

Green Economy Development: A Study on the Bibit Indah and Mangrove Center (BISMA) Program

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ABSTRACT

The green economy provides a strategic approach to integrating economic development, environmental conservation, and community welfare in coastal areas.

This study aims to examine how the BISMA Program (Bibit Indah and Mangrove Center) utilization in Nelayan Indah Sub-district. Using a qualitative case study approach, data were collected through in-depth interviews, field observations, and documentation, and analyzed using an interactive qualitative analysis model. The findings show that the program integrates mangrove conservation with community-based economic development through capacity building, livelihood diversification, and institutional strengthening. The Mawar Lestari Group experienced a 44.32% increase in average income, equivalent to Rp776,471 per member, alongside strengthened livelihood diversification and awareness of mangrove conservation. The program also contributed to stronger community institutions supporting local conservation and economic activities. These findings indicate that mangrove-based community development can support the transition toward a green economy by connecting ecosystem conservation, livelihood improvement, and community empowerment within corporate social responsibility initiatives.

Keywords: Coastal Development; Community Empowerment; Green Economy; Green Entrepreneurship; Mangrove Center

JEL Classification: Q01; Q56; Q57

INTRODUCTION

The mangrove ecosystem plays a highly crucial role in maintaining environmental sustainability while driving the economic development of coastal areas. Ecologically, mangrove forests provide essential ecosystem services, such as carbon sequestration, coastal protection from erosion and storms, provision of biodiversity habitats, and enhancement of fisheries productivity. This multi-dimensional contribution is closely aligned with the achievement of several Sustainable Development Goals (SDGs), particularly SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land) (Eyzaguirre et al., 2023; Nihan et al., 2025). Alongside its ecological functions, mangroves also hold significant economic potential through the development of ecotourism, sustainable aquaculture practices, and the utilization of high-value economic derivative products such as foodstuff, medicines, and biofuels (Hossain et al., 2025; Izudin et al., 2025; Purwanti et al., 2020; Simarmata et al., 2023; Suswadi et al., 2023).

In Indonesia, the mangrove ecosystem is increasingly recognized as a strategic asset in the implementation of the green economy. The government, along with various stakeholders, has launched a variety of initiatives, including community-based mangrove management, carbon trading or credit systems, and ecotourism zoning to align economic growth with ecological sustainability (Arfan et al., 2024; Fatimatuazzahroh et al., 2018; Purwanto et al., 2026). Various economic valuation studies also prove that the monetary value of environmental services provided by mangrove forests, whether in absorbing emissions, preserving biodiversity, or supporting fishermen's livelihoods, is exceptionally high, thus being considered capable of providing a tangible contribution to the national green economy strategy roadmap (Ramadona et al., 2022; Sribianti, 2021).

However, despite the abundant economic and ecological potential, the realization of green economy development through mangrove derivative programs still faces several fundamental barriers on the ground. The first barrier is rooted in knowledge and data gaps, where comprehensive standardization of methods and indicators to evaluate the socio-ecological dimensions of mangroves in relation to achieving SDG targets remains limited (Eyzaguirre et al., 2023). Furthermore, empirical studies regarding the long-term economic impacts of mangrove cultivation derivative programs, such as specific aquaculture schemes and the effectiveness of ecotourism investments, are also highly limited (Barbier & Cox, 2003; Sumarmi et al., 2022). This condition is exacerbated by governance and institutional challenges, where current mangrove management practices often operate partially and lack multi-stakeholder or cross-sector collaboration, ultimately triggering program inefficiencies and conflicts of interest on the ground (Purwanti et al., 2020; Wahyudi et al., 2014). The weakness of local institutional frameworks and the limited institutional capacity of coastal communities also serve as major barriers to sustainable economic utilization (Wahyudi et al., 2014).

In addition to governance issues, significant economic and social barriers exist. Many mangrove investment-based programs fail to transform into tangible improvements in community welfare due to the low financial literacy of local communities and utilization patterns that remain traditional and subsistence-oriented. Furthermore, the downstreaming of mangrove derivative products, such as processed food and biofuels, has not been optimally developed due to limited supporting infrastructure, low mastery of processing technology, and minimal market access. These socio-economic gaps are further compounded by ongoing environmental threats. Physically, the mangrove ecosystem continues to face intense pressure from land conversion for industrialization, non-environmentally friendly intensive aquaculture, and agricultural expansion that triggers deforestation and habitat degradation (Hagger et al., 2022). Ironically, restoration and rehabilitation projects that have been carried out often remain

fragmentary and lack an integrated strategic direction to mitigate threats sustainably (Goenadhi, 2022; Hossain et al., 2025; Kurniawan et al., 2022; Siddiq et al., 2019).

Although various studies have shown that mangrove conservation can improve environmental quality and support the livelihoods of coastal communities, most studies still focus on ecological restoration or community participation separately. Research on mangrove utilization as an economic instrument generally emphasizes product development or ecotourism without examining its relationship with local institutional strengthening and program sustainability. Thus, research explaining how CSR-based programs can simultaneously integrate mangrove conservation, green economy development, community institutional strengthening, and livelihood diversification within a unified empowerment framework remains limited. Therefore, this study attempts to fill this gap by analyzing the BISMA program as a mangrove-based CSR model that integrates ecosystem conservation, green economy development, local institutional strengthening, and coastal community livelihood diversification within a sustainable empowerment framework.

Against these gaps, the BISMA Program (Bibit Indah and Mangrove Center) provides an empirical context for examining how mangrove conservation can be integrated with community-based green economy development through a CSR intervention. Implemented in Nelayan Indah Sub-district, the program combines mangrove ecosystem conservation, environment-based livelihood development, and community capacity building. Accordingly, this study aims to examine how green economy development is implemented through the BISMA Program and how its implementation contributes to economic, environmental, and community-level outcomes. The significance of this study lies in demonstrating how mangrove-based CSR initiatives can move beyond conventional conservation and welfare-oriented interventions by connecting ecological protection with economic value creation and livelihood diversification. The study further contributes to the literature by examining these dimensions within an integrated community empowerment framework, particularly through the development of mangrove-based economic activities that seek to create livelihood opportunities while maintaining ecosystem sustainability. In doing so, this study provides empirical evidence on how community-level CSR interventions can connect environmental conservation, economic development, and local institutional strengthening, thereby illustrating the potential of mangrove-based initiatives to operationalize green economy principles in coastal communities.

LITERATURE REVIEW

Green Economy Development

The green economy is a progressive framework that aims to achieve stable economic growth without compromising environmental sustainability and social welfare (Devi et al., 2025; Zhao, 2021). Unlike conventional economic models, this concept places a specific emphasis on improving energy efficiency, protecting the environment, and fostering harmonious development to address global ecological challenges, such as extreme climate change and natural resource depletion. The core principles of green economy development involve a structural transition toward a low-carbon economy, the utilization and promotion of renewable energy, and the adoption of circular economy practices that minimize waste.

In its implementation, green economy development directly integrates ecological values into economic calculation systems, reflecting the significance of natural assets and ecosystem services (Magazzino et al., 2025). This process demands a transformation of

traditional exploitative industrialization models into sustainable ones through the adoption of green technology, the optimization of green finance, and the implementation of various policies responsive to environmental preservation. As a macro example, the European Green Deal initiative represents a large-scale investment in sustainable infrastructure targeting the achievement of net-zero emissions by 2050 (Spilnichenko et al., 2023).

Furthermore, the green economy strategy focuses on strategic productive sectors such as agriculture, green manufacturing, sustainable tourism, and renewable energy, which simultaneously contribute to the creation of green jobs while enhancing the skills of the local workforce (Maclean et al., 2018). In the modern era, this transformation process is heavily supported by digitalization technologies, which play an important role in increasing transparency, real-time environmental monitoring, and ecological risk assessment. Although offering numerous new growth opportunities, the transition toward a green economy still faces severe challenges, including high initial investment costs, gaps in regulatory or supporting policies, and social disparities among coastal or inland communities.

Mangrove Cultivation Derivative Programs

Derivative programs in mangrove cultivation hold a highly strategic value for coastal ecosystem recovery, global climate change mitigation, and local community empowerment (Barnuevo et al., 2017; Padhy et al., 2022; Salminah et al., 2020). Ecologically, mangrove forest areas provide extraordinarily vast ecosystem services, encompassing carbon sequestration capabilities, biodiversity conservation, and the provision of a natural buffer against coastal erosion and sea waves. To address the increasingly massive degradation of mangrove forests caused by destructive human activities and climate change, various recovery schemes such as rehabilitation projects, silvofishery (wamina) methods, and community-based management approaches have been widely implemented in various coastal areas (Suswadi et al., 2023).

Community-managed mangrove cultivation programs have proven effective in increasing the active participation of local communities, fostering ecological awareness, and channeling tangible economic benefits through the development of the ecotourism sector and the responsible utilization of natural resources (Fatimatuazzahroh et al., 2018). As a concrete example in Indonesia, the success of the mangrove cultivation program in the Karangsong area, Indramayu, successfully transformed an area severely affected by abrasion into an independent ecotourism center, thereby proving a real synergy between economic profit and environmental preservation. Another example is found in the mangrove work program in East Kalimantan, which focuses on carbon emission reduction and sustainable forestry management, although in practice it still faces challenges related to community group acceptance and land compensation schemes.

Despite recording numerous successes, the sustainability of mangrove derivative programs is still overshadowed by various technical and social constraints, such as water salinity management, limited human and financial resources, and the need for stronger local regulations (Padhy et al., 2022). Therefore, the formulation of integrative strategies encompassing ecotourism development, community capacity empowerment, and climate change adaptation is highly recommended to ensure the long-term success of mangrove cultivation programs.

Conceptual Link between Green Economy and Mangrove Cultivation Derivative Programs

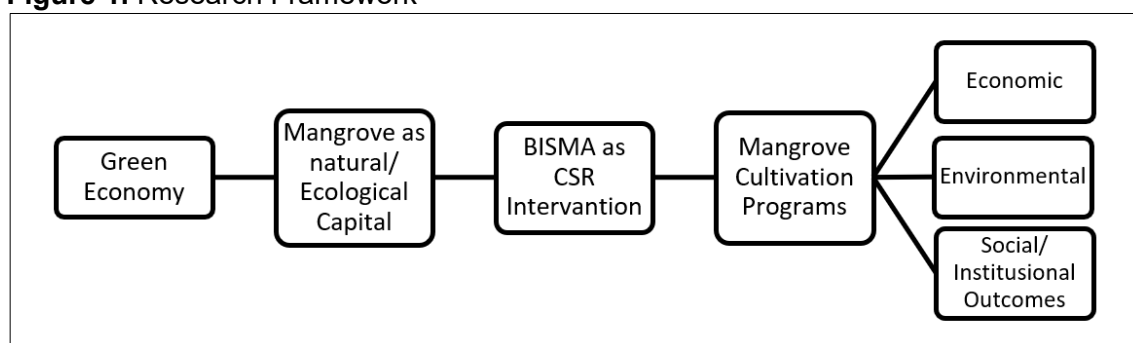
The relationship between green economy development and mangrove cultivation derivative programs can be understood through the principle of creating economic value

while maintaining the ecological functions of natural resources. From a green economy perspective, natural ecosystems are not merely conservation objects but also productive assets that can support sustainable livelihoods when utilized within ecological limits. Accordingly, mangrove-based economic activities can operationalize green economy principles at the community level by generating economic value, diversifying livelihoods, and strengthening incentives for ecosystem conservation. Activities such as mangrove-based product development, sustainable aquaculture, and other environment-based livelihood activities therefore represent potential mechanisms for connecting ecological conservation with local economic development.

In this study, the BISMA Program is positioned as an empirical representation of this relationship. The program integrates mangrove conservation with community capacity building and the development of mangrove-based economic activities through interventions such as training, mentoring, productive facilities, market support, and institutional strengthening. These interventions are expected to contribute to three interconnected dimensions of community outcomes: environmental sustainability, reflected in conservation awareness and practices; economic improvement, reflected in income generation and livelihood diversification; and social and institutional strengthening, reflected in community capacity, collective action, and local institutional development. This conceptual relationship provides the basis for examining whether and how the BISMA Program translates green economy principles into community-level livelihood and sustainability outcomes.

Conceptual Framework

Figure 1. Research Framework



As illustrated in Figure 1, the framework proposes that these interventions facilitate the development of mangrove-based livelihood activities while maintaining the ecological functions of the mangrove ecosystem. The expected outcomes are therefore multidimensional, comprising environmental outcomes, such as increased conservation awareness and practices; economic outcomes, including income generation and livelihood diversification; and social and institutional outcomes, including strengthened community capacity, collective action, and local institutional arrangements. The framework does not assume that these outcomes occur automatically; rather, it provides an analytical basis for examining how the BISMA intervention connects mangrove conservation with economic and community development. The main argument of this study is that a mangrove-based CSR program can contribute to green economy development when ecological conservation is integrated with livelihood opportunities and supported by community capacity and local institutional arrangements.

RESEARCH METHOD

Research Approach

This study employed a qualitative case study approach to examine the implementation and community outcomes of the BISMA Program. A qualitative approach was selected because the study sought to understand the experiences, perspectives, interactions, and institutional processes underlying the implementation of the program. The case study design enabled an in-depth examination of BISMA within its real-life community and institutional context, particularly in relation to mangrove conservation, green economy development, and community livelihood diversification. The study was conducted in Nelayan Indah Sub-district, where the BISMA Program was implemented, with field data collected from April to June 2026.

Sampling Method and Key Informants

Informants were selected using purposive sampling based on their direct involvement in, knowledge of, or institutional relevance to the BISMA Program. The study involved seven key informants, with one informant representing each relevant stakeholder category. These included one representative of the BISMA operating group, one member of the Mawar Lestari Group, one representative of the PaNesir Group, one sub-district government official, one representative of Human Initiative, one representative of Yayasan Nuansa Alam Indonesia, and one representative of the relevant government agency. These informants were selected to capture complementary perspectives from program implementers, community beneficiaries, supporting organizations, and government institutions involved in or knowledgeable about the program. Data collection continued until information saturation was reached, indicated by the point at which successive interviews and cross-checking with other data sources no longer generated substantially new themes or information relevant to the research questions. The profiles of the key informants are presented in Table 1.

Table 1. Profile of Key Informants

No.	Stakeholder / Supported Group	Number of Informants	Rationale for Informant Selection
1	BISMA Operating Group	1 / 11	Selected because the informant has direct knowledge of the management and implementation of the BISMA Program, including its planning, implementation, monitoring, and evaluation processes. The informant provides information on program objectives, activities, coordination, and the development of program interventions.
2	Mawar Lestari Group	1 / 12	Selected as a representative of the main community beneficiary group involved in mangrove-based economic activities. The informant has knowledge of the program from the community perspective, including participation in planning, implementation of livelihood activities, monitoring of group activities, and assessment of program outcomes.
3	PaNesir Group	1 / 13	Selected to provide a complementary community perspective on the implementation of BISMA and its environment-based activities. The informant has knowledge of community participation and program processes, including implementation, monitoring, and evaluation of activities involving the group.
4	Nelayan Indah Sub-	1 / 14	Selected because of the institution's role in supporting and coordinating community development and environmental activities at the local level. The

	district Government		informant has knowledge of the program's planning, implementation, coordination, monitoring, and evaluation, as well as its relationship with local institutional arrangements.
5	Human Initiative	1 / 15	Selected as a supporting organization involved in community development activities. The informant provides an external stakeholder perspective and has knowledge of the program's planning and implementation processes, community capacity building, monitoring, and evaluation of activities supported by the organization.
6	Yayasan Nuansa Alam Indonesia	1 / 16	Selected because of its involvement and knowledge in environmental and community development activities related to the program. The informant provides a complementary perspective on mangrove conservation, community engagement, implementation, monitoring, and evaluation of environmental interventions.
7	Relevant Government Agency	1 / 17	Selected to represent the government institutional perspective on environmental management and community development. The informant has relevant knowledge of the program and its alignment with local environmental policies, as well as its planning, implementation, monitoring, and evaluation from an institutional perspective.
Total		7	

Data Collection Method

Data were collected through three complementary techniques: in-depth interviews, field observations, and document analysis. In-depth interviews were conducted with selected informants to explore their experiences, perceptions, and assessments of BISMA implementation and outcomes. Field observations were used to examine community activities, mangrove-related practices, and the implementation of program interventions in their actual context. Documentary data included program development records and relevant archives covering the 2022–2025 implementation period. The combination of these techniques enabled the researcher to examine the program from multiple sources and perspectives.

Data Validity

The credibility of the findings was strengthened through source triangulation, whereby information obtained from one informant was compared and cross-checked with information from other informants and documentary or observational sources. This process was used to identify consistencies and discrepancies across sources and to strengthen the interpretation of findings. Triangulation was particularly important for validating claims concerning program implementation, community participation, economic outcomes, and institutional changes.

Data Analysis Method

The data were analyzed using the interactive qualitative analysis model of [Miles and Huberman \(1994\)](#). The analysis involved four interconnected processes: data collection, data reduction, data display, and conclusion drawing/verification. During data reduction, interview transcripts, observation notes, and documentary materials were organized and focused according to issues relevant to the research questions. The reduced data were then displayed in structured narratives and thematic categories to identify patterns and

relationships among program interventions, community processes, and outcomes. Conclusions were subsequently developed and continuously verified by comparing emerging interpretations across data sources (Miles & Huberman, 1994).

RESULTS

Existing Regional Conditions and Rationalization of the BISMA Program

The implementation of the BISMA - Corporate Social Responsibility (CSR) Program by PT Pertamina Patra Niaga Fuel Terminal Medan is deeply rooted in the ecological emergency and socio-economic vulnerability occurring in Lingkungan VII, Nelayan Indah Sub-district, Medan Labuhan District. This coastal area has experienced significant environmental degradation due to mangrove deforestation and land conversion, which subsequently triggered severe coastal erosion and destroyed the natural defense barrier of the mainland. On the other hand, the majority of the local community works as fishermen who are highly dependent on weather conditions. This unpredictability of marine catches creates erratic income patterns and places family economies in a vulnerable state. This imbalance between natural exploitation and conservation efforts underlies the birth of the BISMA Program, with the strategic goals of restoring the quality of the coastal environment through active mangrove conservation, driving environment-based economic independence, and increasing local community awareness, capacity, and preservation skills.

The causal relationship between regional issues and the program's objectives demonstrates an ideal integration with the concept of green economic development. Through systematized mangrove cultivation management, the BISMA Program has successfully transformed ecological challenges into new, sustainable economic assets without damaging nature. This synergy is realized through the active involvement of residents in producing mangrove seedlings independently and the development of the Mangrove Center as a hub for skills training, derivative product innovation, and pioneering ecotourism. The research results show that this CSR intervention does not merely focus on physical ecological restoration, but simultaneously creates green jobs and transforms the traditional subsistence patterns of fishermen into a coastal community that is independent, competitive, and resilient to climate change.

Implementation of Green Economy Development through the BISMA Program in Nelayan Indah Sub-district

The implementation of green economy development through the BISMA Program in Nelayan Indah Sub-district is carried out through a phased approach that is systematically structured in chronological order. In the initial phase in 2022, investment was focused on laying the ecological foundation and introducing environment-friendly economic alternatives. The realization of activities centered on the rehabilitation of the coastal ecosystem through intensive mangrove planting and maintenance to restore damage caused by abrasion and to recover the declining vegetation cover. Along with this physical restoration, the green economy pillar began to be introduced through sustainable fisheries training, particularly in fish breeding. This initial step aimed to equip the community with environment-friendly cultivation skills, thereby enabling them to create adaptive new sources of income without exploiting or damaging the coastal ecosystem being rehabilitated. During this year, a total of 1,000 mangrove seedlings were recorded as planted.

Entering 2023, the BISMA program escalated its focus toward strengthening local institutional capacity and economic independence through the Mawar Lestari Group. In this phase, interventions were no longer merely centered on physical planting, but on increasing the value added of coastal natural wealth through skills training in making

locally processed products. To ensure the sustainability of the group's business, the community's soft skills were strengthened with business management and administration training covering basic financial literacy, the formulation of effective marketing strategies, and the development of business partnership networks. This holistic intervention throughout 2023 successfully triggered a socio-economic transformation in Nelayan Indah Sub-district, where community groups that were initially passive beneficiaries evolved into productive and independent business actors, while continuously keeping environmental sustainability as their operational foundation. During this year, a total of 1,000 mangrove seedlings were recorded as planted.

In 2024, the BISMA program advanced to the downstreaming phase, production capacity building, and intensive business mentoring. The main focus was directed toward the tangible implementation of the skills acquired by the community into MSME-scale commercial production activities based on mangrove potential, such as the production of jeruju sticks and mangrove syrup. Mentoring by the CSR team was carried out comprehensively, covering the entire value chain—ranging from hygienic processing techniques, product quality standardization, production cost calculation, packaging, to processing business legalities and permits. This transition toward modern production was fully supported by the procurement and maintenance of physical facilities, including processing equipment, drying machines, packaging tools, and storage areas. The presence of this appropriate technology instantly boosted the efficiency and production capacity of local MSMEs, while empirically proving that environmental recovery and economic growth can run hand in hand under the corridor of a green economy. During this year, a total of 1,000 mangrove seedlings were recorded as planted.

The integrative commitment of the BISMA program reached its peak in 2025 through economic diversification strategies, food security strengthening, and coastal ecosystem resilience enhancement. From the environmental protection aspect, an environment-friendly Wave Breaker (APO - Alat Pemecah Ombak) was constructed, which effectively reduces wave impact, accelerates natural sedimentation, and secures critical growth areas for mangrove seedlings. In terms of economy and food security, the fisheries sector was strengthened through tilapia fish cultivation that productively utilizes coastal canals without damaging the ecosystem, targeting a yield of 20,000 fish. The community was provided with routine mentoring regarding pond management, the use of natural feed, ideal fingerling stocking, and natural pest and disease control to ensure the cultivation cycle remains environmentally friendly. During this year, a total of 1,500 mangrove seedlings were recorded as planted.

As the closing pillar and a guarantee for program sustainability in 2025, a Mangrove Nursery Park was established, oriented as an ecological learning center as well as a new economic generator. Through full management by the local community, this park integrates plant care, growth monitoring, and educational visits from various communities with commercial economic activities in the form of selling superior mangrove seedlings. This diversification scheme not only expands the community's income sources so that they do not depend on a single sector, but also consolidates the function of the Mangrove Center as an independent, circular, and sustainable green economy pilot model in Nelayan Indah Sub-district (Interview with I1, 2026).

Community Outcomes of the BISMA Program

Social and Institutional Outcomes

The program was accompanied by changes in community organization and institutional arrangements. Program documentation records the establishment of a Decree Letter (SK) for the Coastal Fishermen Farmers Group under the BISMA Program. An additional institutional commitment was formalized through a Memorandum of Understanding on

Mangrove Protection between PT Pertamina Patra Niaga Fuel Terminal Medan and Nelayan Indah Sub-district (No. 002/PND449000/2025-50 – No. 400/127) (Interview with I7, 2026).

The program documentation also records the emergence of a new conservation policy at the sub-district level in 2025. These institutional developments indicate that mangrove conservation activities were increasingly supported through formal community and local-government arrangements.

Environmental Outcomes and Community Environmental Awareness

Environmental activities included mangrove planting, seedling maintenance, establishment of the Mangrove Nursery Park, and environmental education. Program records indicate that 4,500 seedlings were planted during the 2022–2025 implementation period. Field observations also identified the development of community activities related to seedling cultivation and maintenance.

The program was also associated with changes in community practices related to mangrove use. Community members who previously depended on activities that could contribute to mangrove degradation were introduced to conservation-oriented activities and mangrove-based livelihood alternatives. Environmental education was delivered alongside practical activities in the nursery and mangrove rehabilitation areas (Interview with I1, 2026).

Livelihood Diversification and Community Welfare

The development of mangrove-based products provided additional livelihood activities for participating community members. Products documented during the program included mangrove-based processed foods, jams, mangrove crackers, and jeruju sticks. The program also developed partnerships with schools, government institutions, and private-sector organizations for activities including mangrove planting and environmental education.

The Mangrove Nursery Park provided an additional economic activity through the production and sale of mangrove seedlings. The development of these activities expanded the range of livelihood options available to participating community members beyond dependence on fishing activities (Interview with I2, 2026).

Economic Outcomes

The economic outcomes were most clearly observed among the 17 members of the Mawar Lestari Group. Program evaluation data show that the average income of participating members increased from Rp1,864,705 to Rp2,641,176, representing an increase of Rp776,471 per member or 44.32% (Implementation Reports, 2026).

These data provide quantitative evidence of changes in the income of participating community members during the implementation of the program. The income increase occurred alongside the development of mangrove-based products, supporting facilities, business mentoring, and livelihood diversification activities.

Community Assessment of Program Implementation

The Community Satisfaction Index (IKM) assessment produced an overall score of 3.235, equivalent to a converted score of 80.875, which falls within the “Good” category. The assessment was based on 10 community respondents (Implementation Reports, 2026). Five elements received the highest score of 4.00, equivalent to a converted score of 100.00: community participation, program relevance, alignment between planning and implementation, fairness in program implementation, and community acceptance of the

Community Development Officer (CDO). All 10 respondents (100%) assigned the maximum score to these five elements.

At the same time, several elements received a score of 2.650, categorized as "Poor," including corporate commitment, program sustainability, corporate responsiveness to community issues, field officer responsibility, corporate synergy with other stakeholders, and program benefits. These results indicate that, despite the positive overall assessment, respondents identified several aspects requiring further improvement, particularly program sustainability, stakeholder coordination, responsiveness, and the distribution of program benefits.

DISCUSSION

Ecological Restoration and Environment-Based Livelihoods

The findings show that the BISMA Program combined mangrove rehabilitation with the development of environment-based livelihood activities. Between 2022 and 2025, the program supported mangrove planting, seedling maintenance, environmental education, and the development of alternative livelihood activities such as fish breeding and sustainable aquaculture. This approach addressed two interconnected conditions identified in the study area: ecological degradation and the vulnerability of fishing-dependent household incomes.

This finding is consistent with the green economy perspective, which emphasizes that economic development should improve human well-being while reducing environmental risks and ecological pressures (Devi et al., 2025). It also supports previous studies showing that community-based mangrove management can simultaneously contribute to ecological restoration and local livelihood development (Fatimatussahroh et al., 2018; Padhy et al., 2022). The BISMA case demonstrates how these two objectives can be addressed through a single community-based intervention, in which livelihood alternatives are introduced alongside mangrove rehabilitation rather than treating conservation and economic development as separate activities.

However, the findings also indicate that ecological restoration and economic improvement operate on different timescales. Mangrove recovery requires sustained maintenance and long-term ecological processes, whereas coastal households face immediate income needs. This condition highlights the importance of livelihood diversification during restoration processes. In this case, the provision of alternative economic activities provided additional livelihood opportunities that could reduce dependence on activities placing pressure on mangrove resources. Nevertheless, the long-term ecological effectiveness of the program remains dependent on continued maintenance, community commitment, and institutional support beyond the period of CSR intervention.

Economic Diversification and Green Value Creation

The second major finding concerns the transition from basic environmental rehabilitation toward the creation of economic value from mangrove-related resources. The BISMA Program gradually developed community capacities through product-processing training, business administration, financial literacy, marketing, production equipment, and business licensing. This process enabled the Mawar Lestari Group to develop products such as jeruju sticks and mangrove syrup, while the Mangrove Nursery Park created an additional income-generating activity through mangrove seedling production.

These findings support previous studies that emphasize the economic potential of mangrove resources through sustainable product development, ecotourism, and other

non-timber uses (Hossain et al., 2025; Padhy et al., 2022; Suswadi et al., 2023). The BISMA case further indicates that the creation of green economic value does not depend solely on the availability of natural resources. It also requires capacity building, production infrastructure, product development, and market-oriented support. In this respect, the program illustrates how CSR intervention can facilitate the transition from resource utilization toward value-added economic activities.

Nevertheless, the findings also reveal an important limitation concerning the sustainability of this economic diversification. The development of products and production facilities does not automatically guarantee long-term market viability. Previous studies have identified limited market access, technological capacity, product quality, and supporting infrastructure as recurring constraints in community-based mangrove enterprises (Wahyudi et al., 2014). Similar challenges are evident in the BISMA case, particularly in relation to the continued need for mentoring and external support. Therefore, the sustainability of the green economic model depends not only on the ability of communities to produce mangrove-based products but also on their capacity to manage markets, maintain product quality, develop partnerships, and gradually operate with reduced dependence on CSR assistance.

Institutional Strengthening and Program Sustainability

The third finding concerns the institutionalization of mangrove conservation and community development. The BISMA Program was accompanied by the establishment of a Decree Letter (SK) for the Coastal Fishermen Farmers Group, a Mangrove Protection MoU between PT Pertamina Patra Niaga Fuel Terminal Medan and Nelayan Indah Sub-district, and the development of a local conservation policy in 2025. These arrangements indicate that the program generated institutional responses beyond individual training and economic activities.

This finding is consistent with previous research emphasizing that the sustainability of mangrove management requires strong local institutions and supportive governance arrangements (Purwanti et al., 2020; Wahyudi et al., 2014). Formal institutional arrangements can provide a basis for defining responsibilities, maintaining collective commitments, and coordinating activities among communities, companies, and government institutions. In the BISMA case, the emergence of formal agreements and local policy suggests that CSR intervention contributed to incorporating conservation objectives into local institutional arrangements.

However, the existence of formal arrangements should not be equated automatically with institutional sustainability. The critical issue is whether the commitments established during the CSR intervention can continue to operate after the intensity of corporate assistance decreases. Previous studies have highlighted that institutional weakness and fragmented governance can undermine the continuity of community-based environmental programs (Purwanti et al., 2020). Therefore, the long-term sustainability of BISMA depends on the implementation and enforcement of these institutional arrangements, the continuity of stakeholder coordination, and the capacity of local actors to maintain the program independently. This finding suggests that institutionalization should be understood not merely as the creation of formal documents but as the development of functioning governance mechanisms that can sustain collective environmental and economic action.

Welfare Improvement and Distributional Challenges

The economic evaluation provides quantitative evidence of improved welfare among members of the Mawar Lestari Group. The average income of participating members increased from Rp1,864,705 to Rp2,641,176, representing an increase of Rp776,471 or

44.32%. This increase occurred alongside the development of mangrove-based products, business mentoring, production facilities, and livelihood diversification. The findings therefore indicate that environmental-based economic activities can generate measurable financial benefits for participating community members.

This result is consistent with the green economy literature, which emphasizes that environmental sustainability should be accompanied by inclusive economic opportunities and improved community welfare (Devi et al., 2025; Maclean et al., 2018). It also complements previous studies on mangrove-based livelihoods, which demonstrate that sustainable utilization of mangrove resources can contribute to household income while supporting conservation objectives (Padhy et al., 2022). The BISMA case provides empirical evidence of this relationship at the community-program level by demonstrating a measurable increase in the income of participating group members.

At the same time, the distribution of these benefits requires further attention. The income increase was measured among the 17 active members of the Mawar Lestari Group and therefore should not automatically be interpreted as an improvement in welfare for the wider population of Nelayan Indah Sub-district. This finding raises an issue of inclusiveness in community-based green economy programs. Previous research has emphasized the importance of ensuring that economic benefits from environmental programs are broadly accessible to local communities rather than concentrated among a limited group of beneficiaries. Consequently, the future development of BISMA should consider mechanisms for expanding participation, strengthening linkages between the core group and other community members, and increasing access to economic opportunities for households that remain outside the main beneficiary group.

The Community Satisfaction Index provides additional evidence regarding community perceptions of program implementation. The overall score of 80.875 indicates a “Good” assessment, while community participation, program relevance, alignment between planning and implementation, fairness, and acceptance of field officers received the highest ratings. However, lower scores concerning corporate commitment, program sustainability, responsiveness, stakeholder synergy, and program benefits indicate that positive perceptions of current implementation do not necessarily guarantee long-term sustainability. This distinction is important because the performance of a CSR-based green economy intervention should be assessed not only through immediate satisfaction and income improvements but also through the capacity of the program to sustain environmental, economic, and institutional outcomes over time.

CONCLUSION

The implementation of the BISMA Program demonstrates how CSR-based coastal development can integrate mangrove restoration, community capacity building, and environment-based economic activities through a phased intervention. From 2022 to 2025, the program progressed from mangrove rehabilitation and environmental training to livelihood diversification, downstream development of mangrove-based products, sustainable aquaculture, and community management of the Mangrove Nursery Park. The program generated multidimensional outcomes, including ecological rehabilitation, strengthened local institutional arrangements, development of mangrove-based economic activities, and a 44.32% increase in the average income of the 17 participating members of the Mawar Lestari Group. These findings indicate that mangrove conservation can be linked with tangible livelihood opportunities when ecological rehabilitation is accompanied by capacity building, productive infrastructure, and institutional support.

However, the findings also indicate that the sustainability of these outcomes cannot be assumed from short-term program achievements alone. Continued mentoring, market development, institutional enforcement, and broader access to economic opportunities remain important to reduce dependence on corporate support and prevent benefits from being concentrated within the core beneficiary group. For CSR-based coastal development, future programs should therefore move beyond project-based interventions toward locally institutionalized and market-connected models that strengthen community ownership, sustain ecological outcomes, and progressively expand economic opportunities across the wider coastal community.

LIMITATION

This study has several limitations that should be considered when interpreting its findings. First, the qualitative case study design provides an in-depth understanding of the implementation and community-level outcomes of the BISMA Program, but it does not allow for statistical generalization or rigorous estimation of causal relationships between program interventions and observed outcomes. Future research could therefore employ quantitative approaches to measure the magnitude of economic, social, and environmental impacts and to examine the relationships between program interventions and community outcomes more systematically. Second, this study captures the implementation and outcomes of the program within a specific period and therefore cannot fully assess the long-term sustainability of its ecological, economic, and institutional impacts. Longitudinal research is needed to examine whether changes in livelihood, income, environmental behavior, and local institutions are sustained after corporate intervention is reduced or withdrawn. Third, the study focuses on a single CSR program and geographical context. Comparative research involving similar mangrove-based CSR or community development programs in different coastal areas would provide a broader basis for identifying contextual factors, common mechanisms, and variations in program effectiveness. Such comparative and longitudinal approaches could further strengthen the evidence base for developing transferable models of CSR-based green economy development in coastal communities.

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DECLARATION OF CONFLICTING INTERESTS

The authors have declared no potential conflicts of interest concerning the study, authorship, and/or publication of this article.

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