

Local Government Unit Initiative on Implementing Marine Protected Areas in Barangay Kamanga and Colon, Maasim Sarangani Province

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Abstract. This study assessed local government unit initiatives in implementing Marine Protected Areas (MPAs) in Maasim, Sarangani Province. The evaluation focused on the effectiveness of MPA program implementers using the Management Effectiveness Assessment Tool (MEAT), collected secondary data on coral reefs and reef fish conditions, conducted a community perception survey, and assessed socioeconomic impacts. Despite the establishment of MPAs and the adoption of related policies, knowledge gaps persist regarding their actual effectiveness in achieving conservation objectives. This study evaluated the management performance of two MPAs: Kamanga Marine Ecotourism Park and Sanctuary and Colon Marine Sanctuary. Employing a descriptive design, MEAT was used to assess their effectiveness. Results indicate that both MPAs were well-established, with robust stakeholder involvement and legal enforcement. However, Kamanga Marine Ecotourism Park and Sanctuary outperformed Colon Marine Sanctuary in areas such as patrolling, infrastructure, institutional support, and impact assessment. Kamanga Marine Ecotourism Park and Sanctuary received an "excellent" rating, while Colon Marine Sanctuary was rated "very good." Both MPAs have stable funding, but Colon Marine Sanctuary requires monitoring, communication, public engagement, and financial management improvements. The study also identified challenges from natural factors and human activities, including pollution and fishing. However, there is positive community awareness about MPAs, and fishers report benefits such as increased fish stocks.

Keywords: Marine protected areas; Environmental protection; Coral reef assessments; Sustainable practices; Local government initiatives.

1.0 Introduction

The Earth's oceans are vital ecosystems that provide numerous ecological services, including climate regulation, oxygen production, and the provision of resources for millions of people worldwide. However, increasing human activities, such as overfishing, pollution, and habitat destruction, have placed immense pressure on marine biodiversity and ecosystem health. In response to these challenges, Marine Protected Areas (MPAs) have emerged as critical conservation tools to safeguard marine ecosystems, mitigate human-induced impacts, and ensure the sustainable use of aquatic resources (IUCN 2020).

In the Philippines, MPAs are designated sections of the ocean where human activities are restricted. This is done to conserve marine life, habitats, and the natural processes that keep the ocean healthy. MPAs can encompass diverse ecosystems like coral reefs, seagrass meadows, mangroves, and even deep-sea environments. Human activities are regulated in these areas to protect and conserve marine biodiversity, habitats, and ecological processes. By limiting or restricting fishing, mining, and coastal development, MPAs offer a sanctuary for marine

species, allowing them to thrive and maintain healthy population levels. (Claudet, et al., 2011). A growing body of scientific evidence supports the establishment and effectiveness of MPAs. Numerous studies have demonstrated the positive impacts of MPAs on marine biodiversity, including increased species abundance, diversity, and Biomass (Edgar et al., 2014). Establishing and managing Marine Protected Areas (MPAs) is a complex process that requires effective stakeholder engagement and collaboration between scientists, policymakers, local communities, and indigenous peoples. The effectiveness of MPAs relies on the engagement of stakeholders, who possess valuable expertise on the social, economic, and environmental aspects that impact the administration of these regions (Twitchell et al., 2018).

Furthermore, MPAs can generate socioeconomic benefits by supporting sustainable fisheries, enhancing tourism, and securing livelihoods for coastal communities. (Gill et al. 2017). However, numerous designated marine protected areas (MPAs) lacked more effective management strategies or inadequately implemented those that do exist, culminating in substandard administration and, at worst, the formation of "paper parks" (Maestro et al., 2019). Recognizing the growing urgency of environmental concerns, the Philippines has established a robust legal framework to support the creation of Marine Protected Areas (MPAs) at both national and local levels. This framework includes various legal instruments, facilitating the designation and management of MPAs for conserving marine ecosystems and biodiversity at national and local levels, aiming to conserve marine ecosystems and biodiversity.

The enactment of the National Integrated Protected Area System Act (RA 7586), amended as the Expanded National Integrated Protected Area System or RA 11038, aimed to integrate the concept of MPAs into a network. RA 10654, also known as the Fishery Code of 1998 and the Local Government Code of 1991, promotes local government units' establishment of marine reserves or sanctuaries. Republic Act No. 11038, known as the ENIPAS Act of 2018, established comprehensive guidelines for establishing and managing protected areas, including marine sanctuaries. This legislation established laws and procedures aimed at conserving biological diversity, encouraging the sustainable utilization of resources, and safeguarding vital ecosystems, thus strengthening the country's dedication to environmental management. The Philippine Fisheries Code of 1998, Republic Act No. 8550, was promulgated to enhance the legal framework for Marine Protected Areas (MPAs). This legislation focuses on managing fisheries and aquatic resources, including provisions for establishing marine reserves and sanctuaries. The Fisheries Code plays a crucial role in maintaining the health and productivity of maritime ecosystems by controlling fishing operations and protecting important habitats. The abovementioned legal bases are significant because they contribute to environmental sustainability, biodiversity conservation, and the protection of fisheries resources. By establishing and enforcing MPAs, the Philippines seeks to achieve a harmonious equilibrium between preserving ecological integrity and fulfilling the socio-economic requirements of its population. The legislative frameworks enable local people and government agencies to work together to protect the seas, promoting a comprehensive and participatory approach to managing marine resources essential for the long-term well-being of Philippine waters.

The Municipality of Maasim is home to two designated MPAs: Kamanga Marine Ecotourism Park and Sanctuary, situated in Sitio Tampuan, Barangay Kamanga, and Colon Marine Sanctuary, located in Barangay Colon. These Maasim Marine Protected Areas were established on February 9, 2006, by enacting Ordinances Nos. 06-020 and 06-021. The Kamanga Marine Ecotourism Park and Sanctuary covers 43.85 hectares, and the Colon Marine Sanctuary covers 30.68 hectares. They are integral components of the extensive Sarangani Bay Protected Seascape. Recognizing the importance of measuring their effectiveness, the Local Government Unit (LGU) of Maasim emphasized the necessity for research to evaluate these MPAs in Maasim, Sarangani Province. Evaluating an MPA's management helps identify strengths and weaknesses, make informed decisions, and improve initiatives for the future. Moreover, the study provides baseline information for subsequent studies and the conservation and protection management of the Marine Protected Area of Maasim Sarangani Province.

2.0 Methodology

2.1 Research Design

This study covered the local government initiative to implement Marine Protected Areas in Maasim, Sarangani Province, using the Management Effectiveness Assessment Tool (MEAT), gathering secondary biophysical and ecological assessment reports, a socio-economic impact survey, and a community perception survey. Management

effectiveness was evaluated based on documents and physical outputs, including meeting minutes, accomplishment reports, the physical structure of observation posts, demarcation buoys, and other relevant aspects outlined in the Management Effectiveness Assessment Tool (MEAT). Biophysical and ecological impacts were measured through coral reef and reef fish assessments. The social and economic impact assessment was conducted through a questionnaire among registered Brgy fishers in Kamanga and Colon. Moreover, a survey questionnaire evaluated the community perception among heads of households, local organizations, wives of fishermen/farmers, students/youth (age 18 and above), local business owners, and school heads and teachers. These methods were simultaneously employed throughout the study period.

2.2 Research Locale

The study focused on the Marine Protected Areas in Maasim, Sarangani Province, specifically the Kamanga Marine Ecotourism Park and Sanctuary and the Colon Marine Sanctuary. Kamanga Marine Ecotourism Park and Sanctuary is located in Barangay Kamanga, Maasim Sarangani Province, with coordinates of 05°52'31.6" North and 125°05'31.5" East. This MPA is bordered on the east by Barangay Tinoto, on the North by South Cotabato-Sarangani Road, on the west by Sarangani Energy Corporation (SEC), and on the south by the Celebes Sea. While Colon Fish Sanctuary is located in Barangay Colon with coordinates of 5° 51 15.90" North and 125° 0 20.80" East, This MPA is bordered on the west by Barangay Población.

2.3 Research Participants

Three groups of respondents participated in this study. The first group involved program implementers, including the management body of the barangay council, BFARMCS, LGU of Maasim, NGAs, NGOs, Bantay Dagat, and industries. The second group comprises the community, heads of households, local organizations, wives of fishermen and farmers, students and youth (aged 15 and above), local business owners, and school heads and teachers. The third group consisted of registered fishermen residing in Barangay Kamanga and Colon, where Marine Protected Areas are located.

2.4 Research Instrument

The effectiveness of Marine Protected Areas (MPAs) management was assessed using the Management Effectiveness Assessment Tool (MEAT). MEAT, developed through the collaboration of several organizations, provides a streamlined and objective method to evaluate MPAs, focusing on key performance indicators and processes that contribute to effective management (MPA MEAT, 2011). This tool involves analyzing the outcomes of management actions to determine their success. In addition to MEAT, biophysical and ecological data were collected from municipal agriculturists and environmental centers.

This secondary data, which includes information on coral reefs and fish distribution, helps establish a baseline understanding of the marine ecosystem. By comparing current data with historical records, researchers can identify environmental trends and evaluate the impact of conservation efforts.

A Community Perception Survey was conducted to gauge local attitudes, knowledge, and practices concerning the MPA. This survey helps determine the community's awareness and understanding of the MPA, identifying areas needing further education and communication. A survey was administered to registered fishermen in Barangay Kamanga and Colon to assess the socio-economic impact of the MPA. This quantitative survey aimed to understand how the MPA has influenced their livelihoods, capturing their perceptions, concerns, and needs.

2.5 Data Gathering Procedure

This study utilized a range of methodologies. In February 2024, the researcher conducted preliminary surveys, interviews, and site validation throughout the second and third weeks. The secondary data collection for resource assessment for coral reefs and reef fish was scheduled for the second week of February 2024. Subsequently, in the third week of February 2024, a Management Effectiveness Assessment Tool (MEAT), a community perception survey, and a socioeconomic impact survey were conducted. Additionally, the researcher visited the local community for data gathering.

Before the respondents answered the questions, the researcher translated the community perception and socioeconomic questionnaires into the local dialect to overcome language barriers. Before collecting the required data

for the study, the researcher sought permission from the thesis adviser by drafting a letter. Furthermore, the researcher requested cooperation from the respondents, who were to fill out survey questionnaires to ascertain the impacts of the MPA on their community. The MEA tool was the foundation for assessing the MPA's management effectiveness.

2.6 Ethical Considerations

This research study adhered to ethical guidelines and received a certificate of exemption from ethics review from the Mindanao State University- General Santos Institutional Ethics Review Committee (MSU-General Santos IERC). The exemption was granted based on the requirements that were submitted, confirming that the study protocol and related documents had been reviewed and approved for implementation. The study, titled "Local Government Unit Initiative: Its Impact in the Implementation of Marine Protected Area in Barangay Kamanga and Colon, Maasim Sarangani Province," was assigned Approval No. 025-2024-MSUGSC-IERC with a Study Protocol Code of 2024-025-SR. The approval, effective from January 23, 2024, to January 23, 2025, was given under the provisions that the study involves a non-sensitive survey and the participants' names are anonymized.

3.0 Results and Discussion

3.1 Kamanga Marine Ecotourism Park and Sanctuary (KMEPS) Management Effectiveness

Table 1. Management Effectiveness Assessment Tool (MEAT) Evaluation Result for KMEPS

Level	Year requirement	Actual score	Possible score	All threshold questions satisfied?	MPA level satisfied?
Established At least one year At least 20 cumulative score All level I thresholds met	Yes	26	27	Yes	Yes
Strengthened At least 3 years At least 31 total cumulative score All levels 1 & 2 thresholds met	Yes	15	15	Yes	Yes
Sustained At least 5 years At least 47 total cumulative score All levels 1, 2 and 3 thresholds met	Yes	18	21	Yes	Yes
Institutionalized At least 7 years At least 63 total cumulative score All thresholds met	Yes	20	21	Yes	Yes

Level I (MPA is established)

The Management Effectiveness Assessment Tool (MEAT) evaluates Marine Protected Area (MPA) effectiveness in stages. At Level I, Kamanga Marine Ecotourism Park and Sanctuary (KMEPS) focused on establishment tasks, conducting three consultation meetings to engage local stakeholders. In 2008, an underwater assessment revealed high species richness, identifying 32 coral genera and 92 fish species. By 2020, monitoring indicated moderate reef fish conditions but high fish biomass. The management plan, updated in 2023, guides the MPA's operations. The management body includes local councils, organizations, and government agencies, with the Kamanga division captain as chairperson. Information and enforcement efforts involve the "Bantay Dagat" enforcers and community monitors. Regular resource assessments are conducted, achieving 26 out of 27 points at Level I.

Level II (MPA Management is Effectively Strengthened)

At Level II, KMEPS enhanced core management responsibilities, including enforcement, equipment maintenance, and biophysical monitoring. An Integrated Coastal Management (ICM) strategy complements enforcement. Training for "Bantay Dagat" enforcers and regular patrolling are key activities. The MPA maintains comprehensive violation records and allocates fines to management funds. Infrastructure support and public education through

Information, Education, and Communication (IEC) materials were emphasized. KMEPS achieved a perfect score of 15 out of 15 points at Level II.

Level III (MPA Management is Sustained for at least 5 Years)

Level III highlights continued operations over five years, including ordinance revisions and monitoring. The Integrated Coastal Management Plan (2023–2027) oversees management. Despite limited meetings due to the pandemic, enforcement and IEC efforts continued. Regular biophysical surveys by DENR XII and socioeconomic monitoring by the LGU Fisheries Technician are conducted. Financially, the MPA generated Php 220,893.00 in net income by June 2023, allocated among local stakeholders. Violators face penalties, and feedback mechanisms enhance management. KMEPS scored 18 out of 21 points at Level III.

Level IV (MPA Management is Institutionalized for at least 7 Years)

Level IV focuses on long-term institutional development and support from provincial LGUs and other organizations. Enhanced enforcement, livelihood training, and management capacity initiatives are key. The ICM Plan integrated into the Comprehensive Land Use Plan (CLUP) ensures cohesive management. Effective collaboration with national and local agencies supports the MPA. Recognition includes being named one of the top 10 MPAs in the Philippines and winning conservation awards. Coral reef restoration and infrastructure development aid MPA sustainability. Revenue from fees and penalties covers operational expenses. KMEPS scored 20 out of 21 points, achieving an "excellent" rating of 79 out of 84. Colon Marine Sanctuary (CMS) Management Effectiveness

3.2 Colon Marine Sanctuary (CMS) Management Effectiveness

Table 2. Management Effectiveness Assessment Tool (MEAT) Evaluation Result for CMS

Level	Year requirement	Actual score	Possible score	Are all threshold questions satisfied?	MPA level satisfied?
Established At least 1 year At least 20 cumulative score All level I thresholds met	Yes	23	27	Yes	Yes
Strengthened At least 3 years At least 31 total cumulative score All level 1 & 2 thresholds met	Yes	11	15	Yes	Yes
Sustained At least 5 years At least 47 total cumulative score All level 1, 2 and 3 thresholds met	Yes	12	21	YES	NO
Institutionalized At least 7 years At least 63 total cumulative score All thresholds met	Yes	12	21	NO	NO

Level I (MPA is Established)

The Colon Marine Sanctuary has successfully established itself as a Marine Protected Area (MPA), gaining acceptance, approval, and securing a budget for at least one year. This demonstrates a clear understanding of the value of MPAs and a strong commitment to the sanctuary's success. The management plan, developed through stakeholder consultations, is part of the Integrated Coastal Management Plan 2023-2027, fostering a sense of ownership and collaboration. Comprehensive baseline assessments lay a crucial foundation for monitoring conservation progress. Information, Education, and Communication (IEC) activities are well-coordinated, promoting public understanding and support. Key personnel, including MPA enforcers and biophysical monitors, are designated. The management body involves the municipal government, people's organization, barangay

council, and MFARMC, with 3 Bantay Dagat enforcing regulations and conducting scientific evaluations. Despite the establishment of a management body, roles and responsibilities need clearer definitions to avoid inefficiencies. The MPA achieved a score of 23 out of 27 points at Level I, fulfilling all required standards and objectives.

Level II (MPA Management is Effectively Strengthened)

At Level II, the Colon Marine Sanctuary addressed essential tasks such as enforcement, equipment maintenance, and biophysical monitoring. A well-defined enforcement plan and trained staff ensure compliance. Regular operations, including patrolling and violation documentation, demonstrate adherence to management criteria. Despite not initiating legal proceedings or penalties, financial resources from the LGU and Integrated Protected Area Fund (IPAF) support MPA initiatives. While infrastructure maintenance has lagged, annual IEC programs and collaborative biophysical monitoring by DENR XI and ECPC Sarangani are effectively executed. The sanctuary achieved Level II with a score of 11 out of 15 points, meeting all Level I and II criteria.

Level III (MPA Management is Sustained for at Least 5 Years)

Level III focuses on sustaining MPA management effectiveness over five years. The Colon Marine Sanctuary operates under the Integrated Coastal Management Plan 2023–2027, though its governing ordinance has not been updated. Financial stability supports ongoing conservation efforts, with an operational enforcement system. However, the IEC program needs enhancement, relying solely on verbal presentations since 2022. Regular participatory biophysical surveys and socioeconomic monitoring by OMAG are conducted, though comprehensive data is lacking. Despite an effective enforcement system, no legal actions were reported, indicating compliance issues. The absence of a feedback mechanism hampers management evaluation. Scoring 13 out of 21 points, the sanctuary has yet to meet Level III's minimum threshold but shows promise with improvements in identified areas.

Level IV (MPA Management is Effectively Institutionalized for at least 7 Years)

Level IV emphasizes institutionalizing the MPA, with provincial LGU support, and incentives, and assessing socioeconomic and ecological impacts. The sanctuary's management plan is integrated into broader development plans, demonstrating a commitment to marine protection. Effective stakeholder coordination includes the Philippine Coast Guard, PNP Maritime, DENR XII, BFAR, and private companies. Consistent public awareness campaigns over seven years highlight educational efforts. Essential support facilities ensure necessary infrastructure. Improvements include developing an incentive-linked performance monitoring system, enhancing public engagement strategies, equipping the management body with enforcement authority, exploring expansion initiatives, and achieving financial self-sufficiency. Currently, the sanctuary relies on LGU and IPAF funds. Diversifying revenue streams could enhance financial independence. The Colon Marine Sanctuary scored 60 out of 84, classified as "very good" according to MEAT criteria

3.3 Biophysical and Ecological Data (Coral reef and Reef Fishes)

The study used secondary data for coral reef and reef fish monitoring assessments in Kamanga Marine Ecotourism Park and Colon Marine Sanctuary. Four years of data (2020–2023) were collected from the DENR XII through the Coastal Resources and Foreshore Management Section (CRFMS), including coral reef cover, fish biomass, fish richness, and fish density.

The assessment methodology employed BMB Technical Bulletin No. 2017-05, which provides guidelines for evaluating coastal and marine ecosystems, and BMB Technical Bulletin No. 2019-04, which serves as a technical guide for assessing and monitoring biodiversity in these ecosystems. Data collection included assessing the condition of coral reefs using the Underwater Photo Transect (UPT) method and reef fish condition using the Underwater Visual Census (UVC) method. The coral data collected were analyzed using CPCe (Coral Point Count with Excel extension); the coral reef fish data were analyzed to provide fish density, fish richness, and biomass values (BMB Technical Bulletin No. 2019-04). In 2020, monitoring of the coral reef and reef fish was conducted on September 8; in 2021, it was conducted on March 11; in 2022, it was conducted on July 26; and in 2023, it was conducted on July 6.

3.4 Maasim Marine Protected Areas Coral Cover (2020-2023)

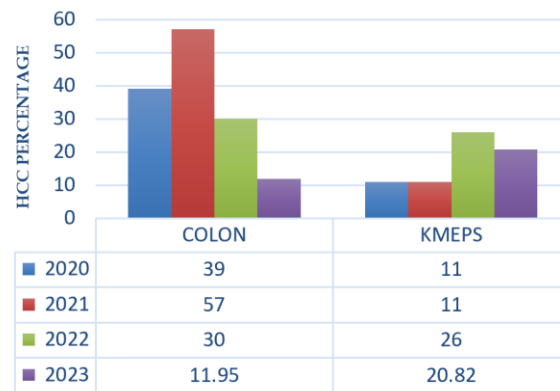


Figure 2. Live Hard Coral Cover of the MPA based on 2020 to 2023

The live hard coral cover in Kamanga Marine Ecotourism Park and Sanctuary has been consistently low from 2020 to 2023, ranging from 11% to 26%; this falls under the "poor" category based on the coral reef cover classification (BMB TB No. 2019-04 by Licuanan et al., 2017). The poor condition in 2020 was attributed to a combination of factors, including Shallow transects laid in an area mostly composed of rubble with patches of hard coral (Waheed et al. 2015), the presence of coral predators like Crown-of-Thorn Starfish (*Acanthaster planci*), which feed on branching corals (Kayal et al., 2012) like *Acropora* species which are dominant in the area, in the published study of Kalya it was said Outbreaks of the coral-killing seastar *Acanthaster planci* are intense disturbances that can decimate coral reefs and vulnerability to the harsh underwater environment including strong waves that cause siltation and hinder coral reproduction (Otaño-Cruz et al. 2017).

In 2021, the hard coral cover remained at 11% (poor condition). An outbreak of crown-of-thorn starfish was again observed. There was a significant improvement, with hard coral cover reaching 26% in 2022, classified as fair condition. However, crown-of-thorn starfish were still present. In 2023, the hard coral cover again dropped to 20.82% (poor condition) due to the presence of solid waste, fishing activities within the MPA, Crown-of-Thorn Starfish, and coral bleaching (El-Naggar et al., 2020).

Meanwhile, the coral reef ecosystem in Colon Marine Sanctuary is a type of fringing reef. Colon Marine Sanctuary showed a positive trend from 2020 to 2021 (see Figure 2), with hard coral cover increasing from 39% (good condition) to 57% (excellent condition). However, the condition deteriorated in the succeeding years. In 2022, the hard coral cover dropped to 30% (fair condition) due to outbreaks of Crown-of-Thorn Starfish, the presence of solid waste, and sedimentation. The condition further declined in 2023 to 11.95% (poor condition) due to the presence of Crown-of-Thorn Starfish, sedimentation, solid waste, and coral bleaching. The decline in live hard coral cover in Kamanga Marine Ecotourism Park and Sanctuary from 2020 to 2023 can be attributed to a combination of natural and anthropogenic factors (setter et al., 2022).

3.5 Reef Fish Condition (Species Richness, Fish Density, and Fish Biomass)

Reef Fishes Condition in KMEPS

Table 3. KMEPS Fish Species Diversity, Density, and Biomass from 2020 to 2023

Year	Fish Species Diversity (species/1000m ²)	Fish Density (individual/1000m ²)	Fish Biomass (mT/km ²)
2020	Poor (29)	Moderate (1031)	Very High (50)
2021	Poor (29)	Moderate (1093)	Very High (67)
2022	Very Poor (25)	Moderate (719)	Very High (53)
2023	Poor (44)	Moderate (1070)	Very High (45)

Fish diversity in Kamanga has also been consistently low (25 to 44 species per 1000 square meters), falling under the "poor" category. Fish density, on the other hand, has been moderate (ranging from 719 to 1093 individuals per 1000 square meters) throughout the four years. Interestingly, the fish biomass has been very high (45 to 67 metric

tons per square kilometer) despite the low coral cover and fish diversity, and this could be due to the presence of a few large fish species that contribute significantly to the overall biomass (Ramírez-Ortiz et.al, 2020).

Reef Fishes Condition in CMS

Table 4. CMS Fish Species Diversity, Density, and Biomass from 2020 to 2023

Year	Fish Species Diversity (species/1000m2)	Fish Density (individual/1000m2)	Fish Biomass (mT/km2)
2020	Poor (27)	Poor (567)	High (30)
2021	Very Poor (23)	Moderate (779)	High (22)
2022	Very Poor (18)	Poor (336)	Medium (19)
2023	Poor (37)	Poor (606)	Medium (15)

Fish diversity in Colon has also been consistently low (18 to 37 species per 1000 square meters), falling under the "poor" category. Fish density varies, ranging from poor to moderate (336 to 779 individuals per 1000 square meters). Fish biomass is medium, ranging from 15 to 30 metric tons per square kilometer throughout the four years; this is lower than the fish biomass in Kamanga because of fewer large fish in the Colon Marine Sanctuary.

3.6 Community Perception Survey about Maasim Marine Protected Areas

Awareness

Table 5 shows the level of the majority (86.5%) of respondents who are aware of the Kamanga and Colon Marine Protected Area (Q1). Among those aware, 64.6% correctly identified the MPA as a protected habitat for marine organisms, while 35.4% did not recognize it as such.

Table 5. Community perception on the Maasim Marine Protected Area in terms of awareness

Indicators	Frequency	Percentage (%)
Q1. Do you know what Kamanga and Colon Marine Protected Area is?		
Yes	83	86.5%
No	6	6.3%
Not Aware	7	7.3%
If yes, what is it?		
Protected Habitat for marine organisms	62	64.6%
Not Protected Habitat for marine organisms	34	35.4%
Fishing Ground for Fishers	5	5.2%
Not Fishing Ground for Fishers	91	94.8%
Diving Area for Divers	37	38.5%
Not a Diving Area for Divers	59	61.5%
Q2. What are the benefits of Colon and Kamanga MPA that you can derive from MPA?		
Provide food, livelihood, and medical benefits to the people.	72	75%
Not Provide food, livelihood, and medical benefits to the people.	24	25%
Protect us from the extreme/ destructive effects of storm surges, waves, and currents	14	14.6%
Not Protect us from the extreme/ destructive effects of storm surges, waves, and currents	82	85.4%
Provide recreational, physical, and mental benefits, tourism activities, and spiritual activities	9	9.4%
Not Provide recreational, physical, and mental benefits, tourism activities, and spiritual activities	87	90.6%
No Benefits	8	8.3%
with Benefits	88	91.7%
Q3. Does the condition of KAMANGA and Colon MPA affect the food source for various species like mollusks, crustaceans, and fishes?		
Yes	44	45.8%
No	45	46.9%
Not Aware	7	7.3%
Q4. Does the condition of KAMANGA and Colon MPA affect fish economic activity of the community?		
Yes	36	37.5%
No	54	56.3%
Not Aware	6	6.3%

The high awareness level is a positive sign, indicating a basic understanding of the existence of this environmental conservation area. However, a considerable percentage still needs to recognize its protected status. This suggests a need for further education or outreach programs to enhance understanding and appreciation for protected marine habitats. For Q2, a substantial majority (75%) recognize the MPA's role in providing food, livelihood, and medical benefits, there is a significant drop in recognition of other specific benefits, such as protection from natural disasters (14.6%) and recreational or tourism benefits (9.4%). This discrepancy suggests that the community may primarily see the MPA through a utilitarian lens focused on immediate economic benefits rather than broader ecological or societal benefits. Only 14.6% believe the MPA protects them from extreme weather events. This low recognition could stem from a lack of awareness or understanding of the ecological services MPAs provide. MPAs often contribute to coastal protection by preserving natural barriers like coral reefs and mangroves, which mitigate the impact of storm surges and erosion. The low percentage might indicate a need for more education on these indirect benefits. A mere 9.4% recognize the recreational and tourism benefits. This suggests that either these benefits are underdeveloped or not effectively communicated. MPAs can attract tourism, leading to economic growth through activities like diving and eco-tourism. The low recognition might be due to the community not yet experiencing these benefits or not seeing the potential for tourism development. While 91.7% acknowledge some form of benefit from the MPA, the specific types of benefits recognized vary widely. This general acknowledgment contrasts sharply with the low percentages for specific benefits, indicating a potential gap in detailed understanding or communication about the diverse advantages of MPAs. The community might not be fully informed about the various benefits of the MPA. Education campaigns could focus more on the ecological services provided by the MPA, such as storm protection and mental health benefits from recreational activities. Residents might prioritize immediate, tangible benefits like food and livelihood over long-term ecological benefits, which are less visible and may be perceived as less urgent. Emphasizing the long-term sustainability and indirect benefits of the MPA could help shift this perception. If residents doubt the MPA's effectiveness in providing certain benefits, their responses would reflect that skepticism. Building trust through consistent enforcement of MPA regulations and demonstrating tangible results could improve perception. The data indicates that while there is a general recognition of the MPA's benefits, there are significant gaps in understanding and awareness of the full spectrum of advantages it provides. Addressing these contradictions through enhanced education, better communication strategies, and developing underutilized benefits like tourism could help the community fully appreciate and support the diverse benefits of the Colon and Kamanga MPA.

About 45.8% of respondents believe that the MPA's condition affects the food source for various species like mollusks, crustaceans, and fishes (Q3), demonstrating an understanding of the ecological interdependencies within marine ecosystems. However, the lower percentage (37.5%) that thinks the MPA's condition affects the fish economic activity of the community (Q4) suggests a potential disconnect between ecological health and economic sustainability perceptions. This presents an opportunity for educational initiatives bridging the environmental conservation gap.

Knowledge

Table 6. Community perception on the Maasim Marine Protected Area in terms of knowledge

Indicator	Mean	SD	Interpretation
Q5. Dynamite Fishing activity that might likely affect the Colon and Kamanga MPA?	4.90	0.607	Strongly Agree
Q6. Pollution activity that might likely affect the Colon and Kamanga MPA?	4.94	0.431	Strongly Agree
Q7. Global Warming activity that might likely affect the Colon and Kamanga MPA?	4.93	0.363	Strongly Agree
Q8. Poaching activity that might likely affect the Colon and Kamanga MPA?	4.88	0.548	Strongly Agree
Q9. Tourism Damage activity that might likely affect the Colon and Kamanga MPA?	4.77	0.747	Strongly Agree

Legend: 4.50-5.00= Strongly Agree (SA), 3.5-4.49= Agree (A), 2.50-3.49= Moderately Agree (MA), 1.50-2.49= Disagree (D), 1.00-1.49 = Strongly Disagree (SD)

Table 6 presents the community's perceptions of various activities that might affect the Colon and Kamanga Marine Protected Area (MPA). Each indicator is rated on a scale from 1 to 5, where 5 corresponds to "Strongly Agree." The community overwhelmingly agrees that dynamite fishing poses a significant threat to the MPA, as indicated by the high mean score of 4.90. The standard deviation of 0.607 suggests a relatively small variance in responses, showing strong consensus on this issue (Q5). Dynamite fishing is known to cause extensive damage to marine ecosystems, which likely drives this strong agreement. Pollution is seen as a critical threat to the MPA, with a mean score of 4.94, the highest among the indicators. The very low standard deviation of 0.431 indicates an exceptionally strong consensus (Q6). This reflects a clear recognition of the harmful effects of pollution on marine

life and water quality. The impact of global warming on the MPA is also strongly acknowledged, with a mean score of 4.93. The low standard deviation of 0.363 signifies a high level of agreement (Q7). Global warming affects ocean temperatures, coral bleaching, and sea-level rise, all of which can severely impact marine protected areas. Poaching is recognized as a significant threat with a mean score of 4.88 and a standard deviation of 0.548, indicating substantial agreement among respondents (Q8). Poaching undermines conservation efforts by depleting protected species and disrupting the ecological balance within the MPA. While still rated strongly, tourism damage has a slightly lower mean score of 4.77 and the highest standard deviation of 0.747 among the indicators (Q9). This suggests some variation in opinions, possibly due to differing views on how tourism is managed and its perceived benefits versus harms. Unregulated tourism can lead to habitat degradation and pollution, but well-managed eco-tourism can also bring economic benefits and raise awareness about conservation. The community strongly agrees that all the listed activities – dynamite fishing, pollution, global warming, poaching, and tourism – pose significant threats to the Colon and Kamanga MPA. The mean scores for all indicators are very high, close to the maximum rating of 5, reflecting a strong consensus on these issues.

Attitude

Table 7. Community perception on the Maasim Marine Protected Area in terms of attitude

Indicator	Mean	SD	Interpretation
Q10. I feel the need to protect the Colon and Kamanga MPA because it affects my source of livelihood.	4.69	0.850	Strongly Agree
Q11. I am always willing to help protect the various MPA by promoting sustainable use of biodiversity resources.	4.66	0.792	Strongly Agree
Q12. I want to show my family, relatives, and friends how to conserve and protect Maasim MPA.	4.68	0.703	Strongly Agree
Q13. I will support and participate in local and national government efforts/programs to protect Maasim MPA.	4.72	0.817	Strongly Agree
Q14. I depend on people who are more knowledgeable in protecting our CFS because they know better.	4.41	0.924	Strongly Agree
Q15. I do not want to contribute to Colon and Kamanga MPA conservation activities because it is not my primary concern.	1.82	0.894	Disagree

Table 7. presents the community's attitudes toward protecting the Colon and Kamanga Marine Protected Areas (MPAs). The community strongly agrees on the necessity to protect the MPA because it impacts their livelihoods, with a mean score of 4.69. The standard deviation of 0.850 suggests a moderate level of consensus. This high level of agreement underscores the direct economic dependency of the community on the MPA, highlighting its importance for local sustenance and employment (Q10). The willingness to help protect MPAs by promoting sustainable biodiversity use is also highly rated at 4.66, with a standard deviation of 0.792. This indicates a strong and relatively consistent commitment to sustainability among respondents, reflecting an awareness of the need for long-term resource management (Q11). Respondents express a strong desire to educate their family and friends on conserving and protecting Maasim MPA, as evidenced by the mean score of 4.68 and a lower standard deviation of 0.703. This suggests a high level of personal responsibility and community engagement in conservation efforts (Q12). Support for participating in government-led conservation programs is the highest rated at 4.72, with a standard deviation of 0.817. This strong agreement indicates robust community backing for official conservation initiatives, essential for effective policy implementation and enforcement (Q13). The community acknowledges the importance of depending on more knowledgeable individuals for conservation guidance, with a mean score of 4.41. The higher standard deviation of 0.924 suggests more variability in responses, possibly reflecting differing levels of trust or access to expert knowledge (Q14). There is a strong disagreement with the statement that conservation activities are not a primary concern, as shown by the low mean score of 1.82. The standard deviation of 0.894 indicates some variability, but overall, it reflects a significant commitment to contributing to MPA conservation activities (Q15).

Moreover, the majority of respondents have been involved in activities led by the local government or the DENR in the past six months (Q16), either regularly (16.7%) or occasionally (59.4%) (see Table 8). This indicates a relatively high level of community engagement in environmental initiatives. The reasons for attending/participating in environmental activities vary, with motivations such as obligation, learning updates, seeking clarification, and other unspecified reasons. This suggests a diverse range of factors influencing participation levels.

Table 8. Community perception on the Maasim Marine Protected Area in terms of attitude

Indicators	Frequency	Percentage (%)
Q16. In the past six (6) months, have you been involved in activities led by the local government or the DENR in your area?		
Regularly	16	16.7%
Occasionally	57	59.4%
Never	23	24.0%
If regularly or occasionally involved, why have you attended/participated?		
It is my obligation	31	32.3%
It is not my obligation	65	67.7%
To learn updates and new information	44	45.8%
Not to learn updates	52	54.2%
To clarify or ask questions	2	2.1%
Not Clarify	94	97.9%
Others	2	2.1%

Practices

Subsequent Table 9 presents the findings of the study on community perceptions (PRACTICES) regarding Kamanga Marine Ecotourism Park and Sanctuary and Colon Marine Sanctuary. Most respondents (81.3%) stated that they never dispose of their garbage irresponsibly when they are away from a trash bin (Q17). This demonstrates a positive attitude towards responsible waste management. A significant percentage (85.4%) reported never directly harvesting fish and resources from the ocean near Colon and Kamanga MPA (Q18) for daily sustenance, indicating a low impact on marine resources directly attributed to this community. A substantial portion (61.5%) of respondents sometimes join tree-planting activities and clean-up drives in their community (Q19), showcasing moderate engagement in environmental initiatives. While a large majority (80.2%) never post photos of Kamanga & Colon on social media (Q20) to encourage visits, a notable percentage (17.7%) sometimes engages in this activity, potentially contributing to promoting awareness about the area. At the same time, waste management practices (96.9%) contribute to conservation and protection (Q21) through proper waste management at home. This includes practices such as proper segregation (70.8%), encouraging family awareness (1.0%), integrating waste management in teaching (1.0%), putting garbage in sacks (2.1%), indicating a positive environmental attitude within households. However, some respondents did have improper practices that have negative environmental impacts like burning and Burying (11.45%), segregation and Burying (7.3%), and sometimes burning plastic (1%). Improper waste management practices such as burning, burying, and mishandling plastic have significant negative environmental impacts, especially in marine protected areas where ecosystem fragility is a concern. Addressing these improper waste management practices requires a multifaceted approach involving education, community engagement, infrastructure development, and enforcement of regulations. A small but significant portion (16.7%) of respondents is actively advocating and participating in activities related to the conservation and protection of Colon and Kamanga MPA within their community (Q22). These activities include engaging in environmental causes, clean-up drives, and spreading information about environmental protection. A considerable number of respondents (52.1%) sometimes report illegal activities affecting the environment to local enforcers (Q23), while a notable percentage (29.2%) always do so. This indicates a proactive stance toward addressing environmental violations.

Table 9. Community perception on the Maasim Marine Protected Area in terms of practices

Indicators	Frequency	Percentage (%)
Q17. I throw my garbage such as plastic straw, candy wrappers, plastic bottles, etc. anywhere especially when I cannot see garbage bins nearby.		
Never	78	81.3%
Sometimes	18	18.8%
Always	0	0%
Q18. I directly harvest fish and other resources from the ocean near COLON and KAMANGA MPA for my family's daily sustenance.		
Never	82	85.4%
Sometimes	11	11.5%
Always	3	3.1%
Q19. I join tree-planting activities and clean-up drives in my community.		
Never	13	13.5%
Sometimes	59	61.5%

Always	24	25.0%
Q20. I take photos of Kamanga and Colon, and then I post them on social media to encourage friends and relatives to visit.		
Never	77	80.2%
Sometimes	17	17.7%
Always	2	2.1%
Q21. In our home, I'm contributing to the conservation and protection of Kamanga & Colon MPA by practicing proper waste management.		
Yes	93	96.9%
No	3	3.1%
If yes, please state how:		
Always Integrate in Teaching	1	1%
Burning	1	1%
Burning/Burying	1	1%
Burying	1	11.45%
I encourage my family to be aware of the effect	1	1.0%
Proper segregation	68	70.8%
Just put the garbage in the sack.	2	2.1%
segregation/Burying	7	7.3%
Sometimes Burning Plastic	1	1.0%
Not Contributing to the conservation and protection	3	3.1%
Q22. In our community, I am advocating and participating in activities involving the conservation and protection of Colon and Kamanga MPA.		
YES	16	16.7%
NO	80	83.3%
If yes, please state how:		
Engaging in environmental causes	1	1 (1.0%)
Coastal Clean Up	1	1 (1.0%)
Educating Family	1	1 (1.0%)
Implement Laws/ Spread Information	1	1 (1.0%)
Encourage the community to participate in environmental Activities	1	1 (1.0%)
Organizing activities such as Clean-up drives	2	2 (2.08%)
Participating In Environmental Activities	5	5 (5.20%)
Spread Information About Environmental Protection	1	1 (1.0%)
Apply in Teaching Lesson	1	1 (1.0%)
Tree Planting and Coastal Clean-Up	1	1 (1.0%)
Not advocating and participating in environmental activities	81 (84.4%)	81 (84.4%)
Q23. On illegal activities affecting the environment in our area, I immediately call the attention of our local enforcers.		
Never	18	18.8%
Sometimes	50	52.1%
Always	28	29.2%

3.7 Socioeconomic Impact of Maasim Marine Protected Area

A mean score of 4.208 indicates that the majority of respondents are well aware of the existence and locations of MPAs in their fishing areas. The relatively high standard deviation of 1.247 suggests some variability in awareness levels, which could point to differences in access to information or engagement with MPA-related activities among community members (Q1). Respondents express a strong familiarity with the rules and regulations governing fishing activities within MPAs, as evidenced by a mean score of 4.115. However, the substantial standard deviation of 1.337 highlights a significant variation in familiarity, indicating that some community members may need further education or clearer communication regarding these rules (Q2). The establishment of MPAs is generally perceived to positively impact the availability and size of fish stocks outside protected zones, with a mean score of 3.979. The moderate standard deviation of 1.056 suggests varying degrees of perceived impact among fishers, likely influenced by individual experiences and specific fishing locations (Q3). There is agreement that MPAs contribute to the enhancement of marine biodiversity, resulting in a more sustainable fishing environment. A mean score of 4.083 and a lower standard deviation of 0.842 indicate a relatively consistent positive perception of biodiversity enhancement due to MPAs (Q4). The restrictions imposed by MPAs are perceived to affect livelihoods, with a mean score of 3.760 positively. The standard deviation of 1.044 reflects a range of experiences, with some respondents possibly benefiting more directly from the MPA's protective measures and associated programs (Q5). The mean score of 3.698 indicates a neutral stance on whether MPAs have increased awareness among fishers about conservation and sustainable practices.

Table 10. Fishers Perception on Socioeconomic Impacts of Maasim Marine Protected Area

Indicator	Mean	SD	Interpretation
1. I am aware of the existence and location of Marine Protected Areas (MPAs) in my fishing areas.	4.208	1.247	Strongly Agree
2. I am familiar with the rules and regulations governing fishing activities within Marine Protected Areas.	4.115	1.337	Strongly Agree
3. The establishment of Marine Protected Areas (MPAs) has positively impacted the availability and size of fish stocks outside the protected zones.	3.979	1.056	Agree
4. MPAs have contributed to the enhancement of marine biodiversity, resulting in a more sustainable fishing environment.	4.083	0.842	Agree
5. The restrictions imposed by MPAs on fishing activities have affected my livelihood positively.	3.760	1.044	Agree
6. MPAs have increased awareness among fishers about the importance of conservation and sustainable fishing practices.	3.698	1.048	Neutral
7. The presence of MPAs has provided alternative opportunities or support (e.g., training and alternative livelihood programs) to offset the impact of fishing restrictions.	4.042	1.329	Strongly Agree
8. MPAs have improved the health and resilience of marine ecosystems, indirectly benefiting fishers in the long term.	4.010	0.788	Agree
9. MPAs increase my fish catch.	3.667	1.111	Agree
10. The local government has effectively communicated and engaged fishers in the decision-making processes related to the establishment and management of MPAs.	3.656	0.961	Agree
11. I Support the Establishment of MPA in my area.	3.698	1.557	Strongly Agree

The standard deviation of 1.048 points to diverse opinions, suggesting that while some fishers may have gained awareness, others have not seen significant changes in their understanding or practices (Q6). Respondents strongly agree that MPAs provide alternative opportunities or support to offset the impact of fishing restrictions, with a mean score of 4.042. The higher standard deviation of 1.329 indicates varied experiences, possibly due to differences in the availability or effectiveness of such programs across the community (Q7).

There is general agreement that MPAs have improved the health and resilience of marine ecosystems, indirectly benefiting anglers in the long term. A mean score of 4.010 and a relatively low standard deviation of 0.788 suggest a shared positive perception of ecosystem health improvements (Q8). The mean score of 3.667 reflects the agreement that MPAs have led to an increase in fish catch. The standard deviation of 1.111 indicates some variability in this perception, likely influenced by individual fishing experiences and local environmental conditions (Q9). Respondents agree that the local government has effectively communicated and engaged fishers in the decision-making processes related to MPAs, with a mean score of 3.656. The standard deviation of 0.961 suggests a moderate level of consistency in these perceptions, indicating room for improvement in government outreach and involvement efforts (Q10). The strong agreement with the establishment of MPAs, as reflected by a mean score of 3.698, shows general support within the community. However, the high standard deviation of 1.557 indicates significant variability in support levels, suggesting the presence of both strong proponents and opponents of MPAs (Q11). The data indicates a generally positive perception and awareness of the Maasim Marine Protected Area among the community, with strong support for its establishment and recognition of various benefits. However, there are areas with notable variability and neutral responses that suggest the need for targeted interventions.

3.8 Identified LGU Initiatives in Support of Maasim MPA's

The management body overseeing Marine Protected Areas (MPAs) in collaboration with various agencies and industries has implemented a range of initiatives aimed at effective MPA management. These activities, which could serve as models for other local government units (LGUs), include:

- Annual distribution of fishing paraphernalia to registered fisherfolk, supporting sustainable practices and contributing to economic development.
- Allocation of funds for Coastal Resources Management (CRM) programs, including enforcement efforts such as patrolling and personnel incentives.
- Regular updating of Fish and Boat Registers and issuance of licenses to promote regulatory compliance and identify beneficiaries for aid and grants.

- d. Distribution of fishing boat engines to support the livelihoods of registered fishermen and promote sustainable fisheries management.
- e. Formulation and adaptation of an Integrated CRM Plan (ICRMP) to ensure the sustainable development of coastal and marine resources.
- f. Annual Scubasurero events to clean marine ecotourism parks and sanctuaries, fostering environmental stewardship.
- g. The BasuraRaffle program incentivizes waste segregation among residents to promote sustainable waste management and community engagement.
- h. Partnerships with agencies for enforcement efforts, including joint patrols with law enforcement and maritime agencies.
- i. The Barangays Monthly Coastal Clean-up program encourages community participation in reducing marine debris and pollution.
- j. Low-cost projects like distributing materials for sanitary toilets to coastal residents, supporting waste management and pollution reduction.
- k. Juvenile fish release programs to revitalize fish populations in MPAs and assist fishermen in increasing fish stocks.
- l. Crown of Thorns (COT) collection program was initiated to mitigate the impact of COT outbreaks, involving collaboration with NGOs and NGAs.
- m. These initiatives demonstrate a comprehensive approach to MPA management, encompassing economic development, environmental stewardship, and community engagement.

4.0 Conclusion

The Kamanga Marine Ecotourism Park and Sanctuary (KMEPS) and Colon Marine Sanctuary (CMS) have both been evaluated by thorough assessments utilizing the Marine Effectiveness Assessment Tool (MEAT) at various levels of management effectiveness. KMEPS showed remarkable achievement and progress in several areas of management effectiveness. KMEPS achieved outstanding results in stakeholder involvement, legal enforcement, financial assistance, and ecological monitoring from the formation of the Marine Protected Area (MPA) to ensure its effective maintenance over an extended period of years. The specific assignment of responsibilities, frequent evaluations, and cooperation with diverse parties have led to its "excellence." Classification, achieving a score of 79 out of 84 in the MEAT assessment. However, although the Colon Marine Sanctuary (CMS) showed proficiency in strategic planning, stakeholder involvement, and enforcement planning, areas still require development. The need for clarity in managerial duties, the limited effectiveness of legal enforcement outcomes, and the reliance on a narrow range of funding sources are areas that demand attention. Although CMS received a "very good" rating with a score rating of 60 out of 84, there is still potential for improvement to ensure long-term sustainability and success.

The analysis of coral reef conditions and reef fish populations in Kamanga Ecotourism Park and Sanctuary (KMEPS) and Colon Marine Sanctuary (CMS) reveals a concerning trend of deterioration in reef health over the past few years. Both sites face challenges from natural factors like coral predators, harsh environmental conditions, and anthropogenic threats such as solid waste, fishing activities, and sedimentation.

The Community Perception Survey on Maasim Marine Protected Areas provides valuable insights into the community's awareness, attitudes, and practices regarding environmental conservation. The survey highlights a commendable level of awareness among respondents regarding the existence and benefits of Marine Protected Areas (MPAs), including their role in providing food, livelihood, and ecological services. However, there are notable areas for improvement, such as enhancing understanding of the broader ecological functions of MPAs, bridging the gap between ecological health and economic sustainability perceptions, and addressing improper waste management practices.

The study highlights a significant level of awareness and understanding among fishers regarding Marine Protected Areas (MPAs) and their regulations, indicating positive strides in conservation initiatives and sustainable fishing practices. While variability exists in perceptions, particularly regarding livelihood impacts and fish catch, the overall sentiment leans towards recognizing the benefits of MPAs for marine biodiversity and ecosystem health and promoting awareness about conservation.

5.0 Contributions of Authors

Author 1: Conceptualization, Methodology, Data Collection, Data Analysis, Writing - Original Draft Preparation, Project Administration. Author 1 was responsible for developing the research concept, designing the methodology, and collecting data from the marine protected areas in Barangay Kamanga and Colon. He also conducted data analysis, wrote the initial draft of the manuscript, and managed the overall progress of the project. **Co-Author:** Supervision, Conceptual Guidance, Writing - Review & Editing. He provided overarching supervision and guidance throughout the research process, from the initial conceptualization to the final stages of the project. He offered valuable insights and expertise, contributing significantly to the conceptual framework and methodological approach of the study. Additionally, He played a key role in reviewing and editing the manuscript, ensuring its scholarly rigor and coherence. Each author has read and approved the final version of the manuscript and agrees to be personally accountable for the author's own contributions and for ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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