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Rapid assessment of mangrove forest in Bagacay, Tinambac, Camarines Sur, Philippines

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Abstract

Mangrove forests provide essential ecological services but remain vulnerable to both natural disturbances and human activities. This study assessed the mangrove ecosystem of Barangay Bagacay, Tinambac, Camarines Sur by examining its species composition, water and soil characteristics, vegetation condition, and socio-cultural relevance. Using transect–quadrat sampling, basic physicochemical analysis, and community surveys, eight true mangrove species and one associate were identified, with *Kandelia candel* and *Nypa fruticans* as the dominant species. The presence of the rare *Kandelia candel* underscores the environmental importance of the area. Results show generally suitable water and soil conditions but with visible vegetation gaps and signs of disturbance. Community respondents expressed high awareness of mangrove value but noted weak enforcement of protection measures. Overall, the study highlights the need for stronger community participation, environmental education, and improved management strategies for the Bagacay mangrove ecosystem.

Keywords: mangrove, ecosystem, rare, endangered, conservation

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1. Introduction

Mangrove forests, which are found in tropical and subtropical intertidal zones, are unique, robust coastal ecosystems with salt-tolerant trees and plants. However, human activity, a lack of environmental regulations, and the effects of climate change, such as sea level rise and other causes of global warming, continue to threaten these ecosystems. Mangrove forests serve as an important barrier against storms, storm surges, and soil erosion, and they also provide habitats for marine life, offering a means of sustenance and livelihood for numerous communities. They also promote biodiversity, increase fisheries productivity, and act as significant carbon sinks. Because they act as a natural barrier to lessen soil erosion, these trees' robust root systems are crucial for preserving secure shorelines. Accurate conservation and sustainable use of mangroves depend on an understanding of their current condition.

Globally, mangroves are crucial for both the ecology and the economy. They are one of the tools in regulating climate, protecting the coastlines, and are essential to the diverse ecosystems. Conservation projects are prioritizing science-based evaluations that consider local conditions and community dynamics due to growing concerns. Numerous significant elements, including species diversity, water quality, and community involvement, have an impact on mangrove health. In response to habitat loss and other environmental concerns, some tropical nations in Asia, Africa, and the Americas are giving priority to the condition of their mangrove forests and carrying out quick environmental assessments. Because they sustain a diversity of mangrove systems, these habitats are significant to many coastal communities in the Philippines. However, these forests face several challenges: recent typhoons have caused significant damage; trash buildup is a significant issue, as mangrove forests serve as a natural filter; abandoned fishponds persist; and conservation regulations are not always effectively implemented. Fortunately, Barangay Bagacay in Tinambac, Camarines Sur, which is adjacent to San Miguel Bay, has a mangrove forest that sustains local livelihoods, protects the shoreline, and acts as a fish nursery. The area is also of considerable ecological value, as it supports *Kandelia candel*, a rare mangrove species found in only a few locations within the Philippines. These issues underscore the need for a detailed ecological assessment.

Although the Bicol Region's mangroves have been studied, little is known about the specific species, soil and water conditions, vegetation, and community-related aspects of Bagacay. In this particular area, no study has yet integrated ecological data with indigenous knowledge and conservation strategies. Furthermore, more research is necessary to understand the *Kandelia candel's* habitat, potential risks, and conservation opportunities in Bagacay, despite its susceptibility to soil and water conditions. These knowledge gaps make it difficult to develop effective local management plans. This project will enhance awareness of conservation, connect ecological studies with community perspectives, and give essential knowledge to enable future management of the Bagacay mangrove environment. Therefore, this study will do a rapid assessment of the mangrove forest in Barangay Bagacay, focusing on species composition, vegetation patterns, soil and water parameters, and community elements that impact mangrove exploitation and conservation.

2. Methodology

The study aimed to employ a rapid ecological assessment of the mangrove forest of Barangay Bagacay, Tinambac. Emphasizing taxonomic identification, physicochemical parameters, and vegetation analysis. It also adopts a descriptive and mixed-methods research design to examine the socio-economic and cultural characteristics of households near a mangrove forest and to evaluate their involvement in conservation efforts. Quantitative data are gathered through structured household surveys, while qualitative insights were obtained from key informant interviews and field observations.

Background of the Study Site - Barangay Bagacay is a coastal community in Tinambac, Camarines Sur, located near San Miguel Bay. The community relies heavily on fishing and mangrove resources for livelihood. The mangrove forest plays a key role in shoreline protection and biodiversity conservation.

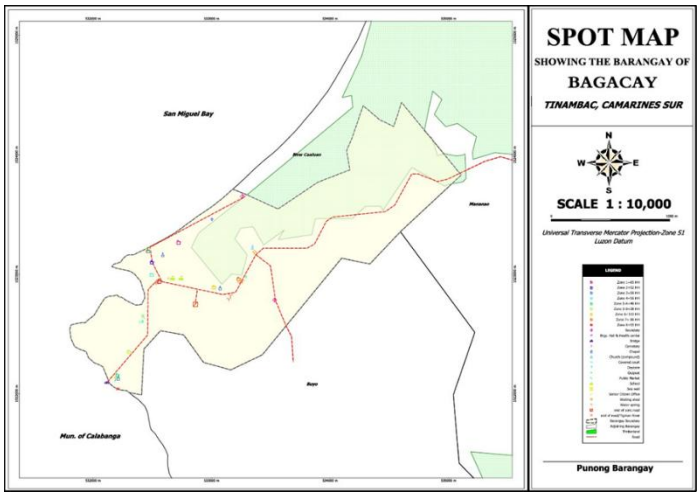

Figure 1. Spot Map of Barangay Bagacay

The primary source of income and livelihood for the people of Bagacay heavily relies on catching fish, given its proximity to the San Miguel Bay. Making the mangrove forest an integral part of the livelihood and shoreline protection of the community. The mangrove forest in San Miguel Bay has been documented to support high biodiversity and is recognized for its valuable role in sustaining and mitigating coastal hazards (Fortes & Salmo 2017).

Sampling Site

Figure 2. Satellite image of the sampling area

The study was conducted in the mangrove forest of Barangay Bagacay, Tinambac, Camarines Sur, located in the Western part of the community. The data gathering happened last November 29, 2025, at 11:50 AM until 2:30 PM.

Field Sampling Procedure - The researchers conducted a field sampling using a transect–quadrat method. First, the researchers used a transect line to measure the size and set up the quadrat of the sampling points for each quadrat; each quadrat had a measure of 10m x 10m with 10m intervals, beginning from landward to seaward as pointed by the arrow in Figure 2. Second, once the setting up of the quadrat is done, the researchers identify the

mangrove species present inside the quadrat. The mangrove species were identified using the Field Guide to Philippine Mangroves by J.H. Primavera, PhD. Next, was performed the physicochemical parameters were measured by measuring the level of quality of water (pH, temperature, conductivity, TDS, and salinity) and soil (pH, temperature, and texture). Lastly, vegetation analysis and visual observation by the researchers were employed in the area, and community interviews were conducted using a survey questionnaire.

Figure 3. (A) Laying of the transect line; (B) Species identification; (C) Physicochemical analysis of water and soil; (D) Community interview.

Study Area and Respondent Selection - The study was conducted in coastal barangays located within a one-kilometer radius of the mangrove forest. A simple random sampling design was employed to select participants, ensuring that all members of the population had an equal chance of being chosen as respondents. The selected respondents provided information on mangrove resource dependence, food security, and conservation efforts. In addition, key informants—specifically the fisherfolk's president, a barangay employee, and the coastal resource management officer—were purposively selected as respondents to assess conservation efforts related to mangrove forests. Respondents were also asked about their willingness to pay for the conservation of mangrove ecosystems. The demographic variables considered in the study included age, educational attainment, and source of income, while the socio-economic variables focused on community-based conservation initiatives related to mangrove ecosystems.

3. Result and Discussion

Mangrove Identification - The researchers recorded a total of 8 true mangrove species representing 5 families, namely (Acanthaceae, Euphorbiaceae, Rhizophoraceae, Arecaceae, and Sonneratiaceae), and 1 mangrove associate represented by (Pteridaceae) in Barangay Bagacay, Tinambac, Camarines Sur (Table 2). Among the most represented families were the Rhizophoraceae with 3 species, followed by the Acanthaceae with 2 species, while the remaining families had 1 species each, where species from the families Rhizophoraceae and Acanthaceae often account for a large portion of species diversity (Baylon et al., 2025; Primavera & Esteban, 2008). Among the most dominant species in the area was the *Kandelia candel* with 34 recorded individuals, followed by *Nypa fruticans* with 25 individuals. The dominance of *K. candel* is particularly significant due to its restricted and localized distribution in the Philippines and its known sensitivity to changes in water flow and soil conditions (Malabrigo et al., 2021). While *Sonneratia ovata* and *Acrostichum aureum* earned the third spot with 16 individuals each. *R. apiculata*, *R. mucronata*, *E. agallocha*, *A. volubilis*, and *A. ilicifolius* had fewer numbers (Table 1). This can be attributed to its natural zonation patterns, regeneration after disturbances or selective environmental conditions, which are frequently seen in mangrove forests affected by both natural and anthropogenic activities (Ellison et al., 2020; Baylon et al., 2025).

Table 1
Partial record of the identified mangrove species in Bagacay, Tinambac, Camarines Sur

Species	Q1	Q2	Q3	Total
Acanthus ilicifolius	1			1
Acanthus volubilis	1			1
Excoecaria agallocha			3	3
Kandelia candel	8	14	12	34
Rhizophora apiculata		1	1	2
Rhizophora mucronata		7		7
Nypa fruticans	9	3	13	25
Sonneratia ovata	9	7		16
Acrostichum aureum			16	16

The dominance of Rhizophoraceae in Bagacay is common in South Asian mangrove forests, where *R. apiculata*, *R. stylosa*, and *R. mucrunata* are resilient to tidal fluctuation and salinity gradients (Rangkuti et al., 2025). This species serves as the cornerstone of coastal communities as it provides ecological functions, such as sediment stabilization and coastal defense, and it serves as the foundation of mangrove rehabilitation (De Los Santos et al., 2025). Surprisingly, the presence of the rare mangrove species, *K. candel*, in Bagacay is promising, as this type of mangrove can only be found exclusively in the province of Aurora (Malabrigo et al., 2021). The recent visit of the renowned mangrove expert Dr. J.H. Primavera confirmed the existence of *K. candel* (Figure 4) in the Bicol Region. Even the Department of Environment and Natural Resources (DENR), Goa, confirmed the presence of *K. candel*. According to the Coastal Resource Management Office (CRMO) of Tinambac, headed by Mr. Felicito Delos Santos, the investigation is still ongoing to determine whether the *K. candel* species found in Bagacay is planted by humans or naturally regenerated, brought by the ocean current, a known process in mangrove propagule movement (Ellison et al., 2020). He also added that there are 300+ individuals of *K. candel* already recorded in Bagacay as of the present. Among the dominant partially identified species by the team was *K. candel*, with 34 individuals. The *K. candel* is very sensitive to the quality of water and soil, reducing the chances of successful colonization in other areas (Malabrigo et al., 2021). The result represents the thriving dominance of *K. candel* in Bagacay, which could indicate that the brackish environment of the area is ideal for the survival of the said species. This finding supports earlier observations of its local abundance and persistence, despite species known sensitivity to changes in water flow and soil characteristics (Malabrigo et al., 2021; Ramli et al., 2022).

Moreover, there were efforts made by the locals to plant their propagules in other parts of the mangrove forest; however, the mortality rate reached 100% suggesting the true nature of its sensitivity to soil and water. This result associates with the earlier studies indicating that *K. candel* is highly sensitive which shows low a survival when planted outside its preferred microhabitat (Malabrigo et al., 2021; Ellison et al., 2020). The same mortality patterns have been widely observed in mangrove restoration projects where species are introduced without careful consideration on site specific environmental conditions, particularly in the case of habitat-specialist species (Ellison et. al, 2020).

Table 2
Composition of mangrove species in Bagacay, Tinambac, Camarines Sur

Family	Scientific Name	Local Name	IUCN Global
True Mangrove			
Acanthaceae	Acanthus ilicifolius	Lagiwliw, Ragoyroy	LC
	Acanthus volubilis	Lagiwliw, Ragoyroy	LC ↓
Euphorbiaceae	Excoecaria agallocha	Lipata, Buta-buta	LC ↓
Rhizophoraceae	Kandelia candel	Bakawan Baler	LC ↓
	Rhizophora apiculata	Bakawan Lalaki	LC ↓
	Rhizophora mucronata	Bakarwan Babae	LC ↓
Arecaceae	Nypa fruticans	Nipa, Sasa	LC
Sonneratiaceae	Sonneratia ovata	Pedada	NT ↓
Mangrove Associate			
Pteridaceae	Acrostichum aureum	Palaypay	LC ■

Legend: IUCN – NE (Not Evaluated); DD (Data Deficient); LC (Least Concern); NT (Near Threatened); VU (Vulnerable); EN (Endangered); CR (Critically Endangered); EW (Extinct in the Wild); EX (Extinct)
Population Trend – Decreasing ↓ Stable ■ Blank is Unknown.

The documentation of 8 true mangrove and 1 mangrove associate suggests that the species richness of the mangrove area is below the typical range of 10 – 14 species for a Philippine mangrove stand (De Los Santos et.al 2025). According to the International Union for the Conservation of Nature (IUCN), the identified mangroves were mostly tagged as (LC) or least concern; however, the population trend continues to decrease. *Sonneratia ovata* is the only identified species that has been tagged by IUCN as near threatened, suggesting its vulnerability to endangerment. The presence of associate mangrove in the area *Acrostichum aureum* suggests its colonization in the seaward portion of the sampling site, the probability of disturbance, canopy gaps, and altered hydrology (De Los Santos et.al 2025).

Figure 4. Taxonomic description of Kandelia candel

Physicochemical Analysis of Water and Soil - The physicochemical parameters of water and soil provide baseline values for the ecological condition and sustainability of the mangrove forest in supporting mangrove growth and survival (Ellison et al., 2020).

Table 3
Physicochemical parameters of water in Bagacay, Tinambac, Camarines Sur

Parameters	pH	TDS (mg/L)	Temperature (°C)	Conductivity (mS/cm)	Salinity (mg/L)
Mean Value	7.77	678.33	30.23	899.67	506
Optimal Range	6.70 to 8.00	15,000 to 35,000	19 to 30	≤ 50,000	≤ 35,000

The pH value is within the range, neutral to slightly alkaline, which is ideal for mangrove microbial activity and nutrient cycling in mangrove environments (Alongi, 2014). TDS or Total Dissolved Solids is very low, indicating freshwater dominance; far below brackish estuarine levels, likely influenced by river input or seasonal rainfall (Ellison et al., 2020). The temperature is slightly high but they remain within acceptable limits, typical of tropical mangroves during a hot day (Alongi, 2014). The conductivity is very low, confirming low ionic strength and freshwater influence, which is a common condition associated with riverine input and rainfall-dominated mangrove systems (Ellison et al., 2020). While the salinity is extremely low, having an average value of 506 mg/L, equivalent to ~0.5 ppt, far below the 15–35 ppt range typical for mangroves (Alongi, 2014). These freshwater-dominated conditions contrast from the preferred salinity range of most mangrove species and show that the site is mainly influenced by freshwater inputs rather than regular tidal seawater exchange (Malabrigo et al., 2021).

Table 4
Physicochemical parameters of soil in Bagacay, Tinambac, Camarines Sur

Parameters	pH	Temperature (°C)	Texture
Mean Value	6.67	26.33	Silt/Sand
Optimal Range	5.00 to 7.50	24 to 32	Silt/Sand–Loam Clay

Soil characteristics help explain the persistence of mangrove species at the area of the study. The pH value is slightly acidic to neutral, ideal for mangrove root respiration, microbial activity and nutrient availability (Alongi, 2014). The temperature is within the optimal range, supports enzymatic activity, organic matter decomposition, and seedling growth (Ellison et. al. 2020). While the texture is suitable, promotes aeration and water retention, typical of mangrove intertidal zones, which is distinct productive mangrove sediments and supports root stability and oxygen exchange (Ramli et al., 2022). The water of Bagacay is freshwater-skewed, likely due to strong riverine input or seasonal rainfall. This deviates from the brackish conditions *Kandelia candel* typically prefers, suggesting adaptive resilience or transitional habitat use. Meanwhile, the soil conditions of Bagacay are highly suitable for *K. candel*; the soil texture promotes root anchorage and oxygen diffusion. At the same time, the pH and temperature support microbial processes and nutrient availability. With this baseline data, it is no surprise that the *K. candel* survives in Bagacay due to the favorable conditions that the area offers, emphasizing the importance of site-specific environmental factors in mangrove persistence (Malabrigo et al., 2021; Ellison et al., 2020).

Figure 5. (A) Rivirine stand of mangrove in Barangay Bagacay;

(B) Representative of mangrove stand in beachfront area

Mangrove Identification - During the field sampling, the team observed the vegetation area of the mangrove forest dominated by the *K. candel*. Based on the satellite image (Figure 2), local households are near the sampling site. Associated with the presence of community is the presence as well of human trash in the area; however, we cannot conclude yet that 100% of the trash found is coming from the nearby community. Some of which might come from the upper community brought by the flow of the river, or possibly brought by the wave from other nearby municipalities. which is common pathway for trash buildup in mangrove ecosystem (Bijsterveldt et al., 2023). This buildup can alter forest structure and reduce mangrove ecosystem functions by suppressing roots and affecting sediment conditions (Isniani and Mutaqin, 2025). In terms of canopy coverage, large gaps are evident as a recent category 5 typhoon devastated the town of Tinambac a week before the sampling schedule. Severe typhoons create canopy damage, tree breakage and loss of mangrove canopy, especially in exposed coastal location (Alongi, 2008). Human imprints of the past are observed, since the mangrove forest was a former fishpond zone by the residents. Conversion of mangroves to aquaculture ponds is reported to modify hydrological regime, destroy soil structure as well as retard the restoration process of the ecosystem after abandonment of ponds (Setyawan et al., 2002; Primavera, 2006). Finally, the team observed that the mangroves in the area are infested with disease and insect infestation. Mangrove under environmental stress, from land conversion to changes in water flow or storm to damage, are more susceptible to pests and disease that can compound forest health issues and weaken its ability to resist declining mangrove conditions (Rahman et al., 2024).

Figure 6. (A) One of the researchers standing on a ruin remains inside the mangrove forest, highlighted by an orange circle; (B) Infested leaves of K. candel

Demographic profile of the respondents

Table 5
Demographic profiles of the respondents

Variable	Category	Frequency (n)	Percentage (%)
Age	18-25	0	0
	26-35	1	5.55
	36-45	2	11.11
	46 and above	15	83.33
Sex	Male	10	55.55
	Female	8	44.44
Highest Educational Attainment	Elementary	9	50
	High School	8	44.44
	Vocational/Technical	0	0
	College Graduate	1	5.55
Occupation	Fisherman/gleaning of crabs	10	55.55
	Farmer	0	0
	Employee	2	11.11
	Fish Vendor	6	33.33
Total Respondents (N) = 18			

Table 5 shows the demographic profile of the respondents in terms of age, sex, highest educational attainment, and occupation. Majority of resource harvesters in the mangrove were male (55.55%), while females (44.44%) primarily contributed through household-based activities and selling of fish in the local market. Women are as much economic players in the local fisheries value chain as men, with both consuming and selling their catch (Middleton, et. al. 2024). Most respondents (83.33%) were aged 46 years and above, possessing extensive ecological knowledge of the mangrove ecosystem and demonstrating the capacity to engage in mangrove-related livelihood activities, such as crab gleaning. Older fisherfolk often possess familiarity about seasonality of resources, availability patterns and harvesting methods that support livelihood activities (Ecology & Society, 2021). Mangrove ecosystems represent great direct economic importance to the livelihoods of millions of coastal residents throughout the world who harvest marine resources; extract timber for construction, firewood, and charcoal production (Suman, 2019).

In terms of educational attainment, most respondents had completed elementary (50%) and high school (44.44%), while only 1 had reached college levels (5.55%). This educational profile shows limited access to formal employment opportunities, which may contribute to the community's continued dependence on mangrove resources for income and subsistence (Ecology & Society, 2021). The primary occupation of the respondents was gleaning crabs, followed by fishing and fish vending.

Socio-Economic Dependence on Mangroves

Table 6
Socio-Economic Dependence of respondents on mangrove resources

Variable	Category	Frequency (n)	Percentage (%)
Resources obtained from mangroves	Fish	0	0
	Crabs ("*an-it*")	18	100
	Honey	0	0
	Fuelwood	0	0
Frequency of Harvesting	Daily	11	61.11
	Weekly	5	27.78
	Rarely	2	11.11
Level of importance of mangroves	Very important	18	100
	Moderately important	0	0
	Slightly important	0	0

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Conservation Status of Mangrove Ecosystem - Most residents recognized the ecological significance of the mangrove ecosystem, including its function as a fish nursery, a natural barrier against strong waves, and a habitat

rich in fish and crabs. Additionally, the area contributes to local pride due to its frequent visitation by researchers, which has been recognized value of local ecosystems and appeared to increase community awareness (Bennett, et. al., 2018). Based on the interview, legal restrictions on mangrove cutting, discourage residents from cutting down the trees due to the associated sanctions. Awareness of the law and local policies has shown positive impact to the community compliance and participation in mangrove conservation (Reciproco et al., 2023). However, residents faced several challenges in maintaining the ecosystem. Despite legal restrictions on mangrove cutting, some residents especially children always cutting down trees without facing any penalties. This situation reflects the weak enforcement of environmental laws in the area. Another issue is the scattered waste along the coastal area. Additionally, lack of personnel responsible for the "*Bantay Bakawan*" program, primarily due to insufficient funding, limits effective enforcement and monitoring of the policies on mangrove protection (Reciproco et. al., 2023). Nevertheless, residents expressed willingness to pay with any amount for the conservation management of the mangrove ecosystem, indicating positive attitude of the local community toward being stewards of the environment and for sustainable management of resources (Reciproco et. al., 2023).

Most residents participate in mangrove protection activities organized by the barangay and local government units (LGUs), including the "Mangrove Planting Program", coastal clean-up drives and educational awareness campaigns. The involvement of the community in mangrove management has been widely shown to improve conservation outcome by strengthening local stewardship, adherence with the regulations and long-term sustainability, especially when supported by effective governance frameworks (Walters, 2004; Primavera & Esteban, 2008). Despite for these initiatives, there is a need for stronger enforcement of ordinances and environmental laws related to mangrove protection, improved information dissemination, and the provision of incentives to support the sustainable maintenance of the mangrove ecosystems.

During the mangrove planting activities, participants were unable to identify the specific species they had introduced into the area. Notably, they were unfamiliar with *Kandelia candel*, a rare mangrove species documented in Bagacay, Tinambac, Camarines Sur. The presence of this species in the locality is significant, as *Kandelia candel* is a true native mangrove in the Philippines and has been assessed as critically endangered due to its limited distribution and declining populations (Malabrigo, et., al, 2021). Its occurrence in Bagacay suggests unique ecological conditions that support its growth, making the site an important refuge for biodiversity. The lack of awareness among community members regarding its identity, origin, and ecological role highlights a gap in local knowledge and conservation practice. Understanding when and how *Kandelia candel* was established in Bagacay is crucial, as it provides insights into species dispersal, habitat suitability, and biodiversity conservation. Moreover, raising awareness of its rarity and ecological importance can strengthen community-based conservation initiatives and ensure that such valuable species are protected for future generations. However, the respondents acknowledged the importance of protecting mangrove species.

4. Conclusion

This study assessed the mangrove ecosystem of Barangay Bagacay, Tinambac Camarines Sur using field observations and community-based information. The site supports eight true mangrove species and one mangrove associate, with *Kandelia candel* and *Nypa Fruticans* identified as the most abundant species. The occurrence of *K. candel* emphasizes the ecological significance of the area because of its limited distribution in the Philippines and its sensitivity to environmental changes. Water measurements indicated that the site is dominated by freshwater conditions, as shown by very low salinity and conductivity values. Despite these conditions, soil characteristics such as pH, temperature, and texture were favorable for mangrove growth and contributed to the continued presence of *K. candel*. These results suggest that suitable soil conditions play a key role in supporting mangrove species in Bagacay.

Several signs of disturbance were observed in the mangrove forest, including canopy gaps caused by recent typhoons, remains of old fishponds, pest infestation, and scattered solid waste. These disturbances affect the structure of the forest and may reduce its stability if not properly managed. The local community depends heavily

on mangroves, especially for crab gleaning, which is an important source of income. Most residents are aware of the importance of mangroves and are willing to help in conservation activities. However, weak enforcement of local rules, lack of manpower, and limited knowledge about mangrove species have reduced the effectiveness of current protection and planting efforts. Overall, the mangrove ecosystem in Barangay Bagacay is still functioning but remains vulnerable to natural and human-related pressures. Continued protection, proper management based on scientific findings, and stronger involvement of the community are needed to maintain the benefits provided by the mangrove forest.

Implications and Significance - Despite its rarity, the persistence of *Kandelia candel* in Bagacay implies a critical research frontier for understanding mangrove resilience in coastal systems. As a keystone mangrove species, it plays a pivotal role in ecological functions such as shoreline stabilization, carbon sequestration, and the provision of nursery habitat, underscoring the necessity of integrating a broader framework for climate adaptation and environmental justice. Moreover, its existence demonstrates the significance of Bagacay in safeguarding a rare mangrove species, and it highlights the area's role as a critical ecological and educational resource for the future to come. The absence of integrated assessment, lack of baseline data, and limited species information limit our knowledge of the mangrove forest area in Bagacay, Tinambac, and underline the need for more investigation and study. This rapid assessment of the mangrove forest in Bagacay could lay the foundation for future researchers, students, and educators to conduct a thorough study of the area. It provides a site for advancing studies on mangrove ecology, ecosystem services, and climate resilience.

For teachers, practitioners can design field-based activities such as mangrove mapping, biodiversity monitoring, or shoreline experiments that connect classroom theory with real-world ecological processes. This also allows teachers to bridge environmental science with economics, sociology, and human behavior. Students could gain exposure to ecological fieldwork methodologies, data collection, and analysis, fostering skills in scientific investigation and critical thinking. In addition, by engaging students with rare mangrove species, learners develop environmental consciousness and a sense of responsibility towards the local ecosystem. Schools and academies can position themselves as hubs for environmental education, partnering with local government, NGOs, and fisherfolk associations to co-develop conservation programs. This rapid assessment provides baseline materials for the schools to design science-based action plans and policy recommendations, tailored to the Philippine context.

Recommendation - Future studies should focus on understanding the origin, growth, and long-term survival of *Kandelia candel* in Bagacay. Monitoring water and soil conditions during different seasons and expanding sampling areas will help improve future mangrove management and conservation planning. The presence of the rare *Kandelia candel* in Bagacay could signify the significance of the mangrove forest, with its prevalence in the area elevates the conservation value of the site. Existing *Kandelia candel* trees should be protected, and the planting of this species should only be done in areas with suitable soil and water conditions. Mangrove planting activities should follow proper species selection to increase seedling survival. Local government units should strengthen the enforcement of mangrove-related rules. Reviving the Bantay Bakawan program can help improve monitoring and reduce illegal cutting and waste dumping. Providing funds for the organization's patrol efforts, signboards, and waste control will support these efforts. The community should be given more training on mangrove species identification and their ecological importance. Increasing community awareness about *K. candel*, e.g., providing information brochures, will help residents be more informed and protect this species. Involving students and youth groups in mangrove activities can also encourage long-term care of the mangrove forest.

AI Use Disclosure - We used Grammarly and Co-Pilot, the latest versions in paraphrasing, correcting grammatical text while preserving its original meaning, and idea generation. All outputs were reviewed, verified, and edited by the authors, including fact-checking sources and validating results. No confidential or personally identifiable data were entered into AI tools. The authors take full responsibility for the content.

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