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River as Alternative Infrastructure for Water Transportation and Emission Load Sharing in Banjarmasin City, South Kalimantan

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ABSTRACT. The high mobility and population in Banjarmasin City causes increased pollution and emissions, especially those from motorized vehicles. But the city of Banjarmasin, which is geographically surrounded by connecting rivers that have high vegetation, can be an alternative solution to share the emission load from transportation activities centered on city roads. This article aims to determine the appropriateness of using rivers as water transportation infrastructure and reducing emissions in Banjarmasin City. The research was conducted in a descriptive qualitative manner based on several existing studies. The results show that Barito River are suitable for use as transportation infrastructure and can efficiently reduce the emission load of the Banjarmasin city road.

Keywords: Emissions, rivers, transportation, vegetation, water.

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1. Introduction

The city of Banjarmasin, located in South Kalimantan, is known as the City of a Thousand Rivers because its area is + - 98.46 km2 which consists of 25 small islands separated by rivers. There are two major rivers in Banjarmasin, namely the Barito River and the Martapura River.

Transportation is an activity that is very important for everyone in all places, including urban areas (Sari, 2008). One form of transportation is through waterways which usually use boats or when as a means of moving places. Water transportation in the city via rivers has become a characteristic of the city of Banjarmasin, which is in accordance with its geography with the number of rivers in the city as a means of transportation for the mobilization of residents to various urban areas (Abidin, 2016). Although there is also transportation on land, this river transportation is the local transportation for the people of Banjarmasin city.

In urban areas, air is one of the most important and major things in supporting the life of city people. Until now, air has also become a problem that needs to be taken seriously because to get clean air you have to pay a high price, because the air has been polluted so that its quality is reduced (Inayah, Suhel, and Andriani, 2019). In the city of Banjarmasin, traffic jams caused by motorized vehicles have become commonplace. This is a big factor in air pollution from the capital city of South Kalimantan province. The increasing population of the city population and the desire for high mobilization are one of the causes of the decline in air quality in the city of Banjarmasin.

With the shape of the city of Banjarmasin, which has a connecting river in every area of the city, it is an aid factor in dividing motorized vehicle air pollution in this city. Fortunately, on the edge of every river in Banjarmasin city, there is a vegetation ecosystem that can reduce air pollution a little. Therefore, this research is made with the aim of river transportation to be one of the load dividers for traffic density and air pollution in the city of Banjarmasin.

2. Materials and Methods

2.1 Methods

The method used in this research is descriptive qualitative which uses or takes from secondary data based on existing studies. Using qualitative methods because it is based on phenomena that occur in society. As well as descriptive because it describes the subject or object as it is in fact and is researched appropriately.

2.2 Region Research

The city of Banjarmasin is located between 3°15' - 3°22' South Latitude and 114°32' - 114°38' East Longitude. Banjarmasin city is located in the Southern part of South Kalimantan Province at an average altitude of 0.16 meters under the sea surface and the condition of the area is relatively flat. The city of Banjarmasin located area of Kuala Martapura River which empties on the east side of the Barito River.

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3. Result and Discussion

Table 1. Data on river traffic activities in Banjarmasin City in 2013

Months	Ships (number)		Passenger (person)		Goods (tons)		2-wheel vehicles	
	In	Out	In	Out	In	Out	In	Out
January	1233	1192	37187	40679	275	792	14972	14580
February	1162	1104	32674	36806	2641	1037	12761	12560
March	1092	1101	35842	38867	578	1049	14761	14550
April	1240	1196	32020	35985	276	666	10080	10121
May	920	877	19325	19942	-	208	11718	11922
June	883	856	14640	15314	-	115	8820	11345
July	909	871	13246	11964	-	132	7816	7812
August	923	873	13278	20318	-	-	1812	10326
September	1012	923	15016	19728	-	104	8115	10512
October	993	861	14927	15355	210	225	8012	11257
November	973	911	13611	15786	-	112	11928	11732
December	1011	977	14860	14913	301	224	12113	12006
Total	12351	11742	256626	185657	4281	4664	122908	1387234
2012	6515	5087	145065	147394	5441	6967	52050	39132
2011	10967	9321	264483	290052	10715	20853	85601	84645
2010	13813	12199	432614	433897	6838	11332	188910	183170

Source: Department Of transportation, communications, and information technology the City of Banjarmasin

Table 2. Data on river conditions in Banjarmasin City

Type of data	Location	Size
The depth of the river at low tide	1. The Barito River	10
	2. Martapura River	4
	3. River Andai	2.5
	4. Alalak River	2.5
Height of the Bridge at High Tide	1. Freedom Bridge	2.75
	2. A. Yani Bridge	3,1
	3. Old Market Bridge	3.5
	4. PDAM Bridge	2.75
	5. The Andai River Bridge	2.5
	6. Basirih Bridge	3.5
The condition of the depth of the water that can be viewed from the height of the bridge's free mast	1. Antasan Bridge	4,4
	2. A. Yani Bridge	4
	3. Tangi Wooden Bridge	7.5
	4. Freedom Bridge	4
	5. The 9 November Bridge	4.75
	6. The Andai River Bridge	3,4

Source: Department of Transportation, Communication and Information of Banjarmasin City

Data regarding river conditions in Banjarmasin City can also be seen in table 2. In this table, the ideal depth of the river during low tide is the Barito River, which has a depth of up to 10 meters. The situation at low tide must be considered because the ships crossing this river are large ships. This is important to avoid the boat getting stuck in a shallow river due to low tide. This significant river contribution is needed due to the uneven development in the Kalimantan area. However, the positive effect is that urban emissions which are dominated by motor vehicle fumes are not too much and affect the urban air as a whole. Because basically, the biggest contributor to emissions is motorized vehicles (Ismiyati, Marlita, and Saidah, 2014)

In general, the positive impacts of water transportation, especially rivers, are as follows:

- There is no need to build a waterway because there is a river as a container for flowing water naturally
- It only needs construction in a few spots, such as the construction of a pier
- Can provide services directly for settlements along the river
- Able to reach inland areas that cannot be reached by road
- Environmentally friendly and free of jams
- It causes less air pollution

While the disadvantages of water transportation are as follows:

- Transport speed is slower than other modes of transportation
- Comfort and safety are relatively low compared to safer land vehicles
- Estimating longer trips is time consuming, which can reduce productivity
- The supporting facilities are still lacking

3.2. Make people aware of the importance of river water quality

South Kalimantan is one of the provinces that has many rivers which are used as natural resources (Rochgiyanti, 2011). One of them is a river in the city of Banjarmasin. The condition of the rivers which are wide in the city of Banjarmasin should be used as best as possible. The

assumption that a river is only a watershed must be transformed into an area that must be utilized as well as possible. Indigenous peoples who mostly use simple canoes are an example. This indigenous community applies the river as their front yard, which is something that must be guarded and cared for. With this, the indigenous people depend on the existence of the river and keep the river well-groomed and sustainable. Urban communities must imitate the attitude of protecting and preserving the quality of river waters. Rivers, which are inundated by rubbish, such as in most big cities, in addition to causing an unpleasant smell, they also cause water flow to be obstructed. This will become a problem when the river is used as a medium for water transportation.

The challenge going forward is to convince the public that river transportation is a wider and more sustainable marine transportation system. Furthermore, consideration is needed in various sectors and evaluation of this river transportation. And the development of the transportation sector needs to be directed so that a reliable, highly capable, effective and efficient transportation system can be realized (Stellamaris, 2017).The thing that will attract public interest is infrastructure, so it is important to revitalize old ships so they can be replaced with newer ones. The replacement of this fleet will also show the government's intention to implement this river transportation system. There are several criteria for ships that must exist, namely:

- It is flat and can still operate in shallow rivers
- The type, strength and placement of the locomotive force are adjusted and prepared for the possibility of a shallow river section
- The dimensions of the ship space must match the width of the river by taking into account the carrying capacity which must be more profitable for the transportation of goods compared to the cost of transporting motorized vehicles such as trucks.

Previously, the river was often used as a garbage disposal area and a drain for disposing of waste. This makes the river a place that is not beautiful to look at. The decline in river aesthetics has resulted in decreased public concern about river quality. One of the factors that reduce the aesthetics of the river is the slum settlements along the river. The river has a unique environment that is manifested in traditional settlements as a response to the nature of its environment (Hamidah et al., 2014). As happened on the Barito River, there are many settlements along the river which are used as housing options. The reason for this problem is the high cost of land in cities.

The existence of river transportation that serves the community is expected to increase awareness of the quality of river waters. The river, which is used as transportation infrastructure, will certainly be paid attention directly and with high intensity because it is often traversed. Arrangement of the river body also needs to be done so as not to cause undesirable things such as accidents and health problems for the residents.

One solution that can be done by local governments is to develop tourist areas on the riverbank. For example, a riverbank can be used as a recreational park or a protected area that has a unique ecosystem in it. This area can be used as a model for other places in order to be able to organize the river water area properly. With this tourist area, river transportation modes such as boats and klotok can be maximally utilized besides as a means of transportation. However, in developing tourist areas, the safety aspects of local river transportation must also be considered so that they do not interfere with river traffic activities.

3.3. Efficiency of carbon sequestration by river vegetation

The application of river transportation to the maximum will certainly divide the emission load from urban areas where there are roads to river areas that relatively have a lot of vegetation around them. This vegetation plays a role in the absorption of carbon dioxide from the emissions of fossil fuel-fueled transportation modes. The number of green open spaces (RTH) in Banjarmasin City has not been able to absorb carbon dioxide as a whole so that it can reduce urban air quality. This can have an impact on the quality of public health, especially on the respiratory organs. In Figure 1, it can be seen that on road 1 (RTH Sabilal), the resulting CO2 emissions are 6,799.78 kg / hour, road 2 (PKK Park) 3,168.09 kg / hour, road section 3 (Taman Cambodia) 10,678, 29 kg / hour, road 4 (RTH UNLAM) 5,225.23 kg / hour, road 5 (Jahri Saleh Animal Park) 594, 59 kg / hour, and road section 6 (Sultan Suriansyah Building) of 11,710.92 kg / hour. Carbon dioxide emissions are caused by motorized vehicles, which are dominated by motorbikes and cars. The increasing population growth is also a factor in the large burden of carbon dioxide emissions in the city of Banjarmasin.

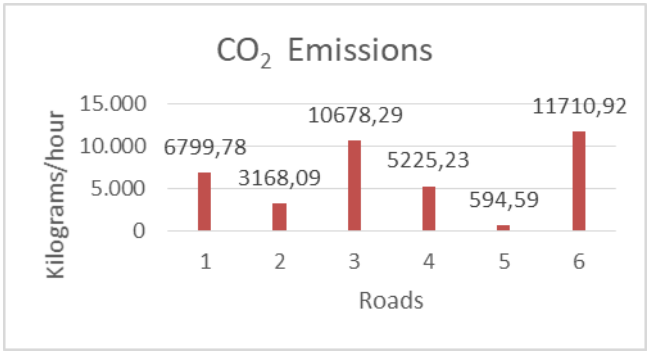

Fig.1 Graph of CO2 emission load in Banjarmasin City

CO2 emissions produced by motorized vehicles that burn with perfect CO2 gas flames, so that the resulting emissions can be measured in units of kilograms per hour with the association of several factors, including the type of vehicle, emission factors, specific energy consumption and long roads, where it can be implemented in the following formula:

Q = Ni x Fei x Ki x L

With:
Q = Total emission (kg / hour)
Ni = Number of motorized vehicles type-i (vehicles/ hour)
Fi = emission factor
Ki = Specific energy consumption type-i (liters/ 100km)
L = Road Length (km)

The burden of carbon dioxide emissions in urban areas can be minimized by having green open spaces (RTH) in cities. According to RI Law No. 26 of 2007 concerning Spatial Planning states that the ratio of the amount of green open space to the total area of a city is 30% consisting of 20% public open space and 10% private open space. Banjarmasin City area has Green Open Space (RTH) with the following amount of carbon absorption as shown in Figure 2:

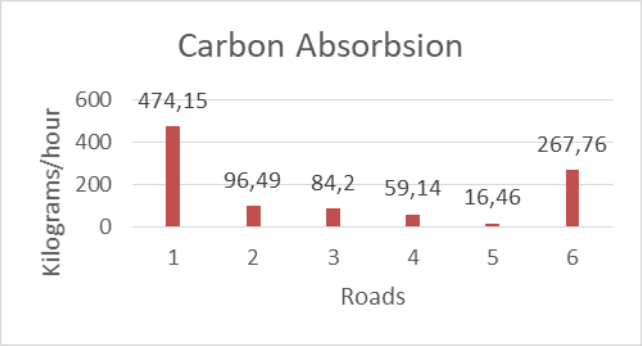

Fig.2 Graph of carbon absorption in Banjarmasin City

The approach was conducted to determine the absorption of carbon by plants using the formula as follows : absorption ability tree = absorption of CO2 x n, with a description of n = the number of trees. On road 1 (RTH Sabilal), the absorption of carbon by trees is 474.15 kg / hour, road 2 (PKK Park) 96.49 kg / hour, road section 3 (Cambodia Park) 84.20 kg / hour, section road 4 (RTH UNLAM) 59.14 kg / hour, road 5 (Jahri Saleh Animal Park) 16.46 kg / hour, and road 6 (Sultan Suriansyah Building) 267.76 kg / hour. Road section 1 (RTH Sabilal) has the largest amount of vegetation so it has the largest carbon absorption as well, while road section 5 (Taman Satwa Jahri) has the smallest vegetation so that it has the least carbon absorption.

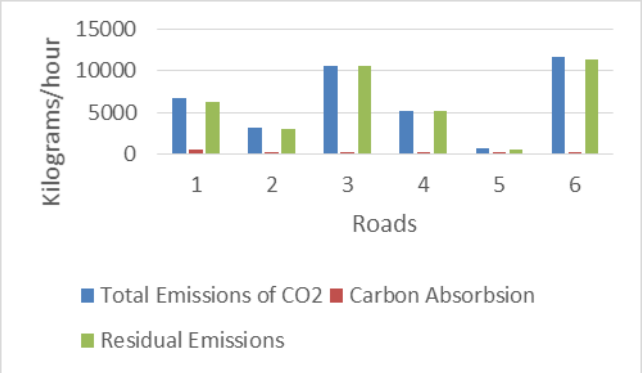

Fig.3 Comparison of Emissions, Absorption Capacity, and Remaining Emissions in Banjarmasin City

According to Lestari (2018) in Figure 3, the carbon absorption in the six measurement sites has not been able to absorb all emissions caused by motorized vehicles. Therefore, it is necessary to share the burden of carbon dioxide emissions from roads to rivers that have more vegetation around them so that they are more efficient in absorbing carbon emissions from passing boats and ships.

4. Conclusion

Emissions are caused by the passing of motorized vehicles which are dominated by motorbikes and cars, with the presence of water transportation, the number of vehicles on urban roads will decrease because some of them are diverted to water transportation. In addition, vegetation is effective in the process of absorbing emissions, which in urban environments is obtained from green open spaces. However, the number of green open spaces (RTH) in Banjarmasin City has not been able to absorb carbon dioxide as a whole, so it can reduce urban air quality. The vegetation around the river plays a role in absorbing carbon dioxide from the emissions of fossil fuel-fueled transportation modes. With the transfer of emission loads on the Banjarmasin city roads to river areas that have more surrounding vegetation using alternative water transportation, the emission levels and vehicles on the Banjarmasin city roads are reduced because more emissions are absorbed by vegetation. This can have an impact on improving air quality and public health, especially in the respiratory organs because air pollution is decreasing. And based on the characteristic data of several rivers in Banjarmasin (width and depth), we can conclude that the Barito River is a suitable river to be used as a river transportation infrastructure.

References

Abidin, Z. (2016) 'Studi revitalisasi angkutan sungai sebagai moda transportasi perkotaan di kota banjarmasin', Agregat, 1(1), pp. 23-32.

Hamidah, N., Rijanta, R., Setiawan, B., and Marfai, M. A. (2014) 'Kajian transportasi sungai untuk menghidupkan kawasan tepian sungai kahayan kota palangkaraya', Tata Loka, 16(1), Pp. 1-17.

Inayah, N., Suhel, H., and Andriyani, M. (2019) 'penyajian peta kualitas udara kota banjarmasin (so2 dan no2)', Jurnal Poros Teknik, 11(1), pp. 7-11.

Ismiyati, Marlita, D., and Saidah, D. (2014) 'Pencemaran udara akibat emisi gas buang kendaraan bermotor', Jurnal Manajemen Transportasi dan Logistik, 1(03), pp. 241-248.

Lestari, E. A. P. (2018), 'Efektivitas ruang terbuka hijau dalam mereduksi emisi gas karbon di kota Banjarmasin, Kalimantan Selatan' , Seminar Nasional Geomatika 2018: Penggunaan dan Pengembangan Produk Informasi Geospasial Mendukung Daya Saing Nasional, Institut Pertanian Bogor, Bogor.

Muziansyah, D., Sulistyorini, S., and Sebayang, S. (2015) 'Model Emisi Gas Buangan Kendaraan Bermotor Akibat Aktivitas Transportasi (Studi Kasus: Terminal Pasar Bawah Ramayana Koita Bandar Lampung)', JRSDD, 3(1), pp. 57-70.

Najib, M. (2005) 'Perilaku pemukim terhadap lahan permukiman sekitar sungai di kawasan pusat kota', Mektek, 6(19), pp. 113-119.

Nizar, A. M., Artana, K. B., and Ariana, M. (2016) 'Kajian Teknis dan Ekonomis Bunkering LNG untuk Pemenuhan Bahan Bakar Gas Kapal Pelni', Jurnal Teknik ITS, 5(2), pp. 361-366.

Rahman, S., Mentayani, I., Rusmilyansari, and Mahreda, E. S. (2019) 'Konsep penataan permukiman kumuh tepian sungai di kelurahan sungai bilu kota Banjarmasin', Envirosienteae, 15(3), pp. 397-414.

Rochgiyanti. (2011) 'Fungsi sungai bagi masyarakat di tepian sungai kuin kota Banjarmasin', Jurnal Komunitas. 3(1),pp. 51-59.

Sari, R. P. (2008) Pergeseran pergerakan angkutan sungai di sungai martapura kota Banjarmasin. Thesis, Universitas Diponegoro.

Stellamaris, Y. (2017) 'Analisis bentuk mode transportasi di sungai di kota Banjarmasin', Jurnal Teknologi Berkelanjutan (Sustainable Technology Journal), 6(1), pp. 47-56..