

# Noise Pollution Produced by Vehicles that Circulating the Urban Center of the City of Machala

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## Abstract

The idea of having a proposal to get a contingency plan to meet and adapt to the downtown area of the city, led us to investigate, Diagnosis noise from vehicles on the streets June 25 and Rocafuerte between the Buenavista and Santa Rosa streets of the city of Machala, in order to provide the authorities, research centers with participation of universities and the general agency and interdisciplinary participation to integrate and arouse awareness campaigns in favor of the noise control, sensitized and learn about the problem and its effects in order to solve a problem of noise pollution by applying proper planning of the growing cities to strengthen the economy and create jobs reflected in better environmental conditions and improve the quality of life for city residents. For this purpose, we used research methods literature, documentary and field, through internet and observation, using techniques such as signing bibliographic fieldwork (data collection with the meter), interviews and surveys with the stakeholders involved in the subject. the result was a proposed contingency plan for induced noise allocations in Canton Machala that can be applied and considered in modern cities and consists of: Objectives of the contingency plan, General considerations of the contingency plan, Implementation contingency plan, contingency plan Benefits, noise abatement

measures, actions to be undertaken by the municipality of Machala, tracking and monitoring, Recommendations of the plan, how can we help to reduce noise pollution in the city of Machala.

**Keywords:** Noise, noise pollution, sound level meter, environment.

## INTRODUCTION

Environmental noise produces negative effects both in health and in different aspects of the periodic life of the people, being this particularly harmful phenomenon in urban areas. Noise pollution is that generated by an unwanted sound that affects the quality of life of an individual, causing not only problems of psychological type (subjective) but also physiological (such as hearing loss) and inclusive social and economic problems.

In these circumstances to develop a contingency plan that will help to improve vehicular circulation and avoid noise pollution taking back- up the statistical study obtained, it will help that our city can take better with their development plans, improvement of the standard of living, improving the level of health, improvement of the level of performance and

satisfaction of its members, increased levels of efficiency, effectiveness and productivity of the people to have a society with good health aimed towards progress. All this, under the criterion that is required to make periodic evaluations of the social impact of the plan applied in perspective of adjusting to the reality of the city of Machala.

The noise has been formed part of our lives, so that, in general are not appreciated all the effects of. Pleasant experiences can often be, but jointly to these feelings, we have sounds annoying and even harmful for the health.

Consequently the noise pollution affects the wellness of the community and consequently to progress and, for this reason, in the developed countries, as in Norse not war, its authorities seek to control and eliminate it, and their citizenship, due to its greater level of collaboration, respect the standards and existing laws.

In the case of noise pollution of Machala, as central axis of this research, will be structured a proposal that will serve as a guide to the competent authorities to plan its activities in an organized manner and technically relevant, focused to avoid contamination of noise produced by vehicles and raising awareness to the present and future people and authorities for that they give greater priority to this problem of environmental pollution.

Pursuant to these considerations, the study was carried out for realize a plan contingencies for noise-induced effects in the Machala Canton, in consideration to this issue reflects a serious reality unsatisfactory or a problem that warranted urgent intervention and which opens the possibility of evaluating the problem of noise pollution vehicles current and involving the municipal authorities University community and the general public about the importance that it should be for this acoustic problem in order to contribute to local, regional and national development.

## THEORETICAL FOUNDATIONS

### A. Noise pollution

"Presence in the environment of noise and vibration, whatever the acoustic emitter that originate them, involving discomfort, risk, or harm to persons, for the development of their activities or to goods of any kind, or that cause significant effects on the environment." [1]

Noise pollution or environmental noise is considered by the majority of the population of large cities as a very important environmental factor that influences of main form in quality of life as unwanted direct consequence of activities that developed in these cities.

"Today, the main sound objects that constitute the acoustic environment in urban areas are related to the means of transport, mainly filmed circulation, which has become in a

short time in the source of acoustic pollution more important in all large cities of the world." [2]

Today, the noise pollution is a serious latent problem for human society producing serious physiological effects (respiratory and cardiac rhythm disturbance), physical (decreased hearing ability) and social (lack of privacy, lack of concentration at work, etc); this is demonstrated by the different studies and reports conducted by experts.

There are many sectors of the population that start to publicly acknowledge that noise pollution is as dangerous to health such as atmospheric pollution.

### B. Noise

"Is called noise to all of unwanted signal that mix with the useful signal that you want to convey, some of which may be accepted depending on the perception that the person has. The noise from an occupational point of view can be described as sound because of their special characteristics is unwanted or which can result in damage to health." [3]

Can be say that it is the result of various types of disturbances that tends to conceal the information when it occurs in the frequency band of the spectrum of the signal, I mean, within its bandwidth. Physiologically it is considered that the sound is any unpleasant or annoying sound.

### C. Vehicle noise

"Noise from the vehicular transport is the main source of this pollutant in the cities, product of the need for mobilization of millions of people to school or to work, in addition to the transport requirements for the system of industrial, commercial, services and administrative support. While normal conversation runs approximately to 55 decibels (dBA) (Gandia, 2003), the vehicular noise of many cities around the world reaches between 80 and 90 dBA, equating even in some cases, with the of a pneumatic drill. Such a situation causes various environmental impacts which, frequently, the environmental authorities pay no or very little attention." [4]

Noise vehicles in urban environments, but do not exclude cities in developed countries, they are increasingly pressing in cities of the third world, by the ignorance and the low interest of the public administration to this problem is also known as ambient noise, whose main source of urban noise is the transit.

Whereas described above, thinking about of a development that do not wear arm social welfare, constitutes a setback from the road travelled by humanity, as advances in knowledge and the technology, are precisely to improve the conditions of man's life.

The processes are changing, now any form of development

adopted a community to this, must underlie a higher overall human wellness. Therefore, insofar as urban systems become more populous, the solutions to the problems should be prioritized with the health and quality of life of the population, status among others, to form healthy cities that have the purpose of obtaining benefits, providing solutions and contribute to the common good and benefit of society.

#### D. Sound

"Sound is a physical change in a medium, which maybe gas, liquid or solid, and that can be detected by the human ear, the sound waves move only in a medium with mass and elasticity, i mean they do not travel through vacuum. " [5]

The sound is in waves acoustic that occurs when the oscillations of the air pressure, are converted into mechanical waves in the human ear and perceived by the brain. The propagation of sound is similar in fluids, where the sound takes the form of pressure fluctuations. In solid bodies the sound propagation involves variations of the stress state of the environment.

#### E. Levels of sounds

"The unit used to express the sound pressure level is the decibel, abbreviated DB. Sound audible sound pressure level varies between 0 dB and 120 DB. The sounds of more than 120 dB can cause hearing damage immediate and irreversible, in addition being quite painful for most people. " "[6]"

Level. - Is the logarithm of the reason of a given amount in respect of a quantity of reference of the same type.

Decibel. - Decibel is a unit used to express the logarithm of the reason between a measured quantity and a reference quantity. The decibel is used to describe the levels of pressure, power or sound intensity.

Sound pressure level.- is the relationship between the sound pressure being measured and a reference sound pressure, is expressed in Watts or in any fraction of a Watt, mathematically it expresses it in the following way:

$$NPS = 20 \cdot \log_{10} (PS/20 \cdot 10^{-6}) \leftrightarrow (N/m^2)$$

#### F. Acoustics

"Acoustics is the science that studies the production, transmission and perception of sound both in the range of human hearing, as in ultrasonic frequencies and infrasound." [7]

The acoustics studies the sound, infrasound and ultrasound, that is to say mechanical waves that propagate through of the matter (both solid as liquid or gaseous) by means of mathematical and physical models.

#### G. Sound level meter

"The sound level meter is the basic instrument of absolute measurement of sound levels. The evolution of sound level meters to analyzers of greater benefits, allows to arrange of equipment that perform all of the tasks to you may face an inspection body. The type of noise to be measured (continuous, impulsive, random, events...), the parameters that can be analyzed during the measurement or after this, the possibilities of expansion and the connectivity with external elements (software processing, noise sources) are some of the elements that must be taken into account to identify the optimum equipment and it's potential." [8]

It is an instrument that responds to a sound of an approximate way to as the human ear would. It is an indispensable tool for measuring the sound pressure level and it's intensity. If it's a sound-integrator level meter, this will be capable of average linear quadratic sound pressure.

"The conventional sound level meter is used to measure noise stable, measured sound pressure level weighted, while that the integrating sound level meter is used to all kinds of noise in fixed positions and measures the weighted equivalent sound pressure level." [9]

The conventional sound level meters are used primarily for the measurement of the sound pressure level with weighted A of the stable noise. The sound meters can be used for all kinds of noises and can measure several parameters simultaneously (sound pressure level with slow or fast temporal average, sound pressure level equivalent sound pressure level and even the sound exposure level).

#### H. Environment

"Urban environment implies in the cities, the air that is breathed, the sounds that are heard in the streets, the garbage that is boot and that is recycled, the house where it lives, water drinking and transportation. At first might seem weird to talk about the environment in a city in which and we see little green and little pure air, but there are do it and there is that defend, respect and care for the environment in which we live and that depends largely on the health. " [10]

By the environment is understood also everything that affects the living being. Especially the life circumstances of people or society in their life conditions. It comprises a set of natural, social and cultural values existing in a place and at a particular time, that influence in the life of the human and in the generations to come.

"The notion of environmental noise, therefore, refers to the sounds unpleasant and even harmful that modify the considered normal or tolerable conditions in a certain region. Excessive ambient noise causes what is known as noise pollution." [11]

If it relates to the quality of life of human beings, the noise is a contaminant of the environment produced by multiple sources of emissions coming from electrical appliances, residential equipment and industrial machinery inside of the buildings, and means of transport, industries, construction, commerce, music or sports shows and pets abroad, these recent so-called also noise community or environmental.

“Everyone has the right to a suitable environment. A suitable environment is considered a precondition for the realization of other human rights, including the rights to life, food, health and an adequate standard of living. There is a partial reference to this in the right to health established in the International Covenant on economic, Social and Cultural Rights (ICESCR), which says that States must comply with the right to health by, inter alia, the improvement of all aspects of environmental hygiene.” [12]

Pursuant to the above, some authors point out that the environmental theme has occurred a social construction of concern, so that even those individuals who are not exposed to environmental problems, they have internalized as a situation of considerable importance in their lives.

#### *I. El The human being*

“Our planet is a balanced environmental set, in which all the elements interact among yes, including man. Sin embargo, human activity, tending to achieve greater comfort and development for our species, has occurred, as unwanted side effect, a degradation process environmental more or less accused according to the areas.” [13]

The human being is the carrier of characteristics unique and irreplaceable, that differentiate it from other existing species: as awareness, the ability to express themselves expressing their ideas through language, knowledge of itself and its around, allowing you to transform reality, knowledge of their emotional States, tendency to self-realization, choice, creativity and development in a society, considering that it works as a whole by the above, it is called it as a bio, psycho, or social agency.

#### *J. Noise and health*

“Studies on noise pollution has directed generally to adult population and mainly to effects in the work environment. Noise of high intensity have similar effects on health that noise of medium intensity prolonged.” [14]

The noise is the auditory sensation inarticulate usually unpleasant. In the environment, is defined as all it annoying to ear. From this point of view, the most exalted music can be described as noise by person who at some point don't want to hear it.

Cuando se utiliza la expresión ruido como sinónimo de

contaminación acústica, se está haciendo referencia a un ruido o sonido, con una intensidad alta que puede resultar incluso perjudicial para la salud humana.

“Is called acoustic trauma to deterioration produced by exposure to noise. This trauma is presented as occupational disease in individuals who have occupations in an environment in which stays long above 80 dB noise, known as chronic acoustic trauma. Acute acoustic trauma occurs in certain activities that generate a great noise impact and accidental situations.” [15]

There are different sources of noise in cities. The main ones are the traffic, human activity, industrial activity, the construction of buildings, recreational activities (local music and entertainment), aircraft and animals. Among all of them stands out as the first source traffic, due among other things to the increase of cars and to cities to a large extent are not designed or adapted for support means of transport.

“The noise is today a disturbing agent of civic life and very especially in the big cities. Many of the productive activities and leisure, they include processes that in greater or lesser quantity release energy in different ways. The noise is a manifestation of these liberated energies, which can damage the human ear and affect the psychological state, as well as lowering the value of the properties.” [16]

The effects of noise on health are the consequences that become present in people exposed to high levels of noise at work or in daily life, mainly in the urban environment. The damages that have been observed frequently and that have impact on the lives of the people are the hearing loss, hypertension, ischemia, discomfort and disturbances in sleep; in the same way they arrive to present changes in the immune system and mutations that have been attributed to these high levels of exposure to noise.

“The presence of the sound in our environment is a common fact of life that hardly all their effects can be seen. It provides such pleasant experiences such as listening to music or the singing of the birds, or allows oral communication between people; but along with these pleasant auditory perceptions, also appears the sound annoying, even harmful, that can limit our relationship life irreversibly.” [17]

The noise of the traffic, transport (such as aircraft or trains), as well as the noisy forms of entertainment (concerts or discotheques) are the main cause of noise in our country. The noise is a reality that affects us in different ways depending on the degree in which we are exposed or its intensity, and that may influence our well-being in different facets of our life, at home, at work, at school, on the street or in our leisure time. A problem with an important social dimension, involving us all, since we are both victims and noise generators.

**K. Loss of hearing due to exposure to noise**

“From a series of measurements made on board various motor vehicles corresponding to the urban transport of passengers are elaborated statistical indicators that allow to give a box of situation of the level acoustic pollution to which the staff of the units are exposed.” [18]

Exposure to harmful levels of noise can occur at any age. Both children, teenagers, young adults and older people Can develop hearing loss induced for the noise.

“Morbidity is the percentage of patients in a given pathology in a given context. Sensitivity to noise is the underlying attitude against noise in general, Unlike the discomfort, which refers to a attitudes against a specific noise.” [19]

Although the effects of noise on hearing are not defined with precision, and raising doubts, there is enough information to allow the development of predictive indexes of the harmful effects of noise on human hearing sensitivity.

“The Induced hearing loss for noise is a permanent hearing loss that it is caused by prolonged exposure to high noise levels. The hearing deteriorates gradually due to exposure to noise...” [20]

The displacement of the threshold is the difference between hearing threshold levels measured before and after of exposure to the ear. If this movement is reversible to retrieve the initial threshold of hearing, it is said to be temporary or transient; But if the ear does not recover completely it is said that the displacement is permanent.

**METHODS**



**Figure 1.** Urban area for the respective study.

This research was carried out in the mode of field research and bibliographic, because the facts were studied in the first instance on the basis of legal rules which are typified

in different codes, laws, regulations, etc., also, was performed visits to the streets June 25 and Rocafuerte between Buenavista and Santa Rosa of the city of Machala to gather the information and and data collection with the sound level meter in some critical points of the city, which served as a great help to obtain technical data required for the configuration of this research.

The research covered the exploratory level, recognizing the variables that compose us, the descriptive level allowed to characterize the researched reality, the level correlated elucidated the degree of relationship between the variables in study and finally the explanatory level detected causes of certain behaviors and channeled the structuring of the solution proposals to the analyzed problem.

Por el enfoque, fue una investigación cuali-cuantitativa pues se obtuvo información directa de los investigados, en virtud de los cuales fue factible desarrollar un análisis crítico de los resultados y proponer alternativas de solución.

**POPULATION AND SAMPLE**

In the present work, was accounted a universe of 450 people and 50 vehicles in a period of one hour, the same that constitute it all the people and drivers of vehicles circulating on these avenues. The population surveyed is detailed below.

People	=	450
Vehicles	=	50

In virtue of that the population passed 100 elements, was obtained a representative sample of census type, by means of the following formula:

$$n = \frac{Z^2 \cdot P \cdot Q \cdot N}{Z^2 \cdot P \cdot Q + N \cdot e^2}$$

- n = people and vehicles circulating
- Z = confidence level = 1.96
- P = Probability of occurrence = 50 % = 0.5
- Q = Probability of non-occurrence = 50 % = 0,5
- N = population = 500
- e = margin of error = 5 % = 0,05

$$n = \frac{(1.96)^2 (0.5)(0.5)500}{(1.96)^2 (0.5)(0.5) + 500(0.05)^2}$$

$$n = \frac{480.2}{0.96 + 1.25}$$

$$n = \frac{480.2}{2.21}$$

$$n = 217.28$$

$$n = 220$$

Therefore the number of people and drivers of vehicles circulating on the streets June 25 and Rocafuerte between the streets Buenavista and Santa Rosa de Machala city streets were 220, who applied a survey through the respective questionnaire, which were distributed in the following way:

**Table I.** RESULTS OF THE SURVEY

TITLE	SAMPLE	%
People	180	80.00
Vehicles	40	20.00
TOTAL	220	100.00

To they were applied a survey through the application of a structured questionnaire which is evident in the results section.

In the present work, the techniques used to collect information were through the use of questionnaires, surveys and interview. The detail of the data collection instruments was established in the following way:

**Table II.** Data Collection Plan

RESEARCH UNIT	RESEARCH TECHNIQUE	INSTRUMENT
People and drivers of vehicles circulating on the streets “25 de Junio y Rocafuerte” between the streets “Buenavista y Santa Rosa”.	SURVEY	SURVEY QUESTIONNAIRE
Technical data acquisition	FIELD	SONOMETER

## RESULTS

The results obtained that in the jacks 1, 2, 3, 4, 5, 6 of the Central streets of the city of Machala sees that in the weekly averages of the different time bands exist similarity in the data obtained, thus you can say that the behavior of the drivers is the same, on the other hand, you can tell that the tendency to rise the noise levels are higher in the night from 12:00 PM - 19:00 PM.

At this point exist a light increase in the weekly averages of the noise levels despite being the same area of study where the sound waves are scattered in the same way, but can be attributed this fact to a slight increase in the flow of trucks of heavy load, urban transport, lack of vehicle control by the local police and municipal in those nighttime hours; These vary from the 83.99, 80.62, 83.99, 83.99, 84.18 and 84.24 decibel basically as is reflected in the levels of maximum allowable limit.

**Table III.** Relationship Knowledge, Application and Relevance Of Strategic Planning

QUESTIONS	People and Drivers of Vehicles that Circulate for the streets “25 De Junio Y Rocafuerte” between the Streets “Buenavista Y Santa Rosa”.			
	Total Respondents 220			
	YES (%)	N°	NO (%)	N°
<b>I.</b> Do you know what vehicle noise?	15,45	34	84,55	186
<b>II.</b> Do you know if there is any contingency plan to prevent pollution from vehicular noise in Machala city?	3,18	7	96,82	213
<b>III.</b> Do you think that vehicular noise causes a disease?	88,64	195	11,36	25
<b>IV.</b> Have you ever had any disease by consequence of vehicular noise?	95,45	210	4,55	10
<b>V.</b> Do you think that the city of Machala must have a contingency plan to avoid vehicular noise pollution?	98,18	216	1,82	4

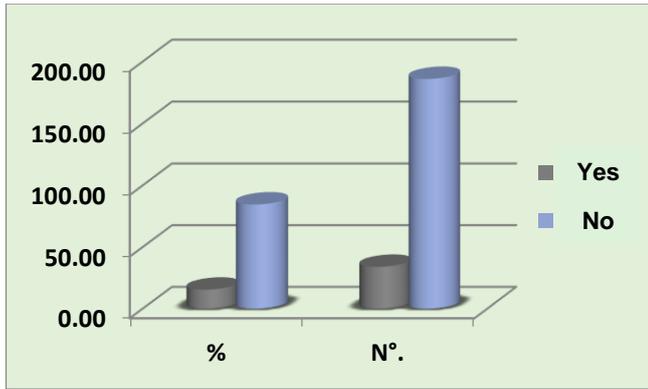


Figure 2. Results of the survey. Question 1

Of the results obtained the 15.45% of the total respondents answered that have knowledge that is vehicular noise and the 84.55% demonstrated that not. Thus you can see that all people and drivers of vehicles travelling in the Central streets of Machala haven't knowledge of what is vehicular noise.

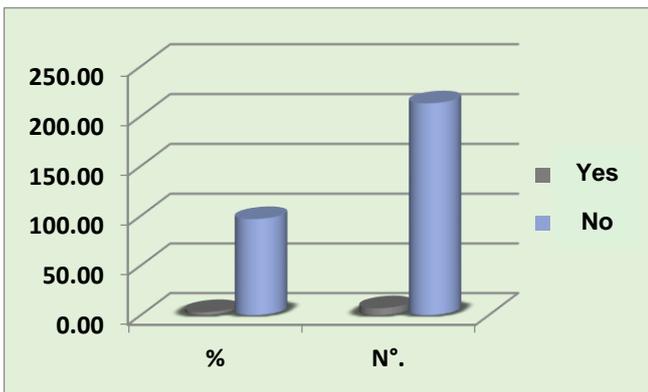


Figure 3. Results of the survey. Question 2

Of the results obtained the 3.18% of the total respondents answered if there is a contingency plan to avoid noise pollution vehicles in Machala city, on the contrary the 96.82% of they indicated that they do not know. As a result you can see that all people and drivers of vehicles do not know that there is a contingency plan.

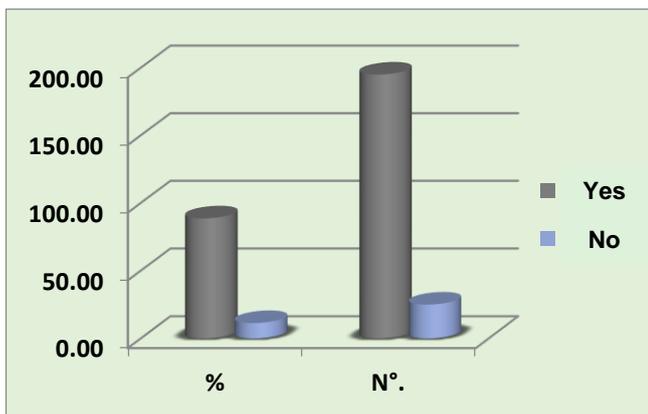


Figure 4. Results of the survey. Question 3

Of the results obtained the 88.64% of the total respondents indicated that they said that if know that vehicular noise cause any disease and only 11.36% expressed that they have not knowledge of this. Accordingly you can see that they do not know about this situation.

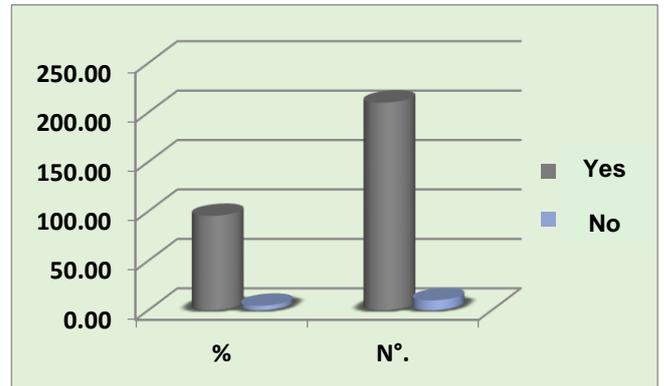


Figure 5. Results of the survey. Question 4.

Of the results obtained the 95.45% of the total respondents agreed that they have suffered some disease as consequence of the vehicular noise, instead the 4.55% indicated that not. In the sequel you can see that the majority of they have had a problem for this acoustic problem.

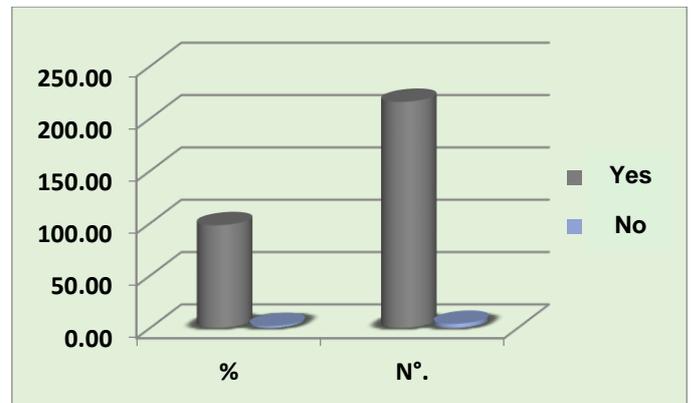


Figure 6. Results of the survey. Question 5

Of the results obtained the 98.18% of total respondents contested that if there should be a contingency plan to prevent pollution of noise vehicular in Machala city and only 1.82% declared that they are not interested. Therefore, you can see that all people and drivers of vehicles circulating on these streets if you want to have it with a program of this type.

## DISCUSSION

The realization of the study determined the existence of limitations of having a regulatory plan for the city of Machala with the purpose of avoid noise pollution.

For the above reasons, is proposed a contingency plan for damages caused by noise in the Canton of Machala, This proposal is directed to ensure the full organization of vehicular traffic through the implementation of Ordinances and laws that go in favour of citizenship This proposal is intended to ensure the full organization of vehicular traffic through the implementation of ordinances and laws that go in favour of citizenship, with the purpose of providing a high level of protection against all possible event of negative effects caused by direct or indirect action of the high noise level in the city.

## CONCLUSIONS

- ❖ The number of people that are affected by disturbances produced by vehicles in a specific range of sound pressure (50-79) dB (A) so much of the day as in hours of the night, is half.
- ❖ The flow of traffic at peak hours, the number of vehicles in circulation with different mechanical characteristics, different emission of noise and excessive speeds uncontrolled.
- ❖ It can be considered that all persons and vehicles that move on the Central streets of Machala, they not have knowledge of what is vehicular noise.
- ❖ You can see that all persons circulating on these streets in the city of Machala, they desire that you have a contingency Plan.
- ❖ In the results of the present study were recorded some peaks in acoustic levels and this has a direct relationship with the passage of heavy duty trucks, buses where joins the noise of engines with the noise of wheels and braking system; resulting less significant the effect of the cars and trucks.
- ❖ Considering as the objective of this project in the that was pretended to make a diagnosis of noise levels by vehicular traffic at critical points, it is valued as covered successfully at the proposing a contingency plan for the city of Machala, scientific evidence of a critical condition of environmental contamination in this city and as a valuable element of consultation in matter of urban planning, as well as providing to the authorities, research centres with the participation of universities and citizens in general the inter-institutional and interdisciplinary participation to integrate and arise campaigns of awareness in favor of the fight against noise.
- ❖ This project provides data that represents interest both on the municipal authorities as the research community; as well as trouble to the readers of the present to know the levels of noise in the city of Machala and its possible effects on human health.
- ❖ Characterizing the noise levels for vehicular traffic in 6 critical points of the city of Machala, is very important to have data that allow having an element of analysis of urban space and transfer this information to suggest adaptations of routes of transport, optimal installation of spaces that require acoustic conditions such as schools, colleges and hospitals, aimed at improving the conditions of quality acoustic environmental of the urban environment.
- ❖ In this effort it is advisable to add the potential of authorities, public initiative, and research centres with the participation of universities and the results of a work of this magnitude with inter-institutional participation and interdisciplinary will be reflected in appropriate environmental conditions for the inhabitants of the city of Machala.

## REFERENCES

- [1] García Rodríguez, Amando. "La contaminación acústica." Fuentes, evaluación, efectos y control. Madrid: Sociedad Española de Acústica (2006).
- [2] García, Amando. La contaminación acústica. Universitat de València, 1988.
- [3] Behar, Alberto. El ruido y su control. Arbo, 1977.
- [4] Ramírez González, Alberto, Efraín Antonio Domínguez Calle, and Isabel Borrero Marulanda. "El ruido vehicular urbano y su relación con medidas de restricción del flujo de automóviles." Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales 35.135 (2011): 143-156.
- [5] Matras, Jean-Jacques. El sonido. El Ateneo, 1979.
- [6] Torija, A. J. "" Modelización y predicción de la estructura temporal y espectral del nivel de presión sonora como herramienta para la gestión de paisajes sonoros urbanos".(Tesis doctoral). Universidad de Granada." (2010).
- [7] Savioli, Carlos. Introducción a la Acústica. Francisco Etchelecu, 1977.
- [8] Mondaray, José Alfonso, Francisco Javier Yebra, and Luis Lorenzo. "Empleo en campo de los sonómetros. Factores a considerar y su contribución a la incertidumbre de medida." Congreso español de metrología. Vol. 8. 2005.
- [9] Bayona, Teresa Álvarez. "ASPECTOS ERGONÓMICOS DEL RUIDO: EVALUACIÓN."
- [10] URIBEONDO, Ma Pilar BORDERÍAS, and Eva Ma MARTÍN RODA. Medio ambiente urbano. Editorial

UNED, 2012.

- [11] Soria, Lora, Federico deMiro Chavarría, and JuanFederico de Lora Soria. Técnicas de defensa del medio ambiente. Labor,, 1978.
- [12] Jordano Fraga, Jesús, et al. La protección del derecho a un medio ambiente adecuado. No. D50 284. IICA, San Salvador (El Salvador). Centro Nacional de Tecnología Agropecuaria y Forestal, San Salvador (El Salvador). Centro Internacional de Mejoramiento de Maíz y trigo, San Salvador (El Salvador). Programa Regional de Maíz, San Salvador (El Salvador)., 1995.
- [13] Alonso, Luz, and Isabel Escorcía de Vásquez. "El ser humano como una totalidad." Revista Científica Salud Uninorte 17 (2012).
- [14] Jiménez, Julio Díaz, César López Santiago, and Cristina Linares Gil. "Ruido y Salud." El Ecologista 38 (2003): 48-51.
- [15] Otárola Merino, Francisco, Francisco Otárola Zapata, and Andrés Finkelstein Kulka. "Ruido laboral y su impacto en salud." Cienc. Trab 8.20 (2006): 47-51.
- [16] De Esteban Alonso, Alfonso. "Contaminación acústica y salud." Observatorio medioambiental 6 (2003): 73-95.
- [17] Cabaní, Fernando Tolosa. "Efectos del ruido sobre la salud." Revista ROL de enfermería 28.2 (2005): 26-31.
- [18] Miyara, Federico, and Jorge A. Sanguineti. "LA CONTAMINACIÓN ACÚSTICA EN LOS MEDIOS DE TRANSPORTE URBANO DE ROSARIO (\*)." UNR Ambiental 1996.2 (1996).
- [19] Sandoval, Avelino Martínez. "Ruido por tráfico urbano: Conceptos, medidas descriptivas y valoración económica." REVISTA DE ECONOMÍA Y ADMINISTRACIÓN (2005).
- [20] Narváez, Narváez, and José Nepalí. Determinación del ruido ambiental provocado por el tráfico vehicular en el casco urbano del cantón Salcedo, provincia de Cotopaxi. periodo 2013. BS thesis. LATACUNGA/UTC/2015, 2015.