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THE GREENBELT FOR CONVENIENCE OF THE CITY

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ABSTRACT

An important factor in environment comfort of the city are the noise and clean air quality. This are important because it often encountered and has always been the biggest affected factor and a problem that always arises when a city develops. Of course it becomes very important to be handled, because it deals directly with the urban environment comfort that is especially for the inhabitants of the city. The development of the city is always followed by the development of transportation which also always have a negative effect in the form of air pollution from the results of vehicle exhaust and noise pollution generated by the engine driving the vehicle.

This research aims to explore the function of vegetation as a green channel or Green Belt in urban development in overcoming or minimizing the impact of air pollution and sound pollution.

In this research the method used is to conduct experiments in the laboratory to find out how many pollutant particles are successfully absorbed or captured by the surface of the plant leaf with Gravimeter, that is the amount of weight in grams per square centimeter of leaf sample. To measure noise, used sound meter measuring instrument on green belt area with area of 20m X 100m square. Sound samples were taken in the green belt area as much as (9) nine dots with a fixed distance to determine the noise level in the sample area and compared with the sound sample area that did not use green belt.

In the experiments show that plants on the Green belt, which is located around the highway, has excellent ability to absorb pollutant particles in the surrounding air. In the case of the amount of vegetation in absorbing the pollutant particles, the plant character is preferable to plants with broad leaves and leaves with a rough surface. While on the noise measurement results show, dimensions of width and density of plants on the green belt showed significant numbers in lowering noise.

Keywords: comfort, green belt, vegetation

1. Introduction

The development of the city is always followed by the development of transportation to be calculated and planned well. Predictions and developments should be well known in order for the city's growing transport system to have no negative effect. This will be bad for the city, especially for city dwellers, such as air pollution from the exhaust of vehicles and noise pollution generated by the engine driving the vehicle.

Highways and industrial centers, is the mover of urban economy which is the source of the two pollution mentioned above. The function of vegetation in urban development becomes important to overcome or minimize the impact of air and sound pollution.

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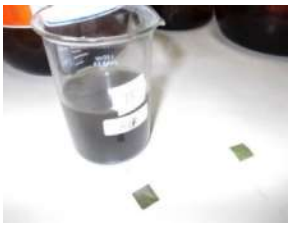
Chemically plants or vegetation have properties that can reduce air pollution because some exhaust gases from respiration and vehicle exhaust like CO2 is needed by plants in the process of photosynthesis. While physically, the form of plant canopy, leaf surface type, leaf width and arrangement of combinations between several types of plants with its character is very effective in reducing air pollution. Air pollutant particles such as Pb and CO can be absorbed or captured by the physical properties of the plant, especially on the type and shape of leaves.

Arrangement and utilization of several types of vegetation with the above mentioned functions on the area around the highway as Green Belt, is an appropriate solution to reduce air pollution and noise pollution. This will certainly improve the comfort of the city environment. The green open space (RTH) in the city is not only a room overgrown with plants, but must have the function of reducing the problems that arise in a city such as air pollution and noise pollution that will ultimately impact on the increased quality of life of its inhabitants due to increased comfort.


Digital scale


Brush


Tree leaves


Beaker


Oven

Figure 1 Tools used in the gravimetri method

2. Material and Methods

2.1. The Gravimetric Method

The gravimetric method is the method used to calculate the capacity of the leaves to absorb or (catch) the dust to obtain the total population of trees to be planted in an area (Irianti, 2010). The tools used in this

$$\text{The capacity of leaves to absorb the dust} = \frac{\text{(weight of beaker + dust) - (initial weight of beaker)mg}}{\text{Leaf area (cm2)}}$$


Rasamala


Leaf of tree X_2


Leaf of tree X_3

Figure 2 Leaf sample used in the gravimetri method experimental

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experiment are: 1) 6 pieces of 150 ml beaker size; 2) brush; 3) oven; 4) digital scales and 5) water aquades see the picture (Figure 1). The material used is a leaf sample (Figure 2) of 3 tree species as much as 20 grams (Figure 1). This leaf sample is taken from a collection of plants on the edge of the highway which is used as a sample of green belt with an area of 20m X 100m. The implementation steps are:

1) Leaf sampling of 3 species of trees by taking 3 mature mature leaves on the ground facing the road weighing about 20 grams.
2) Knowing the weight of glass beaker with weighed
3) Consider 10 g leaves
4) Take samples of pollutant particles on the leaf surface by washing the leaves in a beaker using aquades
5) Considering the weight of soluble pollutant particles by evaporating water in a beaker in a 2 x 24 hour oven. Do it for 2 experimental samples. Measure the area of leaves that have been washed by gravimetric metho.

The three types of plant samples used in this experiment are: 1) rasamala (Althingia excelsa); 2) tree X1; and 3) tree X2. Furthermore, S1 is the code for rasamala tree, S2 for tree X1, and S3 for tree X2.

2.2. Noise Measurement

The experiments for noise were carried out with two treatments ie on open areas without shade trees and areas covered by tree canopies. The instrument used is the SPL (Sound Pressure Level) meter by measuring the sound sample with SPL at a distance of 0, 10, 20, 30, 40, 50, 70 m from the highway which is the source of noise.

3. Results and Discussions

3.1 Observation to Know Leaf Capability to Absorb Pollutants

Suspended dust (Pollutants) = (Weight shrink + dust) - Weight of baker

Table 1 The calculation result sorption of pollutants by leaf

Leaf code	repeat	Early Weight of baker (mg)	Weight of baker (mg)	Polutan (mg)
S_1	1	76.306	186.532	110.226
S_1	2	114.335	195.382	81.047
	Rata-rata			95.6365
S_2	1	108.486	181.045	72.559
S_2	2	123.05	204.524	81.474
	Rata-rata			77.0165
S_3	1	62.161	139.91	77.749
S_3	2	122.692	172.244	49.552
	Rata-rata			**63.6505**

ISBN: 978-602- 5428-06- 7| Pg. 139-152

3.2 Stages of Gravimetry Method Process :

By washing using water aquades, the dust that caught leaf surface is calculated by the

$$\text{Leaf area (cm2)} = \frac{\text{Leaf weight (g)}}{\text{Leaf weight 1cm x1 cm}}$$

The results of the calculation of the leaf area of each sample is shown in table 2. Then followed by the calculation of leaf jerking capacity by the formula:

The results of sorption capacity calculation leaves, can be seen in table 3.

Green belt (Figure 3) in this experiment is assumed to have an area of 100 x 20 meters, measured from the border of the Darmaga Bogor highway 20 meters into the arboretum and has a length of 100 meters. Assumptions tree canopy diameter of 6 meters and the planting distance of 6 x 6 meters. The number of trees compared to the length and width of the green belt so that the number of trees obtained as much as 16 x 3 trees. Thus, the population of trees in the green belt is 48 trees (Fig. 3).

To find out the number of pollutant particle producers, the next step is to calculate the vehicles that pass on Jalan Raya Darmaga for 15 minutes by recording. Aspects to consider

Table 2 Area of each leaf type

Leaf code	Repetition	Leaf weight (g)	Leaf weight 1cm x1 cm	Leaf Area (cm2)
S_1	1	20.437	0.013	1572.076923
	2	20.001	0.016	1250.0625
S_2	1	22.3	0.018	1238.888889
	2	20.321	0.019	1069.526316
S_3	1	20.256	0.015	1350.4
	2	20.364	0.020	1018.2

formula:

$$\text{Sorption Cap.}(mg/cm^2) = \frac{\text{Polutant (mg)}}{\text{Leaf Area(cm2)}}$$

Sorption capacity:

Table 1 shows the results of the pollutant weight calculation from the washing results, then continued by looking for leaf area to know the number of particles per unit of leaf area with the formula:

Table 3 Sorption capacity of each leaf type

Leaf code	Repetition	Polutant	Leaf Area	Sorption capacity
S_1	1	110.226	1572.077	0.07011489
	2	81.047	1250.063	0.06483433
S_2	1	72.559	1238.889	0.0585678
	2	81.474	1069.526	0.07617767
S_3	1	77.749	1350.400	0.05757479
	2	49.552	1018.200	0.04866627

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Emission = Volume of vehicles (gasoline) x (emission of particles) / (1 gasoline vehicles) + Volume of vehicle (diesel) x (particle emissions) / (1 diesel vehicle)

Konversi 1 kendaraan/ km

a. Emisi kendaraan bensin = Volume kendaraan (bensin) x $\frac{100}{1000}$ x 0.22 g/ km/ kendaraan

b. Emisi kendaraan diesel = Volume kendaraan (diesel) x $\frac{100}{1000}$ x 1.28 g/ km/ kendaraan

when making this observation is, the type of vehicle that uses diesel fuel and gasoline. This will affect the amount of emissions produced because diesel and gasoline have different particle emissions. From the observation results obtained the number of vehicles through Jalan Raya Darmaga is 109 vehicles using diesel fuel and 218 vehicles using gasoline. Total vehicle volume is 327 vehicles. After the calculation is obtained the number as in (Table 4).

Table 4 Emisi kendaraan

Jenis kendaraan	Emisi (g/km/kendaraan)
Solar	4.796
Bensin	13.952
Total	18.748

Next is to look for the effectiveness of the GreenBelt function that is on the edge of the highway in absorbing the motor vehicle pollutant particles. For that used the following formula:

Effectiveness Green Belt (%) = vegetation sorption / total emissions x 100%

Table 5 GreenBelt effectiveness

Leaf code	Repetition	GreenBelt effectiveness (%)
S_1	1	29.558
	2	27.332
S_2	1	24.699
	2	32.113
S_3	1	24.271
	2	20.516

ISBN: 978-602- 5428-06- 7| Pg. 139-152

From the calculation in the table 5 obtained that leaves S1 and S2 possess the effectiveness of the green belt is quite high when compared with leaves S3. Leaf type S1 and S2 wider than the leaf S3, so that the resulting pollutant rupture more than the narrow S3 leaf. In a similar study conducted by Irianti (2010) in industrial estates in Karawang, it was found that large leafy trees and rough surfaces, massive structures, and relatively broad and dense canopy coverings, were most effective at reducing the spread of dust inside and around the area.

In the case of the Landscape Arboretum of IPB, plants can be planted (trees) that have these criteria so that the pollutant carried from the vehicle can be reduced to spread. From the calculation results in table 5 found that leaves S1 and S2 have the effectiveness of the green

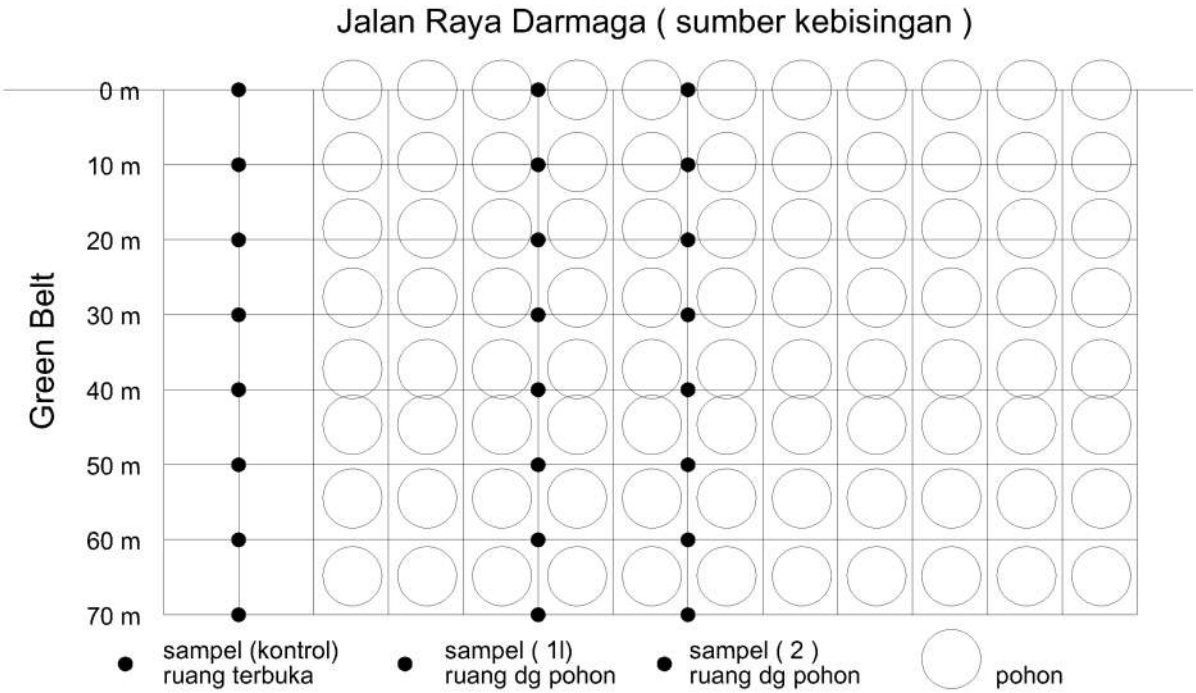

Figure 4 Illustration of noise data with distance interval 10m

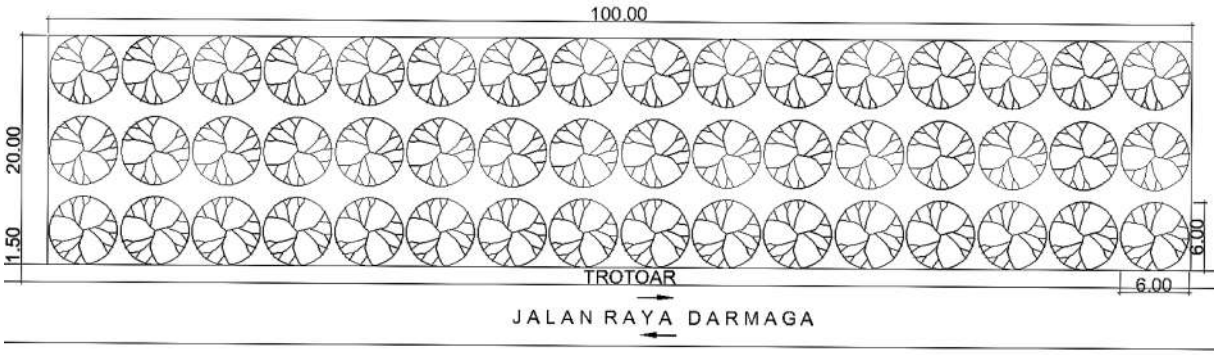

Figure 3 Ilustrasi *Green Belt*

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1.2. Noise Observation of Open Area and Shaded Area of the tree

Experiments for open area noise sampling were performed next to locations not covered by trees. Step through the experiment is to measure as far as 70 meters from the highway towards the location with a wooden peg at any given distance of 10 m (Fig. 4). Tools and then directed from the point 0 and do great value readout noise in decibels (dB).

A tree-covered area noise experiment was conducted at the center of the Landscape Arboretum area. The working procedure is the same as in the open area. The selected area is an area with lots of tree cover to compare with the area without tree cover.

1.2.1. Observation of open area noise

Observation of open area noise is done close to GWW motorbike station then the location is set as point 0. Then it is measured 70 m inward with timber at every 10 m distance. The observation is done by directing the noise gauge every 10 m and then a large noise value is read in decibels (db). Observations were made as many as 2 replications.

Based on the observation it can be seen that in open area, every 10 m distance away from source of noise (traffic) decreasing decibel value. Average difference of decibel value every 10 m between 2 db to 6 db. The magnitude is not very significant due to the absence of elements (barriers) that can reduce noise. Complete data on noise value observation can be seen in the following table.

In Figure curve (Fig. 7) above can be seen that in the open area, every 10 m distance away from the source of noise (traffic) decibel value generated decreased. Although there is a soaring decibel, it can be caused by another

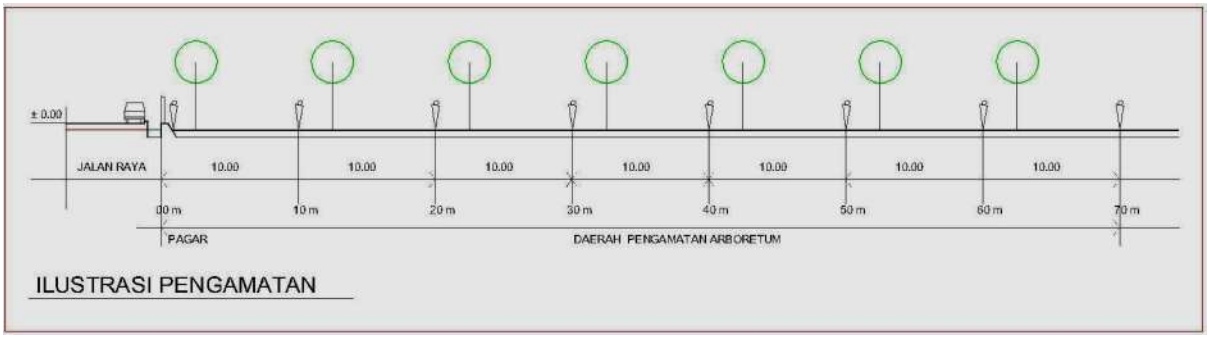

Figure 6 Illustration of Noise Observation distance

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Figure 5 Tool to measure noise level

sound source that arises suddenly when observations are made, such as cars running on

with:

d1 = distance to the highway fence (1 m)

d2 = gateway to measurement benchmarks (10 m, 20 m, 30 m, 40 m, 50 m, 60 m, 70 m).

By using the formula then, the results obtained in (Table 7) below:

From the data and the results of calculations in table it is known that the value of a on each increase in listener distance is smaller. The value of a is the degree of effectiveness of vegetation thickness in reducing noise. At a distance of 10 meters has a range of 9 meters can reduce noise up to 6.611 dB, while at a distance of 50 meters with a range

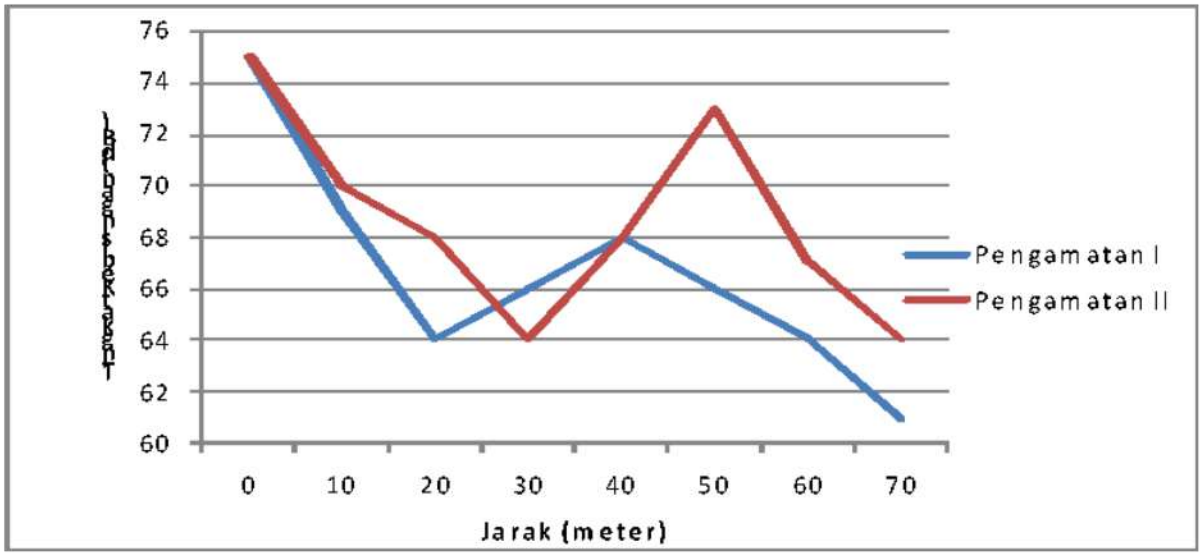

Figure 7 Curve of noise value on observation in open space

GWW roads

$$\frac{d_2}{d_1}$$

1.2.2. Noise Reduction in Open area

Decreased noise in open space can be calculated using the following formula:

$$\text{Decreased noise} = 10 \log \frac{d_2}{d_1}$$

ISBN: 978-602-5428-06-7| Pg. 139-152

Table 6 Data from observation of noise value in open space

Jarak dari sumber bising (m)	Pengamatan I (dB)	Pengamatan II (dB)	Rata-Rata
0	75	75	75
10	69	70	69,5
20	64	68	66
30	66	64	65
40	68	68	68
50	66	73	69
60	64	67	65,5
70	61	64	62,5

of 49 meters can only reduce the noise of 1.06 dB and at a distance of 70 meters with a range of 69 meters can only reduce noise by 0.63 dB. On the curve can be seen significant noise decrease occurs at the first 10 m distance from point 0. (Figure 8)

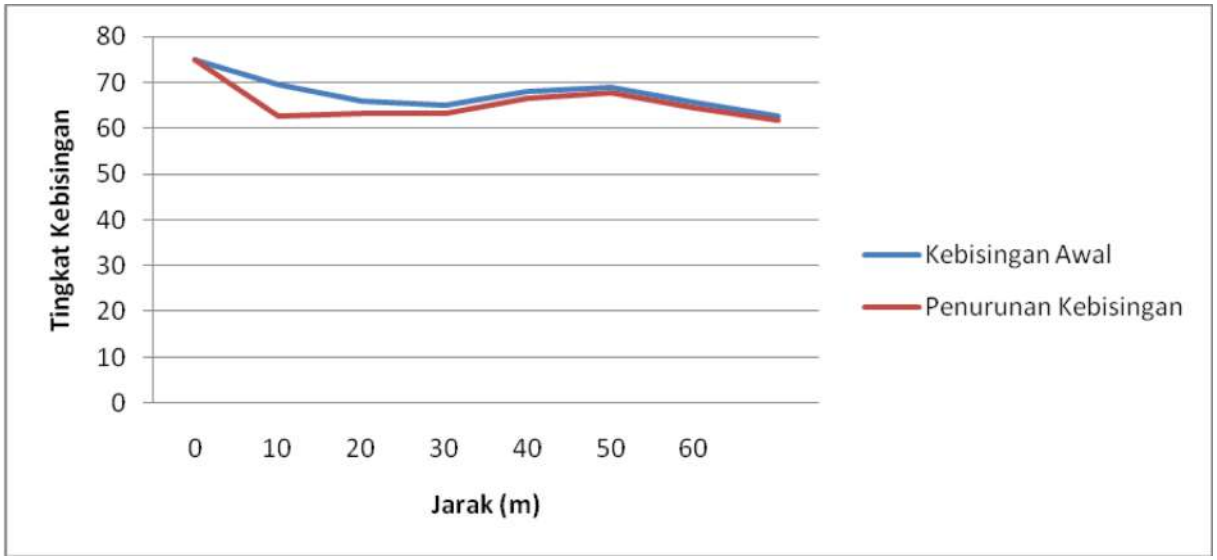

Figure 8 Curve of Noise Reduction in open space

From the explanation can be concluded that at each addition of distance listener (listener progressively farther) then the noise decreased.

Based on the calculation of noise reduction that has been done, then made a curve of the relationship between the initial noise and noise reduction calculation results using logarithms.

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1.2.3. Observations noise shaded area of trees

Based on the observation it can be seen that in the shaded area of trees, every 10 m distance

Table 7 Noise Reduction in open space

Distance (m)	Noise level (db)	Y	x	a
0	75	0	0	0
10	69.5	10	9	-6.61111
20	66	13.01	19	-2.78895
30	65	14.77	29	-1.73207
40	68	16.02	39	-1.33282
50	69	16.99	49	-1.06143
60	65.5	17.78	59	-0.80881
70	62.5	18.45	69	-0.63841

Table 8 Observation of noise value in shaded space of trees

Jarak dari sumber bising (m)	Pengamatan I (dB)	Pengamatan II (dB)	Rata-rata
0	88	72	80
10	73	63	68
20	65	63	64
30	62	61	61,5
40	54	57	55,5
50	61	61	61
60	56	57	56,5
70	60	58	59

Observation of the shaded tree noise is done in the middle Landscape Arboretum area. The experimental steps are similar to those in the open area. The selected area is an area with a lot of tree cover with a fence as a point 0. It is measured 70 m inward with a wooden peg at every 10 m distance. The observation is done by directing the noise gauge every 10 m and then a large noise value is read in decibels (db). Observations were made as many as 2 replications.

away from the source of the noise (traffic) decreased decibel value. Average difference of decibel value every 10 m between 0 db to 15 db. Magnitude is significant, especially at a distance of 0 m to 10 m different 15 db, it is because at a distance of 0 m in the form of a fence that is right on the side of the road and a distance of 10 m directly in the form of a fairly massive tree shade. Complete data on noise value observation can be seen in (Table 8).

ISBN: 978-602- 5428-06- 7| Pg. 139-152

Table 9 Observation Decreas of noise value in shaded space of trees

Jarak (m)	Tingkat kebisingan (db)	Y	x	a
0	80	0	0	0
10	68	10	9	-6.44444
20	64	13.01	19	-2.68368
30	61.5	14.77	29	-1.61138
40	55.5	16.02	39	-1.01231
50	61	16.99	49	-0.89816
60	56.5	17.78	59	-0.65627
70	59	18.45	69	-0.58768

In the picture of the curve (Figure 9) it can be seen that in the shaded area of trees, every 10 m distance away from the decibel source the resulting decibel value decreases. The drastic decrease occurred at a distance of 0 m to 10 m by 15 db, at a measurement every 10 m subsequently decreased consistently. This is due to the shade at the location of the canopy-tree canopy is quite massive.

1.2.4. Decreased Noise in shaded area of trees

Decreased noise in open space can be calculated using the following formula:

$$\text{Decreased noise} = 10 \log \frac{d_2}{d_1}$$

With :
d1 = distance to the highway fence (1 m)
d2 = gateway to measurement benchmarks (10 m, 20 m, 30 m, 40 m, 50 m, 60 m, 70 m).

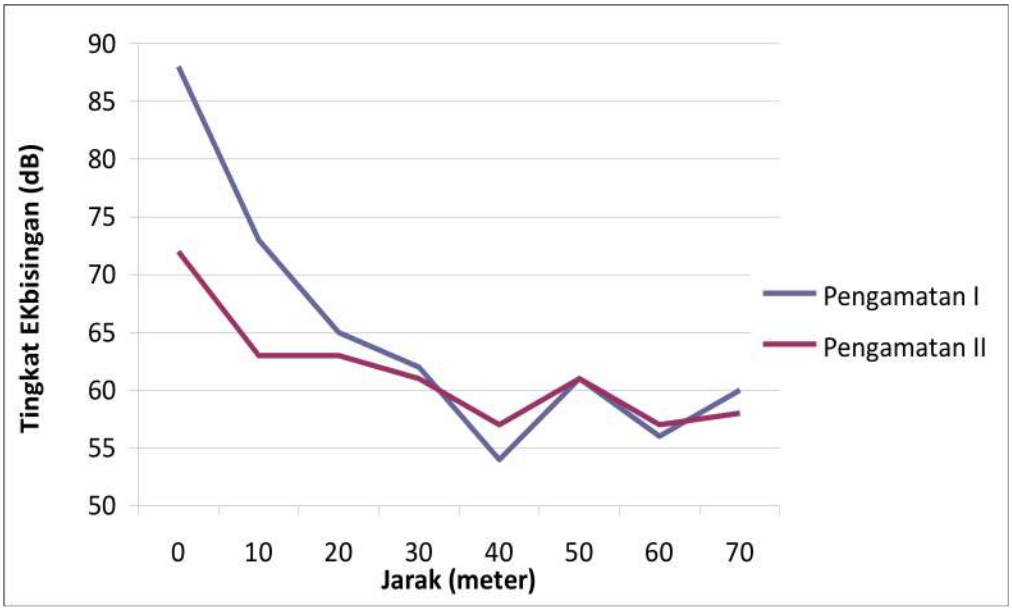

Figure 9 Curve Decrease in noise in the shaded space of trees

ISBN: 978-602- 5428-06- 7| Pg. 139-152

By using the formula then generated the numbers in (Table 9).

From the data and the results of the calculation in the table above note the value of a on each additional listener distance is getting smaller. The value of a is the degree of effectiveness of vegetation thickness in reducing noise. At a distance of 10 meter listeners have a thickness of 9 meters of vegetation can reduce noise up to 6.44 dB, while at a distance of 50 meters with a thickness of 49 meters of vegetation can only reduce the noise of 0.89 dB and at a distance of 70 meters with a thickness of 69 meters reduce noise by 0.58 dB. From the explanation can be concluded that at each addition of listener distance (listener farther) and the thicker the vegetation the vegetation function in reducing noise is higher

Based on the calculation of noise reduction that has been done, then made a curve of the relationship between the initial noise and noise reduction calculation results using logarithms. On the curve can be seen significant noise decrease occurs at the first 10 m distance from point 0. This shows the effectiveness of noise reduction in areas with trees.

Based on non-parametric data perceived by observers, the decrease in noise generated by a set of trees, which in this case is as a function of the Green Belt, seems to indicate a more evenly and smoother noise quality. This shows that in addition to decreasing the intensity of sound, greenbelt area can also improve the quality of sound noise reduction.

The type of noise source in this experiment according to Suma'mur (1995) includes intermittent noise because the noise source is traffic. Whereas according to KEP-48 / MENLH / 11/1996 About Baku noise levels, the experimental results on observations made in open and closed spaces include to the typical road noise standard which averages 60-80 db and its status is strong.

1.2.5. *Green Belt* to Enhance City Comfort

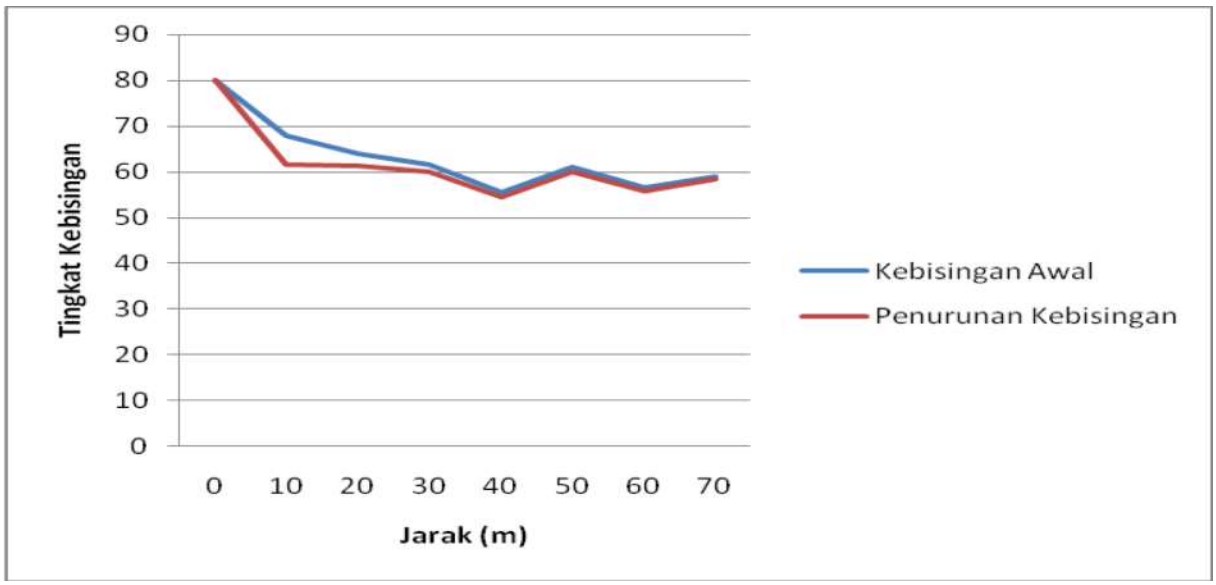

Figure 10 Curve Decreas of noise value in shaded space of trees

ISBN: 978-602- 5428-06- 7| Pg. 139-152

Air or Oxygen (O2) is the vital need of human life on earth, so its existence must be fulfilled. The existence of trees in the middle of the city as a producer (O2) is a must to be maintained.

The ratio between buildings and green open space (RTH) are two things that will always compete. The urban environment must meet the needs of its inhabitants. Cities are man-made environments that must remain responsive to the natural environment. RTH plays a role not only in oxygen providers, but also plays a role in maintaining the availability of clean water in the soil, urban microclimate regulator.

The city is also identic with the busy work and economic activities that almost always the same day. This will cause boredom and cause psychological disturbance of the inhabitants of the city. Park city became one of the solutions. Many studies suggest that the existence of urban parks increases the comfort of the inhabitants who live in the city. In this case, stakeholders must be aware and wise and seek solutions by sitting together.

Negative effects of motor vehicles in the city are very pronounced, ranging from short-term effects and long-term effects. Disorders began to be felt in the decrease of air quality that interfere with respiratory health. One short-term solution that can be done is to create pollutants of pollutant particles that exist around the highway, so as not to spread to the neighborhoods of settlements or other public places of activity. Planting trees as a Green Belt is a wise move in dealing with air pollution so that the air quality in the city does not decrease. So comfort in the city also did not decrease.

In addition to air pollution, the noise generated by motor vehicles also cause the effects of discomfort. Sound with moderate noise, although still on the threshold of human hearing can disturb humans if the voice is repetitive and continuous. That's why the Green Belt function is needed to reduce noise by motor vehicles. Expected by the decrease of noise level, comfort will increase.

4. Conclusion

Based on the results of the above experiments, especially from the data table which is the result of observations processed by the formulas, it can be concluded as follows:

1 From the observation found that Vegetation has a very effective function of reducing air pollution by motor vehicles by reducing the spread of pollutant particles by leaf jerking ability.
2 The more surface area, the denser and the more coarse, the more effec- tive a tree is in absorbing air pollution particles.
3 According to the calculation of noise reduction that has been done, then based on the curve of the relationship between the initial noise and noise reduction of the calculation results by using the logarithm, on the curve can be seen significant noise decrease occurs at the first 10 m distance from point 0. This indicates that the Tree as Green Belt is very effective for lowering Noise in a region. In addition, around the observation area there is no shrub / shrub on the edge of the road / fence as the Green Belt of the lower noise, so the parameter is only the Big Tree.

ISBN: 978-602- 5428-06- 7| Pg. 139-152

4 That at every addition of distance of listener (listener progressively farther) then noise decreasing. In other words, the most effective way to reduce noise, is to keep the Object as far away as possible from the sound source it originated.
5 That at every addition of listener distance (listener farther) and the thicker the vegetation the vegetation function in reducing noise is higher.
6 In addition to lowering the noise level, Greenbelt can also improve the quality of noise noise reduction.

In this study, researchers restricted the study to the level of noise reduction and the spreading of air pollution particles by way of sniffing by Greenbelt. In the next study, it can be reviewed again in relation to other comfort variables.https://jurnal.umj.ac.id/index.php?journal=index&page=user&op=register

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