Strategic Planning of Urban Settlement through a Model of Public Service Facilities

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Abstract. Densely populated residential areas always encounter city problems related to appropriate standards of living. Population growth and urbanization directly affect the low level standard of public service facilities. This research was conducted in Jatimulyo Kampong, Lowokwaru District, Malang City. Research objectives were to develop strategies for urban settlement through a model of public service facilities. The first step used an analysis Unmanned Aerial Vehicle (UAV) to investigate the land cover of a residential area. The second stage measured the level of public service facility services in urban areas, then analyse it based on population growth rate, and projection of urbanization to the public service facilities based on government standards. The next stage of data analysis is spatial analysis using ArcGIS to know which residential area could be served well by public facilities. Results of the research were the services of public service facilities in urban areas were quite good based on the current population. However, in year 2036, could not accommodate the increasing number of homes and public services facilities because the land required for development was not equal with the availability of land. The appropriate strategies were needed to improve the services level of the public service facilities in Jatimulyo Kampong.

1. Introduction

Economic and employment growth drives the rate of urbanization. The rate of savings and capital investment feeds into expansion of the building stock and land-use conversion, as both a supply-side push factor of production, and a demand-side pull by consumers. Economic structures and employment patterns also affect the trends of peri-urbanization. Business technology affects not only employment but supply chain logistics, the distribution of production, services and consumption [1]. Urban built structures and infrastructure are the components of the physical urban system itself. The floor space per person for living and working, and the land intensity of such floor space, are the primary determinants, especially when household size is taken into account. Then, the pattern of housing investment, housing form, community services, settlement density and morphology, are each relevant to the growth and pattern of peri-urban development. Transport and communications are the other key factors, as infrastructure can encourage or inhibit urban/rural migration, counter-urbanization, or re-urbanization. Transport is not only a matter of direct expansion: there has been a systemic change from a public transport-based radial pattern, to car and highway-based network pattern [2]. Therefore, a study is required for the strategy of urban settlement planning through a model of public service facilities.
Large cities still interest some parts of Indonesian society. Big city development as the centre of economic activity is a powerful pull for society, influencing high work force from both inside and outside of the city, causing a strong current of urbanization. One main problem that always accompanies urban areas development is density population. Urbanization has caused a very rapid explosion in the city population; one implication is the clumping work force in large Indonesian cities. The high number of people who choose to settle in the city increase the number of both legal and illegal settlements. In the high-density settlement, many houses are not liveable and irregular [3].

Various problem arises from high-density settlement areas, like the lack of standardized public service facilities. As time goes by, problems of these settlements become increasingly complex, the lack of attention from related parties also increase the protraction of this problem. This study is located at Jatimulyo Kampong, Lowokwaru District, Malang, could be seen in Figure 1.

2. Methods

2.1. Spatial Analysis and Buildings Distribution
The spatial analysis and building distribution use JOSM tools. JOSM (Java Open Street Map) is an Open Street Map Data tool editor. All plot building would be digitized then embedded with attributes and certain explanations, enabling every building to have different coordinates and information. The data needed for spatial analysis and building distribution are spatial data of land use, roads and building [4].

2.2. Recent Aerial Photo Analysis
Aerial Photo Analysis use drones that equipped with camera to observe the high-level and detailed condition of the related settlements, distribution of public building, street network, and land cover [5] [6]. They are then used as the latest database and verified with the data obtained aerially or through satellite. These data are also used as a reference for other analysis like delineation settlement region, threshold limit, etc.

2.3. Public Service facilities Analysis
Public service facilities analysis is performed using SNI 03-1733-2004 on Procedural Guidelines for Environmental Planning of Urban Housing [7]. The input data includes the number of public service facilities, area vehicle types as well as the range of services to produce the standardized service level [8].

2.4. Regional Services Threshold
The type of public service facilities are based on SNI 03-1733-2004 on Procedural Guidelines for Environmental Planning of Urban Housing [7]. This includes public service facilities of the education and learning public service facility, health public service facility, trading and commerce public service facility, culture and recreation public service facility, as well as open room, park and sports field. Each public service facility has a maximum service threshold while the population will also produce waste, and also require a certain amount of resources. Both have a clear correlation. Thus the population, the projected population and the potential basic needs of the population in the settlement area can be calculated.

3. Result and Discussions

3.1. Overview of Jatimulyo Kampong
Jatimulyo Kampong, Lowokwaru District, Malang City has an area of 259.75 ha. The northern boundary is Tunggulwulung District, the southern boundary is Penanggungan District, the western boundary is Dinoyo, and the eastern boundary is Mojolangu District. Jatimulyo Kampong is located at an altitude of 445 meters above sea level. The typology of Jatimulyo village consists of rice fields, cultivation, plantation, animal husbandry, mining/quarrying, handicrafts and small industries, medium and large
industries and trade and services. Jatimulyo Kampong is divided into ten community groups which are divided into 75 neighbourhood groups [9, 10].

3.2. Spatial Analysis, Buildings Distribution and Recent Aerial Photo Analysis

The results of the spatial analysis, buildings distribution and recent aerial photo analysis shows that Jatimulyo Kampong, Lowokwaru District is one of the high-density urban settlement region in Malang with a strategic location closed to the educational centre. The results of the spatial analysis could be seen in Figure 2.

Figure 1. Administration Map of Jatimulyo Kampong
3.3. Public Service Facilities Analysis
Here is the explanation about public service facilities analysis [11].

- Public services facilities in the Jatimulyo Kampong consists of 1 unit of hall meeting, 35 units of security posts, and an office of Jatimulyo Kampong. Based on the analysis results, the public service scale of the Jatimulyo Kampong office does not require an additional new office, but the area should be enlarged to meet the needs of the Jatimulyo Kampong community. Based on the analysis, up to 2036, public services facilities in the form of hall meeting require an additional 11 units and enlargements.

- Educational and learning public service facilities in Jatimulyo Kampong consists of 16 units of kindergarten, 12 units of Primary School/ Islamic Primary School, 3 Junior High Schools, 3 High Schools and 1 Higher Education; Malang State Polytechnic. Based on the analysis of the public service scale and projected needs analysis, up to 2036, all types of educational and learning public service facilities require enlargements and additional units. Education and learning public service facilities in the form of kindergarten require seven additional units, Primary School requires six additional units, Junior High School require three additional units, and High School requires three additional units. Besides, it is also necessary to develop new education and learning public service facilities in the form of libraries with an additional 12 units in The year 2036 to increase the reading interest of both students and public.

- Health public service facilities in Jatimulyo Kampong consists of 9 units of clinics, three units of medication hall, 1 unit of mother and child clinic, 1 unit of community health centre, and 1 unit of pharmacy. Based on the analysis of health public service scale, the construction of new health centres is not required, but health centres should be enlarged to meet the needs of Jatimulyo Kampong community. Based on the projected needs analysis, up to 2036, mother and child clinic, community health centre and the pharmacy do not require additional units nor enlargements. While medical clinic requires an additional 14 units and enlargements, nine additional units of medication hall and six new units of physician hall.
The existing religious public service facilities in Jatimulyo Kampong consists of 15 mosques, 47 small mosques and 1 unit of the monastery. Based on the public service scale analysis, mosque does not need new constructions, but it is necessary to enlarge it to meet the needs of the Jatimulyo Kampong community. Based on the projected needs analysis, up to 2036, mosque and monastery do not need new construction nor enlargements. While small mosques require 70 additional units and enlargements.

Trade and commercial public service facilities in Jatimulyo Kampong consist of 69 units of small shops, four shopping lots, and 1 unit of traditional market. Based on the analysis of the public service scale and projected needs analysis, up to 2036, the traditional market does not require additional units nor enlargements. While small shops require an additional 48 units and enlargements and one additional unit of shop.

Culture and recreational public service facilities in Jatimulyo Kampong consist of 1 unit of multipurpose hall / youth hall. Based on the analysis of the public service scale and projected needs analysis, up to 2036, multipurpose hall / youth hall does not require additional units or enlargements.

Open space, parks, and sports fields facilities in Jatimulyo Kampong include one playground, four sports fields, one green area and four graves. Based on the analysis of the public service scale and projected needs analysis tool, up to 2036, sports field and green area do not require additional units or enlargements. While playground requires 145 additions and enlargements and the grave needs one more addition.

**Figure 3. Distribution of Public service facilities Map in Jatimulyo Kampong**

3.4. Public Service Facility Threshold in Jatimulyo Kampong

Jatimulyo Kampong is 259.75 ha wide with land use as described in Table 1 and existing land use on Figure 3 Details of the number of houses and public service, meanwhile facilities that which could be
made available or could not be provided in Jatimulyo Kampong in year 2036 could be seen in Table 2. Until the year 2036, Jatimulyo Kampong is still not able to accommodate the addition of both home and public service facilities such as a community centre, kindergarten, elementary school, junior high school, High school, medical clinics. Thus, it could be concluded that up to 20 years ahead, it was necessary to study the strategy of urban settlement planning through a model of public service facilities in Jatimulyo Kampong.

Table 1. Regional Services Threshold of Jatimulyo Kampong Year 2036

| Information                        | Land Area (ha) |
|------------------------------------|----------------|
| Jatimulyo Kampong                  | 259.75         |
| River Border                       | 55.34          |
| Rice Fields                        | 128.17         |
| Existing and projected houses and facilities | 76.24          |
| Rest of the land                   | 0              |

Table 2. House and Public Service Facility Threshold of Jatimulyo Kampong

| Information             | Projection (unit) | Year 2036 |
|-------------------------|-------------------|-----------|
|                         | Built Up (unit)   | Non Built up (unit) |
| a. Big House            | 186               | 0         |
| b. Medium House         | 558               | 0         |
| c. Small House          | 1,115             | 111       |
| d. Community Hall       | 11                | 11        |
| e. Kindergarten         | 7                 | 1         |
| f. Primary School       | 6                 | 5         |
| g. Junior High School   | 3                 | 1         |
| h. High School          | 3                 | 2         |
| i. Library              | 12                | 0         |
| j. Clinic               | 14                | 4         |
| k. Medical Hall         | 9                 | 0         |
| l. Physician Practice   | 6                 | 0         |
| m. Small Mosque         | 70                | 12        |
| n. Small Shop           | 48                | 0         |
| o. Shopping Lot         | 1                 | 0         |
| p. Playground           | 145               | 0         |
| q. Grave                | 1                 | 1         |
Figure 4. Services Threshold of Jatimulyo Kampong Year 2036

3.5. Model of Spatial Planning in Jatimulyo Kampong

Model of spatial planning in this study using landuse model. In the land use model if land use changed for example the green area, it would change the level of oxygen supply from vegetation, and if there was change in settlement area (yellow area) would change the level of public service facilities (increased or decreased). The examples of Model Spatial Planning in Jatimulyo Kampong could be seen in Figure 5, and Figure 6.
Figure 5. Examples: Model Spatial Planning 1 in Jatimulyo Kampong

Figure 6. Examples: Model Spatial Planning 2 in Jatimulyo Kampong
4. Conclusions

Based on the result of spatial analysis and building distribution and recent aerial photographs, Jatimulyo Kampong, Lowokwaru District is one of the densely populated urban settlement in Malang due to its strategic location and proximity to the educational centre.

Population projection analysis of Jatimulyo Kampong projected the population of Jatimulyo Kampong on year 2036 as many as 29,219, from 21,782 in 2016. Based on public service scale analysis and projected facilities needs to 2036, it requires an additional 11 units community hall, 7 units of kindergarten, 6 units of primary school, 3 units of junior high school, 3 units of high school, 12 units of libraries, 14 units of clinics, 6 units of physician practices, 70 units of small mosque, 48 units of small shops, 1 unit shopping lot, 145 units of playground and 1 grave.

Jatimulyo Kampong 20 years in the future could not accommodate the increasing number of home and public services facilities because the land required for development was not equal with the availability of land. Therefore a study is required for strategy of urban settlement planning through a model of public service facilities.

Strategies that could be applied were: 1) created a plan that fits the threshold, 2) Spreading the growth centres of the city to other areas such as Kedungkandang district in Malang City, therefore the growth of the city could be more evenly, and 3) The growth of the area guided by building intensity regulations such as Building Coefficient and Floor Building Coefficient.

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