JMM17 JURNAL ILMU EKONOMI DAN MANAJEMEN
Volume 11 No 02 – September 2024 – ISSN (Online): 2355-7435

Available Online to https://jurnal.untag-sby.ac.id/

JMM17: Jurnal Ilmu Ekonomi dan Manajemen

S3 Accredited SK No. 72/E/KPT/2024

Journal page is avaliable to
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Development of The Mangrove Environmental Sustainability Strategy (Mess) Model as an Integration of Business And Environmental Conservation

Mochammad Arifin[1]; Evi Farsiah Utami[2]; Desita Rizky Amelia Kusumaningtyas[3]*

Department of Design & Creative Industry, Universitas Dinamika, Surabaya, Indonesia,

**email: [a] marifin@dinamika.ac.id*

ARTICLE INFO

Article history:
Received: 24 January 2024
Revised: 30 April 2024
Accepted: 2 September 2024
Available online 2024

Keywords:
Mangrove Tourism;
Environmental Sustainability;
Management Strategy;
Blue-Green Economy;
East Java

IEEE style in citing this article:
Mochammad Arifin, Evi Farsiah Utami, Desita Rizky Amelia Kusumaningtyas(2024) "Development of The Mangrove Environmental Sustainability Strategy (Mess) Model as an Integration of Business And Environmental Conservation" *JMM17: Jurnal Ilmu Ekonomi dan Manajemen*, vol. 11, no. 2, pp. 84-95, 2024.

ABSTRACT

The development of this model is necessary to achieve a balance between business interests and environmental conservation by integrating local business needs with mangrove conservation efforts. This model supports sustainable management, improves the welfare of local communities, and supports the Sustainable Development Goals. This research prioritizes efforts to design a comprehensive and integrated framework for managing mangrove ecosystems. This research design combines quantitative and qualitative approaches. A quantitative approach is used to collect numerical data related to relevant business and environmental aspects. A descriptive approach is used to provide a detailed picture of the existing conditions and dynamics of local business interests as well as environmental conservation efforts in the mangrove areas studied. The results of the research application show that there is a balance between mangrove tourism exploration and environmental sustainability and conservation.

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1. Introduction [Heading of Section]

The background to this research is driven by two main factors. First, mangroves are very important ecosystems ecologically and economically [1], [2]. Mangroves provide habitat for various marine species, protect coastlines from abrasion, and offer valuable resources to local communities [3].

However, mangroves are often the target of over-exploitation and habitat destruction due to human activities such as the tourism industry [4], [5], [6], [7]. Second, there is a conflict between mangrove conservation efforts and local economic needs [8], [9], [10]. While mangrove conservation is important to maintain ecosystem sustainability, many local communities depend on mangroves for their livelihoods [11], [12], [13], [14].

The development of the MESS Model is important because it offers an approach that integrates local business needs with environmental conservation efforts. This model can create a better balance between environmental protection and local economic needs [15]. This framework can identify strategies that enable sustainable mangrove management. Thus, this research is important in efforts to maintain the sustainability of mangroves and support holistic sustainable development.

The research gap in this research is the lack of a comprehensive framework to resolve the conflict between local economic needs and environmental protection in mangrove areas [10], [16], [17], [18]. Although there have been various efforts to manage mangroves sustainably, an integrated approach between local business practices and environmental conservation is still lacking. Most research tends to focus on certain aspects, such as natural resource management, local business development, or conservation efforts, without thoroughly considering how effective integration between all these elements can be achieved. Apart from that, based on data from the Peat and Mangrove Restoration Agency (BRGM), there are 210,000 ha of mangrove ecosystems with less than 70% cover. Most of the mangrove forests in Indonesia have been degraded into ponds and housing.
This figure continued to decline until 2017. Based on the One Indonesian Mangrove Map using the Landsat Satellite Imagery method from the Geospatial Information Agency with a manual interpretation method, the area of mangrove land throughout Indonesia became 3,361,216. In addition, National Geographic Indonesia in 2019 stated that 50% of the mangrove forest area had been destroyed. As a result, the sustainability of mangrove ecosystems is often threatened by unresolvable conflicts of interest between economic development and environmental conservation [15]. This research can fill this gap by developing a comprehensive and integrated model, which enables effective integration between sustainable business practices and mangrove conservation efforts, to achieve a better balance between economic needs and environmental protection in mangrove areas are.

2. State of the Art

This research involves understanding the challenges in mangrove conservation and sustainable management efforts. Several previous studies have identified threats to mangrove ecosystems and tried various ways to manage them. However, there has been no research that fully integrates aspects of business and environmental conservation in one integrated framework as proposed in this research.

The uniqueness of this research lies in how it addresses gaps in mangrove management. This research introduces the MESS Model which is designed to combine sustainable business practices with mangrove conservation efforts. This model aims to create a better balance between local economic interests and environmental protection in mangrove areas. In addition, this research actively involves local stakeholders in the model development and implementation process, thereby ensuring the resulting solutions are relevant and sustainable. Some relevant aspects in the state-of-the-art of this research are shown in Figure 1.

Figure 1 SOTA

Apart from that, the novelty of this research lies in several innovative aspects that have not been widely studied in previous research. In Figure 2 several important points are explained that show the novelty of this research. This research is seen as having the potential to produce several significant novelties in the field of environmental conservation and sustainable business development as shown in Figure 2.

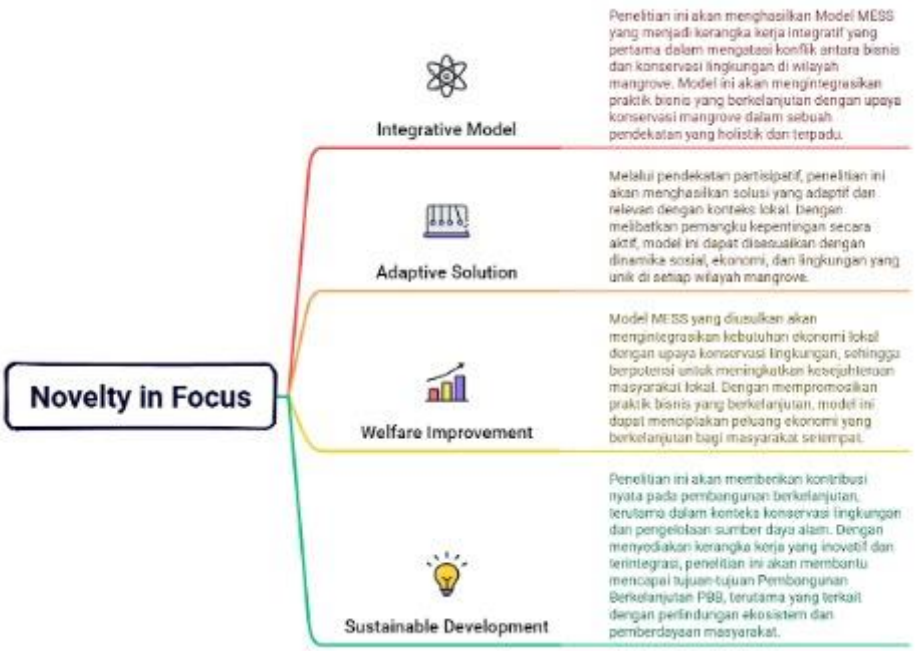

Figure 2 Novelty in Focus

In the context of fundamental theory, this research refers to theoretical frameworks that can be used as a basis, including Contingency Theory, Systems Management Theory, Human Relations Theory, Ecological Conservation Theory, and Participatory Development Theory as guidelines for

compiling methodology, analyzing data, and developing solutions that can be implemented. in the context of mangrove management, as shown in Figure 3.

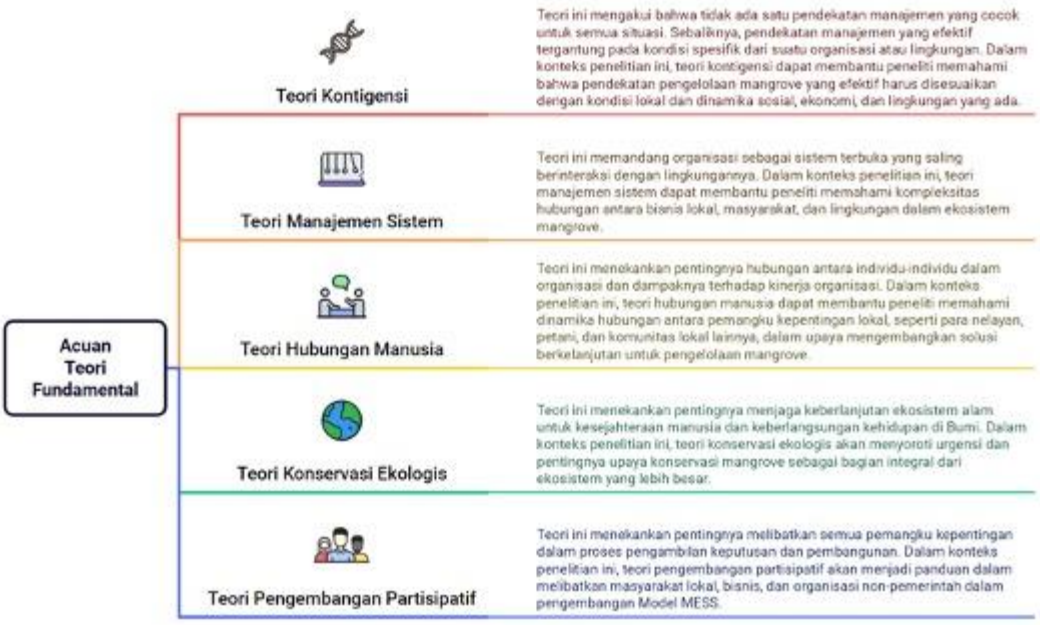

Figure 3 Fundamental Theory Benckmarking

3. Method

This research design combines several methodological approaches to gain a comprehensive understanding of the integration of business and environmental conservation in mangrove ecosystem management. A quantitative approach is used to collect numerical data related to relevant business and environmental aspects, such as production or business income data, as well as biodiversity or mangrove density data. This data is then analyzed statistically to gain a deeper understanding of the relationship between these factors. Furthermore, a descriptive approach was used to provide a detailed description of the existing conditions and dynamics of local business interests as well as environmental conservation efforts in the mangrove areas studied.

This approach involves direct observation and recording of business practices and conservation activities in the field. A phenomenological approach is applied to understand the experiences and perceptions of local stakeholders regarding the relationship between business and environmental conservation around the mangrove ecosystem. This involves in-depth interviews with stakeholders, such as tourism entrepreneurs, local fishermen, pond farmers, or conservation workers, to understand their views, values, and motivations regarding business practices and conservation efforts. Finally, a model development approach was used to design and test the MESS Model as a framework that can be implemented to integrate sustainable business practices with mangrove conservation efforts. This context involves the process of designing models based on findings from data and literature analysis, as well as testing the models to ensure their effectiveness in achieving conservation and sustainable development goals. By combining these various approaches, it is hoped that this research can provide in-depth insight and effective solutions in overcoming the challenges of business integration and environmental conservation in mangrove areas.

3.1 Research Approach and Stages

The main stages in this research consist of the Preparation Stage, Model Development Stage, Model Testing Stage, and ending with the Evaluation and Dissemination Stage as explained in bellow.

In an effort to find solutions to the problems that have been formulated, this research adopts several research paradigm approaches. The paradigm approach in this research refers to 4 approaches which include a quantitative approach, a descriptive approach, a phenomenological approach, and a model development approach described in Figure 6. By integrating these four paradigm approaches, this research is expected to make a significant contribution to the development of strategies holistic and sustainable management of mangrove ecosystems, thereby maintaining a balance between business interests and environmental conservation in the long term.

By adopting various approaches, this research can reveal patterns of relationships between local business practices and environmental conservation efforts in mangrove areas through a quantitative-descriptive approach, enrich understanding of the experiences and values held by local stakeholders through a phenomenological approach, and develop a Mangrove Model Environmental Sustainability Strategy (MESS) is effective in integrating sustainable business practices with mangrove conservation efforts through a model development approach.

The three research approaches used, namely the quantitative-descriptive approach, the phenomenological approach, and the model development approach, have strong relevance in supporting the achievement of the objectives of this research. The quantitative-descriptive approach facilitates the collection of numerical data to analyze the relationship between local business practices and environmental conservation efforts in mangrove areas, while descriptive analysis helps in providing a clear picture of the existing conditions and dynamics of business interests and environmental conservation. A phenomenological approach enriches understanding of the experiences and values of local stakeholders related to business practices and environmental conservation around mangroves, providing in-depth insight into their challenges, hopes and aspirations. Thus, the results of this research provide in-depth insights and holistic solutions to overcome complex challenges in mangrove management, while promoting sustainable development and welfare of local communities.

4. Results and Discussion

4.1. Results

The development of the Mangrove Environmental Sustainability Strategy (MESS) Model was conducted through a series of steps, including qualitative research, expert interviews, and field observations at various mangrove conservation sites. The findings reveal the interrelationship between business activities and environmental conservation, which ultimately shaped the core components of the MESS Model. The model consists of three key pillars:

1. **Business Integration in Conservation Efforts**: The results indicate that integrating sustainable business practices into mangrove conservation leads to positive outcomes for both economic and environmental aspects. Businesses that adopted eco-friendly practices, such as sustainable harvesting of resources, eco-tourism initiatives, and green technologies, contributed to preserving the mangrove ecosystems while maintaining profitability.
2. **Community Engagement and Empowerment**: The model highlights the critical role of local communities in achieving long-term sustainability. The involvement of local stakeholders in decision-making, education, and sustainable practices has enhanced the resilience of mangrove ecosystems and provided economic opportunities through eco-tourism and sustainable resource management.
3. **Environmental Impact Monitoring**: Another significant outcome from the study was the development of an integrated environmental monitoring system. This system utilizes modern technologies like satellite imagery and IoT devices to track environmental health indicators, such as soil salinity, water quality, and biodiversity. The data collected helps inform business strategies and conservation efforts, ensuring adaptive management practices.

4. **Policy and Governance Framework**: Findings also suggest that strong policy frameworks are necessary to support the integration of business and environmental conservation. Government regulations that incentivize sustainable practices and provide financial support to businesses adopting green technologies were found to be essential in fostering the adoption of the MESS model.

Best Practices in Mangrove Management Adopted by Local Communities

Effective mangrove management is essential to ensure the sustainability of the ecosystem and the benefits that can be obtained by local communities. Best practices in mangrove management focus not only on conservation, but also on community empowerment, sustainable use of resources, and improving economic well-being. Here are some best practices that can be adopted by local communities in mangrove management:

1. Mangrove Restoration and Rehabilitation

Local communities can be involved in mangrove restoration and rehabilitation programs to restore ecosystem functions lost due to damage. This can involve planting mangrove seedlings, improving soil quality, and cleaning up polluted areas. This activity not only increases the area of mangrove land but also educates the community about the importance of the existence of mangroves.

2. Sustainable Utilization of Mangrove Resources

Sustainable use practices include the use of mangrove resources such as timber, marine products, and other raw materials without damaging the ecosystem. Communities can develop non-destructive harvesting techniques, such as planned harvesting and the use of non-timber products from mangroves, to support livelihoods while maintaining ecosystem sustainability.

3. Ecotourism Development

Developing mangrove-based ecotourism is an effective way to increase people's income while preserving the environment. The community can develop tourist trails, provide guides, and promote local products. This activity not only provides a new source of income, but also raises awareness about the importance of mangroves among visitors.

4. Community Involvement in Decision-Making

Involving local communities in decision-making processes related to mangrove management is an important practice. By forming a working group or community forum, the community can voice their opinions, identify problems, and contribute to solutions. This creates a sense of ownership and responsibility for the mangrove ecosystem.

5. Education and Counseling

Education and counseling to the community about the importance of mangroves and good management practices are very important. Training programs can be held to increase knowledge about ecosystems, how to maintain and protect mangroves, as well as the economic benefits that can be obtained from good management. This can include the use of environmentally friendly farming or fishing methods.

6. Development of Supportive Local Policies

Communities need to be involved in the development and implementation of local policies that support sustainable mangrove management. This includes advocacy for the protection of mangrove lands from conversion to non-agricultural land, land use permit arrangements, and law enforcement against illegal activities that damage mangrove ecosystems.

7. Collaboration with Research Institutions and NGOs

Collaborating with research institutions and non-governmental organizations (NGOs) can provide technical support and resources for mangrove management. These collaborations can include joint

research, restoration projects, or training programs. Thus, the community can take advantage of broader knowledge and experience in mangrove management.

8. Community-Based Monitoring and Evaluation

Local communities can be involved in monitoring and evaluating the health of mangrove ecosystems on a regular basis. By involving them in data collection, communities not only become part of the management process, but also learn to understand the conditions of their environment. This can be done through training in observation and data recording techniques.

9. Environmentally Friendly Technological Innovation

The community can adopt environmentally friendly technology that supports mangrove management. This includes the use of non-destructive fishing gear, efficient irrigation systems, or environmentally friendly cultivation techniques. This technology can help people increase productivity while maintaining ecosystem sustainability.

10. Development of Economic Incentive Programs

Creating economic incentive programs to encourage local communities to participate in mangrove management is also important. This can be in the form of financial assistance, market access, or business development programs that support local products from mangroves. This incentive can encourage the community to be more active in maintaining and managing their resources.

The best practices in mangrove management that can be adopted by local communities are very diverse and include aspects of conservation, utilization, education, and participation. By adopting these practices, communities can not only maintain the sustainability of mangrove ecosystems but also improve their economic well-being. Active involvement in mangrove management will ensure that the long-term benefits can be enjoyed by future generations, while protecting this invaluable natural resource.

Technological Contribution in Sustainable Mangrove Management

Technology plays an important role in supporting sustainable mangrove management. With technological advances, the management of mangrove ecosystems can be carried out more effectively and efficiently, strengthening conservation efforts, and improving the welfare of local communities. Here are some of the ways in which technology can contribute to sustainable mangrove management:

1. Remote Monitoring and Sensing System

Remote sensing technologies, such as satellite imagery and drones, allow for real-time monitoring of mangrove ecosystems. Using geographic data, researchers and managers can monitor changes occurring in mangrove forests, including deforestation, land change, and other environmental impacts. This information is important for making the right decisions in mangrove management and conservation.

2. Databases and Geographic Information Systems (GIS)

Geographic Information Systems (GIS) enable efficient collection, management, and analysis of mangrove-related data. With an integrated database, managers can access information about ecosystems, land use, and environmental conditions. This allows for better mapping and planning for mangrove restoration and management.

3. Ecosystem Restoration Technology

Technologies in mangrove restoration, such as bioengineering-based recovery techniques and the use of hydroponic systems for planting mangrove seedlings, can increase the success rate of planting. These techniques help in overcoming frequently faced challenges, such as unsuitable soil conditions or high salinity.

4. Innovation in Fishing and Agricultural Practices

The use of environmentally friendly technologies in fisheries and agricultural practices can help local communities utilize mangrove resources without damaging the ecosystem. For example, the selective use of fishing gear can reduce unwanted fishing, while integrated agricultural techniques with mangroves can increase agricultural yields while maintaining ecosystem sustainability.

5. Mobile Applications and Digital Platforms

Mobile applications and digital platforms can be used to raise public awareness about the importance of mangroves as well as educate them on good management practices. This application can also be a tool for reporting violations of the law against mangrove ecosystems, thereby strengthening law enforcement and protection.

6. Modeling and Simulation

Modeling and simulation technology can be used to predict the impact of environmental changes and human activities on mangrove ecosystems. Using computer models, managers can simulate various management scenarios and strategies, making it easier to choose the most effective approach to resource conservation and management.

7. Data Analytics and Big Data

Data analysis and big data technology can help in the collection and processing of big data related to mangroves. With proper analysis, this information can provide deeper insights into behavioral patterns and interactions between environmental, social, and economic factors that affect the sustainability of mangrove ecosystems.

8. Environmental Awareness Campaign Through Social Media

Social media can be used to increase public awareness and participation in mangrove management. Online campaigns can help educate the public about the importance of mangroves, as well as encourage concrete conservation actions. The community can share information, experiences, and successful local initiatives through this platform.

9. Green Infrastructure and Adaptation Technology

The development of green infrastructure that uses mangroves as part of urban design can help in mitigating climate change. Adaptation technologies such as the use of mangroves for coastal protection and flood control can strengthen environmental resilience, while providing economic benefits to the community.

10. Technology-Based Education and Training

Education and training programs that use technology can increase local communities' understanding of mangrove management. For example, using virtual simulations to teach mangrove restoration techniques or online training on natural resource management. In this way, the community will be better prepared to participate in sustainable management activities.

Technology has great potential to improve sustainable mangrove management. With the use of modern monitoring systems, innovative technologies in management practices, and digital platforms for education and advocacy, local communities can be more effective in preserving mangrove ecosystems and improving their well-being. The integration of technology in mangrove management strategies will not only help in conservation, but also create a balance between economic needs and environmental conservation.

4.2. Discussion

The development of the MESS Model underscores the potential for a synergistic approach that combines business interests with environmental conservation. This study provides evidence that businesses do not need to view environmental conservation as a separate or competing goal but rather

as an integrated part of their long-term strategy. By incorporating sustainable practices, businesses can reduce operational costs, enhance their brand image, and meet increasing consumer demand for eco-conscious products and services. The role of the local community is particularly vital. Empowering communities to take an active role in the stewardship of mangrove ecosystems leads to greater engagement and more sustainable management practices. In contrast to traditional conservation models that often exclude local stakeholders, the MESS Model emphasizes the importance of collective action, ensuring that those who directly depend on the mangrove ecosystem for their livelihoods are not only involved in the conservation process but also benefit economically from it.

Mangrove conservation is an important issue that requires active community involvement to achieve success. For this reason, effective communication strategies can play a key role in increasing public awareness and understanding of the importance of mangrove ecosystems. Here is an in-depth explanation of how communication strategies can increase public awareness about mangrove conservation.

1. Conveying Clear and Accurate Information

a. Use of Easy-to-Understand Language

Communication strategies must ensure that information is conveyed in a language that is easy to understand for all groups, including people who do not have a formal educational background. Avoiding technical terms and using concrete examples can help communities better understand issues related to mangroves.

b. Submission of Data and Facts

It is important to provide supporting data and facts about the benefits of mangroves, such as their role in climate change mitigation, coastal protection, and habitat provision for various species. Clear statistical data can provide concrete evidence that strengthens the argument for conservation.

2. Building Awareness Through Educational Campaigns

a. Public Information Campaign

Holding a public information campaign on mangrove conservation can raise awareness. This activity can be in the form of distributing brochures, posters, and educational videos explaining the importance of mangroves. Social media and online platforms can also be leveraged to reach a wider audience.

b. Workshops and Training

Organizing workshops and training for local communities can increase understanding of conservation techniques and sustainable resource management. In this activity, participants can learn directly from experts and interact with other stakeholders.

3. Encouraging Community Participation

a. Involvement in Conservation Activities

Inviting communities to be directly involved in conservation activities, such as mangrove planting, beach cleanup, and ecosystem monitoring, can increase a sense of ownership and responsibility for the environment. This activity also provides an opportunity for the community to learn about the importance of mangroves firsthand.

b. Establishment of Environmental Care Groups

Encouraging the formation of groups or communities that care about the environment can facilitate discussion and collaboration between community members. This group can serve as an agent of change that disseminates information and best practices in mangrove conservation.

4. Using Media and Technology

a. Utilization of Social Media

Social media is a very effective tool to reach the public, especially the younger generation. Through campaigns on platforms such as Instagram, Facebook, and Twitter, information about the importance of mangroves can be disseminated quickly and widely. Engaging in visual content can attract attention and increase awareness.

b. Mobile Application and Website

Developing a mobile app or website that provides information about mangroves, conservation activities, and ways to contribute can also increase community engagement. This digital platform can serve as a useful resource and facilitate access to information.

5. Collaborate with Other Stakeholders

a. Collaboration with Non-Governmental Organizations (NGOs)

Partnering with an NGO with experience in conservation can provide additional support in the implementation of communication campaigns. NGOs often have extensive networks and expertise in community mobilization that can be utilized.

b. Cooperation with the Government and Educational Institutions

Involving governments and educational institutions in conservation campaigns can reinforce the message. Educational programs in schools about mangrove ecosystems and conservation can build awareness from an early age.

6. Evaluation and Feedback

a. Measurement of Communication Effectiveness

After implementing a communication strategy, it is important to evaluate how effective the campaign is in raising public awareness. Surveys, interviews, and group discussions can be used to gather feedback and evaluate the impact produced.

b. Adjusting the Strategy

Based on the results of the evaluation, communication strategies can be adjusted to increase effectiveness in the future. Identifying what works and what needs to be improved can help create a more responsive approach to people's needs.

A good communication strategy is very important to increase public awareness about the importance of mangrove conservation. By conveying clear information, building awareness through educational campaigns, encouraging community participation, utilizing media and technology, and working with stakeholders, communities can be empowered to play an active role in conservation efforts. The impact of an effective communication strategy will be very meaningful for the sustainability of mangrove ecosystems and the well-being of the communities that depend on them.

Incorporating cutting-edge environmental monitoring technologies is another significant contribution of this research. The integration of real-time data collection through satellite imagery and IoT technologies ensures that mangrove ecosystems are monitored accurately and continuously. This enables businesses and conservation managers to make informed decisions and take prompt action when environmental degradation is detected, ensuring the long-term sustainability of both the ecosystem and business operations. The importance of a supportive governance structure cannot be overstated. The study highlights the need for policy reforms that incentivize businesses to adopt sustainable practices, such as tax breaks for eco-friendly initiatives or grants for community-based conservation projects. Such policies are crucial in overcoming financial and operational barriers that businesses face when trying to integrate sustainability into their operations.

However, the model's implementation is not without challenges. Despite the promising results, there is a need for continued advocacy to align all stakeholders, including businesses, local governments, and communities, around a common sustainability agenda. Additionally, scaling the MESS Model

across different regions and industries may require adapting the model to local environmental, social, and economic conditions. In conclusion, the MESS Model offers a promising framework for achieving both business success and environmental sustainability in mangrove conservation. Its integrated approach provides a roadmap for businesses seeking to balance profitability with ecological responsibility, contributing to the overall goal of preserving vital coastal ecosystems for future generations.

5. Conclusions

The development of the Mangrove Environmental Sustainability Strategy (MESS) Model demonstrates the potential for a harmonious integration of business practices with environmental conservation, particularly in the context of mangrove ecosystems. This model provides a comprehensive approach to ensuring that business activities can contribute to the long-term preservation and restoration of these vital ecosystems, while simultaneously promoting economic viability. The research highlights that businesses can successfully adopt sustainable practices, such as eco-tourism, resource management, and the use of green technologies, which not only enhance profitability but also foster environmental conservation. Additionally, the active involvement of local communities in conservation efforts has proven to be crucial in ensuring sustainable outcomes, as it provides both environmental and economic benefits to the people who rely on these ecosystems for their livelihoods. Moreover, the integration of advanced environmental monitoring technologies, such as satellite imagery and IoT devices, has allowed for better tracking of ecosystem health, enabling informed decision-making and adaptive management practices. The role of supportive policy frameworks is also pivotal, as government regulations and incentives for businesses adopting sustainable practices help overcome barriers to environmental stewardship. Ultimately, the MESS Model offers a practical and scalable framework for integrating business goals with environmental conservation, benefiting both the economy and the environment in mangrove conservation areas.

6. Future Research Recommendations

While the MESS Model offers a strong foundation, there are several key areas for future research to enhance its effectiveness and application. First, expanding the model's applicability to other ecosystems, such as coral reefs, wetlands, or forests, would be valuable in understanding whether its principles can be generalized or need to be adapted to different environmental contexts. Second, conducting longitudinal studies that assess both the economic outcomes for businesses and the long-term health of mangrove ecosystems would provide deeper insights into the sustained impact of the MESS Model. In addition, further research into the behavioral and cultural factors influencing community engagement in conservation efforts could offer more tailored strategies for empowering local stakeholders. Another area for exploration is the potential use of emerging technologies, such as artificial intelligence (AI) and blockchain, to enhance environmental monitoring and ensure real-time tracking of sustainable practices. Furthermore, studying innovative policy and governance models that encourage collaboration between businesses, governments, and local communities could provide valuable insights into regulatory frameworks that support sustainable business operations. Finally, research on how to scale the MESS Model to different regions with varying economic, political, and social conditions is crucial for its global application. By addressing these areas, future studies can further refine the MESS Model, making it more adaptable and effective in promoting sustainable business practices and environmental conservation worldwide.

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