

SOCIAL AND ENVIRONMENTAL IMPACTS OF ECO GREEN AIRPORT IMPLEMENTATION AT SOEKARNO-HATTA AIRPORT

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Abstract: One of Angkasa Pura's current focuses is on the implementation of Eco Green Airport. The purpose of this study is to analyse and evaluate the social and environmental impacts of the implementation of the Eco Green Airport concept at Soekarno-Hatta Airport. The method used is a descriptive qualitative approach through in-depth interviews with relevant parties and field observations. The results showed that from the social side, the research found an increase in environmental awareness among workers and the surrounding community. On the environmental side, the application of renewable energy, such as solar power generation, reduced greenhouse gas emissions, and saved coal consumption. Overall, the implementation of the Eco Green Airport concept at Soekarno-Hatta Airport is effective in reducing environmental impacts and improving community welfare, but requires a better long-term strategy to achieve optimal sustainability.

Keywords: *Eco Green Airport, Soekarno Hatta Airport, Sustainability, Renewable Energy*

1. Introduction

Airport, as defined in the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 39 of 2019, is an area used as a place for aircraft to land, take off, and up and down passengers and loading and unloading goods equipped with adequate safety and security facilities. As one of the strategic infrastructures, airports have an important role in driving economic growth, both at the regional and national levels, so their development is a government priority (Ministry of Transportation, 2019). However, in the midst of technological advances and an increasing number of flights, airport activities often lead to significant environmental and social impacts. One initiative to preserve the environment and reduce negative impacts is to implement the Eco Green Airport concept (Sun et al., 2022).

ICAO and IATA also issue guidelines and standards to encourage airports to implement environmentally friendly practices, including energy management, waste management, and carbon emission reduction (Scholz, 2020). According to the Director General of Civil Aviation Regulation No. SKEP/124/VI/2009, an Eco Green Airport is an airport that measures environmental impacts to create a healthy environment in and around the airport. Airport Council International (ACI) defines Eco Green Airport as an airport that is committed to reducing environmental and social impacts, achieving resource efficiency, and supporting

sustainable growth. This concept includes waste management, use of renewable energy, reduction of carbon emissions, and efficient water management. The application of the Eco Green Airport concept is expected to reduce negative impacts on the environment and improve airport operational efficiency (Sreenath et al., 2021).

Implemented the Eco Green Airport concept by building a water reservoir garden, utilizing solar energy, using glass walls for natural lighting, and managing water and waste in an environmentally friendly way (Mulyanda et al., 2022). PT Angkasa Pura II continues to run the Eco Green Airport program by referring to the AMDAL document as a guideline for environmental management, in accordance with Law No. 32 of 2009 concerning Environmental Protection and Management. At Soekarno-Hatta Airport, which is one of the largest airports in Indonesia, the implementation of Eco Green Airport has been implemented with various measures, including the use of renewable energy, waste management, and greening the airport reduces greenhouse gas emissions through tree planting, the use of renewable energy, electric vehicles, and Intelligent Transportation System (ITS) systems in line with the 41% emission reduction target by 2030 according to Presidential Regulation No. 18 of 2022 (Nur'aqil et al., 2022). In addition, Soekarno-Hatta Airport integrates environmental strategies in CSR programs in line with Article 74 paragraph (1) of Law No. 40 of 2007 concerning Limited Liability Companies, including the Community Development Program as part of social and environmental responsibility (Uci Rosalinda et al., 2022).

Incheon International Airport has implemented the Eco Green Airport concept with a low-carbon vision. It currently has ACI "Level 3" status and is working towards "Level 3+," with a focus on waste management, including construction waste in accordance with local laws (Baxter, 2022). Meanwhile, PT Angkasa Pura I Yogyakarta International Airport (YIA) in Kulon Progo became the first airport in Indonesia to receive a GreenShip Building "Gold" certificate from the Green Building Council Indonesia (GBCI) in 2021 (Han et al., 2020). In 2023, YIA also won first place in Anugerah Subroto for the Energy Management category (Pandiangan et al., 2023).

Airport development often negatively impacts the environment and social fabric of surrounding communities (Comendador et al., 2019). The increase in the number of flights and intensity of operations at airports directly impacts air quality degradation, which in turn increases the risk of health problems for surrounding communities (Haq & Putro, 2021). Emissions from aircraft and support vehicles in the airport area are one of the main causes of air pollution (Ricardianto et al., 2017). In addition, noise generated by aircraft during takeoff and landing, as well as from vehicles around the airport, can cause sleep disturbances, stress, and long-term health problems, including hearing loss. This noise can also disrupt daily routines, affect comfort, and ultimately reduce the quality of life of the surrounding community (Arylia & Surachman, 2022).

Increased airport activity leads to the accumulation of solid and liquid waste that requires special management. Solid waste such as aircraft debris and construction waste can pollute the environment, while liquid waste such as residual fuel has the potential to pollute water and soil

which can endanger public health and ecosystems (Raffah & Kristiastuti, 2021). The density of airport activities has an impact on the psychological and social aspects of society, such as social pressure due to loss of green space, increased mobility, rapid urbanization, and social fragmentation that reduces the harmony of residents due to a dense and noisy environment (Nurkholidah & Pratiwi, 2017).

Overall, increased activity at the airport is not only an environmental issue that needs to be addressed, but also poses social challenges that require special attention. The urgency of this research lies in the importance of understanding and evaluating the social and environmental impacts of the implementation of Eco Green Airport at Soekarno-Hatta Airport. With a better understanding of how these initiatives affect the community and the environment, policy makers can formulate more effective strategies to reduce negative impacts and increase benefits to society. Therefore, airport site selection and development must consider environmental sustainability. Law No. 1/2009 on Aviation stipulates that aspects of safety, security and environmental sustainability must be considered in the organization of aviation.

Although this initiative offers great potential to improve sustainability, empirical research focusing on the implementation and impact of the Eco Green Airport concept at Soekarno Hatta Airport is limited (Piao et al., 2021). Previous research has mostly highlighted the technical and economic aspects of Eco Green Airport implementation, such as operational efficiency and cost savings (Greer et al., 2020). Therefore, this study aims to identify and analyze the social and environmental impacts of implementing the Eco Green Airport concept at Soekarno-Hatta Airport, as well as explore stakeholders' views on the changes. Thus, the title of this study is "Social and Environmental Impacts of the Implementation of Eco Green Airport at Soekarno-Hatta Airport." This research is expected to make an important contribution in filling the literature gap by presenting empirical data on the social and environmental impacts of implementing the Eco Green Airport concept, especially at Soekarno-Hatta Airport. The results of this study are expected to serve as a basis for the development of more comprehensive and sustainable policies in airport management, as well as provide new insights for environmentally friendly airport development initiatives in Indonesia.

2. Literature review

Airport

Airport is a land or water area used for landing and takeoff of aircraft, as well as facilities for passengers and goods (Malik & Ardan, 2019). Its functions include aviation safety and security, and supporting local and national economic growth through intermodal travel (Max et al., 2023). Airport components are generally divided into two categories, namely airside and landside. The facilities of each of these airport components are generally shown in table 1 below:

Table 1

Airports and their Facilities

Source : (Belvadiyanti et al., 2022)

Facilities and Airport	
Air Side	Land Side
Runway	Passenger Terminal Building
Taxiway	Passenger Terminal Cargo
Apron	Building Operations
	Airport Support Facilities

Eco Green Airport Concept

According to (Mulyani et al., 2023) Eco Green Airport is a concept focused on enhancing efficiency and environmental sustainability. It incorporates innovations to reduce emissions, improve fuel efficiency, and minimize environmental impacts. According to the 2022 Sustainability Report, these airports utilize alternative fuels like biofuels and hydrogen, reducing reliance on fossil fuels. They also adopt energy-efficient technologies and greener materials to lower operational costs and promote sustainability. (Immamah et al., 2023).

Based on the Regulation of the Director General of Civil Aviation Number SKEP/124/VI/2009 on Eco Airport, there are eight components in environmental management and monitoring at the airport, namely: waste management, energy management, water management, air management, noise management, vegetation management, environmental audit, and education and training. For an airport to function effectively and efficiently, environmental aspects must be considered in addition to technical aspects. Therefore, any airport construction and development must consider the concept of eco airport (Raffah & Kristiastuti, 2021).

The Eco Green Airport concept refers to an airport that is committed to minimizing environmental and social impacts, improving resource use efficiency, and supporting sustainable growth. Aspects emphasized in this concept include waste management, renewable energy utilization, carbon emission reduction, and optimal water management (Raimundo et al., 2023). Eco Green Airport has been recognized internationally, with several major airports adopting this approach to achieve global sustainability standards (Budianschi et al., 2012).

Impact

Impact according to the Big Indonesian Dictionary (KBBI) is a strong impact or influence that has an effect (both positive and negative) or a strong enough collision between two objects to cause significant changes in the momentum of the system experiencing the impact. Impact is a strong influence that has both positive and negative consequences (Khairul Rahmat et al.,

2020). Meanwhile, the impact according to (Sam et al., 2021) is a real change in behavior or attitude produced by policy outputs.

Social Impact Theory

The term “Social” comes from the Latin Socius, which means friend or society. Social has a general meaning of society in the narrow sense of prioritizing common interests or society. Social implies a collection of individuals who interact with each other so as to foster a common feeling (Amiman R, Moku B, 2022).

This theory addresses how major interventions or changes in the system can affect local communities and society in general. The social impact of Eco Green Airport includes improving the quality of life of the surrounding community, creating new job opportunities, and increasing environmental awareness (Freudenburg, 1986)

Environmental Management Theory

This theory emphasizes the wise management of natural resources and the implementation of policies that support the reduction of negative impacts on the environment. In the context of Eco Green Airport, green technologies such as waste management and the use of renewable energy play an important role in managing and minimizing the airport's ecological footprint (Miller & Twining-Ward, 2006).

Sustainability Theory - John Elkington's Triple Bottom Line (TBL):

Sustainability is based on three main aspects namely People (Social), Planet (Environment), and Profit (Economy). Soekarno-Hatta Airport implements Eco Green Airport with the aim of supporting the balance between these three aspects. Emphasis on environmental preservation and improving social welfare is an important focus in this research (Limijaya & Felisia, 2014).

Corporate Social Responsibility (CSR)

In the global context, the term Corporate Social Responsibility (CSR) has been used since the 1970s and became increasingly popular, especially after the book *Cannibals With Forks: The Triple Bottom Line in 21st Century Business* (1998), by John Elkington who developed three important components of sustainable development, namely economic growth, environmental protection, and social equity, which were initiated by The World Commission on Environment and Development (WCED) in the Brundtland Report (1987), Elkington packaged CSR into three 3P focuses, namely good companies not only hunt for economic benefits (profit) but also have concern for environmental sustainability (planet) and community welfare (people) (Magfirah & Putri Dewanggi, 2020). CSR is the commitment of a business to act ethically, operate legally and contribute to improving the quality of life of its employees and their families, local communities, and the wider community (Maarif et al., 2022).

Previous Research

Previous Research such as (Mulyani et al., 2024) have of the study show that the demand for electrical energy at Kulon Progo Airport is increasing every year. In 2025, the electricity demand is estimated to reach 95,646,025 kWh, and increase to 149,182,889 kWh in 2030. Based on the calculation, 1,129 wind turbines are needed to meet the electrical power supply needs at the airport in 2035. The research focuses on the implementation of wind energy, while the author's research covers all aspects of Eco Green Airport at Soekarno Hatta Airport. According to (Immamah et al., 2023) Green Airport implementation is regulated internationally by ICAO and also regulated in Indonesia. Research shows a positive correlation between Green Airport and passenger satisfaction, where good facilities and services at green airports increase satisfaction. The focus of this research is on passenger satisfaction based on the application of Eco Green Airport, while the author's research discusses the social and environmental impacts of implementing Eco Green Airport. Last (Boca Santa et al., 2020) this journal discusses a sustainable green airport model based on environmental and social management systems. This research successfully developed a sustainable green airport model by analyzing various categories related to facilities, processes, and systems at the airport. This journal focuses on the development of sustainable green airport models in general, while the author's research focuses on the social and environmental impacts of implementing eco green airports, especially at Soekarno-Hatta Airport.

3. Research method

This research uses a descriptive qualitative approach to understand the social and environmental impacts of implementing the Eco Green Airport concept at Soekarno-Hatta Airport. This approach was chosen because the research focuses on exploring the perceptions, experiences and views of the community and related parties in depth. Qualitative methods emphasize the collection of richer and more in-depth data, allowing for a more comprehensive understanding of the phenomenon under study. This research uses a descriptive design to provide a clear picture of the social and environmental phenomena that occur (Susanto et al., 2024).

Data were collected from primary and secondary sources. Primary data sources were obtained through in-depth interviews with purposively selected key participants from relevant divisions such as the Environment Division, Electricity Division, Renewable Energy Maintenance and Management Division. Participants were selected to explore their views on the social and environmental impacts of implementing Eco Green Airport. Semi-structured interviews provided flexibility in exploring related topics. Direct observation at Soekarno-Hatta Airport and its surroundings was conducted to observe the implementation of Eco Green Airport, including waste management, energy use, and social interaction with the community. Secondary data was drawn from literature studies and documents related to the implementation of Eco Green Airport at Soekarno-Hatta Airport as well as reports and publications from airport authorities and environmental organizations.

This research was collected over three months from July 1st to September 1st, 2024. Data analysis was conducted inductively by following three main stages: data reduction, data presentation, and conclusion drawing/verification (Miles, M. B. & Huberman, 1992). To maintain data validity, this study used triangulation techniques, which compares data collected from various sources and data collection techniques. Thus, triangulation helps minimize bias and increase the accuracy of research results (Carter et al., 2014).

4. Results and discussion

4.1 Overview of Angkasa Pura II Company

Angkasa Pura II Company (Persero) is a state-owned enterprise that manages airports in western Indonesia. Established in 1962 as Perusahaan Negara Angkasa Pura Kemayoran, its name changed in 1965 to Perusahaan Negara Angkasa Pura to expand its duties. In 1974, its status changed to Public Company (Perum) Angkasa Pura, and in 1984 Perum Pelabuhan Udara Jakarta Cengkareng (PPUJC) was established to manage Jakarta Cengkareng and Halim Perdana Kusuma airports. The company's name changed to Perum Angkasa Pura II in 1986. In 1992, the company's legal status was changed to a limited liability company, Angkasa Pura II Company (Persero), to improve efficiency. This name was inaugurated on November 18, 2008.

As a state-owned enterprise, Angkasa Pura II Company (Persero) is committed to providing dividends to the state, the best service to service users, and paying attention to corporate social responsibility. For 28 years, the company has shown rapid progress in airport services and infrastructure. Angkasa Pura II Company (Persero) also provides flight information services for the Jakarta airspace (Flight Information Region/FIR) and currently Angkasa Pura II Company (Persero) has managed 12 airports in western Indonesia including Soekarno Hatta International Airport. The airport is located at Jalan Raya Soekarno-Hatta, Cengkareng Tangerang 19120 Banten, Indonesia.

4.2 Social Impacts of Eco Green Airport Implementation at Soekarno-Hatta Airport

The implementation of the Eco Green Airport concept at Soekarno-Hatta Airport has increased environmental awareness, both among airport workers and the surrounding community. Based on the Environmental Permit Implementation Report Semester 2 Year 2023 from Soekarno-Hatta Airport, the data supports the research on social impacts, including good communication between the airport and the surrounding community. The report noted changes in community perceptions and the absence of significant unrest. The social impact of this implementation shows positive results, especially in community relations. One indication is good waste management, including waste segregation and the use of hydrothermal treatment technology for solid waste, further reinforcing the assertion that waste transportation no longer passes through residential areas, thus not disturbing local residents.

The community has also shown tolerance to noise generated by airport activities, which is considered within reasonable limits. The surrounding community has become accustomed to and can accept the noise level as part of their daily lives. For passengers and airport users, the

implementation of Eco Green Airport has an impact in the form of increased comfort and experience while at the airport. Beautiful green areas, noise management, and cleaner energy systems create a quieter and more comfortable environment. This also shapes the long-term expectation of airport users towards eco-friendly facilities at other airports. In addition, the airport also involves the local community in activities, such as hiring local labor to meet the airport's operational needs, which increases social acceptance as well as employment opportunities for residents. Training programs organized for airport workers on green practices help improve their skills, thus creating a more competent workforce in sustainability.

Interactions between airport managers and local communities have also improved through corporate social responsibility (CSR) programs that focus on environmental conservation. Programs such as reforestation and waste management involve the participation of local communities, which increases their sense of ownership and participation in maintaining the environment around the airport. At the organizational level, the implementation of the Eco Green concept has also brought about a change in work culture, where sustainability aspects are a major concern in daily operations. This creates a work climate that is more environmentally and socially conscious.

Overall, the implementation of Eco Green Airport at Soekarno-Hatta Airport has brought significant social impacts, both in terms of increasing environmental awareness, improving the quality of life of the surrounding community, and new job opportunities. Despite challenges in adjustment by some workers, this initiative has made a positive contribution to the community inside and outside the airport. Tree planting and landscaping efforts in Terminal 3 also create a more beautiful and comfortable atmosphere. The green environment presented not only has a positive impact on airport users, but also on airport staff who work in the environment. With a fresher and more aesthetic atmosphere, the experience at the airport becomes more enjoyable for all parties involved. Overall, the implementation of the Eco Green Airport concept at Soekarno-Hatta Airport has improved the quality of social relations between the airport and the surrounding community, created a healthier environment, and supported better and harmonious relationships in the vicinity.

1.3 Environmental Impacts of Eco Green Airport Implementation at Soekarno-Hatta Airport

The implementation of the Eco Green Airport concept at Soekarno-Hatta Airport has had a significant environmental impact through various efforts to reduce the ecological footprint of airport operations. One of the main impacts is the reduction of greenhouse gas emissions through the application of renewable energy, such as Solar Power Plants (PLTS) and energy saving systems. This initiative not only helps reduce dependence on fossil fuels, but is also in line with global efforts to reduce carbon emissions, especially in the air transportation sector which is known as one of the major contributors to global warming. Soekarno-Hatta Airport has also succeeded in improving energy efficiency through the implementation of energy-saving technologies, such as LED lights and more efficient air conditioning systems. These measures significantly reduce overall energy consumption, which has a positive impact on the

environment by reducing harmful gas emissions. Based on data from PT Angkasa Pura II's 2023 Sustainability Report, electrical energy consumption at the airport was recorded at 24,967,979 GJ, while fossil fuel consumption was 184,508 GJ, indicating a significant improvement in energy efficiency.

The implementation of environmentally friendly technologies such as PLTS and energy management systems has gradually contributed to reducing the carbon footprint. Based on available data, the installation of PLTS at Soekarno-Hatta Airport has successfully reduced coal consumption by 463.62 tons, which in turn contributed to the reduction of carbon emissions by 550.54 tons of CO₂. This emission reduction is equivalent to the positive environmental effects resulting from planting 753 trees. Although the use of renewable energy such as solar power plants has been implemented, the use of fossil fuel generators is still a part of airport operations. In 2023, based on data obtained from Main Power Station 2, the fuel consumption of the generator set was recorded at 4,373 liters, which was used mainly to support airport operations during power interruptions from the main grid. The use of solar panels in the AOCC building has been optimized to reduce dependence on conventional energy, but its contribution to carbon emission reduction is still limited. Overall, the implementation of green technologies such as solar power plants, energy-efficient LED lighting, and energy management systems shows that Soekarno-Hatta Airport has taken progressive steps in reducing environmental impacts.

In addition, efforts in waste management are also a key focus in this initiative. Waste segregation programs at source, as well as the processing of organic waste into compost, have reduced the amount of waste that ends up in landfills, while helping to reduce soil pollution around the airport. The volume of waste managed reached 36,980.63 tons, which shows an improvement in waste management compared to the previous year. The use of technologies such as hydrothermal treatment, which is a waste treatment method using water at high temperature and pressure to convert solid waste into more useful materials, also helps reduce the impact of solid waste generated from airport operations. This process not only reduces the volume of waste significantly, but also enables energy recovery from organic waste by converting it into reusable liquid or gaseous fuels. With this technology, Soekarno-Hatta Airport is able to manage solid waste more efficiently, while reducing negative impacts on the surrounding environment.

Another positive impact is seen from sustainable water management through the implementation of a wastewater treatment system that allows recycling of water for irrigation and toilet use. Rainwater collection technology is also utilized to reduce reliance on groundwater, which helps maintain the balance of water resources in the surrounding area. In addition, air pollution reduction efforts through the use of electric vehicles and electric-based Ground Power Units (GPUs) help lower nitrogen oxide (NO_x) and fine particulate matter (PM_{2.5}) emissions, which in turn improves air quality in the airport area.

With regard to noise, the airport management has implemented strategies to reduce noise pollution, such as flight path arrangements that minimize the impact of noise on surrounding residential areas and quieter landing procedures. This greatly helps reduce the disturbance that

may be felt by the community around the airport. Soekarno-Hatta Airport is also expanding green areas by planting trees and plants, creating green open spaces that not only function aesthetically, but also help absorb carbon, provide habitat for wildlife, and reduce the urban heat island effect.

As the airport is located in a flood-prone area, implementing Eco Green Airport also involves upgrading the drainage system and adding stormwater storage capacity, so that the risk of flooding can be minimized. These measures not only protect the airport's infrastructure, but also have a positive impact on the surrounding environment by reducing pressure on the city's drainage system. To ensure sustainability, regular monitoring of air, water and noise quality is conducted. This allows for immediate corrective action to be taken if there is any violation of the established environmental standards. Soekarno-Hatta Airport has also achieved ISO 14001 certification related to the Environmental Management System, which is proof of the airport's commitment to implementing environmentally friendly practices in a sustainable manner. This certification ensures that all airport operational processes meet international standards in terms of environmental management, including reducing environmental impacts, efficient use of resources, and better waste management. This achievement strengthens Soekarno-Hatta Airport's position as one of the leading airports that supports the concept of Eco Green Airport at the global level.

Overall, the implementation of Eco Green Airport at Soekarno-Hatta Airport has brought significant changes in efforts to manage a more sustainable environment. Although various initiatives have successfully reduced the negative impact of airport operations on the environment, including emissions reduction, energy efficiency, and waste management, there is still room for further development. To achieve more ambitious sustainability goals, more intensive measures are needed to expand the use of renewable energy and reduce dependence on fossil fuels. With continued strengthened commitment, the airport has the potential to become a sustainability model for other airports nationally and globally.

5. Conclusion

This study has analyzed the social and environmental impacts of implementing the Eco Green Airport concept at Soekarno-Hatta Airport. The results show that this initiative has made a significant contribution in reducing negative impacts on the environment and improving the quality of life of communities around the airport.

In terms of the environment, the application of renewable energy, especially solar power plants (PLTS), has succeeded in reducing greenhouse gas emissions by 550.54 tons of CO₂ and saving coal consumption by 463.62 tons. Better waste management through sorting and recycling programs also played a role in reducing the volume of waste sent to landfills to 36,980.63 tons. This shows that Soekarno-Hatta Airport has taken progressive steps in managing the environmental impact of its operations. On the social side, the study revealed an increase in environmental awareness among workers and the surrounding community. Community involvement in corporate social responsibility (CSR) programs also creates a better

relationship between the airport and the local community. Programs such as reforestation and training in sustainable practices not only provide environmental benefits but also improve the quality of life of the community.

While these positive results show significant progress, the study also identified several challenges, including the need for infrastructure optimization and addressing traffic congestion around the airport. Therefore, a better long-term strategy is needed to ensure the sustainability and effectiveness of implementing the Eco Green Airport concept at Soekarno-Hatta Airport. Overall, the implementation of the Eco Green Airport concept at Soekarno-Hatta Airport has shown that sustainability can be achieved through a combination of the use of environmentally friendly technologies, effective waste management, and community involvement. This research provides a strong basis for further policy development in the management of more sustainable and environmentally friendly airports in Indonesia.

6. Implications

The results of this study indicate that the Eco Green Airport concept can be effectively implemented at major airports such as Soekarno-Hatta with the support of appropriate policies as well as active participation from the community and related stakeholders. The application of green technology not only provides environmental benefits but also has a positive impact on the social and economic welfare of the surrounding community.

7. Research limitations

This study has several limitations. Firstly, the data was obtained from airport management interviews which may affect the accuracy and scope of the findings if the data is incomplete. Second, time and budget constraints limited the depth of analysis, so some aspects of Eco Green Airport implementation could not be examined in detail. Third, the research focus on Soekarno-Hatta Airport may not fully reflect implementation at other airports in Indonesia, with results possibly differing at airports with different characteristics.

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