The effect of regional living environmental improvement on community response to aircraft noise

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INTRODUCTION

During the past four decades, the Japanese Government has performed any kind of measures for mitigating severe noise impact around airfields, which means civil airports and airbases of defense facilities, systematically under the national framework of airfields environmental measures. Although the aircraft noise measures of our country have introduced in the emergency when the aircraft noise exposure level was enormous, modern concept of environmental problems have changed from that of end-of-pipe to the principle of prevention. It can be said as an efficient preventive measure that making up the situation in which resident moderates community annoyance with constructing the good partnership between local community and airfields even if the people live in the high noise exposure region. As shown by Mayuzumi (2003) and Shinohara et al. (2007), the land around airport is used for creating natural ecosystem, contribution to agricultural industry, developing of a resource recycling system and so on around Narita International airport. This land use would be performed in order to promote a partnership between airport and the residential or local community as well as to prevent noise related problems from occurring.

This paper gives the results of a small size questionnaire survey around a military airfield in order to examine the effect of regional living environmental improvement on response to aircraft noise and discuss about promoting a better partnership between defense facilities and the local community or residence.

METHOD

Procedure

Questionnaire survey was conducted to the residents living around Atsugi airbase in 2006 using a leave-and-pick-up method. The airbase is operated by Japanese self-defense force and US force. The questionnaire was distributed to residents living in the area where the noise exposure level ranged from 70 to 90 by $WECPNL_d$. The index of $WECPNL_d$ used for Japanese airbases is denoted using an approximation of the original equation defined in the past document of ICAO Annex 16 and Japanese original index, where, $WECPNL_d$ is nearly equal to L_{den} + 18 dB. In this paper, L_{den} is used for the index of noise exposure level.

Questionnaire

Questionnaires included the five items questions which were 1) evaluation of quality of life such as convenience of life, total living environment, degree of satisfaction with work, recreation and so on, 2) evaluation of living environment such as local air quali-

ty, sound environment, urban ecosystem and local water quality, 3) evaluation of annoyance of aircraft noise, 4) degree of satisfaction with measure for regional living environmental improvement such as improvement of urban ecosystem or construction of public facilities and 5) face sheet. 5-point verbal annoyance scale ("extremely", "very", "moderately", "slightly" and "not at all") was used in the questionnaire of item 3.

Respondents

Table 1 shows the sample size and valid responses of this survey. The questionnaire was distributed to 144, 197, 467 and 394 residents living in the areas where L_{den} is less than 57, ranged from 57 to 62, from 62 to 67 and more than 67 respectively. The total sample size of this study was 1202. As a result of the survey, 362 responses were obtained from the areas (response rate 30.1 %). Table 2 shows gender and age of the valid respondents.

Table 1: The sample size and valid responses of this survey

L_{den}	Valid responses	Distribution	Valid response rate
-57	90	394	23 %
57-62	118	467	25 %
62-67	41	197	21 %
67-	31	144	22 %

Table 2: Gender and age of the valid respondents

Age	Male	Female	Total
20-29	3	2	5
30-39	4	13	17
40-49	12	23	35
50-59	39	24	63
60-69	70	30	100
70-	54	6	60
Total	182	98	280

RESULTS

Dose-response relationship between %HA and L_{den}

Using data of item 3 in the questionnaire, dose-response relationship between L_{den} and highly annoyed response rates was calculated and shown in Figure 1. The number of people who responded to only top category of 5-point verbal scale was counted as percent highly annoyed (%HA). X-axis means L_{den}, Y-axis means scale value of annoyance. Bar scale means 95% confidence interval. Jonckheere-Terpstra trend test was taken and it was confirmed that %HA significantly increased according to L_{den}.

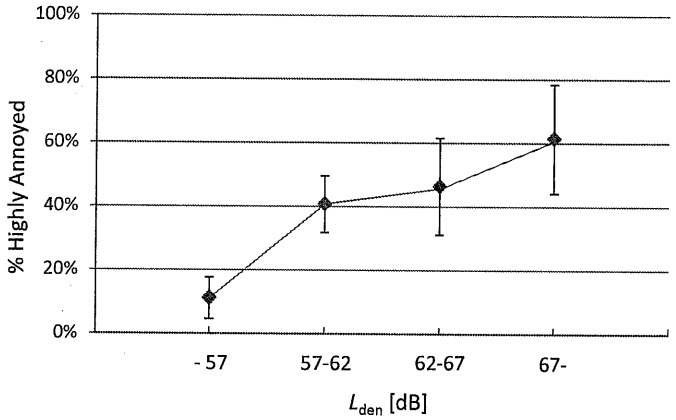

Figure 1: Dose-response relationship between L_{den} and %HA (Bar scale means 95% confidence interval of %HA for each L_{den} category)

Degree of satisfaction with measure for regional living environmental improvement

Using data of item 4 in the questionnaire, the relation between degree of satisfaction with measure for regional living environmental improvement and L_{den} was examined. The evaluation of the satisfaction on verbal scale ("satisfy", "not satisfy" and "neither") were dichotomized by categorizing as "satisfy" response and "not satisfy or neither" response. Multiple logistic regression analysis was applied to the rate of "satisfy" response. The categories of L_{den} (less than 57, 57-62, 62-67 and more than 67 dB) were included in the logistic model as independent variables. In order to adjust for confounding factors, gender (male, female), age (20-39, 40-59, and elder than 60) and residence year (less than 1 year, 1-3 years, 3-10 years, and more than 10 years) were also included in the model as independent variables.

Figure 2 shows the result for the logistic regression analysis. The control of the odds ratio was the value at the site of "less than 57 dB". The asterisk indicates significant odds ratios (*: $p<0.05$, **: $p<0.01$).

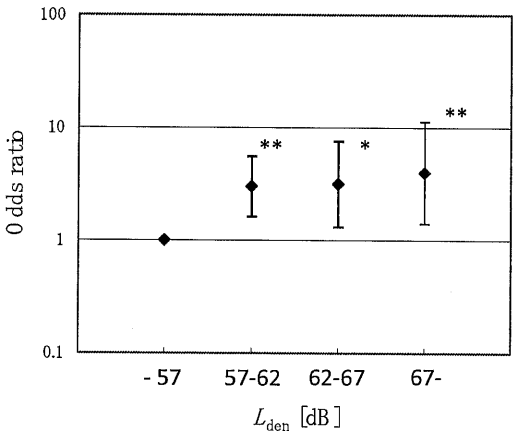

Figure 2: Odds ratio of satisfaction with measure for living environment improvement vs. L_{den} (Bar scale means 95% confidence interval of odds ratio for each L_{den} category)

This result suggests that residents living in the area where aircraft noise level is moderately high are not satisfied with measure for living environment improvement now, and there is some kind of inter-linkage between satisfaction with the measure and annoyance.

Effect of regional living environmental improvement on community response

Figure 3 shows two kinds of dose-response relationships, one is calculated using response of annoyance whose respondent satisfied with the environmental improvement around airbase such as developing parks, and the other is calculated using response rate of annoyance whose respondent doesn't satisfy with. X-axis means L_{den}, Y-axis means scale value of annoyance. Bar scale means 95% confidence interval. It is found that the feeling of annoyance is mitigated by satisfying with environmental improvement in the area where L_{den} is less than 62 dB. This result suggests the possibility that defense facilities and the local community or residence can promote a better partnership if the land-use or environmental improvement is accepted by residence after aircraft noise exposure level is decreased on a some level. At the same time, the feeling of satisfaction with environmental improvement doesn't contribute to mitigating annoyance in the region where noise exposure level is higher, and this result also supports the concept of traditional aircraft noise measure that noise reduction at source should be done firstly in the area where aircraft noise exposure level is enormous.

Figure 4 shows the ideal measure for living environmental improvement that respondents answered in the questionnaire item 4. Many of them answered that urban ecosystem is needed. Urban eco system might assume an important role for promoting a better partnership between defense facilities and the local community or residence.

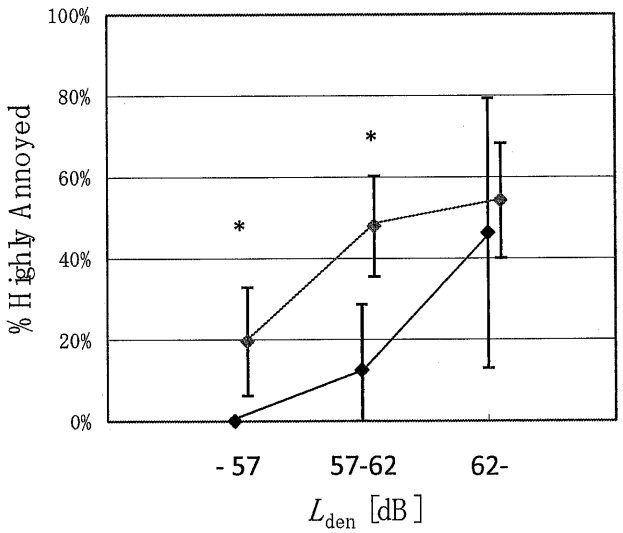

Figure 3: %HA vs. L_{den} and satisfaction with measure for living environmental improvement (Bar scale means 95% confidence interval of %HA for each L_{den} category)

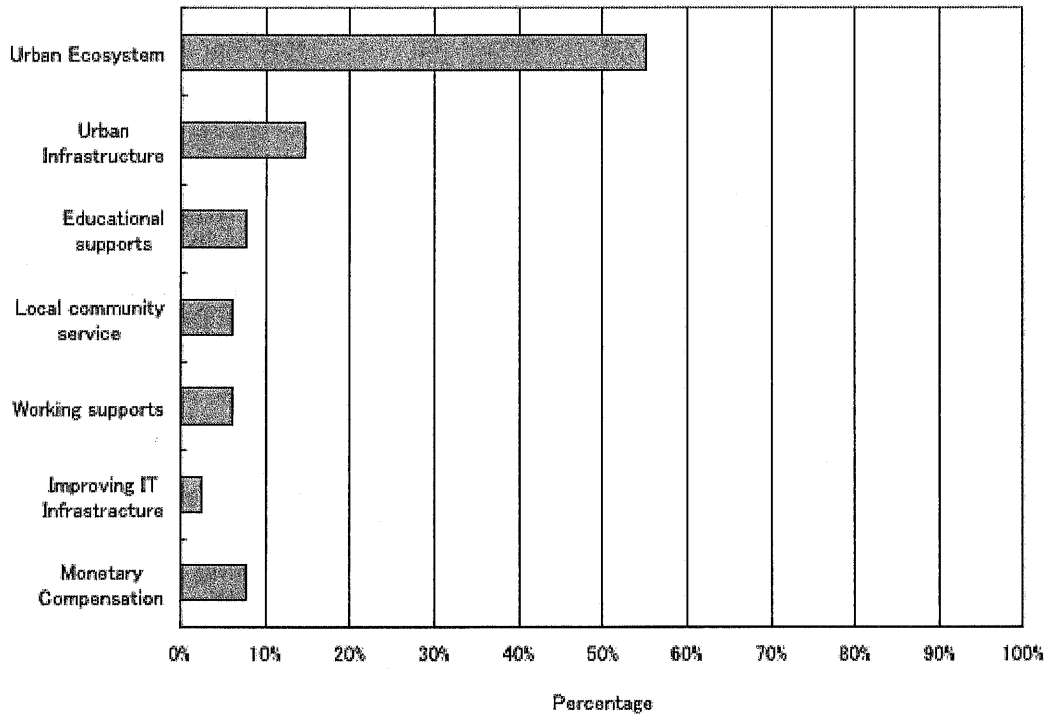

Figure 4: The ideal measure for living environmental improvement that respondents answered

CONCLUSION

This paper gives the results of a questionnaire survey around a military airfield and it was found as below.

- Residents living in the area where aircraft noise level is moderately high are not satisfied with measure for living environment improvement, and there is some kind of inter-linkage between satisfaction with the measure and annoyance.
- It would be suggested that the possibility that defense facilities and the local community or residence can promote a better partnership if the land-use or environmental improvement is accepted by residence after aircraft noise exposure level is decreased on a some level.
- The feeling of satisfaction with environmental improvement doesn't contribute to mitigating annoyance in the region where the amount of the noise exposure is higher.
- Urban eco system might play an important role for promoting a better partnership between defense facilities and the local community or residence.

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Issues in the development of a survey simulation tool to explore robust estimation of models of annoyance due to aircraft noise

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ABSTRACT

A community survey simulation tool is described that has been developed to examine the effects of sampling populations around airports on the estimation of annoyance models. Aircraft noise exposure is predicted on a fine grid around airports for single operations with Integrated Noise Model (INM) or Noise Model Simulation (NMSim); these are used with airport operations scenarios to determine noise exposure at points on a finely resolved grid. Survey populations are defined for the areas surrounding the airports using available microdata and aggregate data from the U.S. Census; households and associated individuals are assigned to noise grid points. Demographic data can be incorporated into the simulation tool to examine the potential for non-acoustic confounding factors. Various sampling methodologies and signal-to-noise ratios are used in Monte Carlo simulations to examine how they affect parameter estimates in an annoyance model that includes number-of-events and a measure of average event sound level as predictor variables.

INTRODUCTION

A goal of current research is to predict how a community will react to changes in airport operations. Advances in aircraft design are resulting in reductions in sound level produced by aircraft, but aviation forecasts predict continuing growth in air traffic in the years to come. A central question surrounding the topic of annoyance to aircraft noise concerns a trade-off between the number-of-events and the sound level of aircraft. Most predictive models of community annoyance to aircraft noise are functions of the average A-weighted sound energy and do not explicitly contain an independent number-of-events term. Different combinations of aircraft sound levels and number-of-events can produce the same A-weighted energy average, but do they result in the same level of community annoyance?

Several researchers have developed models that are an alternative to energy equivalence-based models such as L_{dn}, L_{den}, or L_{night}. These alternative models typically contain two types of terms: measures of the sound level of events, e.g., average of individual events' PNL_{max}, L_{Amax}, *ASEL,* etc.; and number-of-events (*N*) above a certain sound level (Rylander et al. 1980), or the logarithm of the number-of-events above a certain sound level (TRACOR 1970, 1971; Connor & Patterson 1972, 1976; Rice 1977a, b; Powell 1980; Bullen & Hede 1986a, b; Vogt 2005; Le Masurier et al. 2007). The noise exposure forecast (*NEF*), Australian variant (*ANEF*), and Noise and Number Index (*NNI*) are community noise metrics that also involve number-of-events terms, see, e.g., Bradley (1996). While such measures are used in some countries, other countries have moved to using metrics based on average A-weighted sound energy. In the ANASE study in the UK (Le Masurier et al. 2007) there was an argument made for including a number-of-events term based on a comparison of the data collected in that study to data collected earlier in the Aircraft Noise Index Study (Brooker et al. 1985), though there is some disagreement as to whether the data supported that conclusion (Brooker 2008a, b).