



# Community Response to Noise: Research Progress in East Asia since ICBEN1988

### Takashi Yano\*

Department of Architecture, Kumamoto University, Japan

#### Abstract

After ICBEN 1988, we performed a cross-cultural study on community response to road traffic noise in Sweden and Japan. Thereafter, community responses to road traffic and railway noises were compared between Hokkaido, a colder area of Japan, and Kyushu, a warmer area. To develop the noise study internationally, ICBEN Team 6 members constructed standardized noise annoyance scales initially in nine languages in 2001 and then three additional Asian languages, Chinese, Korean, and Vietnamese. Beginning in 2005, socio-acoustic surveys on community response to transportation noises have been conducted in Vietnam. From 2010 to 2012 a nationwide social survey on wind turbine noise was performed. These results were reflected in the WHO Environmental Noise Guidelines in 2018. For the future meta-analyses and noise policies, a socio-acoustic survey data archive (SASDA) was established in INCE/Japan in 2011 which has been used for the secondary analysis. The outline of the above research projects is briefly reviewed.

### Introduction

Noise has been recognized to be a serious environmental problem worldwide since the late 20th century. The International Commission on Biological Effects of Noise (ICBEN) has contributed to the global noise policies through ICBEN congresses since the 1st congress in Washington. In particular, research on community response to noise has been progressed not only in western countries but also in Asian countries since ICBEN1988, held in Stockholm. In 1999, WHO community noise guidelines [1] were published based on the research findings accumulated until that point; few research from Asia were quoted and reflected in the guidelines from Asia. In 2018, WHO Environmental Noise Guidelines for European Region [2] were published using new findings including quite many Asian studies principally since 2000. This report summarizes the research progress in Japan and Vietnam for more than 30 years.

## Cross-Cultural and Cross-Regional Studies on Community Response to Transportation Noises (1990s)

Sato [3] conducted social surveys on community response to road traffic noise in Gothenburg, Sapporo, and Kumamoto and compared the exposure-annoyance relationships. They showed that while the exposure-annoyance curve for detached house residents in Gothenburg was significantly higher than that for Japanese detached houses, the exposure-annoyance curve for apartment house residents in Gothenburg was significantly lower than the corresponding Japanese curve. The former may be partially caused by the specific lifestyle; that is, people enjoy outdoor activities in their gardens and parks during summer in Gothenburg. Yano [4] compared exposure-annoyance relationships between Hokkaido (a colder area of Japan) and Kyushu (a warmer area) and between road traffic and railway noises. No significant difference was found between Hokkaido and Kyushu but railway noise was significantly more annoying than road traffic noise in both areas. This indicated that there was no railway bonus in Japan. Japanese detached houses were closer to the railways than European houses and thus Japanese people may have been more annoyed by railway noise due to not only noise but also vibration exposures.

ISSN: 2643-7066



\*Corresponding author: Takashi Yano, Department of Architecture, Faculty of Engineering Kumamoto University, Kurokami 2-39-1, Chuo-ku, Kumamoto 860-8555, Japan

Submission: 🔛 June 19, 2023

Published: 🛱 July 13, 2023

Volume 4 - Issue 4

How to cite this article: Takashi Yano. Community Response to Noise: Research Progress in East Asia since ICBEN1988. COJ Tech Sci Res. 4(4). COJTS. 000591. 2023. DOI: 10.31031/COJTS.2023.04.000591

001. 10.31031/0013.2023.04.000391

**Copyright@** Takashi Yano, This article is distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use and redistribution provided that the original author and source are credited.

## International Joint Study on Standardized Noise Annoyance Scales (1990s-2000s)

At the business meeting of ICBEN Team 6 in Nice 1993, Fields and de Jong, the chairs of Team 6, proposed an international joint study to construct standardized noise annoyance scales comparable among different languages and the team members agreed to do so. The protocol of the experiment was devised by Guski and his colleagues. The experimental procedure is very simple. First, recruit at least 30 subjects from at least two areas in a linguistic region. Then, have the subjects do the following:

- a. Select 21 modifiers describing annoyance degrees from the minimum to maximum.
- b. Classify the 21 modifiers into nine categories at the maximum.
- c. Select modifiers appropriate for a 5-point scale.
- d. Select modifiers appropriate for a 4-point scale.
- e. Make line-marking evaluation of the intensities of the modifiers.

Using this data, construct standardized scales according to the following three criteria: equidistance (the modifiers for the scale should be equidistant), preference (the modifiers should be selected at each scale point but not at the other points), and agreement (the standard deviation of the intensity should be small).

In the joint study, standardized noise annoyance scales were constructed in nine languages [5]. Dutch, English, French, German, Hungarian, Japanese, Norwegian, Spanish, and Turkish. English scales were "not at all," "slightly," "moderately," "very," and "extremely." Afterwards nine scales were individually constructed in Chinese, Korean, Vietnamese, Thai, Polish, Danish, Portuguese, Romanian, and Slovenian. These were adopted in ISO TS 15666 [6].

# Community Response to Transportation Noises in Vietnam (2000s-2010s)

Fields [7,8] and Bassarab [9] published three updated catalogs of social surveys of residents reaction to environmental noise. They collected 318 surveys in 1991, 521 in 2000, and 628 in 2009. Of these only 5, 15, and 32 surveys are listed from Asian countries other than Japan in the respective catalogs. In this context, Nguyen [10] have conducted social surveys on road traffic and aircraft noises in five cities of Vietnam since 2005. They compared the exposure-annoyance relationships with those in EU [11]. The exposure-annoyance curve for aircraft noise in Vietnam was consistent with EU's but that for road traffic noise in Vietnam was much lower than EU's. The latter may be because a huge number of motorbikes were utilized for the daily use in Vietnam and people were used to the road traffic noise. Nguyen [12] studied the effects of step changes in aircraft noise exposure around Hanoi Noi Bai International Airport before and after the operation of the new terminal building in December 2014 from September 2014 to August 2018. While annovance increased just after the operation in March and September 2015, the exposure-annoyance curve gradually approached to the curve before the operation. They

have also performed step-change studies around Tan Son Nhat International Airport in Ho Chi Minh City, Vietnam [13].

### A Nationwide Social Survey on Wind Turbine Noise in Japan (2010s)

Since the late 1990s, many wind farms have been constructed to produce renewable energy for environmental sustainability throughout Japan. Serious noise problems have occurred near the wind farms. In such social contexts, a research project entitled "Research on the evaluation of human impact of low frequency noise from wind turbine generators" was conducted from 2010 to 2012, under the auspice of the Ministry of the Environment, Japan [14]. Kuwano [15] performed social surveys on public health at 34 sites near wind farms from Hokkaido (the northern area of Japan) to Okinawa (the southern area). The exposure-annoyance curve was drawn and compared with that for road traffic noise in Japan. Wind turbine noise was more annoying than road traffic noise and the difference was around 9 to 6 dB in the range from 10 to 20% Highly Annoyed (HA). This trend is consistent with the other studies, such as Janssen [16].

## Asian Data in WHO Environmental Noise Guidelines for European Region

WHO Environmental Noise Guidelines for European Region [2] was published in 2018. The title indicates that the guidelines were for European region but some Asian surveys were quoted and reflected in the guidelines. Thus, the guidelines can be used worldwide. While the guideline values evaluated every noise source for its effects on cardiovascular disease, annoyance, effects of sleep, cognitive impairment, and hearing impairment and tinnitus, all the guideline values for average noise exposure (L<sub>den</sub>) were decided in respect to annoyance. The values for road traffic, aircraft, railway, and wind turbine noises are 53, 45, 54, and 45 dB, respectively. Guski [17] published a systematic review on environmental noise and annoyance for the WHO guidelines. They drew the average L<sub>den</sub>-%HA curve for road traffic noise using data from 25 surveys in which 10 surveys were from Asia (Vietnam, Hong Kong, and Japan). Road traffic noise annoyance in Asia was lower than that in Europe. The average  $L_{\rm den}\mbox{-}\%\mbox{HA}$  curve for aircraft noise was drawn using 12 surveys in which three are from Vietnam. Points were lower in the Vietnamese data than European data but close to Miedema & Oudshoorn's curve [18]. The average  $L_{den}$ -%HA curve for railway noise was drawn using nine surveys. Of these there was only one Japanese survey whose data points were higher than those of Europe. In the guidelines [2] Kuwano's and Janssen's L<sub>den</sub>-%HA curves for wind turbine noise are drawn. The trend of the curves is different but the  $L_{den}$  value corresponding to 10%HA is around 45dB for both curves.

# Socio-Acoustic Survey Data Archive (SASDA) (2010s-2020s)

With accumulating socio-acoustic survey data in Japan as a background, a socio-acoustic survey data archive (SASDA) was established in 2011 following the TNO data archive for individual comparisons among surveys for academic use and meta-analysis for global noise policies [19]. The different point from the TNO archive is that SASDA is open for academic use. At the present time, 23 datasets are stored in the archive. The outline, operation of the archive, and individual survey catalogs are shown in the following URL: https://www.ince-j.or.jp/old/04/04\_page/04\_doc/ bunkakai/shachodata/?page\_id=972. The contents of the catalog were followed by Fields [20]. Several articles were published using data sets for the archive [21-24].

#### **Summary and Further Remarks**

This report summarizes a series of studies on community response to noise in Japan and Vietnam for more than 30 years. Starting from cross-cultural study on community response to road traffic noise between Sweden and Japan in 1990s, a cross regional study on road traffic and railway noises, the construction of standardized noise annoyance scales, socio-acoustic surveys on transportation noises in Vietnam, a nationwide survey on wind turbine noise, and the establishment of socio-acoustic survey data archive have been conducted in a successive or parallel ways. The quality of social surveys in Japan and Vietnam was very low mainly because of non-random sampling of residents and noise exposure estimates based on short-term noise measurements [25]. Since random sampling depends on the social system such as accessibility to the personal data, it may be difficult to improve soon. Shortterm (24-hour or a week) measurements have been used in Japan and Vietnam but long-term noise exposures are required as the noise indices. Therefore, noise maps have been recommended to estimate noise exposures. Noise maps or simulations were used in recent social surveys in Japan and Vietnam [26,27]. Though many surveys on noise annoyance have been conducted in Asia, surveys on outcomes other than annoyance and effects on sleep have seldom been performed. These surveys should be conducted despite the difficulties associated with them.

#### References

- 1. WHO (1999) Guidelines for community noise.
- 2. WHO (2018) Environmental Noise Guidelines for European Region.
- Sato T, Yano T, Bjorkman M, Rylander R (2002) Comparison of community response to road traffic noise in Japan and Sweden - Part I: Outline of surveys and dose-response relationships. Journal of Sound and Vibration 250(1): 161-167.
- 4. Yano T, Morihara T, Sato T (2002) Comparison of community responses to railway and road traffic noises in Kyushu, a warmer area of Japan, and Hokkaido, a colder area. Proceedings of Forum Acusticum.
- Fields JM, De Jong RG, Gjestland T, Flindell IH, Job RFS, et al. (2001) Standardized general-purpose noise reaction questions for community noise surveys: Research and a recommendation. Journal of Sound and Vibration 242(4): 641-679.
- ISO/TS 15666 (2021) Acoustics-Assessment of noise annoyance by means of social and socio-acoustic surveys.
- Fields JM (1991) An updated catalog of 318 social surveys of residents reactions to environmental noise (1943-1989). NASA/CR 187553.
- Fields JM (2001) An updated Catalog of 521 social surveys of residents reactions to environmental noise (1943-2000). NASA/CR-2001-21125.
- Bassarab R, Sharp B, Robinette B (2009) An updated Catalog of 628 social surveys of residents reactions to environmental noise (1943-2008).

- Nguyen TL, Yano T, Nishimura T, Sato T (2016) Exposure-response relationships for road traffic and aircraft noise in Vietnam. Noise Control Engr J 64(2): 243-258.
- 11. European Commission (2002) Position paper on dose response relationships between transportation noise and annoyance 2002.
- 12. Nguyen TL, Trieu BL, Hiraguri Y, Morinaga M, Morihara T, Yano T (2020) Effects of changes in acoustic and non-acoustic factors on public health and reactions: Follow-up surveys in the vicinity of the Hanoi Noi Bai International Airport. Int J Environ Res Public Health 17(7): 2597.
- Nguyen HN, Trieu BL, Nguyen TL, Morinaga M, Hiraguri Y, et al. (2023) Models of aviation noise impact in the context of operation decrease at Tan Son Nhat Airport. Int J Environ Res Public Health 20(8): 5450.
- 14. Tachibana H, Yano H, Fukushima A, Sueoka S (2014) Nationwide field measurements of wind turbine noise in Japan. Noise Control Engr J 62(2): 90-101.
- Kuwano S, Yano T, Kageyama T, Sueoka S, Tachibana H (2014) Social survey on wind turbine noise in Japan. Noise Control Engr J 62(6): 503-520.
- 16. Janssen SA, Vos H, Eisses AR, Pedersen E (2011) A comparison between exposure-response relationships for wind turbine annoyance and annoyance due to other noise sources. J Acoust Soc Am 130(6): 3746-3753.
- Guski R, Schreckenberg D, Schuemer R (2017) WHO environmental noise guidelines for the European Region: A systematic review on environmental noise and annoyance. Int J Environ Res Public Health 14(12):1539.
- Miedema HME, Oudshoorn CGM (2001) Annoyance from transportation noise: Relationships with exposure metrics DNL and DENL and their confidence intervals. Environ Health Perspect 109(4): 409-416.
- 19. Yokoshima S, Yano T, Kawai K, Morinaga M, Ota A (2011) Establishment of the Socio-Acoustic Survey Data Archive. Proceeding of Inter-Noise 2011 Osaka.
- Fields JM, de Jong RG, Brown AL, Flindell IH, Gjestland T (1997) Guidelines for reporting core information from community noise reaction surveys. J. Sound Vib 206: 685-695.
- Yokoshima S, Morinaga, Tsujimura S, Shimoyama K, Morihara T (2021) Representative exposure-annoyance relationships due to transportation noises in Japan. Int J Environ Res Public Health 18(20):10935.
- 22. Morinaga M, Nguyen TL, Yokoshima S, Shimoyama K, Morihara T, et al. (2021) The effect of an alternative definition of "Percent Highly Annoyed" on the exposure-response relationship: Comparison of noise annoyance responses measured by ICBEN 5-point verbal and 11-point numerical scales. Int J Environ Res Public Health 18(12):6258.
- 23. Gjestland T, Morinaga M (2022) Effect of alternate definitions of "high" annoyance on exposure-response functions. J Acoust Soc Am 151(5):2856.
- 24. Brink M, Giorgis AL, Schreckenberg D, Evard AS (2021) Pooling and comparing noise annoyance scores and "High Annoyance" (HA) responses on the 5-point and 11-point scales: principles and practical advice. Int J Environ Res Public Health 8(14):7339.
- 25. Guski R, Schreckenberg D, Schuemer R (2017) Supplementary materials: WHO environmental noise guidelines for the European Region: A systematic review on environmental noise and annoyance. Int J Environ Res Public Health 14(12):1539.
- 26. Morihara T, Yokoshima S, Matsumoto Y (2021) Effects of noise and vibration due to the Hokuriku Shinkansen railway on the living environment: A socio-acoustic survey one yar after the opening. Int J Environ Res Public Health 18(15): 7794.
- 27. Nguyen TTHN, Trieu BL, Nguyen TL, Morinaga M, Hiraguri Y, et al. (2023) Models of aviation noise impact in the context of operation decrease at Tan Son Nhat Airport. Int J Environ Res Public Health 20(8): 5450.