Mapping education facilities based on geographic information system

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Abstract. The purpose of this study is to determine the conditions of the community's needs for facilities, spatial distribution, and capacity of educational facilities in the city of Palu. The study used a survey method with a spatial approach as the basis for its analysis and the Neighborhood unit approach as the basis for mapping educational facilities by utilizing GIS in data processing and analysis as a whole. The results of the study show that East Palu Subdistrict is the main service center, indicating that in Tatanga Subdistrict there is even distribution of development in the field of providing primary school education facilities, and the capacity of primary school capacity in Tatanga Subdistrict is categorized more.

1. Introduction
Educational planning in the city of Palu needs to be based on physical and social supply and demand. Negative factors such as the environment that does not support education such as geographical location that can hamper access to services and positive factors such as the support of parents [1]. This relates to the availability of educational facilities and infrastructure, educational resources, and education systems that are aligned with regional conditions and scientific and technological progress [2]–[5]. The distribution of students from the distance has approached the student's home and in terms of the quality of input has also spread in various schools so that there is no longer the dichotomy of superior and non-superior schools [6], [7].

Education One of the efforts in realizing effective and efficient education development, local governments are obliged to implement Permendikbud No. 17 of 2017 concerning Acceptance of New Students (PPDB). The zoning policy contained in the Ministry of Education and Culture is also implemented in the City of Palu, with the aim of ensuring that the calling of students can only be conducted objectively, accountably, transparently, and without discrimination so as to encourage increased access to educational service facilities. The implementation of PPDB Zoning in Central Sulawesi Province has been successful in the effort to equalize access and quality of Education. The implementation of this policy is a form of commitment of the Palu municipal government in realizing even distribution of quality education. However, this must be evaluated because in reality in various regions which first applied the policy there were many obstacles and constraints. The existence of a quota program in PPDB had an unexpected impact on the school, namely the difficulty in dealing with students receiving regional education guarantees when the teaching and learning process took place due to the low raw input possessed by students receiving regional beneficiary guarantee [8].

The mapping of school facilities is an important factor in the overall education planning process because it is not static but dynamically follows the ongoing educational development [7], [9]. This mapping is needed by the Palu City Education Office for strategic planning so that the PPBD zoning system is right on target and in accordance with the needs of schools and the community. The development of geospatial and relational database of education, demographic, social and economic information is important to be carried out as a foundation in education planning and decision making [10]–[12]. Planning in the provision of educational facilities, especially primary and secondary schools, should be adjusted to the criteria for distance of service coverage based on the Neighborhood Unit [13], [14]. So that it can be seen that the zoning system policy is proven to be able to increase the gross participation rate of students [15].
Utilization of spatial data using Geographic Information Systems (GIS) in the science of Geography is able to facilitate in obtaining, recording, and collecting data that is spatial (spatial) [16]–[18]. The spatial data can facilitate the public in obtaining accurate information about the distribution of educational facilities (schools) and obtain information about the PPDB zoning system in Palu. The mapping of educational service facilities (schools), of course, can be a source of data for educational planners to realize a fair, equitable and quality education. Based on these considerations, we need an information system that is able to provide geospatial data and information related to education services, especially basic education facilities (schools) [19], [20].

This study, in general, aims to analyze the suitability of the placement of basic education service facilities (schools) based on the provisions of SNI and Permendikbud No. 7 of 2017. Mapping the basic education service facilities (schools) is obtained by knowing the spatial distribution of schools, the level of availability of schools, and the quality educational facilities (schools). Geographic Information System (GIS) was chosen, because it has the ability to analyze it. GIS in Geography can be a tool or system that can accommodate research to describe (map) basic education service facilities in Palu City. GIS can provide various information about social facilities for the public which contains the distribution of social facilities, categories of available social facilities, information on names and addresses of social facilities, and displays facility markers with various icons on maps [21].

2. Methods

This study uses a survey method with a spatial approach as the basis for its analysis. The survey was conducted to determine the location of the school building, school accessibility, and the tendency of the population to choose schools. Secondary data is used to support field surveys whose sources are obtained from offices that are related to research problems such as teacher data, student origin, number of classes, and availability of learning facilities, and school achievement. The consequences of using this survey method require a tool to hold a large amount of varied data. Therefore, this study requires tools in the form of interview questionnaires and a checklist for objects that cannot be interviewed. Data collection was carried out with a purposive sampling technique which will then be analyzed quantitatively and qualitatively. This study uses aids in the form of satellite imagery as a source of primary data obtained by remote sensing interpretation techniques and observations in the form of an accuracy test to see the truth of objects interpreted in field conditions. Geographic Information System (GIS) was chosen, because it has the ability to analyze it. GIS in Geography can be a tool or system that can accommodate research to describe (map) basic education service facilities in Palu City. The method used is the buffer area in accordance with established zoning regulations and to determine the distribution pattern of educational facilities using the nearest neighbor analysis with GIS [22], [23].

3. Results and Discussion

Educational facilities in the city of Palu in general are for elementary school (SD) and junior high school (SMP) levels, while senior high schools (SMA) are controlled by the provincial education office. This management difference is based on Law No. 23 of 2014 concerning Regional Government, which in the management of basic education, early education and non formal education is managed by the district or city government. For this reason, in the discussion in this chapter educational facilities are focused on basic education (elementary) to secondary (junior high).

The spatial distribution of basic education facilities in Palu can be seen from the distribution of school needs, school service capacity, school capacity and the completeness of the learning facilities. In order to answer from the first objective in this study, researchers used two main variables, namely capacity and serviceability. The service power variable is interpreted by measuring the needs and availability of basic education facilities in the city of Palu.

3.1 Serviceability of Basic Education Facilities

a. Level of Availability of Educational Facilities

The level of availability of educational service facilities in the city of Palu can be answered with a scalogram matrix arranged based on the number of existing facilities and multiplied by the score of these facilities. Scores of each facility differ according to the level of the educational facility
concerned. The higher the level of service, the higher the level of availability, and the lower the hierarchy, the lower the level of availability [24].

### Table 1. Scalogram Matrix (modified)

| No | Sub-district     | Total Population (2017) | PAUD | SD | SMP | SMU | SMK | Total Variabel | Total Unit | Rangking |
|----|------------------|-------------------------|------|----|-----|-----|-----|----------------|------------|----------|
| 1  | Palu Barat       | 61.424                  | 24   | 21 | 7   | 1   | 0   | 4              | 53         | IV       |
| 2  | Tatanga          | 39.369                  | 9    | 11 | 7   | 1   | 1   | 5              | 29         | VI       |
| 3  | Ulujadi          | 27.319                  | 4    | 15 | 2   | 1   | 0   | 4              | 22         | VII      |
| 4  | Palu Selatan     | 69.492                  | 50   | 14 | 8   | 1   | 0   | 4              | 73         | II       |
| 5  | Palu Timur       | 70.378                  | 36   | 23 | 12  | 2   | 3   | 5              | 76         | I        |
| 6  | Mantikulore      | 62.822                  | 11   | 22 | 5   | 5   | 3   | 5              | 46         | V        |
| 7  | Palu Utara       | 22.834                  | 40   | 13 | 3   | 2   | 0   | 4              | 58         | III      |
| 8  | Tawaei           | 20.382                  | 1    | 14 | 3   | 1   | 1   | 1              | 20         | VIII     |

| Total Variabel | 7   | 7   | 7   | 4   |
| Total Unit     | 175 | 173 | 47  | 14  | 8   |
| Rangking       | I   | II  | III | IV  | V   |

Source: [25]

The scalogram matrix of the Palu City education service facilities shows that East Palu District is the Main Service Center. School levels can generally be found in almost all villages, except Vocational Schools with the highest number of schools are PAUD and SD. The deviations that occur regarding the distribution of educational facilities are in the District of South Palu. Although this kelurahan has the second largest population (69,492 inhabitants) after Kec. East Palu, but this region does not have a sufficient level of schooling (facilities) in terms of quantity. Senior high school education is the least school facility in this district. This condition is different if we look at Mantikulore and North Palu. Both of these regions have a smaller population than the South Palu sub-district, but are able to provide a higher number of senior secondary schools. These conditions can indicate that the school-age population (SMA) in the District of South Palu more schools outside the district. In this case, junior high school graduates from this region will tend to continue their studies in other regions, whether in one sub-district or outside the sub-district.

b. The suitability of the needs of educational facilities in the city of Palu

The high population growth in the city of Palu, is not matched by an increase in existing educational facilities, this can be seen from the number of educational facilities in each district. Table 4.2 shows that out of the 9 sub-districts in the city of Palu at the high school level, there are five districts that have an adequate number of educational facilities, namely Tatanga, East Palu, Mantikulore, North Palu, and Tawaei Districts. Ulujadi sub-district has a level of conformity with the appropriate category, and two sub-districts namely West Palu and South Palu sub-districts fall into the inappropriate category. At the elementary and junior high levels, this facility is able to serve the community in each sub-district, while for kindergarten, only the sub-district of Tawaei is in the inappropriate category.

Data analysis will focus on the Tatanga sub-district, to see the extent of the performance of the existing educational facilities in the sub-district, which can later be used as a reference for the description of the education facilities in Palu. This sub-district selection considers the level of appropriateness of education facilities that is minimal at all levels of school and the completeness of data from each school. Based on these two points, the sample chosen was elementary school facilities in Tatanga District.
Table 2. Suitability of educational facility needs

| No | District       | No. of Education Per Level (Existing) | Suitability of Education Facilities Need Per Level |
|----|----------------|--------------------------------------|--------------------------------------------------|
|    |                | TK  | SD   | SMP | SMA/K | TK  | SD   | SMP | SMA/K |
| 1  | Palu Barat     | 24  | 21   | 7   | 1     | Very Suitable | Very Suitable | Very Suitable | No Suitable |
| 2  | Tatanga        | 9   | 11   | 7   | 2     | Very Suitable | Very Suitable | Very Suitable | Very Suitable |
| 3  | Ulujadi        | 4   | 15   | 2   | 1     | Very Suitable | Very Suitable | Very Suitable | Very Suitable |
| 4  | Palu Selatan   | 50  | 14   | 8   | 1     | Very Suitable | Very Suitable | Very Suitable | No Suitable |
| 5  | Palu Timur     | 36  | 23   | 12  | 5     | Very Suitable | Very Suitable | Very Suitable | Very Suitable |
| 6  | Mantikulore    | 11  | 22   | 5   | 8     | Very Suitable | Very Suitable | Very Suitable | Very Suitable |
| 7  | Palu Utara     | 40  | 13   | 3   | 2     | Very Suitable | Very Suitable | Very Suitable | Very Suitable |
| 8  | Tawaeli        | 1   | 14   | 3   | 2     | No Suitable   | Very Suitable | Very Suitable | Very Suitable |

Source: Analysis Data

c. The elementary school’s capacity in Tatanga District

The results of comparison of minimum class availability and needs will refer to Muta’ali (2000). Classification of needs is grouped into three categories, namely; less for sufficiency level <100%, enough for sufficiency level = 100% and more for sufficiency level> 100%. The results showed that the capacity of elementary schools in Tatanga sub-district was stated to be more. Several factors affect the capacity of capacity in Tatanga District, Namely; development of public facilities, good accessibility, and availability of classrooms.

The development of public facilities in Tatanga Subdistrict tends to be more advanced than the surrounding sub-districts and this greatly influences the development of educational facilities in Tatanga Subdistrict. The more complete and advanced public facilities in an area are complemented by the completeness and progress of social facilities. In addition to the development of well-developed public facilities, Tatanga sub-district is also followed by the development of its accessibility when compared to other sub-districts in Palu City. The accessibility such as road facilities and public facilities that support accessibility. The accessibility facilities greatly affect the mobility of the population both locally in Tatanga District and in and out, such as from Ta-tanga District to / from Slawi District. Good mobility can affect the government in terms of infrastructure development in this sub-district, including the construction of much more advanced education facilities. Seeing the condition of Tatanga Sub-district as has been described, it is not surprising that the capacity of primary schools in Tatanga District is 101% and the percentage shows that the capacity of primary-level schools in Tatanga District is more than the ideal capacity (100%). This condition is caused by the population of elementary school age who live in Tatanga Sub-district, all of them go to elementary schools in Kematan Tatanga.

In addition to physical conditions, capacity in Tatanga District is also directly affected by the number of classrooms available and the minimum number of classrooms needed. Based on the data obtained, the number of classrooms in Tatanga Subdistrict there are 76 classrooms at the elementary
school level and the number of minimum needs needed is 75 classrooms. Based on these data, there are 1 class rooms in Tatanga District.

Figure 1. Distribution of Educational Facilities in Tatanga District

d. Completeness of primary school facilities and infrastructure in Tatanga District

The results of research conducted on the state of facilities and infrastructure of primary schools throughout Tatanga District based on the Minister of National Education Regulation No. 24 of 2007 carried out in 11 public elementary schools. The data used as identification include infrastructure data including: classrooms, library rooms, science labs, leadership rooms, teacher rooms, places of worship, UKS rooms, toilets, warehouses, circulation rooms, and sports facilities. The availability of these infrastructures and the facilities in them in all primary schools in Tatanga District are presented in Table 4.4. the results obtained show that SDN Inpres Palupi has a high availability of facilities and infrastructure (90%). Whereas SDN Pengawu has the lowest availability of facilities and infrastructure (60%) compared to 11 other elementary schools.

Figure 2. Diagram of percentage of availability of primary school facilities and infrastructure in Tatanga District
Facilities and infrastructure become one of the attractions of students in choosing primary schools. This is in accordance with the high level of availability of facilities and infrastructure in Palupi Inpres SDN, thus making many people choose to send their children to school. This can be seen from the number of new students who entered SDN Inpres Palupi in 2018 of 77 students.

An interesting finding can be seen in Pengawu Elementary School with the minimum availability of facilities and infrastructure, which is only 60% but the community's interest to study at the school is very high. In 2018 there were 75 new students with a total of 470 students. One of the reasons that resulted in many students entering Pengawu Elementary School was because the location of the school was in a densely populated area with a large number of elementary school age children, so many students chose to enter the school.

3.2. Factors causing the distribution of educational facilities

a. Analysis of the factors causing the distribution of public primary school education facilities in the study area using the classification and scoring methods.

Accessibility is an ease to reach the destination from one place to another. The better the level of accessibility of an area, the easier it will be to link one region to another. The variables in determining accessibility include the factor of school distance from the highway.

| No | School Distance Classes With Highways (meters) | Classification | Skor |
|----|---------------------------------------------|----------------|------|
| 1  | 5-20                                       | High           | 3    |
| 2  | >20-35                                     | Medium         | 2    |
| 3  | >35-50                                     | Low            | 1    |

Source: Analysis Data

Based on the calculation results obtained that the closest distance is 5 meters and the farthest is 50 meters. Based on Table 2 we can know that the farther the distance, the lower the class. This is because the farther the school is from the highway, the less good the accessibility, so it is classified in the lower class.

b. Factors of population trends in utilizing educational facilities

The current tendency of the community to utilize educational facilities is that they choose educational facilities that are close to where they live. This is because the community considers that the quality of schools today is almost the same, which is good. In addition, schools that are close to where you live will certainly save money. One of the distribution of students in the Tatanga sub-district is Tatanga Elementary School, some of the students are from East Palu.

Figure 3. distribution of students in Tatanga State Primary School
Based on the results obtained, it can be seen that the tendency of the population to utilize educational facilities including 95%, primary school students in Tatanga Sub-district use educational facilities within their sub-districts, while 5% of students use educational facilities from outside the sub-district. Tatanga. Students from outside Tatanga sub-district are from neighboring Sub-districts. It can be concluded that the community has confidence in the selected primary school and has the perception of all schools in the region that have the same quality.

3.3 Suitability of basic education facilities in Tatanga District
Based on the analysis of suitability, it can be concluded from 11 elementary schools scattered in Tatanga District, there are three schools that have a shortage of PNS class teachers namely, SDN Inpres Tavanjuka, SDN 14 Palu and SDN Inpres Bayoge. While eight schools, have a number of class teachers in accordance with the number of study groups. In addition to PNS subject teachers, especially Islamic religion student teachers, Duyu Public Elementary School does not have any Islamic religion teachers with PNS status. The results also showed that most schools had a shortage of PNS Physical Education teacher subjects. It can be concluded that the data shows there is a lack of teachers especially class teachers who teach at primary schools in Tatanga District, namely SDN Inpres Tavanjuka.

3.4 Spatial Distribution of Educational Facilities
In this study the distribution patterns of educational facilities in the study area were calculated using the Geographic Information System with Arc GIS software 10.1. Calculation using GIS method enables getting results quickly, accurately, and efficiently, so that the distribution pattern of educational facilities can be known with certainty. Based on the results obtained, we can know that the distribution pattern of educational facilities (school buildings) in elementary schools in Tatanga District has a uniform distribution pattern (dispersed) with an average value of 1.77. This indicates that in the study area there was even distribution of development in the field of providing primary school education facilities [26].

4. Conclusions
The results of the study show the distribution pattern of educational facilities (school buildings) with GIS in elementary schools in Tatanga sub-district has a uniform distribution pattern (dispersed) with an average value of 1.77. This indicates that in the study area there was even distribution of development in the field of providing primary school education facilities. The next result shows that the capacity of primary schools in Tatanga sub-district is stated to be more. Several factors affect the capacity of capacity in Tatanga District, Namely; development of public facilities, good accessibility, and availability of classrooms. The data obtained shows that the number of classrooms in Tatanga Subdistrict there are 76 classrooms in elementary school level and the number of minimum needs needed is 75 classrooms. From this data it appears that there is an excess of classrooms in Tatanga District by 1 classroom. The level of availability of facilities and infrastructure is high in SDN Inpres Palupi, thus making many people choose to put their children in the school. This can be seen from the number of new students who entered SDN Inpres Palupi in 2018 of 77 students. An interesting finding can be seen in Pengawu Elementary School with only 60% availability of facilities and infrastructure but the interest of the community to study at the school is very high, in 2018 there were 75 new students with a total of 470 students. One of the reasons that resulted in many students entering the school was due to the position of the school in a densely populated area, so many students chose to enter the school. Based on the results obtained it can be stated that from 11 elementary schools spread across Tatanga District, there are three schools that have a shortage of PNS class teachers namely, SDN Inpres Tavanjuka, SDN 14 Palu and SDN Inpres Bayoge. While eight schools, have a number of class teachers in accordance with the number of study groups. In addition to PNS subject teachers, especially Islamic religion student teachers, Duyu Public Elementary School does not have any Islamic religion teachers with PNS status. The results also showed that most schools had a shortage of PNS Physical Education teacher subjects.
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