International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 39 No. 1 June 2023, pp. 136-145

Utilization Of Geographic Information Systems (SIG) In Mapping Rivers As Alternative Transportation Routes In Jakarta

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Abstract – Public transportation is an important means of transportation for people's lives. The importance of transportation is reflected in the increasing need for transportation services to move people and goods from one place to another. For this reason, there needs to be a way to be able to overcome congestion that occurs due to heavy traffic activities that occur on land. One way is to use the river as an alternative means of transportation. River currents can be used as a means of transportation by using watercraft such as amphibious buses. Therefore, river mapping studies are needed to study optimal routes so as to integrate amphibious bus transportation routes. The way that can be done is by maximizing the use of geographic information systems (GIS) for making mapping of the river path, so it is hoped that with the existence of water transportation routes, it can be a good solution to reduce the level of congestion that occurs in DKI Jakarta.

Keywords – Arcgis, River, Geospatial Information System, Mapping.

I. INTRODUCTION

Public transportation is one of the important means of transportation for people's lives. This can be seen by the increasing need for the use of transportation services to move people and goods from one place to another [1][2][3]. This continues to happen with increasing intensity every year. Therefore resulting in increasingly heavy motor vehicle traffic in DKI Jakarta, congestion is very likely, especially on main roads and other arterial roads[3].

So a solution or way is needed to overcome the congestion that occurs. One way is to use the river as a means of transportation. River currents can be used as a means of transportation both by small boats, boats and by using amphibious vehicles[4]. Therefore, river mapping studies are needed to learn how to create optimal routes so that they are expected to integrate water and land transportation routes[5][6].

This condition encourages the author to try to solve existing problems or provide alternative solutions by conducting research on the use of river routes in DKI Jakarta as alternative transportation routes. The way that can be done is by maximizing the use of Geographic Information Systems (GIS) to determine the distribution of river areas in DKI Jakarta, which can be processed using Arcgis 10.8 software. So it is hoped that with the existence of water transportation routes, it can be a good solution to reduce the level of congestion that occurs in DKI Jakarta[7].

Geographic Information System (GIS) is a computer system that can be used to map, analyze, and manipulate data (related to location and geometry) and other related information. GIS provides visualization and analysis of geographic data to help understand the relationships between geographic phenomena in making decisions based on relevant information. Geographic

Information Systems can also be used various activities to collect, and analyze an object or other phenomenon that can be reviewed for location. The use of GIS in decision making is a very important feature in the analysis process. GIS is a series of tools, methods and processes that facilitate and encourage efforts to solve problems and understand objects on the earth's surface[8][9].

Arcgis is a software suite that has various functions and extensions in it, so it is integrated and can apply concepts from various databases, especially geodatabases[8]. ArcGIS is software developed by ESRI. ArcMap is a menu in GIS mapping and analysis software in ArcGIS that has many capabilities. Some of ArcMap's key capabilities include[10]:

1. Map Creation: ArcMaps allows users to blindly display interactive maps and display geographic data and related information.
2. Spatial Analytics: ArcMap has a variety of analytics tools to analyze geographic data and find patterns and relationships.
3. Data Management: ArcMap allows users to manage, store, and share geographic data in a variety of formats.
4. Collaboration and Sharing: ArcMap allows users to work together and share geographic information in real-time.
5. Data Visualization: ArcMap allows users to visualize geographic data and understand relationships between geographic phenomena.
6. Geoprocessing: ArcMap has a wide array of geoprocessing tools that allow users to efficiently process and analyze geographic data.
7. Modeling and Analysis: ArcMap has the ability to model and analyze geographic phenomena and predict results based on data

II. Material And Method

Based on the problems presented in the background section, it is necessary to conduct research to solve the problems that occur, namely by using research methods, literature studies. This is done in the steps of the data collection process as a basis for making maps, processing research materials and reading journals about related research[11].

In this study, the river chosen by the author as the object of research is in 3 main rivers in DKI Jakarta, including the Ciliwung river, then the Pesanggrahan river (west canal), and the sunter river. These rivers are rivers that have the longest width and stretch so they are expected to be used as alternative transportation routes. In addition, the three rivers are right in areas that experience a lot of congestion points so it is expected to be used as an alternative transportation route[12].

The purpose of this study is to determine the study of mapping the best river routes to integrate alternative transportation routes. The river is the Ciliwung river. Which stretches across the capital city of DKI Jakarta which flows from south Jakarta to north Jakarta with a river span length of 36.67 KM[8][14].

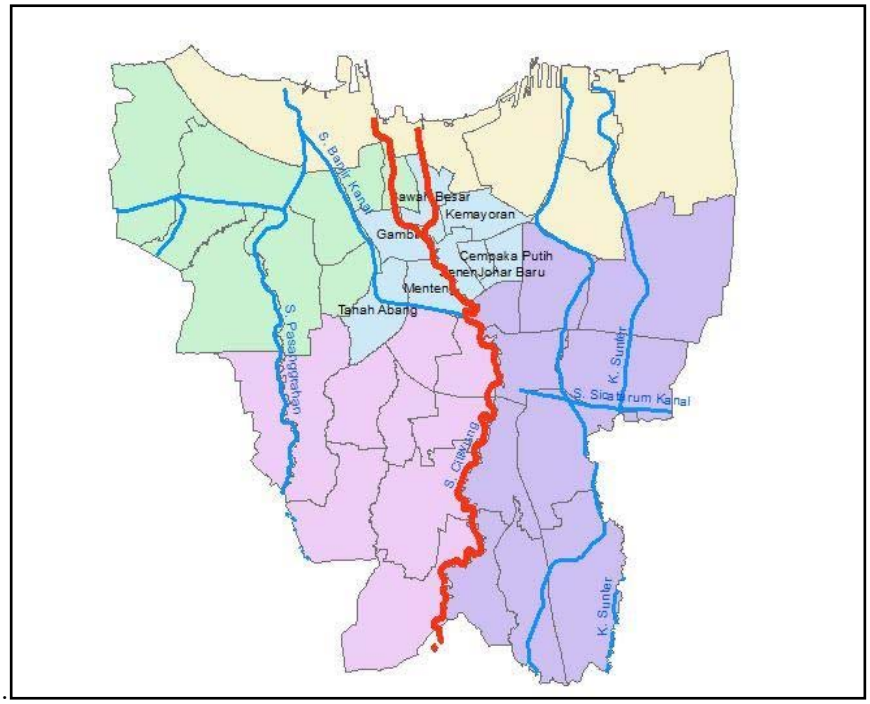

Figure 1. The research location of the Ciliwung river (middle zone) in DKI Jakarta as a recommendation for river transportation routes. (Source: Processed by researchers, 2023).

Next is the Pesanggrahan river or the west canal river route, which passes through the area around west Jakarta including Grogol, Petamburan, Kebon Jeruk to Cengkareng with a main river length of 27.41 KM. This river is divided into 2 lanes that flow to South Jakarta through Kembangan and which go to Central Jakarta then join the Ciliwung river. It has the potential to be used as a water transportation route because it is connected to other rivers[15][16].

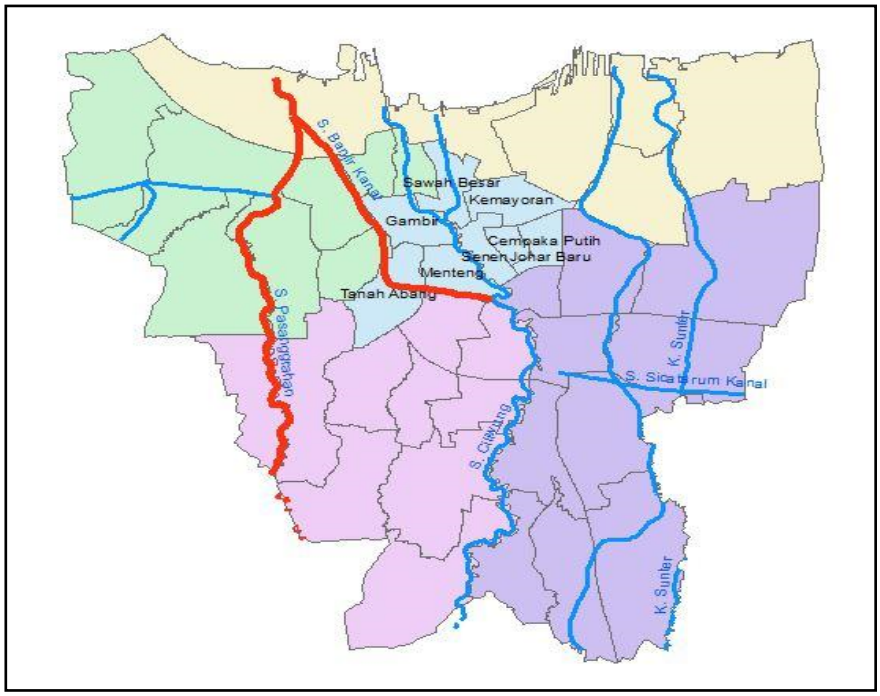

Figure 2. The research location of the Pesanggrahan river (west canal) in DKI Jakarta as a recommendation for river transportation routes. (Source: Processed by researchers, 2023).

The last river route that became the location of the study was the sunter river or the east canal line, which stretched along 30.99 KM. This river is connected to areas outside Jakarta such as Bekasi so that its use can be maximized as an alternative river route[17].

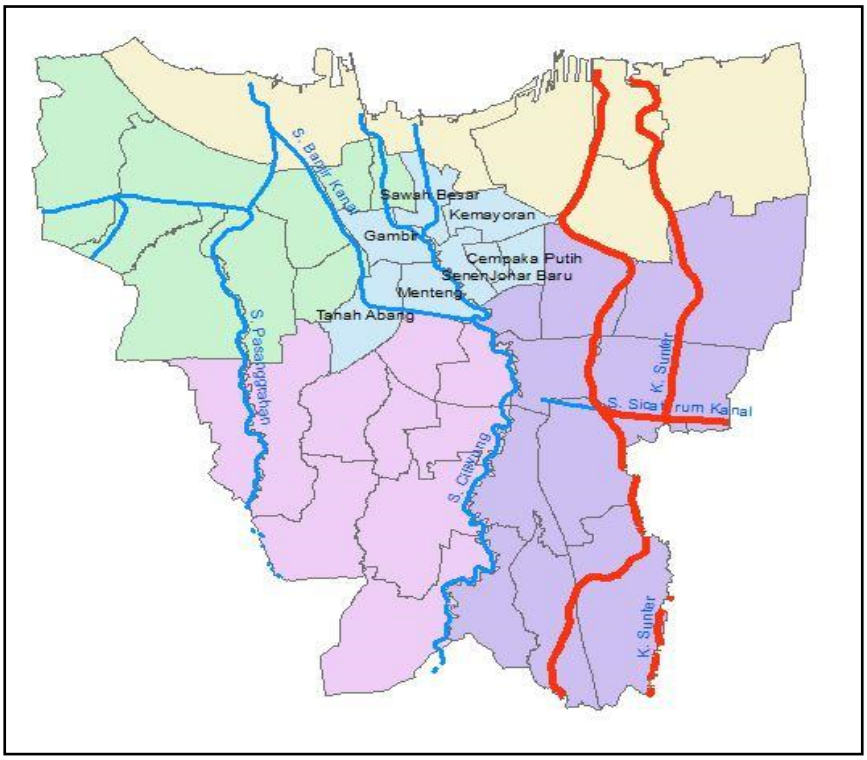

Figure 3. The location of research on the Sunter river route (East zone) in DKI Jakarta as a recommendation for river transportation routes. (Source: Processed by researchers, 2023).

In this study the author used data obtained from DEMNAS, RBI, administrative boundary data, and river shapefile data that was processed to obtain an overview and mapping of data on length, depth, water level and river width, as well as satellite image data (Landsat)[18].

III. Results And Discussion

3.1. Input Data

The data processed in this study is data that has been collected in the form of data from DEMNAS, Rupa Bumi Indonesia (RBI) and Administrative Boundaries which are then processed to obtain river path maps in accordance with the research objectives[18][19].

3.2. Map of DKI Jakarta Reasearch Administration

The location of this research is in DKI Jakarta Province. The main focus lies on the large river route that crosses the area in DKI Jakarta[19]. The area is divided into 5 regional zones, namely:

1. West Jakarta as shown by the green picture
2. North Jakarta as shown by a lilac color image
3. Central Jakarta as shown by the orange image
4. South Jakarta shown by the purple picture
5. East Jakarta shown by a light blue picture.

Then there are 3 main rivers that pass through almost all parts of the DKI Jakarta province including:

1. The western canal river route is the Pesanggrahan river which crosses the west Jakarta area zone.
2. The Ciliwung river path is a river that stretches from the north of Jakarta, the middle to the south of Jakarta, passing through almost part of the central area of DKI Jakarta.
3. The eastern canal river route, namely the sunter river and the Citarum river, passes through the part from the north of Jakarta to the east of Jakarta.

The part of the area passed by the river path based on the zone of the area is shown by the figure as follows:

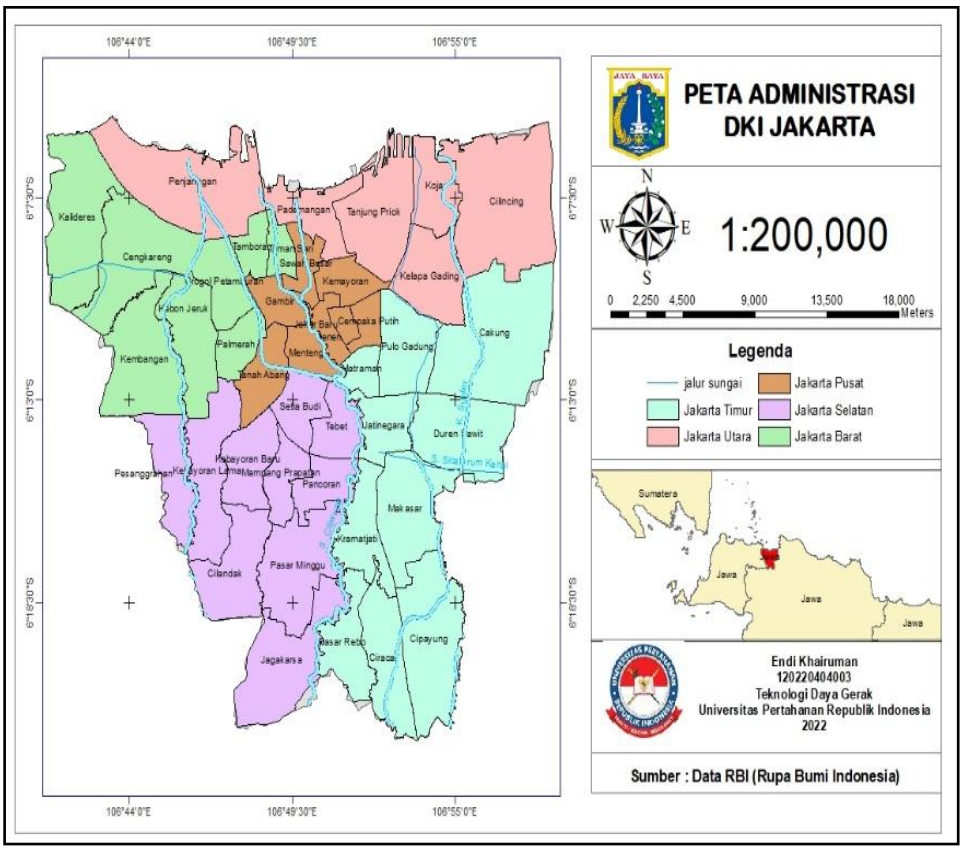

Figure 4. The administrative map of DKI Jakarta research includes sub-districts and river paths that cross. (Source: Processed by researchers, 2023).

3.3. Cropping Map and Landsat

Map cutting was carried out to divide the area that can be used as a river transportation route, in this study 5 river divisions were carried out based on regional zones so that the transportation route can be used by all areas in Dki Jakarta[15][16][17], namely as follows:

1. West Jakarta

In the zone of the west Jakarta area, a river that is feasible and can be used as a water transportation route is the pesanggrahan river route. The specification of the river is that it has an average depth of 7 meters with an average river width of 25 meters.

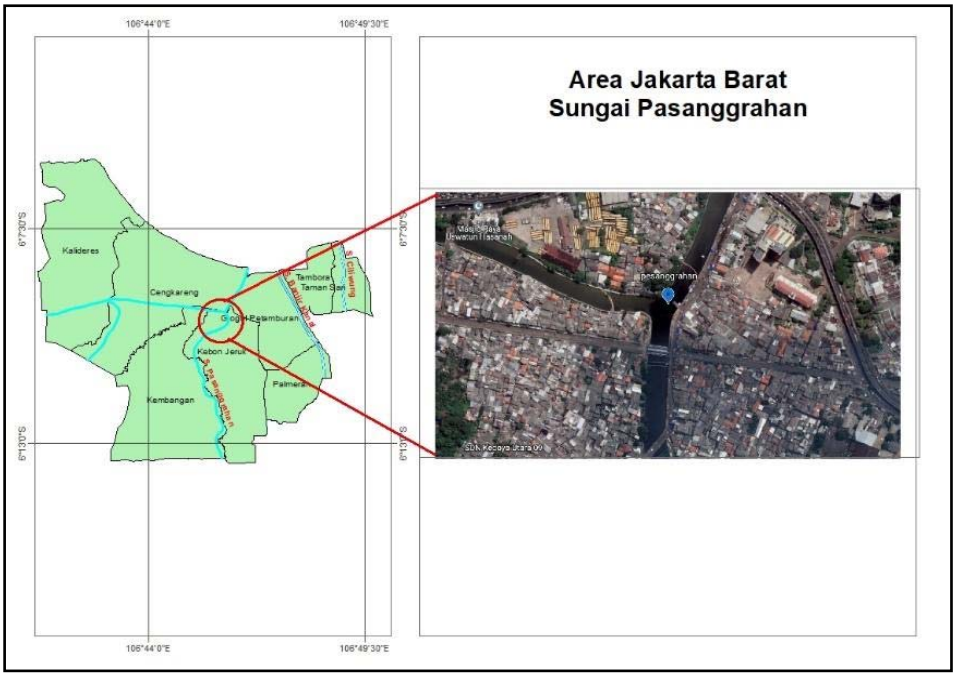

Figure 5. Layout of Pesanggrahan river map in West Jakarta. (Source: Processed by researchers, 2023).

2. Central Jakarta

In the zone of the central Jakarta area, a river that is feasible and can be used as a water transportation route is the main Ciliwung river route which includes the areas of Gambir, Johor Baru, Sawah Besar and Kemayoran. The specification of the river is that it has a maximum depth of 12 meters and an average width of 30 meters with a maximum width of 50 meters, this river path is able to cover almost all parts of Jakarta.

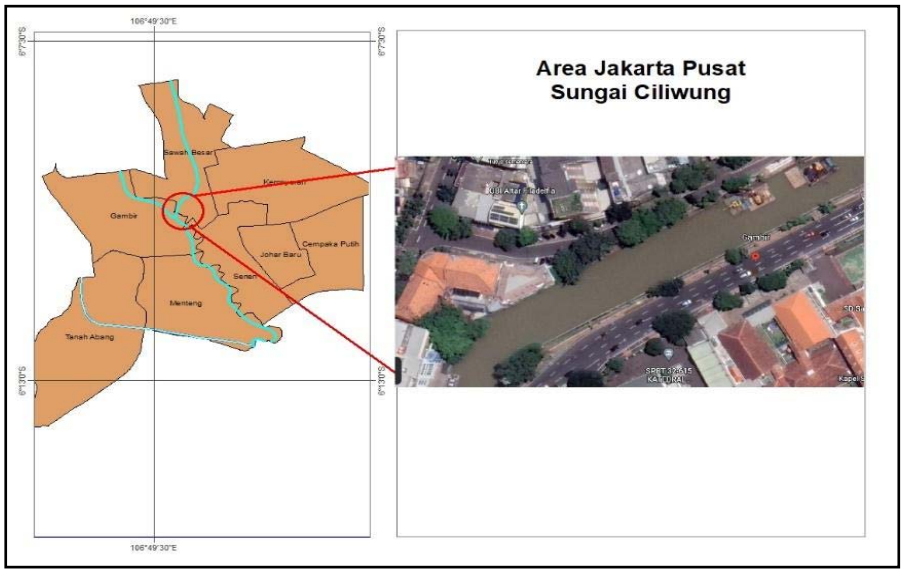

Figure 6. Map layout of Ciliwung river in central Jakarta. (Source: Processed by researchers, 2023).

3. North Jakarta

In the zone of the north Jakarta area, a river that is feasible and can be used as a water transportation route is the Sunter river route through the Tanjung Priok, Kelapa Gading, Cilincing and Koja areas. The specification of the river is that it has an average depth of 5 meters with an average river width of 20 meters.

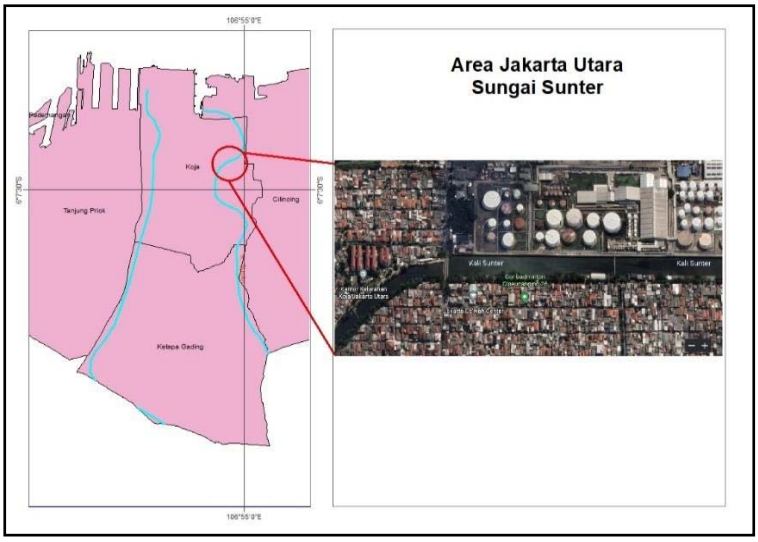

Figure 7. Sunter river map layout in North Jakarta. (Source: Processed by researchers, 2023).

4. South Jakarta

In the zone of the south Jakarta area, a decent river that can be used as a water transportation route is the Ciliwung river route through the Tebet, Pancoran and Sunday market areas. The specification of the river is that it has an average depth of 12 meters with an average river width of 25 meters.

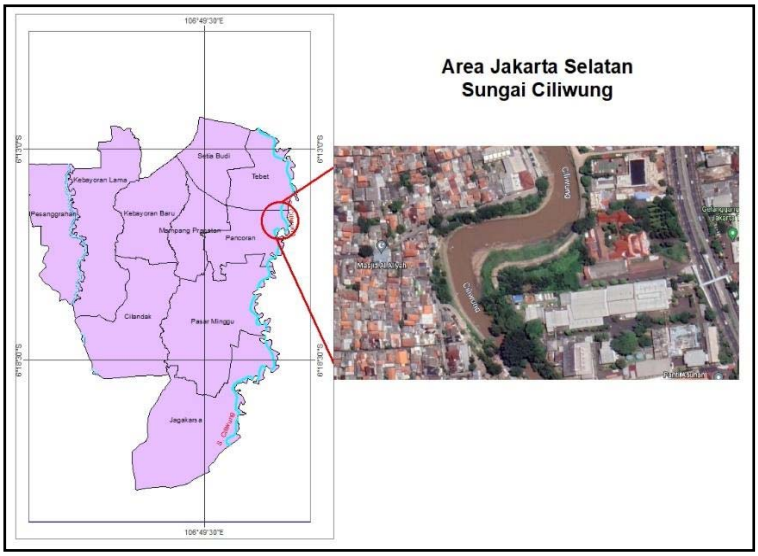

Figure 8. Layout of Ciliwung river map in South Jakarta. (Source: Processed by researchers, 2023).

5. East Jakarta

In the zone of the east Jakarta area, a river that is feasible and can be used as a water transportation route is the river route east canal Sunter canal, namely in the areas of pulo gadung, duren sawit and cakung The specification of the river is that it has an average depth of 5 meters with an average river width of 20 meters.

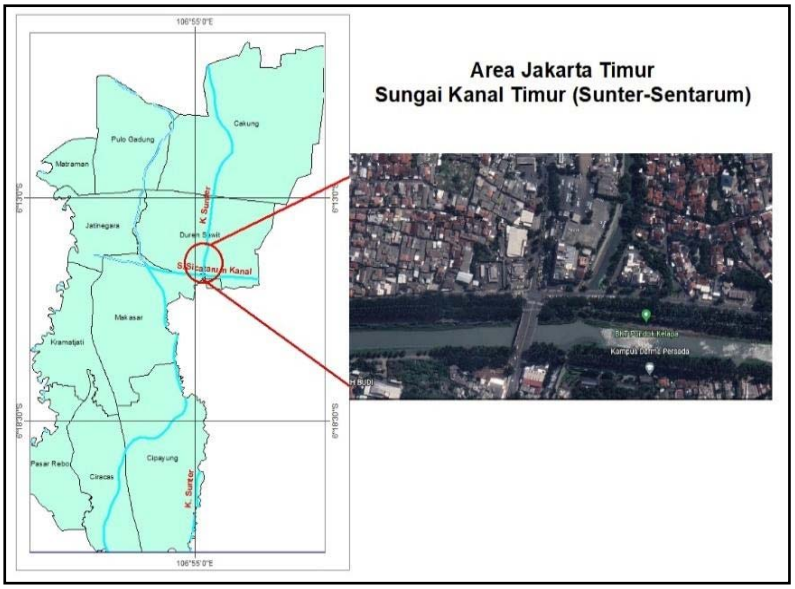

Figure 9. Sunter river map layout in East Jakarta. (Source: Processed by researchers, 2023).

3.4. River specifications

The specification of each river that will be used as an alternative transportation route. The parameters used are river name, river length, minimum depth, maximum depth, minimum width, maximum width, construction conditions[14][20][21]. The following is a table of specifications for each river.

Table 1. Ciliwung river specifications (Source: Processed by researchers, 2023).

No	Parameters	Specifications
1	River Name	Ciliwung
2	River Type	Main River
3	River Length	36,67 Km
5	Minimum River Width	5 Meters
6	Maximum River Width	50 Meters
7	Minimum River Depth	2 Meters
8	Maximum River Depth	12 Meters
9	River Construction Conditions	Partially Damaged

The data addressed by table 1. It is a specification data from the Ciliwung river which was studied as an alternative river transportation route.

Table 2. Specification of the Pesanggrahan river (Source: Processed by researchers, 2023).

No	Parameter	Specifications
1	River Name	Pesanggrahan
2	River Type	Sungai Utama
3	River Length	27.41 Km
5	Minimum River Width	10 Meters
6	Maximum River Width	40 Meters
7	Minimum River Depth	1 Meters

8	Maximum River Depth	7 Meters
9	River Construction Conditions	Partially Damaged

Data addressed by table 2. It is a specification data from the Pesanggrahan river which was studied as an alternative river transportation route.

Table 3. Sunter river specifications (Source: Processed by researchers, 2023).

No	Parameter	Specifications
1	River Name	Sunter
2	River Type	Sungai Utama
3	River Length	30.99 Km
5	Minimum River Width	20 Meters
6	Maximum River Width	20 Meters
7	Minimum River Depth	1 Meters
8	Maximum River Depth	17 Meters
9	River Construction Conditions	Partially Damaged

Data addressed by table 3. It is a specification data from the Sunter river which was studied as an alternative river transportation route.

IV. Conclusion

The main river is divided into 3 parts and spread in every area of DKI Jakarta. These rivers include:

1. Pesanggrahan River covers the West Jakarta area, which is located in the sub-district; Grogol Petamburan, Kebon Jeruk, Kembangan, Cengkareng, Kalideres, Palmerah. With river specifications, namely; river length is 27.41 KM, the average river width is 25 meters with the largest width of 40 meters, the average river depth is 5 meters.
2. Ciliwung River stretches longitudinally from south Jakarta to the lowlands in North Jakarta precisely in Sunter sub-district with a length of 36.67 meters, an average width of 30 meters and an average depth of 5 meters.
3. The eastern canal river includes the Sunter River and joins the Citarum River, the specification of the river is 30.99 km with an average width of 20 meters with an average depth of 5 meters.

Of the three rivers, the Ciliwung river has suitable specifications to be used as an alternative transportation route, so that it can be used as access for amphibious vehicles in the future. In order to provide other options as a solution to solve congestion that occurs on land transportation routes. The use of water transportation is very relevant to be used in the future considering the limited land transportation routes that exist, especially in DKI Jakarta at this time.

Acknowledgment

The author would like to thank Mr. Colonel Kes. Dr. Ir. Sovian Aritonang, S.Si. M.Si for direction and guidance. Thank you also to the amphibious vehicles group colleagues who have worked together to express ideas in providing solutions to solve congestion in DKI Jakarta and colleagues involved in writing this article.

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