Article

Assessment of sound pressure levels in tourist spots of Munnar, Kerala

Chindu Chandran[1], **Prodyut Bhattacharya**[1], **Manoj Kumar Singh**[2]

[1]University School of Environment Management, GGSIP University, Delhi, India

[2]Department of Biological Sciences, Ashoka University, Haryana, India

E-mail: chindu.chandran@yahoo.com

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Abstract

Ecotourism is one of the tourism industry's fastest-growing sub-sector. The loss of the pristine acoustic ecosystem of the destination is closely associated with activities related to tourism and is one of the least recorded pressures. The acoustic deterioration of the area serves as a counter motive and contributes to reducing tourist numbers. The current study reports prevailing ambient noise levels in tourist sites of Munnar through a control effect design and check if the noise level are within the specified Central Pollution Control Board (CPCB) noise level standards. The equivalent sound pressure level was determined in the presence and absence of visitors during low and peak tourist seasons from Jan 2018 - June 2019 at various tourist spots, activity zones, and roadsides of different areas of Munnar using Sound Level Meter Testo 815. The preliminary results show that the noise level being stable around 50 dB in the absence of visitors and increases up to 80 dB in the presence of visitors at tourist spots like Eravikulam National Park (84 dB), Top Station (79 dB), and Munnar Town (81 dB). The study results recommend limited vehicular traffic along the tourist trails in peak hours, introducing environmentally friendly transport, and implementing zoning as better ecotourism practices for the Kerala State Tourism Department.

Keywords environment; sustainability; noise level; decibel; ecotourism.

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1 Introduction

For several nations worldwide, sustainable tourism has become an important economic priority. Many alternative types of tourism are introduced by developing countries that depend heavily on tourism-based economies, such as nature-based tourism, Ecotourism, adventure tourism, cultural tourism, rural tourism, etc. Tourist's foot drops for a destination with blooming tourism that exerts many anthropogenic pressures on the local climate (Das et al., 2014). The loss of a pristine acoustic ecosystem of destinations closely associated

with activities related to tourism is one of the most negligible recorded pressures (Liu et al., 2017). Conflicts between tourism growth on the one hand and the environment and landscape have always been a hot issue.

One of the significant tourism impacts is the deterioration of the acoustic environment, linked to transportation with increased vehicular traffic, leisure activities, and their implications on the nearby land use (Sharma and Bhattacharya, 2014). As a result, various noise pollution issues in tourist regions have been observed. Traffic noise causes ecological impacts like changes in animal behaviour, spatial distribution, anti-predator behaviour, reproductive success, foraging behaviour, population density, and community structure (Joshi et al., 2020; Sordello et al., 2020; Chandra et al., 2021; Gohel et al., 2021). Noise pollution is among the consequences of the uncontrolled development of mass tourism (Lebiedowska, 2005). Seasonal tourist transportation affects the acoustic environment when considerably increased road traffic flows are accommodated in often inadequate local infrastructure, especially in hilly destinations like Munnar. The roads are narrower, and there are only single lanes.

The relationship of noise with the tourist environment at various levels is observed in tourism studies. Concerning the immediate environmental impact of tourism through pollution, noise, and disruption, a dynamic feedback mechanism characterizes the indirect, irreversible, and long-term effects of tourism on the quality of the environment (Boschmann, 2008; King et al., 2009). Several studies around the world have started the ecological impact on the natural environment of the native population (Fitzgibbon et al., 1995; Bhattacharya, 2003a, 2003b). Studies on sound and tourist experiences remain to be limited, and they mainly focus on three themes. First, noise pollution and its influence on tourists (Morillas et al., 2013; Merchan et al, 2015). Second, the value and importance of a quiet and natural soundscape (Rantana and Valtonen, 2014; Watts and Pheasant, 2015); and third, the multi-sense scape experience and sonic interpretation (Kang and Gretzel, 2011; Wolf et al., 2013).

Numerous studies have uncovered that noise levels exceed the standards prescribed by the Central Pollution Control Board (CPCB) and Ministry of Environment, Forest and Climate Change, Govt. of India (MoEFCC) (Naik and Purohit, 1999; Mohan, 2000; Gupta, 2003; CPCB, 2000; Rane et al., 2012; Mangalekar, 2012; Kumar et al., 2013). In India, numerous studies on noise levels, noise climate, Leq, and Lmax have been carried out (Tandel et al., 2012; Chaudhari et al., 2012; Kumar et al., 2013). The Ministry of Environment, Forest and Climate Change, Govt. of India, has notified the Noise Standards and Guidelines as shown in Table 1, realizing the need to control and regulate noise levels.

Table 1 Standard noise level in the air (as per CPCB guidelines).

Area Code	**Category of Area**	**Limits in dB (A)**	
		Day Time (6 a.m. to 10 p.m.)	**Night Time** (10 p.m. to 6 a.m.)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Area	50	40

Source: Noise Standards for Ambient Noise Level recommended by CPCB notified in the Noise Pollution (Regulation and Control) Rules, 2000

Munnar is facing rapid development as a tourist destination. As a result of increased tourism, an effort has been made to research noise level variations that contribute to the risk of noise pollution. The primary reason for increased noise levels is transport vehicles like bikes, buses, and recreational vehicles. These cause

significant noise pollution. Considerable increase in noise levels has been recorded on weekends when tourists visiting the town are more than on weekdays. The present study main objective is noise monitoring of the study area to establish the baseline noise levels and focuses on the following: a) Discuss the current noise level scenario at the tourist spots of Munnar, b) Compare the noise levels at the peak and lean seasons, and c) Suggest measures to mitigate any related externalities.

2 Study Area

The study has been carried out at the hill station of Kerala- Munnar, covering the geographic location of 10°04′45″- 10°05′58″ latitude and 77°02′40″-77°03′45″ longitude of Devikulam block in Idukki district of Kerala as shown in Fig. 1. Munnar, part of the Western Ghats, has distinct geomorphic features and biophysical and biological processes. It is the world's most biologically unique diverse area, with great geological, cultural, and aesthetic values. Munnar is one of the most significant tourist spots and hill stations on the Western Ghats Mountain, Kerala. Many domestic tourists and people from neighbouring states like Tamil Nadu, Karnataka, etc., visit Munnar on weekends as easily accessible by road. This leads to increased noise levels due to many vehicles, sound systems, and many other sound emission forms for tourist attractions. A sudden spurt of tourism combined with haphazard developments in the name of tourism and allied infrastructure was the immediate outcome. Water supply, sewage, solid waste, energy, loss of green and natural areas, urban sprawl, land degradation, traffic, transportation, housing, space for public services and infrastructure, air pollution, and noise are all significant concerns faced by the tourism industry.

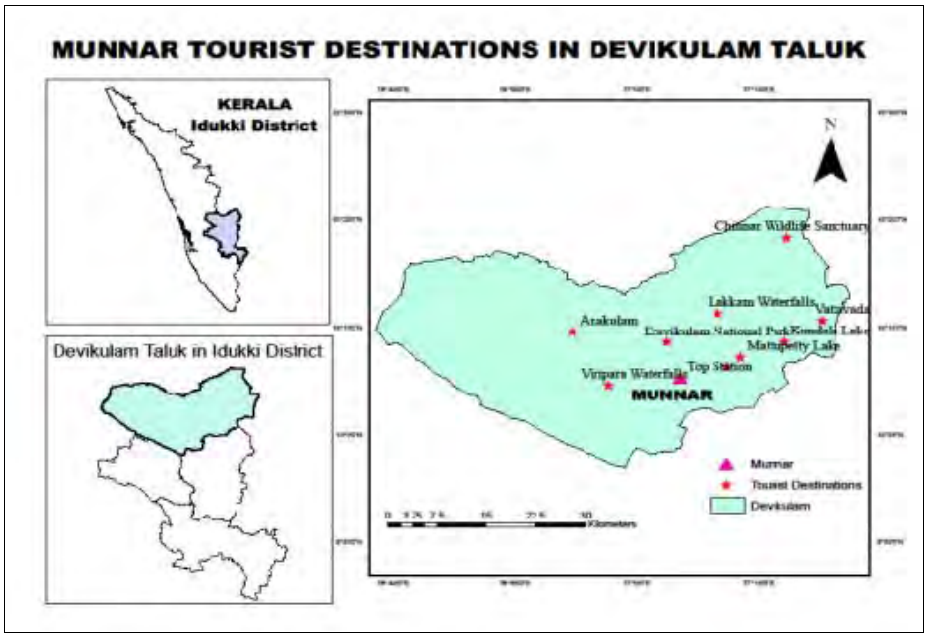

Fig. 1 Study area map of tourist destinations in Munnar, Kerala.

The study area was sampled for ambient noise at specific tourist spots falling under five different ecological indices, i.e., Local Recreation Zone, Leisure Tourism Zone, Buffer Conservation Zone, Ecotourism Zone, and Core Conservation Zone. Maximum conservation and minimum tourism must be permitted in the Core Conservation Zone, followed by Buffer Conservation Zone. Ecotourism activities and educational activities are allowed in Ecotourism Zone. The last two zones, Leisure Tourism Zone and Local Recreation Zone, can be mainly used for tourism activities as it falls under the least fragile environment (Sidhique, 2015).

Table 2 Study sites - tourist spots under different ecological index (Sidhique, 2015).

Ecological Index	Tourist Spots
Local Recreation Zone (picnic spots, mass tourism, and Infrastructure development)	Munnar Town, Anariyankal Dam
Leisure Tourism Zone (infrastructure and tourism promoting activities)	Mattupetty Dam, Kundala Dam, Pothamedu View Point
Buffer Conservation Zone (Fragile environment, minimum Ecotourism, conservation in-focus)	Top Station, Eravikulam National Park, Lakkam Waterfall, Chinnar
Ecotourism Zone (planned and regulated activities)	Viripara - Kainagiri Waterfall
Core Conservation Zone (ecologically sensitive)	Pampadum Shola National Park

The study's used a control impact design to determine sound levels at high visitor usage sites. The ambient noise levels recorded at the study sites (Table 2) will be examined to see if they fall within the CPCB's Noise requirements for ambient noise levels, notified in the Noise Pollution (Regulation and Control) Rules, 2000. According to which the forest area would fall under (D) Silence Zone as mandated by Law. To address this, we determined the various visitor tourist spots within the different zones of Munnar as described in the study done by Sidhique (2015). We recorded the sound levels in different seasons (Summer, Winter, Monsoon) with and without visitors in these zone-specific sites.

3 Methodology

3.1 Approach to measure sound

The destination's acoustic environment/soundscape is essential in creating a pleasant visitor experience and satisfaction, and natural silence is necessary for tourists to appreciate the expected landscape. At the same time, artificial sound (noise) is strictly managed (Liu et al., 2017). Sound measuring without response measurement, often known as the "acoustical technique" is widely used in environmental and workplace monitoring and has several benefits (Gramann, 1999). Such scientific instrumentation is a recent development in recreational contexts. The main issue is usually short-term exposure and deterioration in the quality of the tourist experience, rather than long-term health implications from continual sound exposure. According to studies conducted by several researchers, one can measure overall ambient noise levels at varied and carefully selected places using appropriate noise meters (Barathwal, 2002; Das et al., 2014; Bhalla et al., 2015; Vilcea et al., 2016; Esmeray, 2021). The use of such a metric, on the other hand, makes sound interpretations simple.

3.2 Instrument used

Sound Level Meter Testo 815 was used to monitor sound levels at the Tourist spots mentioned above. The instrument specifications and details as listed in Table 3. The measurement time can be changed from 1 second to 125 milliseconds using the Fast/Slow button to evaluate the noise source properly. It is possible to change the frequency analysis from characteristic curve A to C. The characteristic curve A correlates to the human ear's impression of sound pressure, whereas the characteristic curve C can also assess a sound's low-frequency components. The dB (A) unit's readings and the time weighting are adjusted to Fast by default. With the help of the optional calibrator and the screwdriver provided, the equipment was calibrated on-site. When measuring outdoors, the supplied wind protection hat assures accurate readings and, if necessary, protects the microphone from dirt and dust.

Table 3 Sound Level Meter Testo 815 instrument generic and sound pressure data.

Sound Level Meter Testo 815	Generic and Sound Pressure Data
Frequency weighting	A/C
Section measuring range	30 - 80 dB; 50 - 100 dB; 80 - 130 dB
Time weighting	FAST 125 ms setting / SLOW 1 s setting
Measuring range	+32 to +130 dB
Frequence range	31.5 Hz to 8 kHz
Accuracy	±1.0 dB
Resolution	0.1 dB
Measuring rate	Measuring rate

3.3 Sampling methodology

The sound level meter was placed 1 to 1.2m above the ground surface level in an upright position 50cm away from the body to mitigate any biasness of sound directionality. The calibration of the device was done before each measurement. To reduce the error, readings were taken continuously for 30 minutes at an interval of 2 minutes. The sound pressure levels were recorded for all the peak and non-peak tourist seasons of summer, winter, and monsoon for two consecutive years of 2018 and 2019. The maximum noise levels (Lmax), minimum noise levels (Lmin), and equivalent noise levels (Leq) were measured for ten days at 11 tourist spots mentioned in Table 2. The coordinates of the tourist spots at which measurements were taken were determined by Garmin eTrex Legendr HCX GPS device. The GPS (Global Positioning System) points were transferred onto land's digitized satellite image by Easy GPS and Q GIS software. The study methodology was finalized by analyzing and understanding various research studies. Other relevant information (traffic flow, types of vehicles, meteorological conditions, urban variables, etc.) was also noted. The method following in the study is as shown in Fig. 2.

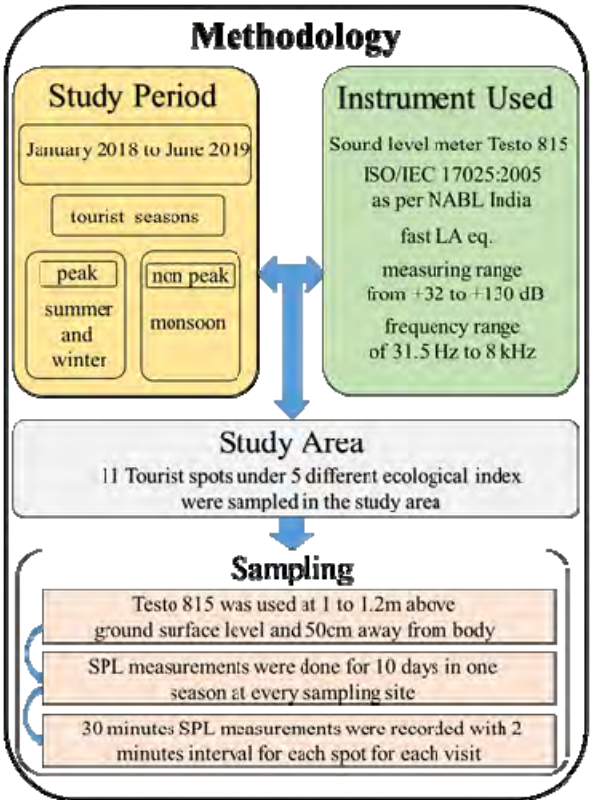

Fig. 2 Flowchart for the methods involved in the study.

The tourist centres in Munnar were grouped into five tourist routes, as shown in Fig. 3. The tourist attractions are located in and around Munnar and fall in Munnar, Devikulam, Chinnakanal, Pallivasal, and Mankulam panchayats. The tourist routes are as follows:

1) **Route 1: Munnar to Chinnar** (Munnar – Eravikulam National Park – Lakkam Waterfalls – Chinnar)
2) **Route 2: Munnar to Pothamedu** (Munnar – Pothamedu View Point).
3) **Route 3: Munnar to Top Station** (Munnar - Mattupetty Dam - Kundala Dam – Pampadum Shola-Top Station).
4) **Route 4: Munnar to Mankulam** (Munnar – Viripara Kainagiri Waterfalls)
5) **Route 5: Munnar- Anariyankal** (Munnar – Anayirankal waterfalls).

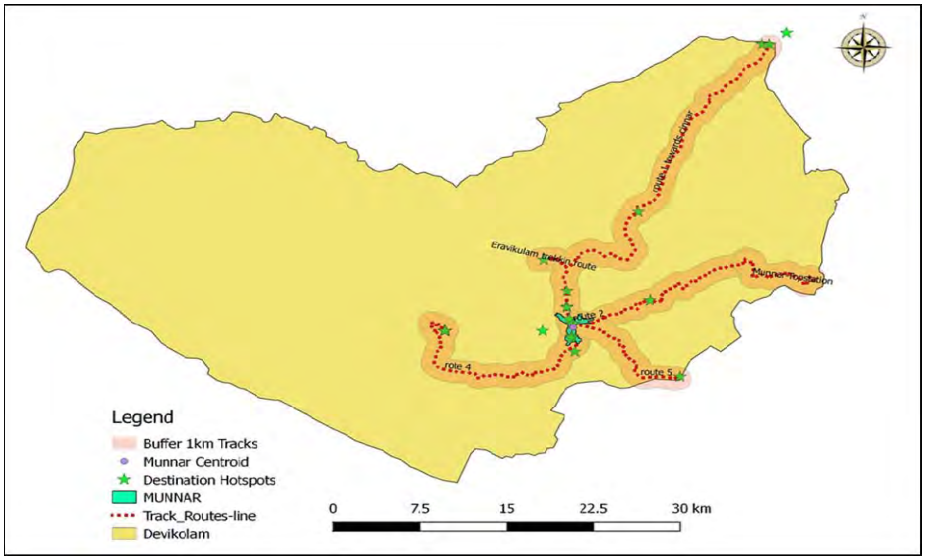

Fig. 3 Study area map showing the tourist circuits and tourist spots in Munnar, Kerala.

4 Results

The sound level was recorded at the selected points of the study site with the aid of a noise level meter and compared with the readings during the peak and lean activity periods. The graph in Fig. 4 shows the prevailing ambient noise levels in the various tourist spots of Munnar hill station. Using CPCB Noise guidelines (2000) (Table 1) and Sidhique (2015) (Table 2), different zones have been created to demarcate various tourist spots and further categorize them in silence, residential, commercial and industrial area according to recorded measurements of Fast LA eq. recordings for average values of the spots.

In the above graph (Fig. 4), a comparative analysis has been brought up for all the Silence Buffer Conservation Zones, Commercial Ecotourism Zones, Commercial Leisure Tourism zones, and Commercial Local Recreation Zones for all the tourist destinations. The hedge coloured lines represent the CPCB day noise limits.

During the peak tourist seasons of summer in 2018 and 2019, many Silence Buffer Conservation Zones of various destinations like Lakkam Waterfall, Eravikulum National Park and Top station crossed the CPCB limits. Also, in the Core Conservation Zone of Pampadum Shola National Park, the noise level exceeds the prescribed limits of CPCB during peak seasons of winter and summer 2018 (Table 4 and 5; Fig. 4).

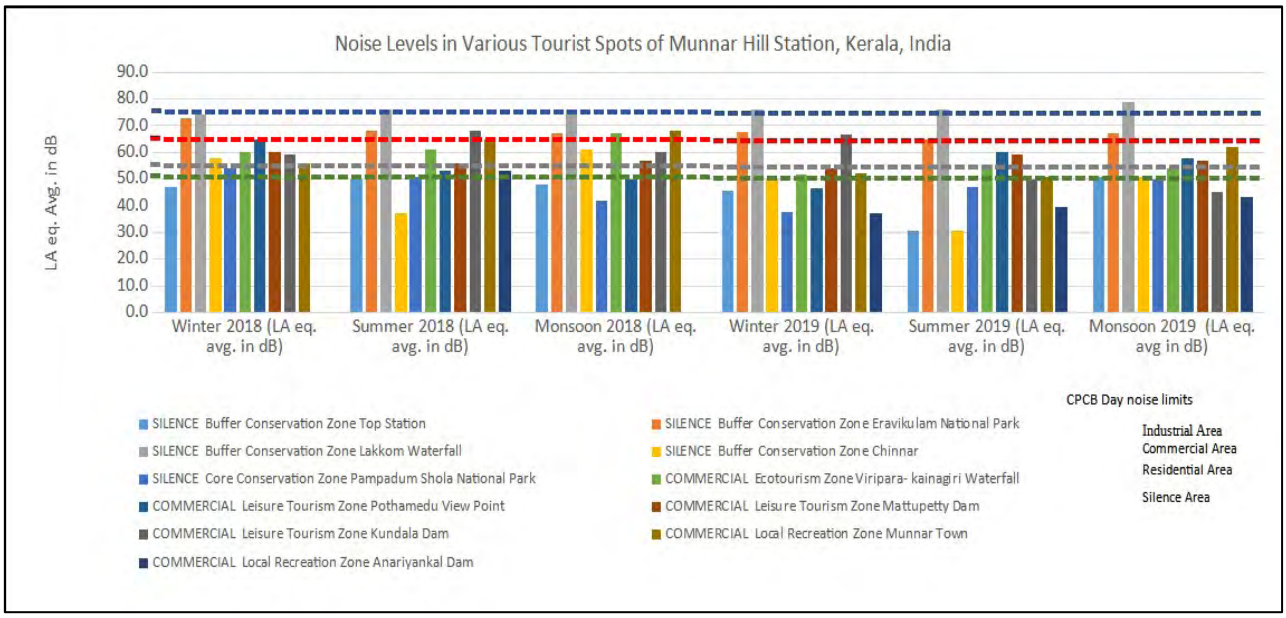

Fig. 4 Graph represents the ambient noise levels prevailing in various tourist spots of Munnar during both peak tourist (summer and winter) and non-peak tourist (monsoon) seasons, consequently for the years 2018 and 2019.

Table 4 Noise (LA eq. avg. in dB) for the tourist spots for the year 2018.

Tourist Spots	Peak Tourist Season		Non- Peak Tourist Season
	Winter 2018 (LA eq. avg. in dB)	Summer 2018 (LA eq. avg. in dB)	Monsoon 2018 (LA eq. avg. in dB)
Top Station	47.0	50.0	48.0
Eravikulam National Park	73.0	68.0	67.0
Lakkam Waterfall	74.0	76.0	76.0
Chinnar	58.0	37.1	61.0
Pampadum Shola National Park	54.0	51.0	42.0
Viripara- kainagiri Waterfall	60.0	61.0	67.0
Pothamedu View Point	65.0	53.0	50.0
Mattupetty Dam	60.0	56.0	57.0
Kundala Dam	59.0	68.0	60.0
Munnar Town	56.0	65.0	68.0
Anariyankal Dam	Data Not Recorded*	53.0	Data Not Recorded*

*Data was not recorded as the road entry was closed due to the road widening process for Cochin Madurai NH.

The Commercial Ecotourism Zone of Viripara –Kainagiri Waterfall; Commercial Leisure Tourism Zones of Pothamedu View Point, Muttapety Dam, Kundala Dam; and local recreational zones of Munnar town and Anariyankal Dam has very rarely crossed CPCB limits in the two consecutive years (Table 4 and Table 5; Fig. 4).

Table 5 Noise (LA eq. avg. in dB) for the tourist spots for the year 2019.

Tourist Spots	Peak Tourist Season		Non- Peak Tourist Season
	Winter 2019 (LA eq. avg. in dB)	Summer 2019 (LA eq. avg. in dB)	Monsoon 2019 (LA eq. avg in dB)
Top Station	45.7	30.4	51.0
Eravikulam National Park	67.7	64.9	67.0
Lakkam Waterfall	76.0	76.0	79.0
Chinnar	49.7	30.7	51.0
Pampadum Shola National Park	37.8	47.0	50.0
Viripara- kainagiri Waterfall	51.9	55.6	54.0
Pothamedu View Point	46.6	60.0	58.0
Mattupetty Dam	54.2	59.0	57.0
Kundala Dam	66.6	50.0	45.0
Munnar Town	52.0	50.6	62.0
Anariyankal Dam	37.3	39.7	43.5

5 Discussion

The above results show that tourist destinations, such as Pampadum Shola National Park, Chinnar, and Top Station, etc. which are classified as silence areas and buffer conservation zones, experienced a significant increase in ambient noise levels that exceeded the silence area CPCB noise limits of 50 dB during the peak tourist season of 2018 and 2019.

Many commercial areas comprising leisure tourism, Ecotourism, and local recreation zones representing Pothamedu View Point, Viripara-Kainagiri waterfall and Munnar town show noise levels with CPCB limits consecutively for both the years. For Eravikulam National Park falling under silence area and core/buffer zone noise levels are relatively high for all the sampling space of two years 2018 and 2019. The impact of the noise that may seem to be getting absorbed in the natural open area, thereby showing less impact at present, might lead to severe effects in the future. The current level of continuous noise in the area may cause various symptoms in the future, as shown by the multiple studies (Pizam, 1978; Butler, 1993; Lohani et al., 1997). Given the potential impact of soundscape on tourist experience and tourist satisfaction, a more comprehensive assessment of tourist sensory satisfaction is required to enhance tourism experiential product development and destination marketing operations.

Furthermore, given the importance of soundscape to tourists and their happiness, locations should devote more attention to improving the acoustic environment and, if possible, incorporating proper appeal and image into their marketing campaigns (Ming and Chung; 2019). Tourists who visit to have fun, relax, and have a good time are likely to be negatively affected physiologically and psychologically due to excessive noise. Employees, as well as citizens and tourists, are adversely affected by noise. Employees in a noisy work environment suffer physical and psychological consequences, and job satisfaction and performance suffer as a result. Excessive noise has a negative impact on productivity and well-being, resulting in stress (Gokgoz, 2013). One of the environmental challenges, particularly in ecotourism areas, is noise pollution, which has a detrimental impact on inhabitants and tourists. This scenario is also essential in terms of tourist destination preference criteria.

6 Conclusion

From the above results, it can be concluded that hill station Munnar and its various tourist spots show a relatively normal distribution of sound in all the categories of the CPCB. However, in some cases like Eravikulam National Park, Pampadum Shola National Park, CPCB ambient sound limits have been crossed during all the seasons, which is a cause of worry. Since these classifications of the tourist spots in zones have eased in grading the noise distribution in the study area, it can be used for future noise-related studies in any ecotourism destination. The noise measurements and observations reveal massive vehicle intensity in the peak seasons of Munnar Tourist spots, which can be regarded as the main reason for the noise in the town center. The often unplanned and extensive use of space to accommodate more tourist activities will eventually degrade the physical environment, one of the primary attraction points. In fact, for some places, the necessity for the immediate introduction of tourism/environment sustainability indicators is more than evident. Tourism should contribute to sustainable development and environmental protection and provide the necessary means for that. However, to promote sustainable tourism, it is essential to understand both the benefits and the costs of tourism.

Additionally, a more systematic measurement of direct and indirect tourism costs and benefits and green accounting systems that include the acoustic environment is needed. Action is required at all policy levels, such as better integrating tourism with sustainable development necessitates significant investments in training, public awareness, the exchange of experience and best practice knowledge, and the coordination of strong local engagement. Noise reduction and protection should be compulsorily included in all environmental considerations.

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