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Model of Motor Vehicle Gas Distribution Based on Ecology-Health, Economic, Social-Cultural and Law Factors In the City of Pekanbaru

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Abstract

Background and Purpose: Air pollution will make the city environment unhealthy and can interfere with human health, therefore one must strive to not increase air pollution. One way to reduce air pollution in cities is to reduce carbon emissions and build Green Open Spaces (GOS). Therefore, the purpose of this study is to create a model for distribution of motor vehicle exhaust emissions in the city of Pekanbaru.

Materials and Methods: Air pollution at a certain level can be a combination of one or more pollutants, either in the form of solids, liquids or incoming gases dispersed into the air and then spread to the surrounding environment. Further analysis of environmental factors in the form of socio-cultural, economic and ecological factors are explored in this study. Other important environmental parameters in pollutant studies are ecological factors as well. While the economic factors in question is the willingness to pay, it shows the minimum cost needed to anticipate the amount of exhaust emissions caused by motorized vehicles and calculate the economic value associated with public health.

Results: The emission of gas produced by each vehicle is below the predetermined standard quality threshold, namely LH Regulation No. 12 of 2010. Although the measurement results in Table 1 do not exceed ambient air quality standards, but the increase in a trend that can cause air quality deterioration was detected. The components in these two strategies need to get more emphasis and attention so that the existence of charcoal trading business can be sustainable.

Conclusion: The results obtained from this study are a model of exhaust gas distribution in the form of gas emission distribution contours supported by ecological data (E), economics (E) and socio-cultural (S), especially in creating recommendation models in policy making both in the form of laws, government regulations or regional regulations, which is the simplest prerequisite for motor vehicle owners when the vehicle registration is extended. This model is better known as the E_2S + H model.

Keywords: Model; Gas Emission; Anomaly

Background

Transportation is generally defined as the transfer of goods or people from one place to another. Transportation is the movement from one place to another by a variety of different means, whether it be transportation powered by and driven by humans, animals (horses, cows, buffaloes), or machinery. Transportation is a major source of air pollution in urban centers. Transportation activities contribute approximately 45%, 50% and 90% of NOx, total HC and CO emissions. Although the development of the latest technology can significantly reduce the amount of emissions, the rate of increase in the number of motor vehicles is quite high and the distance of travel makes it seem useless.

Air pollution at a certain level can be a combination of one or more pollutants, either in the form of solids, liquids or incoming gases dispersed into the air and then spread to the surrounding environment. The speed of this spread will depend on local geography and meteorological conditions [1].

In Indonesia today approximately 70% of air pollution is caused by the emission of motorized vehicles which emit harmful

substances that can cause negative impacts, both on human health and on the environment, such as lead (Pb). In Indonesia, the number of motorcycles is more than half (73.5%) the total vehicle population [2]. Motor vehicles contribute almost 100% lead emissions [3]. The impact caused by air pollution turned out to be very detrimental to humans as omnivorous creatures that are very dependent on food pathways but also in the pollution cycle. Various types of diseases that can be passed on to humans by the above air pollutants such as; upper respiratory tract infections, damaged lungs, hypertension, heart disease, cancer and so on [3].

Control of emissions carried out to reduce harmful exhaust gases in motorized vehicles has been widely carried out, especially in developed countries. There are several types of methods and techniques, including by selecting fuel, selecting certain processes and maintaining machinery. As for reducing motor vehicle exhaust gas, the method usually used is engine modification, modification of exhaust gas lines, modification of fuel use or fuel system [4]. Whereas in this study, it will utilize the results of the gas emission model based on the results of the monitoring of three stations which will be connected with the obligation of the owner of a motorized vehicle to meet the quality standards that have been determined at the time of renewal of the motor vehicle's license plate number.

Materials and Methods

Generally the traffic consists of a mixture of fast vehicles, slow vehicles, heavy vehicles, light vehicles and non-motorized vehicles. In relation to the road capacity, the effects of each type of vehicle on the overall traffic flow are calculated by comparing the influence of passenger cars. This is used as a unit and is called the 'passenger car unit' (PCU).

Figure 1: Location of the Arengka Morning Market Intersection (Source: Photo Drone December 2017)

A model is a form made to mimic a symptom or process. In general, models can be grouped into three models, namely [5]:

a) Quantitative models are models in the form of mathematical formulas, statistics, or computers.
b) A qualitative model is a model in the form of a diagram or matrix that states the relationship between elements. In the qualitative model there are no mathematical, statistical or computer formulas.
c) The iconic model is a model that has the same physical form as the item imitated, even though the scale can be enlarged or reduced. Through the iconic model, experiments can be conducted to determine the behavior or process that is imitated [6].

According to Suratmo (2002), the system is a description of the structure or form of the relationship between two or more components that are functionally integrated. According to Fauzi and Ana (2005), Abdulla (2006), the model is a representation of a reality from a modeler [7,8]. The model is a bridge between the real world and the world thinking to solve a problem. This translation process is called modeling which is nothing but a process of thinking through logical sequences.

Further analysis in this study is to analyze environmental factors in the form of socio-cultural, economic and ecological factors. Other important environmental parameters in the study of waste/pollutants are ecological factors; ecology is a reciprocal relationship between living organisms and the surrounding environment. Exhaust emissions produced ecologically can have an impact on environmental sustainability, so in this study, it will discuss the effects of exhaust gas emissions from the results of field measurements on the tolerance values of existing ambient air quality standards. This research was carried out in the location of the morning arengka market intersection in Pekanbaru as in Figure 1.

While the economic factors in question are the willingness to pay and how much is needed to anticipate the amount of exhaust emissions caused by motorized vehicles and calculate the economic value related to pulmonary infections as follows:

Calculations of economic value due to pulmonary infections are:

$$E = J_k \, x \, B_p \qquad [1]$$

Where:

E = Economic value due to pulmonary infections (rupiah)

J_k = Number of cases (people)

B_p = One-time treatment fee (rupiah) [5]

In addition, socio-cultural data analysis that can be done is using descriptive verification analysis, so that the results obtained from the questionnaire distributed will show the community's perception of the socio-cultural values that arise in the air around the research area. In addition, it will provide an in-depth analysis of the state of the people directly affected by polluted air.

Public perception of charcoal (PanglongArang) is done by using a questionnaire based on a housing quality indicator (HQI) and the Likert Scale [9].

Interval	Categories
1.0 - < 1.75	Really bad (RB)
≥ 1.75 - < 2.5	Bad (B)
≥ 2.5 - < 3.25	Good (G)
≥ 3.25 – 4.0	Really good (RG)

Table 1: Public perception categories based on the housing quality indicator (HQI) [10]

Results

A. Measurement of Ambient Air Quality and Impact on Health Ecology in Pekanbaru City

Model development in this sub-chapter uses field data based on existing measurement stations. Besides that, the data presentation that will be used uses micro units of gram per square meter (μg/Nm³) as shown in Table 2. The data obtained are data that can be used as real field models that occur at the time of the research. Based on the data obtained shows different values at each station measuring gas emissions. The tool used in this monitoring is the Air Quality Monitoring System (AQMS). The ambient air quality of Pekanbaru City is monitored in a 1 hour observation period with monitoring parameters such as SO_2, CO and NO_2.

No	Parameter	Station	Measurement length	Location	
Location				ST-1 (PEF3) : Tampan	ST-2 (PEF2) : Sukajadi
				00 28'55,6" dan 101 25' 8,6"	00 32' 33,5" dan 101 26' 2,2"
1.	SO_2	μg/Nm³	1 Jam	44,8	3,47
2.	CO	μg/Nm³	1 Jam	762	778,73
3.	NO_2	μg/Nm³	1 Jam	24,1	5,57

Ket : ST = Stasiun; ST-1 = Soekarno Hatta Street, in front of the Eka Hospital, sampling date July 4 2018;

ST-2 = Residential settlement at PT. Riau Crumb Rubber Factory (PT. RICRY), sampling date July 4 2018;

ST-3 = Staff Housing PT. Surya Inti Sari Raya, sampling date July 4, 2018

Table 2: Ambient Air Quality According to Field Measurement Location in 2018 which was during rush hour (07.00 WIB).

Based on Table 2, the ambient air quality produced for each parameter is not solely caused by an increase in the number of motorized vehicles; an increase in the number of motorized vehicles in relation to ambient air distribution is contributed by several other sources besides motorized vehicles. The existence of motorized vehicles in this study each day produces a relatively small value of gas emissions in the city of Pekanbaru in air pollution based on ambient air quality standards. This is due to the emission produced in each vehicle is below the predetermined quality standard [11]. According to Guoxiang (2012), to reduce greenhouse gas emissions and pollutant gases is closely related to fuel consumption so that vehicle efficiency is reflected in the amount of gas emitted.

B. Community Perception of Motor Vehicle Gas Emissions

Table 3 shows community perceptions of the contribution of motor vehicle exhaust emissions in contributing to environmental damage. The value of public perception obtained from 100 respondents showed a good decision with a score of 2.65.

No	Interval	Categories	Result	Decision
1	1,0 - < 1,75	Really Bad (RB)	2,65	*Good*
2	>= 1,75 - < 2,5	Bad (B)		
3	>=2,5 - < 3,25	Good (G)		
4	>=3,25 – 4,0	Really Bad (RB)		

Table 3: Decision making on people's perceptions of the state of exhaust emissions

C. Economic Values due to Gas Emissions

The cost of vehicle emission losses is the value of vehicle emissions load which calculates the analysis of emissions load obtained from the increase in vehicle volume that causes congestion, so this study wants to see the negative impact of economic losses by estimating the first cost of emissions from each pollutant produced from the vehicle using cost assumptions based on pollutant costs used in the Victoria Transport Policy Institute (2011) research, Victoria Transport Policy Institute [12].

(VTPI) is an independent research organization dedicated to developing innovative and practical solutions to transportation problems regarding innovative and practical solutions regarding problems with the level of air pollution of motor vehicles.

N0	Type of vehicle	Type of pollutant	Emission factor (g/kg BBM)	Fuel	Emission load (ton/year)	Value of loss (Rp/Ton)
1.	Passenger Car	CO_2	3172	Solar	0,0225	64.575,-
2.	Passenger car	CO_2	3180	Gas	0,3457	992.159,-
3.	Motorcycle	CO_2	3180	Gas	0,0728	208.936,-

Table 4: Economic Analysis of Value of Losses Due to Gas Emissions

According to Patterson (2010), the concentration of greenhouse gases throughout earth's history has fluctuated naturally, with plate tectonics being the primary, first order control [13]. However, since the Industrial Revolution rapid rises in combustion-related GHG's, principally CO_2, have resulted from related increases in the extraction and burning of the fossil fuels oil, natural gas, and coal. Concern has existed over rising GHG levels and potential climate change since the early 1970's [14]. It is now the consensus of the majority of the scientific community that increases in atmospheric GHG are responsible for measured increases in global average air and sea surface temperature.

Discussion

A. Quality Analysis of Environmental Air Quality and Impact on Health Ecology in Pekanbaru City

The factor of accumulation of vehicles during peak hours followed by road narrowing which can lead to a long burning while there is no movement is a factor that needs to be considered in this study. Vehicles that are on the road every day will take less time if there is no congestion so it will be very effective in overcoming the contri-bution of gas emissions that can cause a decrease in air quality ambiance. Air pollutant emissions from mobile sources have been regulated for almost half a century. During this time, the focus has largely been on tightening emissions standards for on road vehicles and engines, particularly passenger cars and small trucks (light-duty vehicles) [15]. Gases such as carbon dioxide, sulphur dioxide and hydrogen sulphide can be remove from ex-haust gases by different methods [16]. To make it easier to analyze the distribution of gas emission in the city of Pekanbaru can be seen in Figures 2, 3 and 4. In addition, it is necessary to see that the main source of atmos-pheric sulfur dioxide is anthropogenic activity associated with burning fossil fuels and industrial processes that may have associations with various morbidity and mortality. As such, several regional and global regulatory agencies have recommended ambient air limits to reduce environmental exposure [17]. Although the increase in gas emissions in the city of Pekanbaru has not been so dangerous that there needs to be a concern for environ-mental safety, the form of business that must be done is to strengthen policies in an effort to save the environ-ment and natural resources as that which has been done by the Moroccan state, over the past decade, the Moroccan government has invested in strengthening its policies to protect environmental and natural resources [18].

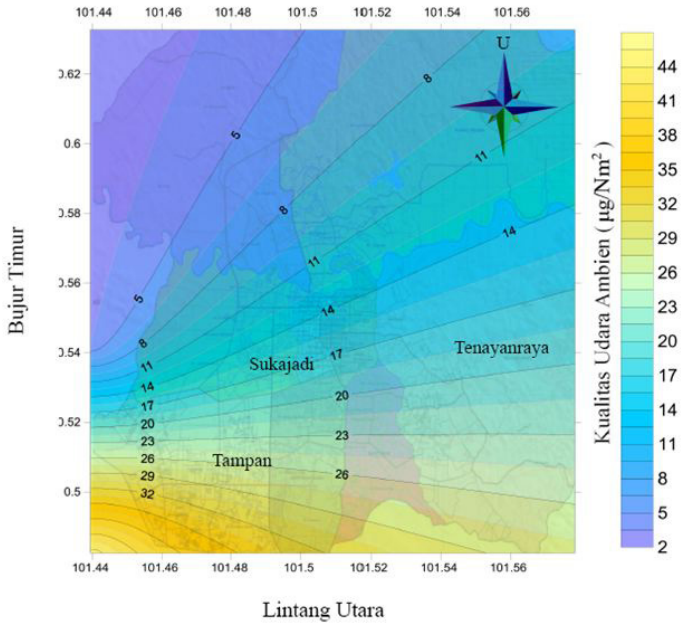

Figure 2: SO_2 emission distribution model in Pekanbaru City

Figure 2 is a SO_2 emission spark plug distribution model at stations 1, 2 and 3. The biggest value is at station 1, which is 44.8 μg/Nm³, where this station is located at JalanSoekarnoHatta in front of Eka Hospital. This value indicates that there is a significant contribution to the location between the morning at the Arengka market intersection and the SKA intersection that often occurs with the accumulation of motorized vehicles so that it causes an increase in SO_2 gas emission values at that location. At station-2 has SO_2 gas emissions of 3.47 μg/Nm³ while station-3 is 5.32 μg/Nm³.

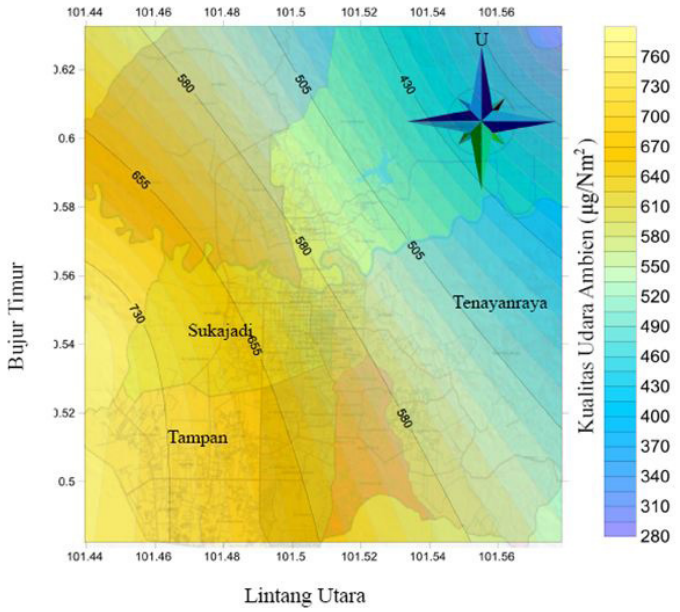

Figure 3: Model of CO emission distribution in Pekanbaru City

Figure 3 shows the distribution of CO emissions in Pekanbaru City with an emission value of 778.73 μg/Nm³ at station-2, while at station-1 is 762 μg/Nm³. This value is not so different that it can be said that there is an increase in the value of CO gas emissions at station-1 caused by motor vehicle gas emissions at the study location (between Simpa SKA and Simpang Arengka Morning Market). While at the 3rd station there is only 290.39 μg/Nm³. The accuracy of calculating emissions from mobile combustion sources is also determined by the factors used to convert fuel use into emissions. Uncertainty in the factors is primarily due to the variability in which they are measured, and the variability of the supply source. However, uncertainty may arise if only dollar value of fuels purchased is used to estimate fuel consumption. If fuel economy factors are used to estimate fuel use, uncertainty may arise if distance traveled and/or fuel economy is roughly estimated.) [19]. According to studies carried out by use of fossil fuel is major source of emission of greenhouse gases [20].

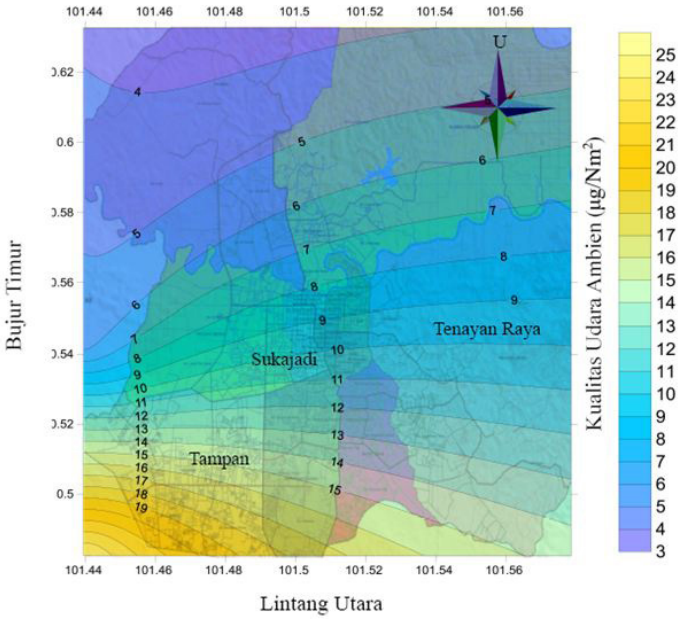

Figure 4: Distribution model of NO_2 emissions in the city of Pekanbaru

Figure 4 provides information on NO_2 emission distribution at each station, the maximum value is at station-1 (JalanSoekarnoHatta in front of Eka Hospital) which is 21.4 μg/Nm³ while at station-2 is 5.57 μg/Nm³ and station-4 4, 04 μg/Nm³. An increase in the

emission value of NO_2 emissions illustrates that at the location of the study there has been a buildup of motorized vehicles and there has been continuous burning but there has been no movement (movement) of the vehicle.

In another aspect it can be seen that there has been a waste of fuel in the city of Pekanbaru due to the accumulation of motorized vehicles due to congestion. There needs to be a solution that can overcome this problem such as the construction of a new road (Fly Over) which is being carried out by the Pelanbaru City government [21].

Based on Figures 2, 3 and 4 where gas emissions generated by motorized vehicles are below the predetermined standard quality threshold that is LH Regulation No. 12 of 2010. Although the measurement results in Table 1 do not exceed ambient air quality standards but the increase in trend can cause declining air quality has begun to be detected. Furthermore, this study wants to state that the value of gas emissions obtained can be used as one of the policy parameters in road clearance based on the results of monitoring from the existing station. Differences in the results obtained at each station indicate the existence of gas emission anomalies caused by a process, such as the burning process and waste in fuel use. The resulting anomaly does not depend on the quality standard alone, but more on the difference in the monitoring points at each station.

When viewed ecologically-health that, the respiratory organs are the most expected part to become affected by air pollutants. A number of specific compounds derived from motor vehicle exhaust gases such as sulfur and nitrogen oxides, particulates and oxidant compounds can cause irritation and inflammation of the respiratory tract. Although the levels of sulfur oxides in the exhaust gas of motor vehicles with gasoline are relatively small, they still play a role because of the number of motorized vehicles with diesel fuel is increasing. In addition, according to epidemiological studies, sulfur oxides together with particulates are synergistic so as to further increase the danger to health, this needs to be a serious issue for policy makers.

A. Analysis of Public Perception of Motor Vehicle Gas Emissions

Table 2 is the value obtained from the questionnaire given with 20 statements, which this value provides an illustration that the community's perception of the Good category is not merely good in the real sense, because in addition to giving an opinion on the questionnaire, there are several opinions from the discussion when collecting questionnaire data, some respondents stated that their perception of air pollution due to exhaust emissions was good compared to the haze caused by forest fires. If all this time there have been no forest fires, they are more likely to say that they are not so dangerous because of motor vehicle exhaust emissions. As far as they have experienced and know that the existence of motorized vehicles that are increasingly increasing today can cause new problems such as congestion, noise and air pollution, but specifically for air pollution, the impact on public health is not yet felt. This is in accordance with the answer through a questionnaire that was distributed to 100 respondents.

B. Economic Value Analysis Due to Motor Vehicle Gas Emissions

Calculation of the economic value of losses due to motor vehicle exhaust emissions for carbon dioxide composition based on calculations in Table 4 is not very large. However, there are five other compositions which on average have financial losses not exceeding Rp. 30,000,000, - / year [12]. Although this value is quite small in years, the effect of the contribution of vehicle exhaust emissions is not only on the value of first emissions, there is another value, namely health. This value of health can sometimes not be calculated with the value of money we have, for example for people who smoke allergy can cause them to live for life so that during their lives they are busy working to meet the needs in health care.

C. Analysis of the Environmental Law Due to Motor Vehicle Gas Emissions

The role of Law Number 32 of 2009 concerning Environmental Protection and Management is to guarantee legal certainty and provide protection for the right of everyone to obtain a good and healthy environment, and to preserve the environmental function and prevent pollution and / or environmental damage. However, the increase in the number of motorized vehicles with fossil fuels is caused by the absence of regulations that regulate in more detail the restrictions on the use of motorized vehicles, as well as the lack of effectiveness of law enforcement, especially in the environmental field [22,23].

According to the Letter of the Minister of Home Affairs Number 660/108 / SJ dated January 3, 2014 to the Governors, Mayors and Regents throughout Indonesia regarding the test of Vehicle Exhaust Gas emissions based on a letter from the Ministry of Environment relating to the requirements to pass the emission test for vehicle registration renewal, based on several things, among others, as follows;

1) The evaluation results of the Ministry of Environment have seen a decline in urban air quality of which around 60 percent is contributed by air pollution from the transportation sector (especially from motor vehicle exhaust emissions). Air pollution is very influential on the condition of environmental quality and public health as a result of air pollution from the transportation sector.
2) In the provisions of the provisions of Article 210 of Law Number 22 Year 2009 concerning Road Traffic and Transportation, it is stipulated that "Every motorized vehicle operating on the road must meet the requirements for exhaust emission thresholds and noise levels". To fulfill this requirement, every motorized vehicle is required to carry out road-worthy testing (including testing of motor vehicle exhaust emissions) carried out by the One-Roof Manunggal Administration System work unit coordinated by the local police apparatus and involving Regional Government officials.
3) In order to reduce air pollution from the transportation sector, it is suggested that in each extension of the Motor Vehicle Number Certificate (STNK) it is necessary to test the exhaust emissions of motor vehicles by referring to the provisions of the legislation.

Recommendations

The above discussion has made it clear that in order to overcome city air pollution a comprehensive effort is also needed including the improvement of the transportation sector, without neglecting other sectors, learning from other big cities that have succeeded in reducing congestion, air pollution and reducing greenhouse gas emissions, then some recommendations below can be an alternative, among others:

1. Vehicle age restrictions, especially for public transport, need to be considered as one solution, because the older the vehicle,
2. Especially those that are poorly maintained, the greater the potential to contribute to air pollutants. Especially those that are poorly maintained, the greater the potential to contribute to air pollutants.
3. The biggest potential of pollution by motorized vehicles is traffic congestion and climbs. Therefore, traffic regulation, signs, and actions against driving violations can help overcome traffic congestion and reduce air pollution.
4. Before being applied Emission testing as a condition for renewal of the vehicle registration must be carried out periodic emission testing on public and private vehicles even though in the test picks have been routinely carried out.
5. Support and active participation from the community is needed to reduce vehicle exhaust emissions by saving the use of vehicles or repairing the vehicle's engine so that more perfect fuel combustion can occur.

An important note for a country is that the smaller the standard quality value indicates the more dangerous these parameters are for the health environment. Countries that set low quality standards indicate countries that are ready in the technological, social and economic aspects to deal with air pollution problems.

Conclusion

The resulting exhaust gas emissions indicate the presence of gas emission anomalies at each station. Stations with more vehicles indicate an increase in gas emissions, especially when measuring gas emissions at each station not during forest fires. The economic loss value that is incurred is not so great due to motor vehicle gas emissions, as well as the public perception is in the good category. So it can be concluded that the effects of vehicle accumulation during congestion is a major cause of an increase in gas emissions in the city of Pekanbaru.

Significance Statement

The results obtained from this study is a model of exhaust gas distribution in the form of gas emission distribution contours supported by ecological data (E), economic (E) and socio-cultural (S), especially in creating a recommendation model in policy making both in the form of legislation legislation, government regulations or regional regulations, the simplest is a prerequisite for motor vehicle owners when the vehicle registration is renewed. This model is better known as the $E_2S + L$ model.

References

1. Prawiro, Ruslan H (1988) Ecology Environmental Pollution, Satyawacana, Semarang [EkologiPencemaranLingkungan, SatyaWacana, Semarang].

2. Directorate General Land Transport (2012) Perhubungan Darat Dalam Angka, PDDA: Jakarta, Indonesia.

3. Sugiarti (2009) [Gas Pencemar Udara Dan Pengaruhnya Bagi Kesehatan Manusia] Air Pollutant Gasses and The Influence of Human Health. Jurnal Chemica 10: 50-8.

4. Irawan, Bagus RM (2008) The Effect of Methanol on Reducing Exhaust Emissions Carbon Monoxide in Gas in Motor Vehicles. [Pengaruh Methanol Terhadap Pengurangan Emisi Gas Buang Carbon Monoksida pada Kendaraan Motor Bensin. Jurnal Traksi] 6: 1-9.

5. Syahril, Sukendi, Zulkarnain, Juandi M, Muhammad KD (2018) Fluid Actual Velocity Model For Mitigation Of Pollutant Contamination In Pekanbaru City Advances And Applications In Fluid Mechanics J 21: 367-77.

6. Suratmo FG (2002) [Panduan Penelitian Multidisiplin] Multidisciplinary Research Guide, IPB Press, Bogor.

7. Fauzi A, Ana S (2005) Fisheries and Marine Resource Modeling for a Policy Analysis, Gramedia Pustaka Utama, Jakarta.

8. Abdulla F, Al-Assad T (2006) Modeling Of Ground Water Flow For Mujib Aquifer, Jordan. Earth Sys Sci 115: 289-97.

9. Hindun KN, Ilya F, Khai M (2012) Study of Community Perception of Environmental Quality of Settlements in Jaban Hamlet. Proceedings of the Scientific Meeting of IPLBI. [Studi Persepsi Masyarakat Terhadap Kualitas Lingkungan Permukiman di Dusun Jaban. ProsidingTemuI lmiah IPLBI].

10. Sugiyono (2015) Non parametric statistics for research [Statistik Non parametris Untuk Penelitian]. Penerbit Alfabeta, Bandung.

11. Guoxiang L (2012) Greenhouse Gases – Emission, Measurement And Management, Intech, Croatia.

12. Victoria Transport Policy Institute (2011) Transportation Cost and Benefit Analysis II, Australia.

13. Patterson J (2010) Exploitation of Unconventional Fossil Fuels: Enhanced Greenhouse Gas Emissions, Concordia University Canada.

14. Patterson J, Perl A (2007) The End of Cheap Oil: Crossroads for Kyoto. Energy Sources, Part B, 2: 105-111.

15. Committee on State Practices in Setting Mobile Source Emissions Standards (2006) State and Federal Standards for Mobile-Source Emissions, the National Academy of Sciences, United States of America.

16. Tanmay UG, Veena R, Sunil K (2014) Various Methods to Reduce SO_2 Emission- A Review. Int J Ethics In Eng and Manage Educ 1: 1-6.

17. Erin L et al (2018) Exposure Assessment of Ambient Sulfur Dioxide Downwind of an Oil Refinery in Curaçao, Journal of Environmental Protection, 9: 194-210.

18. Lelia.C, Maria. S (2018) How Much Does Environmental Degradation Cost ?. The Case of Morocco, Journal of Environmental Protection, 9: 254-265.

19. Environmental Protection Agency (2016) Greenhouse Gas Inventory Guidance Direct Emissions from Mobile Combustion Sources.

20. Robert W Howarth (2014) A Bridge to Nowhere: Methane Emissions and the Greenhouse Gas Footprint of Natural Gas. Energy Science & Engineering 2: 47-60.

21. Pemerintah Provinsi Riau Dinas Pekerjaan Umum Dan Penataan Ruang (2017) Traffic Survey Report, Road Review DED Fly Over Morning Market PT [Laporan Survey LaluLintas, JalanArengka Review DED Fly Over PasarPagiPT].

22. Muhammad S, Aminullah E, Soesilo B (2001) Environmental, Social, Economic, Management Dynamic System Analysis. [Analisis Sistem Dinamik Lingkungan Hidup, Sosial, Ekonomi, Manajemen]. UMJ Press, Jakarta.

23. Sunil J Kulkarni, Nilesh L Shinde (2014) A Review on Hydrogen Sulphide Removal from Waste Gases. Int J Adv Res Sci Eng Technol 1: 181-3.