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Advancing Sustainable Mangrove Restoration: A Community-Driven Edu-Ecotourism Business Model in Banyuasin

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Abstract

Coastal communities in the Banyuasin District heavily rely on mangrove ecosystem services. However, unsustainable livelihood practices are driving mangroves into degradation. Our study aims to identify alternative livelihoods that can transform more sustainable mangrove businesses and practices. This will be achieved by co-developing a business model through participatory action research (PAR) in mangrove villages of Banyuasin. Our study revealed potential community-driven edu-ecotourism businesses in Sungsang and Marga Sungsang Village for further development. This business heavily relies on the natural authenticity of its mangrove, which amplifies the urgency to restore the degraded mangrove in the landscape. Thus, there is a high alignment of the business model canvas components with restoration activities such as the development of a mangrove seedling nursery, selling, and planting. This community-driven business is financially viable, according to the financial metrics, with a net present value (NPV) of IDR 180,148,622, a benefit-cost ratio (BCR) of 1.3, an internal rate of return (IRR) of 52.88%, and a payback period (PBP) of 1.7 years. The development of this business model can leverage sustainable livelihood opportunities and reconcile multiple interests while amplifying the urgency of restoring mangroves. The collaborative efforts among the community during this process serve as an exercise to build collective knowledge, strengthen social ties, and enhance trust and communication. This, in turn, leads to stronger collective action and social capital, which can sustain mangrove restoration beyond the project duration.

Keywords: business model, edu-ecotourism, mangrove restoration, participatory action research

1. Introduction

About 40% of global mangrove forests are in Asia, with Indonesia holding half of Asia's mangrove share, or approximately 20% [1]. Indonesia's current mangrove forests span 3.3 million hectares, not including the estimated 0.76 million hectares of potential habitat for mangroves [2]. Mangroves in Southeast Asia stored 8,682.32 $MtCO_2$-e of blue carbon, with Indonesia holding 68% of the blue carbon shares compared to the other Southeast Asian countries [3]. This justifies mangroves' pivotal role in contributing to Indonesia's climate change adaptation and mitigation [4–6]. However, concerns increase due to mangrove decline and loss, driven by anthropogenic pressures, particularly aquaculture and natural causes [5,7]. Climate change intensifies the existing threat to mangroves in Asia, as they are likely to experience temperature increases, precipitation changes, sea level rise, climatic oscillations, and hydrodynamic energy, potentially leading to increased frequency and intensity of tropical cyclones [8,9].

About 120 million people worldwide, including Indonesia's coastal communities, live near the mangrove forest, highly dependent on the ecosystem services the mangrove provides [10,11]. Mangrove ecosystem services, such as coastal protection, fisheries, raw materials, and other services, provide USD 15,000–50,000/ha annually [12]. The decline and loss of mangrove ecosystems will devastate coastal communities, especially when they are already vulnerable and facing extreme poverty [13]. As a result, it is critical to address mangrove degradation issues while also considering the human dimension of coastal communities that live in and around mangrove forests. As a response to the increasing challenges, the

Government of Indonesia is improving the governance of the mangrove ecosystem, as outlined in the National Roadmap for Mangrove Regulation 2021-2030, with a government regulation on mangrove protection and management to follow [2]. Under Presidential Regulation No. 120 Year 2020, the government, through the Peatland and Mangrove Restoration Agency, is coordinating current government efforts to restore 600,000 ha of degraded mangroves. Mangrove restoration has emerged as a prominent strategy to maintain the critical function and economic benefits [14].

Mangroves on Sumatra Island have one of the most considerable CO_2 absorptions after Papua and Kalimantan, amounting to 2,118.59 $MtCO_2e$. This ecosystem is central to supporting Indonesia's commitment to emission reduction. However, 26,064.18 ha of mangroves were deforested from 2009 to 2020 [15]. Banyuasin has a significant mangrove forest, amounting to 130,000 ha of mangrove inside and outside the Sembilang National Park. Despite most of the mangrove being in the protected forest, deforestation caused the loss of about 10,000 ha of mangrove from 2014 to 2019 [16]. The mangrove ecosystem of Banyuasin, which is a part of the Musi River, is facing various pressures from anthropogenic activities [17], which are influenced by the low economic level of the community [18]. The district also experienced an increasing expansion of oil palm plantations in wetlands [19]. Reconciling the need for economic growth while halting mangrove degradation becomes critical to realizing the mangrove restoration agenda. A gap remains in finding alternative livelihoods that align with economic improvement and mangrove restoration objectives while enhancing community participation in restoration.

Our study in Banyuasin focuses on Sungsang IV and Marga Sungsang, where expansion of agriculture occurred, livelihood opportunities were limited, and most communities relied on the mangrove forest. The local community's participation in terms of acceptance, support, and management practices is key to successful mangrove restoration [18,20]. This justifies the urgency of putting the local community first, as they need mangroves, and the restoration project can benefit from their active participation and local wisdom [21]. Using participatory action research, this study underscored a community-driven approach to foster community participation and engagement. The community and the researcher co-developed alternative livelihoods to transform more sustainable mangrove practices through the edu-ecotourism business model for mangrove restoration. Our research employed a business model canvas combined with a financial feasibility assessment and SWOT (strengths, weaknesses, opportunities, and threats) analysis, assessing community-centred alternative livelihoods.

2. Materials and methods

We conducted this study from November 2022 to December 2023 under the participatory action research (PAR) framework. Our research location covered the Sungsang IV and Marga Sungsang villages of Banyuasin II Subdistrict, Banyuasin District, South Sumatra Province, Indonesia (Figure 1). Both villages were located near the Musi River and adjacent to the Bangka Strait Sea. Sungsang IV and Marga Sungsang altogether account for 3% of mangrove cover in Banyuasin, according to our spatial analysis. We conducted a desk study on 17 community-based business development case studies in mangrove ecosystems. We also conducted a baseline survey in 298 households using purposive sampling. We used the findings to support field observation, focus group discussions, and interviews with local community members and stakeholders. We used the business model canvas [22,23] as a tool, helping the community outline their collective business ideas into a value proposition and other key components necessary to support business success (Figure 2). Further development of PAR with business models may leverage social and political transformation [24], with the community role and participation at the forefront in identifying problems and testing potential solutions. We conducted both quantitative and qualitative analyses, such as descriptive, financial, and SWOT (strengths, weaknesses, opportunities, and threats) analyses. In financial feasibility, we used criteria such as NPV (net present value), BCR (benefit-cost ratio), IRR (internal rate of return), and PBP (payback period). In SWOT analysis, we compared the external and internal factors to develop a strategy supporting business success. We accounted for the costs of tourism facility development, such as the track,

nursery, fishing spot, and canteen. We also calculated the cost of seeding and planting mangroves, including the labor cost. This cost component reflected the key activities outlined in the business model canvas that support mangrove restoration. A group of communities will operate the business on government-owned public land and utilize loans with rates of 14%. We performed all calculations under the duration of a three-year business timeframe and the *ceteris paribus* assumption.

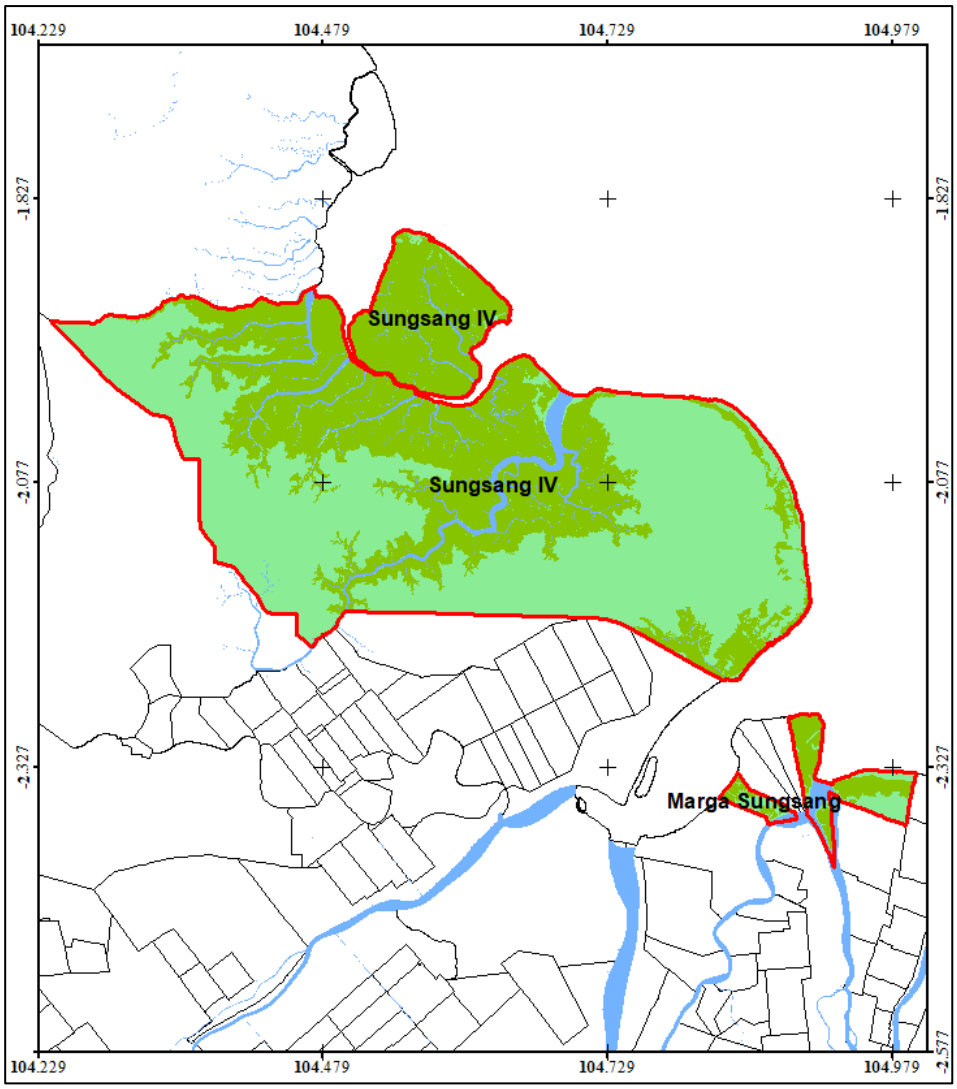

Figure 1. Participatory action research occurred in Sungsang IV and Marga Sungsang Village, Banyuasin District, South Sumatra Province.

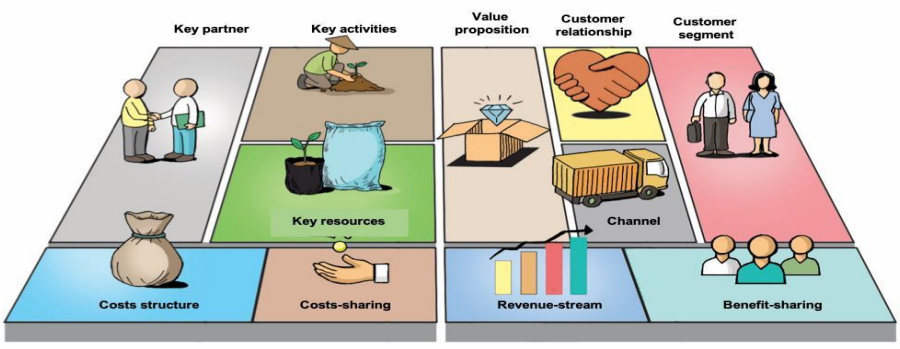

Figure 2. The participatory action research used the business model canvas to develop a collective business at the community level [23, adapted from 22] in its planning phase.

3. Results and discussion

3.1. Results

3.1.1. Mangrove potential

Sungsang IV and Marga Sungsang have a competitive advantage in edu-ecotourism due to their location on the Banyuasin peninsula, one of the migratory transit regions for North Siberian birds. The migrant birds rely on the mangrove forests and muddy plains of Sungsang as critical feeding grounds [25]. Agussalim and Hartoni [26] also indicate the presence of Tongtong *(Leptoptilos javanicus)* and Bluwok Herons *(Mycteria cinerea),* which were listed as endangered by the IUCN (International Union for Conservation of Nature) and protected by the Ministry of Environment and Forestry. This adds value to Sungsang as a potential bird-watching spot. In addition, we also observed that Sungsang and Marga Sungsang have various types of flora and fauna, such as nypahs *(Nypa fruticans)*, long-tailed macaques *(Macaca fascicularis)*, mudskippers *(Periopthalmus sp.)*, and saltwater crocodiles *(Crocodilus porosus).* River cruise activities focusing on mangrove biodiversity can be a potential tourism option because rivers traverse the villages. The village also has an emerging sand area, which is a unique tourist attraction.

Table 1. Identification of mangrove villages' potential and its associated type of activities or products for community-driven edu-ecotourism.

Edu-ecotourism potential	Type of activities or products
Nature/landscape	River cruise, sunset-viewing, emerging sands
Biodiversity	Birdwatching, biodiversity observation, planting/seeding mangrove, research, and field lecturing or field school
Local culinary and product	Pedada sweet jam, syrup, chip, *sambal*, and hand soap.

Both villages are the focus of the restoration intervention under CIFOR-ICRAF facilitation, in which the community planted mangroves in 38.33 ha of the action arena [27]. To support mangrove planting, the project and community developed a nursery in Sungsang IV to supply the demand for restoration in both villages with 12 different types of mangrove species. Since their opening, the nursery and action arenas have welcomed visitors from the private sector, university students, and lecturers for field lectures and educational activities. Between May 2023 and April 2024, at least 1,602 documented visitors visited the nursery and action arenas. About 1.6% of these visitors are university students who researched mangroves. We estimated the visitor count is higher than our documentation since many of the local community and tourists (undocumented) occasionally visit the nursery and action arena.

The development of mangrove edu-ecotourism villages was aligned with the current vision of the local government. Tourism was included in the Sungsang IV village government's economic development program. The local community has utilized and produced mangrove Pedada *(Sonneratia caseolaris)* fruit for sweet jam, chips, syrup, *sambal*, and hand soap. Although the production scale is small, mangrove products have the potential to be upscaled as icons for Sungsang mangrove tourism souvenirs. In 2022, the village won the Best Tourism Village award at the provincial level and the 75 Best Tourism Villages at the national level in 2023, highlighting its unique mangrove nursery, local culinary, and culture [28]. **Table 1** summarizes the overall potential of the mangrove villages for tourism.

3.1.2. Business model for advancing mangrove restoration

In developing the business model, we began by facilitating the development of common visions among the community groups in Sungsang IV and Marga Sungsang Village. The Sungsang IV community agreed on the common vision of "realizing sustainable mangrove for community welfare." Marga Sungsang described their vision as "protected mangrove, improved economy." Both communities shared a common vision to balance the ecological and economic benefits of mangroves for the community. To achieve this objective, the degraded mangrove must be restored, and the remaining intact mangrove needs to be protected, for the ecosystem to continue to provide benefits for the community. Based on the results of the desk study and our field observations of the potential of mangroves in

Sungsang area, we assisted the community in developing a business model for edu-ecotourism. This business model aligned with community interests, as stated in several discussions and the baseline survey. About 85% of the respondents in Sungsang IV and Marga Sungsang expressed an interest in developing future mangrove edu-ecotourism, particularly edu-ecotourism in mangrove forests (47%), guided tours and boats (43%–47%), and emerging sands (32%). The government's tourism program and the community-based restoration project, which CIFOR-ICRAF and its partners facilitate, aligned with this interest. Furthermore, the District Government of Banyuasin has outlined a plan for ecotourism development, emphasizing the importance of incorporating key components such as amenities, accessibility, and attractions into the planning process. The Forest Management Unit (FMU) of Palembang Banyuasin also expressed their agreement and interest in ecotourism development, and the FMU recommended the development of an ecotourism grand design and institutions.

The community group of Sungsang IV and Marga Sungsang proposed mangrove restoration edu-ecotourism as the value proposition for their business model. The proposed edu-ecotourism will cover guided walk in mangrove, planting activities, and education of mangrove ecosystem and restoration. This unique edu-ecotourism will leverage the competitive advantage of the mangrove ecosystem in both villages to achieve multiple objectives, including restoring and protecting mangroves and enhancing public awareness of their importance to the local economy (Figure 3). The edu-ecotourism will target local tourists, students, teachers or lecturers, and researchers as customers. It will reach the customers through digital and conventional marketing channels, such as social media, leaflets, and banners. The community group will manage the customer relationship by providing customer-oriented, responsive services. They will undertake key activities to realize the business model, including developing the grand design, roadmap, and marketing strategy, as well as creating edu-ecotourism facilities and materials. The key activities will require key resources such as human resources, financial capital, and social capital. These implied costs are delineated in the cost structure. The village fund, project support from CIFOR-ICRAF, and voluntary contributions from the local community will cover the costs of developing edu-ecotourism. The business will generate revenue from its tourism admission ticket, tourism package, and sales of culinary, souvenir, and seedling products. The group members will disburse 70% of the profit or benefit accordingly, with the remaining 30% going towards the restoration fund. Lastly, the community group will establish partnerships and collaborations with key partners such as national, provincial, and district governments, CIFOR-ICRAF, and CSOs, such as the Watershed Forum and other community groups in Sungsang and beyond.

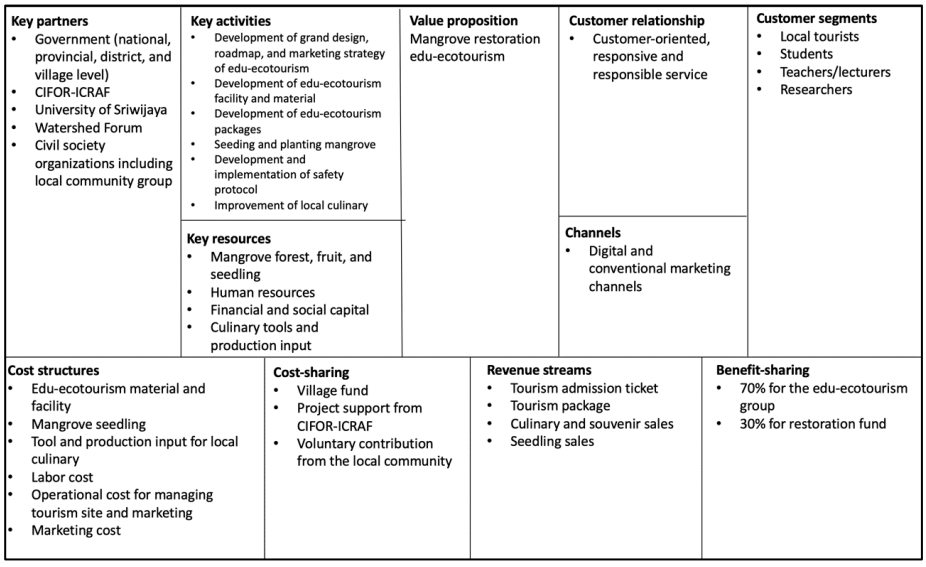

Figure 3. Community-driven business model canvas for mangrove restoration edu-ecotourism in Banyuasin District detailing the value proposition, cost-benefit sharing mechanism, and other critical components to achieve a successful edu-ecotourism business.

3.1.3. Feasibility of and strategy for improving the edu-ecotourism business on mangrove

Edu-ecotourism business on mangroves generated a net present value (NPV) of IDR 180,148,622 or approximately USD 11,255, a benefit-cost ratio (BCR) of 1.3, meaning that every IDR 1 will generate a benefit amounted to IDR 1.3, an internal rate of return (IRR) of 52.88%, which was substantially higher than the rates (14%), and a payback period (PBP) of 1.7 years or 20 months. This finding indicated that the edu-ecotourism business on mangroves was financially feasible, although the benefit-cost ratio was low. The edu-ecotourism profit will be contingent upon the number of tourists or visitors and the achievement of the restoration target. The increased number of visitors will increase the monetary benefit of edu-ecotourism. This will also assist the community, and the project will achieve the target, as the tourism planting activities combined with education on mangrove ecosystem and restoration will raise awareness and support for mangrove forests. We also observed the potential multiplier effect of edu-ecotourism, which can increase homestay occupancy, leading to increased economic turnover in Sungsang.

To support the edu-ecotourism business in achieving its objectives, we developed a SWOT analysis identifying critical external and internal factors. This will help the community group consider necessary strategies for ensuring business success. We observed that mangrove edu-ecotourism in Sungsang has a high potential for success due to the existing demand or interest from local tourists, its proximity to the capital, the unique value of the edu-ecotourism, community participation, and existing relationships with partners and stakeholders such as the University of Sriwijaya, the Watershed Forum, and others. However, there were also weaknesses and threats that, if they persist and are unresolved, will hamper progress towards achieving the tourism and restoration targets. Hence, we recommend that the community improve efficiency and effectiveness in material and labor use when developing the edu-ecotourism facility, building capacity in edu-ecotourism and hospitality, and collaborating openly with investors and other stakeholders. **Table 2** outlines a detailed SWOT analysis and the strategies.

Table 2. SWOT analysis of community-driven edu-ecotourism on mangroves in Banyuasin District.

	Strengths	**Weaknesses**
	1. Unique value of edu-ecotourism on mangrove 2. Community interests in innovation and participation in mangrove restoration 3. Potential diverse revenue streams and multiplier effect generated from the edu-ecotourism 4. Local labor absorption 5. Proximity to the district and provincial capital	1. Upfront costs required to develop an edu-ecotourism facility 2. Experience of the local community in managing the edu-ecotourism business
Opportunities 1. Local tourist interests in mangrove edu-ecotourism 2. Existing partnerships with stakeholders and partners 3. Central and provincial government programs to support local tourism development	**S-O strategy** 1. Development of an edu-ecotourism package and education material in collaboration with the local stakeholder and tourism actor 2. Development of attractive and informative marketing content and strategy, including the use of social networking applications for leveraging digital marketing 3. Organizing routine festival and event	**W-O strategy** 1. Improving efficiency and effectiveness in material and labor use 2. Capacity building in edu-ecotourism and hospitality for the local community in cooperation with the central and provincial government, as well as other stakeholders
Threats 1. Extreme weather that may disrupt the edu-ecotourism activities. 2. Unsustainable practices and businesses that contribute to the further degradation of mangroves	**S-T strategy** 1. Development of edu-ecotourism roadmap and packages with considering weather prediction 2. Improvement of safety protocol in edu-ecotourism 3. Improving cooperation with local government to increase public awareness and influence alternative, sustainable business practices on the ground	**W-T strategy** 1. Development of collaboration and investment opportunity

3.2. Discussions

Our research found that realizing successful national emission reduction from the mangrove ecosystem comes from connecting the dots and scaling up successful local efforts. This can be realized by putting the community at the forefront of restoration while building social capital to mobilize their voluntary contributions beyond the project duration [29]. According to a previous study, increased engagement of the local community in mangrove restoration will advance their awareness and sense of ownership, which may enhance the success rate of restoration and guarantee sustainability in efforts beyond project duration [30]. A study on community-based mangrove management indicates that a community-based approach can influence mangrove biodiversity, but poverty alleviation is necessary to optimize the outcomes [31]. Therefore, in coastal communities where poverty and dependency on mangroves are high, restoration intervention ideally should serve multiple ecological and socioeconomic interests. Implementing interventions, such as facilitating the transition to sustainable business models and practices, not only halts further degradation of mangroves but also serves as a viable alternative to the transition towards a green economy. This can be done through innovative business models such as the community-driven edu-ecotourism that emphasizes the natural authenticity of Banyuasin mangroves. This leverages sustainable livelihood opportunities among the coastal communities while amplifying the urgency of restoring mangroves.

In our experience, participatory action research, combined with institutional analysis and development to advance contextual understanding and business model development, can catalyse change and impact through cross-learning and collective action development, it facilitates [32]. We observed shared experiences in Banyuasin mangrove restoration, where participatory action research fostered community engagement and collaboration in identifying challenges and developing solutions. The community's common vision is fundamental to collaborative efforts, where it coordinates, motivates, and ensures the business model will be centred around their common interests and needs. As the community works together, it provides an opportunity to build collective knowledge, strengthen social ties, and enhance trust and communication. A follow-up assessment of the ecosystem's carrying capacity, capacity building, and further institution strengthening is needed to ensure the successful implementation of community-driven edu-ecotourism.

Edu-ecotourism on mangrove is a pathway to motivate community-based mangrove conservation and restoration efforts, which provides benefits for the local community while attracting incentives and partnerships [33]. We found that the business model canvas and its subsequent analysis have been useful tools in catalysing community-based mangrove restoration efforts, while encouraging the local community to reflect on human relationships with the mangrove ecosystem. Establishing a follow-up monitoring and evaluation mechanism is crucial as the model undergoes implementation and matures. Developing and implementing a business model should be seen as an iterative process that embraces uncertainty and complexities while encouraging the community to continuously reflect, refine, and adapt the model as the circumstances change. The monitoring and evaluation activity also provide an opportunity to learn and adjust the model for improved outcomes in the future, which also aligns with a previous study [23].

Finally, restoration should be seen as a strategic opportunity to repair, not only the ecological condition, but most importantly, the human-nature relationship [34]. Thus, a transdisciplinary approach incorporating social sciences and community knowledge is needed to address barriers beyond biophysical and ecological that persist in restoration [35]. To achieve the intended restoration outcomes, we observed that active involvement and support from multistakeholder groups at the local level contribute to the success of a community-driven business model. The partnership between the community group and multi-stakeholders can enhance resource mobilization, knowledge sharing, and capacity building necessary to sustain the efforts in the long term. This begins with aligning diverse interests and efforts with greater policy commitment. By fostering community-driven restoration efforts and integrating innovative business models like edu-ecotourism, we can create sustainable, scalable solutions that restore vital ecosystems like mangroves and

improve the livelihoods of coastal communities, contributing to ecological and socioeconomic resilience.

4. Conclusions

Coastal communities, including Sungsang IV and Marga Sungsang, are at risk of the dual threats of climate change impact and extreme poverty. In this context, protecting and restoring mangrove forests have become urgent priorities for maintaining critical ecosystem services and supporting sustainable livelihoods and communities. This study proposed innovative and alternative business models that benefit the community, ecosystem, and biodiversity, using the business model canvas as a tool, combined with financial feasibility and SWOT analyses. The study actively engaged the community to understand their challenges and collaboratively develop solutions by employing participatory action research. This encourages the community to explore alternatives to sustainable mangrove utilization while shifting their perspective toward long-term ecological and economic resilience. Our analysis indicates that the proposed business model is financially viable and strongly aligned with the local community interests and government-led mangrove restoration agenda. Reconciliation of these multiple objectives and interests provides a strong foundation for implementation. To ensure the achievement of the intended objective, community-based edu-ecotourism institutions must be strengthened and equipped with the capacity and a grand design or roadmap of implementation, followed by continuous monitoring, reflection, and refinement. The combination of approaches in the study enhances potential replicability across regions and ecosystems. Future research focuses on assessing the carrying capacity of the mangroves, the trade-offs among different types of business model options, and scaling-up strategies to optimize and advance sustainable mangroves management.

Author Contributions

DP: Conceptualization, Methodology, Investigation, Writing - Review & Editing; **HP**: Writing - Review & Editing, Supervision; **RGM**: Methodology, Investigation, Writing; **SDK**: Review & Editing; **QPI**: Review & editing, Supervision; **FAH**: Investigation, Writing; **SN**: Investigation, Review.

Conflicts of interest

There are no conflicts to declare

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