

Toward Sustainable Aviation Noise Governance: A Policy Review

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ABSTRACT

This study examines aviation noise in the Philippines through a policy review integrating pilot perspective, community experiences, and legislative efforts. Previous studies focusing on residents near airports (Abaya et al., 2007; Sombilla et al., 2013; Espenido et al., 2018), reported daily noise exposure ranging from 65 to 110 decibels, resulting in health consequences including sleep disturbances, hearing impairment, hypertension, and cardiovascular risks. Social impacts such as annoyance, communication interference, and reduced quality of life further highlight the inadequacy of current interventions. Insights from 29 pilots, revealing significant concerns about noise's impacts, stress, fatigue, and concentration difficulties during critical flight phases, compounded by challenges with air traffic control. While operational adjustments like night-flight avoidance and noise abatement are practiced, few pilots received formal training, reflecting institutional gaps. Legislative responses, embodied in the 'Aviation Noise Limit Act', recognize noise as a public health disturbance but remain unenacted despite repeated advocacy. Findings underscore the need for integrated solutions such as enforceable legislation, community mitigation and enhanced pilot safety to balance aircraft efficiency with public health toward sustainable aviation noise management.

INTRODUCTION

Aviation noise has been a significant cause of annoyance and nuisance among the locals, and its greater effect is causing pollution to the general public, especially the nearby residents at the airport. Basner et al. (2017) stated that aviation noise, defined as unwanted sound and is a major environmental issue in aviation. It can disturb sleep, hinder children's learning, cause community annoyance, and increase health risks. The impact is massive because it is often that these airports are built and constructed in urban areas, specifically in major cities. The change in the activity levels in the airport has definitely changed the way of life of the communities surrounding the area, which basically hinders them from living quietly. The increase in flyovers, landings, and take-offs has inevitably irritated the locals and this has sparked for the urge to call for change as noise pollution caused by airports is becoming a pressing issue. In a report conducted among 47 European airports, it has been found that about 3.2 million people are affected and exposed to more than 45 decibels, and about 1.4 million were exposed to over 40 decibels. Further, the survey also revealed that around 1 million locals per day experience aircraft noise of more than 50 frequencies with more than 70 decibels of noise (Gallagher, 2021), and this can be concluded as beyond annoyance because this noise with such high decibels and increased frequencies causes serious problems concerning an individual's health and the environment. As cited from the account of the World Health Organization, the round-the-clock operations of an airport cause disturbed sleep that may result in neural and hormonal changes, which may further affect blood pressure and heart. Aside from this, a usual dilemma includes hearing damage, and further consequences include the delay in learning among children in the affected areas around the airport. Therefore, airport noise is increasingly a source of annoyance, and a health issue, which has already begun since the 1960s and continuously progressed at present. With the vital consideration of the negative effects of aviation noise, international organizations such as the International Civil Aviation Organization (ICAO) have already created and implemented a policy for noise abatement, through the Balanced Approach (BA) in Aircraft Noise Management which undertakes an equilibrium in minimizing aviation noise, at the same time, considering the economic benefits garnered from the aviation industry (ICAO, n.d.).

In the study of Zaporozhets (2022), the ICAO BA to aircraft noise management highlights four elements, noise reduction at source, compatible land-use planning, operational abatement procedures, and operating restrictions applied through cost-benefit analysis to reduce exposure and ultimately minimize population annoyance. In China, six strategies were proposed to reduce aircraft noise at Guangzhou Baiyun International Airport: optimizing aircraft type, limiting night flights, adjusting flight procedures, modifying runways, land use planning, and sound insulation (Xie, Zhu, & Lee, 2023). In Kuwait, researchers studied how to reduce airplane noise around Kuwait International Airport. They used real flight data and international standards to check if rules were followed. They also suggested charging airlines fines when noise levels go above limits, especially at night. This would push airlines to cut flights and lower noise overall (AlKheder & ALMutairi, 2023).

In the Philippines, there are already two (2) pending Senate bills and seven (7) pending House bills to provide management and reduction of aviation noise, especially for affected residential areas. Despite this, the legislative branch has yet to move forward on its approval and the bill remained pending. This stems from the lack of information, awareness, resources, and capability for a comprehensive understanding of aviation noise and the application of mitigation measures.

This study examines the impact of aviation noise in the Philippines by reviewing previous research on impact of aircraft noise on residents living near airports, analyzing pilot feedback, and assessing legislative responses through the proposed 'Aviation Noise Limit Act'. It explores how noise affects both communities and pilots, at the same time, it evaluates the adequacy of existing policy measures and considers how legislation can be strengthened to better protect public health and flight safety. The objectives are to analyze the effects of aviation noise on pilot's performance and community well-being and to assess whether the provisions of the new bill are sufficient in addressing noise concerns. By integrating these dimensions, the study provides comprehensive framework for understanding aviation noise and identifying strategies for effective management.

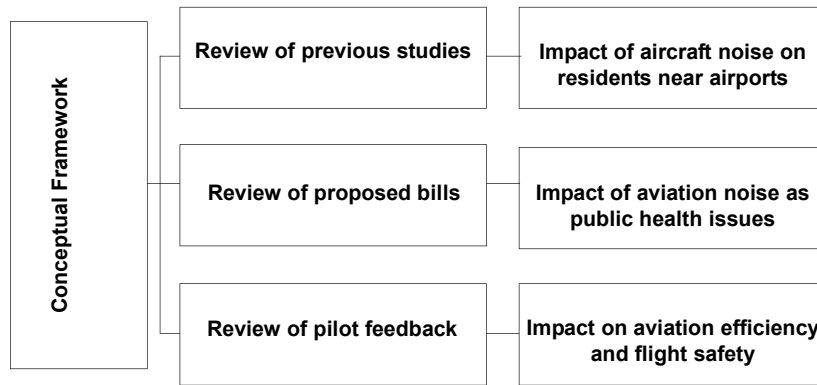


Figure 1. Framework for Aviation Noise Impacts in Policy Review

Aircraft Noise: Summary of Studies in Major Airports in the Philippines

Aircraft noise significantly impacts communities near airports, affecting daily life and health. Several studies have examined the impact of noise on communities near major airports in the Philippines, revealing significant effects on health, communication, and daily life. One study focusing on the Ninoy Aquino International Airport affecting residents in nearby Barangays San Dionisio and Rizal. Another research conducted at Francisco Bangoy International Airport in Davao City recorded noise intensities. Meanwhile, a study at Mactan-Cebu International Airport highlighted how tree cover can mitigate noise exposure, with residents near Barangay Pajac.

Ninoy Aquino International Airport (NAIA)

In the Philippine context, aircraft noise is also one unmanageable aspect of air travel. In fact, studies have already depicted and focused on this as a variable, wherein in a study conducted by Abaya et al., (2007), noise at varying degrees have already been experienced by the locals around the airport, particularly in Barangay San Dionisio and Rizal, which is nearby NAIA, which is the main airport in the country, and the general foreground of the locals concerning this issue on noise pollution caused by aviation is that, they “have gotten used” to it because of the long exposure they had experienced and endured. In particular, about 200,000 locals were exposed

to a range of 65 to 75 decibels, and 40,000 people have been subjected to a range of 70 to 75 decibels. Aircraft noise impacted the residents adversely. It hindered their conversations and disturbed sleep due to the 24-hour operations of the airport. The extreme noise could potentially cause impairment of the aural system. These findings have been found in the two nearby barangays of the country's main airport and the effects have already been grave, it is unfathomable how noise pollution can be more to all the barangays and locals surrounding the less than a hundred airports across the country.

Francisco Bangoy International Airport (Davao International Airport)

An identical study was conducted at Francisco Bangoy International Airport in Davao City. Republic Act No. 11457 (2019) created the Davao International Airport (DIA) to administer and operate the facility, which serves as another major hub for flights in Mindanao located in the southern portion of the Philippines. Research revealed that aviation noise of varying intensities affected nearby communities. Residents in areas farther from the airport were still exposed to 40-60 decibels of noise, while those who lived closer were exposed to 90 to 110 decibels. Exposure to these noise levels affected the residents' rest and sleep. Residents have experienced detrimental effects particularly in terms of their hearing ability and communication. Residents of Roseville Subdivision, located 3.3 kilometers from the airport, could be exposed to as much as 89.15 decibels. Those who live in Vincent Heights (at 2 kilometers from the airport) could be exposed to about 87.15 decibels, while resident of Victoria Heights (3.2 kilometers from the airport) and La Verna Subdivision (1.4 kilometers from the airport), to 86.63 and 69.5 decibels, respectively. The aircraft noise has caused further disturbances in their activities and also affected their mood. Therefore, this situation calls for the creation of policies that will regulate noise pollution attributed to the aviation industry given that most of these airports are situated in the busiest and crowded cities across the country (Sombilla et al., 2013).

Mactan Cebu International Airport (MCIA)

The study conducted by Espenido et al. (2018) at MCIA focused on the assessment of the intensity of noise that a hamlet was exposed to. The small community was situated 1.8 kilometers from the said airport where landings and takeoffs occur daily. The data were recorded using Sound Meter Pro, a mobile application installed on two different mobile devices, LG G3 and Asus Zenfone Max. These phones were calibrated in a laboratory to avoid any bias. The study found that tree cover located in front of a hamlet reduced the intensity of noise exposure that hamlet experienced compared to areas without tree cover. The peak noise exposure experienced by residents at MCIA was recorded at 82.56 decibels, a level associated with significant noise annoyance. In a locality adjacent to MCIA's runway, Barangay Pajac, the residents experienced varied degrees of effects such as annoyances coming from the aircraft noise. The study found an associated increase in risk for high blood pressure and heart attack with exposure to aircraft noise. Residents exposed to noise levels exceeding 50 decibels are 20% more likely to develop hypertension than those exposed to lower noise levels. Meanwhile, sleep disturbance was significant for residents who were exposed to 45 to 65 decibels of noise. Despite this, Barangay Pajac is surrounded by trees and shrubs which were found effective for noise abatement; hence, it has been recommended that more trees should serve as canopy cover to decrease aircraft noise received among the residents.

Aviation Noise Policy and Legislative Responses in the Philippines

These findings suggest that aviation noise poses a significant challenge. According to Air Transport Action Group (2020), the aviation noise remains a concern, especially for those living near the vicinity of airports. Nevertheless, the aviation industry has been working to reduce noise. For the past ten (10) years, the aviation noise has decreased by half, and 15% of the noise footprints have been lower compared to previous models. In 2016 International Civil Aviation Organization (ICAO) Assembly, the world governments agreed to implement the first global carbon emissions mechanism (Air Transport Action Group, 2020).

As international organizations are already taking their initiatives in addressing aviation noise and its abatement to reduce the adverse impacts it creates, in the Philippines, the lawmakers have sought to pass laws to formalize standards to address this concern. In 2010, through the House of Representatives, Hon. Rufus B. Rodriguez and Hon. Maximo B. Rodriguez, Jr. initially filed the tagged House Bill No. 1649 under the Fifteenth Congress. The bill emphasized the absence of a law that would determine and deal with airport noise and its impact. The bill acknowledged the disturbance caused by aviation noise, particularly to rest and sleep. It sought to define noise limits to outline its management and minimization to benefit the residential areas surrounding airports. It likewise aimed to have an appropriate plan that covers zoning, land use, as well as relocation. Section 3 of the bill indicates the responsibility of the Air Transportation Office under the then Department of Transportation and Communication to establish a medium-term plan which would reduce the number of individuals affected by aviation noise of 60 decibels and above by 75%. In the development of the said medium-term plan, the Air Transportation Office should consider tailoring strategies for noise abatement such as soundproofing, and create these recommendations and suggest changes in policies to meet the above-mentioned objective. The bill also outlined requirements for compliance among airports such as establishing an hourly average sound level at 6 decibels and below for an hour period, creating a limit of not more than 70 decibels for the single event maximum level, and down to not more than 55 decibels for nighttime, and not more than 20 decibels for an hour period. These requirements are considered achieved if the airport did not exceed three violations in a 24-hour period. In addition, the day-night average sound level was set at below 45 decibels.

Despite being repeatedly filed from 2010 to 2023, the Aviation Noise Limit Act was never enacted because Congress adjourned before completing the legislative process, causing the bills to lapse. It was also not considered a legislative priority of the President. Three years later, the same proponents, Congressmen Rufus and Maximo Rodriguez, Jr. filed the same bill, tagged as House Bill No. 3293 in November 2013 under the Sixteenth Congress. The bill had the same provisions across its 11 sections. Five years later, in January of 2018 under the Seventeenth Congress, Congressman Rodriguez, Jr. re-proposed the bill House Bill No. 6952 under his name. The bill, titled 'Aviation

Noise Limit Act,’ sought to protect health by discerning the impacts of aviation noise on the residential areas located near airports and establishing initiatives to manage the noise level to which residents were exposed. Moreover, it aimed to reduce the population disturbed by aircraft noise. The 2018 bill ensured that the people’s rights were constitutionally protected, particularly the right for quiet enjoyment their private properties. In August 2019, Hon. Rufus B. Rodriguez again refiled the bill through the Eighteenth Congress and this was tagged as House Bill No. 3763. The same 11 provisions since 2010 were adopted. These two original proponents of the ‘Aviation Noise Limit Act’ were from Cagayan De Oro. Meanwhile, on March 2021, eleven years after the initial proposition of the bill, Hon. Luis Raymund “LRay” F. Villafuerte, Jr. of Camarines Sur proposed the same bill and was tagged as House Bill 9094, and the bill had the same exact 11 provisions from the initial bill proposition. In January 2023, Hon. Rufus B. Rodriguez filed the same bill once more, and was tagged as House Bill No. 6751. In the same year, in August 2023, Congressman Villafuerte, Jr. also filed the same bill and was tagged as House Bill No. 8730, with same provisions.

On the other hand, the Senate through the Fourteenth Congress in 2007 had been the first to file an act in management and reduction of aviation noise affecting residential areas which was filed by Senator Manny Villar and was tagged as Senate Bill No. 242. This bill was the original source of the subsequent propositions in the House of Representatives. Three years later, in 2010, a month after Congressmen Rodriguez Rodriguez, Jr. filed the House Bill 1649 in July, Senator Jinggoy Estrada filed the bill under the Fifteenth Congress and was tagged as Senate Bill No. 465, with the similar provisions. The following table consolidates the legislative efforts in both the House of Representatives and the Senate to establish a uniform system for managing and minimizing aviation noise. These bills, collectively referred to as the ‘Aviation Noise Limit Act’, were filed across multiple Congresses by different authors, reflecting a sustained advocacy for protecting public health and ensuring the quiet enjoyment of residential areas near airports.

Table 1. Author's Consolidation of the Proposed 'Aviation Noise Limit Act' from the House of Representatives

Bill Number	Congress	Full Title	Short Title	Principal Authors
HB 1649	15th (2010)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Rufus B. Rodriguez Hon. Maximo B. Rodriguez, Jr.
HB 3293	16th (2013)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Rufus B. Rodriguez Hon. Maximo B. Rodriguez, Jr.
HB 6952	17th (2018)	An Act Providing for Aviation Noise Management and Reduction in Residential Areas	Aviation Noise Limit Act	Hon. Maximo B. Rodriguez, Jr.
HB 3763	18th (2019)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Rufus B. Rodriguez
HB 9094	18th (2021)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Luis Raymund "LRay" F. Villafuerte, Jr.

HB 6751	19th (2023)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Rufus B. Rodriguez
HB 8730	19th (2023)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Luis Raymund "LRay" F. Villafuerte, Jr.

Table 2. Author's Consolidation of the Proposed 'Aviation Noise Limit Act' from the Senate

Bill Number	Congress	Full Title	Short Title	Principal Authors
SB 242	14th (2007)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Manny Villar
SB 465	15th (2010)	An Act Establishing a Uniform System in Determining and Dealing with Airport Noise and Its Impact	Aviation Noise Limit Act	Hon. Jinggoy Ejercito Estrada

METHODOLOGY

This study employed a triangulated policy review approach, integrating pilot perspective, community experiences, and legislative efforts to examine aviation noise in the Philippines. A total of 29 pilots participated, responding to a structured electronic questionnaire. The survey included multiple-choice and open-ended questions, covering topics such as experience level, exposure to noise, stress and health impacts, decision-making impacts, and opinions on noise abatement measures. Pilots submitted responses online, ensuring ease of participation. Percentages were calculated by dividing the number of respondents for a given answer by the total number of pilots and multiplying by 100. Pilots completed the survey at their convenience, ensuring a diverse range of perspectives. Anonymity was maintained to encourage honest and unbiased feedback.

Community data were obtained through a review of existing studies on residents living near major airports such as NAIA, DIA, and MCIA. Reported aircraft noise exposure levels in decibels were extracted from the literature and analyzed, no primary field measurements were conducted as part of this study.

Legislative review, on the other hand, centered on the 'Aviation Noise Limit Act', analyzing its provisions and thresholds, and proposed compliance mechanisms. By synthesizing these 3 dimensions, the methodology highlights the interplay between operational practices, community health outcomes, and regulatory frameworks.

RESULTS

The survey gathered responses from 29 pilots, providing insights into their professional experiences, concerns and exposure levels, as well as opinions on noise abatement measures.

Pilot Experience and Aircraft Type

The respondents represented a diverse range of experience levels. Most pilots had more than 21 years of experience (41.38%), followed by those with 0–10 years (34.48%) and 11–20 years (24.14%). In terms of aircraft operated, 27.59% primarily flew jet aircraft, while 27.58% operated turboprop,

piston, or fixed-wing aircraft. Helicopter pilots accounted for 24.14% of respondents, followed by Cessna operators (10.34%), multi-engine aircraft operators (6.90%), and trainer aircraft pilots (3.45%).

Exposure to Aviation Noise and Its Effects

More than half of the respondents (51.72%) reported flying near residential areas on a daily or frequent basis, while 34.48% did so occasionally and 13.80% rarely. A majority (62.07%) acknowledged concerns regarding aviation noise. Furthermore, 75.86% believed that aviation noise negatively affects public health and well-being, citing potential impacts such as hearing impairment, sleep disruption, stress, and reduced quality of life.

Operational Adjustments and Impact

To minimize noise impacts, 68.97% of pilots reported implementing operational adjustments, including compliance with noise-abatement procedures, route modifications, and power management techniques. Aviation noise exposure remained common, with 48.28% reporting constant exposure and 20.69% experiencing it often. Despite this exposure, only 13.79% indicated that noise influenced their operational decision-making, while 86.21% reported little or no effect due to established procedures and professional experience.

Communication, Fatigue, and Concentration

Most respondents reported that aviation noise had minimal (55.17%) or moderate (20.69%) effects on communication with Air Traffic Control (ATC). Only 13.79% reported significant or severe impacts. While 37.93% experienced stress or fatigue associated with aviation noise exposure, the majority (62.07%) did not consider it a major concern. Similarly, 58.62% reported no significant impact on concentration during critical flight phases, although 41.38% acknowledged some degree of concentration impairment.

Training and Noise Abatement Measures

Formal training on coping with aviation noise was limited, with only 13.79% of respondents reporting that they had received relevant training or briefings. Regarding existing noise-abatement measures, 55.17% either agreed or strongly agreed that current measures are generally sufficient, while 27.59% remained neutral and 17.24% expressed disagreement.

Regulation and Proposed Solutions

Opinions regarding stricter aviation noise regulations were mixed. Approximately 44.83% supported stronger regulations to address community health and environmental concerns, while 48.28% opposed additional restrictions and 6.89% remained neutral. Respondents recommended several measures to reduce aviation noise and its effects, including improvements in aircraft and engine technology, wider use of noise-canceling headsets and hearing protection, enhanced implementation of noise-abatement procedures, regulation of thrust reverser use, limitations on late-night operations, installation of sound barriers and vegetation buffers, and increased pilot awareness and training. These recommendations highlight the need for a balanced combination of technological, operational, and policy-based approaches to sustainable aviation noise management.

Table 3. Summary Results on Aviation Noise Impacts and Coping Strategies

No.	Category	Response Breakdown
1	Years of Experience	• 0–10 years: 34.48% • 11–20 years: 24.14% • 21+ years: 41.38%
2	Aircraft Type	• Helicopter/Rotary Wing: 24.14% • Jet Aircraft: 27.59% • Cessna: 10.34% • Multi-Engine: 6.90% • Trainer: 3.45% • Turboprop/Piston/Fixed Wing: 27.58%
3	Flying Near Residential Areas	• Daily/Frequent: 51.72% • Occasional: 34.48% • Rare: 13.80%

4	Concerns About Aviation Noise	• Yes: 62.07% • No: 37.93%
5	Impact on Public Health	• Yes: 75.86% • No: 24.14%
6	Operational Adjustments Due to Noise	• Yes: 68.97% • No: 31.03%
7	Exposure to Noise During Flights	• Always: 48.28% • Often: 20.69% • Sometimes/Rarely/Never: 31.03%
8	Influence on Decision-Making	• Yes: 13.79% • No: 86.21%
9	Impact on Communication with Air Traffic Control	• Minimal: 55.17% • Moderate: 20.69% • Significant/Severe: 13.79% • No Impact: 10.35%
10	Stress or Fatigue Due to Noise	• Yes: 37.93% • No: 62.07%
11	Impact on Concentration During Flight Phases	• Yes: 41.38% • No: 58.62%
12	Training on Coping with Noise	• Yes: 13.79% • No: 86.21%
13	Opinions on Noise Abatement Measures	• Strongly Agree: 13.79% • Agree: 41.38% • Neutral: 27.59% • Disagree: 17.24% • Strongly Disagree: 0.00%

14	Support for Stricter Noise Regulations	• Yes: 44.83% • No: 48.28% • Neutral: 6.89%
15	Suggested Noise Reduction Strategies	• Aircraft and engine design improvements • Noise-canceling headsets and hearing protection • Improved implementation of noise-abatement procedures • Limiting late-night flights and operating hours • Regulation of thrust reversers and flight operations • Sound barriers, vegetation buffers, and community mitigation measures

The survey results reveal that most respondents recognize aviation noise as a public health concern and report experiencing its effects during flight operations. This analysis provides valuable insights into pilot experiences with aviation noise, highlighting areas for improvement in noise management and policy development.

DISCUSSION

The findings from 29 pilot respondents reflect diverse levels of experience, aircraft types, and exposure to aviation noise. Most pilots had more than 21 years of experience and operated a mix of jet aircraft, helicopters, and turboprop or fixed-wing aircraft. More than half frequently flew near residential areas, and a majority recognized aviation noise as a public health concern, particularly for hearing, sleep, and stress. Most respondents reported implementing noise-abatement procedures to minimize impacts. While aviation noise had limited influence on operational decision-making and ATC communication, some pilots experienced fatigue, stress, and concentration challenges. Formal training on noise management was limited. Respondents

recommended improved aircraft technology, enhanced noise-abatement procedures, hearing protection, and balanced regulatory measures to reduce aviation noise impacts.

Community experiences, on the other hand, especially those residents near major airports such as NAIA, DIA, and MCIA face daily exposure ranging from 65 to 110 decibels. This constant exposure has been linked to serious health effects, including sleep disturbance, hearing impairment, hypertension, and cardiovascular risks. The social consequences are equally significant, with persistent communication interference, heightened annoyance, and a decline in overall quality of life becoming persistent realities. Although vegetation buffers have shown promise in mitigating noise, many residents have simply adapted to the constant exposure, underscoring the limitations of current mitigation strategies and the urgent need for more comprehensive interventions.

Lastly, legislative efforts, embodied in repeatedly filed 'Aviation Noise Limit Act', attempt to formalize standards by defining thresholds and mandating compliance. The bills recognize aviation noise as a public health disturbance and prove medium-term plans to reduce affected populations by 75%. However, despite sustained advocacy across multiple Congresses, these measures remain unenacted. The findings therefore highlight a pressing need for integrated solutions combining pilot training, community-based mitigation, and enforceable legislation to address aviation noise holistically. The author summarizes aviation noise impacts through three dimensions, namely: pilot, communities, and legislative efforts, integrating them into a policy framework for sustainable aviation management.

Table 4. Summary of Aviation Noise Management Dimensions

Dimension	Pilots (Feedback Study)	Communities (NAIA, DIA, and MCIA)	Legislative Efforts (Aviation Noise Limit Acts)
Exposure	Frequent exposure depending on aircraft type and routes	65-110 dB daily near airports	Defined thresholds: d"70 dB single event, d"55 dB nighttime, d"45 dB day- night average

Health	Impacts Sleep disturbance, hearing impairment, stress, fatigue,	difficulty concentrating Sleep disturbance, hearing loss, hypertension,	cardiovascular risks, mood changes Bill recognizes aviation noise as a public health disturbance
Social / Operational Impacts	Communication interference with ATC, reduced focus during critical flight phases	Communication interference, annoyance, reduced quality of life	Seeks to protect quiet enjoyment of communities
Adaptation/ Mitigation	Operational adjustments (avoiding night flights, noise abatement procedures)	Communities “got used to” noise; vegetation buffers effective	Medium-term plan: reduce affected population by 75%; strategies like soundproofing, zoning, relocation
Training / Information Advocacy	Few pilots trained on coping with noise; training gap	Limited awareness beyond vegetation mitigation	Lack of public awareness on regulatory compliance and abatement strategies
Regulatory Opinions	Pilots divided on stricter regulations	Demand stricter controls and mitigation	Bills filed repeatedly (2007–2023) but not enacted; need a strong advocacy
Suggested Improvements	Better aircraft design, noise- canceling headsets, limiting late-night flights	More vegetation canopy, stricter airport regulations	Uniform system for managing noise; enforceable compliance standards

CONCLUSION

The findings from this research demonstrate that aviation noise is not merely an environmental nuisance but a multidimensional issue affecting pilots, communities, and policymakers alike. Pilots encounter operational and personal challenges, communities face direct health and lifestyle impacts, and legislative efforts remain stalled despite clear recognition of the problem.

The persistence of exposure and its consequences underscores the urgency of moving beyond fragmented responses toward coordinated action. Only through this integrated approach can aviation noise be minimized while safeguarding both public health and flight safety.

Recommendations and Future Studies

To effectively manage aviation noise, **policymakers and aviation authorities** should prioritize **noise reduction initiatives** that strike a balance between **aviation development and environmental protection**. Implementing **stricter noise abatement policies**, such as **limiting late-night flights, optimizing flight routes, and improving aircraft designs**, can significantly reduce **noise pollution near residential areas**. Evidence from Frankfurt Airport showed that a night-flight ban (23:00–05:00) reduced noise-related sleep disturbances and awakenings among nearby residents (Elmenhorst et al., 2024). Flight route optimization can reduce airport noise by redistributing flight paths away from overexposed communities while maintaining operational efficiency. A case study reported noise reductions of up to 16.8% and shorter flight times (Guo et al., 2026). Sahai et al. (2017) found that optimizing aircraft design using psychoacoustic and sound-quality metrics may reduce community noise annoyance by producing less disturbing noise profiles while maintaining aircraft performance objectives. Investments in **pilot training programs** that focus on **noise mitigation strategies** will improve **operational awareness** and enhance **flight safety**. Additionally, the **aviation industry should collaborate with researchers and environmental experts** to explore **innovative noise reduction technologies**. Strengthening **legislative frameworks**, including the **passage of the ‘Aviation Noise Limit Act’**, will provide **clear regulatory guidelines** for noise management. **Community engagement and public awareness campaigns** should also be conducted to inform residents about **existing noise reduction measures** and encourage their participation in **policy discussions**. These recommendations will help establish a sustainable aviation environment that addresses noise-related challenges effectively.

Based on the findings of this study, the table below outlines a phased plan of recommendations for aviation noise management. The proposed measures encompass operational, regulatory, technological, and community-

based interventions aimed at reducing noise exposure and enhancing environmental sustainability. Collectively, these measures support a sustainable aviation noise management framework that balances aviation growth, environmental protection, public health, and community well-being.

Table 5. Author's Recommended Sustainable Aviation Noise Reduction Plan

Area	Short-Term (1-3 years)	Medium-Term (4-7 years)	Long-Term (8-15 years)
Noise Abatement	Limit late-night flights and optimize flight routes to minimize residential noise exposure.	Mandate quieter aircraft designs through aviation noise regulations.	Promote adoption and implement advanced aircraft noise reduction technologies.
Land Use & Mitigation	Identify high-noise zones, secure funding for relocation and soundproofing.	Implement soundproofing programs for homes, schools, and hospitals.	Establish relocation and compensation programs for severely affected communities.
Pilot Training	Integrate noise-abatement procedures into pilot training.	Expand simulator-based noise mitigation training.	Institutionalize noise management competencies in aviation education.
Legislation and Advocacy Campaign	Advocate for an aviation noise limit act and conduct public awareness campaigns.	Develop airport noise action plans and strengthen community engagement.	Regularly update regulations and maintain long-term stakeholder participation.

Future studies must expand the scope of research to include more locales airport and broader range of pilots, covering international and regional flights. Collaboration with aviation schools and research units will strengthen data collection and training initiatives. Comparative studies with the Association of Southeast Asian Nations (ASEAN) airports and other regional aviation organization are essential to benchmark practices and identify best solutions. Involving health and environmental experts, along with stakeholder organizations, will ensure a multidisciplinary approach that integrates public health, environmental sustainability, and aviation efficiency.

Compliance with Ethical Standards

This paper is authored by a single individual committed to ethical research practices. Respondents provided informed consent for participation, were fully briefed on the study's objectives, and their identities were protected to ensure confidentiality.

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