



Buffer Zone of Existence as a Non-Activity Area Within the Airport

Dyah S Pradnya P

Universitas Sebelas Maret, Surakarta, Central Java 57126, Indonesia

dyah_spp@staff.uns.ac.id

Abstract. The Buffer Zone, also known as the green belt, is an open space surrounding the aircraft runway line without buildings and activities. Despite its intended purpose, this zone is often utilized for agricultural activities. However, the presence of aircraft movement and emission pollutants, reaching up to 600 grams per kilometer, poses potential environmental health problems and could impact crop yields. Thus, this research aims to explore the relationship between activities within the buffer zone and environmental health. The study used qualitative methods to gather comprehensive data and conduct a thorough analysis. Data sources and architectural literature in the context of environmental health were utilized. The findings indicate that agricultural land is situated adjacent to infrastructure facilities, with the coexistence of vegetation, including food plants, within the zone raising concerns about potential pollutant exposure. Sub-infrastructure could also contribute to pollution levels. Consequently, it is essential to refrain from converting farmland into infrastructure areas to avoid adverse effects on the environment, such as reduced green open spaces and environmental degradation. Instead, natural and common vegetation should be nurtured and utilized to serve as barriers, provide shade, and maintain environmental integrity. The development of infrastructure in the buffer zone should be carefully planned to prevent exacerbating air pollution around the airport. By considering such factors and implementing suitable measures, the buffer zone could be effectively utilized while ensuring environmental health and sustainability.

Keywords: Buffer-Zone, Health, Airport, Environment, Air Pollution.

1. Introduction

Most airports are located within special and closed areas, incorporating a network of infrastructure facilities at specific distances to facilitate monitoring, regulate circulation, and ensure sterilization. Such measures are implemented to enhance security and reduce risks associated with aircraft movement operations. Furthermore, airports are often bordered by natural features such as beaches, cliffs, and suburban areas of cities or villages.

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Within the airport boundaries, there are two barriers. The first barrier (Barrier I) serves as a sterile area dedicated to aircraft operations and related infrastructure. It is enclosed by transparent fences and monitored by CCTV for added security. On the other hand, barrier II consists of a vegetation area functioning as a buffer zone. Transparent fences and limited accessibility doors define the limits of this zone.

The buffer zone is positioned along the edge of the airport perimeter within barrier II, serving two primary functions, that are an open space (recreation, tourism, and health): This zone provides green open spaces, promoting recreational activities, tourism, and overall public health. On the other hand as agricultural land (rice fields or plantations): The buffer zone includes agricultural land, accommodating rice fields and plantations.

Air pollution data reveals that the largest volume of pollutants emanates from aircraft emissions, directly impacting ambient air quality for humans, plants, animals, and the surrounding environment. Consequently, the buffer zone surrounding the airport is inevitably affected by aircraft emissions. Figure 1 illustrates the emission data:

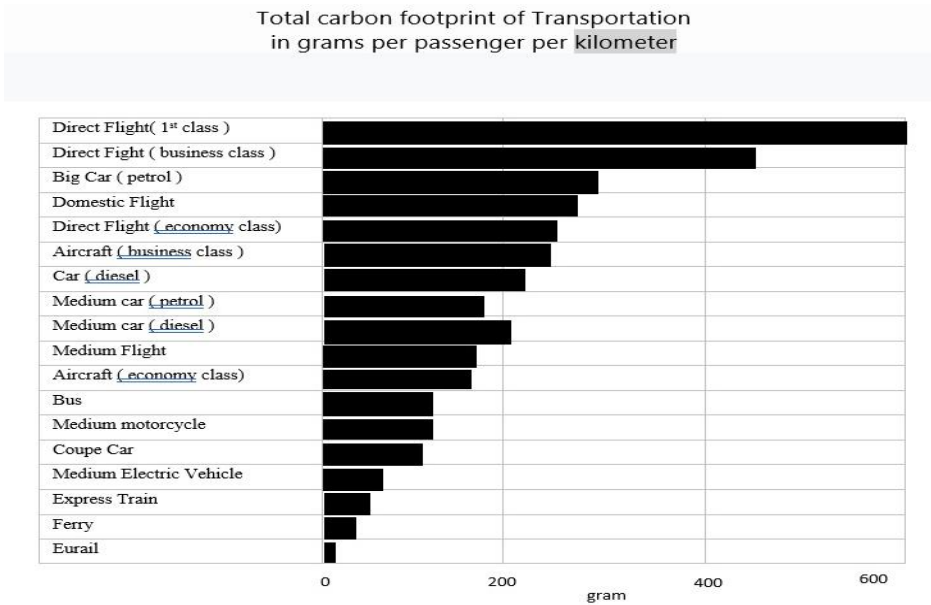


Fig 1. Carbon footprint of transport modes. [1] (Redraw : Dyah S Pradnya P, 2023)

The disposal of aircraft emissions occurs in five nearby locations depending on flight schedules and services, that are Taxiway Area, Apron Area, Take off Area , Landing Area and Hangar.

Previous research has highlighted the detrimental impact of urbanization, increased traffic flow, natural resource consumption, pollution, and the encroachment on natural spaces, particularly in beach and coastal tourism, which poses significant threats to ecosystems [2] Such activities result in carbon emissions from energy consumption and transportation, as well as changes in carbon stocks due to land use and cover changes, especially in urban expansion. Mitigating such emissions could be achieved through the utilization of clean energy [3], as explored in the zonation strategy for land management in urban agglomerations.

It is crucial to acknowledge that such emissions contribute to the accumulation of Greenhouse Gases (GHGs), which significantly impacts the world's climate. The relationship between emissions and their effects on global climate is illustrated in the following illustration (Figure 2):

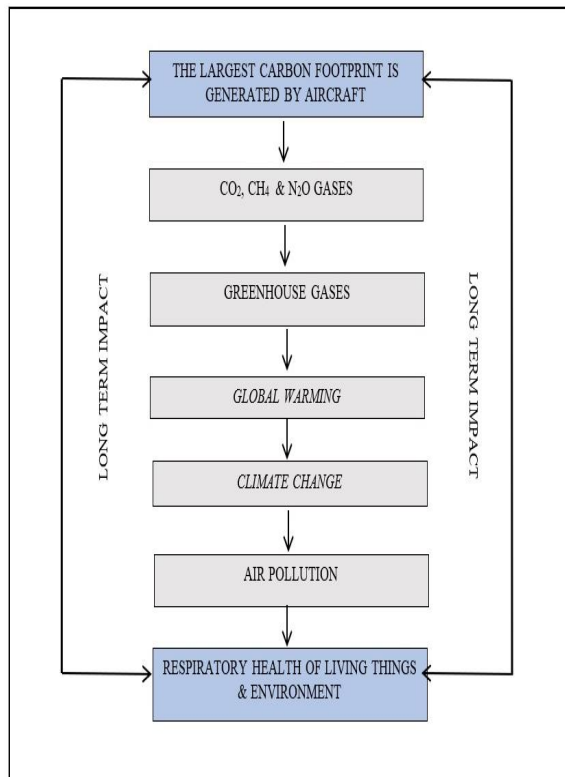


Fig 2. Long Term Impact

The operational impact of aircraft on the environment has been addressed through various regulations and guidelines. Notably, the Regulations Directorate General of Civil Aviation number: SKEP/124/VI/2009 provides guidelines for the Implementation of Environmentally Friendly Airports (Eco Airport). This regulation aims to mitigate the environmental effects of airport operations.

“Article 208: To erect, change, or preserve buildings and plant or maintain trees within the flight operation safety area must not exceed the height limit of the flight operation safety area.”

“Article 209: Exceptions to the provisions for erecting, changing, or preserving buildings as referred to in paragraph (1) must obtain the approval of the Minister and meet the following conditions:

- a. Are facilities that are necessary for flight operations.
- b. Fulfill special aeronautical studies.
- c. Are in accordance with the technical provisions of flight operation safety.”

Buildings that exceed the limits referred to in paragraph (2) shall be informed through the aeronautical information service. The following clauses quoted from Regulations provide some descriptions of such issues:

Regulation of Airport Location (Article 201): “The determination of the airport location is carried out by considering:

- a. The national master plan of airports.
- b. Aviation safety and security.
- c. Compatibility and balance with local culture and other related activities at the airport site.
- d. Economic, financial, social, regional development, technical development, and operational feasibility.
- e. Environmental feasibility.”

Airport Development (Article 214): “An airport, as a building with a special function, must consider aviation safety and security provisions, the quality of airport services, environmental sustainability, and intermodal integration and multimodal.”

PT. Angkasa Pura's Statement in ICAO Seminar on Green Airports (29-30 November 2021) stated that “The implementation of eco-airport initiatives and effective environmental management systems is carried out through the implementation of environmental management systems using the ISO 14001 approach, where almost all managed airports have received ISO 14001 certificates” [4]

Further application of habitat management or biodiversity studies as programs are required to control wild animals at airports, waste management programs including liquid and solid waste management, and socializing Green Airport Programs to tenants and airplane

passengers (such as reducing the use of straws in restaurant tenants, reducing the use of shopping plastics, and others).

In the meantime, accessibility in Buffer Zone (Side Entrance - SE): According to UU no.1/2009 about Aviation, the determination of the airport location (Article 201, paragraph 1) is carried out by taking into account the national master plan of the airport, aviation safety and security, compatibility and balance with local culture and other related activities at the airport site, economic, financial, social, regional development, technical development, and operational feasibility, and environmental feasibility.

Furthermore, Aviation Security and Safety: According to UU no.1/2009 about Aviation, Article 210 prohibits anyone from being in certain areas of the airport, creating obstacles, and/or carrying out other activities in the safety area of flight operations that may endanger flight safety and security, unless obtaining permission from the airport authority. Article 432 states that “any person who will enter a restricted security area without having a restricted area entry permit or airplane ticket as referred to in Article 334 paragraph (1) shall be punished with a maximum imprisonment of 1 (one) year or a maximum fine of Rp500,000,000.00 (five hundred million rupiah)” [4]

Finally, in the article 205 (1) states that “The area of airport interest as referred to in Article 202, point g, that is an area outside the airport working environment that is used to ensure flight safety and security, as well as smooth accessibility of passengers and cargo.” Therefore, the buffer zone, acting as a transition area between the airport and non-airport zones, necessitates a reevaluation and replanning aligned with the principles of Green Architecture. This approach emphasizes sustainable land use and ecological balance. Additionally, effective control measures are crucial to address the transformation of buffer zones into non-aviation functions, which may potentially compromise airport security. For instance, the presence of livestock approaching the runway in Lombok serves as a significant case highlighting the importance of managing buffer zones in a manner that ensures aviation safety and environmental protection. By adopting Green Architecture principles and implementing robust control strategies, airports could maintain a harmonious coexistence with their surrounding ecosystems while ensuring the utmost safety for all stakeholders involved.

2. Method

The research will be conducted using a qualitative method to ensure comprehensive data collection and analysis. By employing such approaches, the study aims to gain a deeper understanding of the subject matter. Qualitative methods will allow for in-depth exploration and insights into the participants' perspectives, experiences, and attitudes related to the architecture in the context of environmental health. To ensure a robust and reliable research outcome, various data sources will be utilized, including primary data collected from interviews, surveys, or observations, as well as secondary data from existing literature and

relevant studies related to architecture and environmental health. By combining such different sources of information, the research aims to provide a comprehensive and well-rounded analysis of the topic

3. Result and Discussions

3.1. Agricultural land is adjacent to the infrastructure facilities area

Airport infrastructure serves as a crucial facility responsible for controlling, regulating, and supervising flight operations. Therefore, it is essential to establish well-defined regulations and carefully select locations for such infrastructure. However, due to various factors, the boundaries of barrier II (buffer zone) often become ambiguous, with areas of vegetation serving different functions. This, in turn, could lead to environmental health degradation, particularly concerning air pollution, which is primarily attributed to airport emissions. The planning process for infrastructure location or the utilization of the surrounding areas, with regards to distance and function, has undergone changes that were not thoroughly considered. The lack of anticipation and preparation for potential environmental impacts may manifest in the long term, culminating in sustainable consequences (Figure 3).

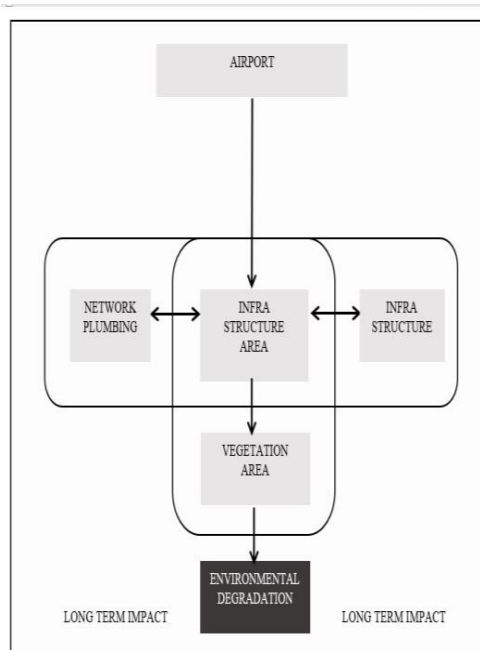


Fig 3. Planning Process For Infrastructure

This is aligned with Regulation of the Director General of Civil Aviation No.: KP 39 /2015 About Technical Standards and Operations Civil Aviation Safety Regulations – Part 139 (Manual of Standard CASR – Part 139) Volume I of Aerodromes, [5]which are:

Site maintenance. Grass, shrubs, and so on should remain cut to a certain height, for example, less than 0.6 m. Trees in such locations are not allowed to exceed the obstruction limits described above.

Also, from the example case in the Decree of the Minister of Transportation Number: KP 835 of 2014 concerning the Master Plan of Budiarto Airport in Curug, Tangerang Regency, Banten Province (Flight Navigation), that:

6. In the Possible Accident Hazard Area, buildings that could increase the fatality rate in the event of an aircraft accident are not allowed, including gas station buildings, Hazardous Chemical Factories or Warehouses, SUTT and / or SUTET.

7. In order to use land, waters or air in any area specified in this Regulation, it shall comply with the following requirements: a. not to interfere with flight navigation signals or radio communications between airports and aircraft; b. does not make it difficult for aviators distinguish air sign lights from other lamps; c. does not cause glare in the eyes of aviators using the airport; d. does not weaken visibility around the airport; e. does not cause any bird hazard or in any other way may endanger

interfere with the landing, take-off or movement of aircraft intended to use the airport. [6]

Based on the observation and analysis of the subject, it is evident that there are discrepancies between regulations, the application of Airport Architecture design, and the actual condition of the area. As a result, design tolerances, such as sporadic solutions, often lead to inadequate consideration of potential environmental impacts. Furthermore, the lack of participatory efforts involving community empathy contributes less to the enhancement of environmental health quality.

3.2. The existence and type of vegetation mixed with food plants

Airport vegetation plays a crucial role in maintaining a healthy environment and providing protection within the buffer zone. The vegetation is categorized into four groups, including: plant shrub, grass plants, plant phytoremediation and food crop

Considering the significance of environmental health and the impact of emissions on respiratory health, the Regulation of the Minister of Health of the Republic of Indonesia Number 44 of 2014 emphasizes the implementation of Healthy Ports and Airports. It outlines integrated activities, encompassing environmental health, facility management, promoting clean and healthy living behavior, ensuring occupational safety and health, and enhancing security measures.

However, field data reveals that the buffer zone is frequently utilized for food crop cultivation by the local community. Although there are zoning guidelines in place, the

proximity to air pollution sources could potentially affect the quality of such food crops, posing health risks.

To mitigate the degradation of crop quality and health issues stemming from aircraft emissions, it is imperative to reevaluate the function of the buffer zone and consider its usage for non-food crops. Moreover, the presence of multiple Side Entrances (SE) in the buffer zone may raise security concerns, warranting careful management and control measures (Figure 4)

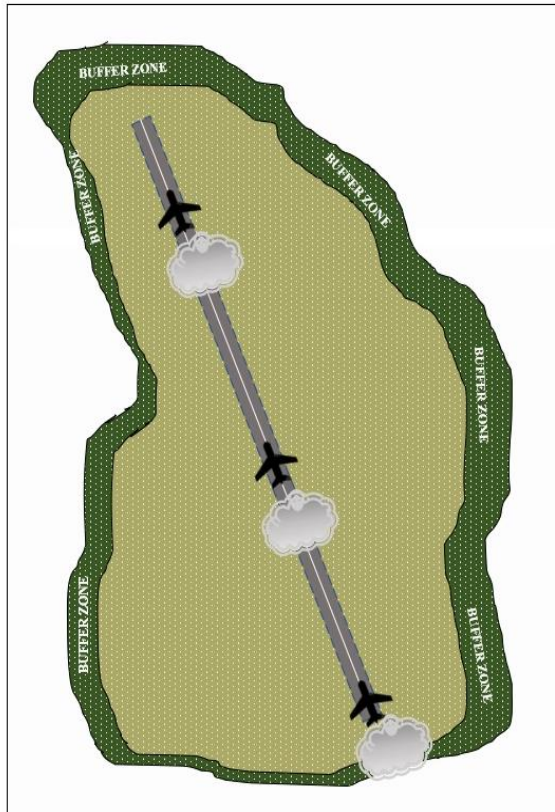


Fig 4. Buffer Zone

3.3. The sub-infrastructure could be a new pollutant

Infrastructure within the airport area primarily serves flight operations and includes facilities like RKFF (fire department, quarantine center, wastewater treatment plant, etc.).

On the other hand, infrastructure outside the airport area varies, with a majority comprising military facilities in close proximity and civilian facilities in moderate to long distances. Such facilities could be classified as follows, Military Non-Commercial Facilities: Examples include military housing and the TNI office complex, Military Commercial Facilities: Examples include the International Flight Academy, College of Aerospace Technology, Flight Attendant & Airline Staff Training (FAAST), Flight Attendant Training Flight Attendant (P3) Nusantara, and Flight Staff & Flight Attendant Education and Civil Commercial Facilities: Examples include shops, restaurants, gas stations, banks, toll roads, and integrated transportation services.

In addition, there is a multimodal utility network or integrated terminal that encompasses cars, motorcycles, taxis, airport trains, and buses, along with parking spaces, all of which constitute sub-infrastructure within the airport area. However, the existence of multimodal transportation increases the volume of emissions at airports, contributing to global warming.

The presence of infrastructure outside the airport area has led to the transformation of once fertile rice fields into built-up areas. Over time, this change has altered the characteristics of the rice fields, making the soil tend to be dry. With an increasing number of pollution sources due to the expansion of infrastructure and housing facilities, it becomes crucial to control and limit further development in the environment surrounding the airport (Figure 5).

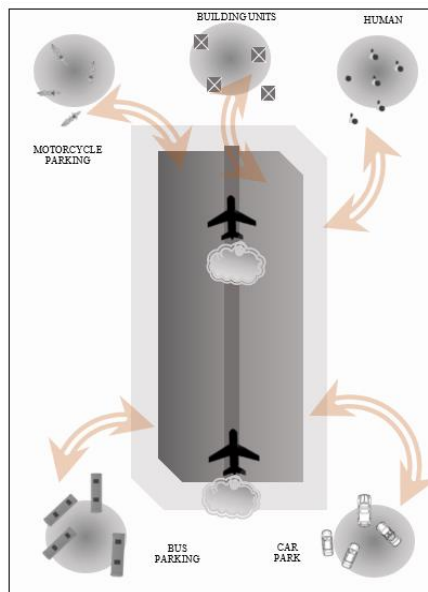


Fig 5. Impact of The Presence of Infrastructure Outside The Airport Area

4. Conclusion

The buffer zone should be established at a certain distance from the airport infrastructure, clearly marked with signs and subject to strict restrictions. The airport construction is planned to be located on damaged land, allowing it to be processed, managed, and designed in harmony with the environment's function and sustainability through Green Architecture design. Such an approach aims to preserve fertile land, which in turn will reduce the loss of green spaces (RTH), mitigate environmental degradation, prevent the decrease of clean water volume, minimize soil dryness, prevent flooding, and reduce chemical (B3) content in plant yields. The feasibility study prioritizes improving environmental quality in constructive collaboration with the green economy (Green Economy), as data shows that an increase in investors, especially from outside the region, is directly linked to environmental damage due to increased transactions and social activities. Restoring the Buffer Zone area as a sterile area with minimal activity enhances airport security. Then it is essential to protect and utilize natural/common vegetation for its multiple benefits, including acting as a barrier, providing shade, enhancing aesthetics, engaging in phytoremediation, and contributing to environmental structure. Proper planning of phytoremediation vegetation is necessary, focusing on non-food crops and considering factors such as air flow, sunlight exposure, insect presence, human circulation, soil capacity, and water storage volume. Such plants should be strategically placed away from power sources and digital equipment to avoid interference. Therefore the infrastructure outside the airport, which is owned by the government and associated with the airport, includes utility networks, integrated terminals, gas stations, and more. The planning of this infrastructure should prioritize minimizing air pollution at the airport. Therefore, it is crucial that the infrastructure always manages waste and waste activities effectively, ensuring that garbage does not accumulate, electronic waste is safely packaged, and environmental activities are well-planned.

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