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Community response to aircraft noise in Ho Chi Minh City and Hanoi

Thu Lan Nguyen [a,*], Takashi Yano [a], Huy Quang Nguyen [a], Tsuyoshi Nishimura [b,1], Hiroaki Fukushima [b,1], Tetsumi Sato [c,2], Takashi Morihara [d,3], Yoritaka Hashimoto [e,4]

[a] Graduate School of Science and Technology, Kumamoto University, 2-39-1 Kurokami, 860-8555 Kumamoto, Japan
[b] Graduate School of Engineering, Sojo University, 4-22-1 Ikeda, 860-0082 Kumamoto, Japan
[c] Faculty of Engineering, Hokkai Gakuen University, Minami 26-Jo, Chuo-ku, 064-0926 Sapporo, Japan
[d] Ishikawa National College of Technology, Kitachujo Ta-1, Tsubata, Kahoku, 929-0392 Ishikawa, Japan
[e] Faculty of General Information, Okayama University of Science, Ridai-cho 1-1, Kita-ku, 700-0005 Okayama, Japan

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ABSTRACT

To formulate Vietnamese and global noise policies, social surveys on community response to aircraft noise and combined noise from aircraft and road traffic were carried out in Ho Chi Minh City from August to September 2008 and in Hanoi from August to September 2009. In total, 1562 and 1397 responses were obtained in Ho Chi Minh City and Hanoi, respectively. The aircraft noise was measured for seven successive days, and the combined noise was measured for 24 h. Aircraft and combined noise exposures ranged from 53 to 71 dB and 73 to 83 dB L_{den} in Ho Chi Minh City and from 48 to 61 dB and 70 to 82 dB L_{den} in Hanoi, respectively. The dose–response curve for aircraft noise for Vietnam was established and fitted onto the curve for the European Union. For the same noise exposure, the aircraft noise annoyance in Hanoi was higher than that in Ho Chi Minh City because of the lower background noise level in Hanoi.

1. Introduction

Noise policies are broad in scope. They must include at least exposure limits and an action plan of noise abatement as well as expenses and payment that cover many fields of technical, social, and economic sciences. Community noise-control policies and guidelines on mitigating noise have been laid down in many developed countries, especially in Europe [1–3]. Boegli et al. [4] introduced a noise abatement policy consisting of six basic principles in which exposure–response relationships were defined as the base principle of the framework. Miedema and Vos [5] presented exposure–response relationships for three transportation noise sources. These strongly affected the recommended curves in successive EU position papers in 2002 (e.g., [1]) and then affected EU noise regulation. In 1999, to facilitate global coverage and applicability, the Guidelines for Community Noise (WHO) [6] were prepared to improve guidance at the national and regional level. The guideline values were given for specific environments, for example, a criteria level that is defined to cause a serious annoyance during daytime and in the evening for the outdoor living area is 55 dB (L_{Aeq}). However, it has been pointed out in many studies that community response to noise was affected by non-acoustic factors such as culture, climate, lifestyle, and house type [7–9]. Hence, a question arises as to whether the findings of previous studies, which were obtained mainly for developed countries, are applicable to the rest of the world, especially developing countries. Many papers on noise policies in developing and emerging countries were presented by Finegold and Schwela [10]. They emphasized a concern about whether the approaches being taken by western governments are applicable for implementation in developing and emerging countries. Indeed, a special effort was said to be needed in order to better understand the differences between "developed" and "developing and emerging" countries and the implications of these differences in implementing adequate noise control approaches. Vietnam is the second most populous country in Southeast Asia with 31.7 million people living in urban areas accounting for 37% of the national population. The impact of market-based economic transformation and its pace have severely affected Vietnam's transportation conditions, resulting in an increasing volume of traffic and much noise being emitted from vehicles. The involvement of Vietnam will contribute to the knowledge of the situation of developing and emerging countries in terms of environmental noise in the world. It is supposed to be a meaningful voice when global policies are discussed.

* Corresponding author. Address: Kumamoto University, Graduate School of Science and Technology, Department of Architecture, 2-39-1 Kurokami, 860-8555 Kumamoto, Japan. Tel.: +81 96 342 3560.
E-mail addresses: linh2lan@gmail.com (T.L. Nguyen), yano@gpo.kumamoto-u.ac.jp (T. Yano), nhuyquang@yahoo.com (H.Q. Nguyen), nisimura@cis.sojo-u.ac.jp (T. Nishimura), sato@arc.hokkai-s-u.ac.jp (T. Sato), morihara@ishikawa-nct.ac.jp (T. Morihara), hashimoto@archi.ous.ac.jp (Y. Hashimoto).
[1] Tel.: +81 96 326 3605.
[2] Tel.: +81 11 841 1161.
[3] Tel.: +81 76 288 8185.
[4] Tel.: +81 86 256 9634.

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The first official document relating to noise assessment in Vietnam was published in 1979 and was for noise in the workplace. It was known as TCVN3150-1979 and regulated "Methods for measuring noise at workplaces in manufacturing areas". It took until 1988 for the first specific data on community noise exposure measured in Hanoi, the capital of Vietnam, to be published. However, documented data are very limited with only three noise values available during a day—average level for the rush hour in the morning, rush hour in the afternoon, and all day. In total, 41 noise standards have been promulgated in Vietnam up to November 2009. These standards have mainly focused on acoustic measurement methods and noise emitted by particular vehicles and machines. Community noise is mentioned in only one standard—TCVN 1549-1998. This standard regulates the maximum permitted noise level in public and residential areas irrespective of the sources of that noise. These standards are constructed based on the experience of western countries and Japan. Actual exposure data measured in two major cities in Vietnam, Hanoi and Ho Chi Minh City, were shown to exceed those regulated in these criteria by 8–33 dB. The application of these standards is indeed very limited since they were not constructed based on actual figures from Vietnam and were not accompanied by the documents of cooperation or pays principles.

Therefore, the first and also the most important thing needed to do to initiate the establishment of noise policy in Vietnam is to propose dose–response relationships based on actual data of exposure and community response in Vietnam. In order to meet this requirement, community response to transportation noise has been investigated in Hanoi and Ho Chi Minh City, since 2004. It has been found that the Vietnamese were less annoyed by road traffic noise by about 5 dB than European people [11]. The dose–response relationships for the Vietnamese were established for road traffic noise exposure and annoyance response. The present study, which assesses the effects of another type of transportation noise, that is, aircraft noise, is essential to generate a database for formulating Vietnamese and global noise policies.

Along with the rapid development of road traffic, another section of Vietnam's transportation network, the civil aviation market, is now in a phase of strong and rapid growth. The civil aviation market is expected to carry 84 million passengers per year by 2020 [12]. The existence of many residential areas in the vicinity of almost all airports in Vietnam has made aircraft noise, together with road traffic, a main noise source that is causing adverse effects on the quality of Vietnamese life. This study, which analyzes the impact of aircraft noise not only as a single source but also as a combined source together with road traffic noise, can contribute to the evaluation of a mixed noise environment.

Because the two airports in the two abovementioned cities targeted in this study have different features, the results of this study are expected to broaden knowledge of aircraft noise annoyance in Vietnam. The objectives of this study are (i) to propose a representative dose–response relationship for aircraft noise annoyance in Vietnam and (ii) to assess the acoustic and non-acoustic factors moderating the response difference among sites and between the two cities.

2. Methods

2.1. Survey sites

The two cities chosen for the surveys are the busiest major metropolitan areas in Vietnam. In these cities, the effects of transportation noise on the health of the urban population continue to grow. The increase in transportation noise is due to rapid urbanization and industrialization. Tan Son Nhat Airport, Vietnam's largest international airport with around 200 takeoffs and landings per day, is located inside a crowded residential area of Ho Chi Minh City with busy commercial streets, as shown in Fig. 1. Noi Bai Airport is the second largest international airport in Vietnam and provides aviation transportation for the capital city, Hanoi. The handling capacity of Noi Bai Airport is less than half of Tan Son Nhat Airport [13]. Noi Bai Airport is located 45 km from downtown Hanoi and is in the hub of many national arterial roads and industrial zones (Fig. 2).

Ten residential areas were selected around Tan Son Nhat Airport including eight sites under the landing and takeoff paths of aircraft and two other sites laying to the north and south of the runway (Fig. 1). Nine sites were selected around Noi Bai airport including seven sites under the landing and takeoff paths of aircraft and two sites to the south of the runway (Fig. 2). The site selection was intended to reflect the aircraft noise exposure covering locations at various distances from and in directions relative to the airport.

Because this study was intended to investigate aircraft noise both as a single and as a combined source, all the sites except Sites 9 and 10 in Ho Chi Minh City and Site 6 in Hanoi were selected from residential areas that had roads passing through them. The houses facing the roads were selected for the combined noise survey, and those set back from the road were selected for single aircraft noise surveys, as shown in Fig. 3. Sites 9 and 10 in Ho Chi Minh City were located inside a large residential area, whereas Site 6 in Hanoi is a rural village with no major roads passing through it. Only the survey on aircraft noise was conducted at these three sites.

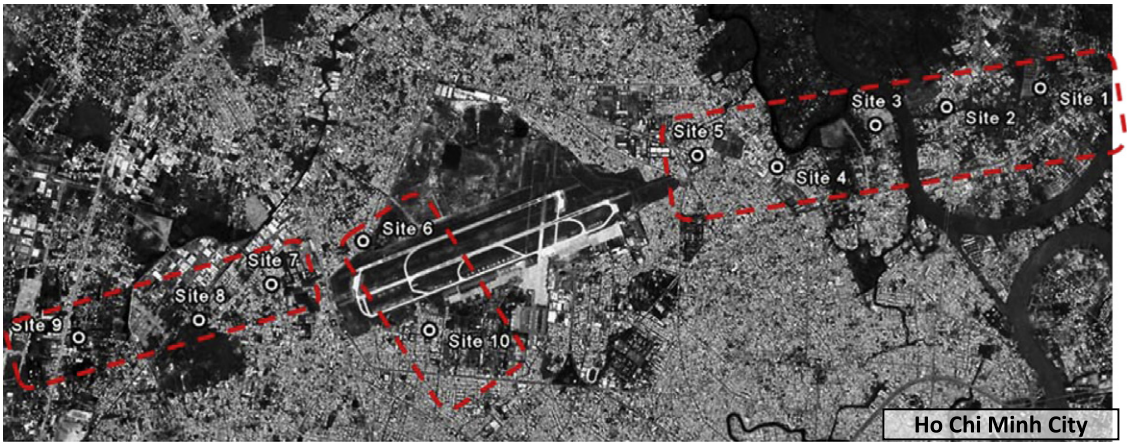

Fig. 1. Map of survey sites in Ho Chi Minh City. *Source*: Google Earth.