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An Assessment of Noise Pollution Levels of Selected Sawmills in the Kerala State

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Abstract

Introduction: The nature of work involved in sawmills generates lot of noise to the working environments. Noise is hazardous to human health as it can cause physiological as well as psychological effects on the workers. **Objectives:** The present study aimed to measure the noise pollution level in the various workstations of sawmill and the Hearing Threshold Level (HTL) among sawmill industry workers. **Materials and Methods:** Reconnaissance surveys were carried out to ascertain whether the sawmills were fully operational and fit for this study or not. Two sawmills which is in Kochuveli and Kilippalam located in the district of Thiruvananthapuram, Kerala were eventually selected for data collection. Nine sawmill workers coming under the various age groups spanning from 20 to 65 years was considered for the study of Noise Induced Hearing Loss using audiology test at National Institute of Speech & Hearing (NISH), in Thiruvananthapuram district in the state of Kerala, India. **Results & Conclusions:** The results revealed that the measured values clearly depict very high noise levels indicating the dangerous situation prevailing in this sawmill industries which affects the Occupational health and immediate actions are required from the regulatory authorities for its control at source, path, and receiver end. The study recommended that proper workplace practices such as use of personal protective equipment, new and modern machines, training, and occupational safety programmes need to be implemented in the considered sawmills.

Key Words: Sawmill Noise; Audiology; Occupational Noise; Personal Hearing protective equipment; Noise Induced Hearing Loss; Noise Assessment; Sawmill Workers; Machinery Noise.

1.0Introduction

Woodwork has been useful to human societies since ancient civilizations and will continue to play dominant roles in the world as the demand for wood products is on the increase **[6]**. The building construction industry has also witnessed marvelous growth and wood from logs serves as a major construction material which is done through sawmill activities. These activities could generate appreciable amount of noise because of machine operation, cutting and sawing, and these activities occur every day for a long period of time resulted in an extreme acoustic environment exposure to sawmill workers **[5]**.

World Health Organization reported that noise is the third most hazardous type of pollution, after air and water pollution **[8, 15]**. Noise is generally defined as an undesirable or an unpleasant sound whose origin can be traced to the Latin word “nausea” **[1,4]**. Industrial noise is derived from industrial equipment sources such as heavy-duty machines, generators, aircrafts, sewing machines, pumps, and fan blades etc. Industrial noise pollution may be any undesired sound originating from industrial machines or equipment that causes annoyance, nuisance, sleep deprivation, decreased school performance, stress, increased blood pressure and other physical, sociological, and psychological effects to human being and its environment **[1,2,10,11]**. The hearing loss among millers and copper smiths caused by the excessive noise was first reported in 1713 before the era of Industrial revolution by Bernado Ramazzini [**8]**.

In developing country, economic growth mainly depends upon the urbanization through rapid industrialization resulting in an increase of industrial noise pollution due to industrialization without proper assessment and investigative measures. The regulation of industrial noise is the greatest challenge stands in front among all the industries throughout the country **[2]**.

The rate at which industrial workers become exposed to very high levels of noise has now become an issue of global concern because several studies have revealed that these unchecked exposures are influencing factors for other serious health challenges **[1,4]**. The world Health organization (WHO) estimates that 250 million people have a hearing loss who lived in developing countries **[3,16]**.

The review of past literatures revealed that only a limited number of research studies on occupational noise induced hearing loss (NIHL) were conducted in the state of Kerala. The hearing threshold level (HTL) among sawmill industry workers needs to be clarified, and the factors related to this HTL need to be understood. The present study aimed to assess the noise pollution level and the HTL among sawmill industry workers in Kochuveli (Coastal Zone) and Kilippalam (Urban Zone) in the state of Kerala. The noise levels associated with sawmill machines were also investigated in this present study. The parameters associated with the hearing loss of sawmill workers and the concern for remedial and preventive measures to eradicate this hazard is also reported in this study **[2,4,12,16]**.

2.0 Materials and Methods

The study was conducted in between May 2021 to June 2022. Reconnaissance surveys were carried out to ascertain whether the sawmills were fully operational and fit for this study or not. Two sawmills which is in Kochuveli and Kilippalam sites of Thiruvananthapuram in the state of Kerala were eventually selected for data collection while the various workstations such as Band sawing machines, resawing machines, planer mill and Band-saw blade sharpen grinder were also considered. A high precision portable hand held Sound level Meter was used to assess the machinery noise levels in dBA for the individual workstations of the saw mill industry.

The hearing ability test was conducted among the nine selected workers of various age groups spanning from 20 years to 65 years from two sawmills at the department of audiology in the National Institute of Speech & Hearing (NISH), in Thiruvananthapuram district in the state of Kerala, India.

3.0Results and Discussion

The onsite measured noise levels of various workstations of the sawmills located in the Coastal and Urban Localities of Thiruvananthapuram district of the state of Kerala in India was presented through **Figs. 1 to 3**. It is very much clear that the noise pollution levels are almost similar in coastal and urban location and the geographical factors do not seem to have any influence on the noise levels.

As per the National Quality Index Standards Noise levels up to 80 dBA is set as the upper limit for the occupational exposure limit for a 8-hour work duration **[8]**. From the values it is very much clear that the machines are generating noise levels much above 80 dBA even during idling and well above 100 dBA during the Wood feeding and sawing operation. The noise quality index like Leq, Lnp, L10, L50 & L90 values of each workstation of the sawmills, indicates a very unsafe and intolerable noise levels **(Figs. 4 & 5)**. The values above, indicates the level of exposure of noise to the workers thereby affecting their health and auditory system. From the prima facie observations it is to be noted that the machineries are old and do not have the provision of Noise barriers and machine guards. However, unlike other pollution, noise is given least importance in industries **[2]**. This is mainly due to the lack of awareness about its ill effects on health **[7,9,17]**.

The bandsaw operation is the first and foremost operation in a sawmill and is the first procedure carried out in the sawmill wood processing. However, the duration of band sawing compared to other processes are of shorter duration since the only operation coming into execution is the cutting of log in to halves and quarter cut band sawing converting the logs into cants or planks of wood. Hence the duration of exposure of worker to noise from a band sawing machine compared to other machineries are less (Fig. 1) **[2]**. This is mainly due to the intermittent operations whereby the machine is frequently changing its operational mode from idling to feeding mode and vice versa **[2].** The lower values below 100 dBA depicts the idling mode of the machine which is

even much above the permissible occupational exposure limit. Whilst the higher noise levels above 100 dBA depicts the noise levels during wood feeding to the machinery for its processing.

Resawing operation in the second workstation is an edging operation during which the cants or planks of wood would be further broken down by an edger into multiple flitches or boards. Resawing operation is a continuous and a lengthy operation leaving a wood worker to maximum noise exposure. However, from the Fig. 2, the monitored noise levels of resawing machines are much higher than the noise levels of band sawing machines. In fact in a band sawing machine the time of machine idling is lengthier than in a resawing machine. But during resawing the feed time constitutes the majority and only a very little time is given for idling. Thus, the frequency of high noise levels is more. Also, it is seen that during idling the machinery noise in a resawing machine is well above 110 dBA which eventually reaches up to a noise level of 120dBA which is very intolerable to an auditory system. A higher noise substantially leads to higher mechanical vibrations which can even affect the Cardiac systems leading to heart ailments **[9]**.

The planer mill in the third workstation performs the chipping operations on the board or flitch. As seen in the Fig. 3 the monitored noise levels below 100 dBA is the idling state of the machine with the lowest noise level recorded in the sound level meter as 91 dBA which is much above the permissible standards for the occupational noise exposure limit. In fact the planing operation is a continuous wood feeding procedure which chips out the wood and gives a fine finish to the timber. The edged or trimmed wood after resawing is fed into the planer mill. As it performs the chipping operation, a higher level of noise and structure borne machinery vibrations are being emitted out by the machine to noise levels ranging from 100 dBA to a maximum level of 119 dBA. The planer mill located in the urban zone was noisier with levels reaching up to 119 dBA when compared to 108 dBA maximum noise levels recorded in the coastal zone sawmill. But when looking into the machine idling mode lower noise levels, the urban zone planer milling machinery emitted noise levels as low as 86.8 dBA which is even above the permissible occupational noise exposure standards in comparison to 94dBA lower levels of coastal zone planer machinery.

Overall, the on-site monitored values clearly depict very high noise levels indicating the dangerous situation prevailing in this small-scale industrial sector and requires immediate actions from the regulatory authorities for its control at Source, path, and Receiver end **[3,16,12]**.

The experimental setup of the audibility test was shown in Fig. 6. Audiogram plots of the sawmill workers coming under the various age groups are shown in Figs 7 & 8. An audiogram is a graph that plots frequency against sound levels to evaluate the hearing sensation and retrieve information about human hearing abilities to diagnose and identify Noise induced Hearing Loss (NIHL) caused by Industrial Noise Pollution **[3,13]**. Nine Sawmill workers coming under the various age groups spanning from 20 years of age to 65 years of age was considered for the study. The test for audiology was conducted at National Institute of Speech & Hearing (NISH), in Thiruvananthapuram district in the state of Kerala, India. The audiogram (Figs 7 & 8) clearly depicts hearing loss among experienced and aged group of Sawmill workers who have been exposed constantly to machinery noise for more than 20 years causing a state of permanent deafness **[3]**. The Noise Pollution levels monitored in the selected site clearly depicts excessive noise exposure levels much above the permissible standards **[16].** From the Figs. 7 & 8 we find mild to moderate hearing loss among middle aged workers whose age spans from 30 years to 45 years. It is in this age span; the workers are more involved in industrial activities leading to excessive prolonged exposure to noise and its resulting hearing loss. The audiogram values of very young workers coming under the age span of 20 years to 30 years show starting symptoms of mild hearing loss. Medical test and surveillance if executed at the proper time can save the future impacts on auditory health caused by the Machinery Noise Pollution. The description about Speech and Hearing quality and its implication on real life situations is presented in Table 2.

4.0 Conclusions

According to the findings of the present study, the noise levels generated in all workstations of the sawmills are generally above 80-85 dBA which is the occupational exposure limit of National ambient sound quality index recommended by the Central pollution control board. The level of noise emitted from the cutting machineries especially the resawing and planer milling machines are very much higher of the range of 121 dBA weighted scale when compared to 113 dBA maximum noise levels of band sawing machinery. From the observations, it can be concluded that the machineries employed in the sawmills under study were employing very old and

obsolete machineries which demands urgent overhauling and service. Also, it was observed that none of the workers, in both the sawmills were wearing any hearing protection equipment's while working. Hence the workers especially the machine operators are exposed to such high noise levels for a longer duration, which adversely affect temporarily or permanently, their auditory health leading to noise induced hearing loss. The present study qualitatively and quantitatively evaluates the cause and effect aspects of machinery noise emissions and their impact on the left and right ear hearing ability of the exposed workers by undertaking audiometric tests to ascertain the extent of noise induced hearing loss ranging from mild to severe hearing loss for the various frequencies versus sound in decibels. Senior and elderly sawmill workers of age groups above 50 to 65 years who have more than 20 years of working experience suffer from severe hearing loss. The middle aged workers with age group ranging from 30 to 45 years with more than 10 years of experience have mild to moderate hearing loss and the young workers with the age group between 20 to 30 years, show slight deviations to mild hearing loss at certain mid frequency levels in the audiogram plots . Therefore this study concludes that there is a direct cause effect relationship between machinery noise and its impact on auditory health of workers.

References

1. Abiola Ajayeoba, O., Adewoye Olanipekun, A., Waisu Raheem, A., Oluwaseun Ojo, O., and Ayowumi Soji Adekunle, R., 2020, "Assessment of Noise Exposure of Sawmill Workers in Southwest, Nigeria," Tech Science Press., 55(1), pp. 69-75.
2. Agbalagba, E.O., Akpata, A.N.O., and Olali, S.A., 2013, "Investigation of Noise Pollution Levels of Four Selected Sawmill Factories in Delta State, Nigeria," Advances in Applied Acoustics., 2(3), pp. 83-90.
3. Asit Adhikari., and Subhashis Sahu., 2016, "Prevalence of Noise Induced Hearing Loss (NHIL) among Sawmill Workers in West Bengal, India," International Journal of Current Research and Academic Review., 4(9), pp. 12-20.
4. Choudhari, V.P., Dhote, D.S., Patil, C.R., 2011, "Assessment and control of sawmill noise. International Conference on Chemical, Biological and Environmental Sciences," (ICCEBS'2011), Bangkok, pp. 299-303.
5. Ejikeme Ugwoha. Yusuf Momoh and Felix Arusuraire, E., 2016, "Assessment of noise pollution in selected sawmills in Port Harcourt," International Journal of Engineering Research and Application., 6(11), pp. 20-25.
6. FPL (Forest Products Laboratory) 2010: Wood handbook-wood as an engineering material, general technical report FPLGTR-190, United States Department of Agriculture, U.S.A.
7. Helder Cesar Tinoco, Gilson Brito Alves Lima, Annibal Parracho Sant'Anna, Carlos Francisco Simões Gomes and João Alberto Neves dos Santos., 2019, "Risk Perception in the Use of Personal Protective Equipment against Noise-Induced Hearing Loss," Journal of Gest. Prod., São Carlos., 26(1), pp.1-21.
8. Mojisola Bolarinwa., (2018), Noise Level Assessment in Selected Nigerian Plank Industries: Bodija, Olorunsogo and Olunde in Ibadan, Oyo State, Nigeria, *International Journal of Innovative Science and Research Technology*, Vol. 3(7), pp. 686-693.
9. Phayong Thepaksorn, Supawan Thongjerm, Salee Incharoen and Wattasit Siriwong, 2017, "Job Safety Analysis and Hazard Identification for Work Accident Prevention in Para Rubber Wood Sawmills in Southern Thailand," Journal of Occupational Health., 59(1), pp. 542-551.
10. Peippo, M.M., Hakkala, M.T., Heikkinen, M.O., 2000, "Road traffic noise: Turku urban area, PSSD Task Report, Baltic Region Healthy Cities Office," Regional Council of Southwest Finland., pp. 26-27.
11. Ouis, D. B. (2001). Annoyance from road traffic noise: A review. Journal of Environmental Psychology, 21(1), 101–120. DOI 10.1006/jevp.2000.0187.

12. Razman Mohd Rus., Aziah Daud., Kamarul Imran Musa., and Lin Naing., 2008, "Knowledge, Attitude and Practice of Sawmill Workers Towards Noise-Induced Hearing Loss in Kota Bharu, Kelantan," Malaysian Journal of Medical Sciences., 15(4), pp. 28-34.
13. Ugbebor, J.N., and Yorkor, B., 2015, "Assessment and Evaluation of Noise Pollution Levels in Selected Sawmill Factories in Port Harcourt, Nigeria," International Journal on Emerging Technologies., 6(2), pp. 1-12.
14. Vaishali, P.C., Deepak, S.D., Chandrakant, R.P., 2011, "Assessment and Control of Sawmill Noise," Proccedings of Int. Conference on Chem. Biol. Environ. Sci., (ICCEBS'2011) Bangkok.
15 Vasiliki Dimou., 2014, "Noise Measurements in Timber Industries," Drvna Industrija., 65(3), pp. 243-249.
16. Waheed Hussein Elsaidy., and Ayman Ahmed Mahmoud., 2020, "Prevalence of Noise Induced Hearing Loss among Employees at Wood Industry in Damietta Governorate," International Journal of Medical Arts., 2 (1), pp. 253-259.
17. WHO (2005) Occupational noise: assessing the burden of disease from work-related hearing impairment at national and local levels. Environmental Burden of Disease Series, No. 9, World Health Organization, Switzerland.

Table 1. Nomenclature

S.No.	Notations Used	Description
1.	L10	10 percentile noise level
2.	L50	50 percentile noise level
3.	L90	90 percentile noise level
4.	L_{Max}	Maximum Noise Level Recorded
5.	L_{min}	Minimum Noise Level Recorded
6.	L_{eq}	Equivalent Noise Level
7.	L_{np}	Noise Pollution Level
8.	BSM	Band Sawing Machine
9.	RSM	Resawing Machine
10.	PM	Planer Mill
11.	BSB	Band Saw Blade Sharpen Grinder

Table 2. Speech and Hearing Quality in Real Situations

Noise Levels in dB	Description of Hearing Quality	Status of Hearing Ability
0 TO 20 dB	✓ Understand Speech in a Noisy Environment. ✓ No Amplification is needed.	Normal Hearing
Between 20 to 40 dB	✓ Difficulty in understanding speech in noisy environment. ✓ Regularly Asking People to Repeat. ✓ Regularly missing what people are saying.	Mild Hearing Loss
Between 40 to 70 dB	✓ Extreme Difficulty in understanding Speech in Noisy Environment	Moderate Hearing Loss
Between 70 to 90 dB	✓ Significant difficulty in understanding speech in most situations. ✓ Avoiding Noisy places to avoid missing of conversations.	Severe Hearing Loss
Between 90 to 120 dB	✓ Experience major Communication Problems in all situations. ✓ Requires Visual Assistance like sign language.	Profound Hearing Loss

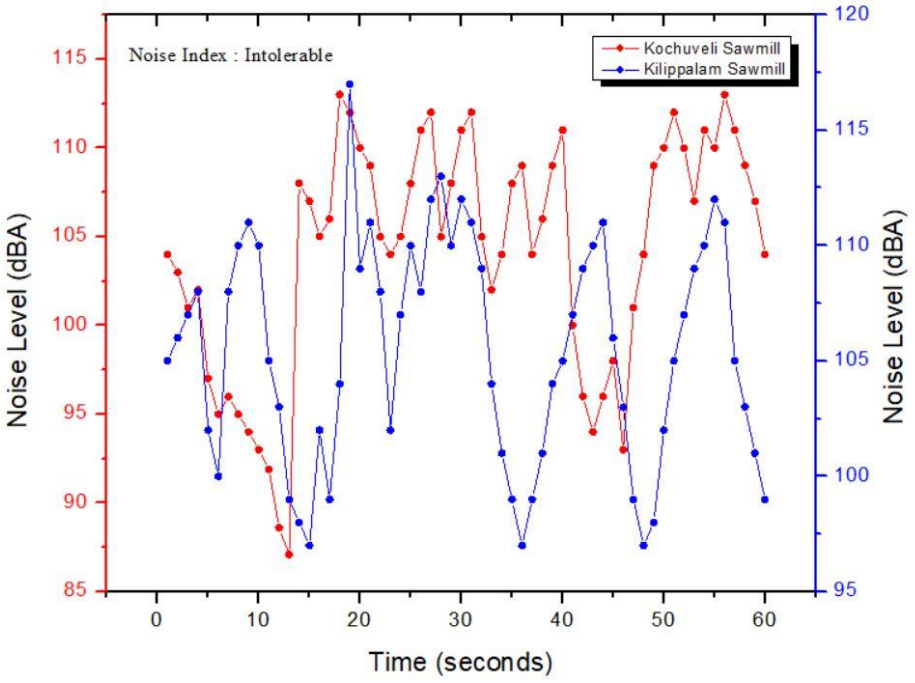

Fig. 1 Noise Level during Band Sawing Operation

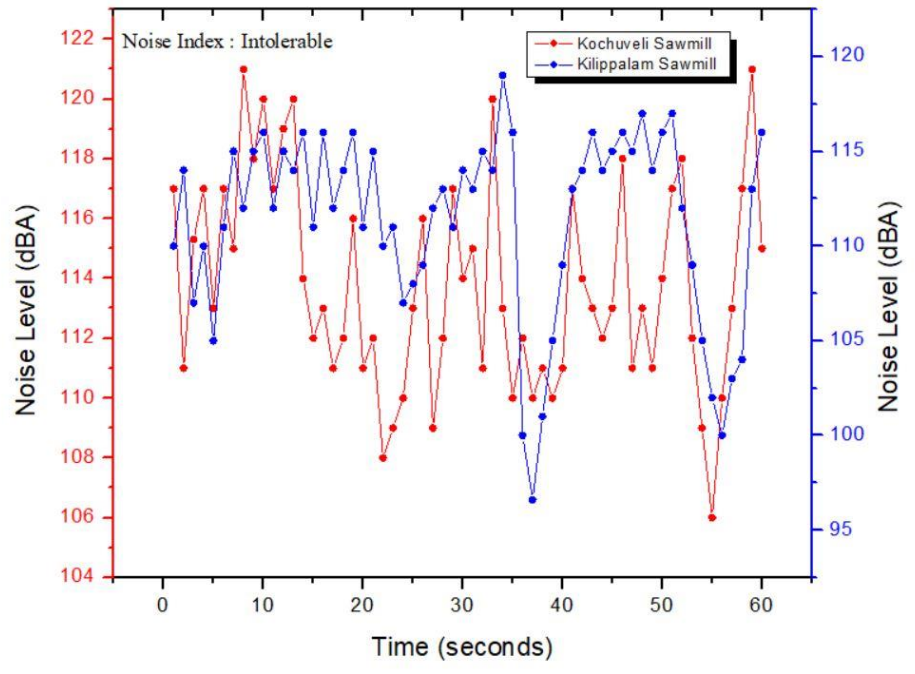

Fig. 2 Noise Level during Re Sawing Operation

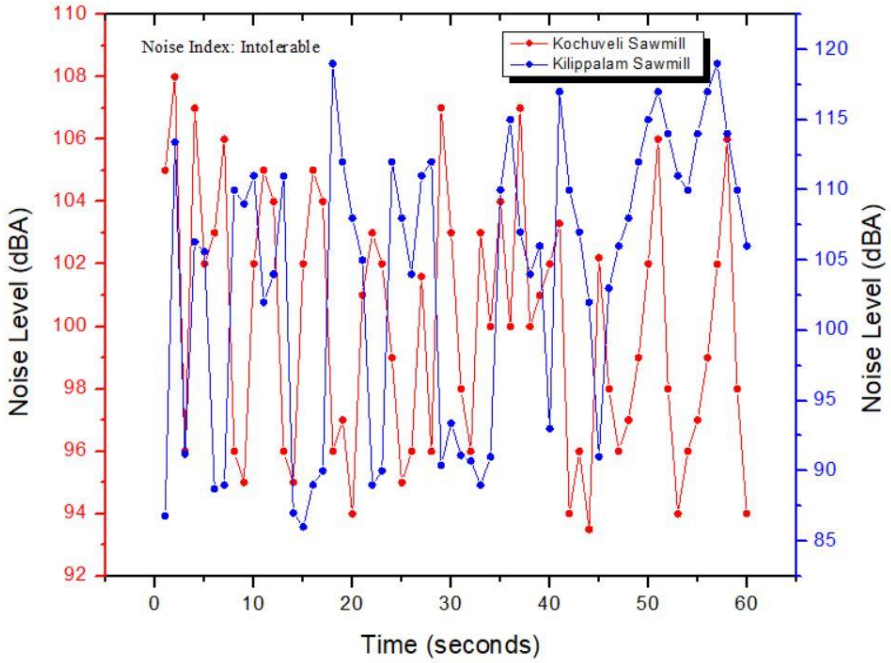

Fig. 3 Noise Level during Planer Mill Operation

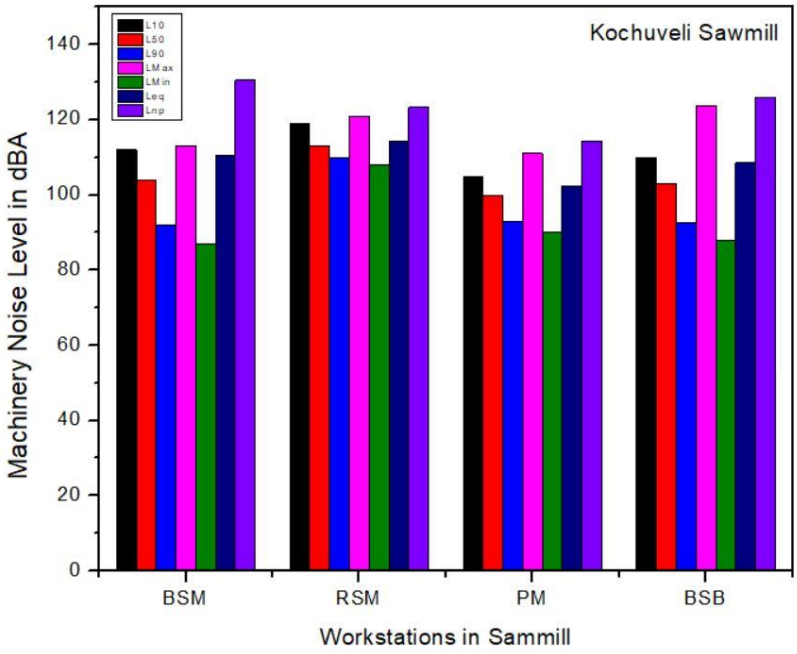

Fig. 4 Machinery Noise Levels in Kochuveli Sawmill (Coastal Zone)

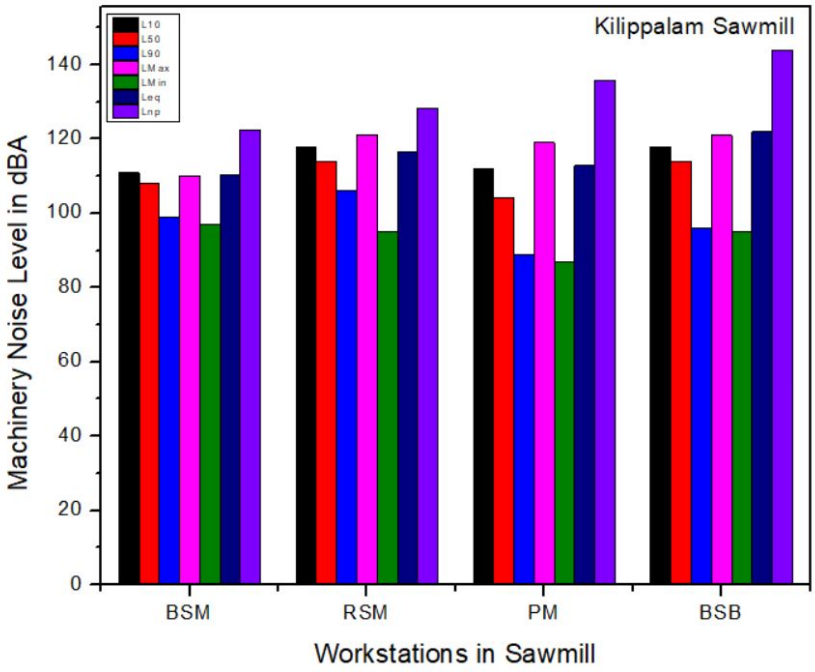

Fig. 5 Machinery Noise Levels in Kilippalam Sawmill (Urban Zone)

Fig. 6 Experimental Setup of Audiology Test

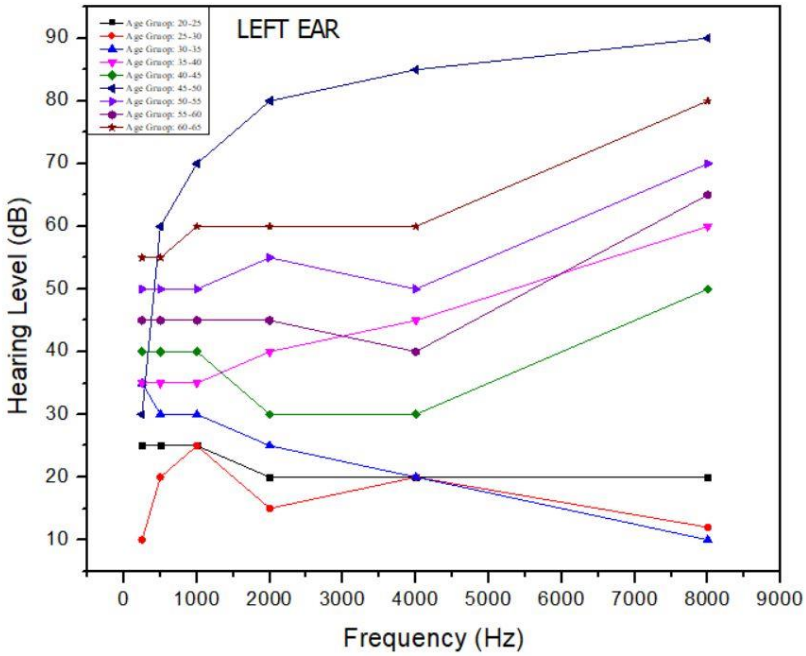

Fig. 7 Hearing Threshold Noise Level in Left Ear

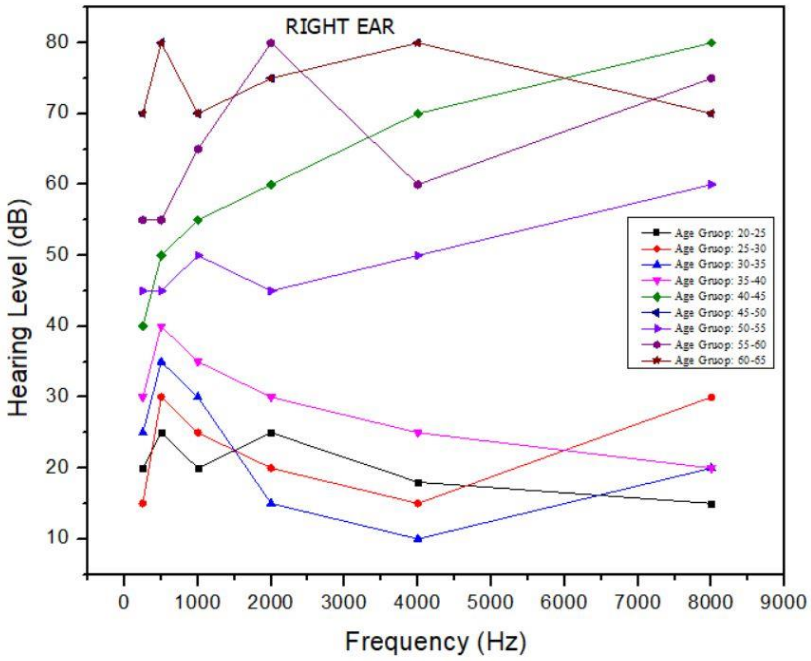

Fig. 8 Hearing Threshold Noise Level in Right Ear