

MARINE ECOSYSTEM MANAGEMENT PROGRAM AS AN ECOTOURISM-BASED CLIMATE SOLUTION BY GRIYA BIRU FOUNDATION IN REALIZING SMART ISLANDS THROUGH BLUE ECONOMY & SDG's (CASE STUDY, TELUK PESAWARAN, LAMPUNG)

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Abstract

According to an analysis by the Global Carbon Project Scientific Team, Indonesia ranks as the sixth largest CO₂ emitter globally, with 700 million tons of CO₂ per year, an 18.3% increase over the previous year. The processing industry accounts for 340.71 million tons. According to the Monterey Bay Aquarium Research Institute, climate change triples the threat of marine degradation. Bappenas estimates economic losses of Rp 408 trillion in the coastal and marine sector during 2020-2024. Meanwhile, the ocean absorbs over 90% of excess heat and 25% of CO₂; and contributes IDR 20 trillion to the Indonesian economy. The Ministry of Tourism's 2023 survey shows 64% of Indonesia's tourism is influenced by marine tourism. Griya Biru Foundation is committed to providing solutions through a marine ecosystem management program in Pesawaran Bay, Lampung, where 40% of the area is damaged by climate change. With the Integrated Coastal Zone Management approach, this program optimizes the potential of 150-250 hectares of mangroves, 70-100 hectares of coral reefs, and 30-50 hectares of seagrass beds. The program also introduces pentahelix collaboration to create a smart island with a focus on smart environment, smart living, smart society, and smart government. Early successes include the rehabilitation of 10% of the damaged marine ecosystem and the involvement of 50 people from the Tourism Awareness Group (Pokdarwis) and Family Empowerment and Welfare (PKK) in ecotourism management. This program is expected to become a blue economy-based ecotourism management model that supports SDGs, especially points 8, 13, and 14, as well as being an inspiration for other coastal areas in Indonesia.

Keywords: Marine Ecosystem Management, Climate Change, Ecotourism, Smart Island, and Pesawaran Bay-Lampung.

A. INTRODUCTION

Climate change has become one of the greatest challenges of the 21st century, as the use of fossil fuels and deforestation contribute to significant increases in greenhouse gas emissions each year. According to the Intergovernmental Panel on Climate Change (IPCC), the Earth is projected to experience a temperature rise reaching 1.5°C as early as 2030, sooner than previously anticipated (Kennial Laia, 2021). Consequently, concrete steps are needed to address this warming, including leveraging the role of oceans in absorbing heat from the atmosphere. Marine ecosystem

management, philosophically, represents an effort by the Indonesian people to embody a core national principle, as reflected in the second precept of Pancasila: “just and civilized humanity.” Two indicators within the concept of justice reflect values that can be manifested through human actions in managing marine ecosystems as a climate mitigation effort, while civility is a quality that aids individuals in assessing the right and wrong of their actions.

Despite efforts, emissions continue to rise due to human behavior. According to the Global Carbon Project, Indonesia ranks as the sixth-largest emitter globally, with total emissions reaching 700 million tons of CO₂ annually. This figure represents an 18.3% increase from the previous year (Cindy Mutia Annur, 2023), with the industrial processing sector contributing the largest share at 340.71 million tons (Adi Ahdiat, 2024). As a result, global temperatures continue to rise, threatening the balance of ecosystems and human life on Earth. Rising temperatures also pose a threefold threat to marine ecosystems. According to the Monterey Bay Aquarium Research Institute (MBARI) report (Pörtner et al., 2019), climate change threatens marine ecosystems through six pathways: 1) Sea level rise, currently occurring at twice the rate, reaching 0.42 centimeters per year; 2) Coral bleaching, impacting 60.5% of coral reefs globally (Ahmad Arif, 2024); Indonesia is predicted to lose more than half of its coral areas by 2044 (The Conversation, 2023); 3) Toxic algae (HABs), increasing by 5-10 times, which endangers marine life; 4) Marine habitat loss, with a 2% decline in ocean oxygen over the last 50 years, leading to species loss and fish migration; 5) Ocean acidification, where seawater pH has decreased by 0.1% unit or a 30% increase in acidity, affecting the abundance of marketable fish species; 6) Fisheries, with the FAO predicting a 33% decline in fish stocks by 2050. Currently, 5.08 million Indonesian fishers rely on marine resources for their livelihoods.

From a sociological perspective, coastal communities are among the most impacted by climate change. Research by Climate Central reports that 10.4 million people in Indonesia are at risk of losing their homes due to annual coastal flooding by 2030. This figure is expected to rise by 61% to 16.8 million by 2100 (Aryo Bhawono, 2024). Besides facing reduced income due to climate change, as previously noted, coastal communities are increasingly vulnerable to poverty, exacerbating social inequality. On a legal basis, Indonesia is currently obligated to commit to climate change mitigation through the Paris Agreement, ratified in Law No. 16 of 2016 on the Ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC). The follow-up action from this ratification is through Indonesia's Enhanced NDC (ENDC), with a target of 29% reduced emissions, which increases to 31.89% in the ENDC, while the target with international support rises from 41% to 43.20% (Kementerian Lingkungan Hidup dan Kehutanan Indonesia, 2022). In addition, this aligns with Indonesia's low-carbon development policy, integrated into the roadmap for Sustainable Development Goals (SDGs) by 2030.

Given the challenges mentioned above, innovation and mitigation efforts in climate change in Indonesia are essential and must align with the Sustainable Development Goals (SDGs). Thus, Griya Biru Foundation (GB Foundation) emerges as a solution provider for climate change mitigation through marine ecosystem management based on ecotourism, utilizing technology to realize smart islands through the concept of a blue economy and SDGs. The blue economy concept forms a foundational basis for GB Foundation, promoting marine ecosystem balance and providing sustainable social and economic benefits for coastal communities.

The pilot project is located in Teluk Pesawaran, Lampung Regency. Based on direct survey results, this area has been identified with a vulnerability rate of up to 40% to climate change impacts, such as rising sea levels and marine ecosystem degradation. However, the region has

significant blue carbon potential, with a mangrove area of 150-250 hectares, coral reefs covering 70-100 hectares, and seagrass beds spanning 30-50 hectares. Therefore, sustained protection and utilization actions are needed to maximize this potential as a climate mitigation solution based on ecotourism. GB Foundation's innovation not only creates opportunities in environmental aspects but also opens economic opportunities for the Teluk Pesawaran community. Today, there is growing public awareness of environmental issues, particularly among Generation Z and Millennials. These groups are generally inclined towards activities with social and environmental impacts, making this program in alignment with their lifestyle and supporting the creation of a smart island.

Several previous initiatives or studies tend to focus on creating smart islands with a primary focus on information technology connectivity. In contrast, the distinctive approach of this article emphasizes a more holistic approach—marine ecosystem management as a climate solution based on ecotourism, while also improving the quality of life for coastal communities in Indonesia. This approach includes four elements: smart environment, smart living, smart citizen, and smart governance in utilizing sustainable natural resources. The primary objective of GB Foundation's efforts is to promote smart tourism development in Indonesia and facilitate the transformation of the marine sector into a national strength in addressing climate and economic crises facing coastal communities. Based on this background, the identified issues that form the problem boundaries discussed in this paper are: 1) How can marine ecosystem management as a climate solution based on ecotourism be implemented to realize a smart island through the Blue Economy Concept? 2) What are GB Foundation's strategies in marketing and communication to enhance understanding and engage the public in ecotourism-based conservation of marine ecosystems as a climate solution in Indonesia?

B. RESEARCH METHOD

The method used in implementing this initiative adopts a descriptive-qualitative approach with the Participatory Action Research (PAR) method (Susanto, 2022), applied in a participatory manner to understand the social dynamics and needs of the coastal community of Teluk Pesawaran in marine ecosystem management based on ecotourism for climate solutions. The PAR method focuses on developing community knowledge, positioning them not only as objects of empowerment but also as active subjects in the change process (Afandi, et al., 2023). Additionally, the authors employ the Integrated Coastal Zone Management (ICZM) approach, a comprehensive method that considers environmental, social, and economic sectors within coastal areas (Burbridge D., 1998). This approach aims to foster a sense of ownership and responsibility toward coastal areas as their own. ICZM and the Sustainable Development Goals (SDGs) are integrated through the penta helix concept, involving five key elements: Academia, Business, Government, Community, and Media, in designing interventions for community potential development (Suyanto & Wahyuni, 2020).

For program implementation, the GB Foundation team uses stages that adopt the PRA approach, which include: 1) Engagement (Mamik, 2020), in the initial phase, where the team directly interacts with the community through their daily activities. This phase aims to build trust and closeness with them while gathering information as a basis for further discussions with the community; 2) Assessment (Afrizal, 2019), in this phase, the team acts as facilitators in group discussions with the community. Based on observations, the community actively identifies potential, problems, and empowerment needs in their area; 3) Planning, the team collaborates with

the community to develop suitable empowerment programs and plan appropriate actions to address the issues. At this stage, the GB Foundation team assists the community in identifying key cadres who will coordinate the program's implementation; 4) Intervention, the intervention phase becomes the final stage in community assistance to design an appropriate conservation program based on empowerment. The facilitator team provides training to the community on drafting activity plan proposals and presenting them to village officials. This stage aims to equip the community to independently continue the program after facilitators are no longer accompanying them. The analysis of this implementation is expected to provide insights into the effectiveness and challenges of blue economy-based coastal ecosystem management in Teluk Pesawaran and to produce an optimal strategy model that can be applied in other coastal areas in Indonesia.

C. FINDINGS AND DISCUSSION

1. Marine Ecosystem Management Program as a Climate Solution through Ecotourism to Realize a Smart Island Based on the Blue Economy Concept in Teluk Pesawaran, Lampung

a. Location

Our program operates in Teluk Pesawaran, Lampung Regency, specifically in Teluk Pandan and Marga Punduh districts. While vulnerable to climate change impacts like landslides, floods, and tsunamis, the region's mangrove, coral reef, and seagrass ecosystems hold great potential for blue economy development. These ecosystems contribute to blue carbon for climate mitigation and support marine ecotourism, creating jobs and boosting incomes. GB Foundation's program aligns with Pesawaran Regency's Climate Village Program (Proklim), regulated by the Ministry of Environment and Forestry (KLHK) under Regulation No. P.84/MENLHK-SETJEN/KUM.1/11/2016., aiming to enhance environmental resilience and community welfare through collaborative efforts.

b. Marine Ecosystem Management Program as a Climate Solution through Ecotourism in Realizing a Smart Island via the Blue Economy Concept & SDGs

The Sustainable Development Goals (SDGs) represent a crucial global commitment, with special emphasis on marine ecosystems, given that oceans cover the majority of the Earth's surface (Zhang, 2024). This focus on SDG-related issues has led to greater attention toward the blue economy concept (Qi, 2022). The blue economy was first introduced by Gunter Pauli in the 2000s, who defined it as the efficient and sustainable use of marine resources to address global environmental and economic challenges, such as climate change and poverty. In Indonesia, a Blue Economy Roadmap was designed by BAPPENAS in 2023 with a vision extending to 2040, aiming to optimize marine potential to support national economic growth, protect the environment, and enhance the welfare of coastal communities—objectives that align with the SDGs.

GB Foundation supports three specific SDG goals that are in line with Indonesia's blue economy roadmap. First, Goal 8 involves developing the blue economy through coastal tourism as a climate solution, creating jobs to improve the welfare of coastal communities in Teluk Pesawaran. Second, Goal 13, strengthens resource management in Teluk Pesawaran through blue carbon initiatives that support decarbonization, aiding Indonesia in reaching its net-zero emissions target. Third, Goal 14, seeks to protect Teluk Pesawaran's marine ecosystems from climate change impacts. Through these three goals, the GB Foundation aims to build a resilient and sustainable coastal environment as a concrete step

toward creating a "smart island," thereby preserving marine ecosystems, mitigating climate change, and enhancing coastal community welfare.

The term smart island generally refers to technology and island environments. However, no specific framework currently defines smart island, suggesting that conceptualizing it should not be limited solely to information and communication technology but also address community needs (Costa & Yun, 2018). Within this framework, a smart island is viewed as an ideal scale for policy innovation, combining the blue economy with smart technologies that enhance marine ecosystem management and blue carbon absorption for climate mitigation. Thus, a smart island can be defined as a region emphasizing democratized digital marine systems, employing technologies like artificial intelligence (AI), the Internet of Things (IoT), and data analytics for monitoring and managing marine ecosystems.

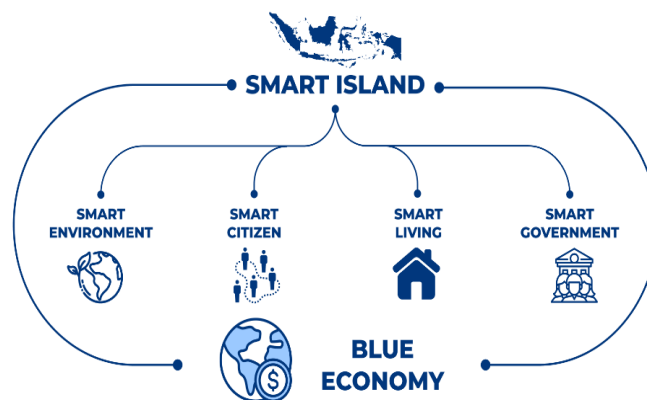


Figure 1. Concept Smart Island by Griya Biru Foundation

Source: Author

Figure 1 shows that the concept of a smart island based on the principles of the blue economy. Key indicators for realizing a smart island involve four essential components, detailed as follows:

(1) Smart Environment

A smart environment is a key component of the smart island concept, emphasizing the effective, responsible, and sustainable management of marine ecosystems. The implementation indicators for a smart environment at sea generally refer to management principles based on technology and sustainability. In this context, GB Foundation implements these principles through several steps, including the use of technology for marine conservation, the application of blue carbon solutions, and the enhancement of climate solutions-based ecotourism capacity. This approach is driven by the potential of the coastal communities in Teluk Pesawaran, which possess vast marine ecosystems, including 150-250 hectares of mangroves, 70-100 hectares of coral reefs, and 30-50 hectares of seagrass beds. Research shows that mangrove ecosystems can store carbon below the soil surface, up to 1,000 tons per hectare.

Seagrass meadows can absorb about 83,000 metric tons of carbon per square kilometer annually. Meanwhile, coral reefs protect mangrove and seagrass habitats

from large waves and erosion, thus enabling these ecosystems to store carbon more effectively. The high potential for blue carbon in these ecosystems needs to be preserved through ecotourism education about the benefits of mangroves, seagrass, and coral reefs in climate mitigation efforts. This will help raise awareness and encourage community participation in maintaining these ecosystems. The existence of these various ecosystem elements also presents opportunities for carbon credit schemes as nature-based solutions (NBS), which can support the global achievement of Net Zero Emissions.

(2) Smart Citizen

Smart Citizen is an approach that positions human resources as a key element in determining a nation's 'intelligence'. The concept of smart citizens plays a crucial role in educating individuals to proactively take responsibility for the progress of society, particularly in the context of marine conservation. Three main indicators of community engagement, especially from the general public, are: 1) Increased democratic participation in environment-based policies; 2) Enhanced public understanding of ethics in marine ecosystem management; and 3) Achieving mutual agreements that involve communities directly affected (Sovacool, 2014).

Smart citizens have a vital role in raising awareness and engaging the public. GB Foundation utilizes social media for environmental campaigns aimed at educating the broader public and encouraging active participation in environmental preservation efforts. Additionally, GB Foundation collaborates with local media and environmental influencers to spread information on marine conservation, especially targeting the youth. A digital feedback system is also being developed to allow the public to provide input on the condition of marine ecosystems. These efforts demonstrate GB Foundation's commitment to creating ecotourism as a climate solution supported by technology and digital literacy, enabling communities to play an active role in creating a healthy and sustainable ecosystem.

(3) Smart Living

Smart Living is a dimension of the smart island concept that ensures the livability of society by achieving harmony in environmental governance, facilities, and services to meet the needs of the community. Smart Living in coastal and marine areas aims to improve public access to healthy and sustainable marine resources. The smart living concept applied by the GB Foundation focuses on local skill development and economic empowerment through training and community development. The Sustainable Ecotourism Development Model is structured around four main pillars: environmental preservation, cultural preservation, attraction enrichment, participation-based education, community solidarity, and local economic empowerment.

GB Foundation's efforts include training in ecotourism skills, such as tour guiding, homestay management, and crafting based on marine ecosystems. These training programs aim to increase community income and reduce dependency on the over-exploitation of marine resources. To expand the economic benefits, the GB Foundation also partners with local SMEs to develop marine-based products such as souvenirs made from shells and mangrove materials. Through these initiatives, GB Foundation

not only creates local economic opportunities but also promotes inclusive and sustainable economic growth in the Teluk Pesawaran area.

(4) Smart Government

Smart Government refers to the extensive use of technology by the government to carry out its administrative duties. On the other hand, smart government also involves the intelligent transformation of governance by incorporating public participation, transparency, and service improvements. Smart government is closely linked to community involvement, as such engagement represents a form of democracy where citizens become part of the policymaking process related to their community's development (Mellouli et al., 2014). According to (Herr, 2012), structured policies for the protection of coastal habitats can reduce pressure on ecosystems and assist in climate change mitigation efforts. Countries that effectively implement policies to protect blue carbon ecosystems can enhance their environmental resilience against climate change and create long-term benefits for their communities.

Governments can support blue carbon conservation through participation in carbon credit schemes. Collaboration with international organizations allows governments to develop programs that engage local communities in the rehabilitation and conservation of coastal ecosystems. This approach often takes the form of empowerment programs, where the government provides training, resources, or incentives for communities involved in conservation activities. Such programs are crucial for the sustainability of projects, as local communities are directly involved and impacted by the health and sustainability of coastal ecosystems (Alongi, n.d.).

2. Marketing and Communication Strategy by Griya Biru Foundation to Enhance Community Understanding and Engagement in Marine Ecosystem Conservation-Based Ecotourism as a Climate Solution in Indonesia

Currently, public awareness of the importance of the environment is increasing, yet the understanding of the role of marine ecosystems as climate mitigation remains limited. In response to this, and to support the success of programs that rely on public participation as contributors, GB Foundation implements a marketing strategy consisting of Top of the Funnel (ToFU), Middle of the Funnel (MoFu), and Bottom of the Funnel (BoFu), (Kingsuk, n.d.) through both digital and conventional media. This strategy can assist GB Foundation in identifying and maintaining prospects (inbound) from the public who have awareness and interest in contributing to the Foundation's programs, as explained by the following three stages:

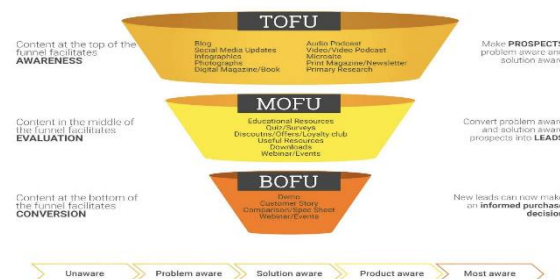


Figure 2. Steps of TOFU, MOFU, BOFU

Source: Ratri, 2021

Figure 2 shows the steps of the Top of the Funnel (ToFu), Middle of the Funnel (MoFu), and Bottom of the Funnel (BoFu) approaches. The explanations for ToFu, MoFu, and BoFu are as follows.

a. ToFu (Top of the Funnel)

In the first stage, the target audience is still very broad, and they have not yet committed or shown interest in the programs of the GB Foundation. Therefore, the ToFu stage will focus on raising awareness and generating interest among the audience, encouraging them to explore further information about the GB Foundation's programs through two strategic approaches. First, the conventional approach will involve strategies such as distributing posters/flyers, establishing collaborations with stakeholders, particularly the government, to plan steps for disseminating program information across various village points, and organizing seminars and training sessions for the local community to increase understanding and awareness of marine ecosystem management as a climate solution through eco-tourism.

Second, the use of digital media will encompass designing, creating, and uploading soft-selling content that promotes the concept of smart tourism through eco-tourism based on the conservation or rehabilitation of blue carbon ecosystems and other relevant issues. Social media will be utilized to present informative and engaging content to raise awareness and encourage public participation. Meanwhile, on the website, Griya Biru Foundation will publish articles that will also be distributed through various mass media, while prioritizing the optimization of Search Engine Optimization (SEO) to effectively reach a broader audience.

b. MoFu (Middle of the Funnel)

At this stage, the audience is more specific and aware of GB Foundation's programs as relevant solutions. Efforts shift toward deepening understanding and fostering stronger interest. Conventional approaches include direct community interaction via door-to-door outreach, program socialization, and collaboration with government bodies during seminars and workshops. Digital efforts focus on hard-selling strategies, presenting detailed program content, including objectives, benefits, implementation schemes, and registration processes. Additionally, the Foundation will develop a digital community under the #PeduliLaut campaign to enhance program promotion and build a supportive network for participants.

c. BoFu (Bottom of the Funnel)

In the final stage, the audience is prepared to make a definitive decision regarding participation in GB Foundation's programs. The strategy involves direct engagement through follow-up efforts, such as door-to-door outreach and interactive booths set up in strategic locations near program areas. Digital strategies include inbound and outbound support via WhatsApp, enabling efficient communication and closing processes. These efforts aim to ensure participant commitment and foster long-term engagement.

D. CONCLUSION

Based on the explanation above, it can be concluded that the protection and management of marine ecosystems as a climate solution through eco-tourism, which will be implemented by GB Foundation in the Pesawaran Bay, Lampung Regency, has the potential to realize a sustainable

smart island. This effort aligns with the concept of Blue Economy and the SDGs, particularly goals 8, 13, and 14, as it provides benefits from environmental, social, and economic perspectives for coastal communities, the broader public, and the country. This finding not only offers practical solutions but also uses a collaborative approach involving the Penta Helix framework, integrated with the four elements of a smart island: Smart Environment, Smart Living, Smart Citizen, and Smart Government. This synergy can create a holistic model that not only supports marine environmental preservation but also improves the quality of life for coastal communities, raises awareness and active participation among citizens, and encourages more responsive government support to create a smart island model that is adaptive to climate change.

Through marketing and communication strategies such as ToFu, MoFu, and BoFu, GB Foundation will be able to enhance public understanding and engagement in eco-tourism based on the conservation of marine ecosystems as a climate solution, supported by digital platforms to maximize outreach. Various programs by GB Foundation will not succeed unless further development and strong policies, through regulations and synergy among all stakeholders, are in place to ensure the sustainability of this transformative effort.

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