

Strengthening coastal resilience through community-based mangrove conservation

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Abstract

Mangrove ecosystem degradation due to land conversion and climate change threatens coastal resilience and community livelihoods in Kuala Simbur Village, Jambi. This community service program aims to enhance ecological awareness and strengthen institutional collaboration in mangrove conservation. Utilizing a participatory approach, the program engaged the village government, Village Consultative Body (BPD), and local community groups through environmental regulation education, participatory problem identification, and conservation action planning. Results indicated a significant increase in public understanding of environmental risks and the ecological functions of mangroves. The program's tangible impacts include the formation of community-based mangrove conservation groups and the strengthening of village regulatory frameworks for sustainable coastal management. Community participation increased in direct actions such as conservation area monitoring and land rehabilitation. This initiative demonstrates that the synergy between community awareness and village institutional support is a decisive factor in the successful preservation of blue carbon ecosystems in coastal regions.

Keywords: Mangrove conservation; Coastal resilience; Participatory education; Institutional collaboration

Penguatan resiliensi pesisir melalui konservasi mangrove berbasis masyarakat

Abstrak

Degradasi ekosistem mangrove akibat alih fungsi lahan dan perubahan iklim mengancam ketahanan pesisir serta mata pencaharian masyarakat di Desa Kuala Simbur, Jambi. Program pengabdian ini bertujuan meningkatkan kesadaran ekologis dan memperkuat kolaborasi kelembagaan dalam konservasi mangrove. Menggunakan pendekatan partisipatif, program ini melibatkan pemerintah desa, BPD, dan kelompok masyarakat melalui edukasi regulasi lingkungan, identifikasi masalah partisipatif, serta perancangan aksi konservasi. Hasil kegiatan menunjukkan peningkatan signifikan pada pemahaman risiko lingkungan dan fungsi ekologis mangrove di kalangan warga. Dampak nyata program ini adalah terbentuknya kelompok konservasi mangrove berbasis komunitas dan penguatan kerangka regulasi desa untuk pengelolaan pesisir berkelanjutan. Partisipasi masyarakat meningkat dalam aksi nyata seperti pemantauan area konservasi dan rehabilitasi lahan. Inisiatif ini membuktikan bahwa sinergi antara kesadaran masyarakat dan dukungan kelembagaan desa merupakan faktor penentu keberhasilan pelestarian ekosistem karbon biru di wilayah pesisir.

Kata Kunci: Konservasi mangrove; Resiliensi pesisir; Edukasi partisipatif; Kolaborasi kelembagaan

Contributions to
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1. Introduction

Indonesia stands as the global epicenter for mangrove biodiversity, housing approximately 23% of the world's total mangrove area. These ecosystems are not merely coastal forests; they are sophisticated natural infrastructures that protect shorelines from erosion, support vast marine biodiversity, and function as carbon sinks with storage capacities that significantly outperform terrestrial tropical forests (Koh et al., 2018; Rivera-Monroy et al., 2017; Yayasan Konservasi Alam Nusantara, 2025).

Despite their ecological and economic value, Indonesia's mangroves are in a state of crisis. By 2022, only 30.32% of these forests were classified as being in "good condition," following decades of aggressive land conversion, illegal logging, and infrastructure development (Nurrachmi et al., 2019; Puryono & Suryanti, 2019; Ridwan, 2022; Wahana Lingkungan Hidup Indonesia, 2024). This national trend is acutely mirrored in Jambi Province, particularly within the Tanjung Jabung Timur Regency. Here, high-density mangrove cover has plummeted, replaced by degraded patches that leave the coastline vulnerable to the accelerating impacts of climate change and sea-level rise.

In Kuala Simbur Village, the consequences of this degradation have been catastrophic. Since 2007, the village has lost hundreds of meters of land to coastal abrasion, rendering numerous homes uninhabitable and forcing residents to evacuate (Dong et al., 2024). This environmental decline creates a vicious cycle: as mangroves vanish, the community loses its primary defense against flooding and its main source of fisheries-based livelihoods, which in turn weakens their capacity to adapt to future hazards (Untari et al., 2020).

The region of Tanjung Jabung Timur is unique for its high diversity of species, including *Avicennia*, *Rhizophora*, *Bruguiera*, and the rare *Ceriops decandra*. However, ecological awareness remains a critical barrier (Mustika et al., 2025; Ramli et al., 2023). Previous research underscores that while mangroves are natural barriers, community-based conservation only succeeds when local populations perceive a direct link between ecosystem health and their own well-being (Badola et al., 2012; Jadin & Rousseau, 2022; Koda, 2023).

Strategic intervention at the village level is therefore essential. The Village Government (Pemerintah Desa) and the Village Consultative Body (Badan Permusyawaratan Desa) hold the keys to sustainability by integrating conservation into development planning and strengthening community supervision. This empowerment program is designed to move the community of Kuala Simbur from the role of passive beneficiaries to that of primary actors. By enhancing local understanding and capacity, the initiative seeks to build a socially embedded conservation model that restores the mangrove shield and secures the socio-economic future of this vulnerable coastal village.

2. Method

The methodology for this community empowerment initiative was designed as a multi-phase collaborative process, ensuring that the intervention was both technically sound and socially grounded. Prior to the formal commencement of activities in September 2025, a comprehensive diagnostic phase was conducted through deliberative discussions involving the proposing team, the Kuala Simbur village government, the

Village Consultative Body (BPD), and local stakeholders. This participatory approach allowed for the precise identification of environmental and administrative challenges, leading to a unified program agreement tailored specifically to the needs of the Kuala Simbur coastal region in Jambi Province.

The implementation phase was characterized by an intensive coordination and communication strategy. The team utilized a participatory education model to engage residents directly, focusing on the ecological urgency of mangrove ecosystem preservation as a cornerstone for coastal community resilience. This educational component was paired with a regulatory orientation to ensure that local conservation efforts aligned with existing legal frameworks. To transition from theory to practice, the team facilitated the development of a collaborative framework, which institutionalized mangrove conservation as a shared responsibility across all sectors of the village.

To conclude the methodological cycle, a systematic monitoring and evaluation phase was established following the primary activities. This stage was designed to measure the immediate effectiveness of the community service and provide a data-driven assessment of its achievements. By maintaining a continuous loop between the local government and the community, the program aims to ensure that the mangrove preservation efforts are not merely seasonal but integrated into the long-term governance of Kuala Simbur Village.

3. Results and Discussion

3.1. Kuala Simbur Village mangrove outlook

The baseline assessment of the Kuala Simbur Village mangrove outlook reveals a critical intersection between ecological degradation and community vulnerability. As illustrated in [Figure 1](#), the mangrove ecosystems in this region of Tanjabtim, Jambi, are facing severe pressure from both anthropogenic activities and climate-driven shifts. The primary drivers of this degradation are a pervasive lack of ecological awareness among local populations and insufficient knowledge regarding the multifunctional importance of mangroves. These internal factors are compounded by external pressures such as global warming, which triggers significant sea-level rises that drown existing stands ([Alongi, 2008](#)). Furthermore, widespread land conversion, clearing for settlement, and the over-exploitation of timber resources have systematically weakened the natural coastal barrier.



Figure 1. Condition of mangroves and coastal residential areas

The consequences of this environmental decline are most visible in the form of accelerated coastal abrasion. This phenomenon does not merely disrupt the natural ecosystem but directly threatens the socio-economic stability of coastal residents. When mangrove buffers are removed, the shoreline loses its resilience against wave energy, leading to a reduction in the natural resources and ecosystem services that the community relies upon for their livelihoods (Rafik & Nisa, 2024; Rahayu et al., 2024).

The spatial impact of this crisis is particularly acute across four critically threatened villages in the Tanjabtim region: Sungai Kilat, Sungai Jambat, Kuala Simbur, and Lambur. Among these, the coastal areas of Kuala Simbur and its neighbors have experienced the most devastating land loss. Since the escalation of the abrasion phenomenon in 2007, hundreds of meters of land have vanished into the sea, rendering dozens of homes uninhabitable and forcing residents to abandon their ancestral properties (Tuyani, 2025). This massive displacement underscores the urgent need for the participatory education and community empowerment interventions detailed in the subsequent sections of this report, aimed at restoring the mangrove shield to protect both the environment and the people.

3.2. Participatory education to increase public awareness

The implementation of participatory education in Kuala Simbur is anchored in a mentoring approach that shifts the community's role from passive recipients of information to primary subjects of conservation. By actively engaging the village government, BPD, youth groups, and school children, the program establishes mangrove restoration as a collaborative strategy for mitigating global climate change (Toulwala et al., 2024). This active participation is reflected in the community's leadership during both technical planting sessions and non-technical planning meetings, ensuring that every stage of the service agenda is locally driven.

The process begins with a collective identification of environmental crises, such as the visible erosion of residential coastlines (Figure 2) and the declining income from local fisheries. By recognizing these tangible impacts on their daily lives, residents are empowered to propose preventative solutions rooted in their own experiences. This synergy allows the village government and citizens to co-design a replanting system that accounts for specific tidal patterns and local wisdom regarding the most resilient mangrove species and optimal planting cycles.



Figure 2. Condition of residential areas in coastal area

When communities are integrated into the program from its inception, they develop a profound sense of responsibility for the socio-economic resilience of their coastal home. This education transcends fleeting knowledge, fostering a long-term awareness where the community acts as the guardian of the ecosystem. In terms of monitoring, partners have become adept at identifying early signs of degradation, such as root damage or waste accumulation. The formation of dedicated mangrove conservation groups serves as a strategic pillar, enabling residents to report damage to authorities immediately and conduct regular patrols to prevent unauthorized logging.

Educational efforts also focus on the multifaceted benefits of these forests: ecologically, they serve as vital habitats for marine fauna and buffers against erosion; economically, they sustain the fisheries and fuel sources that support coastal livelihoods; and socially, they strengthen community solidarity through shared conservation goals. Documentation in [Figure 3](#) captures this transition, showing residents taking active roles as agents of change. To ensure these gains are permanent, the village government plays a complementary role by enforcing local regulations that prohibit illegal clearing, thereby mandating a protective environment where community-led monitoring can thrive.



Figure 3. Documentation of community empowerment activities

3.3. Behavior changes and knowledge internalization

The process of knowledge internalization in Kuala Simbur is characterized by a shift from the mere absorption of facts to the integration of ecological principles into the community's collective consciousness. Knowledge regarding mangrove functions, ecosystem services, and environmental risks is no longer viewed as an external instruction but as a personally meaningful framework for everyday decision-making. Because this understanding is rooted in the lived experience of coastal erosion and declining fishery yields, the community has successfully translated theoretical concepts into localized action.

This internalization is most evident in the community's sophisticated ability to apply ecological understanding to their specific environment. Residents now autonomously

identify early signs of mangrove degradation and utilize local ecological knowledge to select appropriate species based on precise tidal patterns. By determining optimal planting periods through a blend of scientific perspectives and ancestral wisdom, the community demonstrates that conservation has become an internally constructed and collectively owned responsibility.

Consequently, there has been a profound transformation in collective behavior. Pro-environmental actions, such as regular mangrove planting, the rejection of illegal logging, and proactive waste management, have moved beyond individual choices to become institutionalized social norms. The formation of community-based conservation groups ensures that the responsibility for the coast is managed at the local level, with reporting mechanisms to village authorities reflecting an increased sense of institutional accountability.

This behavioral shift is reinforced by a diverse network of “agents of change,” including youth groups, women’s organizations, and students who actively promote conservation values among their peers. Through joint monitoring and the enforcement of local regulations, conservation-oriented behavior has become a socially accepted standard. This ensures that mangrove protection efforts in Kuala Simbur are not transient activities tied to a service program, but are sustainable practices that contribute to the long-term socio-ecological resilience of the coastal area.

3.4. Collaboration with local governments on mangrove ecosystem conservation

The establishment of a collaborative framework in Kuala Simbur Village (Figure 4) serves as a strategic blueprint for integrating the diverse interests, authorities, and capacities of multiple stakeholders. By uniting the village government, local communities, academics, the private sector, and civil society, the conservation of mangrove forests transcends individual efforts and becomes a harmonized, multi-sectoral mission (Imron et al., 2021).



Figure 4. Collaboration with the Kuala Simbur Village Government

This inclusive model ensures that mangrove restoration is executed in a coordinated and sustainable manner. Open communication channels and close cooperation allow each party to optimize their specific resources and specialized knowledge (Nugroho et al., 2025). During the participatory education sessions in Kuala Simbur, this synergy was particularly evident in the seamless cooperation between the proposing team and the village government, which provided a formal administrative backbone to the community’s grassroots enthusiasm.

The ultimate objective of this framework is the creation of a management synergy where the protection of the mangrove ecosystem is recognized as a shared responsibility. This collective ownership ensures that the ecological and economic benefits of the mangroves are preserved for the long term, supporting both the environment and the residents who depend on it. By shifting from top-down mandates to a collaborative approach, Kuala Simbur has developed an adaptive strategy that is significantly more resilient to future environmental and social shifts.

4. Conclusion

The community empowerment program in Kuala Simbur Village provides a comprehensive model for coastal resilience, successfully addressing the critical mangrove degradation and severe land loss that have threatened the region since 2007. The program established a clear ecological baseline, identifying that the combination of climate-driven sea-level rise and anthropogenic pressures, such as land conversion and over-exploitation, was the primary driver of the devastating abrasion affecting the Tanjabtim region. This educational intervention also triggered a profound internalization of knowledge and long-term behavioral transformation. Pro-environmental norms have been institutionalized through the formation of community-based conservation groups, where responsibilities such as regular monitoring and the rejection of illegal logging are now socially accepted standards. Finally, the establishment of a robust collaborative framework has united the village government, academics, and the private sector into a synchronized management system. This synergy ensures that mangrove protection is no longer a fragmented effort but a shared institutional responsibility that provides sustainable socio-ecological benefits for the entire coastal ecosystem.

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Author Contribution

Activity Implementation: DSP, MY, H, ANR, JAK, SR; Article Preparation: DSP, MY, H, ANR, JAK, SR, MY; Analysis of service: DSP, MY, Article Revision: DSP, MY.

Conflict of Interest

The authors declare that they have no conflict of interest.

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