Spatial analysis of educational facilities services pattern in Malang peripheral areas

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Abstract. Educational facilities in Indonesia has important function especially to enhance and support community activities, and it's must be provided for all settlement areas. In general, provision of educational facilities still carried out on the basis of population size and spatial availabilities until now, which means for the new facilities development used the scale and capacity of services analysis on related facility. This study conducted based on the characteristics of facility services especially on elementary school facilities on traditional or historical cities. As previous study that had been carried out, the measurement was done with the cell/grid catchment (CGC) analysis to identify the service rates from each areas. Based on the analysis result, rate of elementary school services in the Malang City peripheral areas defined by the grid/cell approach was 134% and it was lower than Malang Regency areas rate with 247%. The pattern of school services in Malang City areas relatively similar between its districts while in the Malang Regency areas has significant differences especially southern and northern districts.

1. Introduction

Access to qualified educational facilities considered as a barometer of the socioeconomic development and national development agenda [1]. Therefore, education development program became as important element of national development policy. On the other hands, universal primary education development also become as part of Millenium Development Goals (MDG's) [2]. In contrast, many developing countries such as Indonesia had struggled in aims to provide better access of qualified education services and it was hampered the constraints of educational supply such as education facilities and infrastructures against the quality and efficiency of education systems. In Indonesia, education sector development is the part of indicators national development agenda as it mandated on RPJMN 2015 – 2019. Therefore, in aim to enhance the education sector development there are several programs that can be done and also related to national program "*Wajib Belajar 9 Tahun*" which are qualified and competent teachers and lecturers recruitment, quality of education curriculum improvement and adequate education facilities (school) provision. Those programs are important to improve educational development in each area, and the important program is provision of educational facilities.

Up today, school provision was done based on basic demographical and physical characteristic aspect and it's still need comprehensive and adaptive plan in aim to identify the demand of new facilities based on existed service scales or rates of educational facilities (elementary schools). Gibbons & Machin identify phenomena between the effects of competition on achievements and

school performance on each area [3]. Those attributes considered as part of facility services and become as important aspect that can increased the quality of services. Moreover, these study is aimed to update the method than can be used to measure the capacities, rates and patterns of education/school facility service in precision. Then those method used to identify areas that has not provided a maximal or optimal facility service and can be used to measure spatial connectivity between regions or areas based on educational facility services, for this research is elementary school.

As mentioned earlier, this research focused to measure educational facilities services especially at primary level that is elementary school which is in Malang City consist of general school and Islamic school. These facilities quite important, especially in supporting the realization of national development priority program in the education field "*Wajib Belajar 9 Tahun*" and currently the management and development of elementary schools are still on the authority of the city and regency government. Until now, there has been no policy on the development and arrangement of educational facility services, ranging from elementary to high school level, so there were competition or accumulation of service occurred related with this educational facilities while on the other hand students have limited choices in accessing the education facility properly especially when student want to choose school near they live. In the end, there is an imbalance or disparity of elementary or primary education services between urban and rural areas. In the Malang City as urban areas and Malang Regency as rural areas, problems related with the elementary school services need to get the best attention especially concentration of school in the certain part of the area. Based on the existing condition, there are areas that have many elementary school that are expected having a high level of services while there are another areas with low availability of elementary school. It is expected that the disparity of elementary school services will be higher in the rural areas than urban areas. Rural communities faced limited services than people in the city. The coverage of elementary school services is as broader as possible so that the capacity of services also expected to be substantial and this certainly affects the level of elementary school services.

2. Configuring the school services pattern

2.1 Literature Review
Several research showed that the school service as part of the school market identification. Garcia-Diaz study the relationship between urban school market concentration (lack of competition) and school technical efficiency [4]. Similar with this research, neither efficiency nor competition is not directly observable. In order to measure school efficiency, the stochastic frontier analysis method (SFA) was used to calculate technical efficiency. In other research, measure competition in a school market by using the Herfindahl–Hirschman market concentration index (HHI) as a proxy of the competition level every school market faces [5]. The index employs the application of Geographical Information System (GIS) tools to incorporate the degree of competition each school faces from peer schools spatially located within a radius of 1 km in their local market area. These radius was considered and used in these research to identify the service coverage of elementary school. The consideration also contained on National Standard (SNI) especially to discover public facilities service coverage. Related with service coverage, several authors delimited the school market or school service coverage based on the geographic zones and county sizes, while the others used the school district boundaries in metropolitan areas [6]. Misra pointed out that geographic delimitation is subject to an aggregation bias given that sometimes the real competition is not captured [7]. In order to define different school market sizes, the authors drew circles around 1 km radius around each school.

2.2 Methods
These study was intended to compare the calculation method in aim to identify the service rates of facilities between basic/conventional method and the modification ones. Later method is referred as cell/grid based catchment method and it perceived has more accurate/precision result to calculate the service level of facility, especially for the educational facilities (schools) services [8]. Basically, those

method was derived from the Floating Catchment Method (FCM) [9]. The cell/grid based catchment method was applied with the help of GIS software through the buffer and overlay tools. In these research, those method are used to configure the service pattern of educational facility in the peripheral areas (Malang City and Malang Regency border areas). As national standard, the service layer/coverage for elementary school unit takes about 1,200 inhabitants or 1 kilometer radius [10]. The method used to identify the number of school service layers that could be catch in each units (villages and sub-districts) and it will be used as input for the calculation as follows:

$$Rate\ of\ Services = \frac{\lfloor \Sigma Layer * 2.400 \rfloor}{\Sigma\ Population} \ x\ 100\%$$

(1)

Moreover, spatial connectivity analysis was done based on the calculation result in order to find the pattern of elementary school services. Method that can be used to identify the spatial relationships between are in the peripheral areas (Malang City and Malang Regency border areas) related with school services is Moran Index 'I [11]. Areas with a high index value indicates that the connectivity with the other areas are quite good, especially in terms of accessing elementary school services.

In this research, Malang City and Malang Regency peripheral areas was selected as study area. As it said before, this research focused on elementary school (general school/*sekolah dasar* & Islamic school/*madrasah ibtidaiyah*) as one of main public facilities both for Malang City and Malang Regency in aim to provide qualified, adequate and equitable public education services. By 2016, there are 275 unit of elementary schools that are scattered on 4 districts in Malang City peripheral areas, in which 229 unit as general school and 29 unit as islamic school [12]. Meanwhile, there are 335 unit of elementary schools in Malang Regency peripheral areas consists 255 unit of general school and 80 unit of islamic school that are scattered on 8 districts [13]. Development of elementary school will be spread in various part of Malang greater region in recent years in order to provide adequate and qualified services to the entire areas and communities, as well as in the study areas.

Distribution of elementary school on each area/district in the peripheral areas rather similar between Malang City parts and Malang Regency parts. In Malang City parts, each district has more than 60 school units on average. Hence, elementary school number in Malang Regency parts ranging around 31 – 40 unit, except Pakis and Singosari district which has more than 50 school units. Purwantoro village has the highest number of elementary school among villages in Malang City peripheral parts around 13 unit, while villages in the Malang Regency peripheral parts has small ranges which is less than 9 unit in each village. In advance, the pattern and service coverages of school will be determined based on those elementary school distribution. Detail information of elementary school availability in Malang peripheral areas can be seen as follows.

Table 1. Elementary School Availability in Malang Peripheral Areas

District	Number of Villages	Population Number	Elementary School Number		
			General School	Islamic School	Total
Malang City					
Kedungkandang	12	188.175	55	24	79
Sukun	11	191.513	57	12	69
Blimbing	11	178.564	58	5	63
Lowokwaru	12	194.521	59	5	64
Total	**46**	**752.773**	**229**	**46**	**275**
Malang Regency					
Wagir	12	83.148	35	3	38
Pakisaji	12	85.677	35	6	41
Tajinan	12	53.744	21	15	36
Tumpang	15	63.440	23	14	37
Pakis	15	153.711	35	18	53
Singosari	17	174.602	54	13	67

| District	Number of Villages	Population Number	Elementary School Number		
Karangploso	9	81.986	22	9	31
Dau	10	74.951	30	2	32
Total	**102**	**771.259**	**255**	**80**	**335**
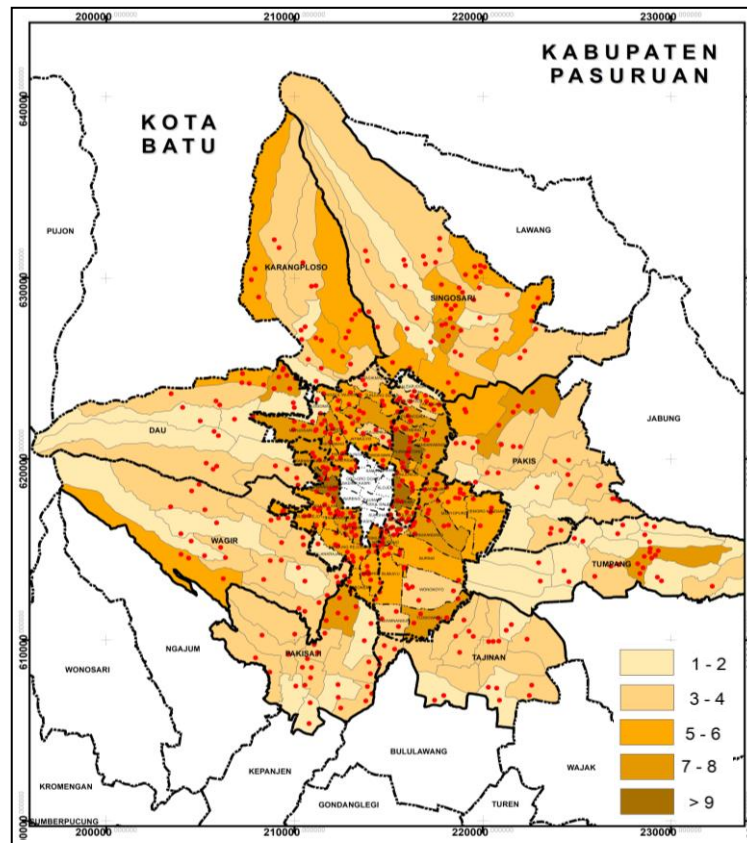
Figure 1. Elementary School Location in the Malang Peripheral Areas

3. Results

First step of the study is calculating the level of elementary school services based on the existing school number in each village (*desa*) and sub-district (*kelurahan*) as the smallest administrative units in Malang City and Malang Regency peripheral areas. Those calculation was done with assumption of communities or students are only able to access elementary schools within the scope of the administrative boundaries or surrounding of their residential areas. In the simple words, school service rates indicating result of comparison between total number of population with the number of school in each administrative unit (village & sub district). According to the analysis results, it can be seen that the average rates of elementary school services in Malang City peripheral parts slightly lower than the average service rates in Malang Regency parts which is 64.6% to 80.85% respectively. Those results illustrated that elementary school both in the Malang City and Malang Regency peripheral parts were not meet the community needs as the normative standard. Elementary school service rates in each district of Malang City peripheral parts has relatively similar value which was ranged between 50 – 70%, and Kedungkandang District has the highest rate around 75%. In the Regency peripheral parts, almost all districts has higher elementary school service rates than the City districts except Pakis District with only has 58.5%. In general, the rate of school services that was done based solely on the number of existing schools (basic method) are quite low compared with the results of later methods. Detailed results of these first/basic method can be seen as in Figure 2 & 3.
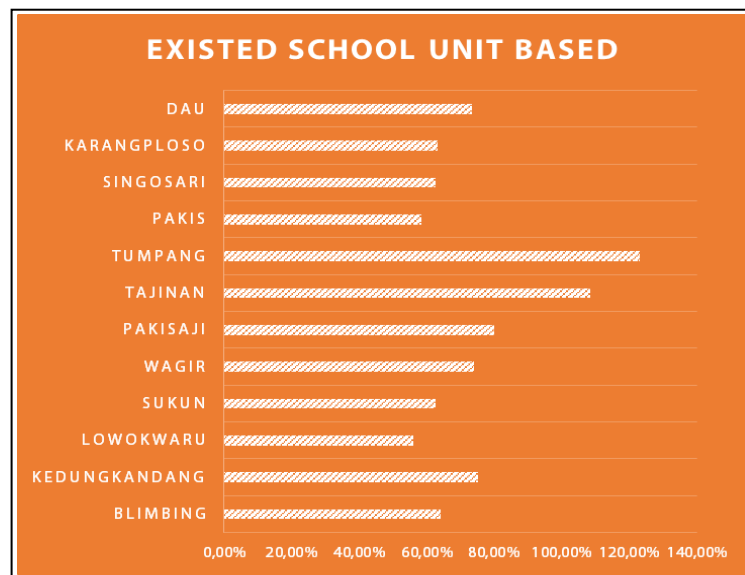
Figure 2. School Service Rates of Districts in the Peripheral areas using the Basic Method
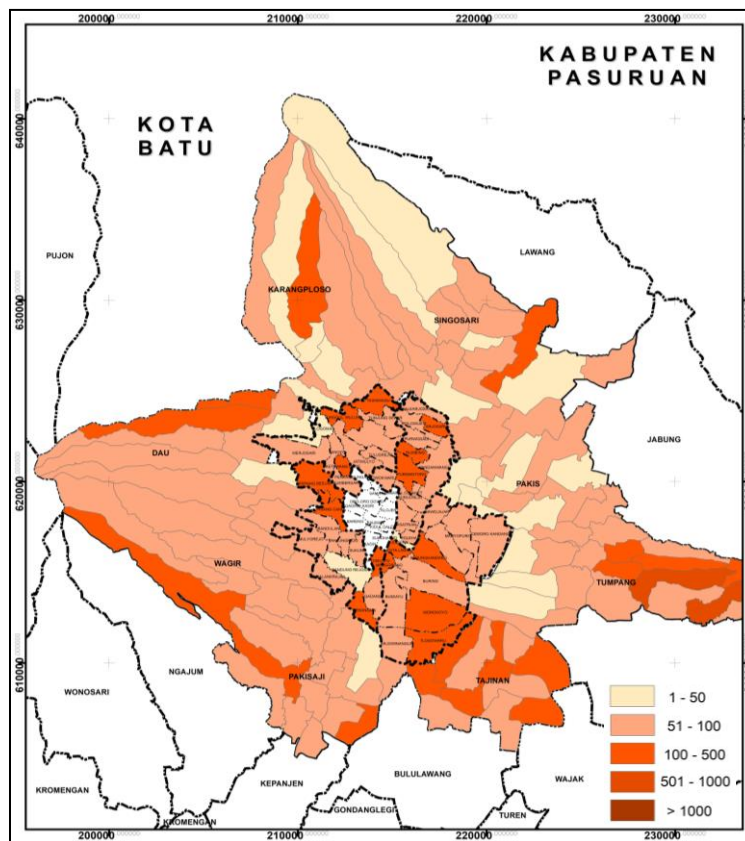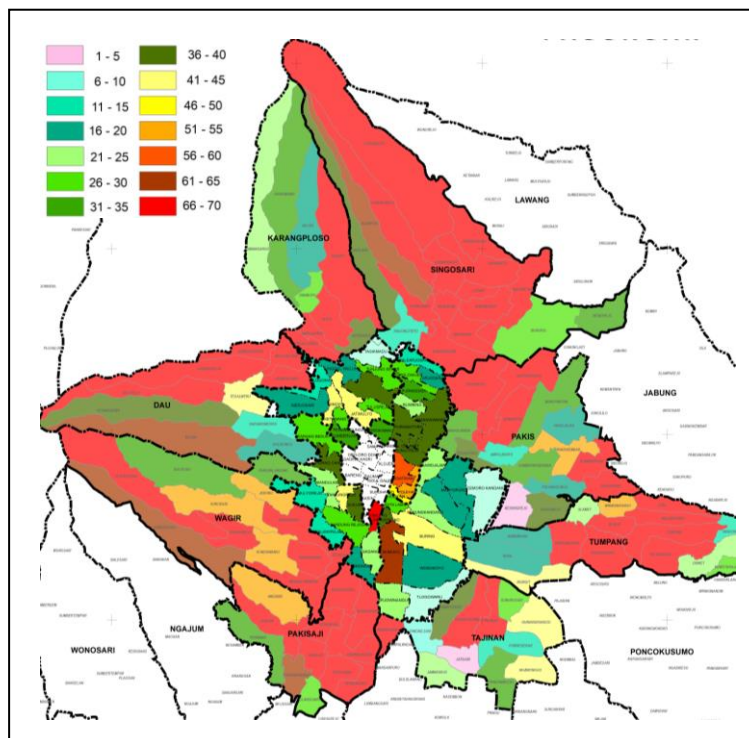

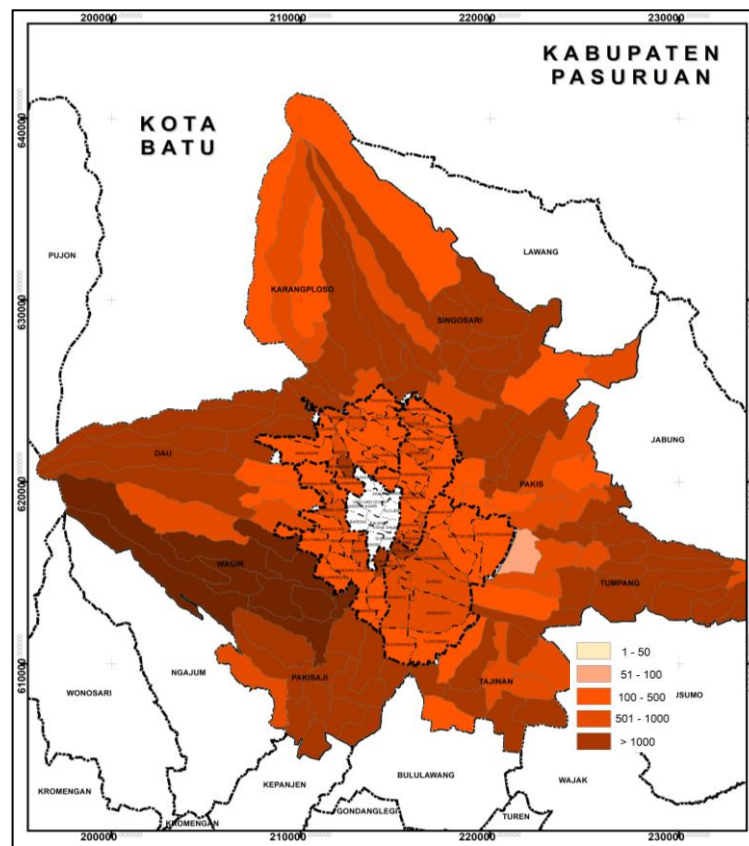**Figure 3**. School Service Rates (%) of Villages in the Peripheral areas using the Basic Method

From the analysis map, it can be seen the configuration of service rates in the Malang peripheral areas. The lowest rates of school service can be found on the east and north parts of Malang peripheral areas especially on the Malang Regency areas such as Pakis, Tumpang and Dau district. Later,

medium rates of service can be seen on the west and south part of peripheral areas both in the Malang City and Malang Regency peripheral parts. Contrast with the district results, school service of sub districts in the Malang City parts has better value than school service of villages and sub districts in the Malang Regency parts. There are few number of sub district that has low rates of school service which is located in the southern and eastern part of the city. In the other hand, villages and sub districts in the Regency that has low rates of school services located near the City areas on averages and those were lower than the villages that are located far from City areas.

Further step were conducted in aim to determine the elementary school service rates and it used the Administrative Boundary Based Catchment (ABC) method. As it has been explained, this method was used with the assumption that the communities or students can access not only the elementary school facilities within the scope of their residential areas but also the elementary schools in the neighboring areas while within the radius of elementary school service coverage which is 1 kilometer. These method was used to identify how many or number layers of elementary school services in each villages and sub-districts in Malang City and Malang Regency. Based on the analysis results, it can be seen that the pattern of elementary school (SD) services both in Malang City and Malang Regency showed a tendency rate of services are quite high, especially in urban or growth activity centers. In Malang City area, there are several sub-districts (kelurahan) served by more than 50 service layers of elementary school such as Kasin, Sukoharjo, Ciptomulyo, Kesatrian, Polehan and Bumiayu sub-district. Similarly, in the Malang Regency area, villages with more than 50 service layers of elementary school mostly located around the capital area (Kepanjen District), western areas and Malang City border areas such as Singosari, Lawang, Pakis, Dau, Karangploso and Pakisaji District. Those result indicates that the provision of elementary school facilities still concentrated in the several growth center areas. The detailed analysis result of Administrative Boundary Catchment (ABC) method in Malang City and Malang Regency can be seen in the following picture (Figure 4).

Figure 4. Number of School Service Layers on Villages/Sub Districts in Peripheral areas using the Administrative Based Catchment (ABC) Method

Figure 5. School Service Rates (%) of Villages in the Peripheral areas using the Administrative Based Catchment (ABC) Method
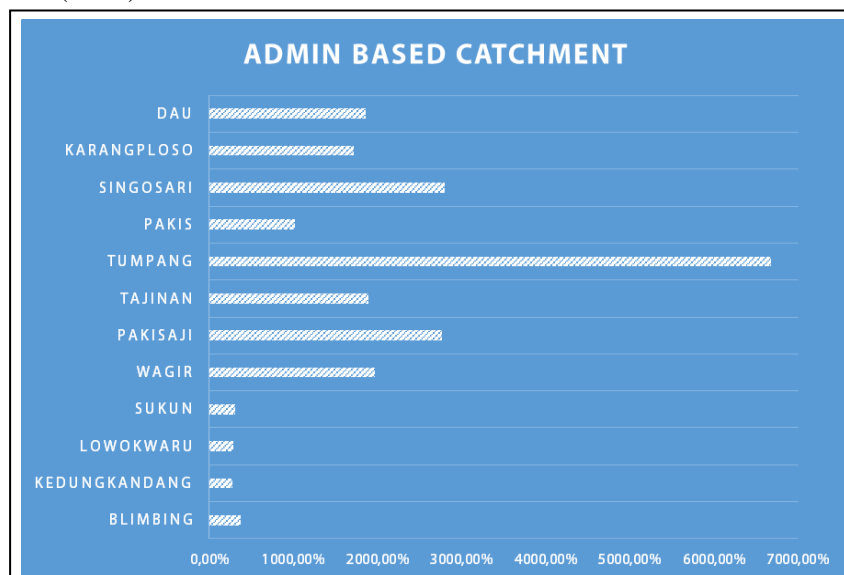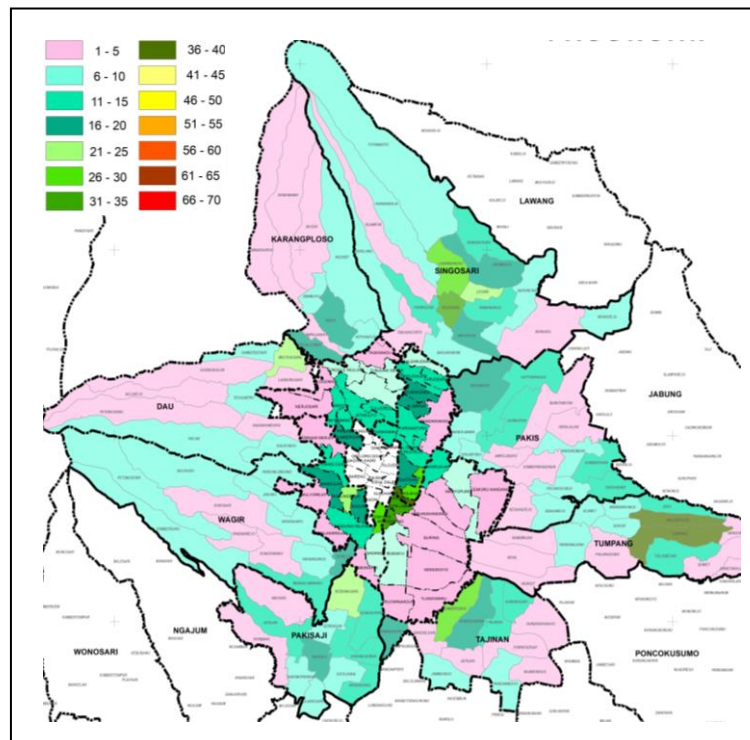

Figure 6. Rate of Elementary School Services of Districts in the Malang peripheral areas using the Administrative boundary Based Catchment (ABC) Method

Those number of school service layers that can be catch in each villages and sub-districts later used as main indicator to calculate the rate of services. Based on the calculation results, it can be obtained

that the average rate of elementary school service in Malang City was much lower than the average rate in Malang Regency area which are 560,82% to 3.095,38% respectively. Klojen District became area in Malang City with average rate of elementary school service was more than 930%, while the other districts has average rates range around 400 – 500%. Meanwhile, almost all the districts in the Malang Regency has a high service rates which reaches around 1.000 – 2.500%. Based on those results, it can be estimated that the elementary school service rates in rural areas is much higher than in urban areas. It was also illustrated that elementary school facilities in Malang City were able to serve 4-5 times the population's needs in each district while elementary school facilities in Malang Regency have the higher service condition that reaches 10-25 times the needs of the existed population in these areas. In other words, students in Malang can choose 4-5 times more elementary school facilities surrounding their residential areas. However, the results was considered less good and precise because these method still did not consider the existing land use and conditions in the research areas, especially for non-built land were still included in the calculation of the rate of elementary school services in Malang City and Malang Regency. In general, the results from these method higher than the basic method results.

The last step done in these research was to determine the rate of elementary school services suing the Cell/Grid Based Catchment (CBC) method. Similar to the ABC method, it was used to identify and find the number service layers of elementary school can be catch in each analysis unit (villages & sub-districts). These method also used the assumption that the communities or students can access the primary school which is not only within their residential areas but also the facilities in the surrounding areas as long as it lies within the standard radius of elementary school service coverage of 1 kilometer. However the distinguish variables that made differences from the previous method was this method used the grid system and considered only built-up land use especially settlement areas so that the service rates assessed only in the urban functional areas. The result of Cell/Grid Based Catchment (CBC) analysis showed that the average of elementary school service layers that can be catch in each sub district in Malang City was less than 40 layers. Sub-district that high number of elementary school services layers mostly located in the center areas of Malang City, such as Jodipan, Kotalama, Kidul Dalem, and Mergosono Sub-district. While in the sub-district on the Malang City periphery areas has smaller number of elementary school service layers which was ranged around 1 – 5 layers only. The similar condition can be seen from the calculation results of service rates in Malang Regency, whereas most of villages or sub-districts has access elementary school services around 1 – 5 layers. Meanwhile, there are some villages with high elementary school service layers between 16 – 20 layers, especially villages that are located between the main corridors to Malang City. Significant differences related with outcome of the CBC method are due to land use considerations that made most of the layer values in cell of unbuilt land are not considered in the calculation or analysis.

Figure 7. Number of School Service Layers on Villages/Sub Districts in Peripheral areas using the Cell/Grid Based Catchment (CGC) Method
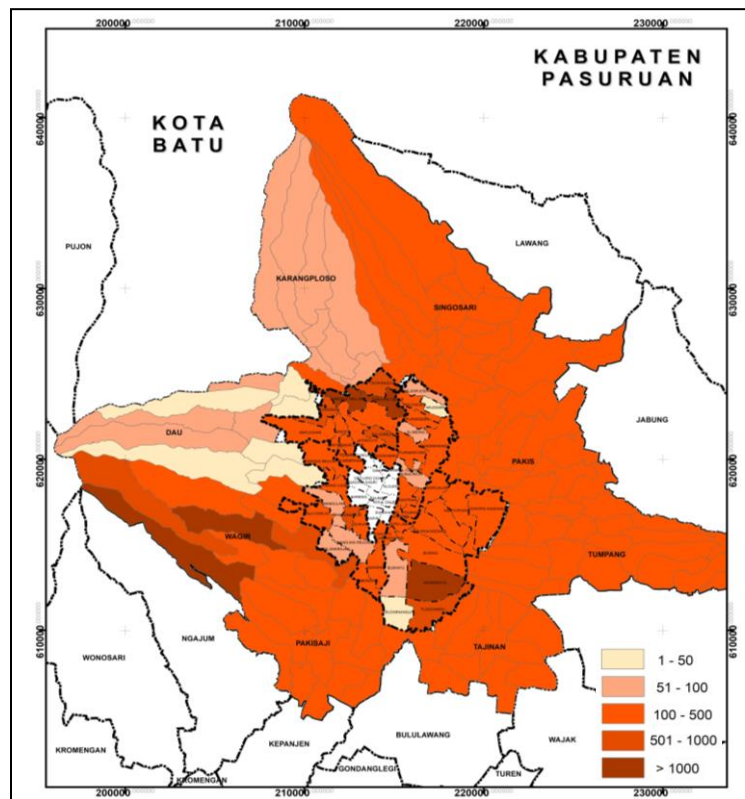
Figure 8. School Service Rates (%) of Villages in the Peripheral areas using the Cell/Grid Based Catchment (CGC) Method
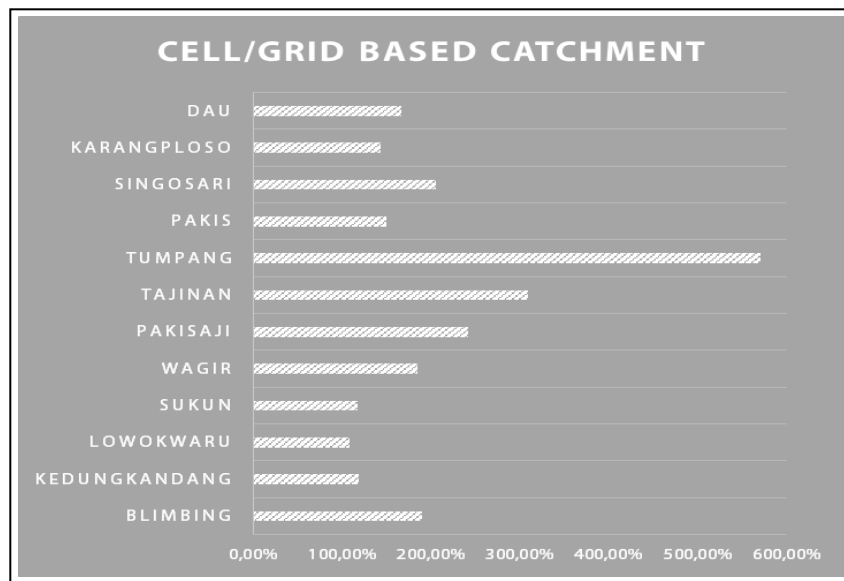
Figure 9. Rate of Elementary School Services of each district in the Malang peripheral areas using the Cell/Grid Based Catchment (CBC) Method

Based on the result of using the Cell/Grid Based Catchment (CBC) method, it is known that elementary school service rates has the significant result compared to the result of previous (ABC method). The rate of elementary school services in Malang City about 272% while the rate of elementary school services in Malang Regency are slightly higher at 319%. Related with rate of elementary school services of each district in Malang City, the average rate around 150 – 200%, except Klojen District which reached an average service rates about 569%. Based on the analysis results, it can be seen that there are sub-districts which did not have service rates up to 100% especially those located in suburban or peripheral areas of Malang City such as Pandanwangi, Arjowinangun, Lesanpuro, Merjosari, Tlogomas, Karangbesuki, Mulyorejo and Bakalankrajan sub-district. Then for the rate of elementary school services at the district level in Malang Regency has values with a fairly diverse range, but in general the average service rates around only 200 – 300%. The analysis results also showed that Kepanjen District become the area with the highest service rate reached 723%. Those illustrated that elementary school facilities in Kepanjen District and surrounding areas were able to serve 7 times the population's needs in related areas. All villages and sub-districts in Malang Regency have more than 100% elementary school service rates on averages, but it is noticed that there are villages with rate less than 100%. In general, the average result of the Cell/Grid Based Catchment (CBC) method lower than the Administrative Boundary Catchment (ABC) method but it did not mean poor results and could be considered as a precise result because the consideration in the calculation of the analysis is more specific such as considered only built-up areas.

4. Conclusion
Based on the research results, it can be seen that there was significant differences related to elementary school service rates and patterns between Malang City and Malang Regency peripheral areas. Using the Cell or Grid Based Catchment (CGC) method, average school service rates Malang City and Malang Regency peripheral areas was slightly different.

These research was part of our research roadmap especially related with educational facility service pattern topics. In the past, we already analyze the rate and pattern about elementary school service in the medium-size city, rural and urban areas also between traditional cities. In the future, we continue to research about school service pattern in the rural areas and metropolitan areas.

5. References

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