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Ethnobiological Knowledge And Conservation Of Seagrass Ecosystems In Davao Oriental, Philippines

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Abstract. *This study investigates the traditional ecological knowledge (TEK) and conservation of seagrass ecosystems in Barangay Lawigan, City of Mati, Davao Oriental, Philippines. Using a mixed ethnobiological approach, data were collected from 50 purposively selected respondents through interviews, focus group discussions, participant observation, and field validation. The research aimed to document local classifications, uses, and perceptions of seagrass, while assessing how knowledge varies across gender, age, and livelihood groups. Findings show that residents possess extensive knowledge of seagrass ecosystems, highlighting their ecological roles as nursery grounds, sources of food and income, and cultural resources. Five seagrass species were identified, with Enhalus acoroides emerging as the most culturally significant, as reflected by its highest Use Value (UV). High Informant Consensus Factor (ICF) scores indicate strong agreement on the importance of seagrasses for fisheries productivity, coastal protection, and biodiversity support. Despite this, conservation remains limited due to economic vulnerabilities, destructive practices, and weak enforcement of local ordinances. Existing community initiatives, such as coastal clean-ups and Bantay Dagat patrols, are not explicitly targeted at seagrass protection. The results reveal a significant gap between the community's rich ecological knowledge and the lack of institutional recognition for seagrass conservation. The study highlights the significance of TEK in guiding community-based and policy-aligned seagrass conservation. Integrating TEK into marine spatial planning and institutional frameworks can enhance biodiversity protection, climate resilience, and sustainable coastal livelihood.*
Keywords: *community perspective, ethnobiological knowledge, Philippines, seagrass ecosystem,*

INTRODUCTION

Seagrass diversity and ecosystem function has emerged as a key research frontier, especially for communities whose livelihoods and cultural traditions are closely bound to coastal ecosystems. Seagrass meadows are important ecosystems that provide many ecological benefits including carbon storage, habitat for marine life and coastal protection. Although seagrass plays a crucial ecological role, its socioeconomic importance is still poorly acknowledged. Economic constraints (Inocentes et al., 2025) and limited community awareness of the ecological and economic importance of seagrass often lead to low participation in conservation efforts (Lukman et al., 2021; Gruberg et al., 2022). The pressure to secure short-term income drives some communities to exploit seagrass habitats, resulting in biodiversity loss and reduced ecosystem services. Addressing these challenges requires assessing and strengthening the community's traditional ecological knowledge to promote sustainable seagrass conservation and protection.

In the Philippines, where many coastal communities rely heavily on small-scale fisheries, seagrass conservation has become increasingly critical. The continued decline of seagrass meadows has led to the loss of nursery habitats for endangered species, weakened fish stocks, degraded water quality, and reduced carbon sequestration capacity (Sondak & Kaligis, 2022). Despite these ecological functions, seagrasses receive far less

conservation attention than coral reefs or mangroves. Consequently, public awareness of their value remains low, with studies indicating that people often perceive coral reefs as providing greater ecosystem services than seagrasses (Woodhead et al., 2021). This imbalance in perception is further compounded by limited education and community engagement, which constrain the effectiveness of conservation efforts (Mikkonen & Raatikainen, 2024).

Moreover, economic pressures and livelihood demands drive some communities to convert seagrass habitats into areas for aquaculture or tourism (Rasowo et al., 2020), thereby overlooking their vital role in sustaining fisheries and local food security (Imbwae et al., 2025). These challenges are even more pronounced in developing regions, where access to environmental education and conservation resources remains limited (Amone-Mabuto et al., 2023). Hence, addressing these issues requires integrated strategies, such as community-based awareness programs, ecotourism initiatives (Pernice et al., 2024), and the inclusion of seagrass education in school curricula (Ahmad-Kamil et al., 2024), to enhance ecological understanding and promote long-term conservation and sustainability (Ibrahim et al., 2022; Spotswood et al., 2025).

Although TEK is frequently incorporated into terrestrial ethnobiological studies, few Philippines seagrass studies combine TEK with quantitative ethnobiological indices such as Use Value (UV) and Informat Consensus Factor (ICF). This creates a research gap in understanding how TEK can inform adaptive, culturally grounded management of marine ecosystem. This study addresses this gap by documenting and analyzing the community's ethnobiological knowledge and perceptions of seagrass ecosystems, including traditional classifications, uses, beliefs, and observed ecological changes over time. It further examines how demographic factors such as gender, age, and occupation influence the distribution and transmission of TEK, providing insight into intergenerational knowledge flow and conservation values.

By assessing the extent and depth of this traditional knowledge, the research seeks to evaluate its contribution to maintaining the ecological integrity of seagrass meadows and promoting sustainable resource use. Moreover, it addresses the limited quantitative understanding of TEK in Philippine coastal communities, where such knowledge remains underutilized despite its potential to inform adaptive and culturally grounded conservation strategies. Integrating these community insights with scientific inquiry strengthens the foundation for inclusive, policy-relevant approaches to seagrass management, advancing ecological sustainability, cultural resilience, and food security amid ongoing environmental change.

MATERIALS AND METHODS

Study Site

The study was conducted in Barangay Lawigan, situated in the City of Mati within the province of Davao Oriental, Philippines. Geographically, the area is located approximately at 6.8022° N latitude and 126.3311° E longitude (6° 48' North, 126° 20' East). The communities within this Barangay were selected because they have (1) common livelihood activities; (2) high reliance on the local ecosystem for meeting both primary and secondary livelihood needs; and (3) abide by the same local ordinances.

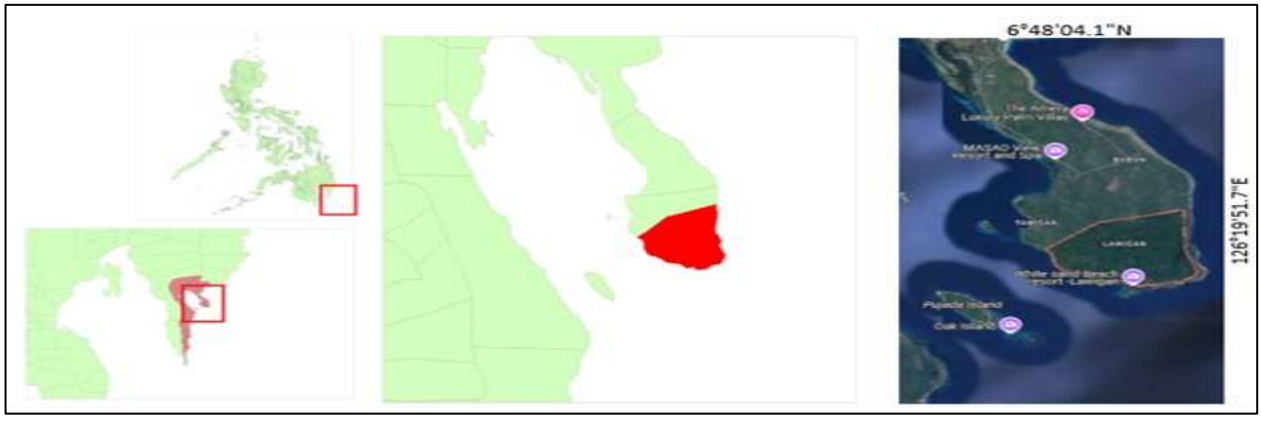

Figure 1. Map of study location in Barangay Lawigan, City of Mati, Davao Oriental, Philippines

Research Design

The study used a qualitative–quantitative ethnobiological approach to document and analyze traditional knowledge related to the seagrass ecosystem. Primary data were gathered through semi-structured interviews, focus group discussions (FGDs), participant observation, and field validation.

Participant Selection

Fifty (50) participants were purposively selected based on residency, age, socioeconomic background, and involvement in coastal and marine activities such as fishing, gleaning, and seaweed farming. The criteria ensured representation across community roles, including elders, traditional fishers, women resource users, and youth, and allowed the study to capture both traditional ecological knowledge and insights shaped by recent education and modernization. Considering socioeconomic status and length of residency helped reflect the varied ways households interact with and depend on local resources.

Data Gathering

Two FGDs with 5–7 participants each were conducted to examine shared knowledge, consensus, and gendered perspectives. Discussions were held in Cebuano to encourage natural expression. All interviews and FGDs were audio-recorded, transcribed verbatim, and translated into English for coding and analysis. Guiding questions focused on seagrass identification, ecological functions, traditional uses, perceived environmental changes, conservation practices, and cultural beliefs.

To validate species identification, guided field walks and in-situ verification were conducted with selected informants. Seagrass specimens were photographed, geotagged, and compared with scientific references using taxonomic keys and regional databases.

Data Analysis

Data analysis followed a mixed-methods approach, integrating descriptive statistics and thematic analysis.

Quantitative data derived from structured portions of the interview were analyzed using PAST software or Microsoft Excel to generate frequency counts, percentages, and cross-tabulations. These results were used to identify trends in knowledge distribution across gender, age groups, and livelihood categories.

Qualitative data from interviews and FGDs were analyzed using thematic coding. Transcripts were manually coded and categorized into emergent themes such as local taxonomy, traditional ecological knowledge, cultural beliefs, resource threats, and conservation practices. A grounded theory approach was applied to allow themes to emerge inductively from the data (Stough & Lee 2021). Triangulation was conducted by comparing results across different data sources (interviews, FGDs, field notes) to ensure validity and reliability of findings.

To quantify the degree of consensus among informants regarding the perceived uses and importance of seagrass species, two ethnobiological indices were employed: the Informant Consensus Factor (ICF) and the Use Value (UV). The ICF measures the extent of agreement among community members by comparing the number of individual use-reports with the number of taxa cited for a particular use category, thereby reflecting the homogeneity of traditional knowledge and the relative cultural importance of different species. Meanwhile, the UV provides an index of the relative significance of each species based on the frequency and diversity of uses mentioned across all informants. In this study, uses were categorized according to their specific functions, while a distinct use-report was defined as a single mention of a particular use by one respondent. Multiple mentions of the same use by different individuals were each counted separately, ensuring that the calculations of UV and ICF captured both the breadth of knowledge and the depth of consensus within the community.

Informant Consensus Factor (ICF) was calculated as (Nur – Nt) / (Nur – 1), where Nur is the number of use-reports in a category and Nt the number of taxa cited. While, Use Value (UV) was computed as $\Sigma Ui / N$, with Ui representing uses mentioned per informant and N the total number of informants. These indices provided a clear picture of how local ecological knowledge is structured and how it can guide community-based seagrass conservation strategies.

Ethical Consideration

Ethical approval was secured from the funding agency's Research Ethics Board. Barangay permits were obtained, and informed consent was collected from all participants. Community consultations were conducted to ensure transparency and encourage local participation.

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RESULTS

Demographics

Figure 1 illustrates the demographic profile of respondents in terms of age, gender, length of residence, and income. Among the 50 participants, 65% were male and 35% female. Age distribution shows that 60% were between 31 and 60 years old, indicating a predominantly middle-aged population; 21% were under 30, while 12% were over 60, representing the elderly group. With regard to residency, about 65% had lived in the community for more than 20 years, reflecting strong local ties and historical familiarity with the environment. In contrast, only 12% were short-term residents with less than five years of stay, including one newcomer who had resided in the area for just two weeks. Lastly, a significant 91% reported monthly incomes below ₱13,000, while only 7% earned between ₱30,001 and ₱40,000.

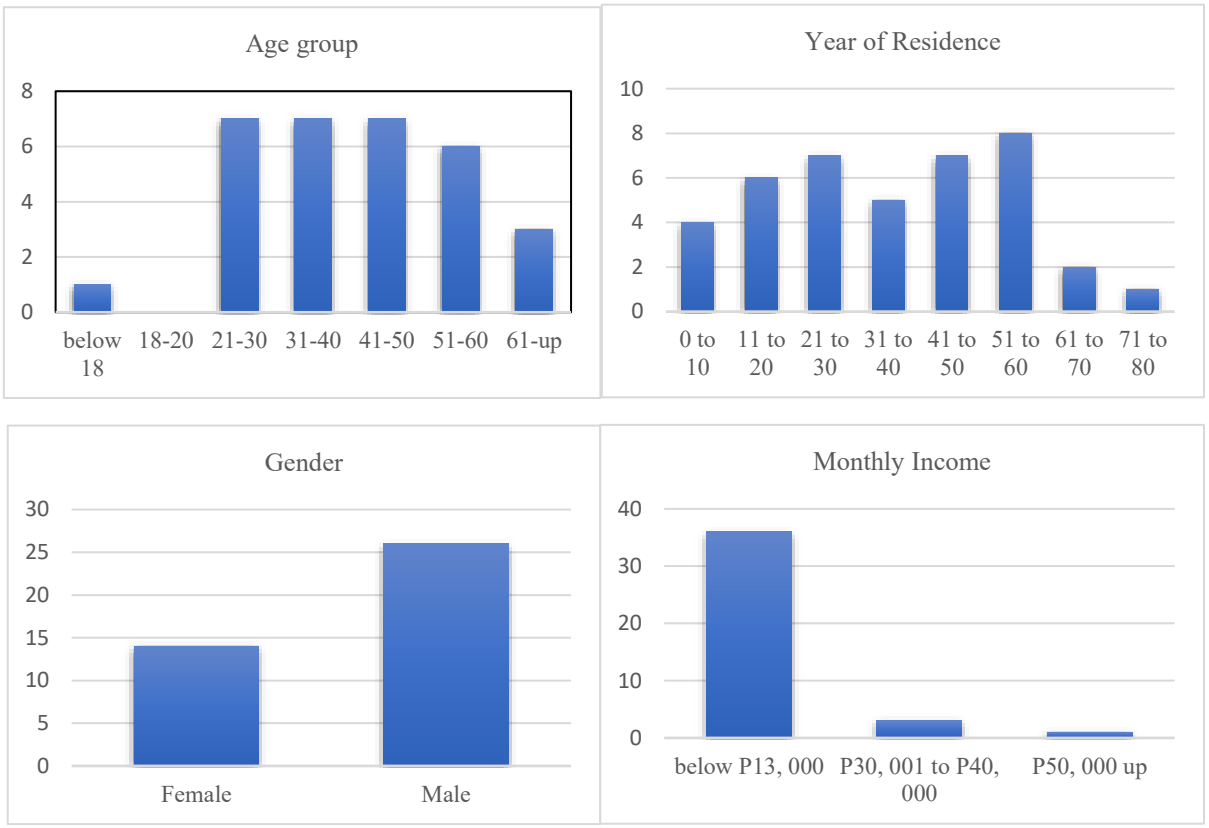

Figure 1. Socio-demographic distribution of respondents in Barangay Lawigan, encompassing age, gender, years of residence, and income level

Use Value and Informant Consensus Factor Calculation

Figure 2A illustrates the calculated use values of five commonly recognized seagrass species based on the use-reports gathered from 50 respondents, while Figure 2B presents the Informant Consensus Factor (ICF) analysis, which evaluates the level of agreement among respondents across specific use categories, including livelihood support, coastal protection, and ecological functions.

The results indicate that Enhalus acoroides accounts for the largest share of total use value at 29%, making it the most utilized seagrass species among those recorded. Cymodocea rotundata and Syringodium isoetifolium each represent 23%, showing comparable levels of use. Halodule pinifolia contributes 18%, reflecting a moderate use value, while Halophila capricorni has the lowest proportion at 7%, indicating minimal use. The distribution shows an uneven pattern of use values, with utilization concentrated in a few dominant species and substantially lower use attributed to others.

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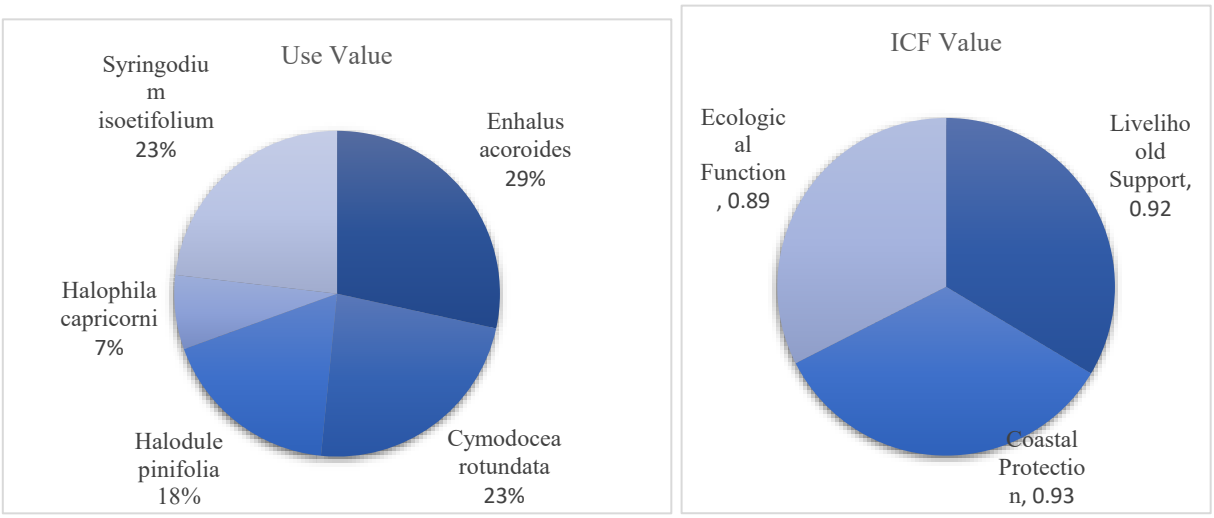

Figure 2A use value calculation for five commonly identified seagrass species based on use-reports collected; figure 2B informant consensus factor analysis measures the degree of agreement among 50 respondents

On the other hand, ICF values were consistently high across all categories, with 0.93 for coastal protection slightly exceeding livelihood support with 0.92 and ecological function with 0.89. The uniformly elevated ICF scores indicate strong community consensus regarding the multifunctional value of seagrass meadows, particularly their roles in shoreline stability, habitat provisioning, and livelihood support.

Demographic profile and its relation to seagrass knowledge and management

Table 1 presents an integrative matrix linking key demographic factors with community observation knowledge, ecological implications, and corresponding intervention priorities in Barangay Lawigan. The matrix synthesizes both quantitative survey patterns and qualitative insights to illustrate how variables such as residency length, income level, gender, and economic capacity influence Traditional Ecological Knowledge (TEK) and conservation behavior. It also identifies associated vulnerabilities or strengths and proposes targeted, priority-ranked interventions to enhance seagrass stewardship and adaptive management within the community.

The demographic analysis reveals that long-term residency (65%) is a major strength in the community, as residents with more than two decades of experience in Barangay Lawigan have developed detailed phenological knowledge of seagrass ecosystems. Their awareness of seasonal cycles, such as seagrass growth during the Amihan season and senescence during Habagat, provides a reliable baseline for ecological monitoring and adaptive restoration planning. This underscores the critical role of place-based ecological knowledge in sustaining conservation efforts. Engaging these residents as local monitoring stewards and involving them in participatory phenology tracking programs would not only strengthen conservation but also legitimize traditional ecological knowledge (TEK) as a scientific complement.

Table 1. Integrative matrix showing how key demographic variables relate to community perception indicators

Demographic Factor	Community Observation / Knowledge	Ecological Implication	Vulnerability or Strength	Recommended Intervention	Priority
Long-term residency (>20 yrs, 65%)	Detailed phenological knowledge	Adaptive baseline	Strength	• Local monitoring stewards • Co-design participatory phenology tracking programs	High

Demographic Factor	Community Observation / Knowledge	Ecological Implication	Vulnerability or Strength	Recommended Intervention	Priority
Short-term residents (<5 yrs, 12%)	Less integrated into traditional knowledge networks	Knowledge transmission gap	Weakness	• Onboarding/orientation sessions • Peer-mentoring from long-term residents	Medium
Income below ₱13,000 (91%)	Reliance on destructive fishing	Anthropogenic disturbance	Weakness	• Low-cost alternative livelihood • Community-based microfinance for conservation-friendly enterprises	Very High
Gender (65% male / 35% female)	Males report boat/compressor impacts; Females report trampling from gleaning	Gender-differentiated impacts	Mixed: different impact vectors offer entry points for tailored outreach	• Gender-responsive outreach and training	High
General economic vulnerability	Low capacity to invest in restoration or protective infrastructure	Adoption lag	Weakness	• Low-cost, community-led strategies	High

By contrast, short-term residents (12%) are less integrated into traditional knowledge networks, which creates a gap in ecological familiarity and knowledge transfer. Without proper orientation, they may inadvertently continue harmful practices, posing a risk to long-term conservation. While their number is relatively small, their potential impact highlights the importance of onboarding and peer-mentoring mechanisms to bridge knowledge gaps and ensure that ecological stewardship becomes a shared community norm.

The results indicate that poverty is the most critical driver of seagrass degradation in Barangay Lawigan, with the majority of households belonging to low-income groups with 91%. Economic vulnerability compels residents to adopt unsustainable practices such as compressor fishing, poison fishing, and intensive gleaning, all of which inflict significant ecological damage through uprooting, trampling, and chemical stress. These findings emphasize the inseparability of livelihood pressures from ecological impacts, underscoring the need to link conservation with socioeconomic interventions.

Also, gender dynamics shape patterns of resource use and disturbance. Men are primarily associated with practices that damage seagrass through boat traffic and compressor fishing, while women are more closely linked to trampling during gleaning. This highlights the different ways in which men and women interact with seagrass ecosystems and suggests that gender-responsive strategies could strengthen conservation outcomes.

Overall, the community demonstrates strong ecological knowledge and concern for seagrass ecosystems but faces structural limitations due to persistent poverty and limited financial capacity. Without addressing these socioeconomic constraints, restoration and protection efforts risk being unsustainable once external support diminishes.

Perceived benefits of seagrass to the community and the actions taken

Figure 3 highlighted two main themes regarding community action to protect seagrass and these are the challenges in enforcement and local coastal management programs and initiatives. Also, presents the perceived benefits of seagrass ecosystems among various community demographic variables, highlighting three major themes namely; livelihood support, coastal protection, and fish habitat and nursery.

The responses reveal distinct social patterns in how different groups understand the benefits of seagrass and the actions needed for its management. Long-term residents tend to emphasize ecological functions, such as fish nursery roles and coastal protection, reflecting deeper place-based knowledge shaped by years of observing local tides, fisheries, and habitat changes. Short-term residents, by contrast, appear less anchored to these ecological details and focus more on immediate livelihood needs or visible enforcement gaps. Gender also shapes the distribution of knowledge, for instance, men, who are often more involved in fishing activities, highlight habitat and resource-use concerns, while women more frequently point to livelihood support and household-level vulnerabilities, illustrating how daily responsibilities influence what aspects of the seagrass system they notice and value. Moreover, economic vulnerability cuts across these groups, amplifying concerns about enforcement and local management actions, as people with fewer financial buffers tend to prioritize interventions that directly stabilize income and resource access.

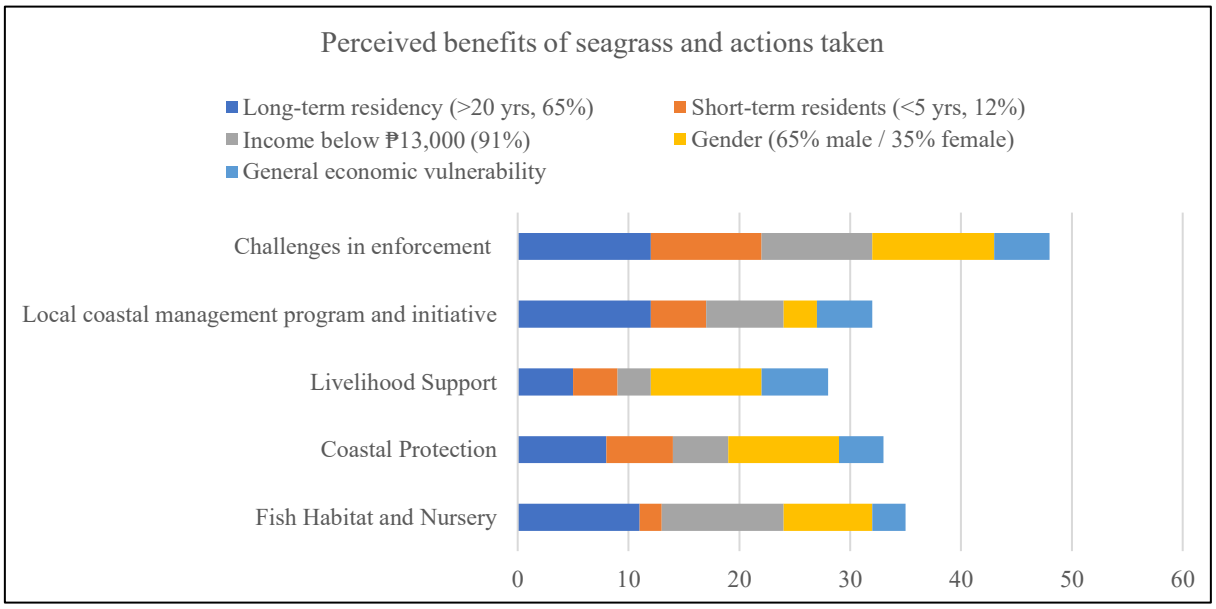

Figure 3 illustrates community perceptions of the benefits and community actions provided by seagrass ecosystems across different demographic groups

The results show that while coastal management programs are recognized by the community, weak and inconsistent enforcement remains the main concern, reflecting gaps in institutional capacity and resources. Long-term residents demonstrate the highest awareness of both initiatives and enforcement issues, making them crucial stakeholders in conservation. Low-income households emphasize enforcement challenges more strongly, as livelihood pressures undermine compliance, while gendered perspectives reveal activity-specific concerns that call for gender-sensitive strategies.

DISCUSSION

The findings of the study underscore the role of lived experience of Barangay Lawigan as a foundation for social–ecological resilience. Their gathered understanding of seagrass species, seasonal cycles, and human impacts represents adaptive learning within an interaction between human–environment system (Wollschlaeger et al. 2022; Tang et al. 2023; Spilker et al. 2020). For example, the need for cost-sensitive ecological awareness initiatives and management, as most residents may lack the financial means to adopt costly sustainable technologies. When combined with the high proportion of long-term residents, this suggests

that while environmental awareness and concern may be present, active participation could be constrained by economic limitations. This localized expertise supports community-based co-management, where TEK complements scientific monitoring by offering fine-scale, context-specific observations that are often overlooked in formal assessments. Such approaches provide a low-cost foundation for adaptive management (Zhao et al. 2022; Leach et al. 2025), though sustained partnerships with higher-income sectors and institutional support remain necessary (Birendra et al. 2021; Pollock et al. 2024).

Community observations revealed a focus on culturally visible species, while less conspicuous taxa were seldom mentioned, an expression of practical selectivity inherent in TEK systems (AngSinco-Jimene 2003; Jones et al. 2022). Residents also associated seagrass phenology with monsoonal shifts, paralleling ecological research linking temperature, rainfall, and salinity to productivity (Bricknell et al. 2021; Aouititen et al. 2025). This convergence demonstrates how TEK not only validates but also enriches scientific understanding by embedding ecological change within lived experience.

However, the persistence of destructive practices such as poison and compressor fishing, boat anchoring, and trampling reveals the fragility of local stewardship systems, echoing similar socio-ecological tensions across tropical seascapes (Betts et al. 2020; Making et al. 2022; Sualang et al. 2024; Mwikamba et al. 2024). Despite community awareness, seagrasses remain undervalued compared to mangroves and coral reefs, reflecting a global policy bias that marginalizes this ecosystem (Vedharajan 2023; Capistrant-Fossa 2024). Observations of parrotfish decline and reduced fish stocks reinforce the ecological significance of seagrass meadows as nurseries and biodiversity reservoirs (Herrera et al. 2022; Whitfield 2020; James & Whitfield 2023). Ethnobiological uses, such as fertilizer, livestock feed, and small-scale trade, further illustrate their multifunctional role in supporting livelihoods (Foster et al. 2025).

Existing grassroots initiatives, including Bantay Dagat patrols and coastal clean-ups, demonstrate local commitment but lack seagrass-specific focus. Weak enforcement and fragmented governance mirror broader patterns in Southeast Asia, Africa, and Latin America, where policy frameworks exist but implementation remains inconsistent (Camarillo et al. 2021; Sjöstedt et al. 2022; Guragain 2023). Even within designated marine protected areas, seagrass coverage is often minimal, as reported in Madagascar and the Gulf of California (Rakotonjanahary et al. 2024; Ramírez-Zúñiga et al. 2024). This governance gap underscores the need for adaptive co-management, wherein TEK is systematically integrated into legislation, monitoring, and restoration programs (Grimm et al. 2023; Herrera et al. 2023).

Overall, findings reveal a disconnect between community knowledge and institutional action. While residents possess strong ecological understanding, they lack access to structured programs that translate knowledge into conservation outcomes. Bridging this gap requires prioritizing high-use and high-consensus species, implementing TEK-informed management tools like seasonal closures, no-trampling zones, and embedding seagrass-specific measures in local policy frameworks. Integrating TEK within a science-based, co-managed system will be vital for sustaining biodiversity, fisheries productivity, and climate resilience in coastal communities (Griffiths et al. 2020; Twomey 2021).

CONCLUSION

The findings of this study show that the Traditional Ecological Knowledge (TEK) of Barangay Lawigan residents is not only the result of generations of experience but also a living example of how communities adapt to change. Their daily interaction with seagrass ecosystems has allowed them to read environmental signs, such as changes in species abundance, monsoon patterns, and water clarity, and adjust their fishing and harvesting methods accordingly. This reflects the idea in social–ecological resilience theory that communities can absorb disturbances and reorganize while maintaining their way of life.

Also, it illustrates the principles of co-management and common-pool resource theory, which emphasize shared responsibility between local communities and institutions in managing natural resources. The residents' deep ecological understanding, combined with ongoing challenges like poverty and weak enforcement, points to the need for participatory management that blends local knowledge with scientific data. With proper institutional support, communities can regulate their own resource use and promote sustainable practices. From a social capital perspective, it also shows the strength of trust, cooperation, and

shared values within the community, although these are sometimes weakened by income gaps and gender roles. Strengthening education, inclusivity, and collaboration can build both ecological and social resilience. Based on these insights, three key actions are recommended. Integrate TEK into marine spatial planning and ecological monitoring so that conservation reflects local realities and priorities. Then, create seagrass-specific local ordinances that formalize TEK and support community-based enforcement. Lastly, promote gender-inclusive monitoring and decision-making, acknowledging that men and women contribute different but equally important knowledge about the marine environment. Embedding these actions in a social–ecological systems framework will help Barangay Lawigan move from reactive conservation toward proactive, adaptive co-management, bridging science and tradition to protect biodiversity, strengthen livelihoods, and preserve cultural heritage.

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