Analysis Of Motorized Vehicle Sound Pollutionin Front Of Mall Yogya Plaza Bogor

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Abstract: Motorized vehicles are a means of transportation to move people from one place to another place. This transfer requires space and time. The space where the motorized vehicle runs is road. Whereas facilities for road users are people. So that vehicles and people are highly interdependent to move them. This study emphasizes the noise pollution of motor vehicles in the surrounding area. The place to go is Mall Yogya Plaza Bogor. The observation point of the highway is 5.75m, 8.85m and the farthest distance on the side of the building wall is 12.42m. Survey data collection, namely the number of motorized vehicles, motorcycles, public passenger cars and freight vehicles. Measuring the level of noise pollution from all three points with point 1, point 2 and point 3. Calculate the speed of vehicles passing through the research point. The relationship between noise pollution and road geometry is with equations such as y = 62.490 + 0.266x1 for a distance of 4.75m from the highway is 68.91 dBA without protective trees and y = 62.259 + 0.195x2 for a distance of 8.85m from the highway is 66 , 20 dBA without tree cover means the level of noise pollution caused. So the results of the analysis of background noise have an influence in the study of sampling distance more than 12.42m. Furthermore, to get better results, measurements of wind speed, wind direction and field conditions such as a toll road that blocks and reflects sound will affect the measurement results, so the accuracy of noise pollution data can be detected properly and measured.

Index Terms: Noise pollution, vehicle speed, motorcycle, public transportation, freight transportation, highway,level of noise.

1. INTRODUCTION

KH Sholeh Iskandar Rd is a national road and this road stands the Toll Ring Outing Road. This road is famous for being very congested and belongs to the Kedungbadak Sub-district, Tanah Sareal District, Bogor, Indonesia. The development of this road in the last ten years shows rapid progress. This road leaves problems which in essence will disturb the comfort and tranquility of road users in driving [1], [2], [3], [4]. If it is not seriously anticipated, it will have very bad consequences for the development of the city [5], [9]. Noise pollution caused by motorized vehicles including public transport and private transportation including motorcycles is caused because of the already heavy traffic on the KH Sholeh Iskandar Rd, Bogor [8]. The development of the last few years the city experienced many changes both in the field of physical development and growth of urban population. The increase in the number of public transport passengers, freight transport and the number of private vehicles reaches 10% per year while the addition of road sections and the length of the road is only around 2% per year. This comparison is clearly not balanced between the addition of the number of motorized vehicles with an increase in the number of roads, so that the capacity of road segments is no longer significant with the growth in the population of the city. The growth of transportation modes is very rapid, especially private vehicles. Cities as one of the distribution services nodes have a very dominant role in spurring economic growth. Roads have an important role, namely the development of the primary arterial road network in urban areas and is part of the national road network and is carried out by the central government and supported by provincial and city governments.

The road network based on its function and role includes 3 groups, namely arterial roads, collector roads and local roads. Whereas roads are generally divided into two types namely, public roads are roads intended for public traffic and special roads are roads intended not for public traffic such as irrigation inspection roads, oil or gas channel inspection roads, plantation roads, mining roads, forestry roads, non-public housing complex roads and roads for national defense and security purposes [6], [7]. In carrying out vehicle operations, moving speed is required for transportation. Speed is the level of movement of a particular traffic or vehicle that is often expressed in kilometers per hour. The intended speed is the average time speed of a number of speeds at a particular location. Vehicle speed is used as a survey guide and calculation of traffic travel time is generally used to get the survey conditions of real traffic flow [10], [11]. The vehicle moves in the traffic flow to collect data which includes the vehicle speed and traffic flow, both in the direction and in the opposite direction to the observation vehicle. Speed is one of the parameters of traffic flow in this case can be divided into.

Time Mean Speed/TMS is the average of the speed of a vehicle that passes through one point on the road in a certain time interval.

The average speed of time is defined as follows:

$$V = 1 \sum Vi \quad (1)$$

Information:

V = average speed of time

Vi = the speed of a vehicle passing through a point on the motion path

Space Mean Speed/SMS is the average speed of the vehicle obtained by dividing the amount of distance traveled by the amount of time required.

The average speed of space is defined as follows:

$$U = \frac{\sum Si}{\sum mi} \quad (2)$$

Information:

U = average speed of space

Si = distance traveled

mi = the time taken to travel distance

Noise pollution is defined as unwanted sound measured in decibell units (dBA). Decibell is defined as ten times 10 logarithms based on a comparison between two rank quantities [12]. Sound strength is proportional to the square of the sound pressure, so an appropriate noise scale is interpreted as:

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Sound pressure level = 20 Log 10 (P1/Po) dBA. (3)

Information:

P1 = measured sound pressure

Po = pressure at the hearing threshold (0 dBA - 120 dBA).

The level of noise pollution in a road section is usually reflected 10% (18 hours) meaning that the average material noise level in the place is exceeded by 10% in an interval of 18 hours (6:00 to 24:00 BBWI). Noise is measured by carrying out local measurements on the side of the road in normal traffic conditions with a dBA measurement unit. Noise pollution due to traffic ranges from 60 - 80 dBA. Control of noise due to traffic on the environment can be done in two ways, namely at the source and by diffraction. Noise can occur due to communication, hearing loss and the influence of health and behavior. Sometimes loud noise is mixed with other sounds that reach the ear and will be recorded by the brain, so that those who receive noise will permanently lose hearing [8]. The sound generated by the mode of transportation is always unpopular, because it disrupts the community and activities around it. Even in certain cases can cause people to have an accident. The sound of vehicles passing through a single point is very uncomfortable (such as trains that will pass at a flat crossing and vehicles that will enter an intersection). This sound causes more noise and can be used as a warning to other vehicles. The effects of noise pollution and some examples of noise levels are summarized in the table below [13], [14],[15], [21].

TABLE 1

NOISE POLLUTION LEVEL

No	Description	Sound pollution effect	Decibell	Sample
1	Caused and accident	Deaf	150	Explosion
		Pain	140	Testing machine
		Threshold	120	Thunder, gunfire
		Feeling so bad	110	Wind drill, airplane
2	Disruption	Reduction of work efficeincy	100	Subway
		Impaired ear function	90	
		Normal speech	85	Heavy traffic road
		Disorder	80	Noise factory
		Other disorders	70	Noise office
			65	The train n the edge on city
			60	Factory

The results of the study are based on the equivalent level of noise pollution (leq) with a unit of sound intensity is decibell amperes or abbreviated dBA which shows that:

Motorcycle = 68.5 dBA
Sedan car = 69.5 dBA
Van (station) = 74.9 dBA
Jeep = 76.5 dBA
Bus = 79.1 dBA
Truck = 80.4 dBA
Trailer truck = 84.6 dBA

The intensity of human hearing and the level of intensity of the environment and situation.

TABLE 2

NOISE POLLUTION LEVEL FOR AREA DESIGNATION ACTIVITY ENVIRONMENT

No	Area designation and activity environment	Noise level dbA
	Area designation	
1	Hosing and setlement	55
	Trade and servies	70
	Office and warehouses	65
	Rung open life	50
	Industry	70
	Government an public facilities	70
	Recreation	70
	Port	70
	Nature preserve	60
2	Activity environment	
	Hospital	55
	School	55
	Worship place	55

In a follow-up study, a comparative level of noise pollution is allowed for each activity that interferes with human activities and is very supportive in daily activities. For activities in crowded places such as markets and malls or supermarkets, 60 dBA is allowed figure 1 below.

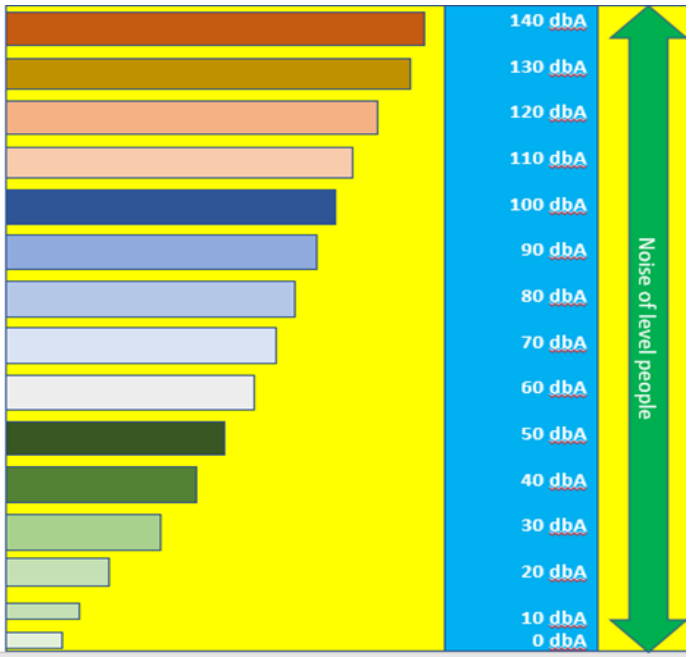

Figure 1 *Decibell diagram of a range of 0 dBA to 140 Dba*

The study examines the relationship between the level of noise pollution caused by motor vehicles in front of the Mall Yogya Plaza on KH Sholeh Iskandar KM 2 Rd, Bogor. The research hypothesis proposes that the level of noise pollution is influenced by the distance from the sound source of motorized vehicles, namely the closer the distance from the sound source, the greater the level of noise pollution it causes and the farther the distance from the sound source, the smaller the level of noise pollution will be found. Observation

data in the study were divided into two parts [16], [17], [18], [19], [20]. Observation data on noise pollution levels on curved roads and observation data on noise pollution levels on straight roads (regional characteristics) [22], [23]. Based on the above data assumptions, we get the linear regression model approach, namely:

$y = a0 + a1.X1 + a2.X2 + a3.X3 + a4.X4 + \ldots\ldots\ldots an.Xn$ (4)

The formulas a0, a1, a2, a3 and a4 are coefficients determined based on research data. Regression analysis, correlation and multiple linear regression tests will be supported by observations of noise pollution levels on curved roads and observations of noise pollution levels on straight paths to get the results of mathematical calculations. Sampling is a way of collecting data or research only the sample elements (part of the population element) are examined, the results are estimated data (estimate). Sampling only records, investigates some objects, symptoms or events and not all of them. The purpose of sampling theory is to make research efficient, meaning that lower costs are obtained by the same high level of accuracy or with the same costs a higher level of accuracy is obtained. Using the least squares method, constants a, coefficients b, c, d, e and n can be calculated by the equations as below:

Square parabolic equation

$y = a + bX + cX^2$ (5)

Geometric Equations

$y = a\,Xb$ (6)

The constants a and b are calculated using a suitable transformation so that the shape becomes linear.

Y = a Xb becomes log Y = log a + b log Y which is linear in log X and log Y where log a = q, then a = 10q.

Exponential Equations

$y = a + bx$ (7)

The constants a and b are calculated using a suitable transformation so that the shape becomes linear.

y = a + bx becomes log Y = log a + X log b which is linear in log X and log Y where log a = r, then a = 10, log b = s, then b = 10

Geometric Equations

$Y = \alpha\, Xb1\, Xc2\, Xd3\, Xe4\, X\, f5$ (8)

Constant values α and b, c, d and e are calculated using suitable transformations so that the shapes become linear.

y = α Xb1 Xc2 Xd3 Xe4 X f5 so log Y = log α + b log X1 + c log X2 + d log X3 + e log X4 + f log X5 which are linear in log X and log Y.

2. RESEARCH METHODS

2.1 Research Site

This research was conducted in front of the Mall Yogya Plaza in the city of Bogor as in figure 2 below. And figure 3 show at front of Mall Yogya Plaza Bogor, KH. Sholeh Iskandar KM. 2 Rd.

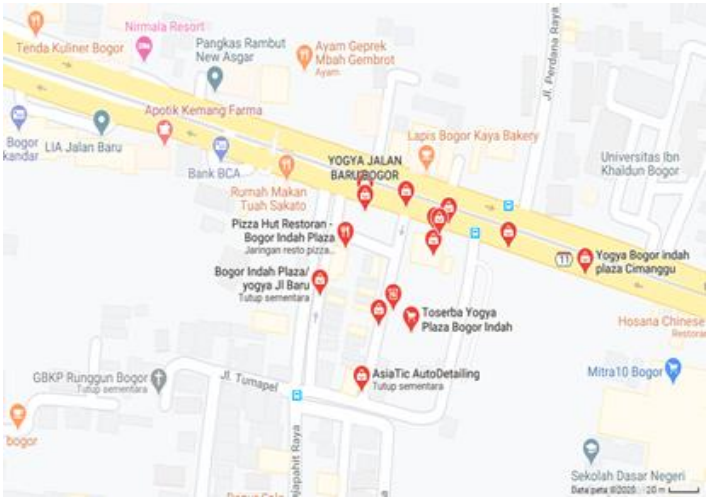

Figure 2 *Research location*

Figure 3 Front *of Mall Yogya Plaza Bogor*

2.2 Research Flow Chart

This field research uses the method of taking data directly and based on data that has been obeyed by using the Microsoft Excel program and data processing of vehicle speed with first level mathematics for figure 4 below.

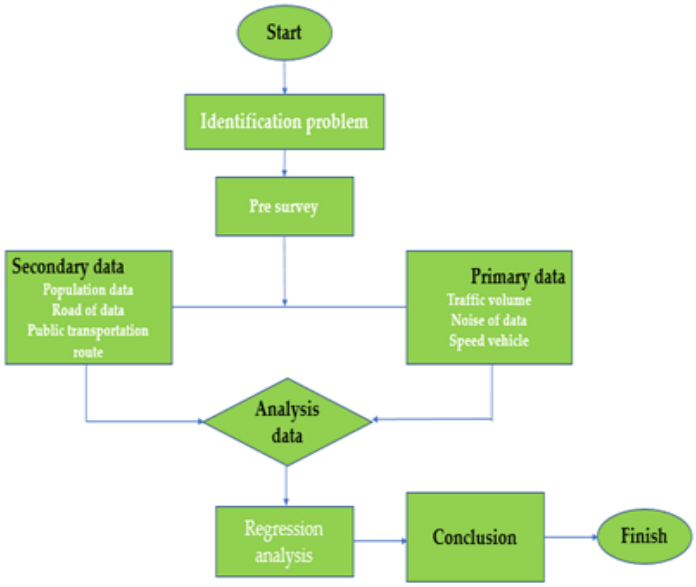

***Figure 4 Research** flow chart*

Identification of the problems of factors that can affect the level of noise pollution at the study location as follows, the volume and composition of motorized traffic, the speed of motorized vehicles, the distance between the road user to the source of traffic noise and the presence of a barrier or absence of a barrier.

3 RESEARCH RESULTS AND DICUSSIONS

3.1 Characteristics of Road Geometric Surfces

Cross section of KH Sholeh Iskandar KM 2 Rd, Bogor. Conducting surveys and measurements in the field we get the geometric road conditions for each observation point. The observation point in this study is the distance of 5.75m, 8.85m and the farthest distance on the side of the building wall which is 12.42m near the north side of the Yogya Paza Mall Mall Bogor.

3.2 The Composition And Speed Of Motorized

Traffic Flow

Data collection starts at 6:00 to 18:00 West Indonesia Time for 12 hours for 6 working days, namely Monday, Tuesday, Wednesday, Wednesday, Friday, Saturday and Saturday.

3.3 Measuring The Level Of Noise Pollution Caused

By The Traffic Flow Of The Motor Vehicle

According to survey data the amount of data needed will be calculated in order to be able to fulfill statistical calculations and be able to represent the amount represented. The level of confidence is 5% and the normal distribution from the statistical table is z = 1.96 and acceptable sampling error, then the error is not more than 5% from the calculation results.

3.4 Data Collection

The data used in this study with the level of noise pollution generated traffic flow and road geometry on the KH. Sholeh Iskandar KM 2 Rd Bogor namely. Register the number of vehicles that pass through the study site in front of the Mall Yogya Plaza Bogor, every day from Monday to Saturday. Vehicles that are recorded are motorbikes, public transportation and barriers for 12 hours starting from 06.00 - 18.00 WIB. Personnel involved in this activity were five surveyors and two local workers with a length of work of six days. The equipment used in this activity is five mobile phones, one set of stationery and a traffic flow calculation form for each set for six working days. Monitor the speed of vehicles passing through KH. Sholeh Iskandar KM 2 Rd Bogor by measuring 5.75m distance and marked for each point, monitoring is carried out on Monday-Saturday. The monitored vehicles are motorbikes, public transportation and barriers for 12 hours starting from 06.00 - 18.00 BBWI. Personnel involved in this activity are six surveyors and two local workers with a length of work of six days. The equipment used in this activity is a Sony brand handy cam as much as one piece, one measuring tape and one stop wach, four-wheeled vehicles and writing instruments each one set and one set speed calculation form, for six working days. Measure SPL with distance = 8.85m (from inside the fence Mall Yogya PLaza) NA-24 brand sound level meter Rion after calibrated with acoustic calibrator approval no 2G-391-O brand Quest technologies (94 dBA), placed at the measurement location at the mall fence, this tool is exposed to the sound source/perpendicular to the highway, observed every three minutes for sixty minutes each observation and activities carried out for 12 hours starting at 6:00 to 18:00 BBWI. Personnel involved in this activity are one surveyor and two local workers with a length of work of six working days. The equipment used in this activity is Rion's NA-24 sound level meter after being calibrated with an acoustic calibrator approval number 2G-391-O brand Quest technologies (94 dBA) as much as one, one handphone, one stop wach and one stationery set and noise pollution calculation form one set for six working days. Measuring SPL with distance = 12.42m (on the outer wall of the Mall Yogya Plaza Bogor) NA-24 sound level meter measuring instrument Rion after calibrated with acoustic calibrator approval no 2G-391-O brand Quest technologies (94 dbA), placed at a measurement location on the sidewalk, this tool is exposed to noise sources/perpendicular to the highway, observed every three minutes for sixty minutes each observation and activities carried out for 12 hours starting at 6:00 to 18:00 BBWI. Personnel involved in this activity are six surveyors and two local workers with a length of work of six days. The equipment used in this activity is Rion's NA-24 sound level meter after being calibrated with an acoustic calibrator approval number 2G-391-O brand Quest technologies (94 dBA) as much as one, one handphone, one stop wach and one stationery set and noise calculation form one set for six working days.

3.4 Data Analysis

Based on the variables that have been discussed then displayed the results of data processing obtained three equations namely

5.75m distance from the highway.

No	Variable	R	R^2	Std Error	F	t hit	Equation
1	x1	0,616	0,379	2,817	5,492	7,088	y=62,490+0,266x1
2	x3,x4	0,629	0,396	1,419	5,777	3,569	y=51,466+0,901x3+0,000197x4
3	x3	0,447	0,200	2,466	4,499	25,736	y=63,465+0,001737x3

The parameters included in the statistical analysis above are the correlation coefficient > 0.60 because based on the

table above that the value above 0.60 the resulting data is very good level of accuracy, namely:

1) Test t (count) = 7.088> t table = 1.725 (fulfilled)
2) Test F (count) = 5.492> F table = 4,410 (fulfilled)

So we will get the following equation:

y = 62,490 + 0,266x1

8.85m distance from the highway.

No	Variable	R	R^2	Std Error	F	t hit	Equation
1	x2	0,600	0,336	0,681	3,116	5,829	y=62,259+0,195x2
2	x3	0,631	0,398	1,698	11,909	42,251	y=71,724+0,001946x3
3	x2,x4	0,634	0,402	2,217	5,,703	32,542	y=72,146-0,01836x3-0,0003474x4

The parameters included in the statistical analysis above are the correlation coefficient > 0.60 because based on the table above that the value above 0.60 the resulting data is very good level of accuracy, namely:

1) Test t (count) = 5,829> t table = 1,725 (fulfilled)
2) Test F (count) = 5,826> F table = 4,410 (fulfilled)

So we will get the following equation:

y = 62,259 + 0,195x2

The farthest distance is 12.42m from the highway.

No	Variable	R	R^2	Std Error	F	t hit	Equation
1	x2	0,676	0,457	1,721	4,520	38,631	y=66,482+0,0000412x2
2	x1,x2, x3,x4	0,648	0,420	7,878	2,712	9,811	y=77,289+0,809x1+0,432x2+0,000069x3-0,0015x4
3	x1	0,530	0,281	2,797	7,047	16,256	y=77,974+0,05473x1

The parameters included in the statistical analysis above are the correlation coefficient > 0.60 because based on the table above that the value above 0.60 the resulting data is very good level of accuracy, namely:

1) Test t (count) = 38,631> t table = 1,725 (fulfilled)
2) Test F (count) = 4,520> F table = 4,410 (fulfilled)

So we will get the following equation:

y = 66,482 + 0,0000412x2

3.5 The Application Of The Linear Regression Equation For The Level Of Noise Pollution To Distance Is:

The equation y = 62.490 + 0.266x1 for a distance of 4.42m from the highway is 68.91 dBA without a protective tree.

Equation y = 62.259 + 0.195x2 for a distance of 8.85m from the highway is 66.20 dBA without protective trees/fences.

Equation y = 66.482 + 0.0000412x2 for a distance of 12.42m from the highway is 66.85 dBA with a fence barrier but parking back ground noise.

4 CONCLUSION

KH. Sholeh Iskandar KM 2 Rd, located in front of Mall Yogya Plaza Bogor for the farthest distance obtained a level of noise pollution of 66.85 dbA with a distance of 12.42m. This is due to the farthest area for the location of motorized car parking both motorbikes and four-wheeled vehicles produce a larger and higher sound so that it can be concluded that the noise pollution caused is noise from background noise. If examined further the relationship between noise pollution and road geometry is with equations such as y = 62.490 + 0.266x1 for a distance of 4.75m from the highway is 68.91 dBA without a protective tree and y = 62.259 + 0.195x2 for a distance of 8, 85m from the highway is 66.20 dBA without a protective tree means the level of noise pollution caused. This equation shows that the geometry of the road even though the study area is flat and smooth road surface still influences the speed of the motorized vehicle as a source of sound.

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