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Carbon emission estimation model and correlation with green open space in Jember City Area

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Carbon emission estimation model and correlation with green open space in Jember City Area

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Abstract. The increase in population and motor vehicles fueled by oil (BBM) resulted in increased Greenhouse Gas Emissions (GHG), especially Carbon gas emissions. Besides the increase in gas is also derived from household waste. The amount of carbon emissions in an area depends on the number of vehicles operating such as main roads, residential roads, roads that are planted with green plants and terminals. One that can reduce carbon dioxide gas is greening, by planting plants that can absorb a lot of carbon emissions. Greening can be done by planting green plants or vegetation on highways and housing. The existence of Green Open Space (RTH) will result in the assimilation of carbon by vegetation which will reduce the concentration of CO2 in the atmosphere. The research objective is to measure the concentration of carbon emissions from motor vehicles, modeling the relationship between carbon emissions and the number of motor vehicles and knowing the need for green space in Jember Regency for CO2 absorption for 5 years. Research by field survey, primary and secondary data by calculating the type and number of vehicles that pass, as well as green space in the City of Jember. The results show carbon dioxide emissions in the Penjaitan Road for four days amounting to 3450.6 kg / year or 2875.5 kg / year / km. The required green open space on Panjaitan road is 0.006 Ha / year or 0.005 Ha / year / km. Cassia Plant 0.54 Trees / km, or Cananga plant 3.8 Trees / km.

1. Introduction

The development of the population in Jember Regency especially the city area actually the area around the campus increased dramatically. As population growth increases, both public and private transportation needs increase dramatically, especially the ownership of motorized vehicles that almost every home already has. Increasing the number of residents and motor vehicles that fueled oil (BBM) resulted in increased Greenhouse Gas Emissions (GHG), especially Carbon gas emissions. In addition, the increase in gas is also derived from household waste.

Increased carbon emissions above the health threshold will caused in respiratory disorders that can cause death. The amount of the carbon emission gas in an area largely depends on the number of vehicles operating such as main roads, residential roads. Tarigan A [1], mentions that the Estimation of motor vehicle emissions in several roads in the city of Medan, with several types of vehicles aided by Emission Factor coefficients obtained from the literature. Muziansyah et.al [2], has made a Model of Motor Vehicle Emission due to Transportation Activities in the Lower Ramayana Market Terminal Bandar Lampung City by taking into account the age of the vehicle, vehicle maintenance, vehicle engine capacity.

Nugrahayu et.al [6], has estimated carbon dioxide emissions from the housing sector in the city of Yogyakarta using the IPCC Guidelines. Purnama et.al [7], has conducted Carbon Monoxide (CO) Monitoring and Meteorological Parameters at Tawang Alun Terminal, Jember Regency. The research sample was determined at an altitude of 8 meters above ground level by observing the number of vehicles operating in Tawang Alun Jember Terminal, during morning time (07.00), afternoon (12.00) and evening (17.00).

One that can reduce carbon dioxide gas is reforestation, by planting plants that can absorb a lot of carbon emissions. reforestation can be done by planting the green plants on the highway or housing. Sukmawati [3], has conducted research on the uptake of carbon dioxide in urban forest plants in Surabaya using the carbohydrate method with samples from Bratang Flora Park, Waru Park, and Wonorejo Seed Garden. The parameters measured are carbon dioxide absorption rate and the amount of stomata.

Widodo et.al [4], has conducted an Estimation Analysis of the Absorption Capability of Carbon dioxide Emissions based on Green Biomass through Utilization of the Alos AVNIR-2 Image in Surakarta City using a vegetation index (NDVI). Marga et.al [5], has estimated carbon in the Meru Betiri National Park forest in East Java aided by Landsat Image TM +. In several previous research journals the estimation of the calculation of Carbon Emissions is based on the number of motor vehicle activities and the condition of the motorized vehicle, as well as the calculation of emission gas assisted by Emission Factors (FE) without regard to reforestation on the highway. In several previous research journals the estimation of carbon emission calculations is only based on the green index (NDVI) assisted with satellite imagery. Purwanto [8], has identified *Normalized Difference Vegatation Index* (NDVI) in Silat Hilir sub-district, Kapuas Hulu Regency by utilizing Landsat 8 Imagery.

The existence of plants in an area or region is needed, among others, as CO_2 absorber. One of them is the existence of Green Open Space (RTH) in urban spatial planning. Green space is a component of the landscape that affects urban air both directly and indirectly <9>. The Law Number 26 of 2007, concerning Spatial Planning, states that the proportion of green open space in an urban area is at least 30% of the urban area. The presence of green space will cause carbon assimilation by vegetation which will reduce the concentration of CO_2 in the atmosphere.

In this research the Carbon Estimation Model will be based on the number and type of vehicles and the condition of the vehicle and pay attention to aspects of greening on the highway. The omission aspect is obtained from NDVI values in Jember City. It also takes into account the correlation between the consumption of fiil fuel and the concentration of carbon emissions produced. Jember City does not yet have data on carbon emissions and the need for green space to reduce concentration CO_2. From the background description, research is needed on the carbon emission estimation model and the correlation with green open space in Jember City.

1.1 Purpose And Benefits Of Research

1. Knowing the average consumption of fuel oil (BBM) in Jember City
2. Measuring the concentration of carbon emissions from motor vehicles
3. Modeling the relationship between carbon emissions and the number of motor vehicles
4. Knowing the needed of green space in Jember City for CO_2 absorption for 5 years

2. Method

Types of research

Types of Research Experiments with field surveys, by calculating the type and the number of vehicles that pass on Panjaitan Road along 1.2 km. Vehicle types are categorized based on: the type of fuel used, the efficiency of the vehicle using fuel (km

/ liter) and the Vehicle Emission Factor (FE) in accordance with the standards of the Indonesian Ministry of Transportation.

Location and Time

The study was conducted on Jalan Panjaitan along 1.2 km, in front of Jember 1 Public High School (Between the Gladak Kembar red light to the RRI Jenber red light) which is one of the traffic jams in Jember City. The time of data collection is four days on 26 August 2019, 2 September 2019, 4 September 2019 and 7 September 2019. Technical Data collection in the morning at 6:00 to 8:00, noon at 11:00 to 13:00, and the afternoon at 15:00 to 17:00.

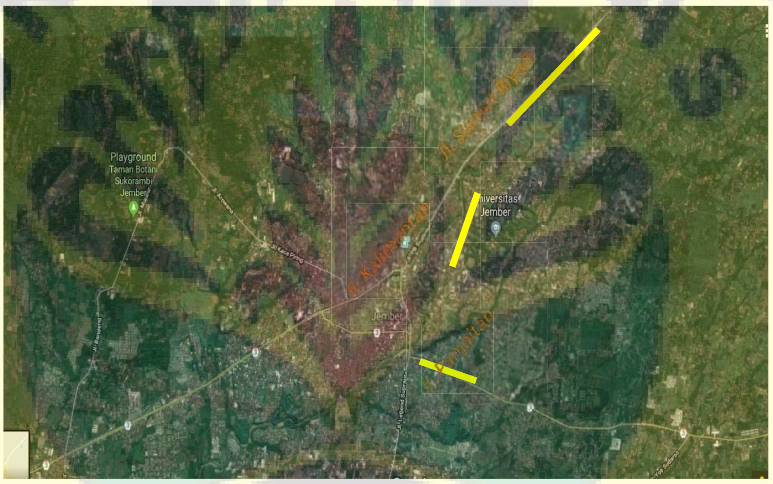

Figure 2. Research Object Location Map

Green Open Space Needs (RTH)

The Law Number 26 of 2007, concerning Spatial Planning, states that the proportion of green open space in an urban area is at least 30% of the urban area. Based on the Minister of Public Works Regulation Number 05 / PRT / M / 2008 Guidelines for Provision and Utilization of Green Open Space in Urban Areas. Green open space in urban areas consists of public green open space and private open green space. The proportion of green open space in urban areas is at least 30% which consists of

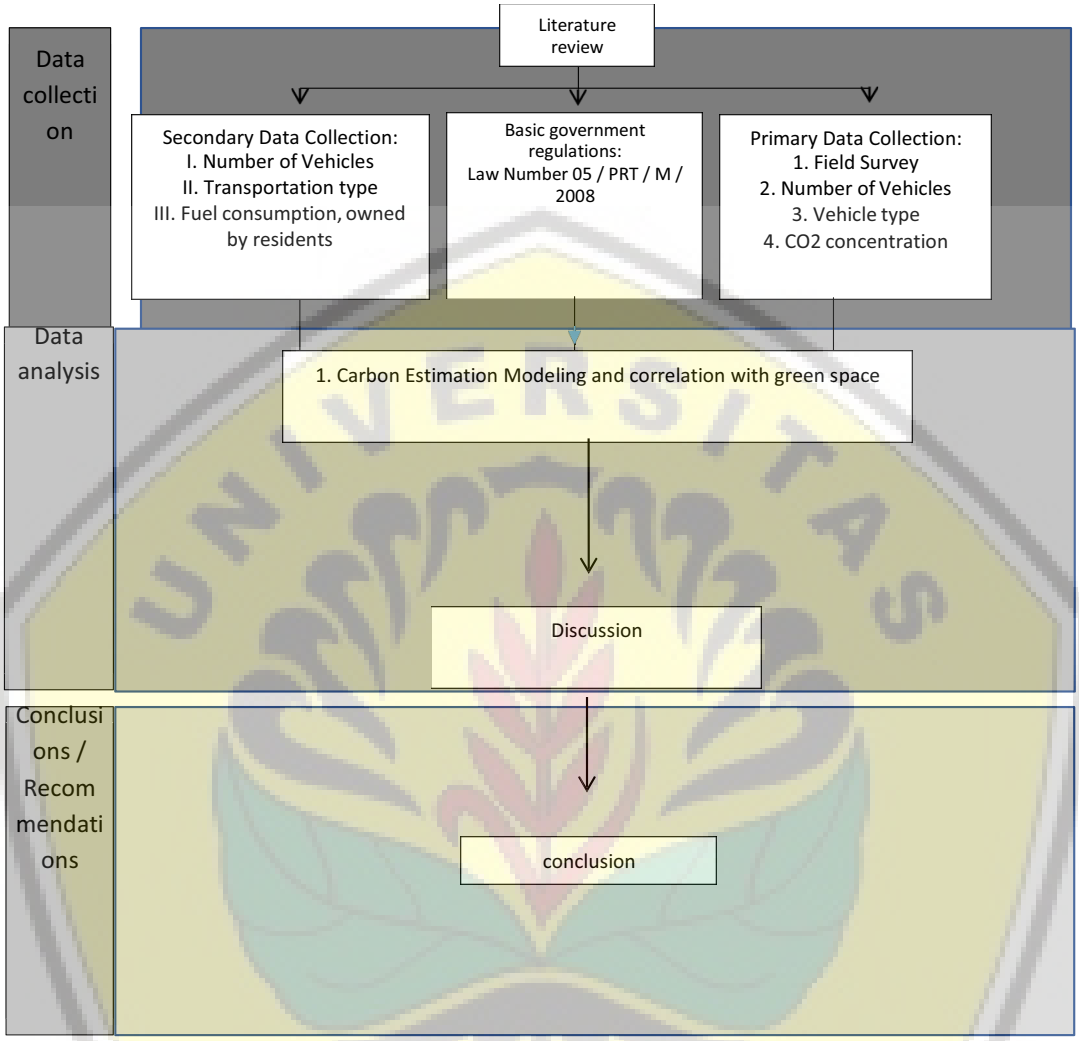

Figure 1. Research Methodology

The Calculation of Carbon Dioxide Emissions

Emission Gas Calculation using the equation (Zhongan et.al):

$$\sum \quad \text{.....(1)}$$

Information :

L = The length of the path under study
Ni = Number of type i motorized vehicles that cross the road (vehicles / hour)
Fpi = Emission factors for type i vehicles (g/km)
i = Motorized vehicle type

Ep = Emission intensity of a segment (g / hour / km)

P = The type of pollutant that is estimated

Calculation of Area and Number of Green Open Space Trees (RTH)

$N_{tree} =$ Ep / C.....(2)

N_{tree} = Number of Trees (kg / tree. Years)

E_p = Gas Emission Intensity (g / hour.km)

C = Absorption of plants absorb carbon dioxide (kg / tree. Year)

Algorithm Calculation of Green Open Space Based on the Amount of Carbon Dioxide Emissions

Step 1: Determine the minimum observation point path greater than 200 m (0.2 km) Step 2: The number of vehicles that pass through the track every hour.

The vehicle based on :

a. Based on the Emission Factors of Gas Emissions produced.

b. Based on the fuel consumption required mileage per liter.

c. The conversion of the number of vehicles passing per hour

d. Perform the calculation of the Intensity of Gas Emission (g/h , km).

Step 3:

a. Selection of plants to be planted based on ability the absorption capacity of gas emissions (tons / ha. year) and (kg / tree.Year).
b. Calculation of the number of trees planted based on absorption these plants against gas emissions.

Step 4: Make a simulation and predict the need for green space based on gas emissions generated in the long run.

3. Results and Discussion

Table 1 Total Carbon Dioxide Emissions In the Morning, Afternoon and Evening In Jalan Panjaitan District Sumbersari Jember

	TOTAL CARBON DIOXIDE EMISSIONS (GRAMS CO2/KM)				
TIME	26/08/2019 (MONDAY)	02/09/2019 (MONDAY)	04/09/2019 (WEDNESDAY)	07/09/2019 (SATURDAY)	TOTAL
06.00 - 08.00	709,576	749,222	435,349	594,919	2849,1
11.00 - 13.00	649,742	637,037	565,924	649,545	2502,2
15.00 - 17.00	789,198	800,576	632,802	664,249	2886,8
TOTAL				**7878,1**	

Source :Personal Data

Total carbon Dioxide Emissions for the past four (6 hours/day) of 7878,1 gr CO2/km/day, then the total carbon Dioxide emissions for one year of 3450,6 kg CO2/Year or 2875,5 kg CO2/Year.km. Based on the Data In Table 2 and figure 2, the gas carbon dioxide emissions on the Road Panjaitan Jember (in front of SMA 1 Jember) along the path of 1.2 km. On Monday gas emissions of carbon Dioxide has the highest value 729,4 gr CO2/km in the morning (6.00 – 8.00), 643,6 g CO2/km during the day (11.00 – 13.00) and 794,9 gr CO2/km in the afternoon (15.00 – 17.00). On Monday (afternoon) is the emission of carbon Dioxide gas high. The emission of carbon Dioxide gas on Wednesday and Saturday decreased.

The cause of the emission of carbon Dioxide Gas in Jalan Panjaitan (SMA 1 Jember), on Monday, the number of vehicles passing a solid result in addition to school children and employees/workers of public and private employees, employees of origin from outside Jember working in Jember has to return to normal activities. On Wednesday gas emissions of carbon Dioxide decreased, the employees using alternative path at a time when school activities start over.On Saturday, the emission of carbon Dioxide gas began to experience an increase in returns, workers or students outside of Jember back to homecoming to the region

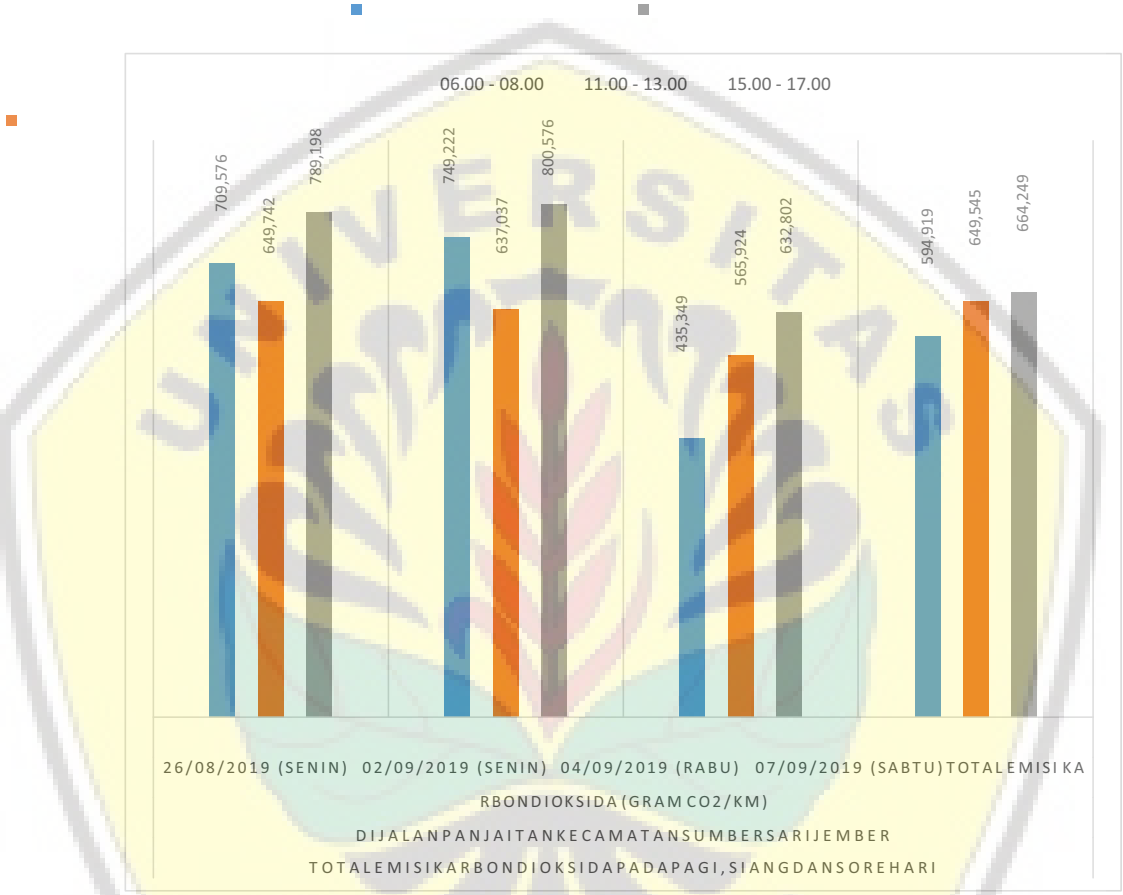

Figure 2 the Chart of carbon Dioxide Emissions Daily (Morning, Afternoon and evening) Measurement For Four Days (6 Hours/day) In Jalan Panjaitan District Sumbersari Jember

of origin, so that the number of vehicles passing on the Road Panjaitan (Depan SMA 1 Jember) back solid.

Table 2. Absorption Of Carbon Dioxide Gas Some Type Of Protective Plants <5>

No	Nama Tanaman	Daya Serap CO_2
1	Plant Protector	569,07 tons/ha.year
2	Bush	55,00 tons/ha.year
3	Meadow	12,00 tons/ha.year
4	Rice field	12,00 tons/ha.year
5	Cassia	5295,4 kg/ha.year
6	Kenanga	756,59 kg/ha.year
7.	soursop	75,29 kg/ha.year
8.	Sawo Kecik	36,19 kg/ha.year

Based on the total emis carbon Dioxide Gas throughout the lintasa of 1.2 km in the vicinity of SMA 1 Jember, and Table 2 the absorption of the Plant Protector to absorb carbon Dioxide by 569,07 Tons/Ha. Year, then required of 0.006 Ha/Year or 0.005 Ha/Year. Km, The Plant Is Protective. If planted Cassia with absorption of CO2 5295,47 kg/tree/Year is required to 0.54 Trees/Km. If planted Boxwood with absorption of CO2 by 756,59 kg/tree/Year is required of 3.8 Trees/Km.

4. Conclusion

1. Motor vehicle emissions in Jalan Panjaitan district Sumbersari Jember by 3450,6 Kg/Year or 2875,5 Kg/Year/Km.
2. In Jalan Panjaitan based on the emission of gas karbondiokasida required of 0.006 Ha/Year. Km plant protector, or 0.54 Tree Kenamga/Km, or 3.8 Tree Cassia/Km to neutralize carbon dioxide emissions caused by motor vehicles passing on the road.

Acknowledgments

Need to taken into account the gas emissions of carbon dioxide at the level of human Settlements and related Needs of Green Open Space (RTH) at a rate of RT or RW.

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