being Poor (*Surat Keterangan Tidak Mampu*) issued in *kelurahan* (household)

3.2. Model

Based on the basic GWR model, the relationship between the area of slum and the variables aforementioned is mathematically expressed as:

$$AS_i = \beta_{0i} + \beta_{1i}RHDRA_i + \beta_{2i}RMDRA_i + \beta_{3i}RCA_i + \beta_{4i}PD_i + \beta_{5i}NSH_i + \beta_{6i}SKTM_i + \varepsilon_i \quad (2)$$

4. Results

Regarding to the ratio of slums area in each *kelurahan*, the analysis shows that several *kelurahan* do cluster into two groups, along with two outliers (see Table 2 and Figure 1). From this analysis, there are three *kelurahan* which have the highest *z*-score and having COType of HH (High-High), indicating the similarity of each *kelurahan* in terms of ratio of slums area. It is indicated that the characteristics in these *kelurahan* is relatively similar.

From the OLS and GWR results (see Table 3), it is found that GWR outperforms OLS by the higher R-square and Adjusted R-square of GWR than that of OLS, though AIC values of both models imply that two models are good fit with minimum parameters. However, it is also found that the significant variables in OLS are only the intercept and the ratio of high density residential area.

Table 2. The result of spatial clusters and outliers analysis

Kelurahan	*Kecamatan*	Local Moran's I	*z*-score	*p*-value	COType
Garuda	Andir	0.006514	2.216655	0.026647	HH
Dungus Cariang	Andir	0.010308	3.772482	0.000162	HH
Maleer	Batununggal	0.020147	5.087551	0	HH

Kelurahan	*Kecamatan*	Local Moran's I	*z*-score	*p*-value	COType
Babakan Sari	Kiaracondong	0.027240	10.117238	0	HH
Binong	Batununggal	0.021094	5.400121	0	HH
Babakan Surabaya	Kiaracondong	0.013313	4.890801	0.000001	HH
Kebon Gedang	Batununggal	0.056198	13.513579	0	HH
Kebon Jayanti	Kiaracondong	0.083101	24.312960	0	HH
Kebon Kangkung	Kiaracondong	0.016754	4.900997	0.000001	HH
Sukahaji	Babakan Ciparay	0.015053	5.077553	0	HH
Warung Muncang	Bandung Kulon	0.016778	5.786343	0	HH
Cibuntu	Bandung Kulon	-0.009798	-3.372949	0.000744	LH
Panjunan	Astana Anyar	-0.009685	-2.190693	0.028474	LH

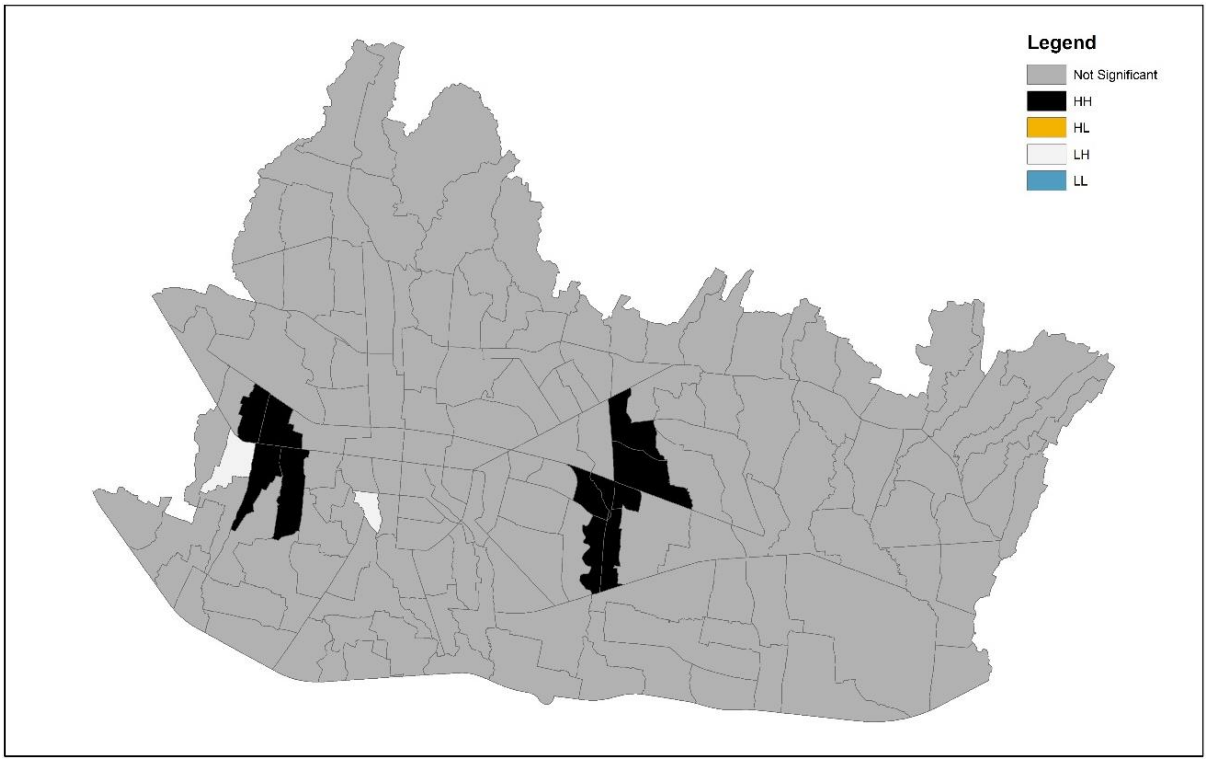

Figure 1. The clusters and outliers of *kelurahan* in terms of slums area ratio.

Table 3. The result of OLS and GWR

	OLS		GWR				
Explanatory Variables	β	Significance (*p*-value <0.05)	Min.	1st Quartile	Median Value	3rd Quartile	Max.
Constant	0.071924	Yes	-0.021176	0.042298	0.067999	0.084537	0.141261
RHDRA	0.188206	Yes	-0.182355	0.182699	0.251664	0.584486	1.683953
RMDRA	-0.071623	No	-2.256099	-0.188014	-0.069691	-0.035128	0.043207
RCA	-0.019501	No	-0.301951	-0.174507	-0.033771	0.136894	0.698841
PD	0.000001	No	-0.000007	0.000001	0.000002	0.000002	0.000004
NSH	-0.000105	No	-0.000373	-0.000183	-0.000115	-0.000076	-0.000019
SKTM	0.000002	No	-0.000048	-0.000001	0.000005	0.000027	0.000106
Residual sum of squares					1.631524		

	OLS		GWR				
Explanatory Variables	β	Significance (p-value <0.05)	Min.	1st Quartile	Median Value	3rd Quartile	Max.
Akaike Information of Criterion	-166.191220				-173.649031		
R-square	0.134172				0.462420		
Adjusted R-square	0.098096				0.268034		

From the GWR, the residuals of the models vary regarding to its spatial location. Ratio of slums area in 69 *kelurahan* can be modeled by the GWR using the same variables as this study does as the residuals are minimum. On the other hand, Figure 2 further suggests that there are more explanatory variables to be included in the GWR (as the area gets red and darker) or even excluded (as the area gets blue and darker).

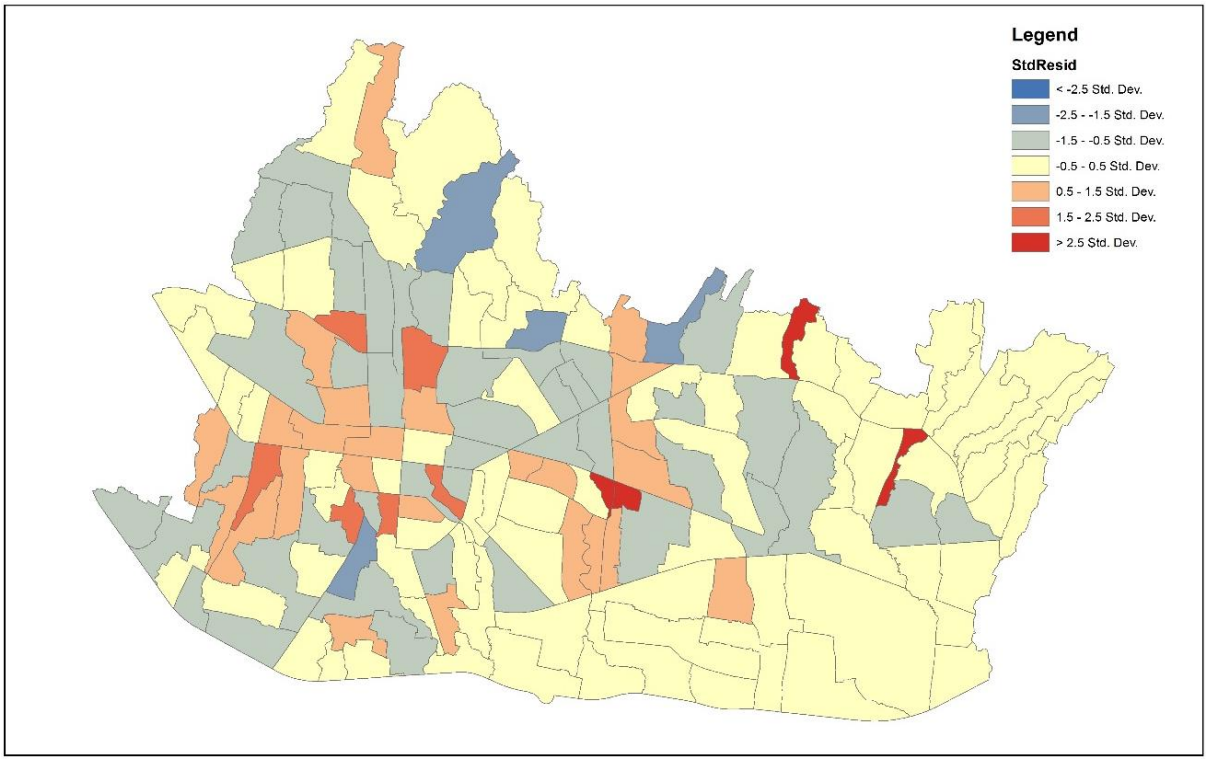

Figure 2. The residuals of GWR.

5. Discussion and Concluding Remarks

From the results, although a *kelurahan* may have a high ratio of slums area, it may be statistically unrelated with its surrounding *kelurahan* in terms of *kampungkota*. There are high yet significant relationships of *kelurahans* clustering by high ratio of slums area. The clustering *kelurahans* indicates that the *kampungkota* may expand beyond the administrative area of *kelurahan*. However, the relatively weak accuracy of GWR models in this study to better define *kampungkota* still needs to be explored. It should also be noted that *kampungkota* is not only slums and squatters, as there is still unclear definition of variables constituting it.

In city scale, there is a palpable difference of *kampungkota* in city centers and periphery area, as the models in both areas are distinctive. It can be noticed that the models are relatively similar in

kelurahans located on the periphery area, while the models of *kelurahan* located in city centers vary considerably. This slightly corroborates the classification of informal settlements as seen in other cities such as Surakarta (Obermayr, 2017). This may be caused by the lack of exploratory variables that better represent the socio-economic and socio-demographic conditions, land use, historical background, and legal framework. Noting that spatial location does influence the variables, it can be concluded that variables of *kampungkota* are different from one to another.

The construction of model is somehow limited by the data availability. *Kampungkota* in this study consists only of the ratio of several land uses—accommodating the location proximity to jobs of slum dwellers by the ratio of commercial area in each *kelurahan* and the tendency to build intensified buildings in a narrow space as represented by the ratio of high density residential area and population density of each *kelurahan*. There is also several socio-economic elements such as the numbers of slums housing and the number of Identification Letter of Being Poor issued in *kelurahan*. There should be more relevant variables in conveying the condition of *kampungkota*, for example the ratio of legal area in *kelurahan* to be built as housings and the growth rate of the housings in each *kelurahan*. These facts suggest the construction of better *kampungkota* information system to integrate this area into city planning (Minnery et al. 2013).

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