The Influence Of Vehicles On Increasing The Amount Of Emissions

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ABSTRACT
This research aims to analyze the influence of the number of motorized vehicles, including Passenger Cars, Buses, Freight Vehicles, and Motorcycles, on emission levels in the period of 2017-2021 in Indonesia. The analysis results indicate that various types of motorized vehicles have a significant impact on emission levels. Passenger Cars do not have a significant effect on emissions, while Freight Vehicles and Motorcycles positively and significantly influence emission levels. These findings underscore the importance of considering various types of motorized vehicles in efforts to reduce their negative impact on the environment and human well-being. The implications of this study provide a strong foundation for developing more effective policies and strategies in managing the mobility and emissions of motorized vehicles in Indonesia

Keywords: *Passenger Cars, Buses, Freight Vehicles, Motorcycles, Emissions.*

1. INTRODUCTION

Mobility or movement is an activity that is carried out by humans almost every day. To facilitate daily mobility, which involves moving from one place to another, humans require transportation. Transportation is one of the basic needs of humans, along with clothing, food, and shelter. The increase in population is directly proportional to the use of transportation, especially land transportation. Land transportation is a vital component of the national transportation system and plays a crucial role in the economic growth of a region, supported by Rahayu et al [1].

Vehicle Types	2017	2018	2019	2020	2021
Passenger Cars	13 968 202	14 830 698	15 592 419	15 797 746	16 413 348
Buses	213 359	222 872	231 569	233 261	237 566
Freight Vehicles	4 540 902	4 797 254	5 021 888	5 083 405	5 299 361
Motorcycles	100 200 245	106 657 952	112 771 136	115 023 039	120 042 298
Total	118 922 708	126 598 776	113 617 012	136 137 451	141 992 573

Table 1. Development of the Number of Motorized Vehicles Detailed by Vehicle Type for the Year 2017-2021 (units)

One of the important means of land transportation that plays a crucial role in people's mobility is motorized vehicles. According to the publication by the Central Statistics Agency (BPS), motorized vehicles are categorized into four (4) types, namely Passenger Cars, Buses, Freight Vehicles, and Motorcycles.

As the population increases, it will be followed by a rise in demand for motorized vehicles. The increasing number of motorized vehicles reflects the high mobility of the population, which aligns with the growing need for adequate transportation. This has an impact on the increasing volume of vehicles on the road, potentially leading to emissions. The number of vehicles will continue to rise, but road capacity remains constant, and under congested conditions, traffic density can lead to higher levels of air pollution. This issue is particularly prevalent on road segments, especially during peak hours, supported by Putri et al [2].

The presence of vehicle congestion during rush hours leads to traffic jams, which is one of the causes of air pollution incidents, supported by Sasmita et al [3]. The amount of exhaust gasses produced by motorized vehicles depends on the vehicle's speed, type, traffic volume, road quality and pavement, as well as intersections, supported by Meneguzzer et al [4]; Olin et al[5].

Emissions are defined as the result of human activities that lead to an increase in the concentration of greenhouse gases (GHGs) such as Carbon Dioxide, Chlorofluorocarbons, and Nitrous Oxide, supported by Soedomo et al [6]. Motor vehicle emissions constitute the primary source of pollution in major cities in Indonesia, contributing to 60-70% of pollution, supported by Nurdjanah et al [7]. In line with this statement, a study, supported by Saepuddin et al [8] revealed that the largest contributor to air pollution is the transportation sector, accounting for 60%, followed by the industrial

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sector at 25%, households at 10%, and waste at 5%. Motor vehicle emissions result from the consumption of fossil fuels, leading to pollutants in the atmosphere.

Table 2. Research Variables

Variable	Definition	Measurement
Passenger Car	Motorized vehicles for the transportation of people that have seats for a maximum of 8 (eight) people, including for the driver or whose weight is not more than 3,500 (three thousand five hundred) kilograms.	Number of passenger car vehicles (Million Units)
Buses	a motor vehicle for the transportation of persons having seats for more than 8 (eight) persons, including the driver or weighing more than 3,500 (three thousand five hundred) kilograms.	Number of Bus vehicles (Million Units)
Freight Cars	motorized vehicles used for freight transportation, such as trucks and pick-ups	Number of freight vehicles (Million Units)
Motorcycle	a two-wheeled motor vehicle with or without housings, with or without side carriages or a three-wheeled motor vehicle without housings.	Number of motorcycles (Million Units)
Emissions	energy, and/or other components produced from an activity that enters and/or is introduced into the ambient air that has and/or does not have the potential as a pollutant element.	CO2 Emission Volume per capita (Metric Ton)

The consumption of fossil fuels in motor vehicles, especially gasoline (pertalite), produces various compounds such as CO (carbon monoxide), THC (total hydrocarbons), TSP (particulate matter), NOx (nitrogen oxides), SOx (sulfur oxides), and Carbon Dioxide (CO2), supported by Nurdjanah et al [7]. If left uncontrolled, motor vehicle emissions lead to an increase in greenhouse gasses (GHGs). Uncontrolled greenhouse gasses contribute to global warming, which can cause an increase in temperature and climate change, supported by Adiastari et al [9].

The objective of this research is to identify the influence of the number of motor vehicles on the per capita emission levels generated by the population of Indonesia over the past ten (10) years.

2. METHODOLOGY

This research employs a quantitative method with an explanatory approach to elucidate the impact of the increasing number of motor vehicles on the emission levels from the year 2017 to 2021.

The data analysis technique utilized is Multiple Linear Regression Analysis. In this study, the independent variables comprise the quantities of passenger cars, buses, freight vehicles, and motorcycles. Meanwhile, the dependent variable is the total emissions. The operational definitions of the variables are outlined in Table 2.

The following provisional equation is proposed:

$$\text{Emissions } i_{it} = \beta_0 + \beta_1 \text{ Motorcycle}_{it} + \beta_2 \text{ Passenger\_Car}_{it} + \beta_3 \text{ Freight\_Cars}_{it} + \beta_4 \text{ Buses}_{it} + \varepsilon_{it} \quad (1)$$

Description:

Emissions_{it} = Emission Rate in the country i in the period t

$\beta_1 \text{ Motorcycle}_{it}$ = Number of motorcycle vehicle units in country i in period t

Passenger_Car it = Number of freight transportation vehicle units in country i in period t

Buses it = Number of bus vehicle units in country i in period t

β_0 = Constant

$\beta_1, \beta_2, \beta_3, \beta_4$ = Regression Coefficient

ε_{it} = Error term in country I in period t

Hypothesis testing is conducted using the R-test, t-test (partial), and F-test (Simultaneous). The R-test (coefficient of determination) is used to measure how significant the ability of independent variables is in explaining the dependent variable. If the coefficient of determination (R-squared) approaches 1, it can be said that the dependent variable is well explained by the independent variables, and vice versa. The t-test is used to determine the individual influence of each independent variable on the dependent variable. The criteria set are as follows: if the probability of the t-test is greater than α (0.05), then there is no significant influence of the independent variable on the dependent variable, and vice versa. The F-test (Simultaneous) is used to test the influence of all independent variables on the dependent variable or the significance test of the model. The F-test can be explained using analysis of variance (ANOVA). The criteria used are: if the significance level (α) of the F-test is less than 0.05, it is concluded that all independent variables collectively have a significant effect on the dependent variable.

3. RESULT AND DISCUSSION

3.1 ***Table 3.*** *R test*

In the regression test results in Table 1, it displays an R value or correlation coefficient of 0.998. This can be interpreted as a strong relationship between the variables, as seen from the R Square value or coefficient of determination (KD), which indicates how well the regression model is formed by the interaction of independent and dependent variables. The coefficient value is obtained as 99.8%, meaning that the variables of Passenger Cars, Buses, Cargo Vehicles, and Motorcycles collectively contribute 99.8% to the Emissions. The remaining 2% is influenced by other factors outside of these variables.

3.2 ***Table 4****. Partial T Test*

Variabel	t	Sig
Passenger Cars	.036	.975
Freight Vehicles	16.579	.004
Motorcycles	-11.958	.007
Buses	1.086	.474

There is no influence between Passenger Cars on Emissions, seen from the Significant value of 0.05 (<0.05) greater than 0.975. There is an influence between Freight Cars on Emissions, seen from the Significant value of 0.05 (<0.05) smaller than 0.004. There is an influence between Motorcycles on Emissions, seen from the Significant value of 0.05 (<0.05) more work than 0.007.

3.3 ***Table 5.*** *Simultaneous F Test*

From the results of the simultaneous test, there is a Sig. value of 0.003 (<0.05), which means that there is a simultaneous influence between the variables of Motorcycles, Passenger Cars, Goods Cars on Emissions.

4. CONCLUSION

The analysis shows that there is a strong influence between the type of motor vehicle (i.e. Bus, Passenger Car, Goods Car, Motorcycle) and the level of emissions. The high coefficient of determination, reaching 99.8%, indicates that most of the variation in emissions can be explained by the combination of these variables. Individually, it was revealed that Passenger Cars had no significant effect on emissions, while Goods Cars and Motorcycles significantly affected emission levels. The F-test results suggest that together, motor vehicle types have a significant impact on emission levels. Thus, this analysis confirms that different types of motor vehicles play an important role in determining emission levels, and it is important to consider them together in an effort to reduce negative impacts on the environment and human well-being.

REFERENCES

[1] D. K. Rahayu and S. Martini, “Peran Moda Transportasi Darat Dalam Mobilitas Tenaga Kerja,” *J. Transp.*, vol.

22, no. 2, pp. 109–116, 2022.

[2] N. H. Putri and M. Z. Irawan, "Mikrosimulasi mixed traffic pada simpang bersinyal dengan perangkat lunak vissim (Studi Kasus: Simpang Tugu, Yogyakarta)," in *Prosiding The 18th FSTPT International Symposium, Unila, Bandar Lampung*, 2015.

[3] A. Sasmita, M. Reza, S. Elystia, and S. Adriana, "Analisis Pengaruh Kecepatan Dan Volume Kendaraan Terhadap Emisi Dan Konsentrasi Karbon Monoksida Di Jalan Jenderal Sudirman, Kota Pekanbaru," *J. Tek. Sipil*, vol. 16, no. 4, pp. 269–279, 2022.

[4] C. Meneguzzer, M. Gastaldi, R. Rossi, G. Gecchele, and M. V. Prati, "Comparison of exhaust emissions at intersections under traffic signal versus roundabout control using an instrumented vehicle," *Transp. Res. procedia*, vol. 25, pp. 1597–1609, 2017.

[5] M. Olin *et al.*, "Engine preheating under real-world subfreezing conditions provides less than expected benefits to vehicle fuel economy and emission reduction for light-duty vehicles," *Appl. Energy*, vol. 351, p. 121805, 2023.

[6] M. Soedomo, "Pencemaran udara," *Bandung ITB*, 2001.

[7] N. Nurdjanah, "Emisi CO2 akibat kendaraan bermotor di Kota Denpasar," *J. Penelit. Transp. Darat*, vol. 16, no. 4, pp. 189–202, 2014.

[8] A. Saepudin and T. Admono, "Kajian pencemaran udara akibat emisi kendaraan bermotor di DKI Jakarta," *J. Teknol. Indones.*, vol. 28, no. 2, p. 2005, 2005.

[9] R. Adiastari, R. Boedisantoso, and S. A. Wilujeng, "Kajian mengenai kemampuan ruang terbuka hijau (rth) dalam menyerap emisi karbon di kota surabaya," *Institut Teknologi Sepuluh Nopember Surabaya*, 2010.