

Spatial Analysis Of Population Density Differences Based On Administrative Area And Land Cover Of Settlements Area Using GIS In Jakarta

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Abstract – Population growth globally is increasing. In 2020 the total world population reached 7.82 billion people. More than doubled over the past 60 years. The total population of the world at that time was 3 billion. This shows that the human population will continue to experience rapid growth in almost all regions of the world. The development of the region as a place of human habitation is increasingly heading towards urban areas. The need for land to settle is increasing. This further triggers an increase in population density. Analysis related to population density is also increasingly becoming a trend. Population growth is an unavoidable phenomenon. Studies related to demography, especially human geography are also growing. Because the main purpose of growing science and technology is to improve human well-being. Therefore, the study of population density is very important. However, generally the most widely used calculation of population density is based on the total population and administrative area. Therefore, according to the author, studies that discuss population density on a more detailed scale need to be reproduced to enrich knowledge. So, using spatial analysis through GIS, researchers want to spatially compare population density based on administrative area and residential land cover in urban Jakarta.

Keywords – population, density, urban, GIS, spatial

I. INTRODUCTION

Population is a major component within a region. Not only does it act as an object, but the population also acts as the subject of a development. The world's population has more than doubled over the 60 years from 1960 to 2020. Based on data from wordbank.org the world's population in 1960 was 3.03 billion, and increased to 7.82 billion people in 2020. The growth and increase in population also occurs in almost all countries. In Indonesia, the total population of the 2020 census results reached 270.20 million people from 97.02 million people in 1961 (BPS Provinsi DKI Jakarta, 2021) [1]. In the same year, the population of DKI Jakarta reached 11.1 million people (data.jakarta.go.id, 2022), increased by more than 1 (one) million people over 1 (one) decade (BPS Provinsi DKI Jakarta, 2021). This shows that the population growth will continue to increase and the number of residents will continue to grow positively. This means that the population density will continue to increase due to the limited area of space.

The limitation of the area of the territory does not mean limiting the growth of the territory. Precisely, the increase in the

number of inhabitants along with the growth of the territory. Regional growth occurs in various aspects, ranging from economic, political, social, cultural and various other aspects. Much of the region is changing towards the city and continues to grow. According to Supriyatno, 2020, A city is a heterogeneous pattern of life, composed of natural and non-natural elements, which is dominated by physical geographical features in the form of buildings, infrastructure, housing and urban roads. It is also said that the symptoms of concentrating large numbers of the population occur in urban areas. The city as a region grew into a center of all activities in almost all aspects. The construction of facilities and infrastructure is also centered in many urban areas. This triggered the flow of urbanization towards the city to get higher and higher. The vulnerability and risk of problems in the city is also increasingly complex. One of them is population density.

Population density is generally defined as a comparison of the number of inhabitants with the unit area of the territory (Marhaeni, 2018 [2]; Suharto, 2020 [3]; Suwito, 2020 [4]). Population density is often associated with population movement (Suharto, 2020). However, there are many benefits that can be derived from the results of population density studies. High birth rates, large numbers of migrations and mortality events can be reflected in the density (Suwito, 2020). Even population density can be attributed to many things. Like some of the following analyses conducted in urban Jakarta, including the pattern of covid-19 spread (Edriani, Rahmadani and Noor, 2021) [5]; the need for green open space (Refi, 2015); Analyzing the feasibility of the national capital region (Almunawar, 2020); Analysis of Covid-19 Deaths (Habni Hamara Azmaty *et al.*, 2021) [6]; and more. One of the impacts of density that affects a regional space is the change in land use. High population density requires land for settlement and further shifts other land uses. This phenomenon causes most urban areas to be dominated by built-up land, one of which is residential land cover. Therefore, in this study, researchers tried to compare spatially using GIS population density based on administrative area and land cover area in urban Jakarta. It is hoped that the results of this study can add insight related to population density analysis that can be used to conduct other analyses that are closely related to the topic.

II. METHODOLOGY

2.1. Study area

DKI Jakarta is one of the provinces that is currently the capital of Indonesia. The metropolis is astronomically located at 6°12' South Latitude and East Longitude 106°48'. It is located at an altitude of 7 meters above sea level, and has a land area of about 662.33km² and 6,977.5km² of ocean area (BPS Provinsi DKI Jakarta, 2021). Geographically bordered by West Java in the eastern part, namely Bekasi Regency and Bekasi City; and South, namely Depok City. West by bordering Tangerang City and South Tangerang City, Banten Province. to the north of DKI Jakarta is directly adjacent to the Java Sea. It consists of five municipal administrative areas and one county administrative area with 110 islands owned. Spatially, the administrative area of DKI Jakarta can be seen in figure 1

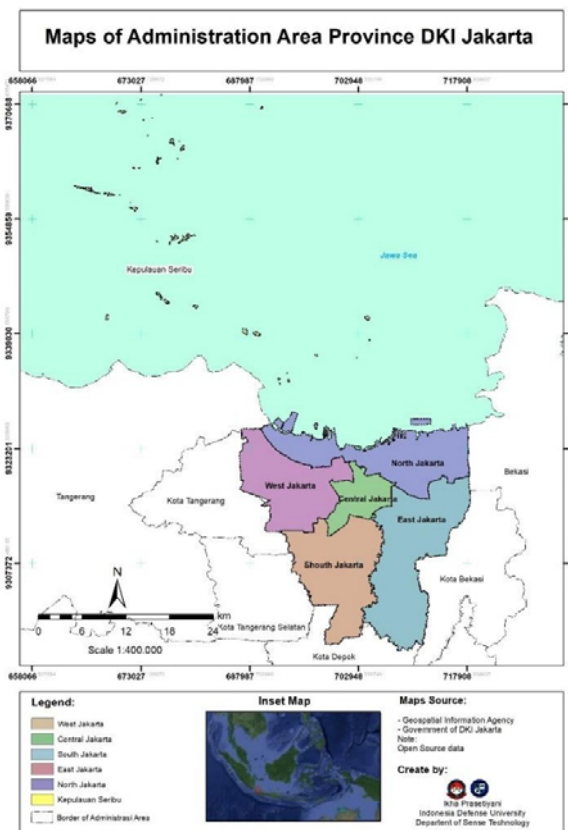


Figure 1. Maps of Administration Area DKI Jakarta Province Source: processing by author

2.2. Work steps

This research began with data collection. Then the process of processing statistical and spatial data using GIS. Furthermore, it conducts an analysis of the results of data processing. Finally, conclusions are drawn from the analysis that has been carried out. The series of research work steps can be seen in figure 2.

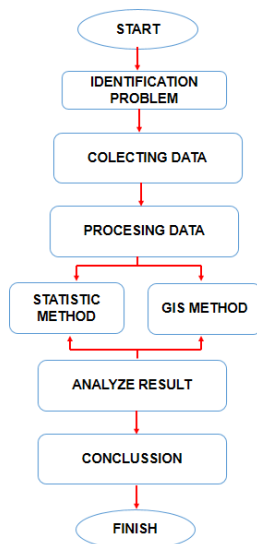


Figure 2. Work Steps Diagram Source: processing by author

2.3. *Data and sources*

This research was conducted by collecting the data needed. Among them is statistical data in the form of the number of residents in DKI Jakarta in 2020 obtained from data, jakarta.go.id. Then spatial data, namely polygon data on administrative boundaries and residential land cover in DKI Jakarta. This data was obtained from the Geospatial Information agency. In addition, other literacy data was also collected that supported the research.

2.4. *Data analysis method*

Statistical and spatial analysis methods were used in this study. Statistical analysis methods are used to calculate population density. Population density can also be referred to as the average number of inhabitants per room or household which aims to show the level of density or distress (Suharto, 2020). The total population is the total population in an area per Regency or City in DKI Jakarta. Meanwhile, the area is the total area of the administrative area obtained from spatial data in the form of polygon data on regional boundaries and residential land cover.

Formula:

$$\text{Population Density} = \frac{\text{Population}}{\text{Administrative Area}} \quad (\text{a})$$

$$\text{Population Density} = \frac{\text{Population}}{\text{Settlement Area}} \quad (\text{b})$$

Geographic Information System is a series of activities used to see a picture of events on the earth's surface and is needed to solve or answer problems that exist in the earth's space (Sugandi, et al, 2009; Bafdal, et al, 2011). A series of activities using computers and software carried out starting from collecting, processing, analyzing and presenting related to an area or space. The data generated from this GIS process is referred to as spatial or geographical information. In essence, GIS is used to carry out the process of managing data from collecting to presenting spatially. Thus, the spatial analysis method was used in this study to see and examine the differences in the urban population density of Jakarta spatially in the form of distribution patterns calculated based on the area of administrative areas and residential land cover.

III. RESULT AND DISCUSSION

3.1. *Result*

The results of statistical data processing obtained from the official website of the DKI Jakarta government data center obtained data on the number of residents per district. Raw data downloaded in the form of a file.csv still includes population data according to age in village/village units. Therefore, it is necessary to generalize the data in the unit of the regency/city area. So that the data obtained is the number of residents per district / city as contained in table 1. Data on the administrative area and residential land of each district/city is required. So that the population density can be calculated and compared. The two area data were obtained from spatial data in the form of administrative boundary polygons and vegetation land cover in the form of settlements. These two spatial data as mentioned in discussion 2.3 were obtained from the Geospatial Information Agency. Data processing is carried out using GIS through mapping applications. The total area is obtained by calculating the geometry area of the two data polygons. The area of land by administration on the polygon of the regional boundary can be obtained directly. Because polygon features have been classified by district/city. Meanwhile, polygon data on the vegetation of the land needs to be clipped and merged based on the administrative boundary polygon data. This process is needed to classify and obtain data on residential land area by district/city. From each GIS process carried out, data on the amount of area based on administration and residential land per district / city is obtained as shown in table 1. So the table contains information about the number of inhabitants, the area of administration and residential land, as well as the results of the calculation of population density.

Table 1. Total Population, Area of Administration and Settlement Area and Population Density ofDKI Jakarta in 2020

No	Kab/Kota	Population (people)	Administrative area (Km)	Settlement area (Km)	Administrative Density (people/km)	Settlement Density (people/km)
1	Kepulauan Seribu	28.152	10,72	0,75	2.625	37.510
2	Central Jakarta	1.153.399	47,58	34,20	24.244	33.720
3	North Jakarta	1.843.537	147,50	51,32	12.498	35.925
4	West Jakarta	2.569.462	125,02	82,18	20.553	31.260
5	South Jakarta	2.367.002	144,97	111,60	16.328	21.190
6	East Jakarta	3.234.003	185,59	115,20	17.425	28.050
TOTAL		11.195.555	661,38	395,37	16.928	28.317

Source: processing and calculation by author

3.2. Discussion

The results of processing population data in GIS obtained from the population distribution map as shown in figure 3. From the picture, you can see the pattern of distribution of the number of residents of each region. The Thousand Islands are an area whose distribution pattern is the rarest only 1 point. From table 1 we know that the number of inhabitants of the Thousand Islands is indeed the least, namely 28,152 inhabitants. Meanwhile, the pattern of population distribution in the mainland area of Jakarta is almost as dense. However, from table 1, East Jakarta is the area with the most population, which reaches more than 3 million. Meanwhile, the cities of West Jakarta and South Jakarta both have a population of more than 2 million. A total population of more than 1 million is reached by the City of Central Jakarta as the center of the Jakarta and North Jakarta areas. This difference in population can be influenced by various factors. For example, activities in these cities, affordability of access, facilities and infrastructure, spatial designation of the area, area and so on. The Thousand Islands can be the least number of inhabitants because indeed in terms of area it is quite limited. In addition, the affordability of fairly limited access in the archipelago area makes the population less attractive to migrate. From this population analysis, there are also many interesting things that can be studied in more depth. Because there are many factors that affect the number of population which will ultimately also affect the level of density.

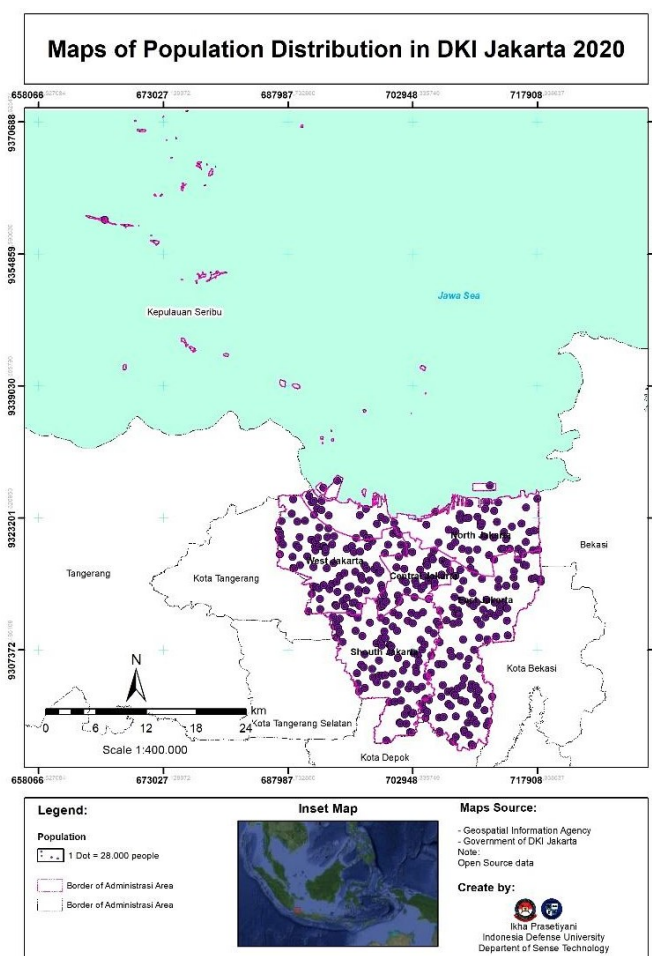


Figure 3. Maps of Population Distribution in DKI Jakarta 2020

Source: processing by author

The total area per area in DKI Jakarta from spatial data both administratively and residential land cover is 661.38km² and 395.37km². From the total area, it is known that more than a middle of the DKI Jakarta area is residential land. This shows that there are many residents living in DKI Jakarta. Whether it's residents who do live in Jakarta, or residents who live for a certain period of time. The population density pattern obtained from the calculation of the number of inhabitants with each criterion of area area is shown in figure 4 and figure 5. From the two images we find different density patterns of the two area criteria. The spatial pattern in figure 5, the population density of the administrative area shows that the cities of West Jakarta and East Jakarta are the areas with the highest density. The lowest density is the Thousand Islands. However, in figure 4, the Thousand Islands are the area with the highest density. As shown in table 1, the population density by area of settlement reaches 37.510 people/km², and the population density by area of the administrative area only ranges 2.625 people/km². Meanwhile, the city of South Jakarta, which has a very dense density classification, becomes quite dense in the spatial classification of population density based on residential land area. From table 1, it is known that the population density ratio of South Jakarta based on residential land area is the lowest, which is 21.198 people/km². From the results of the spatial analysis, we find that the spatial pattern of density of the area administratively and residential land is different. This difference occurs, of course, because the area of the two is different. The difference is because the land cover has a more detailed classification. Not only does it consist of settlements, but there are also other land uses such as green open land, rivers, roads, fields and so on. This difference also becomes very interesting when studied in more depth.

Because, there are many factors that will be related to population density analysis. For example, migration, birth or even physical form of buildings on residential land. Therefore, the population density based on the area of residential land is very

interesting and needs to be studied more deeply with the phenomenon of significant differences.

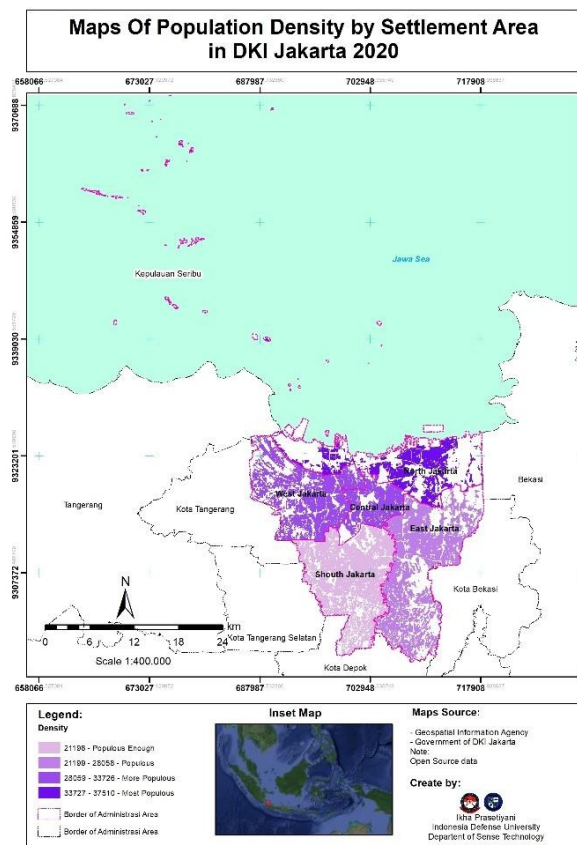


Figure 4. Maps of Population by Settlement Area

Source: processing by author

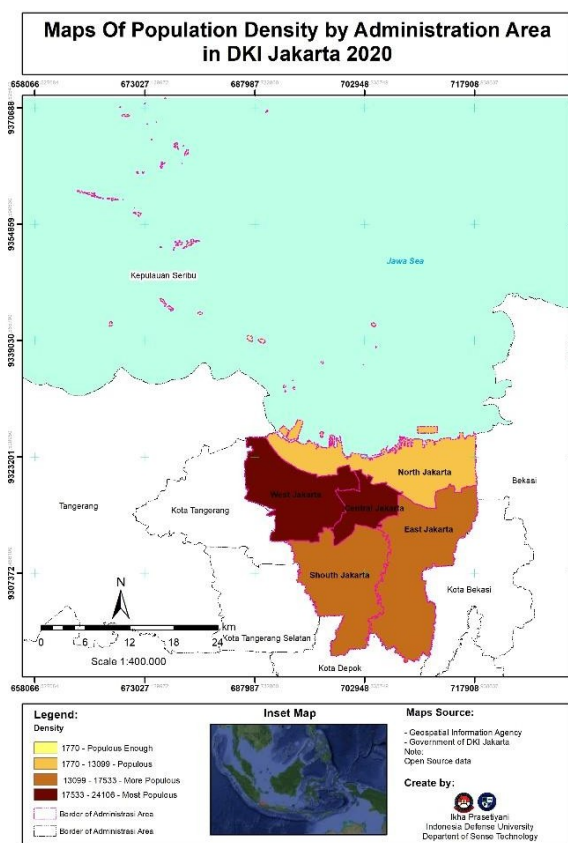


Figure 5. Maps of Population Density by Administration

Source: processing by author

IV. CONCLUSION

From the results of spatial analysis and statistical calculations of the population density formula based on administrative area and residential land, different spatial patterns were found. The population density based on the area of the administrative area shows the result that the areas that have the highest population density are the cities of Central Jakarta and West Jakarta. While the area with the lowest population density is the Thousand Islands. Meanwhile, based on the area of residential land, the area that has the highest density is the Thousand Islands. The area with the lowest density is in the South Jakarta area. Differences in the phenomenon of spatial patterns of population density from different broad criteria turned out to show different results. These differences will be very interesting and need to be studied more in-depth in the next study.

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