EnvironmentAsia
The international journal published by the Thai Society of Higher Education Institutes on Environment

Available online at www.tshe.org/EA
EnvironmentAsia 3(special issue) (2010) 149-155

# Effect of Traffic Noise on Sleep: A Case Study in Serdang Raya, Selangor, Malaysia

Bavani Nadaraja, Yap Xin Wei and Ramdzani Abdullah

*Department of Environmental Management,Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang,Selangor, Malaysia*

**Abstract**

Traffic noise has been recognised as a serious threat to the quality of life in most industrialised nations. The rapid growth of towns, cities and population has increased the density of traffic. There are various effects of traffic noise on people and these effects are often interrelated. The most common yet serious problem is sleep disturbance. In this study field measurement and questionnaire survey were carried out to determine the overall noise level and the view and opinion of the residents on their sleep disturbance. As the $L_{Aeq}$ was higher than the guideline values, contradictorily the survey results showed that most of the residents sleep time was not affected and they were not really annoyed by the traffic noise. This is mainly because most of the residents at the study area residing there for more than 19 years and this is sufficient enough to describe the pattern of outcome where most of the residents were get used with the traffic noise and they adapt it in their daily life as a norm. Yet, countermeasures such as construction of noise barrier are highly recommended to curb the chronic effects. So, a further study is required to establish this.

***Keywords:*** traffic noise; annoyance; sleep disturbance; noise pollution

## 1. Introduction

Noise has always been an important environmental problem for humans. The foremost form of noise pollution is from transportation sources, mainly motor vehicles, aircraft noise and rail transport noise. Traffic noise is probably the most serious and pervasive type of noise pollution. Traffic noise has become a serious problem now because of inadequate urban planning in the past. Homes, schools, hospitals, churches, libraries and other community buildings were routinely built close to main roads without buffer zones or adequate soundproofing. The problem has been compounded by increases in traffic volumes far beyond the expectations of our early urban planners. This alarming increase in the volume of traffic is actually inversely related to the degradation of the environment (Quis, 2001). Environmental noise can produce negative effects on peopleûs health since it interferes with basic activities such as sleeping, resting, studying and communicating. These effects depend not only on the physical characteristics of the noise itself, but also on parameters associated to each person and each environment. Thus, it is important to study noise pollution from a quantitative point of view as well as from the point of view of the annoyance that it produces in the population (Martin *et al*., 2006).

Noise reduces the depth and quality of sleep thus may adversely effect overall mental and physical health (Öhratröm *et al*., 2006). Studies have shown that irregular noise from traffic of a maximum less of 45 dB (A) affects subjective sleep quality, tiredness the following day and the time necessary to fall asleep (Yoshida *et al.,* 1997). This study attempt to determine the overall traffic noise levels of the study area and compared to the Malaysian Department of Environment's recommendation (Table 1) at the residential area and at the same time to look into the residents' perceptions and awareness about the noise problem in general and sleep disturbance in particular.

## 2. Methodology

The sampling area is located in Serdang Raya, Malaysia. Two monitoring points (residential areas) were selected with different distance from the road to carry out the noise measurements. The continuous day night sampling method (The Planning Guidelines for Environmental Noise Limits and Control, 2004) were used where measurements were taken four times a week for a month. The noise measurement was done by using Integrating Sound Level Meter which complies with the IEC 61672 Class 1 Standard. Microphones were positioned at a height of 1.4m above the ground, and at least 1m from any other reflecting surface (Tempest, 1985). The parameters measured were $L_{max}$, $L_{Aeq}$, $L_{min}$, $L_{10}$, $L_{50}$ and $L_{90}$. The types and quantity of motor vehicles that passed through the area were also recorded.

Table 1. Guidelines for Limiting Sound Level ($L_{Aeq}$) from Road Traffic (For Proposed New Roads or Redevelopment of Existing Roads) from The Planning Guidelines for Environmental Noise Limits and Control (2004) by the Malaysian Department of Environment.

| Receiving Land Use Category | Day Time 7.00 am - 10.00 pm | Night Time 10.00 pm - 7.00 am |
|---|---|---|
| Noise Sensitive Areas<br>Low Density Residential Areas | 55 dBA | 50 dBA |
| Suburban Residential (Medium Density) | 60 dBA | 55 dBA |
| Urban Residential (High Density) | 65 dBA | 60 dBA |
| Commercial, Business | 70 dBA | 60 dBA |
| Industrial | 75 dBA | 65 dBA |

In addition to that, questionnaire survey was carried out to evaluate the opinions of the residents about road traffic noise and sleep disturbance. The questionnaire comprised of 11 questions concerning socioeconomic and demographic data of the respondents, level of annoyance, activities disturbed and evaluation on their sleep disturbance. To avoid any biased opinion, surveys were not introduced to the interviewees in advance and respondents were randomly selected on the basis of simple random sampling method.

## 3. Results and Discussion

The types and total number of vehicles that recorded at the measuring point in the both area A and B are presented in Table 2. It is visible that the total amount of vehicles that passed by the both area were more or less the same, which was around 37000 of vehicles.

Both the Fig. 1 and 2 shows the total number of vehicles that had been passed by along the measuring areas. It's visible that the most dominant source of traffic noise at the both areas was from the motorcar where it contributes about 88% of the total number of vehicles.

Since the P value for the both areas are $p<0.01$, so there is a significant different between time and the amount of vehicles. Generally it can be observed from the both Fig. 1 and 2 that the number of vehicles are at peak around 8am to 9am and again a slight increase around 5pm to 6pm. This phenomenon is due to the office hour which starts at 8am, where everyone is rushing to their work places and again after work, which normally ends around 5pm everyone is returning home

Table 2. Type and Total Number of Vehicles at the Area A and B

| Area | Day | Monday | Wednesday | Friday | Sunday | Total | Percentage |
|---|---|---|---|---|---|---|---|
| A | Motorcar | 3562 | 3398 | 4524 | 5064 | 16548 | 88.78 |
| | Motorcycle | 330 | 345 | 381 | 390 | 1446 | 7.76 |
| | Lorry | 131 | 155 | 175 | 123 | 584 | 3.13 |
| | Bus | 9 | 10 | 22 | 17 | 58 | 0.31 |
| | Others | 1 | 0 | 1 | 2 | 4 | 0.02 |
| **Total** | | 4033 | 3908 | 5103 | 5596 | 18640 | 100 |
| | | | | | | | |
| **Area** | **Day** | **Monday** | **Wednesday** | **Friday** | **Sunday** | **Total** | **Percentage** |
| B | Motorcar | 3680 | 3420 | 4443 | 5189 | 16732 | 88.62 |
| | Motorcycle | 339 | 360 | 387 | 419 | 1505 | 7.97 |
| | Lorry | 146 | 161 | 176 | 106 | 589 | 3.12 |
| | Bus | 13 | 9 | 17 | 12 | 51 | 0.27 |
| | Others | 0 | 0 | 1 | 2 | 3 | 0.02 |
| **Total** | | 4178 | 3950 | 5024 | 5728 | 18880 | 100 |

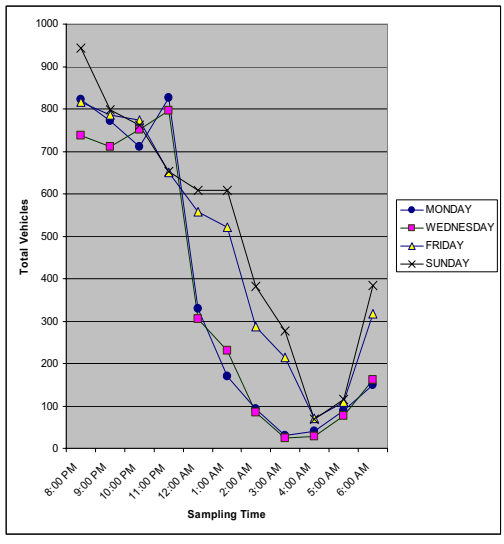



Figure 1. Total Numbers of Vehicles at the Sampling Area A

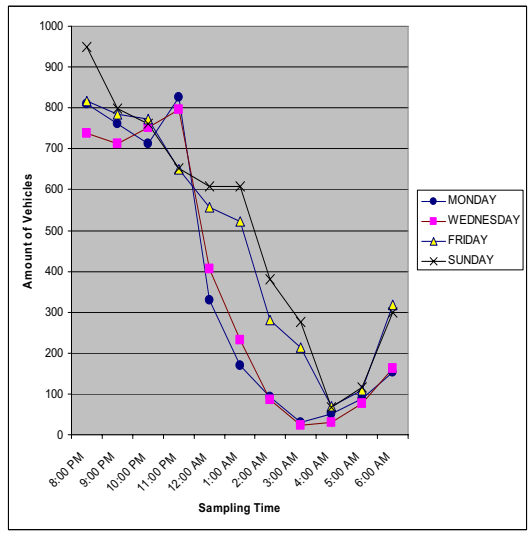
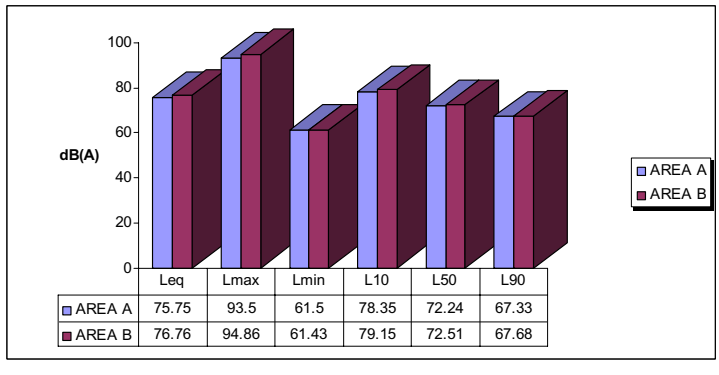



Figure 2. Total Numbers of Vehicles at the Sampling Area B




| | Leq | Lmax | Lmin | L10 | L50 | L90 |
|---|---|---|---|---|---|---|
| AREA A | 75.75 | 93.5 | 61.5 | 78.35 | 72.24 | 67.33 |
| AREA B | 76.76 | 94.86 | 61.43 | 79.15 | 72.51 | 67.68 |

Figure 3. Average Noise Level at Each Measuring Point, A and B

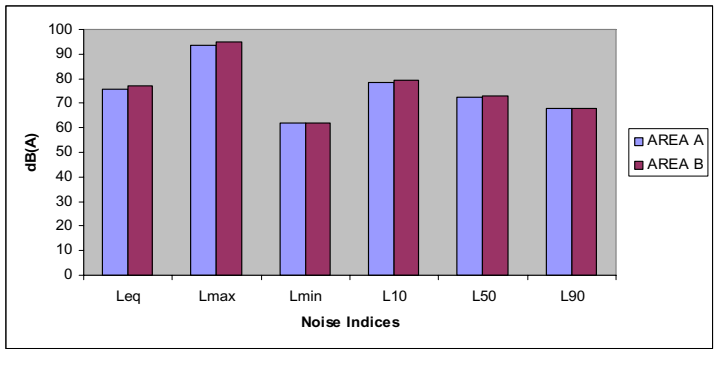



Figure 4. Average Noise Level in Area A and B on Weekdays

after work. The highest number of vehicle was recorded on the Sunday morning. Generally, the results of noise measurements showed that there was a variation in the noise level for the both area A and B. As shown in the Fig. 3, since the total amount of vehicles that passed by the both area A and B does not have much significant differences, so the average reading of the $L_{max}$, $L_{Aeq}$, $L_{min}$, $L_{10}$, $L_{50}$ and $L_{90}$ for the both measuring points shows a very similar results.

### *3.1. Noise Level on Weekdays and Weekends*

The average noise level in each measuring point A and B on weekdays and weekends were shown in Fig. 4 and 5 respectively.

Generally, the results in Fig. 4 and Fig. 5 reveal that there was only a small variation of noise level on weekdays and weekends for the both measuring points. The results showed that residents

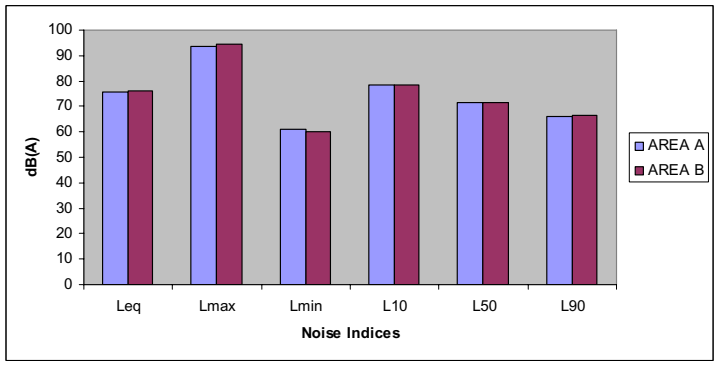



Figure 5. Average Noise Level in Area A and B on Weekends

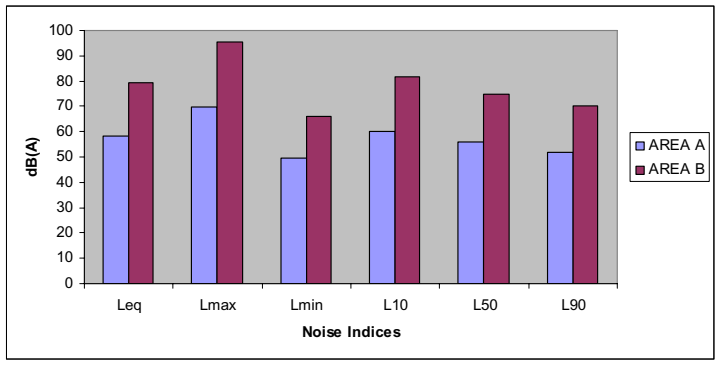



Figure 6. Average Noise Level at the Daytime on Weekdays

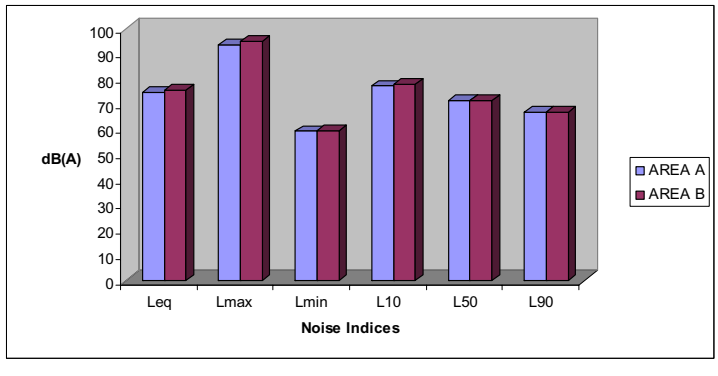



Figure 7. Average Noise Level at the Night Time on Weekdays

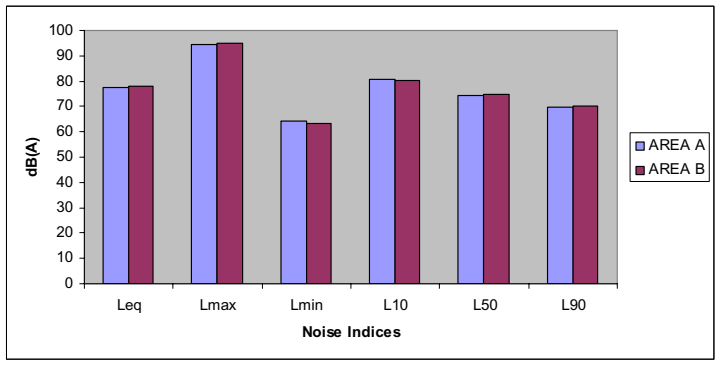



Figure 8. Average Noise Level at the Daytime on Weekends

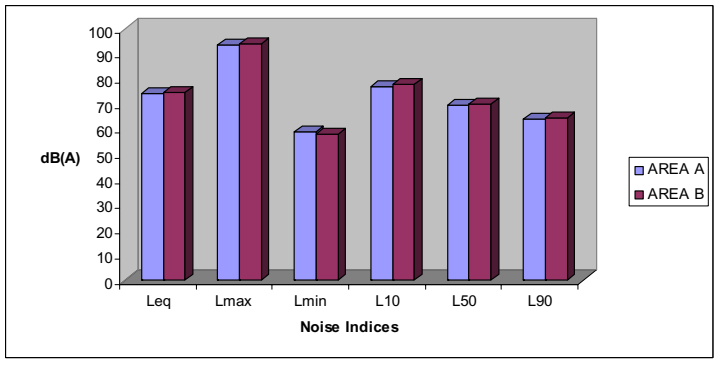



Figure 9. Average Noise Level at the Night Time on Weekends

were exposed to equivalent noise levels ($L_{eq}$) ranged from 73.1 dB (A) to 79.2 dB (A) on weekdays and 72.9 dB (A) to 80.5 dB (A) on weekends. For both weekdays and weekends, it is noticeable that the $L_{max}$ is higher at the Area B compared to the Area A. This is mainly because of the location of the measuring point where it is quite near to the main road where a lot of vehicles will pass by along the road which heading to Serdang Town.

### *3.2. Noise Level for Daytime and Night Time on Weekdays and Weekends*

Figs 6-9, show the comparison of the noise level between daytime and night time at the Area A and B, both on weekdays and weekends. Generally from the figures it was observed that the noise level during night time was much lower than daytime. This was due to reduced human activities during night time. In daytime, the $L_{eq}$ fluctuated about 4.3 dB (A) on weekdays and 4.7 dB (A) on weekends. Meanwhile, at night time, the $L_{eq}$ fluctuated about 6.7 dB (A) on weekdays and 4.5 dB (A) on weekends. Since the P value was $p<0.05$, there was a significant different between noise level and time. From the figure it can be observed that when night time arrive, the human activities become less and the volume of vehicles was reduced as well.

The data obtained were compared with the World Health Organization Health Criteria and the standards from the other countries such as Australia, Germany, Korea and Philippines. It could clearly been seen that the noise level measured in this study exceeded the recommended standards and guidelines in the daytime as well as in the night time. In the daytime, the noise level was 18 dB (A) higher than the World Health Organization (WHO), Recommended Health Criteria and 8 dB (A) higher than Malaysian standards. On the other hand at the night time there was a tremendous different between measured noise level and the other standards. As can be seen from Table 3, the night time noise level measured in this study exceeded the WHO Recommended Health Criteria by 30 dB (A) and the Malaysian guideline values by 15 dB (A).

Table 3. Comparison of Noise Level Measured With Recommended Noise Level Standards and Guidelines by WHO and Other Selected Countries

| Selected Noise Level Standards | Noise Level, $L_{eq}$ dB (A) | |
|---|---|---|
| | Daytime | Night Time |
| Noise Level Measured During the Study | 73 | 75 |
| WHO Recommended Health Criteria | 55 | 45 |
| Germany (Noise Level Guidelines) | 45 | 35 |
| Australia (Recommended Outdoor Background Noise Level | 45 | 35 |
| Japan (Environmental Quality Standards) | 45 | 35 |
| Korea (Environmental Quality Goal) | 50 | 45 |
| Philippines (Environmental Quality Noise Standards) | 50 | 40 |
| Malaysia (Planning Guidelines for Environmental Noise Limits and Control) | 65 | 60- |

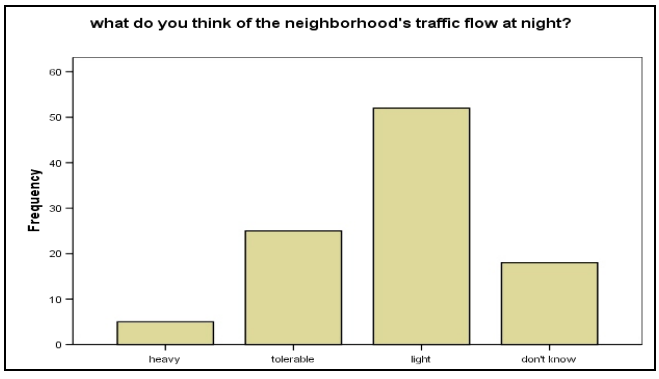



Figure 10. Community Responses on the Traffic Flow at Night Time

*3.3. Questionnaire Survey*

During the realization of this study it was observed that traffic noise was not the major source of environmental noise pollution according to the respondents. The findings of the social survey in Fig.10 revealed that only 5 respondents felt that the traffic flow at night was considered heavy and on the other hand more than 70 percent of respondents felt that the traffic flow was light or tolerable.

When the respondents were asked to comment on the traffic noise at night time, as shown in Fig. 11, only 1 percent of the respondents said it was noisy and affects their night time leisure time but more than half of the respondents (53 percentages) said it was not noisy and they are going on very well with their daily chores.

In the survey, to analyse the relation between perceived interference from road traffic noise with sleep the study sample was divided in those who reported that road traffic noise did not interfere with their sleep and those who reported there was such interference.

From the survey outcome it can be observed that only about 12.5 percentage respondents reported that road traffic noise interfered with their sleep. These respondents woke up more often, had worse sleep quality and had more problems with feeling sleepy during daytime than respondents who said no sleep interference from road traffic noise. The important observation that must noted was that there were about 87.5 percent of the respondents said that there were no interferences in their sleeping quality. This observation was supported by the fact that about 53 percentages of respondents felled that the traffic flow was not in the state of noisy for them as in Fig. 11. This scenario may be due to the fact that most of residents were already used to the traffic noise and they had accepted the noise as part of their living environment because from the survey results it was clearly can be seen, where about 75 percent of the residents were staying there for more than 19 years.

Even though the traffic noise was not a big problem for the respondents, however they were still hoping for much more quitters and conducive living environment. This was visible from the survey outcome where about 87.5 percent of the respondents felt that when the noise levels around their residential area were reduced they will have a better and peaceful environment. They felt that they will enjoy their stay at the residential area even more and have a better quality of life.

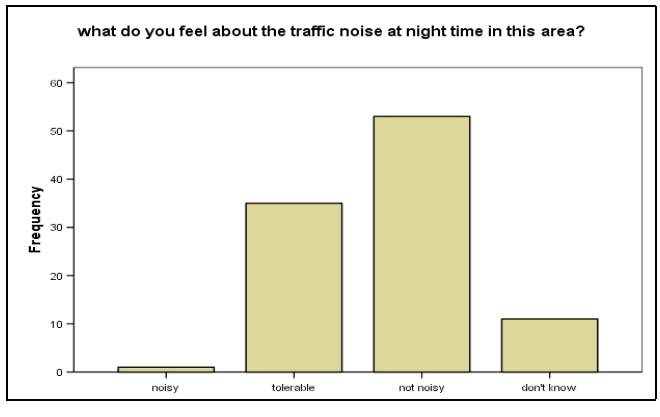



Figure 11. Community Responses on the Traffic Noise at Night Time

## 4. Conclusions

The results of this study showed that there is a significant difference in noise levels and opinions of noise pollution among the respondents. Even though the noise level at the both measuring point A and B had exceeded the WHO Recommended Health Criteria in general and specifically the Malaysian guideline values, surprisingly the residents were not annoyed with the traffic noise. Only a small percentage of them were experiencing sleep disturbance at night. This indicated lack of knowledge and awareness among the residents about the traffic noise pollution. In order to overcome these problems the most effective one is to promote awareness of the population about the risks of daily exposure to high noise levels. In addition to that the authorities should act by providing proper noise control measures such as erection of effective noise barriers should be taken and implemented.

**Acknowledgements**

The authors would like to express their utmost gratitude to Assoc.Prof.Dr Ramdzani Abdullah for his guidance throughout this study. The authors would like to thank Department of Environmental Management, Faculty of Environmental Studies, University of Putra Malaysia for good support of this project.

**References**

Department of Environment. The Planning Guidelines for Environmental Noise Limits and Control, Ministry of Natural Resources and Environment, Putrajaya, Malaysia. 2004.

Martin MA, Tarrero A, Gonzalez J, Machimbarrena M. Exposure-Effect Relationships between Road Traffic Noise Annoyance and Noise Cost Valuations in Valladoid, Spain. Applied Acoustics 2006; 67: 945-58.

Öhraström, Evy, Hadzibajramovic, Emina, Holmes, Maria and Svensson, Helena. Effects of Road Traffic Noise on Sleep: Studies on Children and Adults. Journal of Environmental Psychology 2006; 26: 116-26.

Ouis D. Annoyance from Road Traffic Noise: A Review. Journal of Environmental Psychology 2001; 21: 101-20.

Tempest W. The Noise Handbook, Academic Press, London. 1985.

WHO. Environmental Health Criteria 12: Noise, World Health Organization, Geneva. 2000, 2004.

Yoshida, T, Osada, Y, Kawaguchi T, Hoshiyama Y, Yoshida K, Yamamoto K. Effects of Road Traffic Noise on Inhabitants of Tokyo. Journal of Sound and Vibration 1997; 205(4): 517-22.

*Received 27 August 2009*
*Accepted 3 September 2009*

**Correspondence to**
Dr.Ramdzani Abdullah
Department of Environmental Management
Faculty of Environmental Studies
Universiti Putra Malaysia
43400 UPM Serdang,
Malaysia.
Tel. (603)8946 6759
Fax: (603)8947 6768
Email : ramdzani@env.upm.edu.my