Community Response to Road Traffic Noise : A Review of Social Surveys

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Abstract- Road traffic noise was recognized as one of the serious environmental pollutants and one of the most widespread and growing problems in urban areas. Road traffic noise-induced annoyance is one of the most negative health impacts includes disturbance of rest and sleep, increased blood pressure, increased heart rate etc,. In order to get new polices for regulating traffic noise a social surveys on community response to road traffic noise are required. The present article briefly reviewed the social surveys on community response to road traffic studied by several researchers.

Key words: Road traffic noise, Environmental pollutants, Annoyance, Sleep

I. INTRODUCTION

Noise is a recognized pollutant that can cause a wide range of negative social impacts, it leads to annoyance, reduces environmental quality, and might affect health and cognition. The major sources of noise are industrial noise, traffic noise & community noise. Traffic noise, itself, is categorized into four major groups: road traffic noise, airport noise, railway noise, and seaport noise. Road traffic noise source includes all the vehicles in roads and streets of a city: cars, vans, trucks, buses, motorcycles, etc. This type of noise pollution is considered one of the most invasive types of noise pollution. In road traffic noise, almost 70% of noise is contributing by vehicle noise *[13, 16]*.

Investigations in different countries in the past several decades have shown that road traffic noise affect different activities badly and well-being by disrupting basic activities such as sleep, rest, communication, concentration and cognition; and it may also lead to a general feeling of annoyance *[3]*. It will be a larger and serious social problem in the future if effective precautions are not taken accordingly.

Why social surveys on community response to road traffic noise required?

The impact of road traffic noise, which has far-reaching and wide-ranging effects, has increased because of industrialization and urbanization resulting in an increase in noise levels. Thus, road traffic noise has become an issue of immediate concern to many authorities. Anti-noise laws, ordinances, major highway control regulations and other governmental laws that concern environmental noise cannot be decreed without a priori empirical considerations. Therefore, it is necessary first to carry out social surveys, in order to analyze road traffic noise levels and community response.
Firstly, in this paper reviewed the social surveys on community response to road traffic noise studied by several researchers, and secondly, there is a summary of the analysis methods for collecting data. Finally, the main conclusions are discussed.

II. LITERATURE RELATED TO SOCIAL SURVEYS ON COMMUNITY RESPONSE TO ROAD TRAFFIC NOISE

Jonsson *et al.*, (1969) studied the annoyance reactions to motor vehicle noise in Sweden and Italy using a unified method. They concluded that the differences in annoyance reactions seemed to be depens on differences in living conditions, on different requirements and on different evaluations of motor traffic as a part of the physical environment.

Yeowart *et al.*, (1977) conducted a social survey from residents of 27 different sites in the Greater Manchester area. They distribute the sites into three categories (a) freely flowing traffic on urban roads, (b) motorway traffic, (c) congested or disturbed traffic flow on urban roads. They analyzed the collected data to seek the best index for predicting community response to noise. They used 7 point dissatisfaction scale for measurement of community dissatisfaction from road traffic. They reported that sleep disturbance incidents in a household may increase overall expressions of dissatisfaction whether or not the person questioned is the disturbed member.

Izumi and Yano (1991) studied social surveys of community responses in residential areas heavily exposed to road tragic noise in three cities in Hokkaido, Japan. They used Regression analyses for the annoyance caused by

road traffic noise. They reported that regression models could not explain a large part of the variation in the annoyance responses. Used A path analysis to explain the annoyance responses by nine exogenous and two endogenous variables obtained via the personal interviews. They concluded that path model explained about half of the variation in the annoyance responses and causes the strong effect of sleep disturbance, hearing disturbance to road tragic annoyance.

Osada *et al.*, (1997) used path analysis for a collected data in a social survey on the community response to traffic noise along a trunk road in Tokyo. They established a path model for the noise annoyance, dissatisfaction with living environment, and the respondents to move to the antecedent variables, including noise levels, personal factors, and noise effects. They reported that the noise level, followed by interferences with daily activities strongly effect on annoyance.

Aranaa and Garciab (1998) measured noise exposure by using the subjective response to social surveys in the city of Pamplona, Spain. They reported that noise is most serious in the residential zones exposed to high sound levels. They found that the noise can induce disturbances of sleep in terms of difficulty to fall asleep, alterations of sleep pattern or depth and awakenings; these effects are referred to as primary sleep disturbance effects. They established a correlation between annoyance and noise levels.

Moehler *et al.*, (2000) carried out social surveys on the community response to railway or to road traffic. They reported that night-time disturbance from rail traffic is considerably less than the disturbance from road traffic noise. They found that the measurement of sleep movements using actimeters were unable to find any correlation between sleep movements and the noise nuisance from rail and road traffic noise.

Joncour *et al.*, (2000) conducted a social survey on road traffic, railway noises and directly compared the noise–annoyance. They concluded that railway noise was less annoying than road traffic noise. Night annoyance from the surveys is really lower than annoyances relative to other periods. They used the dose/response assessment for the statistical analysis. However, social surveys have to be interpreted carefully because there are many uncontrolled variables that could possibly affect the results.

Sato *et al.*, (2002) conducted social surveys on the community response to road traffic noise, in Gothenburg, Sweden, and Kumamoto and Sapporo, Japan. They compared the community responses on the basis of the dose response relationships. They observed that community responses in Sapporo and Kumamoto were the same there is not much difference. They reported that people living in detached houses were more annoyed by the house vibration caused by road traffic than those living in apartments and people were annoyed by the exhaust from road traffic to the same extent as noise. They found that people were annoyed by exhaust from road traffic to the same degree as they were annoyed by noise and exhaust fumes are one of the most serious sources of annoyance in the living environment.

***Yano et al.*, (2002)** studied the community response to road traffic noise with the help of social surveys in Kumamoto and Sapporo, Japan, and Gothenburg, Sweden. A path model was applied to data obtained in social surveys. They found that path model not only estimates the direct relation of a variable on annoyance but also the indirect relation of the variable via other variables. They developed an a *priori* path model was constructed using nine exogenous variables and seven endogenous variables. They reported that activity disturbance indoors, such as disturbance in listening to TV/radio, significantly affects noise annoyance, especially apartment houses in Kumamoto and Sapporo, while activity or rest disturbance in gardens or on balconies has a stronger effect in detached houses in Gothenburg.

Yen *et al.*, (2006) studied a socio-acoustic survey on community response to road traffic noise was conducted at eight sites in Hanoi. They used 5-point verbal scale (extremely, very, moderately, slightly and not at all) and 11-point numeric scale for social survey. They reported that road traffic noise in Hanoi was mainly due to the frequent horn sounds. They reported that most of the respondents were equally annoyed by motorbikes, cars and heavy vehicles: 60% for motorbikes, 55% for cars and 65% for buses and heavy vehicles. 22 % of respondents were extremely annoyed by the road traffic noise and 56% were very annoyed, 22% were very annoyed by road traffic vibration and 20% of respondents were disturbed very much by being awakened during their sleeps.

Phan *et al.*, (2008) conducted social surveys on community response (using a 5-point verbal scale and an 11-point numeric scale) to road traffic noise and noise measurements have been conducted in major cities in Vietnam, i.e. Hanoi and Ho Chi Minh city. They reported that road traffic noise in both cities is characterized by a large amount of motorbikes emitting frequent horn sounds. They established Dose-response relationships between noise exposure and % highly annoyed.

Lam *et al.*, (2009) studied the noise annoyance response of road traffic and railway noise from social surveys. A path model and structural equation modeling (SEM) were used for analysis of data. They determined annoyance response is largely by noise disturbance and perceived noisiness rather than total noise exposure. They reported that personal noise sensitivity, attitudes towards different means of transport and perceived quality of the living environment contributing factors to annoyance. They suggested that controlling noise exposure alone, when the noise exposure is not very high, is probably not the most effective means to reduce noise annoyance. Strategies that focus on minimizing noise disturbance to daily activities and reducing people's perceived noisiness will probably be more effective.

Hong *et al.*, (2010) established a relationship between subjective annoyance with sleep disturbance from railway trains and road traffic noise from an extensive social survey in Korea. They reported that sleep is affected more by railway noise than by road traffic noise. They reported that the effect of the age on subjective sleep disturbance did not show any statistical significance.

Phan et al., (2010) conducted two large-scale socio-acoustic surveys of community response to road traffic noise to investigate human reactions to road traffic noise in major cities in Vietnam, i.e. Hanoi and Ho Chi Minh city. They established Dose-response relationships between noise exposure and % highly annoyed. They reported that Hanoi respondents seemed to be more annoyed by noise than Ho Chi Minh City respondents. They concluded that conversation and sleep disturbances were not as serious as expected in either city.

Sobotova et al., (2010) conducted to community response to environmental noise (road traffic noise) of students living in the Bratislava. They used a five-graded verbal scale (recommended by experts from the ICBEN (The International Commission on the Biological Effects of Noise) (Not at all; slightly; moderately; very; extremely) for the studies. They reported that road traffic noise interfered significantly with various activities in the exposed group, especially with reading and mental work, listening to radio and TV, telephone communication, rest, falling asleep and sleep (awakening). Also stated that students in the exposed group were significantly more annoyed by road traffic noise and road traffic noise also made them more nervous and irritable.

Fyhri and Aasvang, (2010) conducted a social survey to road traffic noise. They used Structural Equation Models (SEM) for studying the relationship between noise exposure and noise annoyance. They reported that that sleep is an important negative effect of road traffic noise, even if other factors contribute more to sleeping problems. They found significant relationships between noise annoyance at night and sleeping problems for a community sample from structural equation analysis.

III. MODELING OF COLLECTED DATA

There were several methods for analysis of collected data. Regression models are often used for studying the relationship between noise exposure and noise annoyance. However, simple regression models only take into account the direct impacts of noise exposure on health and thus neglect the indirect effects. Path models and Structural Equation Models (SEM) are more powerful alternatives to multiple regression analysis. Factor analysis and cluster analysis were also used for analyzing of data.

A. Path analysis

Path analysis is a statistical technique used primarily to examine the comparative strength of direct and direct relationships among variables and has been widely applied in the fields of social studies. In ecological studies, path analysis is used mainly in the attempt to understand comparative strengths of direct and indirect relationships among a set of variables. In this way, path analysis is unique from other linear equation models: In path analysis mediated pathways (those acting through a mediating variable, i.e., "Y," in the pathway X → Y → Z) can be examined. Pathways in path models represent hypotheses of researchers, and can never be statistically tested for directionality.

Taylor (1984) used SEM to a noise annoyance study around Toronto Airport and proposed an exploratory model for aircraft noise annoyance in relation to several acoustical and non-acoustical factors. **Izumi and Yano, (1991)** made a path analysis with data from social surveys on community responses to road traffic noise in Hokkaido, Japan, and showed the relation between noise exposures, hearing, and sleep disturbances on road traffic noise annoyance. **Osada et al., (1997)** applied this method to social surveys on community responses to road traffic noise in Tokyo.

B. Structural Equation Modeling (SEM)

Path analysis is a subset of Structural Equation Modeling (SEM), the multivariate procedure that, "allows examination of a set of relationships between one or more independent variables, either continuous or discrete, and one or more dependent variables, either continuous or discrete." SEM deals with measured and latent variables. A *measured variable* is a variable that can be observed directly and is measurable. Measured variables are also known as observed variables, indicators or manifest variables. A *latent variable* is a variable that cannot be observed directly and must be inferred from measured variables. Latent variables are implied by the co-variances among two or more measured variables. SEM is a combination of multiple regression and factor analysis. Path analysis deals only with measured variables.

Fyhri and Aasvang, (2009, 2010) used SEM with the help of the software package AMOS 7.0. They reported that the noise–health relationship found no significant effect of either road traffic noise or noise annoyance on reported hypertension or heart problems. There were weak effects on other self-reported health problems (tiredness, headaches, sore throat).

Yokoshima et al., (2007) applied SEM technique on mixed transportation noises without distinguishing the relative strength of road traffic and railway noises. Their model therefore did take into account the presence of multiple sources but stopped short of incorporating the possible effects due to varying strengths of individual sources on noise–annoyance response..

IV. CONCLUSION

A social Survey on community response to road traffic noise has been reviewed from the previous studies. The results of the analysis confirmed that sleep is an important negative effect of road traffic noise. Road traffic noise was mainly caused due to the frequent horn sounds of vehicles. Many of the researchers used path analysis to collected data for analysis. Researchers surveyed the community reactions to road traffic noise relate to various factors, including noise level and personal conditions, and complicated interrelations also exist among the residential reactions. Some of the researchers compared the road traffic noise with railway noise, railway noise has been found to be less annoying.

Most of the researchers used International Commission on the Biological Effects of Noise (ICBEN) scale for surveying the community response to road traffic. From the literature a number of social surveys on community responses to road traffic noise have so far been conducted in Euro-American countries, a few social surveys have been done in Asian countries. So there is need to conduct social surveys in Asian countries in order to prepare new policies for noise control. The literature also suggests that increased media coverage of a new project can sensitize the affected local community and invoke greater negative reactions. Availability and accessibility of information about the noise abatement procedures have also been shown to have significant influence on people's noise annoyance. Researchers obtained remarkably similar results with different measurement techniques.

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