

Original Article

Attenuating the Negative Effects of Aerotropolis: Sustainable Preservation of Taliptip Mangrove Eco-Park in Bulacan

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Abstract - Mangrove Eco-parks are critical to conserving biodiversity and marine species in coastal communities. The Bulakan Mangrove Eco-park, located in Taliptip, Bulakan, Bulacan, is one of the best examples. The Bulakan Mangrove Eco-park is an important protected area in the province of Bulacan because it covers more than half of the population of mangrove forests in the province of Bulacan and because it provides a wide range of ecosystem and economic services, particularly its rich mangrove biodiversity, which helps regulate floods, saltwater intrusions, and serves as a storm surge barrier for the coastal communities. Furthermore, the Bulakan Mangrove Ecopark provides aesthetic services such as tourism, education and knowledge about the importance of mangroves and cultural traditions. However, despite the minor degradation of Taliptip's environment, the Taliptip Mangrove Eco-Park remained resilient until the government proposed an Aerotropolis, also known as the New Manila International Airport (NMIA), funded by San Miguel Corporation. This multi-million Airport complex will be located in the coastal fishpond of Taliptip, Bulakan, Bulacan, approximately 200 kilometers away from Manila. Even though the aforementioned reclamation project does not include the eco-park in its master plan, it will indirectly impact the eco-ecosystem park's physical condition. The study aims to understand the upcoming aerotropolis's adverse effects and propose possible solutions that can help mitigate the upcoming environmental change through preservation and resiliency. To achieve the study's goal, the researchers first analyze the current condition of the Bulakan Mangrove Eco-park before evaluating potential solutions and recommendations for the site using S.W.O.T analysis. Site visits were also included, revealing that the eco-park is degrading due to the late Typhoon Haiyan and the COVID-19 pandemic, which resulted in poor maintenance of the eco-park. Through conveying solutions that can lessen the negative impact of the upcoming aerotropolis, the analysis of the adverse effects was first conducted by conducting interviews with conservation advocates, eco-park caretakers, and connected local government units. Secondary source findings were also included, such as hazard assessments from environmentalists and advocates. According to the AGHAM (Advocates of Science and Technology for the People, Center for Environmental Concerns) study and the National Institute of Geological Science Hazard Assessment, the impact of aerotropolis was guaranteed to sprawl and degrade the physical environmental condition of the Eco-park and adjacent environs. The reclamation project will contribute to the area is on going ecological damage, causing a chain reaction that will harm the physical and environmental condition of the Eco-park and the marine life roaming around it, particularly the migratory birds, which include endangered species that must be protected. The assessment of the gathered information leads to the conclusion that the Bulakan Mangrove Eco-park is truly endangered and unprepared for the upcoming development in the eco-adjacent park area. Using the information gathered, the researcher develops architectural solutions that can help mitigate the negative impact of the aerotropolis on the Bulakan Mangrove Eco-park.

Keywords - Aerotropolis, Mangrove eco-park, Sustainable preservation, Taliptip.

1. Introduction

Mangrove ecological parks are vital to the ecotourism and biodiversity of a community. One of the better examples is the Bulakan Mangrove Eco-Park in Bulakan, Bulacan. In coastal locations and nearby villages, it serves as the first line of protection against storm surges, rogue waves, tidal currents, and typhoons. Additionally, the mangrove eco-park provides

a habitat for various marine animals and a means of subsistence for the ordinary fishermen in Bulakan, Bulacan. In addition, the eco-park attracts tourists, boosts the local economy, and provides a refuge for a wealth of wildlife. Even though it is still open, the eco-smooth park is currently dealing with a severe issue that could negatively impact both the local ecotourism industry and the biodiversity in the area: the



government's next project, the multimillion-dollar Bulakan Aerotropolis, an airport complex that will be located in Taliptip, Bulakan, Bulacan. The reclamation project will not directly impact the Bulakan Mangrove Eco-park. However, it will indirectly affect marine species, the surrounding environment, and the eco-park, potentially starting a chain reaction of environmental degradation, according to the National Institute of Geological Science and AGHAM's Hazard Assessment. Also, based on on going research by AGHAM - Advocates of Science and Technology for the People, Center for Environmental Concerns - Philippines, and KALIKASAN People's Network for the Environment, "should the Aerotropolis continue with this misdemeanor in implementation, the mangrove forests along Taliptip and its adjacent environs that serve as the habitat of various valuable marine life would be decimated." The destruction and disruption caused by the project would also drive away migratory birds that depend on mangrove forests for their habitat and subsistence. The loss of their source of income would be experienced by impoverished fishermen who depend on mangroves and open coasts for their livelihood ("SMC Aerotropolis, other reclamation projects threaten Manila Bay with ecological collapse," 2018, June 11). Additionally, the manager of Bulakan Mangrove Nursery and Eco-Park in Barangay Taliptip, Bulakan town, Bulacan, states that the manager was taken aback when the manager learned that San Miguel Corporation (SMC) intended to construct an international airport close to the park because no locals had been consulted prior to any decisions being made (SMHC). The Mangrove Ecopark in Bulakan town is 277 meters from the proposed SMHC aerotropolis and would not be impacted by its construction, according to a certification issued on July 22 by Emelita Lingat, Bulacan provincial environment and natural resources officer. The surrounding environment and mangrove forestry, which the Bulakan Eco-Park is working to save and safeguard, will unavoidably be impacted by the multimillion-dollar project, even if it will not directly touch it. A research gap concerning the long-term ecological effects of airport-related activities on mangrove biodiversity and ecosystem services may be found with the mangrove eco-park endangered by airport construction.

2. Materials and Methods

Understanding the methods and tactics to be employed for data gathering is essential to achieving the aims and objectives of the research. This study used descriptive quantitative and qualitative approaches as its methodology. One of the most crucial steps to identify the research problem's demands and potential solutions is to conduct surveys with representatives of the general public, using questionnaires, interviews, and focus groups to determine public interest in the issues the proponents are addressing. In order to analyse the issue and develop a more thorough understanding and interpretation, the research approach required the collection of sufficient data, allowing for the establishment of a stance for a successful research study.

2.1. Data Gathering Procedures

Conducting research required well-organised techniques and procedures to acquire the precise facts needed and involved in the study. The study considered the situation or occurrence in the communal environment. It concentrated on responding to the how, what, and why queries. Research was done using secondary data from books, magazines, newspapers, and the internet through Descriptive Strategy. Focus areas for research included how, what, and why the mangrove eco-park should result in long-term preservation. This was done to understand the issues and circumstances brought on by the projected aerotropolis in the vulnerable mangrove eco-park of Bulakan. To further understand this, researchers also carried out surveys in coastal communities. In order to encourage future designs and advancements, it is also essential to understand and assess what is happening in the aforementioned locations.

2.2. Ethical Considerations

During this research, it is essential to employ predefined approaches and processes to acquire the specific data required and involved in the study. The inquiry considered the context or phenomena of the social environment. It focuses on addressing the how, what, and why questions. Using secondary data from books, magazines, newspapers, and the internet, the descriptive strategy conducts research. The researcher ensured that they interacted personally with the respondents during the interview, did not violate privacy without their permission, did not hurt sentiments, and acknowledged and accurately portrayed the information gleaned from the respondents. It is necessary to recognise and comprehend many factors regarding their nature and role in the research.

Correlating variables and data makes comprehending, comparing, and connecting differences and connections simpler. This aided in gathering data needed to assess the impact and main ramifications of the research. This study relied on secondary data to understand and analyse the statistical link, even if it is not experimental. Data were gathered through surveys, archives, online sources, and direct observation of the environment.

3. Results and Discussion

The researcher must be aware of the various characteristics of the eco-park, including the physical and environmental characteristics of the eco-park and its surrounding areas, the development status, and the requirements and recommendations of the people involved in the said development, in order to identify the various precautions and interventions required to fulfil the study's goals and objectives. These elements are crucial for the researcher's strategies to be improved to complete the study and accommodate both the satisfaction, adaptation, and preservation of the Bulakan Mangrove Eco-Park to help lessen the adverse effects of the proposed development.



Fig. 1 Taliptip, Bulakan's Mangrove Eco-Park Source: Cumaps.net



Fig. 2 Black-faced Spoonbills/*Platalea minor* (Source: Google Image)

3.1. Bulakan Mangrove Eco-Park

The local government created a conservation zone in 2002 to preserve and replicate mangroves for the region's coastal ecosystems to restore biodiversity. Bulakan Mangrove eco-park was established in 2004 due to collaboration between the Department of Environment and Natural Resources and the regional tourism agency. Jimmy San Jose of the Bulakan Environment Office is now responsible for the park. They began turning it into an ecotourism attraction by constructing an eco-trail of around 1800 meters. Enjoy a nature stroll amid mangrove trees, ideal for a couple on a nature-tripping date. The park is lovely and features a tower where visitors may observe birds and snap images of the surrounding landscape. It is also ideal for travellers looking for a calm setting to relax. San Jose claims that by continuing to monitor and cover operating expenses, the Department of Natural Resources (DENR) and the Local Government Unit (LGU) are committed to developing and improving the area. Some of the local fishermen in Barangay Bambang have a source of income because of the eco-boat park's rentals and mangrove seedling plantings. By then, guests at the eco-park will be able to savor and catch fish, go on a boat tour through mangroves, and unwind while taking in the dawn and sunset.



Fig. 3 Black-crowned Night-Heron/*Nycticorax nycticorax* (source: <http://www.birdwatch.ph/>)

3.1.1. Migratory Birds Found in Bulakan Coastal Area

Taliptip is home to a diverse range of migratory bird species, which have been observed soaring over the shoreline, particularly over fish pens and other bodies of water, due to the island's rich marine biodiversity. Bird activity suggests sufficient fish to serve as a feeding site for a wide range of birds. In January 2020, at Bulakan, Bulacan's Barangay Taliptip, a Black-faced Spoonbill, *Platalea minor*, is a migratory bird commonly seen during the annual Asian Waterbird Census (AWC). The multi-site AWC (WBCP) was organized with Wetlands International Philippines, the Wild Bird Club of the Philippines, and the Biodiversity Management Bureau of the Department of Environment and Natural Resources. The only spoonbill listed as endangered by the International Union for Conservation of Nature is the Black-faced Spoonbill. Without a doubt, it requires tidal flats and pristine coastal wetlands.



Fig. 4 Little Egret/*Egretta Garzetta* (source: <http://www.birdwatch.ph/>)

Approximately 200,000 waterbirds spend the winter months along the Manila Bay shoreline, according to Arne Jensen, chair of the WBCP records committee and associate expert for Wetlands International. Ten locations around river deltas and mudflats have been identified as needing restoration and preservation in order for two-thirds of the population to survive. However, only 200 hectares, or 1%, of Manila Bay is protected, and reclamation severely threatens the area's extremely fragile wetlands.

Mangrove Species found in the Bulakan Coastal Area Bulacan has 22 different kinds of mangroves, including the robust piapi (*Avicennia marina*), which serves as a fish refuge and a natural wave barrier. Due to its destruction and use, the development will be exposed to at least 20 typhoons yearly. It will also result in a decrease in the biodiversity of the natural world. Based on the researchers' online conversation with an environmentalist and AGHAM Advocate, these are the most prevalent species in the Bulakan Mangrove Eco-Park area.

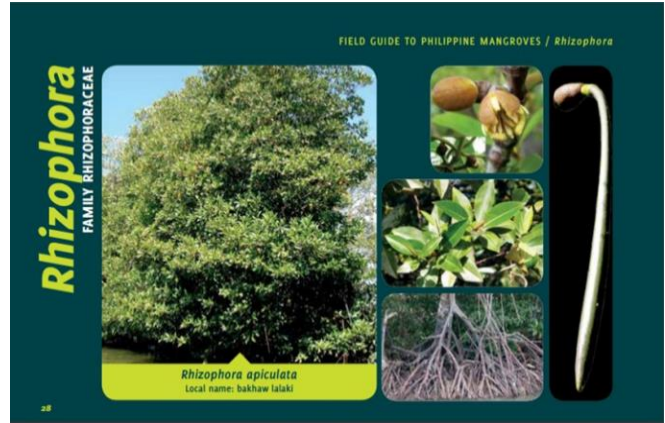


Fig. 7 *Rhizophora* (source: <https://www.zsl.org/>)
Rhizophora local name bakhawanBulakan Mangrove

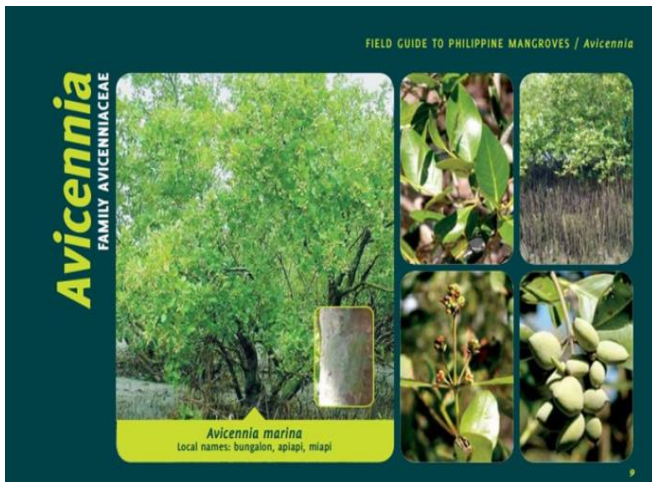


Fig. 5 *Avicennia marina* (source:<https://www.zsl.org/>)
Avicennia marina local name apiapi

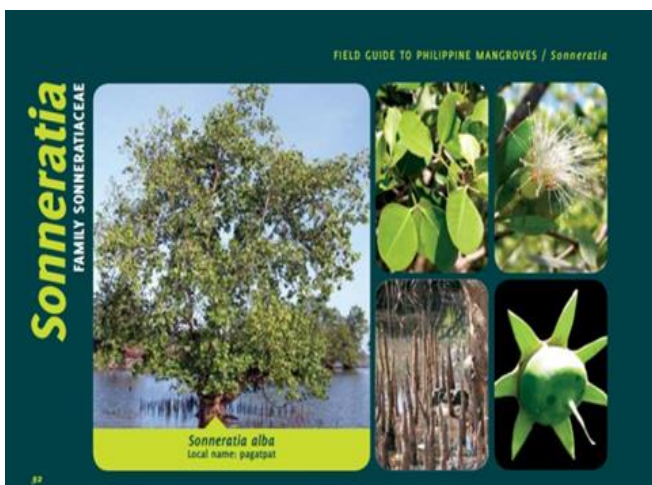


Fig. 6 *Sonneratia* (source: <https://www.zsl.org/>)
Sonneratia's local name is Pagatpat.



Fig. 8 Integrated master plan of the aerotropolis
 San Miguel Corporation Proposed Aerotropolis

San Miguel Corporation is funding the projected Bulacan Aeropolis airport. It would reportedly ease and clear traffic for travellers at Ninoy Aquino International Airport (NAIA) in Manila. New Manila International Airport (NMIA), also known as Bulacan Aerotropolis, is located 35 kilometers north of the city center on the Bulakan shore. It will be Manila's main airport, even though it is Bulacan International Airport. The airport would be built on a 2,500-hectare plot of land with four runways planned. The neighborhood would be transformed into a brand-new residential community with a port and residential and commercial space. The New Manila International Airport will include four parallel runways in addition to a residential, academic, and government hub, according to the integrated master plan. There will be a seaport, an industrial zone, and a ferry service to Bataan and Manila. The Airport Expressway will provide access to the McArthur Highway, the North Luzon Expressway, and Radial Road 9 Extension from the airport. The Shoreline Expressway, which connects Malabon and Bataan, will pass beside the airport.

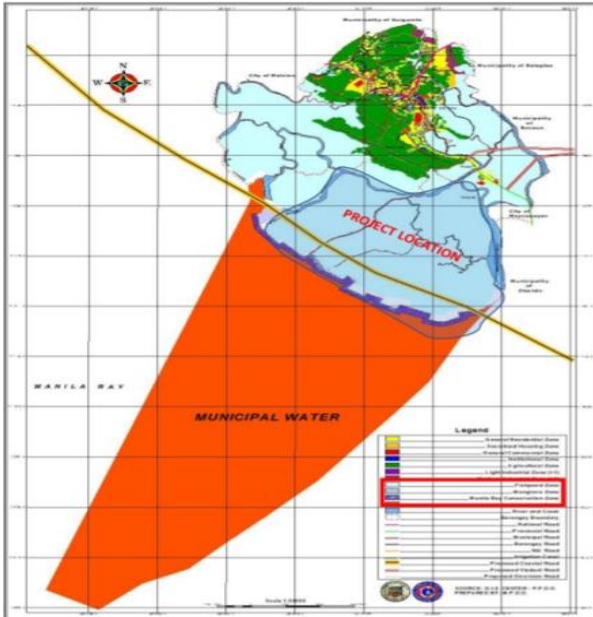


Fig. 9 Project Location

Zoning Map - Municipality of Bulakan

According to San Gabriel (2nd People's Summit on the Impacts of Reclamation, March 26, Bay Leaf Hotel Intramuros), the coastal region of Taliptip is home to a rich biodiversity. There are many fish, seashells, crabs, and shrimp. Bulakan has produced 41 million tons of fish on its own. Additionally, frequent sightings of at least four distinct bird species over the coastal region were reported. These birds are a sign of plenty of fish to sustain various bird species. In order to gather information about the physical and environmental conditions of the park as well as the degree of community awareness of its existence, the local community, caretakers of the eco-park as well as visitors of the Bulakan Mangrove eco-park were interviewed and observed, given that the study is being conducted during the on-going process of the site development of the aerotropolis. Additionally, using Google Meet and other online communication tools, experts from various fields of environmental science and officials from the Department of Environment and Natural Resources were interviewed.

3.1.2. Result of the Survey

The survey findings by 58 respondents in and around Bulakan were collected, assessed and interpreted. In order to gauge the level of community awareness of the Bulakan current Mangrove eco-parks state, a Google form survey was used. The queries and information gathered from the responses are presented in the following charts:

Chart 01: Respondent's Familiarity to Eco-park

The graph shows that 53.4% of the respondents are somewhat familiar with an eco-part. In comparison, 39.7% of the respondents are familiar with an eco-part. Moreover, only 6.9% are unfamiliar with an eco-park.

Are you familiar with what an eco-park is?

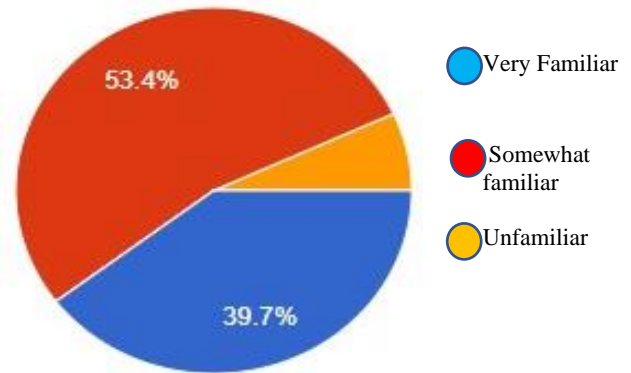
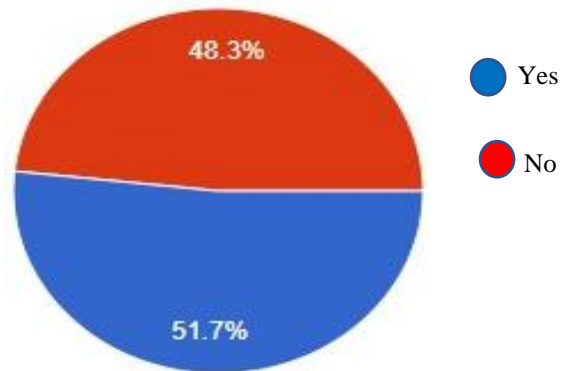


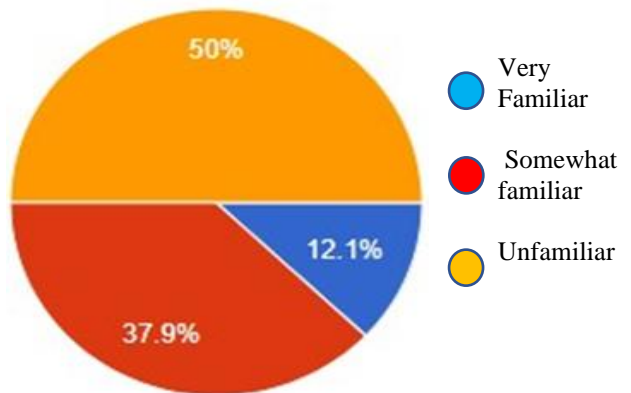
Chart 02: Respondents have been through an Eco-park
Have you ever been to an Eco-park?



The chart shows that 51.7% of the respondents have been to an eco-park, while 48.3% have not been to an eco-park.

Chart 03: Respondent's Familiarity to Bulakan Mangrove Eco-park

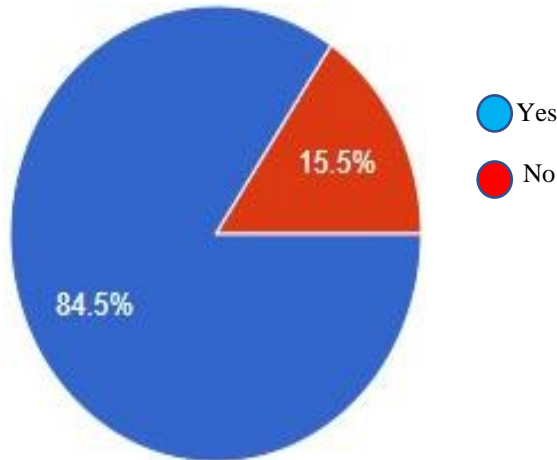
Are you familiar with the Mangrove Eco-park in Bulakan, Bulacan?



The chart shows that 50% of the respondents are unfamiliar about the Bulakan Mangrove eco-park. In comparison, only 12.1% of the respondents are very familiar about the Bulakan eco-park.

Chart 04: Respondents Awareness of the Benefits of Mangroves to Coastal Areas

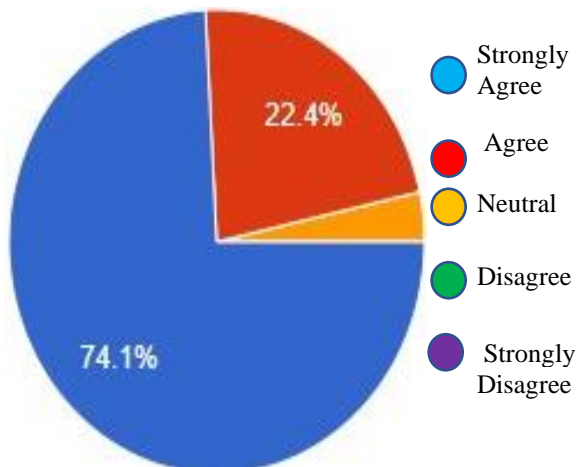
Are you aware of the benefits of having Mangroves in Coastal areas?



The chart shows that 84.5% of the respondents know the benefits of mangroves to coastal areas, while only 15.5% are unaware.

Chart 05: Respondent's Perspective on the Importance of Mangrove to Biodiversity

Do you agree that the Mangroves are an essential biodiversity asset, especially in coastal areas?



The chart shows that 74.1% of the respondents strongly agree that mangroves are an important asset in coastal areas, 22.4% agree, and only 3.5% have a neutral response.

Chart 06: Respondents perspective to the economic contribution of eco-park

The chart shows that 62.1% strongly agree that Bulakan Mangrove Eco-park as a tourist would significantly contribute to the economic growth of the place, and 34.5% also agree with a 3.4% neutral response.

Do you agree that a tourist spot like Bulakan Mangrove Eco-park could contribute to the community's economic growth?

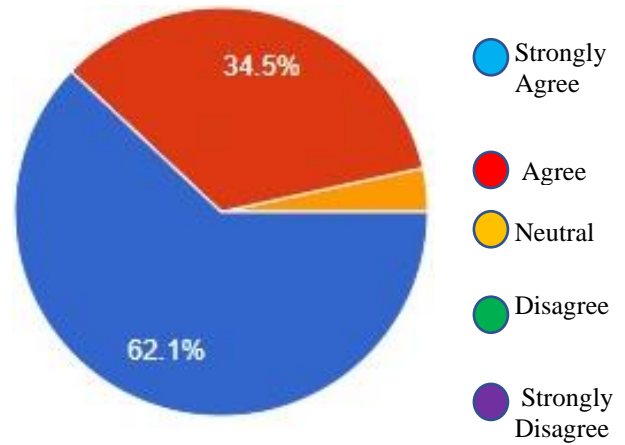
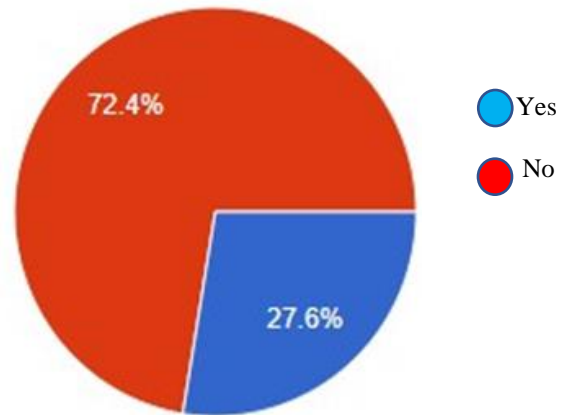


Chart 07: Respondents awareness on Eco-park promotions

Do you find any form of advertisement or promotion about Bulakan Mangrove Eco-park?



The chart shows that only 27.6% of the respondents were reached by an advertisement or promotion regarding the existence of the mangrove eco-park, and a huge 72.4% answered that they did not. According to the survey results, most respondents are aware of what an eco-park is and the advantages mangroves have for the environment, particularly in coastal areas. Only half of them, however, had experience and had visited an eco-park. Additionally, it demonstrates that due to a lack of advertising and promotion—72.4% of respondents claim they cannot discover any—Bulakan Mangrove eco-park is only marginally known to the respondents. On the other hand, Jimmy San Jose stated that the Department of Environment and Natural Resources (DENR) and local government units (LGUs) are eager to beautify and improve the region by continuing to monitor and give operating costs to support Bulakan's tourism industry. The park's 1800 m eco-trail is perfect for a romantic nature

date for couples. You can wander among the park's mangrove forests. It demonstrates that the Bulakan Mangrove Eco-Park has the potential to become a popular tourist destination for birdwatchers seeking to pass migratory birds, conservationists, and scientists researching mangrove ecosystems. However, the lack of visitor issues is made more difficult by the community's inadequate advertising and promotion. In line with this, the eco-park requires facility upgrades and enhancements. Although maintaining the eco-park in its current state has a favorable impact on its preservation.

4. Conclusion

When the Bulakan Mangrove eco-park is faced with the inevitable changes in the physical and environmental aspects that result from the Philippine government's need to decongest the Ninoy Aquino International Airport, challenges arise in mitigating its adverse effects and promoting the preservation, appreciation, and promotion of the Eco-park. The airport complex in Bulakan was built on a 2,500-hectare site. These assessments highlight the circumstances and issues that must be resolved to preserve the Taliptip Mangrove eco-park. Based on the information acquired, the researchers conclude that in addition to the Taliptip Mangrove Eco-current park's environmental and physical problems, the proposed aerotropolis will lead to an even worsening issue with the region's physical and environmental conditions. The following elements could be considered to lessen the Taliptip Mangrove eco-park's deterioration.

The immediate and surrounding areas will experience both temporary and permanent changes due to the Bulacan Aerotropolis' construction. Therefore, it is crucial to consider any potential repercussions at all stages of development (including the construction and operational stages) on the local community's physical, social, and environmental resources (Entec, 2005).

The physical surroundings would change, which would be one of the immediate and evident repercussions. Land loss and reclamation, modifications to river and drainage systems, and the removal of natural wildlife and vegetation all impact the paths used to move sediment and water (Douglas and Lawson, 2003). If the risk is not controlled, these could cause flooding and siltation in the surrounding communities. When all these changes are considered, they will substantially impact the social and physical surroundings of those who live close to the airport. Their way of life, which relies heavily on Manila Bay's abundant aquatic resources, is significantly impacted by the construction of the aerotropolis. It might also increase current risks or introduce new ones to their local populations.

Recommendation

The following are the best suggestions and answers for the Bulakan Mangrove Eco-park's demands to protect and conserve the protected area and promote tourism. As a result,

several recommendations based on the stated needs were produced. These recommendations may then be combined to provide a sound, workable, sensible design solution. Reducing the adverse effects of an Aerotropolis:

- Introduce architectural strategies supporting tourism, sustainability, and Eco-park preservation.
- The mangroves' established methods can be managed and utilized as a medium for ecotourism in the eco-park.
- Include a design strategy that protects the protected area while allowing for sustainable growth.
- The mangroves' established methods can be managed and utilized as a medium for ecotourism in the eco-park.
- Include a design strategy that protects the protected area while allowing for sustainable growth.
- Give tourists boat storage facilities that will allow them to travel to the Eco-park.
- Publish eco-park accessible informational guides.

Architectural Interventions

In order to accomplish the study's principal goal, which is to lessen the adverse effects of the aerotropolis, the only thing required is to consider any potential negative impacts of the reclamation project and implement workable solutions in architectural methods.

Provision for Noise Barriers

Given that the Bulakan Mangrove Eco-park is only 200 km from the aforementioned Aeropolis and that noise barriers are crucial in airport developments, it is a precaution to add an additional layer of barrier there. The noise barriers will be constructed using inexpensive materials like bamboo, integrated with vines that reduce noise, and integrated with solar panels and rainwater catchment for sustainable irrigation of the vines to fulfil the goal of sustainability and eco-responsiveness.

Built Areas as Habitats for Birds

There is a chance that the endemic birds in the area will be disturbed while the aerotropolis is being built and run. Several birds, including migratory birds from one country to another, call the Bulakan Mangrove Eco-park home. It is only necessary for the architectural developments to represent the built environment of the Bulakan Mangrove Eco-park through organic design to lessen the birds' disturbance around the eco-park, particularly for the proposed development. Using local materials and a style that mimics the familiar habitat of endemic birds, organic architecture is a design in which structures are inspired by, constructed around, and blend in with their natural surroundings. This makes the design reflect the environment.

Rapid Land Subsidence

Since at least the 1980s, Manila Bay has experienced a problem with rapid sinking rates, particularly in the KAMANAVA area (Rodolfo et al., 2003). Large

infrastructure projects like airport construction will worsen the issue because of increased loading. Structures on stilts will aid in resolving the issue with the Mangrove Eco-facilities parks. However, it can also be helpful when working in environmentally sensitive areas, especially the Mangrove Eco-park, a protective area where the impact on the land is greatly minimized because of smaller foundations. The most

typical use of stilts is to raise the building above the floodplain.

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