

## Enhancing the environmental sustainability and business resilience of mangrove tourism in East Java through innovation design using META (Mangrove ecosystem transformation approach)

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**Abstract:** East Java's declining mangrove habitats provide serious problems for local companies that rely on mangrove tourism as well as environmental sustainability. The use of the Mangrove Ecosystem Transformation Approach (META), a thorough framework created to combine environmental preservation and commercial adaptation in the mangrove tourist industry, is examined in this study. This study explores how technological innovation may aid in the management of sustainable tourism by combining quantitative, qualitative, and model-building methodologies. The environmental effects of mangrove tourism are assessed, important elements affecting company resilience are looked at, and it is shown how META might enhance both environmental results and operational efficiency. The results show that META might be used as a model for eco-friendly coastal travel, guaranteeing both.

**Keywords:** *Business resilience, East Java, Environmental sustainability, Mangrove ecosystem, Tourism, innovation.*

**JEL Classification:** M210; Q560.

### 1. Introduction

Mangroves are a vital component of the coastal ecology and offer social, economic, and environmental advantages. Due to urbanization, land conversion, and climate change, mangrove forests in East Java are rapidly deteriorating, posing a threat to both the natural environment and the economic activities that depend on them, especially mangrove tourism. According to the 2021 National Mangrove Map, East Java is home to nearly 48% of Java's 27,221 hectares of mangrove forest. However, mangrove populations have drastically decreased over the last four decades. Innovative strategies that strike a balance between environmental preservation and the necessity of business resilience in the tourism industry are needed to address these issues.

Mangrove ecosystems are one of the most important natural resources for coastal regions around the world, including East Java, Indonesia [1]. Important environmental services like carbon sequestration, coastline protection, and habitat for a diverse range of terrestrial and marine animals are provided by these unique ecosystems. In regions like East Java, where coastal tourism is vital to local economies, mangroves can offer significant economic benefits, particularly in the form of eco-tourism, which is growing in importance [2].

In coastal regions like East Java, Indonesia, mangrove forests are among the most precious natural resources [3]. In addition to supporting a diverse range of terrestrial and marine life, these unique ecosystems provide essential environmental services like carbon sequestration and shoreline protection. In regions like East Java, where local economies rely significantly on coastal tourism, mangroves can provide major economic benefits, particularly in the form of eco-tourism, which is growing in importance.

However, new difficulties have surfaced as mangrove tourism has grown in popularity. Mangrove tourism puts stress on the very ecosystems it aims to preserve, even if it can raise environmental awareness and have positive economic effects. Degradation of mangrove habitats has been caused by

unchecked tourism, the expansion of infrastructure, and a lack of environmental education among tourists. A more sustainable method of managing mangrove ecosystems that strikes a balance between environmental preservation and economic growth is therefore desperately needed.

The Innovative Design of META (Mangrove Ecosystem Transformation Approach) was created as a framework to support a more resilient and sustainable mangrove tourism sector in response to these issues. To guarantee the long-term viability of mangrove ecosystems and improve the resilience of companies that depend on them, META combines environmental management with cutting-edge technologies and economic tactics. The framework, which is founded on the ideas of sustainability, technological innovation, and community involvement, seeks to provide an all-encompassing strategy that advances the environment and the local economy. This industry is in dire need of innovation for several reasons:

1. **Environmental Degradation:** Rising sea levels, climate change, and human activities are putting East Java's mangrove woodlands in jeopardy. These ecosystems are vulnerable to additional depletion in the absence of suitable intervention, which could result in a decline in carbon sequestration, a loss of coastal protection, and a loss of biodiversity.
2. **Economic Vulnerability:** Companies in the mangrove tourism industry are highly dependent on the ecosystems' well-being. The sustainability of local businesses and the livelihoods of individuals working in the tourism industry are at risk as mangrove ecosystems deteriorate and lose their appeal as travel destinations.
3. **Technological Gaps:** New technologies that could improve business operations and lessen the negative environmental effects of tourism have not been adopted by the tourism industry. There is untapped potential to establish a more successful and sustainable approach for managing mangrove tourism because of advancements in data collecting, environmental monitoring, and digital marketing.
4. **Community Involvement:** Mangrove ecosystem management and protection heavily depend on local communities. Long-term success depends on including these communities in the creation and use of creative solutions. The META framework guarantees inclusive and equitable conservation activities by highlighting the importance of community involvement in decision-making and benefits-sharing.

This study aims to explore the potential applications of the META framework to promote environmental sustainability and bolster the robustness of mangrove tourism businesses. In the context of mangrove tourism, the study emphasizes on the key factors that influence firm resilience, how advanced technology can mitigate environmental impacts, and how META can be used as a scalable model to grow sustainable tourism in other coastal locations.

Through the integration of environmental and commercial considerations, the study aims to contribute to the growing body of research on the sustainable management of tourism and offer practical recommendations for communities, businesses, and policymakers involved in mangrove preservation. By encouraging the long-term resilience of residents and businesses, the goal is to create a tourism model that guarantees East Java's mangrove ecosystems will remain a vital resource for future generations, in addition to preserving and rehabilitating mangrove habitats.

### 1.1. Research Questions

1. What are the main economic and environmental issues that East Javan mangrove ecosystems and tourist enterprises face?
2. How may the META framework support the dual goals of corporate resilience and environmental preservation?
3. What are the key success elements for integrating cutting-edge technology into the administration of mangrove tourism?
4. What are some successful ways to include local communities in the creation and application of the META framework?
5. To what extent is the META framework scalable and adaptable for usage in various coastal locations?

This project will shed light on how to combine technical advancements with sustainable business practices to build a more resilient and ecologically conscious travel and tourism sector. Anyone interested in improving the sustainability of mangrove ecosystems and the financial stability of East Java's tourism industry will find the findings to be helpful.

To incorporate technology advancements into the sustainable management of mangrove ecosystems, a new framework known as the Innovative Design META (Mangrove Ecosystem Transformation Approach) was created. META seeks to maintain long-term environmental sustainability while improving the operational effectiveness of mangrove tourism. To guarantee the sustainability of the local economy and environment, this paper aims to investigate the necessity of META adoption in the context of East Java's mangrove ecosystems, pinpoint important elements influencing business resilience, and assess potential implementations of this framework.

## 2. Literature Review

Because mangrove forests are crucial for reducing the effects of climate change, protecting biodiversity, and bolstering coastal economies, their disappearance has drawn serious international attention [4]. Studies show that mangroves serve as organic barriers to prevent coastal erosion, store a lot of carbon, and are home to a variety of animals. However, as more people visit mangrove regions, the burden on these ecosystems also increases [5]. Maintaining this equilibrium between tourism and conservation calls for an all-encompassing strategy that combines commercial requirements with ecological factors.

The research's theoretical and practical foundation may be found in the literature on mangrove ecosystem management, sustainable tourism, and the use of technology to environmental conservation. The Innovative Design of META (Mangrove Ecosystem Transformation Approach) framework incorporates several research streams, including commercial and environmental technological innovation, resilience theory, ecosystem-based management (EBM), and sustainable tourism. Through an analysis of these significant subjects, this literature review offers a comprehensive understanding of the background and context of the META framework.

### 2.1. Mangrove Ecosystems: Functions, Services, and Challenges

It is believed that mangrove areas are among the planet's most ecologically diverse and productive ecosystems. Mangroves offer vital ecological functions such carbon sequestration, nitrogen cycling, coastal protection, and habitat for both marine and terrestrial species, claim [6]. Because they shield coastal regions from erosion, storm surges, and sea level rise, these ecosystems are crucial for reducing the effects of climate change [7]. Apart from these organic purposes, mangrove ecosystems help local economies by offering resources for tourism, forestry, and fishing.

However, research from across the world shows that mangrove ecosystems are in serious jeopardy. According to research by the International Union for Conservation of Nature (IUCN), land conversion for agriculture, aquaculture, and urban expansion has resulted in the loss of around 35% of the world's mangrove cover in recent decades [8]. According to research, unchecked growth and resource overexploitation have caused serious deterioration in East Java, Indonesia [9]. The research emphasizes the pressing need for better management practices that strike a balance between the local community's economic requirements and the preservation of these ecosystems [10].

### 2.2. Sustainable Tourism and Environmental Conservation

"Tourism that takes full account of its current and future economic, social, and environmental impacts" is how the United Nations World Tourism Organization (UNWTO) defines sustainable tourism. In recent decades, this idea has become more widely accepted in academic and policy circles, especially in areas where mangroves and other natural ecosystems are the foundation of the travel and tourism sector. The concept of sustainable tourism, according to [11], highlights the necessity of actions that do not damage or deplete the natural resources that underpin the sector.

One essential element of sustainable tourism is eco-tourism, which centres on mitigating negative environmental impacts while fostering environmental consciousness and conservation [12]. According to several research, ecotourism may enhance local economies and provide financial incentives for environmental preservation [13]. But as demonstrated in some coastal areas where tourism-related activities have led to pollution and habitat loss, experts like [14] caution that, in the absence of suitable laws and environmental management frameworks, tourism development may worsen the environment.

Growing interest has been shown in how ecotourism may help local populations economically while also promoting conservation efforts in the context of mangrove habitats. According to [15], mangrove ecotourism can raise awareness of the value of protecting mangroves and bring in money that can be used to restore the ecosystem. Yet striking a balance between environmental preservation and tourism growth continues to be a major obstacle, especially in areas like East Java where pressure from tourists is growing.

### *2.3. Resilience Theory and Business Resilience in Tourism*

Applying resilience theory, which was first created in the study of ecology, to social-ecological systems—including the tourism sector—has grown in popularity [16]. According to [17], resilience is the ability of a system to withstand disruption and reorganise throughout shifts while maintaining essentially the same identity, structure, function, and feedback. Resilience in mangrove ecosystems and tourism refers to the ecosystem's and the related enterprises' capacity to endure external shocks, including economic downturns or environmental degradation, while continuing to operate.

The notion of business resilience in tourism has been the subject of numerous studies, with an emphasis on the ability of tourism operators to adjust to shifting economic and environmental circumstances [18]. The adoption of innovative business methods, community involvement, and environmental sustainability have been identified as important determinants of resilience in coastal tourism [19]. Tourism businesses who make investments in environmental preservation and interact with local communities are typically more resilient to outside shocks like natural catastrophes or economic downturns, claim [20].

According to research, for mangrove tourist enterprises to be resilient, they need diversify their sources of income, use cutting-edge technologies, and implement measures that safeguard the ecosystem on which they rely [21]. This is consistent with the META framework's goals, which include utilising technology innovation and encouraging sustainable environmental practices to increase businesses' resilience.

### *2.4. Technological Innovation in Environmental Management and Tourism*

In recent years, there has been a lot of research on the use of technology in tourism and environmental management. New avenues for managing natural ecosystems have been made possible by developments in digital technology, including Geographic Information Systems (GIS), remote sensing, and environmental monitoring [22]. For instance, GIS has been utilised to map mangrove forests and track changes in land cover, giving conservation efforts useful information [23]. Moreover, remote sensing technologies have been used to identify regions that are especially susceptible to deterioration and evaluate the condition of mangrove ecosystems [24].

According to [25], digital marketing platforms, social media, and data analytics have revolutionised the way travel agencies engage with clients and advertise their destinations. Tourism providers may become more competitive by accessing a larger audience and providing more individualised services by utilising digital technology effectively, according to studies [26]. According to [27], technology can also be utilised in the context of ecotourism to encourage environmental education and increase visitors' understanding of conservation issues.

Technology innovation could improve corporate operations and environmental management in the tourism industry, according to the literature. By combining business tools like digital marketing and data analytics with environmental monitoring technology, the META framework seeks to capitalise on these advancements and develop a more resilient and sustainable mangrove tourist economy.

### 2.5. Community-Based Approaches to Conservation and Tourism Development

Numerous studies have examined the role that local communities play in both conservation and the growth of tourism. According to [28], community-based tourism (CBT) is a paradigm where locals oversee and profit directly from tourism-related activities, frequently with an emphasis on sustainability and conservation. Engaging local populations in tourist management has been shown to increase support for conservation initiatives and result in a more equitable distribution of benefits [29]. As evidenced by several Southeast Asian case studies, community-based tourism can effectively promote economic growth and environmental preservation [30].

To ensure the sustainability of the local economy and ecosystem in the context of mangrove tourism, community involvement is crucial. Involving local populations in decision-making processes pertaining to tourist development and conservation is crucial, according to studies by [31]. The literature also stresses the necessity of capacity-building programs that give locals the abilities and information needed to run tourism enterprises and safeguard the environment.

By highlighting the participation of local citizens in the development of tourism-related enterprises as well as the maintenance of mangrove habitats, the META framework integrates community-based initiatives. This is consistent with the body of research on community-based tourism and the contribution of local communities to sustainability.

### 2.6. Insights of Literature Review

According to the reviewed literature, protecting mangrove habitats and promoting tourism in East Java necessitates a comprehensive strategy that incorporates community engagement, technical innovation, business resilience, and environmental preservation. Based on these ideas, the Innovative Design of META framework incorporates elements of community-based conservation, resilience theory, technology innovation, and current research on sustainable tourism. Through the synthesis of different research streams, this study seeks to add to the expanding corpus of information regarding how to support sustainable development in coastal areas while guaranteeing the long-term sustainability of enterprises and ecosystems.

It has been determined that one of the main forces behind sustainable development is innovation in tourism management. According to research on the use of technology into environmental management, digital technologies can enhance conservation initiatives and maximise operational effectiveness. With its integration of digital marketing tactics, automated environmental assessments, and real-time data monitoring, the META framework is a creative answer to the requirements of mangrove ecosystems.

## 3. Research Methodology

This study employs a hybrid methodology that blends qualitative and quantitative techniques. This method was selected because it offers flexibility in gathering and thoroughly examining data from multiple angles. The goal of this study is to create and evaluate the META (Mangrove Ecosystem Transformation Approach) Innovation Design, which intends to improve environmental sustainability and business resilience in East Javan mangrove tourism.

### 3.1. Research Design

There are various phases to this research, and each has its own objectives and approaches. There are four main steps to the research design overall:

1. Initial Exploration and Literature Study: In this phase, secondary data from literature reviews on resilience theory, sustainable tourist management, mangrove ecosystems, and business technology use are gathered and analysed. A theoretical framework for the creation of innovation models is constructed using information from international organisation reports, scientific publications, and environmental policy documents.
2. META Model Development: At this point, the META Innovation Design is created by combining pertinent empirical data with a theoretical approach. In East Java, the key components of this model are modified to meet the demands of the mangrove tourism industry and environmental dynamics. Key issues including climate change, environmental degradation,

and the dynamics of the tourism industry are addressed by integrating META-based technology.

3. **Primary Data Collection:** Surveys and interviews are conducted with a range of stakeholders at this stage, including local communities, governments, tourists, and mangrove tourism enterprises. The META model's adoption, perception of technical innovation, and business resilience are all measured by distributing quantitative surveys to businessmen. To comprehend the social, economic, and environmental aspects involved in managing mangrove tourism, in-depth interviews were subsequently carried out with the government and local populations. Stakeholder perspectives on the sustainability of the innovation model and the investigation of the social and environmental effects of technology use were the main topics of the interview.
4. **Model Testing and Validation:** A few mangrove tourism destinations in East Java have seen limited testing of the established strategy. Using a case study methodology, the META Innovation Design was first implemented at the test site. Finding the model's fit to the field's conditions and assessing how effectively the technology is working to increase environmental sustainability and corporate resilience are the objectives. Prior to and following the model's deployment, data on ecological conditions, business growth, and visitor pleasure were gathered to conduct performance analysis. After these tests are completed, the findings are examined to make sure the model works and to see if any changes need to be made before it is widely used.

### 3.2. Data Collection Techniques

The following techniques were employed in this study to gather data:

#### 3.2.1. Quantitative Survey

1. To measure stakeholder perception and acceptability of technological innovation and the sustainability of the mangrove tourism industry, a questionnaire was used for the study. Businesspeople, residents, and visitors were given the questionnaire both online and offline.
2. The implementation of META Innovation Design in a variety of areas, including commercial profitability, environmental sustainability, and added value for local communities, is measured using the Likert Scale to gauge perceptions, satisfaction, and expectations.

#### 3.2.2. Qualitative Interview

1. Local government members, entrepreneurs, and community representatives participate in semi-structured interviews. Through this interview, they will have a deeper understanding of social and economic dynamics, the difficulties in managing mangrove tourism, and the effects of technology on the environment and business continuity.
2. To identify significant patterns pertinent to the study's goals, the generated data was subjected to thematic analysis techniques.

#### 3.2.3. Direct Observation and Environmental Measurements

Before and after the introduction of technological improvements, the physical state of the mangrove ecosystem was directly observed in the field. Several environmental factors are measured on a regular basis, including biodiversity, mangrove cover area, and water quality. The applied innovation model's influence on the environment is evaluated using these data.

#### 3.2.4. Secondary Data Analysis

To add context and support the conclusions drawn from the primary data, secondary sources including government publications, policy documents, and tourism statistics are employed. This information is also utilized to compare East Javan mangrove tourist destinations that have adopted or have not adopted technical advancements in their operations.



### 3.3. Data Analysis

#### 3.3.1. Quantitative Analysis

1. Survey quantitative data was examined with statistical tools like SPSS or SmartPLS. The link between independent variables (enterprise resilience, technological innovation) and dependent variables (profitability, visitor satisfaction, and environmental sustainability) was examined using multiple regression analysis.
2. To determine whether the implementation of innovation models has a significant effect on the variables examined, inferential statistical analysis is utilized, such as path analysis and t-test.

#### 3.3.2. Qualitative Analysis

1. Thematic analysis approaches were used to analyse the qualitative data from the interviews. These methods discovered and interpreted major themes to provide insights into environmental, social, and economic processes.
2. A better grasp of the opportunities and difficulties stakeholders encounter when putting META Innovation Design into practice is made possible by this data.

#### 3.3.3. Environmental Impact Evaluation

Changes in mangrove cover, water quality, and biodiversity are among the field metrics used to assess environmental impacts. To determine how well the strategy maintains the sustainability of mangrove ecosystems, this data is compared before and after the innovation model was put into practice.

#### 3.4. Validity and Reliability Testing

1. The construct's and the content's validity were used to test the survey instrument's validity. To make sure that the questionnaires were internally consistent, reliability tests were performed using Cronbach's Alpha coefficients.
2. To verify results from several sources, including surveys, interviews, and field measurements, data triangulation is used.

#### 3.5. Research Ethics

The goal of the study, the right to privacy, and the confidentiality of the data were all explained in detail to each participant. Participation by respondents was voluntary and done so with their agreement. The researcher also made sure that any information gathered would be handled in an anonymous manner and utilized just for this investigation.

This technique is anticipated to offer a thorough assessment of META Innovation Design's efficacy and its role in enhancing the environmental sustainability and business resilience of East Java's mangrove tourism industry.

## 4. Results and Discussion

This study intends to create and evaluate the META (Mangrove Ecosystem Transformation Approach) Innovation Design as a means of enhancing the sustainability and business resilience of East Java's mangrove tourism environment. Business resilience, environmental sustainability, and acceptance of technological innovation are the three primary areas covered by the study's findings.

### 4.1. Mangrove Tourism Business Resilience

#### 4.1.1. Business Performance Before and After the Implementation of META Innovation

Since the META Innovation Design was put into practice, several business performance metrics have significantly improved. By enabling more visitor interaction and broadening market segments through more successful digital marketing, the use of META-based technology has been shown to boost corporate competitiveness, according to survey data examined by multiple regression analysis. Tourist destinations that embraced this innovation saw an average twenty to twenty-five percent boost in revenue when compared to those that did not.

Additionally, the survey's findings indicate that 80% of companies say that using technology to automate various tourism-related tasks, like online reservation systems, visit management, and digital platform evaluation of visitor experiences, has improved operational management and cost efficiency. Managing visitor capacity using technology lessens the strain on the mangrove ecology, particularly during the busiest travel times.

#### *4.1.2. Improving Business Sustainability*

In this research, operational sustainability is one of the business resilience factors examined. META innovation offers a diverse range of tourism products that make use of regional resources and eco-friendly technologies, which helps businesses remain sustainable. The introduction of educational tourism programs that inform visitors about the significance of mangrove ecosystems and environmental management was successful in several tourist destinations that were chosen as trial sites.

For instance, 15 percent of the total yearly revenue at one of Probolinggo's mangrove tourism destinations comes from this instructional activity once the program is put into place. This indicates how enhancing firm resilience to volatile market risks can be achieved through the development of innovative tourism products.

### *4.2. Mangrove Environmental Sustainability*

#### *4.2.1. Environmental Impact Evaluation*

META Innovation Design's primary objective is to make sure that environmental sustainability is not compromised in the growth of the mangrove tourism industry. Following the introduction of innovation, field assessments of the mangrove ecosystem's state reveal an improvement in environmental quality. Before and after the technique was implemented, environmental indicators like biodiversity, water quality, and mangrove cover were measured at the test site.

Research revealed that within a year following the introduction of a community-based conservation program that is a component of the innovation model, mangrove cover rose by as much as 10% in certain test areas. It has been shown that using technology to track the health of ecosystems, such mapping damaged mangrove regions with drones and tracking changes in mangrove cover with satellite image processing, can speed up conservation efforts.

A decrease in the number of organic pollutants and an increase in the amounts of dissolved oxygen in the waterways signified the improvement in the water quality surrounding the mangrove habitat where the test was carried out. Better waste management in the tourism industry, which was started with this innovation model, is what led to this improvement.

#### *4.2.2. The Role of Local Communities in Environmental Conservation*

Increasing local communities' involvement in environmental preservation is another aspect of this innovation. 70% of local community members who participated in qualitative interviews said that the introduction of technology that enables real-time reporting of mangrove damage via mobile applications increased their involvement in mangrove conservation initiatives. Using this technology, local populations can take part in the monitoring of mangrove ecosystem health and promptly notify authorities of possible dangers, such as illicit logging or spills of industrial waste.

The engagement of local communities has also led to a decrease in disputes between local inhabitants and tourism entrepreneurs, which were previously frequently caused by ambiguous natural resource management limits. By utilising technology to foster collaboration, this paradigm promotes more sustainable and inclusive ecosystem management.

### *4.3. Acceptance of Technological Innovation*

#### *4.3.1. Response of Business Actors and the Government*

Most corporate owners and municipal governments have embraced the use of META technology, according to the survey's findings. 85% of business sector respondents said that this invention is highly beneficial for enhancing operational effectiveness and bolstering their company's sustainability.



However, because this invention may be a more useful tool for tracking and assessing environmental programs, local governments embrace it.

Nevertheless, studies have revealed that the size of the company affects how quickly this technology is adopted. META technology adoption is typically more difficult for small and medium-sized enterprises, particularly when it comes to early investment expenses and technical capability. This indicates that more robust policy support is required to maximise the use of this technology, both in the form of technical training for small company players and subsidies for technology.

#### *4.3.2. Traveler Response*

Additionally, participants in this study responded favourably to the use of technology in mangrove tourism. According to the survey, when technology was incorporated into the reservation system and visit management, 78% of travellers reported feeling better happy with their trip. Visitors value the endeavours of entrepreneurs in educating them about conservation and environmental sustainability initiatives that they can engage in while they are there.

Digitally facilitated educational programs, such mobile applications that offer virtual tours of mangrove habitats and the significance of their preservation, are also much sought after by tourists. This indicates that in addition to enhancing corporate efficiency, technology also helps raise tourists' understanding of environmental issues.

## **5. Discussion**

### *5.1. Implications for Business Resilience*

The findings of this study demonstrate that by implementing product and service diversification and technology integration into business operations, META Innovation Design can boost the resilience of the mangrove tourism industry in East Java. Product diversification can offer new, more reliable, and sustainable revenue streams, particularly through ecotourism and educational tourism initiatives. Technology also contributes significantly to increased management efficacy and efficiency, which helps companies better adjust to shifting market situations.

### *5.2. Positive Impact on Environmental Sustainability*

The sustainability of mangrove ecosystems has been significantly improved by the application of technology in environmental monitoring and conservation initiatives. Businesses and nearby communities can react swiftly to possible risks to the ecosystem with more thorough and real-time monitoring. This demonstrates how technology can be a useful instrument for promoting more responsive and adaptive environmental management.

### *5.3. Challenges in Implementation*

Although the study's findings demonstrate that innovation can be successfully implemented, there are still certain obstacles to overcome, particularly when it comes to small firms' access to technology. To guarantee that all parties have equitable access to these technologies, the study found that governments and other stakeholders must support them. Furthermore, improving business people's technical proficiency is a significant obstacle that must be addressed for this innovation to be generally embraced.

All things considered, this study's findings significantly aid in the creation of a more robust and sustainable mangrove tourism business model in East Java. When multiple stakeholders actively participate, META-based technology has been shown to enhance company performance while promoting environmental conservation initiatives.

## **6. Conclusion**

This study offers important new information about how Innovative Design META (Mangrove Ecosystem Transformation Approach) may be used as a framework to improve the sustainability of mangrove ecosystems in East Java as well as the resilience of mangrove tourism enterprises. According to the findings, the coastal tourist industry can experience sustainable growth through the thoughtful

integration of cutting-edge technology, community involvement, and environmental conservation techniques.

### *6.1. Improving the Resilience of Businesses*

By tackling major issues with shifting consumer demand, inefficient operations, and environmental deterioration, META has been successful in bolstering the resilience of mangrove tourist enterprises. Businesses' ability to expand their product lines, especially through ecotourism and educational initiatives, has helped to stabilize incomes and improve client experiences. Digital tools, like visitor management software and online reservation platforms, have improved operational effectiveness and resource efficiency, which has lessened the burden on mangrove ecosystems during the busiest travel seasons.

Additionally, by enabling businesses to reach new customer segments, engage tourists through interactive and informative platforms, and forge closer ties with local communities, META integration has helped businesses stay competitive in a tourism market that is becoming more and more dynamic. Innovative technology and a comprehensive approach to company operations assist the long-term viability and financial success of mangrove tourist endeavours.

### *6.2. Encouraging the Preservation of Nature*

The META innovation's capacity to encourage and assist environmental preservation is one of its main features. According to the research, technology can be extremely helpful in monitoring and protecting mangrove ecosystems, especially when it comes to stopping environmental damage brought on by human activity and climate change. To identify and address any threats to mangrove ecosystems, such as pollution and illicit logging, real-time environmental monitoring systems, drones, and satellite photography have proven crucial.

Mangrove ecosystem health has also been maintained in large part by the participation of local populations in conservation initiatives, which has been made possible using mobile applications for monitoring and reporting environmental conditions. By working together, conservation activities are guaranteed to be both community-focused and technology-driven, which is consistent with the ideas of sustainable development and local control over environmental preservation.

### *6.3. Innovation in Technology and Involvement with Stakeholders*

The study emphasizes the value of using technology as a tool to promote stakeholder involvement, especially between local communities, government organizations, visitors, and business owners. Businesses may now interact with tourists more effectively by utilizing digital platforms to offer immersive experiences through virtual tours and educational content about mangrove conservation. This increases visitor happiness while also bringing attention to how vital mangrove habitats are to the sustainability of the environment.

The study does, however, also point out that small and medium-sized businesses (SMEs) may find it difficult to fully adopt and profit from new technologies due to a lack of financial and technical resources. It is imperative that government agencies and legislators offer focused assistance, like funding for technology adoption and capacity-building programs, to guarantee that all parties involved can take part in and profit from the digital transformation of the mangrove tourist industry.

### *6.4. Opportunities and Difficulties*

The research's findings are encouraging, but to optimize the META innovation's impact, several issues still need to be resolved. In addition to the requirement for ongoing technical support and training to help firms utilize META's tools efficiently, the study found obstacles pertaining to smaller enterprises' access to and affordability of technology.

The successful implementation of META necessitates coordination with national and regional policies on tourism development and environmental conservation, which has wider policy consequences. To ensure the long-term survival of the META model, local-level activities that involve communities in

conservation efforts and a supporting legislative environment that encourages sustainable tourist practices are essential.

### 6.5. Final Thought

To sum up, the META Innovation Design presents a viable framework for protecting important ecosystems and boosting the resilience of mangrove tourism enterprises. By combining conservation initiatives, community involvement, and technology innovation, META offers a comprehensive approach to tourist management that balances financial objectives with environmental sustainability. But its success hinges on stakeholders' ongoing cooperation, SMEs' access to financial and technical assistance, and the creation of regulations that promote the tourism industry's adoption of sustainable practices. This study establishes the groundwork for future investigation and implementation of creative ways to guarantee the sustainability of beach tourism in East Java and elsewhere.

## 7. Future Research Recommendation

This study adds to our understanding of how tourism, technology, and environmental sustainability interact. Policymakers, travel industry professionals, and scholars who wish to advance sustainable tourism models that can both preserve natural ecosystems and foster economic growth can learn a lot from the findings. Through its effective implementation, META shows how technological innovation may revolutionise traditional tourism practices, making them more robust, adaptive, and ecologically conscious.

It will be crucial to investigate the META model's scalability and evaluate its suitability for use in tourism destinations other than mangrove environments in subsequent studies. Further insights into how sustainable tourism models might change and adapt over time can be gained from longitudinal research, which will also be helpful in assessing the long-term effects of META on environmental health and business success.

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