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EFFECTS OF A BELT OF TREES ON ROAD TRAFFIC NOISE ANNOYANCE

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1. INTRODUCTION

A number of studies on noise reduction by belts of trees have so far been carried out and have shown significant reduction in higher frequency range. Of these studies, Kragh[1] pointed out that the psychological effect was more important rather than the physical effect. A considerable number of studies on the psychological and physiological effects have also been performed by using experimental methods. There are, however, few studies based on social surveys probably because of the lack of the areas suitable for the survey. The present study investigates the effect of a belt of trees on road traffic noise annoyance by comparing the community response to noise at the sites with and without a belt of trees.

2. METHOD

Social Survey

A social survey on community response to road traffic noise was carried out along a traffic road in Tomakomai, northern Japan. There is a 17m wide belt of trees only on the north side of the road. Walkways are made through the belt of trees. The traffic volume was counted manually for 24 hours, which was 24,500 per day and the ratio of heavy vehicles was 10.2%.

The questionnaire contains 62 questions, which are related to personal factors, environmental factors, environmental pollution factors, housing factors and effects of road traffic noise. Houses are all detached and are facing the road or separated from it by one or two houses. 290 people, 18 to 65 years of age, were randomly selected from the residence registers on one person per one house basis.

In total, 268 respondents were obtained from them. 184 respondents facing the road or separated from it by one house are used in the following analysis. That is to say, the respondents are 100 on the side with the belt of

trees (north side of the road) and 84 on the side without it (south side of the road). Responses may be affected by the direction of the main windows. The main windows are facing the road on the north side, while they are not on the south side. This situation may not operate to reject the hypothesis that the belt of trees mitigates the road traffic noise annoyance.

Noise measurement

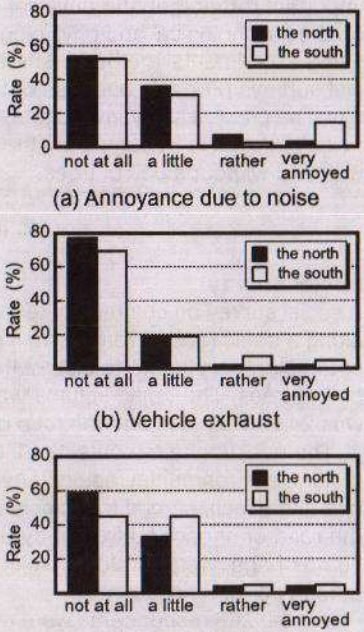
A day-long noise measurement was carried out at a reference point, at a road shoulder in the center of the road. Simultaneous measurements for 5 minutes were also carried out at the road shoulders closest to houses and in front of the houses in order to estimate the noise reduction from the road to the houses. The noise indices such as L_{eq}, L_{dn} and L_{max} were calculated with the whole-day data sampled at every second. In the noise reduction measurements, the sites were divided into 6 blocks taking account of the characteristics of the blocks, and simultaneous measurements were performed at 10 houses in every block. The noise reduction of other houses were estimated by multi-regression formula made by noise reduction data. The noise exposures of all houses were estimated by considering noise reduction of each houses from noise level at the reference point.

3. RESULT AND DISCUSSION

Histograms of the effects of noise

Age distribution of respondents is not different in both sides. Noise exposure is smaller on the north side with a belt of trees than on the south side without it. A systematic difference is not found in noise sensitivity of respondents on both sides. The evaluation of road safety and natural environment is better on the north side than on the south side. This shows that the belt of trees and the walkways through it are favorably evaluated. But 80% of respondents of each side don't feel uncomfortable in air pollution.

Figures 1(a) to (c) show the histograms of some effects of road traffic noise. There are more respondents who are "very annoyed" due to road traffic noise on the south side than on the north side as shown in Fig.1(a). The ratios of respondents who feel "rather annoyed" and "very annoyed" by vehicle exhaust are a little larger on the south side than on the north side



(a) Annoyance due to noise

(b) Vehicle exhaust

(c) House vibration

Fig. 1 Histograms of effects of noise

as shown in Fig.1(b), though the difference for air pollution is not found on both sides as is mentioned above. This may be a psychological effect of the belt of trees. In Fig.1(c) for house vibration, the ratio of respondents who don't feel annoyed is larger on the north side than on the south side. It is because the distance from the road to houses is longer on the north side than on the south side.

Dose-response relationship

Figure 2 compares dose-response relationships for four types of respondents, those living in the houses facing the road or not, and those in the houses facing the belt of trees or not. The rate of "% very annoyed" is the largest in the case that the houses are directly facing the road, and smallest in the case that the houses are facing the belt of trees. However, the dose-response relationships in the case that houses are not facing the road nor the belt of trees show a similar trend and the responses lie in between the cases of the houses facing the road and the houses facing the belt of trees. This suggests that annoyance may be eased up by concealing the noise source and further more by facing trees.

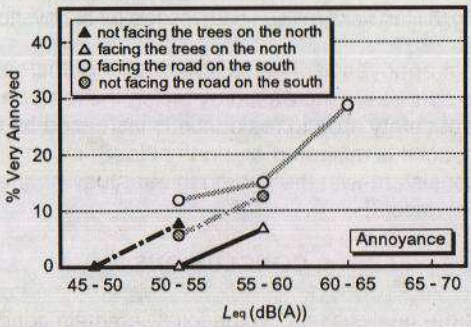


Fig. 2 Dose-response relationship for annoyance

Path analysis of annoyance

Path analysis is useful to clarify causal relationships between annoyance and various factors. Figs.3 (a) and (b) show the total (direct + indirect) effects of the revised path models which are reconstituted by statistically significant factors used in a priori path models for both side. The coefficients of determination of the models are 0.623 for the north side and 0.624 for the south side.

In Figs.3 (a) and (b), a common remarkable point is that vehicle exhaust and vibration have strong effect on noise annoyance. This shows that measures against exhaust and vibration are very important for noise annoyance reduction. These results support the findings obtained in our previous study[2].

Specifically on the north side with the belt of trees, road safety strongly affects annoyance, while quality of sleep, sensitivity to noise and L_{eq} affect annoyance more on the south side. This seems to represent well how vari-

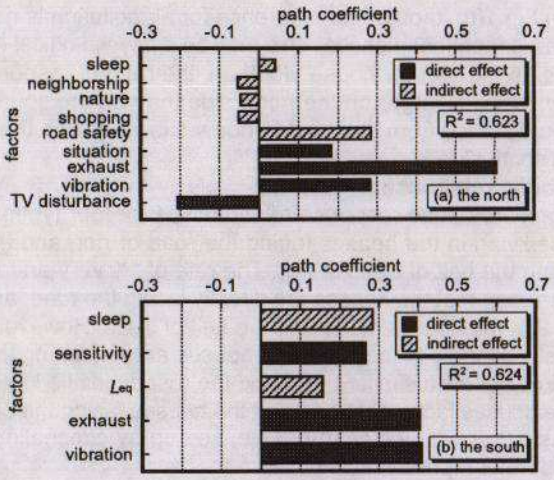


Fig. 3 Results of revised path models for annoyance

ous factors affect annoyance. That is, the effects of factors relating to the attitude to noise source are increased by facing the road on the south side, while the effect of safety around residence is increased by facing the trees and noise annoyance is mitigated on north side. Such an effect of trees on annoyance is consistent with the finding in our study on the effect of noise barriers on annoyance[3].

4. CONCLUSIONS

The results of the analysis lead to the following main conclusions.

1) It is found from dose-response relationship that annoyance may be eased up psychologically by the belt of trees .
2) Vehicle exhaust and vibration have strong effect on noise annoyance commonly on both sides and thus the measures against them are found to be very important.
3) On north side without a belt of trees, factors relating to noise source strongly affect annoyance by facing the road, while the effect of safety affect annoyance more on the north side with trees. This is reasonable to interpret the causal relationship between annoyance and other factors.

References

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