The correlation of housing estate area with regional infrastructure development in peri-urban region of metropolitan Bandung Raya

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Abstract. Housing estates development in the peri-urban area is often used as a solution to meet the needs of urban housing. In this case, the development of housing estates built by developers, are including housing units as well as the facilities and infrastructure. Based on this practice, then two opposite opinions emerge about the participation of developers in the development of housing infrastructure. The first opinion acknowledges that residential developers have assisted the government in providing settlement infrastructure. Meanwhile, the second opinion considers the infrastructure development undertaken by the residential developers has precisely caused inefficient regional infrastructure development. This study aims to examine the correlation between the development of housing estates and the development of regional infrastructure by using simple linear regression analyses, in order to prove whether there is a relationship between the two variables. This research was conducted at West Bandung Regency (Kabupaten Bandung Barat), one of the regency that located in peri-urban of Metropolitan Bandung Area. Two variables used in this study consist of the area of housing estates variable and the infrastructure development variable. The infrastructure development variable is represented by The IKG score (Geographic Difficulties Index). In this study, two different levels of the area were conducted to the examination, the village, and the subdistrict. The result of this examination shows that there is a weak correlation between the variables of the housing estates area and The IKG, even though its relationship is getting stronger when the test performed on a larger area. Based on this research, it can be said that the development of housing estates infrastructure in West Bandung Regency has a lack of significant effect on the regional infrastructure development.

1. Introduction
The development trend of peri-urban areas of major cities in Indonesia has started since the economic boom began in the 1970s [1]. The economic boom was followed by a rapid increase in the property sector. In that period, massive urban development followed by the urban activity expansion towards the outskirts of the city. The peri-urban area, which was originally a rural land, gradually began to convert to urban landscape. In several major cities in Indonesia, during the period of 1980-1990, there has been a large-scale conversion of land in peri-urban areas where agricultural lands converted to offices, retail, commercial areas as well as the development of residential and settlement areas [2]. As occurred in the fringes of Bandung city, the urban center of Metropolitan Bandung Raya, there has been extensive conversion to urban land use, notably residential areas.
Rural land on the fringe of large cities is acquired and transformed into residential areas for several reasons. The main reasons are to escape the hectic of the city and to create a living environment in which the negative aspects of the city life can be controlled [3]. The residential project in peri-urban areas is often developed by the private sector and designed as formal housing. The housing project is generally addressed to the middle-high income market groups who generally interested into the new residential place at peri-urban for avoiding congestion, air pollution and space constraints in the city center, and expecting more reliable security, and better infrastructure [4]. In the peri-urban areas, developers are not only perform housing development but also constructing infrastructure and services facilities as an attraction for buyers and as the corporate brand image [5]. In this case, the housing facilities built by the developers include basic infrastructure, and the public amenities should be utilized by all of the community. But then, one of the emerging issues is the exclusiveness of the use of housing infrastructure that is often only allowed for the local occupants. Another problem that arises as a result of a large number of housing estates development in the peri-urban area is infrastructure inefficiency or deficiency [6].

In terms of regulation related to the issue of housing and settlement infrastructure provision, as stated in Law No. 1 of 2011 on Housing and Settlement Region, the government has regulated the infrastructure provision for every single step of planning, construction and utilization [7]. According to Law No. 1 of 2011 art. 30, planning of public infrastructure, facilities and utilities can be undertaken by any person who has expertise in the field of infrastructure planning, public facilities, and utilities by the provisions of the legislation. While art. 29 states that if infrastructure planning that meets the requirements must be approved by the local government. In art. 47 it is explained that infrastructure development in housing can be built by the central government, regional government or everyone. Furthermore, the infrastructure and housing facilities development that has been accomplished must be delivered to the local government by the provisions of the law.

Following this regulation statement, that is to say, that the infrastructure and the housing facilities eventually will be delivered and will be maintained by the government as the owner of public facilities. In this case, the positive side of developer involvement in housing supply has helped the government to provide the housing needs along with housing facilities and its infrastructure network. As Siahaan at al. [8] proved that the housing estates development of Siantar Marimbun District of North Sumatera gave positive impact in regional infrastructure development. Meanwhile, some of the negative sides that subsequently arise as result of housing estates development in the peri-urban areas are spatial fragmentation and unintegrated infrastructure that emerge due to many developers involved. Moreover, spatial fragmentation occurs between several new housing estates built by different developers as well as between the new housing estates and their surrounding areas [6]. In this case, the negative impacts emerge from unintegrated infrastructure eventually become government ‘homework’, such congestion, unconnected or overloaded infrastructure and also environmental degradation [9].

Pros-cons related to the provision of housing infrastructure by developers have been discussed in previous studies. Nevertheless, only a few studies have undertaken researching the relationship between housing estates area built by developers with the development of regional infrastructure in the peri-urban region of the metropolitan area. Siahaan at al. [8] has conducted correlation study between housing estates with the regional infrastructure development in North Sumatra, but the research was considering perception from the society, not from the spatial aspect. Therefore, this research will specifically study the correlation between housing estate area with regional infrastructure development in the peri-urban region of Metropolitan Bandung Area with considering the impact of wide spread area of housing estates to the infrastructure development. In this research, the development of infrastructure not only seen from the provision, but also in accessibility for broader infrastructure network. This research was conducted in West Bandung Regency, one of the regency with continuous areas onto the urban center of Metropolitan Bandung Raya, which includes the Bandung Municipality and Cimahi Municipality.
Before 2008, West Bandung Regency was part of the Bandung Regency territory. In 2007 according to Law No. 12 of 2007 on The Establishment of West Bandung Regency, then West Bandung Regency became an autonomous region in West Java Province [10]. West Bandung Regency consists of 16 subdistricts and 165 villages. Long before the establishment of West Bandung Regency, the land conversion has become one of the strategic issues in this region, notably residential used. Based on Technical Study Report of Master Plan for Public Housing Provision in Metropolitan Bandung Raya [11], in 2014 the built area in West Bandung Regency attained 19,865.62 Ha or 15.21% of the total area. This value increased 11% from the previous decade that the built area in West Bandung Regency was only 5,580.31 Ha or 4.27%. While the area of housing estates in West Bandung Regency attained 2,066.65 Ha or 10.4% from the built up area. By using Winarso [12] assumption that only 50 percent of the land was designated for housing in residential development and that the medium house would need 100 square meters plot, then in a hectare land would be enough for 50 house units. If it is further assumed that the size of household was 4.2 person (Bandung Urban Development Project 1986), then in 5,580.31 Ha land of housing estates could be accommodating 433,996 persons or about 26% total population of West Bandung Regency were living in housing estates area. This number shows a large population who lives in the peri-urban metropolitan areas, and it will continue to increase in the future. Through this research, it will be known whether the existence of housing estates contribute on supporting the regional infrastructure development by considering the size of the areas. This study is important as a source of information for the policy makers about make technical guidance on the peri-urban residential infrastructure development in the future.

2. Method

This study was conducted using the quantitative method. Data was collected through secondary data collection. The data was obtained through The Reports of Monitoring and Evaluation Data of Housing Estates 2016 by Housing and Settlement Agency in West Bandung Regency and The Index of Geographic Difficulties (Indeks Kesulitan Georafis) of West Bandung Regency 2016 Book or known as The IKG book [13]. The Reports of Monitoring and Evaluation Data of Housing Estates 2016 consists of information on the list of housing estates, developers, the area of housing estates and the infrastructure as well as housing facilities.

The IKG book describes the regional accessibility that refers to three indicators consisting of basic services, infrastructure, and transportation by scoring methods. These indicators of region accessibility have their scores that together configure The IKG. Each indicator consists of several aspects. The aspects of basic services consist of the availability and the accessibility to educational facilities (primarily, elementary, high school), hospitals and other health facilities. The aspects of infrastructure consist of the accessibility to the shopping services, markets, restaurants, banks, electricity services, and fuel/gas. The aspects of transportation consist of traffic and roads quality, roads accessibility, mass transportation, cost and traveling time to district and regency office. It can be said that The IKG represents the description of the regional infrastructure of West Bandung Regency as one of the peri-urban area in Metropolitan Bandung Raya. In the scoring methods of The IKG, the increasing of The IKG value inversely proportional to the increased value of regional infrastructure. That is to say, the higher The IKG score, indicating a lower level of infrastructure accessibility. The IKG scoring consists of two categories include The IKG Village and The IKG Sub-District. As an illustration, the information of The IKG Village can be seen as follows.

| Rank | District | Village | Basic Services | Infrastructure | Transportation | The IKG Village |
|------|----------|---------|----------------|----------------|----------------|-----------------|
| 1    | Lembang  | Lembang | 6.92           | 0.54           | 4.52           | 11.98           |
| 2    | Cililin  | Cililin | 6.84           | 3.13           | 3.7            | 13.67           |
| 3    | Lembang  | Jayagiri| 10.7           | 0              | 4.07           | 14.77           |
To conduct correlation test, this study used simple linear regression analysis in SPSS Statistics. The simple linear regression analysis is a statistical technique that attempts to explore the relationship between two variables, include independent variable and dependent variable [14]. In simple linear regression, the scores on a dependent variable will be predicted by the scores on the independent variable. Regression analysis can also be used to determine the linearity between the dependent variable with the independent variable. To measure the strength of a linear relationship between the two variables, the testing can be performed by t test or probability value (p-value) test. The hypothesis for this research is as follows:

Ho: there was no significant correlation between The Housing Estates Area variable and The IKG variable.
Ha: there was significant correlation between The Housing Estates Area variable and The IKG variable

The confidence intervals of 90% or $\alpha = 0.1$.

If the p-value is less than the significance level ($\alpha = 0.1$), it means that Ha accepted and Ho rejected, but if the p-value is greater than the significance level, it means that Ha rejected and Ho accepted [15]. In this study, the independent variable represented by the area of housing estates and the dependent variable represented by The IKG. The examination of statistic equation on The IKG score will be performed by two different wide-spread area variable, the village area level, and sub-district area level.

3. Results and Discussions

The results will be discussed in 2 subsections; they are the correlation between The IKG Village and The Housing Estates Area at village level and the correlation between The IKG Sub-District and The Housing Estates Area at Sub-District Level

3.1. Correlation between The IKG Village and The Housing Estates Area at village level

The first correlation test was conducted to examine the relationship between The Housing Estates Area (village scope) as the independent variable with The IKG Village as the dependent variable. The result of SPSS statistic test with simple linear regression analysis method for both variables is as follows.

| Model | Variables Entered/Removed | Variables Removed | Method |
|-------|---------------------------|-------------------|--------|
| 1     | Housing_Estates_Area_Village | . | Enter  |

Table 2. Regression for Correlation between The IKG and Wide Area of Housing Estates at Village Level

\[ a. \text{Dependent Variable: IKG\_Village} \]
\[ b. \text{All requested variables entered.} \]
The information can be obtained from the table that the correlation value (R) is 0.213. It is shown that the coefficient value of the influence of independent variables on the dependent variable or the coefficient of determination (R2) is 0.045. It means that the contribution effect of housing estates variable at the village level to The IKG Village variables is only 4.5%, the rest of it is influenced by other variables. Based on these scores, it can be said that the relationship between these two variables is weak. Meanwhile, from the ANOVA table obtained the F-count value of 7,765 with significance level 0.006 (less than \( \alpha \)). It means this regression model was linear and this regression model can be accepted to predict The IKG Village variable. This model also indicates that the hypothesis of The Housing Estates Area variable at the village level correlates with The IKG Village variable is acceptable. From the next table or Coefficients output, it shows that the constants are 43.664. The regression coefficients value -0.128 means that in every 1 ha addition of The Housing Estates Area, then The IKG will decrease as much as 0.128 points. So that, the regression equation is \( Y = 43.664 - 0.128X \). Through this regression equation, it can be said that the increase of The Housing Estates Area at village level is linear with the decline of The IKG Village, or it can be said that the increase of The Housing Estates Area is linear with the increased accessibility and development of regional infrastructure, even though in a very weak correlation.

### 3.2. Correlation between The IKG Sub-District and The Housing Estates Area at Sub-District Level

In the second test, correlation testing is performed between The Housing Estates Area (sub-district scope) as the independent variable with The IKG Sub-District as the dependent variable. The result of SPSS statistic test with simple linear regression analysis method for both variables is as follows.

**Table 3. Regression for Correlation between The IKG Sub-District and Housing Estates Area at Sub-District Level**
From the Table 3, the information can be obtained that the correlation value (R) is 0.485 and it is shown that the coefficient value of the influence of independent variables on the dependent variable or the coefficient of determination (R2) is 0.235. It means that the contribution effect of The Housing Estates Variable at sub-district level to The IKG Sub-District variables is 23.5%, the rest of it is influenced by other variables. The scores show that the relationship between these two variables is a little bit moderate. Meanwhile, from ANOVA table obtained the F-count value of 4.297 with significance level 0.057 (less than \( \alpha \)). It means this regression model was linear and this regression model can be accepted to predict The IKG Sub-District variable. This model also indicates that the hypothesis of The Housing Estates Area variable at the sub-district level correlates with The IKG Sub-District variable is acceptable. From the next table or Coefficients output, it shows that the constants are 92.752. It means that if there’s no value added for housing estates are variable; then The IKG value will be as high as 92.752. The regression coefficients value -0.177 means that in every 1 ha addition of The Housing Estates Area, then The IKG will decrease as much as 0.177 points. So, the regression equation is \( Y = 92.752 - 0.177X \). Through this regression equation, it can be said that the increase of The Housing Estates Area at sub-district level is linear with the decline of The IKG Sub-District, or it can be said that the increase of The Housing Estates Area is linear with the increased accessibility and development of regional infrastructure, with a little bit stronger correlation than the previous examination.

Based on these two tests, it can be said that the existing housing estates development has a weak influence on accessibility and regional infrastructure development of the region. Nevertheless, through this study, it was found that the existence of housing estates that may have little effect on the development of local infrastructure, in fact within the wider scope of the territory provides a stronger influence on the development of regional infrastructure. It can be said that the existence of housing estates still has not significantly contributed to the development of regional infrastructure. One of the reasons is the residential planning that tends to be partial, have not looked at the context of the region as a whole. The residential development in peri-urban areas which involves different and not only a few developers, without more detailed technical guidance, will result on different styles of land development and different micro-infrastructure development solutions. As Winarso [12] showed that large-scale housing developers are able to create new infrastructure subsequently. They can
independently build the new urban infrastructure and often not integrated into the existing regional infrastructure network provided by the government; for example, new sections of roads are often disconnected from broader transportation network system [6]. Meanwhile, for the small-scale housing developers are mostly utilizing existing network infrastructure that sometimes not consider the usage load of the existing infrastructure facilities.

The episode of the urban settlement races ahead of infrastructure development has led the development of peri-urban areas toward the urban sprawl (16). The UN Habitat stated that urban sprawl in many developing countries comprises two main contrasting types of development. One is characterized by large peri-urban areas combined with a lack of infrastructure, public facilities, and basic services, and the other one is a form of peri-urban sprawl in which residential zones for high to middle-income groups and highly valued commercial and retail complexes are well connected by individual rather than public transport. Urban sprawl adds to the urban divide, pushing social segregation along economic lines that result in a spatial difference in wealth and quality of life across various parts of cities and metropolitan areas run down inner cities and more peri-urban areas (17). All of these may happen because the government still does not have comprehensive infrastructure planning as well as more detailed technical guidance to be applied in the smaller scope.

In the residential infrastructure development, the government must have detailed technical regulations in terms of planning, implementation, and supervision so that the built infrastructure will form a sustainable and continuous network with the surrounding environment. Without strict regulation, residential development in the peri-urban areas may also cause infrastructure inefficiency, especially in the wider scope. The importance of a reliable infrastructure network in the peri-urban region should get a serious concern. As Yunus [18] stated that the peri-urban areas are the future determinants of a city, indicating the infrastructure network as a hub of the central urban area with peri-urban areas plays an important role in the concept of metropolitan area development. In this case, the peri-urban area of Metropolitan can be said to have an important role in ensuring the sustainability of the metropolitan urban center in the future.

4. Conclusions
The study shows that in West Bandung Regency, the existence of housing estates affects to infrastructure network accessibility although in a fairly weak correlation. In the first examination, the results show that the housing estate area variable is correlated with the infrastructure development variables, although in a very weak correlation. In the second examination with considering a larger area as the sub-district level, the results show a correlation that tends to be stronger between the two variables. It can be said that the impact of housing estate existence on the infrastructure development is a lack of significant.

This is unfortunate considering the settlements in West Bandung regency today can be said as a supporter of social activities in urban metropolitan areas. In this case, the completeness of public facilities and infrastructure accessibility is one important element to sustain the existence of residential areas. Without prejudice to environmental issues related to the use of peri-urban areas, the prospect of developing peri-urban areas for settlement is very high. Based on the Regional Regulation no 2 of 2012 on West Bandung Regency Spatial Plans, most of the directives of the utilization of the area in West Bandung Regency is intended to support the function of settlements, both urban and rural residential [19].

Based on the above arguments, in the future the government needs to pay more serious attention to the technical development of residential areas in peri-urban, considering there is still a lot of vacant lands and rural that does not have formal infrastructure network and has the potential to be developed into residential to support urban society. In this regard, the housing and infrastructure development in peri-urban areas needs to be seriously planned so that their presence can contribute significantly to establish a comprehensive, efficient and structured regional infrastructure network.
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