

# AN ASSESSMENT OF MARINE SANCTUARY IN BARANGAY MOBOD, OROQUIETA CITY: PRELIMINARY CARRYING CAPACITY AND ECONOMIC VALUATION PERSPECTIVES FOR SUSTAINABLE TOURISM MANAGEMENT

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## Abstract

*This study assesses the sustainable tourism potential of the Marine Sanctuary in Barangay Mobod, Oroquieta City, explicitly highlighting its ecotourism capabilities, carrying capacity, management constraints, and economic valuation. Driven by the need to balance ecological protection with community livelihood, this research uniquely integrates a preliminary carrying-capacity framework and benefit-transfer estimates to guide responsible tourism development. Using a descriptive quantitative approach anchored in sustainable tourism management theory, the study evaluated responses from purposively selected stakeholders. The assessment reveals the sanctuary's strong potential for low-impact activities like snorkeling and firefly watching, alongside pressing management concerns related to sanitation, pollution, and coral depletion. Acknowledging limitations in site-specific data—such as daily visitor counts and willingness-to-pay responses, this study provides preliminary benchmarks for evaluating tourism limits. Ultimately, the findings extend current protected-area scholarship by demonstrating that tourism development in Mobod Marine Sanctuary must prioritize environmental monitoring, activity zoning, and locally retain economic benefits before commercial expansion.*

**Keywords:** *marine sanctuary, carrying capacity, preliminary economic valuation, sustainable tourism, marine protected area, Oroquieta City*

## INTRODUCTION

Marine protected areas and local marine sanctuaries are important mechanisms for balancing biodiversity conser-

vation, coastal livelihood, and tourism development. The global conservation agenda now emphasizes effective and equitable area-based protection; Target 3 of the Kunming-Montreal Glob-

al Biodiversity Framework calls for at least 30% of terrestrial, inland water, coastal, and marine areas to be conserved and effectively managed by 2030 (Convention on Biological Diversity, 2022). In this context, the sustainable development of Barangay Mobod Marine Sanctuary should be treated not only as a tourism initiative but also as a conservation, livelihood, and local governance concern. Conservation, coastal livelihood, and tourism development. The global conservation agenda now emphasizes effective and equitable area-based protection; Target 3 of the Kunming-Montreal Global Biodiversity Framework calls for at least 30% of terrestrial, inland water, coastal, and marine areas to be conserved and effectively managed by 2030 (Convention on Biological Diversity, 2022). In this context, the sustainable development of Barangay Mobod Marine Sanctuary should be treated not only as a tourism initiative but also as a conservation, livelihood, and local governance concern.

Coastal and ocean-based tourism can generate employment and enterprise opportunities, but it can also intensify pollution, habitat disturbance, crowding, and pressure on marine ecosystems when poorly

managed. The High Level Panel for a Sustainable Ocean Economy (2022) emphasizes that coastal and marine tourism should become sustainable, resilient, pollution-reducing, biodiversity-supporting, and beneficial to local communities. Recent reviews likewise note that marine protected areas increasingly need to quantify ecosystem services and social benefits to guide financing, zoning, monitoring, and management decisions (Arkema et al., 2024; Van Schoubroeck et al., 2024).

The earlier assessment examined the tourism potential, community perceptions, policies, and management conditions of Mobod Marine Sanctuary. The sanctuary is located in Barangay Mobod, Oroquieta City, Misamis Occidental, and the existing study identified a total sanctuary area of 20 hectares after an initial 5-hectare establishment and a later 15-hectare expansion. The original assessment also noted that the area supports fishery, mangrove, wildlife, research, and tourism values; however, it reported concerns such as pollution, deforestation, fishing pressures, coral depletion, sanitation problems, and incomplete infrastructure support (Balais, 2014).

This revised manuscript adds two planning concerns that

are highly relevant to sustainable marine tourism: carrying capacity and preliminary economic valuation. Carrying capacity refers to the level of visitor use that can be accommodated without unacceptable ecological damage, resident inconvenience, or decline in visitor experience. Economic valuation identifies the monetary and non-monetary benefits provided by the sanctuary, including recreation, tourism, fisheries, education, habitat protection, and community livelihood. Integrating these perspectives is necessary because tourism promotion without visitor limits and value-based conservation financing may increase site pressure without generating sufficient resources for long-term management.

### **Objectives of the Study**

This study generally assessed the sustainable tourism management potential of Mobod Marine Sanctuary in Barangay Mobod, Oroquieta City by examining stakeholder perceptions, site and management conditions, preliminary carrying-capacity implications, and indicative economic-valuation perspectives as bases for evidence-based conservation, visitor management, and community benefit-sharing.

Specifically, this study sought to:

1. Describe the demographic profile and perceptions of stakeholders using the original frequency, percentage, and weighted-mean results.
2. Identify site conditions, tourism activity potential, policies, and management issues affecting sustainable tourism development.
3. Interpret the existing findings through carrying-capacity and preliminary economic-valuation perspectives as baseline management evidence.
4. Propose updated sustainable tourism management recommendations for Mobod Marine Sanctuary.

### **METHODOLOGY**

#### *Research Design*

This study used a descriptive quantitative secondary-analysis design. It reorganized the existing data from the original undergraduate thesis into an IMRAD-style research article and supplemented the interpretation with updated literature on marine protected areas, visitor management, carrying capacity, and ecosystem-service valuation. No new field survey, interview, or ecological measurement was conducted for this revised manuscript; therefore,

all results should be understood as reanalysis and planning interpretation of an existing dataset.

### *Theoretical and Conceptual Lens*

The study was guided by three complementary lenses. First, social-ecological systems theory frames Mobod Marine Sanctuary as an interconnected system of ecological resources, local users, governance institutions, and management outcomes (Ostrom, 2009). Second, the tourism carrying-capacity approach supports the identification of physical, ecological, social, facility, and management constraints that influence acceptable visitor use (Cifuentes, 1992; Leung et al., 2018). Third, the economic valuation and total economic value perspective recognizes that marine sanctuaries generate direct-use, indirect-use, option, existence, and livelihood values, not only immediate cash revenue (Tamayo et al., 2018; Van Schoubroeck et al., 2024). Together, these lenses align the study's objectives, data analysis, and recommendations by connecting site conditions and stakeholder perceptions with zoning, visitor limits, conservation financing, and community benefit-sharing.

### *Research Locale*

The study site is Baran-

gay Mobod Marine Sanctuary in Oroquieta City, Misamis Occidental. The site was selected because it is a locally significant coastal and marine resource with conservation, fishery, education, livelihood, and tourism potential. Based on the existing assessment, the sanctuary began with 5 hectares and later expanded by 15 hectares, giving a total area of 20 hectares. Its relevance to the present study lies in the coexistence of tourism opportunities, such as snorkeling and nature-based recreation, and management concerns, such as pollution, coral threats, sanitation limitations, and the need for stronger local governance. These characteristics make Mobod Marine Sanctuary an appropriate locale for examining how carrying-capacity planning and preliminary economic valuation can support sustainable marine tourism management.

### *Respondents and Sampling*

The original study reported 34 valid respondents composed of five local officials, five tourism department staff, nine students, and fifteen local residents. Purposive sampling was used because respondents were selected based on their connection to the sanctuary and their capacity to provide relevant

information. However, purposive sampling is non-probability based; therefore, the findings may be affected by selection bias and should not be generalized to all residents, tourists, fisherfolk, vendors, and marine resource users of Barangay Mobod. Future studies should include a larger and more diverse sample representing visitors, fisherfolk, elderly residents, women vendors, tourism operators, youth, local guides, and coastal households.

### *Research Instrument and Data Source*

The existing instrument consisted of a questionnaire and interview guide divided into four major components: present status of the marine sanctuary, policies and laws, strategies and plans, and community participation. This revision used the tabulated survey results and interpretations in the existing thesis as its dataset. Because the data were already aggregated in tables, this manuscript does not include personally identifiable respondent information.

### *Ethical Considerations and AI Use Declaration*

Because this revised manuscript is based on secondary analysis of an existing aggregated dataset, no new human-participant data were collected.

The revision preserved confidentiality by presenting only grouped results and by avoiding personally identifiable information. For any future primary data collection, informed consent, voluntary participation, privacy protection, safe storage of responses, and permission from the relevant academic and local authorities should be secured. The authors should also obtain community-level permission when conducting site mapping, visitor surveys, willingness-to-pay studies, or ecological monitoring in the sanctuary.

AI-assisted language editing and organizational support were used to improve grammar, consistency, and manuscript structure. The authors remain responsible for verifying all data, calculations, citations, interpretations, and final scholarly claims.

### *Data Analysis*

Frequency and percentage were used for demographic profile, yes/no/uncertain responses, activity preferences, and management perceptions. Weighted mean was used for physical aspects, problems, and perceptions toward policies and laws. The original interpretation scales were retained in presenting the results. Ranking entries were

corrected for consistency, especially where equal mean scores required tied or averaged ranks.

### *Carrying Capacity and Preliminary Economic Valuation*

#### *Treatment*

The carrying-capacity component was integrated as a planning framework rather than as a final numerical computation because the original data do not include essential visitor-management variables such as daily visitor arrivals, effective recreation area per activity, visitor turnover, length of stay, water-quality thresholds, coral-cover limits, and management-capacity ratios. The recommended formula for a follow-up computation is:

- Physical Carrying Capacity (PCC) = Available visitor-use area / Area required per visitor x Rotation factor.
- Real Carrying Capacity (RCC) = PCC x correction factors for ecological, social, seasonal, and facility constraints.
- Effective Carrying Capacity (ECC) = RCC x management capacity coefficient.

The economic valuation component was likewise integrated as a preliminary management model. Exact monetary valuation was not computed because the available data do not contain entrance-fee records,

tourist expenditure, transportation cost, visitor origin, willingness-to-pay responses, household income, operating costs, or conservation expenditures. For a future study, the recommended valuation approaches are market pricing, user-fee analysis, zonal travel cost method, contingent valuation, and benefit-transfer analysis. Transferred values should be applied cautiously because marine sanctuary values vary by ecological condition and socioeconomic context (Lopez-Rivas & Cardenas, 2024; Van Schoubroeck et al., 2024).

#### *Secondary Data Integration for Carrying Capacity and Preliminary Economic Valuation*

Secondary data were added to strengthen the carrying-capacity and preliminary economic-valuation components of the study. These figures are not presented as final visitor limits or final monetary values for Mobod Marine Sanctuary. Instead, they are used as planning benchmarks because the available dataset lacks exact visitor counts, usable activity-zone measurements, daily operating hours, visitor turnover, water-quality records, coral-cover measurements, visitor expenditures, willingness-to-pay responses, and site operating costs.

**Secondary Carrying-Capacity Benchmarks**

The carrying-capacity benchmarks below were selected because they are commonly used in marine and reef-based tourism studies and are applicable to activities identified in the original survey, particularly snorkeling and scuba diving. For Mobod Marine Sanctuary, the re-

ported gross area of 20 hectares, equivalent to 200,000 square meters, should be treated only as the starting spatial variable.

The actual usable area must be mapped separately for snorkeling, diving, swimming, boat access, mangrove interpretation, conservation zones, and visitor facilities.

*Supplementary Table A. Secondary data and benchmark inputs for carrying capacity.*

Secondary datum/benchmark	Value or indicator	Source	Use in Mobod Marine Sanctuary study
Gross sanctuary area from existing manuscript	20 hectares or 200,000 sq. m.	Balais (2014); existing manuscript	Starting spatial variable only; must be reduced to usable visitor zones before computing PCC.
Snorkeling space benchmark	150 sq. m. per snorkeler	ADB (2022), Coron and El Nido carrying-capacity assessment	Philippine reef-tourism reference for a preliminary snorkeling PCC scenario.
Alternative snorkeling space benchmark	250 sq. m. per snorkeler	Tang et al. (2021), citing Hutabarat et al. (2009)	More conservative reference for low-density snorkeling in reef areas.
Scuba-diving space benchmark	500 sq. m. per diver, or 2 divers per 1,000 sq. m.	Tang et al. (2021), citing Hutabarat et al. (2009)	Reference value for a preliminary scuba-diving PCC scenario.
Reef-suitability correction variables	Coral cover, water brightness/turbidity, life-form diversity, reef-fish diversity, depth, current, and reef width/spread	Tang et al. (2021); Wibowo et al. (2021)	Variables to reduce PCC into RCC based on ecological sensitivity and activity suitability.
Management-capacity requirement	Site-specific biophysical assessment, stakeholder agreement, and capacity limits	ADB (2022); BIMP-EAGA (2022)	Variables to convert RCC into ECC after staffing, enforcement, facilities, and budget are assessed.

Using the secondary benchmarks above, only gross physical carrying-capacity scenarios can be illustrated. The computations below assume one visitor rotation and use the full 20-hectare area only to show the calculation. They should not

be used as official visitor limits because the full sanctuary area is not entirely available for recreation, and the figures have not yet been corrected for ecological, facility, social, seasonal, and management-capacity factors.

**Supplementary Table B. Indicative PCC scenarios using the 20-hectare gross area.**

Activity/benchmark scenario	Area basis	Formula	Indicative PCC result	Interpretation
Snorkeling using 150 sq. m. per visitor	200,000 sq. m.	200,000 / 150	1,333 visitor-instances per rotation	Upper-bound gross scenario; actual RCC/ECC will be lower.
Snorkeling using 250 sq. m. per visitor	200,000 sq. m.	200,000 / 250	800 visitor-instances per rotation	More conservative gross scenario; still requires zoning and correction factors.
Scuba diving using 500 sq. m. per diver	200,000 sq. m.	200,000 / 500	400 diver-instances per rotation	Gross scenario; must be reduced by coral condition, depth, current, and guide capacity.
Validated computation requirement	Mapped usable area only	Usable area / area required per visitor x rotation factor	To be computed after field mapping	Recommended for final PCC, RCC, and ECC computation.

The gross scenarios show that physical area may appear to accommodate many visitors, but sustainable tourism planning requires a lower effective limit. Real carrying capacity should subtract correction factors related to pollution, sanitation, coral condition, wildlife disturbance, visitor satisfaction, seasonality, and facility adequacy. Effective carrying capacity should then be adjusted based on available guides, Bantay Dagat enforcement, rescue capacity, restrooms, waste collection, signage, and monitoring resources.

### *Secondary Economic Valuation and Benefit-Transfer Inputs*

For preliminary economic valuation, the secondary data were used as benefit-transfer references. Benefit transfer is useful when local primary valuation data are not yet available, but it must be interpreted carefully because the monetary value of a marine sanctuary depends on actual reef condition, mangrove area, visitor demand, local spending, fisheries dependence, household income, willingness to pay, and management costs.

**Supplementary Table C. Secondary economic valuation data for benefit-transfer reference.**

Secondary datum	Reported value	Source	Application to Mobod Marine Sanctuary
Philippine coral reef total economic value (TEV)	US\$4 billion per year, or about US\$140,000 per sq. km. per year	Tamayo et al. (2018)	National benchmark for Philippine reef ecosystem services, including fisheries, tourism, and willingness-to-pay biodiversity values.
Asia-Pacific direct reef economic contribution	US\$25 billion per year from fishing and tourism; US\$19.5 billion from reef tourism	Bartelet et al. (2024)	Regional evidence that non-consumptive reef tourism can generate substantial economic

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Asia-Pacific direct reef economic contribution	US\$25 billion per year from fishing and tourism; US\$19.5 billion from reef tourism	Bartelet et al. (2024)	Regional evidence that non-consumptive reef tourism can generate substantial economic benefits.
Average reef economic productivity in Asia-Pacific	US\$112,000 per sq. km. of coral reef	Bartelet et al. (2024)	Alternative productivity benchmark for benefit-transfer sensitivity analysis.
Coron and El Nido marine ecotourism context	2019 tourist spending of about US\$424.5 million; 1,904 enterprises; 8,588 jobs; around 85% of tourists engaged in snorkeling and diving	BIMP-EAGA (2022), based on ADB data	Philippine context showing the economic relevance and pressure of reef-based tourism when unmanaged.
Valuation caution	Values vary by ecosystem condition, market access, visitor volume, and local socioeconomic context	Lopez-Rivas & Cardenas (2024); Van Schoubroeck et al. (2024)	Use secondary values only as planning estimates until local willingness-to-pay, travel-cost, expenditure, and cost data are collected.

**Supplementary Table D. Indicative benefit-transfer estimate using the 20-hectare sanctuary area.**

Benefit-transfer basis	Computation	Indicative annual value	Interpretation
Tamayo et al. (2018) Philippine reef TEV benchmark	0.20 sq. km. x US\$140,000 per sq. km. per year	US\$28,000 per year	Indicative ecosystem-service proxy only; not actual revenue.
Bartelet et al. (2024) Asia-Pacific reef productivity benchmark	0.20 sq. km. x US\$112,000 per sq. km. per year	US\$22,400 per year	Alternative direct-use productivity proxy only; not actual revenue.
Planning interpretation	US\$22,400 to US\$28,000 per year as indicative benchmark range	Requires local validation	Actual value should be recalculated after mapping reef/mangrove area, visitors, spending, willingness to pay, costs, and conservation benefits.

The indicative benefit-transfer range of US\$22,400 to US\$28,000 per year should be interpreted as a conservative planning proxy, not as cash income. It represents the possible ecosystem-service and direct-use productivity associated with a 0.20-square-kilometer marine area when

broad reef valuation benchmarks are transferred to the site.

For a defensible local estimate, a follow-up study should separately map reef, mangrove, seagrass, tidal-flat, and open-water areas; record visitor arrivals and spending; estimate willingness to pay; document operating and conservation

costs; and compute net benefits retained by the community and local government unit (LGU).

## Results

The results below were reorganized from the existing

survey and management data of the original assessment. The presentation follows a research article format and includes carrying-capacity and preliminary economic-valuation implications based on the findings.

Table 1. Respondent profile based on existing data (n = 34).

Profile variable	Category	Frequency	Percentage
Civil status	Single	30	88.24%
	Married	3	8.82%
	Missing	1	2.94%
Age	18-32 years old	33	97.06%
	63-77 years old	1	2.94%
Gender/Sex	Male	8	23.53%
	Female	25	73.53%
	Missing	1	2.94%
Educational attainment	High school graduate	1	2.94%
	College graduate	11	32.35%
	College level	16	47.06%
	Missing	6	17.65%

The existing profile shows that most respondents were single, aged 18-32 years old, female, and at the college level. This suggests that the assessment was largely informed by younger and relatively educated stakehold-

ers. While their responses are useful for tourism planning, future research should balance the sample by including more fisherfolk, elderly residents, women vendors, tourism operators, local guides, and actual visitors.

Table 2. Present physical aspects of Mobod Marine Sanctuary.

Dimension	Indicator	Mean	Rating	Rank
Uniqueness and natural beauty	Natural beauty	4.00	4	1
	Characteristics	3.74	4	2
	Unique attraction	3.68	4	3
	Beauty	3.29	3	4
	Existing tourism activity	2.56	2	5.5
	Recognized tourist attraction	2.56	2	5.5

	by the DOT			
	Aggregate	3.30	3	
Accessibility	Characteristics	3.74	4	1
	Regular/commercial transport	3.68	4	2
	Accessible by different vehicle types	3.65	4	3
	Accessible all year round	3.50	4	4
	Aggregate	3.64	4	
Basic onsite facilities	Relaxing area	3.65	4	1
	Clean, quality food service	3.09	3	2
	Direction and information signage	3.00	3	3
	Clean restroom	2.44	2	4
	Aggregate	3.04	3	

Accessibility received the strongest aggregate rating (mean = 3.64; rating = 4), indicating that the site can be reached by regular or commercial transportation and different vehicle types. Uniqueness and natural beauty received a moderate ag-

gregate rating (mean = 3.30), while basic onsite facilities also received a moderate aggregate rating (mean = 3.04). The lowest facility item was clean restroom (mean = 2.44), showing that sanitation must be prioritized before expanding tourism activities.

Table 3. Recent condition and present problems in Mobod Marine Sanctuary.

Problem/condition	Mean	Interpretation	Rank
Rapid pollution	2.52	Good	1
Pollution	2.00	Fair	2
Deforestation	1.97	Fair	3
Depletion of corals	1.82	Fair	4.5
Cyanide fishing	1.82	Fair	4.5
Dynamite fishing	1.76	Fair	6.5
Coral bleaching			
Wildlife hunting	1.61	Poor	8
Aggregate	1.91	Fair	

The aggregate problem rating fell within the Fair category (mean = 1.91), indicating that several environmental pressures were already visible in

the original assessment. Rapid pollution ranked first, followed by pollution and deforestation. Depletion of corals and cyanide fishing shared the next rank,

while dynamite fishing and coral bleaching also shared a rank. Wildlife hunting ranked last. These concerns are import-

ant carrying-capacity correction factors because they reduce the level of visitor use the site can safely accommodate.

Table 4. Tourism activity potentials and visitor motivations.

Item group	Response/category	Frequency	Percentage
Local officials launched activities to promote the sanctuary	Yes	20	58.82%
	No	7	20.59%
	Uncertain	6	17.65%
Potential activity	Snorkeling	28	82.35%
	Scuba diving	28	82.35%
	Firefly watching	22	64.71%
	Game fishing	21	61.76%
	Swimming	20	58.82%
	Mangrove paddle boating	13	38.24%
	Skimboarding	8	23.53%
	Kayaking	7	20.59%
Motivation	Relaxation	27	79.41%
	Family gathering	27	79.41%
	Enjoying nature	25	73.53%
	Exploration	24	70.59%
	Picnic	22	64.71%

The activity results suggest that the sanctuary has strong potential for low-impact marine and nature-based activities. Snorkeling and scuba diving were each identified by 82.35% of respondents, followed by firefly watching, picnic activities, game fishing, and swimming. Because this table includes multi-response items retained

from the original dataset, the percentages should be read as item-level response rates rather than as categories that total 100%. These activities require zoning, guide supervision, visitor briefing, and ecological thresholds to avoid coral trampling, wildlife disturbance, crowding, and waste accumulation.

**Table 5. Policies, protection activities, and management responsibility.**

Theme	Response/category	Frequency	Percentage
Policies imposed by the LGU for sustainability	Yes	23	67.65%
	Uncertain	8	23.53%
Protection activity	Clean-up activities	30	88.24%
	Public awareness, education, outreach	28	82.35%
	Guarding marine protected area	21	61.76%
	Orientation to residents	13	38.24%
Responsible actor	Government	29	85.25%
	Concerned citizens	20	58.82%
	People residing along the seashore	19	55.88%
LGU educates tourists and the local community	Yes	22	64.71%
LGU administers proper maintenance	Yes	16	47.06%

Most respondents recognized that policies existed and that clean-up activities and education campaigns were being conducted. However, only 47.06% affirmed proper maintenance, and sanitation-related concerns remained weak. Some categories in this table were retained as affirmative or selected responses from the original

dataset; therefore, percentages should be interpreted as item-level response rates where applicable. These findings show that policy presence does not automatically mean management effectiveness. Visitor limits and user-fee mechanisms must therefore be paired with monitoring, maintenance, enforcement, and transparent reinvestment.

**Table 6. Perception toward policies and laws implemented to sustain the sanctuary.**

Law/policy item	Mean	Remark	Rank
Forestry Code (PD 705)	3.70	Agree	1
Philippine Fisheries Code (RA 8550, as amended by RA 10654)	3.67	Agree	2
NIPAS Act (RA 7586, as amended by RA 11038)	3.64	Agree	3.5
Marine Pollution Decree of 1976 (PD 979)	3.64	Agree	3.5
Philippine Environmental Code (PD 1152)	3.63	Agree	5
Water Code of the Philippines (PD 1067)	3.61	Agree	6

Environmental Impact Statement System (PD 1586)	3.56	Agree	7
National Pollution Control Decree (PD 984)	3.55	Agree	8
Local Government Code (RA 7160)	3.48	Agree	9
Ecological Solid Waste Management Act (RA 9003)	3.33	Neutral	10
Toxic Substances and Hazardous and Nuclear Wastes Control Act (RA 6969)	3.30	Neutral	11
Code on Sanitation of the Philippines (PD 856)	2.39	Disagree	12
Aggregate	3.46	Agree	

The aggregate policy perception fell within the Agree category (mean = 3.46), suggesting that respondents were generally aware of legal and institutional support for the sanctuary. The strongest item was the Forestry Code, while the weakest was the Sanitation Code.

In an updated legal context, future sanctuary planning should also align with the Philippine Fisheries Code as amended by RA 10654 and the Expanded National Integrated Protected Areas System Act of 2018, where applicable to local protected-area governance.

Table 7. Strategies, plans, community support, and fish warden performance.

Strategy/management item	Response	Frequency	Percentage
Strategies/plans presented by the LGU for the community	Yes	19	55.88%
	Uncertain	13	38.24%
City government proposed strategies and plans	Yes	18	52.94%
	Uncertain	13	38.24%
Community supports city/LGU programs and plans	Yes	27	79.41%
Bantay Dagat/deputized fish wardens perform responsibilities	Yes	27	79.41%

The data indicate moderate visibility of LGU plans, high community support, and strong perceived performance of the Bantay Dagat or deputized fish wardens. The uncertainty rates for LGU plans and

city proposals remain important because they show a need for clearer communication of sanctuary zoning, carrying-capacity rules, user fees, permitted activities, prohibited activities, and conservation responsibilities.

**Table 8. Carrying-capacity implications from existing data.**

Component	Existing evidence	Planning implication
Available baseline area	20 hectares or approximately 200,000 square meters	Can be used only as a starting area variable. Usable visitor area must be mapped separately for snorkeling, diving, walking, picnic, boat access, and restricted zones.
Ecological correction factors	Pollution, deforestation, coral depletion, cyanide fishing, dynamite fishing, coral bleaching, wildlife disturbance	These factors reduce real carrying capacity and must be monitored before expanding tourist activities.
Facility correction factors	Restroom weakness, moderate food service, moderate signage, limited maintenance confirmation	Facilities influence visitor satisfaction and sanitation carrying capacity.
Social/experiential factors	Relaxation, family gathering, enjoyment of nature, exploration, picnic	The sanctuary should provide low-density recreation to preserve nature-based experiences.
Management capacity factors	Bantay Dagat/fish warden support, LGU plans, education activities, clean-up drives	Management capacity can increase effective carrying capacity only when enforcement, staffing, equipment, and funding are documented.
Required missing data for computation	Visitor counts, visit duration, operating hours, exact visitor-use area, water-quality data, coral-cover data, staffing ratio, equipment capacity	These must be collected before a defensible PCC, RCC, and ECC can be computed.

The existing data allow a qualitative carrying-capacity diagnosis but not a final numerical carrying-capacity estimate. The available 20-hectare area confirms the spatial scale of the sanctuary, but visitor-use zones are not identified. Therefore, the next study should compute activity-specific carrying capacity for snorkeling, scuba diving, firefly watching, game fishing, swimming, and land-based recreation separately. A single site-wide visitor number may be misleading because marine areas, mangrove areas, beach areas, and facility areas have different ecological limits.

**Table 9. Preliminary economic valuation framework for Mobod Marine Sanctuary.**

Value component	Possible indicator/source	Management use
Direct use value	Entrance fee, snorkeling/diving guide fee, boat fee, rental of low-impact equipment, food service, souvenir sales	Can support maintenance, sanitation, patrolling, visitor briefing, and livelihood opportunities.
Indirect use value	Fish nursery function, mangrove support, shoreline protection, education and research value	Should be recognized even when not collected as cash income.
Non-use and option values	Existence value of coral, mangrove, wildlife, and future visitation	Can be measured through willingness-to-pay and contingent valuation surveys.
Cost side	Waste management, restroom repair, patrol fuel, staff training, signage, monitoring, safety equipment	Must be deducted from gross revenue to identify net management benefit.

Recommended method	Travel cost method, contingent valuation, user-fee analysis, market pricing, benefit transfer	A mixed valuation approach is recommended because marine sanctuary value is both monetary and non-monetary.
Safeguard	Community benefit-sharing and transparent fund use	User fees should be reinvested in conservation and shared with local stakeholders to maintain support.

The preliminary economic valuation framework shows that Mobod Marine Sanctuary can generate direct and indirect benefits if managed properly. The original recommendation to implement entrance fees is consistent with the need for a conservation financing mechanism. However, the fee should be based on willingness to pay, visitor demand, management cost, carrying capacity, and community benefit-sharing rather than being imposed arbitrarily.

## DISCUSSION

The findings show that Mobod Marine Sanctuary has viable ecotourism potential but remains vulnerable to ecological and facility-related constraints. The high accessibility rating is favorable for tourism development; however, accessibility can also accelerate visitor pressure if not accompanied by carrying-capacity controls. In protected areas, ease of access is beneficial only when it is matched with visitor orientation, sanitation systems, designated paths or zones, and enforcement capac-

ity. This supports protected-area visitor management literature that emphasizes the need to connect recreation opportunities with site-specific management limits and monitoring systems (Leung et al., 2018).

The sanctuary's natural beauty and possible low-impact activities provide strong foundations for sustainable tourism. Snorkeling and scuba diving were the highest-ranked potential activities, but these are also activities that can damage coral habitats if poorly managed. For this reason, the sanctuary should adopt activity zoning that separates no-entry conservation zones, supervised snorkeling and diving zones, boating routes, firefly-watching areas, swimming areas, and community livelihood spaces. This is consistent with recent marine protected area scholarship that links ecosystem-service benefits, community well-being, and site-specific management actions (Arkema et al., 2024).

The environmental concerns found in the existing study are directly relevant to carrying capacity. Pollution, deforesta-

tion, coral depletion, cyanide fishing, dynamite fishing, coral bleaching, and wildlife disturbance should be treated as correction factors that lower the real carrying capacity of the sanctuary. In practical terms, the number of visitors should not be increased simply because the total area is 20 hectares. Instead, carrying capacity should be computed only after mapping usable zones, sensitive habitats, facility capacity, safety capacity, and management capacity. This interpretation extends the original assessment by translating environmental problems into specific management variables for future PCC, RCC, and ECC computation. The policy and governance results are promising but uneven. Respondents generally agreed that laws and policies exist, and the community recognized the role of government, education, clean-up activities, and fish wardens. However, weak sanitation and moderate maintenance indicate that enforcement and infrastructure remain key gaps. This finding supports broader marine protected area literature showing that ecological and economic benefits are more likely when protected areas are effectively governed, monitored, and locally supported (Costello, 2024).

Preliminary economic valuation is important because marine sanctuaries often provide benefits that are not reflected in local budgets. These benefits include fish habitat, nursery functions, education, research, recreation, coastal protection, and community pride. The indicative benefit-transfer range presented in this manuscript should therefore be interpreted as a planning estimate rather than actual income. Updated valuation literature emphasizes that marine ecosystem-service values vary by ecological condition, market access, visitor demand, local livelihoods, and management cost; thus, transferred values must be validated with local willingness-to-pay, travel-cost, revenue, and expenditure data (Lopez-Rivas & Cardenas, 2024; Van Schoubroeck et al., 2024).

The revised findings suggest a management pathway: first, improve sanitation and facilities; second, map activity zones; third, compute activity-specific carrying capacity; fourth, conduct willingness-to-pay and travel-cost surveys; fifth, adopt a transparent environmental user-fee system; and sixth, monitor ecological indicators such as coral condition, water quality, fish presence, mangrove health, wildlife disturbance, and waste

volume. This pathway aligns the sanctuary with the broader goal of sustainable coastal and marine tourism that supports ecosystem regeneration, pollution reduction, local employment, and conservation financing (High Level Panel for a Sustainable Ocean Economy, 2022).

### *Limitations of the Study*

This revised manuscript has important limitations. First, it relied on a secondary dataset from an earlier local assessment and did not collect new field data. Second, the original respondents were purposively selected and relatively few in number; therefore, the findings may not fully represent all residents, visitors, fisherfolk, tourism enterprises, and coastal resource users. Third, the available data do not include daily visitor counts, actual visitor-use areas, average length of stay, operating hours, visitor turnover, water-quality data, coral-cover measurements, biodiversity indicators, willingness-to-pay responses, tourist expenditure, local revenue records, operating costs, or management-capacity indicators. For these reasons, the carrying-capacity and economic-valuation components should be read as preliminary planning frameworks and in-

dicative estimates only, not as final visitor limits or definitive monetary valuation results.

## CONCLUSION

Based on the objective, the study concludes that Mobod Marine Sanctuary possesses significant potential for sustainable tourism management; however, its development must be guided by a conservation-oriented, evidence-based, and community-responsive framework. The sanctuary's accessibility, natural attributes, community support, and suitability for low-impact marine and nature-based activities provide a strong foundation for responsible tourism development. Nevertheless, identified concerns such as pollution, sanitation deficiencies, facility limitations, coral-related threats, and insufficient confirmation of regular maintenance suggest that tourism expansion should be pursued cautiously. Any development initiative must therefore be gradual, closely monitored, and supported by appropriate zoning, ecological assessment, visitor management systems, and equitable community benefit-sharing mechanisms.

In relation to the first specific objective, the findings indicate that the existing assessment

was largely informed by young and relatively educated stakeholders, with female and college-level respondents comprising a substantial proportion of the sample. Their perceptions reflect an awareness of the sanctuary's tourism and conservation value. However, to strengthen the representativeness and validity of future assessments, subsequent studies should include a broader range of stakeholders, particularly fisherfolk, local vendors, tourism workers, actual visitors, coastal households, and other community members directly affected by sanctuary management and tourism activities.

With respect to the second specific objective, the study identifies accessibility, natural beauty, and the potential for activities such as snorkeling, scuba diving, firefly watching, swimming, and other nature-based recreational experiences as the sanctuary's major strengths. At the same time, the findings reveal critical management concerns, including pollution, deforestation, coral depletion, weak sanitation systems, and inadequate facility maintenance. Although respondents acknowledged the presence of policies, local government initiatives, clean-up activities, public awareness efforts, and Bantay Dagat enforcement,

the results suggest the need for stronger policy implementation, improved maintenance systems, and clearer communication of rules, responsibilities, and conservation guidelines.

In terms of the third specific objective, the carrying-capacity and preliminary economic-valuation perspectives emphasize that the sanctuary's 20-hectare area should not be treated as a sufficient basis for increasing visitor volume. The available secondary dataset does not allow for the responsible computation of final physical, real, and effective carrying capacity, nor does it support a definitive monetary valuation of the site. Such estimates require more comprehensive site-specific data, including visitor arrivals, usable activity zones, length of stay, ecological indicators, water quality conditions, management capacity, tourist expenditures, willingness-to-pay responses, operating costs, and the extent of economic benefits retained by the local community.

Finally, in relation to the fourth specific objective, the sustainable management of Mobod Marine Sanctuary should prioritize sanitation improvement, facility upgrading, activity zoning, conservation-based visitor limits, guide supervision, transparent

environmental user fees, regular ecological monitoring, and community benefit-sharing. Overall, the sanctuary should be developed as a low-impact marine tourism destination only when adequate management systems are in place and when carrying-capacity and economic-valuation data have been validated through site-specific research.

## RECOMMENDATIONS

- Conduct a full carrying-capacity study before increasing visitor promotion or adding new activities. The study should compute physical, real, and effective carrying capacity per activity zone and validate the secondary benchmarks used in this revision.
- Prepare an updated site zoning plan identifying strict protection zones, snorkeling and diving zones, firefly-watching zones, swimming areas, boat routes, waste-control points, visitor facility zones, and community livelihood spaces.
- Conduct a full economic valuation study using travel cost, contingent valuation, user-fee analysis, market pricing, and benefit-transfer approaches. The study should estimate monetary and non-monetary values and validate the indic-

ative benefit-transfer range presented in this revision.

- Implement a transparent conservation entrance fee or environmental user fee after determining willingness to pay and management cost. A portion of the fee should support sanitation, patrols, coral monitoring, waste management, local guides, and community livelihood.
- Prioritize sanitation and facility improvement, especially clean restrooms, solid-waste management, directional signage, safe access points, and visitor briefing areas.
- Strengthen monitoring of pollution, coral condition, mangrove health, fish presence, water quality, wildlife disturbance, and visitor behavior. Monitoring results should guide visitor limits and seasonal restrictions.
- Provide regular training for Bantay Dagat, guides, tourism staff, and local vendors on marine conservation, safety, visitor management, first aid, and customer service.
- Develop low-impact tourism packages such as guided snorkeling, environmental education tours, firefly watching, mangrove interpretation, and community-based food and souvenir services.
- Improve community communication by pub-

licly posting policies, permitted activities, prohibited activities, user fees, visitor limits, and the use of collected fees.

- Update legal and policy references in future documents to include the Philippine Fish-

eries Code as amended by RA 10654, the Expanded NIPAS Act of 2018 where applicable, the Ecological Solid Waste Management Act, local ordinances, and other relevant coastal resource management policies.

**Proposed Updated Conceptual Framework**

*Table 10. Updated conceptual framework for sustainable management of Mobod Marine Sanctuary.*

Framework stage	Content
Input	Sanctuary resources, existing physical conditions, community support, policies, visitor activity potential, and management capacity.
Assessment tools	Carrying-capacity analysis, preliminary economic valuation, environmental monitoring, stakeholder perception survey, willingness-to-pay survey, and visitor-use mapping.
Management actions	Zoning, visitor limits, user fees, sanitation improvement, enforcement, education, ecological monitoring, and benefit-sharing.
Expected outcome	Sustainable marine tourism, improved conservation financing, protected biodiversity, better visitor experience, stronger local governance, and community livelihood support.

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