Journal of Environmental Science and Management 27-2: 42-60 (December 2024) ISSN 0119-1144

Fisheries Management Arrangements and Socio-ecological Conditions of *Otolithes ruber* (Bloch & Schneider, 1801) Fishery in San Miguel Bay, Philippines

ABSTRACT

This study analyzed the prevailing fisheries management arrangements of coastal municipalities along eight major policies, using 32 indicators, as they influenced the socio-ecological condition of Otolithes ruber fishery in San Miguel Bay, Philippines. Key Informant Interviews and Focus Group Discussions were conducted among local government officials and members of Municipal Fisheries and Aquatic Resources Management Councils across seven municipalities. On-board surveys and observations (fishing trips) were conducted from the selected barangays surrounding the Bay. Morphometric characteristics of O. ruber samples were assessed in terms of size (length and weight), sex type, and sexual maturity. The level of development of fisheries management in San Miguel Bay municipalities is still in established and strengthened status. While expectation in the aspects of legislation and regulations and restrictions were partly met, more areas on fisheries management still need improvement particularly in terms of coastal management planning, law enforcement, and monitoring and evaluation. With the prevailing fisheries management arrangements and policies, O. ruber contributed to about 2%-2.5% to the total catch and its trend is declining yearly. Overfishing and decline of fish stock were evident in the Bay that can be attributed to unregulated, destructive and illegal fishing activities. Resource use and access conflicts among varying and increasing number of fisherfolk were also among the challenges in the Bay. Both municipal and commercial fisherfolk compete for fishing ground that resulted to changes in fishing practices and efforts and inequalities in distribution of benefits (catch and income) across the municipalities. The adverse changes in the coastal habitats and decline in fish stocks and/or catch among small-scale fisherfolk currently observed in San Miguel Bay require for a unified fishery ordinance and comprehensive coastal and fishery management plan to ensure integrated or collaborative conservation efforts.

Keywords: *fisheries management, institutional arrangements, Otolithes ruber, socioecological conditions, San Miguel Bay*

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INTRODUCTION

The fisheries management in the Philippines is largely guided by three key national laws, such as the Local Government Code (LGC) of 1991 (RA 7160); Agriculture and Fisheries Modernization Act of 1997 (RA 8435); and Fisheries Code of 1998 (RA 10654). With the enactment of RA 7160, local government units were given authority to some devolved functions including the management of environment and its natural resources and control over resource access (*Pomeroy and Courtney 2018*). When RA 8550 took effect into law in 1998, fisheries management is one of the devolved authority vested upon local government units. As such, they are given exclusive authority to grant fishery privileges in municipal waters up to 15 km from the shore and to impose rentals, fees and charges. Subsequently, Fisheries Administrative Order (FAO) No. 263, issued in 2019, established a framework for co-management between the Bureau of Fisheries and Aquatic Resources (BFAR) and LGUs through Fisheries Management Areas (FMAs). Despite its intentions for collaborative governance, FAO 263 faces several weaknesses that hinder effective implementation. One major challenges is the ambiguity surrounding the roles and responsibilities of various stakeholders involved in the management of FMAs. The successful implementation of co-management relies heavily on clearly defined duties for BFAR, LGUs, and local stakeholders. Without this clarity, overlapping jurisdictions can lead to confusion and disputes over authority (*Fabinyi 2024*).

Other highlights of the policy and institutional reform enshrined under the Fisheries Code of 1998 were the creation of Fisheries and Aquatic Resources Management Council (FARMC) at the national down to the barangay level and the Integrated Fisheries and Aquatic Resources Management Council (IFARMC) for bays that straddle several municipalities. The FARMCs are duty bound to perform a number of management advisory functions in close collaboration with the local government unit while IFARMC serves as the venue for close collaboration among the LGUs in the management of contiguous resources like the San Miguel Bay. San Miguel Bay had been one of the priorities of the national government projects like the Fishery Sector Program (1989-1995) and Fisheries Resources Management Program (1998-2007). Both programs were implemented to address socioecological issues among bays and gulfs in the Philippines, which are marine ecosystems covering multiple jurisdictions. They focused on governance reform and utilized a co-management approach.

With these programs, institutional cooperation among San Miguel Bay municipalities had intensified and its offshoot was the creation of San Miguel Bay Management Council (SMBMC) in 1998, but ceased its operation after several years due to lack of political support and budget. The IFARMC has assumed the functions previously associated with the SMBMC since 2005, serving as a policy advisory body to local government units to address baywide fisheries issues (*Pomeroy et al. 2010*); this also functions strictly as an advisory body and does not possess regulatory authority- meaning it can recommend policies and strategies to LGUs, but the enforcement and implementation of regulations remain the responsibility of local authorities and relevant national regulatory bodies (*NOAA Fisheries n.d.*).

San Miguel Bay, as a common-pool resource, needs institutional arrangements (structure of rules) in order to guide and control human decisions and interactions on how resources can be used, exploited and developed. The Bay is both under formal and informal institutional arrangements but the former is more dominant form of fisheries management (*Pomeroy and Pido 1995*). Each municipality has the autonomy and authority in managing its municipal waters but with more public participation particularly through consultation with the MFARMC and fisherfolk organizations and cooperatives.

Recent developments indicate that national government agencies, particularly the BFAR, now prioritize providing technical assistance and enhancing livelihood support while coordinating with LGUs for project planning, implementation, and monitoring. This role has been formalized in Memorandum Circular No. 2018-59, which outlines essential policies and guidelines for regulating and monitoring fishery activities in municipal waters. This circular emphasizes LGUs' responsibilities in managing local fisheries and reinforces the need for collaborative governance between national and local entities (*OCEANA 2018*). Subsequently, BFAR issued Memorandum Circular No. 2020-121, directing LGUs to actively participate in the rollout of FAO No. 263, s. 2019, regarding the establishment of FMAs (*DABFAR 2019*). These efforts reflect a coordinative approach to sustainable fisheries management, enhancing the roles of LGUs in protecting marine resources and ensuring food security.

Moreover, establishing property rights in marine environment is one of the incentive systems to encourage involvement or participation of fishers and stakeholders in fisheries management, as identified by *Junio-Memez et al.* (*2007*). This is also a way to lessen overfishing and illegal fishing. The property rights define the users' extent of access, use and exploitation of market and non-market services of the resources, which is necessary to prevent open access fisheries and ensure sustainable socioeconomic benefits. Territorial use rights is another form of property rights that designate the boundary of fishing grounds that can be used exclusively by the registered fisherfolks and at the same time manage for fisheries productivity. Small-scale fisherfolks are given preferential rights use the coastal and fishery resources of San Miguel Bay as it is entirely now declared as municipal waters.

However, this must be coupled with collective effort from different users and stakeholders. Strengthening the institutional actors or social group,s such as Fisheries Organizations, barangays, MFARMCs, LGUs, national government agencies, and private organizations involved in managing resources is critical. These stakeholders are the ones designing and supporting tenure arrangements through the creation and enforcement of rules. A need for strong governance framework and institutions isessential at both national and local levels in order to secure tenurial rights in small-scale fisheries (*Courtney et al. 2016*).

Considering the intricacies in the present governance arrangements in the Bay, the study analyzed the prevailing fisheries management arrangements of coastal municipalities along eight major policies, using 32 indicators, as they influenced the socio-ecological condition of *O. ruber* fishery in San Miguel Bay. Key Informant Interviews and Focus Group Discussions were conducted among local government officials and

members of Municipal Fisheries and Aquatic Resources Management Councils across seven municipalities.

On-board surveys and observations (fishing trips) were conducted from the selected barangays surrounding the Bay, and morphometric characteristics of *O. ruber* samples were assessed in terms of size (length and weight), sex type, and sexual maturity.

MATERIALS AND METHODS

The roles, commitments and interactions of the institutions involved in the management of San Miguel Bay were determined using secondary sources or official records from LGUs, MFARMCs and IFARMC. These documents include the Coastal ResourcesManagement Plan, fisheries ordinances, MunicipalProfile, Fisheries or Environmental Profile and the 1994 approved San Miguel Bay Integrated Coastal andFisheries Management Plan, and FAO No. 263, s. 2019,which established FMAs in the Philippines. FAO 263classified the San Miguel Bay (**Figure 1**) explicitly identifying it as a sub-Fishery Management Area, underscoring its integral role within the broader management framework (*DA-BFAR 2024*).

The respective municipal fishery ordinance, together with the implementing rules and regulations of Republic Act 8550 as amended by Republic Act 10654, FAO 196 presentations related to baywide management and MFARMC were particularly used in the assessment.

Social groups, including national government agencies, civil society organizations and private organizations, are actively engaged in and are extending support for fisheries management in San Miguel Bay as part of the composition of the FMA 1 Management Body (*DA-BFAR 2024*). The nature and extent of interactions of these social groups to the community were determined by analysing available documents in Municipal Agaricultural Office, such as technical and accomplishment reports. The extent and magnitude of efforts or assistance of these social groups in the community were analyzed.

The level of development of fisheries management was determined using eight management policies, such as management planning, legislation, regulations and restrictions, law enforcement; Information, Education and Communication and capability building, monitoring and evaluation, institutional development and partnership, and sustainable financing. A total of 32 indicators were used and for each, guide questions were prepared to aid the Key Informant Interviews (KII).

The MAO officials and MFARMC Chairmen acrossseven municipalities, were interviewed on separate days in August and September 2019. Two officials from BFAR Provincial Offices of Camarines Sur and CamarinesNorte were also interviewed validate information elicited from LGUs and MFARMCs.

Interview results were transcribed by the commissioned transcriptionist. After which, pieces of information were extracted and plotted in a matrix. The

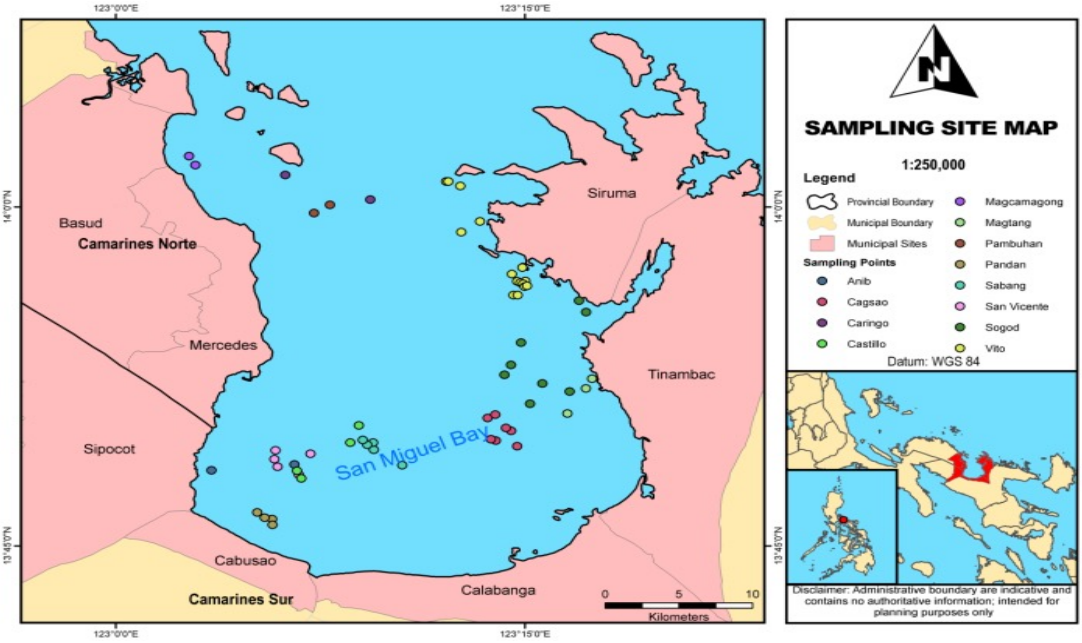

Figure 1. Sampling stations of the study site across selected barangays in San Miguel Bay municipalities, Philippines.

accomplished matrix together with the other means of verification, such as official records from LGUs and MFARMC and the results of the Focus Group Discussion (FGD) and KII with BFAR officials were used in the scoring in each indicator.

To ease and make the scoring more objective, rubrics were used for each indicator. Each indicator has four scores with description. Available rubrics from different fisheries management assessment tools were consolidated and revised to suit in the setting of San Miguel Bay fisheries management. A total of 128 points generated out of the 32 indicators for the 8 fisheries management policies. Percentages were allocated per management policy based from its total number of points or weight contribution to the total points.

Scoring of the LGU and MFARMC answers was done separately, then, the average of their scores per management policy was computed and summed it up. The combined total scores in percentage served as basis in determining the level of development by following the scoring and description (**Table 1**). This table show the influences of fisheries management to *O. ruber* fishery specifically along biophysical, fishing practices and socio-economic aspects.

RESULTS AND DISCUSSION

Institutional Arrangements

The MFARMC, the permanent partner of LGUs in the management of municipal waters, is a multistakeholder body consisting of fisherfolks, civil society organization, government agencies and private organizations. Within the council, committees are created such as, but not limited to, law enforcement, rehabilitation and conservation, livelihood opportunities, research, education and training, legislative, pollution control, land and water use, and fisherfolk settlement.

The over-all management of coastal resources and fisheries in San Miguel Bay is lodged in the authority of seven municipal governments, led by their respective municipal mayors, who are supported by the Sangguniang Bayan (DA-BFAR 2024d). MFARMC, on the other hand, played significant role in fisheries management planning, local legislation, and law enforcement as they are required by law to be consulted by the local governments in matters related to management, conservation, development, protection, utilization and disposition of all fish and fishery/aquatic resources within the municipal waters.

Table 1. Level of Development of Fisheries Management in Local Government Units and Fisheries and Aquatic Resources Management Council.

Level	Phase	Rating	Description
1	Initiated	0%-25% (Poor)	Unsatisfactory. Fisheries management performance was consistently below expectations in most essential areas of fisheries management, and/or reasonable progress toward critical activities was not made. Significant improvement is needed in one or more important areas. A plan to correct performance, including timelines, must be outlined and monitored to measure progress.
2	Established	26-45% (Fair)	Improvement Needed. Fisheries management performance did not consistently meet expectations – performance failed to meet expectations in one or more essential areas of fisheries management policies, and/or one or more of the most activities were not met. Significant improvement is needed in one or more important areas. A plan to correct performance, including timelines, must be outlined and monitored to measure progress.
3	Strengthened	46%-65% (Good)	Meets Expectation. Fisheries management performance consistently met expectations in some essential areas of fisheries management focus or policies, at times possibly exceeding expectations, and the quality of work overall was good. Most critical activities were met.
4	Sustained	66%-85% (Very Good)	Exceeds Expectation. Fisheries management performance consistently exceeded expectations in most of essential areas of fisheries management policies, and the overall output was very good. Required activities were met.
5	Institutionalized	86%-100% (Excellent)	Exceptional. Fisheries management performance far exceeded expectations due to exceptionally high quality of work performed in all essential areas of fisheries management policies, resulting in an overall quality of work that was superior; and either included the completion of major activities or made an exceptional or unique contribution in support to San Miguel Bay objectives.

As alter ego of the local chief executive, the Municipal Agriculture Office (MAO) directly supervises fishery related activities and caters services to the fisherfolks with the assistance from MFARMC especially in project identification and implementation, registration of fisherfolks and boats and monitoring and surveillance operations. Other municipal government offices, such as the Planning and Development Office, Environment and Natural Resource Office, Engineering Office, Disaster Risk Reduction Management Office among others, likewise, supported MAO on a regular basis or per instruction by local chief executive.

Most of the management activities of the local governments are usually conducted in close partnership with the fisherfolks through the MFARMC. The local governments actually recognized the importance of fisherfolks as stewards of the Bay, thus, they were being empowered through constant involvement in planning and decision-making processes. Most of the municipal governments, such as Mercedes, Calabanga and Sipocot let their fisherfolks feel the sense of ownership and having a shared responsibility to protect and manage the Bay. They emphasized to the fisherfolks the authority given to them, as deputized fish wardens, to enforce law and apprehend violators. These LGUs also let their *Bantay Dagat* lead the enforcement operations with less supervision from them but with full assistance from the Philippine National Police. Further, fisherfolks are encouraged to perform administrative tasks, such as Department of Agriculture – Bureau of Fisheries and Aquatic Resources (DA-BFAR), Department of Environment and Natural Resources (DENR), Department of the Interior and Local Government – Philippine National Police (DILG-PNP), Department of Labor and Employment (DOLE), Department of Trade and Industry (DTI), Department of Social Welfare and Development (DSWD), Provincial Local Government Units, Bureau of Rural Development and Fisheries Institutions (BURDFI), International Organization for Standardization (ISO), RARE Philippines, and PEACE Corps.

Though the entire management of municipal waters lies on the municipal government and MFARMC, there are existing fisherfolk organizations or special body created to help them for specific management purposes. For instance, the four sanctuaries (Caringo, Apuao, Quinapaguian and Canimog islands) are being taken care of by the Inter-Island Management Council, while the fisherfolk organizations (*Samahan ng Mangingisda ng Butawanan and Samahan ng Mangingisda ng Penitan*) were in-charged in the protection and management of the two sanctuaries in Siruma. Some local governments such as Basud, Sipocot and Cabusao considered MFARMC as their local body responsible for managing municipal waters considering the roles vested upon them by the law.

Other LGUs, such as Tinambac and Calabanga, recognized MFARMCs as both a recommendatory body and a partner in fisheries management. However, their significant reliance on MFARMCs for major and critical aspects of fisheries management suggests that they can categorized MFARMCs as their management body. Moreover, MFARMCs of Sipocot and Calabanga regarded themselves as a body responsible to protect and manage their municipal waters. In addition, only Calabanga MFARMC mentioned IFARMC as a collegial body to oversee and assist San Miguel Bay stakeholders in its management. Hence, confusion among stakeholders as to which particular management body is responsible for San Miguel Bay was noticeable. Likewise, most of the stakeholders forgot the presence of IFARMC as a\ management body. They also lack the awareness of its role in San Miguel Bay. All municipal governments have created their MFARMC, but a few became inoperative. MFARMC Cabusao maintained connections and participated with the activities of MAO while MFARMC Tinambac is now capacitating the new set of officers and member-fisherfolk organizations. The MAO and MFARMC of Calabanga shared the same sentiments of having only few members who are active and committees that are not functional, though the MFARMC has regular gatherings. Basud and Sipocot believed that their MFARMCs were functional since it usually active in recommending/endorsing ordinances and projects, providing feedbacks and concerns to the management and sourcing out assistance from politicians.

Mercedes considered its MFARMC as functional because the local chief executive regularly tapped them in resolving fisheries problems and issues that arose regarding the management of Mercedes municipal waters. Being recipients of awards from LGU and BFAR is another proof that the MFARMCs of Calabanga and Mercedes are functional. Members of MFARMC Siruma are active but due to some organizational concerns especially to the new officers who were still in the adjustment period, the council are quite slow in its operation. Most of the chairmen contemplated that their council is functional because members are active and regular meetings are being conducted. They, however, lack funds to sustain operations. On the other hand, BFAR viewed the MFARMCs of San Miguel Bay as not well functional on the basis of non-availability of Municipal Fisheries Development Plan in all municipalities, which the MFARMCs have a major role in its formulation.

Based from the criteria established under Fisheries Office Order No. 342, Series 2007, MFARMCs of Calabanga and Mercedes already attained Level 5, which means that they became a model of excellence and serves as inspiration to other FARMCs. Basud reached Level 4 while Tinambac and Siruma were in Level 2. Both Sipocot and Cabusao remained at Level 1.

Recent studies underline the importance of continued assessments of MFARMCs to drive improvements and adherence to established guidelines. This *FishCORAL* (*2021*), which document the progress and challenges faced by various councils, indicate a trend towards greater engagement and cooperation among stakeholders. Additionally, published evaluations on the growth performance of FARMCs affirm the need for structured training and education to assist lower-level councils in achieving higher standards (*Lanzuela 2022*).

Integrated Fisheries and Aquatic Resources Management Council (IFARMC)

The San Miguel Bay Management Council (SMBMC) was established in 1993. This is considered as the first initiative on bay-wide management. The council was able to develop an integrated management plan that guided the stakeholders for the sustainable development of the Bay's fisheries and coastal resources. However, several years after, the SMBMC had ceased its operation due to lack of budget and political support by local mayors. Moreover, the dissolution of the council occurred when a different management approach was introduced and advocated during the shift from Fishery Sector Program (FSP) to Fisheries Resource Management Program (FRMP) (*Sunderlin and Gorospe 1997*; *Bergonio et al. 2023*).

At present, all San Miguel Bay municipalities have their respective MFARMC but some are not well-functional yet. With this, BFAR continuously provided them assistance in managing the organization's operations and resources (*DA-BFAR 2024*).

Seven years after R.A. 8550 took effect; the San Miguel Bay IFARMC was established under the FRMP. Its membership is composed of representatives from the LGU and MFARMC from each municipality (**Figure 2**). This serves as a policy recommendatory body to the local government units to address baywide issues. The IFARMC, likewise, have facilitated to make the coastal management plans and fisheries ordinances integrated among municipalities. There is an integrated law enforcement team operating in the Bay, but this is inoperative at present. Municipalities of Mercedes and Sipocot integrate in their fisheries ordinance the conduct of integrated patrolling to be participated by the representatives from the seven SMB municipalities.

In addition, funds for the operations of the IFARMC are coming from annual contributions from the municipalities but these are not sustained anymore. Hence, activities of the council are limited only to meetings conducted very often. Funds are limited and most are coming from BFAR allocations.

Assessment of the level of development of fisheries management policies

San Miguel Bay demands for an integrated approach in fisheries management. Being at the extremity of the natural ecosystem, it serves as reservoir of all stresses from other economic sectors particularly along the 74 coastal barangays around it. High impacts are concentrated therein which are further aggravated by land-based activities, such as forest destruction, agricultural activities, mining, human settlements among others (*Silvestre 2019*). *Lim et al.* (*1995*) supports the recent observation of this study, in which the open-access conditions of the bay have led to declining fishery resources and increasing conflicts among resource users, exacerbated by illegal fishing and unsustainable practices.

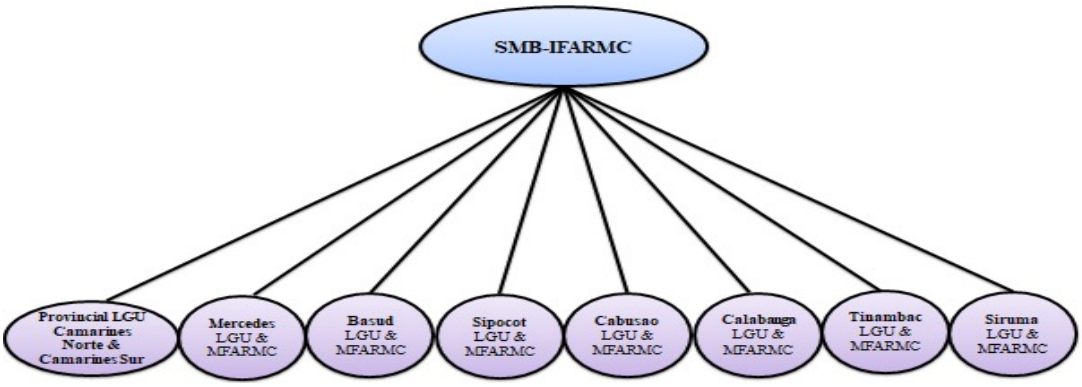

Figure 2. The Integrated Fisheries and Aquatic Resources Management Council of San Miguel Bay, Philippines.

The ecological problems of the Bay relate to both resource overexploitation and habitat destruction while the low returns from fishing and lack of alternative livelihood opportunities are common economic problems. The social problems are the results of inequitable distribution of benefits from the fisheries between and among competing commercial and municipal fishers. In addition, the political issues are mainly attributed to the lack of key political support and limited public participation in law enforcement and compliance. The administrative issues are due to shifting in local administration and lack of institutional capabilities of some stakeholders for effective baywide management. These issues have cross-cutting linkages and imply balance between human well-being and ecological well-being through good governance. This means that approach and solutions must not be taken for single or sectoral concerns instead management must be done in integrated manner across land, water and natural resources in consistent with ecosystem-based approach. Strategies and actions to resolve or mitigate the complex and interrelated issues must adopt the ecosystem approach to fisheries management (EAFM). Moreover, it is necessary that these management policies or actions must be implemented. After which, monitor and evaluate the implementation and adopt best practices and improve the plan and/or its implementation.

The study also assessed the prevailing institutional arrangements in San Miguel Bay as it looked into the level of development of fisheries management policies in the seven municipalities, particularly along the aspects of management planning, legislation, regulations and restrictions, law enforcement; IEC and capability building, monitoring and evaluation, institutional development and partnership, and sustainable financing.

This helped them check and improve implementation and institutional arrangements, adopt implementation based on evaluation and revised their plans and courses of actions, if necessary.

Some municipalities need improvement in the aspects of management planning, law enforcement and monitoring and evaluation while majority met the expectations or targets particularly along regulations and restrictions and legislation (**Table 2**).

Mercedes and Calabanga

For the development of fisheries and management, Mercedes (64%) and Calabanga (54%) are at Level 3 in the implementation. This means that they met the expectations in most essential areas of fisheries management policies (**Figure 3**).

Mercedes obtained four highest scores in regulations and restrictions (75%), law (70.83%), institutional development (65.63%), and partnerships (54.17%). It obtained the lowest scores in monitoring and evaluation (56.25%) and management planning (56.25%). On the other hand, Calabanga obtained lowest scores in management planning (40.63%) and IEC and Capability Building (45.83%).

The over-all output of these municipalities was good. For instance, Mercedes was fully implementing the registration of fishers, fishing vessels and fishing gears and licensing system. They were 60-75% complete in the registration of fisherfolks and boats. On the other hand, the registration of fisherfolks, boats and gears in Calabanga was low in completion rate but it is on-going with the assistance of BFARMCs and MFARMC. Licensing and issuance of auxiliary invoices before

Table 2. Summary of development of fisheries management in San Miguel Bay Municipalities, Philippines.

Municipality	Stage of development	Areas that meet expectation	Areas that need improvement
Mercedes	Strengthened	regulations and restrictions, law enforcement, institutional development and partnership	monitoring and evaluation, management planning
Basud	Strengthened	regulations and restrictions, legislation	law enforcement, sustainable financing
Sipocot	Strengthened	regulations and restrictions, legislation	law enforcement
Cabusao	Established	regulations and restrictions, monitoring and evaluation	management planning, legislation, institutional development and partnership
Calabanga	Strengthened	sustainable financing, regulations and restrictions, legislation	management planning,
Tinambac	Established	regulations and restrictions, legislation, IEC	management planning, law enforcement
Siruma	Established	None	regulations and restrictions, legislation, law enforcement

transporting marine species are properly observed by Calabanga as regulatory and control mechanism of fishery activities in their municipal waters.

The management plans for the four sanctuaries (Caringo, Apuao, Quinapaguian and Canimog islands) in Mercedes were prepared and the Inter-Island Management Council was created to take charge of these sanctuaries. Established sanctuary and reserve in Calabanga are maintained and monitored by the *Bantay Dagat*.

As to law enforcement, the deputized fish wardens have excellent capacity to enforce fishery laws with less supervision from other law enforcement authorities. In fact, there was one case filed and won against commercial fisherfolks. Calabanga are continuously capacitating their old and new fish wardens and deputation is regularly renewed by the local government.

The MFARMCs of Mercedes and Calabanga are very functional as a recommendatory body to LGU Mercedes in terms of policy, programs and projects identification and formulation. Fisherfolk organizations and other local constituencies are also actively involved in program development and implementation but they can be improved through IEC. Both MAO and MFARMC were able to establish linkages and leverage financial support of programs with institutional partners and othergovernment agencies such as DENR and BFAR.

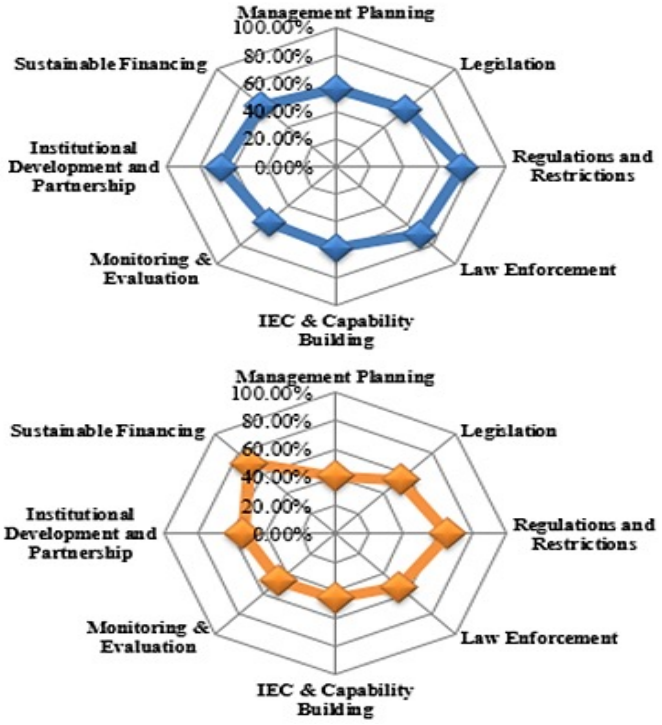

Figure 3. Radar chart showing the development of fisheries management in Mercedes (above) and Calabanga (bottom), Philippines.

Although MAO has limited staff assigned to fishery-related activities and operations, they were able to seek technical assistance with project partners like RARE and ISO. They also have staff from other units which are being tapped to assist the fisheries unit. Calabanga has only one staff assigned to fisheries but with the assistance of some resident volunteers, MFARMC, *bantay dagat* and staff from BFAR, operations and activities are still carried out.

Calabanga has lapu-lapu (*Epinephelus* spp.) production, which is co-managed by LGU and MFARMC. It is a profitable project being sustained since 2017. With this positive impact, they are planning to expand it in the next coming years for better production and more profit. On the other hand, sustainable financing of Mercedes depends on short term income-generating activities such as mariculture and mangrove planting and maintenance.

Calabanga has a 15-year old Municipal Fisheries Ordinance that has not been amended but still religiously follow particularly the licensing system. Likewise, water use zones designated in the ordinance have been established but no zoning plan has been developed yet. Mercedes, on the other hand, has revised its Municipal Fisheries Ordinance as of 2012 and enacted several ordinances like prohibition in the use of compressor, establishment of artificial reef sanctuary, etc. Unlike Calabanga, no water use zoning is implemented in Mercedes.

The low rating of both municipalities in management planning is due to the unavailability of municipal fisheries development plan or no long-term plan for their operation. Moreover, information on the critical habitats, species, ecological processes and cultural values of San Miguel Bay is not sufficient to support planning and decision-making. Although no over-all monitoring strategy is adopted, the municipalities conduct annual coastal marine habitat assessment through BFAR and monitoring of fish catch and mangrove management areas with the assistance from MFARMC and *bantay dagat.* Calabanga has regular fish catch monitoring in most of its coastal barangays. Various ordinances for regulating fishery activities in the municipal waters are in effect but there were still weaknesses or gaps.

Sipocot and Basud

Sipocot and Basud are two of the San Miguel Bay municipalities with small areas of municipal waters. However, the performances in some aspects of their fisheries management policies are consistently meeting the expectations. At Level 3, both of them met most of

the critical activities especially on fisheries management regulations and restrictions (71.88% and 62.50%) and legislation (50% and 58.33%), respectively (**Figure 4**).

The two municipalities have updated their fisheries ordinances, which is revised in 2013 (Sipocot) and 2012 (Basud). Though municipal waters and boundaries have been delineated, the identified water use zoning was not yet established and zoning was not yet developed.

Basud has approximately 500 hectares of marine reserve while Sipocot has no existing sanctuary or reserve because, according to MAO, its municipal waters do not contain significant coastal habitats like mangroves, coral reefs or seagrass beds. As to registration system, this is on-going in both municipalities but registration/ completion rate for fisherfolks, boats and gears is higher in Sipocot. Fish catch monitoring is usually conducted by the Agriculture Technician (AT) for fisheries of MAO with the cooperation of MFARMC.

Tinambac, Cabusao and Siruma

The municipalities of Tinambac (44.61%), Cabusao (42.19%), and Siruma (34.99%) obtained Level 2 stage of development in fisheries management. All have in common along the aspects of regulations and restrictions, institutional development and partnerships,

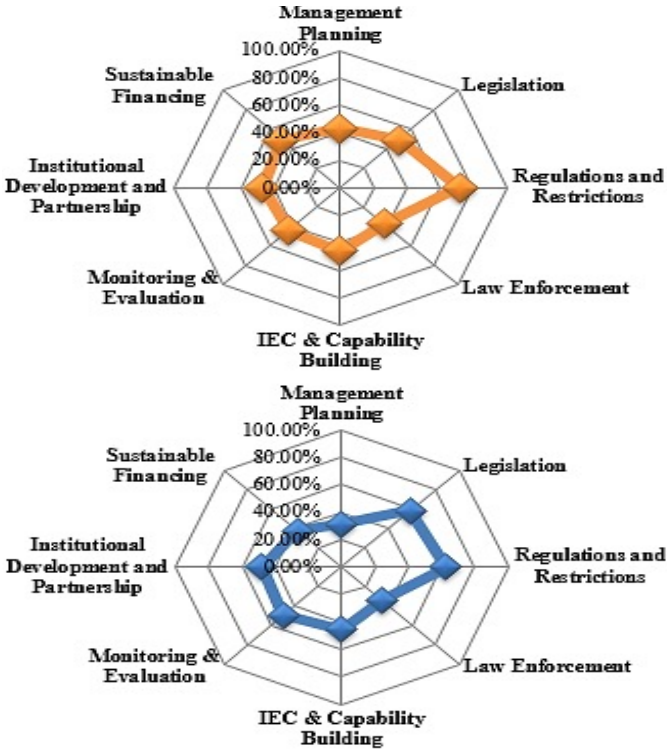

Figure 4. Radar chart showing the development of fisheries management in Sipocot (above) and Basud (bottom) Camarines Sur, Philippines.

and sustainable financing (**Figure 5**).

The registration of fishers, fishing vessels and fishing gears and licensing system are partially implemented and enforced, except Siruma where very low registration rate was observed. However, all of them are requiring fisherfolks to seek license or permit before using fishing boats and gears. Issuance of auxilliary invoices are also a common practice in Tinambac and Cabusao. Tinambac has no sanctuary or reserve but Siruma has two established sanctuaries (in Penitan and Butawanan) and reserves since 2011, Cabusao has an established sanctuary (Castillo and Pandan) in 2017. While Cabusao has already identified its municipal water boundaries, Siruma and Tinambac are still on-going in the settlement of the boundaries of their respective municipal waters.

The three municipalities have no exisitng CRM and Municipal Fisheries Development Plans. A mixed of political and administrative concerns were seen as among the causes of delays in the formulation of these plans. Moreover, information on the critical habitats, species, ecological processes and cultural values of San Miguel Bay are not sufficient to support their planning and decision-making. However, after the reorganization of all MFARMCs, they are now planning to formulate the CRM plans with the help of Peace Corps. The three municipalities have a newly elected MFARMC Chairman and are all being assisted by volunteers of Peace Corps.

In terms of Municipal Fishery Ordinance, both Tinambac and Siruma have revised and enacted ordinances as of 2014 while Cabusao is following its 2002 ordinance. *Bantay dagat* from these municipalities were trained by BFAR in 2018. Their deputation are now being facilitated by MAO, hence, patrolling and other law enforcement activities in these areas are not yet visible. However, in cases infractions of fisheries laws, violators are usually sanctioned administratively.

Coastal habitat monitoring in the municipalities are usually undertaken in their mangroves areas with the recent inventory conducted in Siruma. No fish catch monitoring is facilitated both in Tinambac and Siruma while the Cabusao MAO is regularly collecting landed catch data in Castillo mini port.

The MFARMCs are not active at present because of reorganization. All of them considered that they have inadequate knowledge to manage the critical needs of fisheries and their municipal waters. Training and skills of existing MFARMCs are adequate, but could be further improved to fully

achieve the objectives of management. Likewise, participation of local communities and fisherfolk organizations are present, such as the maintenance and protection of sanctuary and reserve in Cabusao and Siruma. Other San Miguel Bay municipalities, such as Cabusao and Sirima have no work plan that are being followed in their regular operations.

Influence of the prevailing fisheries management on *O. ruber* fishery

The Local Government Code of 1991 devolved a host of functions, responsibilities and authorities from national line agencies to local governments. In addition, Fisheries Code of 1998 supported this devolution and provided institutional and policy reforms in fisheries sector. This created expanded roles for LGUs and line agencies became back-up and/or obliged to play supportive roles. Local participation, through MFARMC, was enhanced as these laws increased and required involvement and consultation from the communities and other stakeholders in matters affecting the welfare of fisherfolks and the protection of coastal and fisheries resources.

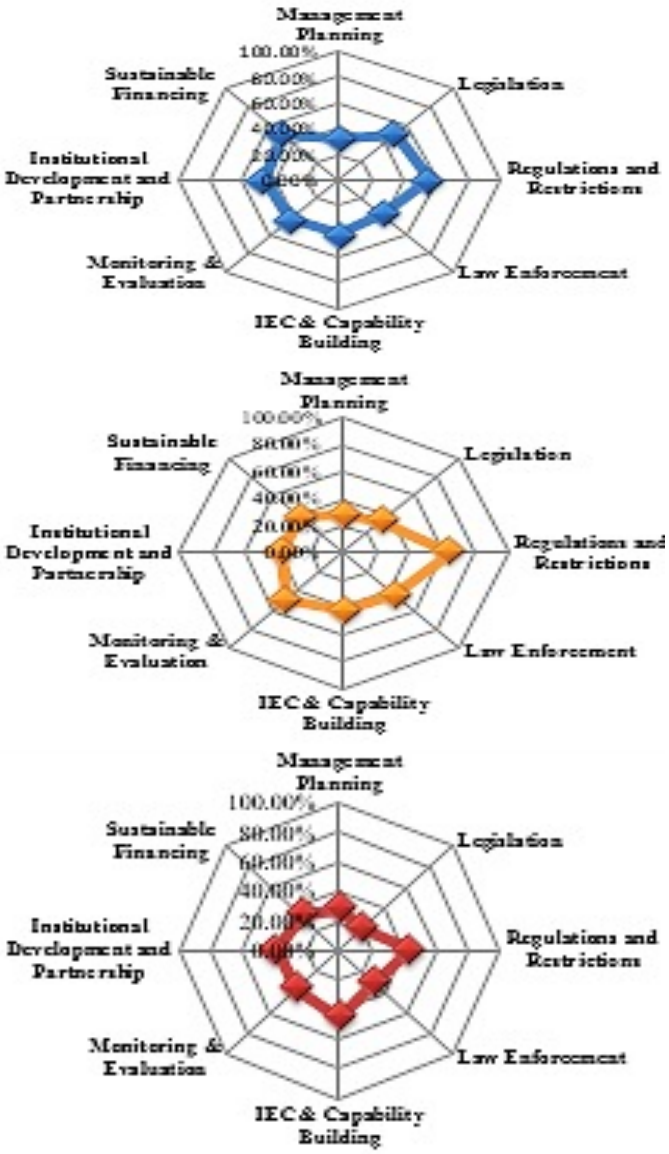

Figure 4. Radar chart showing the development of fisheries management in Tinambac (above), Cabusao (middle) and Siruma (bottom), Philippines.

The LGUs, line agencies and other various organizations are involved in managing the coastal and fisheries resources of San Miguel Bay that affect the various institutions being observed by local authorities and fisherfolks. These may be broadly categorized under national line agencies and their regional offices, local government units – provincial, municipal and barangay levels, non-government organizations (NGOs) and people's organizations (POs). At present, lateral or collaborative arrangements are prevailing in the area as most of the rules emanate and jointly shaped from the interactions between LGUs and MFARMCs together with diverse social groups.

Two of the municipal governments with Level 3 fisheries management (Strengthened) are under the institutional arrangements with strong support both from government agencies (GAs) and non-government organizations (NGOs) such as the case of Mercedes and Calabanga. Basud and Sipocot are also at Level 3 in the development of their fisheries management but they are frequently assisted by various government agencies and few NGOs. While Mercedes and Calabanga are two of the municipalities with large municipal waters, Sipocot and Basud have small territorial waters and coastal communities along San Miguel Bay, hence, probably they are less priority or focus by the NGOs for coastal assistance over other municipalities with larger coastal communities and more dependents to the resources of the Bay (**Table 3**).

On the other hand, both Tinambac and Siruma have large municipal waters and are frequently assisted by many GAs and NGOs and yet they were still under level 2 (established) and needs improvement in some aspects of the fisheries management. This can be explained by limited coastal interventions of the these municipalities as Tinambac became focused in managing its other municipal waters along Lamit Bay while Siruma lacked manpower and fund allocation to support activities for San Miguel Bay. Cabusao has similar circumstances with these two municipalities, however, due to administrative and political challenges, operations in the office of MAO and activities for its municipality were delayed.

Table 3. San Miguel Bay coastal habitat conditions and *Otolithes ruber* characteristics under prevailing fisheries management arrangements.

Municipality	Type and Level of Institutional Arrangement	Stages of Development	FSMR	Coastal Habitats (mangroves, seagrass, corals)	Mean Total Length (in cm)	Mean Weight (in g)	Lenght-Frequency (in cm)	Sexual Maturity (female, male)
Mercedes	Lateral arrangements between LGU, MFARMC and among PLGU 9 NGAs 1 academe 3 NGOs 2 CSO	Strengthened	6	-234 ha mangroves (*FAO 2023*) with 19 species -fair seagrass cover with 8 species -58.24% average live coral in Apuao, Canimog, Quinapaguian and Caringo (*Calvan 2018*) -57.3-61.8% coral cover (from inside to outside of Caringo Sanctuary as of 2015) -35-65% live hard coral cover in Caringo island while 23-44% in Canimog and Quinapaguian islands and 68-75% live corals in Maisog reef (*BFAR 2017*) -43.67 ha mangroves (*MFP 2018*)	20.98 (17.8-27)	93.74 (50-200)	16-20: 17 (M), 2 (F) 21-25: 25 (M), 20 (F) 26-30: 2 (M), 1 (F)	mature: 2, 3; gravid: 7, 23 ripe or spawning: 13,18
Basud	Lateral arrangements between LGU, MFARMC and among PLGU 5 NGAs 1 NGO 2 CSO	Strengthened	1	-~20 ha mangroves (*MFP 2018*)	20.2 (18.3-22.8)	106.44 (80-130)	16-20: 6 (F) 21-25: 3 (F)	mature: 1 (f) gravid: 5 (f) ripe or spawning: 3 (f)
Sipocot	Lateral arrangements between LGU, MFARMC and among 6 NGAs 1 NGO	Strengthened	None	51.4 ha mangroves with 20 species (*MFP 2018*)	17.04 (11-20.5)	50.54 (20-90)	10-15: 7 (M), 2 (F) 16-20: 48 (M), 22 (F) 21-25: 3 (F)	immature: 4 (m) developing virgin: 3, 12 maturing: 7, 5 mature: 12, 22 gravid: 5, 10 ripe or spawning: 2 (m)
Cabusao	Lateral arrangements between LGU, MFARMC and among PLGU 5 NGAs 3 NGOs	Established	1	~16 ha mangroves (*MFP 2017*)	19.72 (16.3-30.2)	82.92 (40-315)	16-20: 16 (M), 16 (F) 21-25: 6 (M), 17 (F) 31-35: 1 (F)	developing virgin: 1, 9 maturing: 2, 2 mature 5, 11 gravid: 18 (f) ripe or spawning: 7 (f) spent: 1 (f)
Calabanga	1 academe Lateral arrangements between LGU, MFARMC and among PLGU 5 NGAs 2 academe 5 NGOs 1 CSO	Strengthened	1	-19 true mangroves species (*ISO 2018*)	19.91 (15.4-24.5)	72.37 s(30-143)	16-20: 54 (M), 41(F) 21-25: 8 (M), 65 (F)	developing virgin: 4, 10 maturing: 10, 4 mature: 19, 23 gravid: 30, 24 ripe or spawning: 43, 1
Siruma	Lateral arrangements between LGU, MFARMC and among 6 NGA 3 academe 3 NGOs 2 CSO	Established	3	-9.2-29.1% coral cover (poor) in 2 FSMR; 17-43% CC in Matandang Siruma and 17.59% in Salvacion (fair) dead coral -61.5% in Penitan while 56.4% in Butawanan (*BFAR 2017*)	19.12 (16-24.5)	69.13 (30-155)	16-20: 13 (M) 21-25: 2 (M), 8 (F)	immature: 1 (m) developing virgin: 1 (m) mature: 5 (m) gravid: 4, 4 ripe or spawning: 3, 4

Note: FSMR – Fishery Sector Management Report; f – female; m – male

Those municipalities with established fish sanctuary and marine reserves (FSMR) are noted as large in total length and weight while those with no FSMR such as Tinambac and Sipocot recorded fish samples with shorter total lengths and lower body weights, that is 14.91 cm mean total length with 32.32 mean weight and 17.04 cm mean total length with 50.54 mean weight, respectively. The possible reason for this is that fish sanctuaries are restricted for any fishing activity, hence, fish stocks are high and available food supply for migrating carnivorous *O. ruber* were abundant. *O. ruber* is amphidromous, which can migrate between freshwater and the sea (in both directions) but not for the purpose of breeding. It also considered as benthopelagic, thus, it can survive and feed on all levels of the water columns along areas of mangroves, reefs, including FSMRs.

Large mangrove areas are noted in the municipalities of Mercedes (234 ha), Basud (43.67 ha), Cabusao (51.4 ha) and Tinambac (1,300 ha), which were all assisted by many GAs and NGOs. In particular, both DENR and Institute of Social Order, an NGO, are present in these municipalities and primarily assisted in the mangrove rehabilitation. On the other hand, the coral cover in Mercedes and Siruma, which are all situated in the fish sanctuaries, recorded poor to fair conditions. Assessment of BFAR revealed that sedimentation or siltation and occurrence of crown of thorns were two of the causes of poor conditions of the coral reefs. These fish sanctuaries are under the care and management of the fisherfolks organizations of the two municipalities.

Presence of mangroves, mostly *Rhizopora* species, all over the municipalities as well as various species found in the coral reefs of Mercedes and Siruma contributed to the availability and abundance of food supply for *O. ruber.* Thus, large numbers of this species and with large sizes (length and weight) were found in Mercedes, Cabusao and Calabanga. Both Calabanga and Cabusao fisherfolks had their fishing activities nearby and along Mercedes municipal waters, as evidenced by the map of actual fishing trips. In addition, samples of *O. ruber* collected from these municipalities were found to be mature, gravid and ripe or spawning in terms of maturity stage. It was further noted that samples of *O. ruber* captured nearby major river systems within Sipocot and Tinambac recorded smaller sizes of *O. ruber* with maturity stage that ranged from developing virgin to mature (Sipocot) and immature to developing virgin (Tinambac).

Similarities in the sizes of *O. ruber* caught across municipalities were due to similarities in the fishing method and effort employed by the municipal fisherfolks.

Timbog is the common fishing method by many fisherfolks in San Miguel Bay and some of them used gillnets with smaller mesh sizes. Using this technique is prohibited in Mercedes and Calabanga as this is considered as active fishing. Nets with small mesh sizes are also prohibited to be used in all municipalities. However, both these restrictions are not fully implemented as violator-fisherfolks are seldom punished and monitoring and surveillance by the local authorities are lacking.

Common fishing areas to catch *O. ruber* were Mercedes, Siruma and Calabanga. While Siruma and Tinambac fisherfolks preferred to do fishing activities near shore and within its municipal waters, fisherfolks of Basud, Sipocot, Cabusao and Calabanga went go far from nearshore and even traversed to adjacent municipal waters and nearby FSMRs. The fisherfolks from municipalities near the mouth of the Bay such as Mercedes and Siruma usually did fishing in their respective waters rarely visited the inner part of the Bay. As observed, most fisherfolks went too far fishing areas to look for better catch, unlike before when fish can be captured nearby shore. The 10% limit in number of fisherfolks to fish in nearby municipal waters is not being observed as fisherfolks can freely come and go in any municipal waters without restriction from local authorities (**Table 4**).

In terms of fishing method, "patalang", "timbog" and "hugos" are being practiced by fisherfolks in San Miguel Bay. The "timbog" method was commonly used in almost municipalities. Although prohibited, using pulse stick or "tupak" in timbog method is considered as effective technique in capturing fish. In fact, total catch of fisherfolks, who used this method from six municipalities, was 30.64 kg. However, the "patalang" method adopted by Mercedes and Basud fisherfolks recorded 18.5 kg and 1kg of *O. ruber*, respectively.

Both "timbog" and "hugos" methods are categorized as active fishing method which are not allowed in municipal waters but not yet abated by the municipal authorities, except in Mercedes where patrolling and regulation activities were regularly conducted by the *bantay dagat*. Law enforcement is one of the strengths of Mercedes based from the assessment of fisheries management conducted by this study. The rampant practice of "timbog" is due to weak enforcement among municipalities and the lack of unified ordinance about prohibition of this method. Integrated Patrolling activities are not also conducted at the moment, Before, the Integrated Patrolling Team was active in enforcing the laws on a baywide scale.

Table 4. Small-scale fishing practices under prevailing fisheries management arrangements in San Miguel Bay, Philippines.

Municipality	Fishing Areas	Fishing Methods	Frequency Duration (in hr)	Boat Type and Size	Gear Type and Size	No. of Fisherfolks
Mercedes	Mercedes Siruma	patalang method	daily (2) 4-5 hrs	motorized 7-12 m	crab pot, gillnet (BSN) 13,200 m (6-7.5 cm MS)	2.-3
Basud	Basud, Siruma, Mercedes	patalang method and timbog (w/ pulse stick or tupak)	daily (2) 2-4 hrs	motorized 7 m	gillnet (BSN) 3,100 m (6-8.5 cm MS)	1-2
Sipocot	Cabusao, Calabanga, Tinambac	timbog (w/ pulse stick or tupak)	daily 3 hrs	motorized 7.5-9 m	gillnet (BSN) 9-9.5 cm	2
Cabusao	Sipocot, Mercedes	timbog (w/ pulse stick or tupak)	daily 8-9 hrs	motorized 6-9.5	gillnet (BSN) 5,700 m (7-10 cm MS)	2.-3
Calabanga	Sipocot, Cabusao, Calabanga, Siruma	timbog (w/ pulse stick or tupak)	daily 4-5 hrs	motorized - 9 m	gillnet (BSN) 12,100 m (8.5-9 cm MS)	2
Tinanmbac	Calabanga, Mercedes, Siruma	timbog (w/ pulse stick or tupak) and hugos method	daily 6 hrs	motorized - 7-9 m	gillnet (BSN) for crab-4.5 cm and fish – 3,400 m (8-11.5 cm MS)	2
Siruma	Tinambac, Calabanga, Siruma Siruma, Cabusao, Mercedes	timbog (w/ pulse stick or tupak) and hugos method	daily 5 hrs	motorized - 7-9 m	double gillnet (BSN) for fish-2,250 m (8.5-10 cm MS) crab and shrimp-450 m (4 cm MS)	2.-3

Note: BSN – bottom set gill net; MS – mesh size

Most of the fisherfolks devoted longer time at the sea on a daily basis with an expectation to have more catches. This was the effect of too many fisherfolks andcontinuous encroachment and operation of commercial fishers in the Bay. With too many competitors for fishing spaces and resources, small-scale fisherfolks tend to fish as frequent as they can and for longer duration and by using multiple and longer fishing gears.

Both motorized and non-motorized boats that ranged from 6 to 10 m long are frequently used. Fishing activities are conducted by 1 to 2 fisherfolks using longer gillnets with varying mesh sizes of 7 to 9 cm. Registrations of fishing boats and gears were conducted in all municipalities, as mandated by BFAR, Several LGUs, however, are still completing their registrations.

License for the use of boats and gears are being issued in every municipality, however, monitoring and regulation based on the issued license or permit were lacking. Thus, any fisherfolk with or without license can operate in the Bay without limitation in fishing effort particularly in terms of frequency and duration to fish, type and size of boats and gears to use. In addition, no municipal governments were implementing restrictions as type of species, size of fish, stage at maturity and catch limits and allocation of fish to be caught.

Fishing gears with smaller mesh sizes are prohibited, however, several small-scale fisherfolks opt to use these since fish were also getting smaller. The shift in gear sizes is also the effect of unstoppable operations of commercial fishers using trawls, which have very fine mesh sizes. Moreover, as their adaptation strategy to fish seasonality, fisherfolks owned multiple gears intended for particular species. They believed that having a variety of gears would make them ready for whatever species are available in the bay and ensure catch all throughout the year.

The “timbog” and “hugos” methods, if not prevented and will be continuously adapted by fisherfolks, may cause adverse effect and threaten the survival, growth and reproduction of *O. ruber* and other marine species. Apart from this, shifting in gear using smaller mesh sizes may aggravate the growth overfishing occurring in the Bay wherein more juveniles may be captured which were mostly discarded by the fisherfolks. The continuous operation of commercial fishers would also exacerbate the conflicts among fisherfolks as they may continuously compete for fishing spaces and the same resources. Expansion of fishing effort may likewise happen as small-scale fisherfolks would try to adapt with the practices of commercial fishers by either using more gears or having longer gears with very small mesh sizes.

Calabanga, Tinambac and Cabusao were among the municipalities with large *O. ruber* catch recorded in three years (2015 to 2017). However, these catches were not purely contributions by the municipal fisherfolks since encroachment and operations of commercial fishers were still prevalent in the Bay.

Around 30% to 35% of the *O. ruber* catch in those years were estimated contributions and came from the

commercial fishers who were known for using trawls. This only means weak enforcement among municipalities and lack of uncoordinated efforts to prevent the illegal operation of commercial fishers. Moreover, tenurial rights over the municipal waters, as indicated in the ordinances, are not yet fully realized by the municipal fisherfolks as support from municipal government are lacking (**Table 5**).

Inaction of MAO and *bantay dagat* of Cabusao to enforce laws was due to weak support received by MFARMC from the political leaders of the municipality. The administrative issues faced by the Office of Municipal Agriculturists were likewise one of the reasons of the delay in the implementation of activities. In Calabanga, there were many deputized fish wardens regularly trained and assisted by BFAR and other enforcement agencies, but it lacked in the implementation as affected by few participation from the fisherfolk-members in the enforcement activities. The less interventions of Tinambac to San Miguel Bay, as it momentarily shifted to focus in Lamit Bay, may be one of the causes of continued operations of commercial fishers in their areas.

On the other hand, the strong support of the local chief executive as well as the active involvement of MFARMC and its *bantay dagat* to the enforcement activities lessened the operations of commercial fishing vessels in Mercedes municipal waters.

Overall, the management and protection of San Miguel Bay municipal waters were given to 7 local governments and MFARMCs. However, continuous support are provided by various government agencies and private organizations through provisions of livelihood opportunities, rehabilitation projects, capability enhancement, administrative and technical assistance, among others. The community, through MFARMC, also helped the local governments in carrying out its roles and responsibilities in the management of the Bay.

The San Miguel Bay Integrated Fisheries and Aquatic Resources Management Council, created in 2001, served as avenue for close collaboration among stakeholders and as policy recommendatory body in addressing bay-wide issues (*Bailey 2018*). At present, IFARMC has its Technical Working Groups consisted of MAOs, academe, BFAR, NGOs (*DA-BFAR 2024b*). Current activities are reorganization of IFARMC leadership, regular meetings and consultations with stakeholders. They were also pushing for the creation of San Miguel Bay – Integrated Fisheries and Aquatic Resources Management Authority (SMB-IFARMA) to harmonize existing mechanisms and management tools purposely to ensure the sustainable development of San Miguel Bay. This effort was supported by most of the local chief executives and political leaders in Camarines Norte and Camarines Sur.

The level of development of fisheries management

Table 5. Catch and estimated income derived from *O. ruber* fishery under prevailing fisheries management arrangements, San Miguel, Philippines.

Municipality	Monthly Average Catch	Estimated Sales from Fresh Catch (‘000)	Estimated Sales from Dried Fish (‘000)
Mercedes	2015: 330.75 (2.55-888.74)	434.38	694.58
	2016: 527.08 (91.41-1,723.70)	621.23	1,106.87
	2017: 808.78 (3.97-2,845.54)	806.86	1,698.43
	2018: 162.69 (51.22;31.49) (*Bergonio et al. 2018*)	none	none
	2023: 35.65 (18.5; 51.89) (*Bergonio et al. 2023*)	none	none
Basud	*46 (3-20)	none	none
Sipocot	*150 (100-200)	none	none
Cabusao	2015: 1,253.03 (77.115-2,415.70)	2,484.76	3,383.17
	2016: 248.98 (93.70-480.75)	478.68	672.25
	2017: 906.88 (495.44-1,473.14)	1,765.49	2,448.58
Calabanga	2015: 3298.41 (1,348.70-5,738.12)	6,922.84	6,926.65
	2016: 2,699.25 (1,581.58-4,715.72) 2017:	5,546	5,668.42
	2,926.68 (1,467.28-5,758.80)	6,296.56	6,146.01
Tinambac	2015: 1,344.92 (542.60-2,834.68) 2016:	1,307.97	2,002.38
	965.93 (123.46-2,280.09) 2017: 1,547.71	917.98	1,448.88
	(204.77-3,940.65)	1,408.51	2,321.56
Siruma	2015: 610.73 (47.11-1,816.50)	496.59	1,282.54
	2016: 600.74 (214.86-1,366.69)	476.55	1,261.56
	2017: 778.31 (154.75-2,254.96)	605.98	1,634.4

among San Miguel Bay municipalities along eight management policies does not vary significantly that ranged from 2 to 3 levels or at the stage of "already established" to being "strengthened" or mean some "needs improvements" while others "meet the expectations". The over-all outputs of these municipalities are good. They consistently met expectations, at times possibly exceeding, in some essential areas of fisheries management policies. Overall, the quality of work overall was also good. Most critical activities were accomplished along licensing and issuance of auxiliary invoices, management of FSMR, functionality of MFARMC, participation of fisherfolks, active law enforcement, sustainable financing mechanisms through Income Generating Projects (IGPs), and frequent linkages w/ NGAs and NGOs.

At Level 3, both Mercedes and Calabanga accomplished most of the critical activities especially along the aspects of fisheries management regulations and restrictions and legislation. Mercedes obtained three highest scores in regulations and restrictions (75%), law enforcement (68.75%), and institutional development and partnership (62.50%) while Calabanga had the three highest scores in sustainable financing (70.83%), regulations and restrictions (65.63%), and legislation (54.17%). On the other hand, Calabanga obtained lowest scores in management planning (40.63%) and IEC and Capability Building (45.83%) while monitoring and evaluation (56.25%) and management planning (56.25%) for Mercedes. Sipocot and Basud are two of the San Miguel Bay municipalities with small areas of municipal waters. However, the performances in some aspects of their fisheries management policies are consistently meeting the expectations.

The municipalities of Tinambac (44.61%), Cabusao (42.19%), and Siruma (34.99%) obtained Level 2 stage of development (**Figure 5**). All of them need enhancements as they did not consistently meet expectations – performance failed to meet expectations in one or more essential areas and activities of fisheries management policies particularly along aspects of regulations and restrictions, institutional development and partnerships, and sustainable financing.

Considering the present arrangements as well as the level of development of fisheries management among San Miguel Bay municipalities, it is good to note the positive and negative consequences in terms of the biophysical, fisheries and socio-economic characteristics of the Bay, especially the influence of these arrangements and fisheries management policies to the conditions of *O. ruber*.

It is noted that municipalities with many supporting government agencies and non-government organizations like Mercedes, Basud, Calabanga, Tinambac and Siruma have large areas of mangroves and majority with established FSMRs. In particular, DENR, BFAR and ISO are the primary organizations that led mangrove rehabilitation and establishments of FSMRs in areas of Mercedes and Siruma. Coral covers are under poor to fair conditions, found mostly in FSMR, but these cannotbe associated with the negligence on the parts of local authorities. Based from the assessment of BFAR in 2017, the potential causes of poor coral cover are sedimentation or siltation and presence of crown of thorns (COTs) (*Acanthaster planci*). The FSMRs of Mercedes are under the care of the Inter-Island Management Council created purposely to manage it while two fisherfolks associations are designated as in-charge in the management of Siruma's FSMR.

Presence of these important coastal habitats including FSMRs contributed to increased fish stocks and abundance of food supply for *O. ruber*. Although occurrence of *O. ruber* inhabiting to FSMRs and mangrove areas were not yet verified *O. ruber* is an amphidromous fish that regularly migrate between freshwater and the sea (in both directions), but not for the purpose of breeding. Hence, most likely the chance of migrating and inhabiting in these places happen during in one of its life stages. Moreover, *O. ruber* is considered as benthopelagic, thus, it can survive and feed on all levels of the water columns along areas of mangroves and reefs including FSMRs.

Small-scale fisherfolks have common fishing grounds. Areas of Mercedes, Siruma and Calabanga are frequently visited to catch *O. ruber.* San Miguel Bay fisherfolks are free to access and withdraw resource in any parts of the Bay with less regulation and prohibition from respective municipal authorities; hence, sharing and overlapping in fishing spaces and competing for same resources are observed. Moreover, locations of fishing grounds are farther now than in the past, wherein fishing activities before were usually conducted nearby the shore. The pattern now is that fisherfolks are travelling towards the middle up to the mouth of the Bay to fish and/or catch *O. ruber*.

Having common fishing area, similarities in fishing methods and type of gears used by the fisherfolks were noticeable from majority of the municipalities. As observed during the on-board survey, three types of fishing methods are employed by the fisherfolks, of which "timbog" (using pulse stick or "tupak") is commonly practiced in most of the municipalities and considered

effective as it guarantees sure catch.

This method, however, was prohibited because it is categorized as active fishing method. Other two methods were "patalang" and "hugos". The former is adapted by fisherfolks from Mercedes and Basud with considerably large catch while the latter is observed in Tinambac and Siruma and catch ranged from 0 to 1 kg of *O. ruber*.

With less regulations and restrictions, fisherfolks from majority of the municipalities have no limits in termsof frequency and duration of fishing and type and size of gears to use. Gears with small mesh sizes were prohibited but some fisherfolks are still using as a way to adapt with the practices of commercial fishers who used trawls with very fine mesh. In reality, even without license or permit, fisherfolks can freely operate anywhere and at any time in the Bay. Prohibited activities are stated in respective ordinances, however, these are not appropriately observed and implemented. Lack of manpower and budget for monitoring, control, and surveillance are the issues and concerns of the municipal governments.

All municipalities have no policy how to regulate the number of fisherfolks. Fisherfolks and boat registrations, as required by BFAR, were ongoing in each municipality for the purpose of creating database. The monitoring and regulatory parts were not clear as how to lessen the expanding fishing effort and address the overfishing problems in the Bay.

With the presence of many GAs, and NGOs across municipalities, there are more fisherfolks associations created and became active. Projects and programs are usually downloaded to the associations and served as partner of LGUs in its implementation. However, after project termination, the association is also terminated. Moreover, municipalities have limited livelihoods for fisherfolks despite presence of various GAs and NGO. Both LGUs and GAs have limited funds to create and sustain livelihood opportunities for the increasing number of fisherfolks. Livelihood projects from NGOs are usually for short-term period and sustainability is not ensured after termination because of lack of technical knowhow and capability of the fisherfolks to manage.

The presence of GAs, especially BFAR, had increase post-harvest facilities, particularly fish landing centers, within San Miguel Bay municipalities. Whispering bidding or "bulungan" system is a highly patronized marketing system by the fisherfolks in areas of Calabanga, Cabusao and Mercedes, wherein brokers have the control of the fish trading. Municipal governments have less interventions or control over the trading scheme of the "bulungan".

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The 30% to 35% of total *O. ruber* catch in Calabanga, Cabusao and Tinamabac are contributions from commercial fishers. Thus, an indication of weak enforcement of laws since they are strictly banned in the waters of San Miguel Bay, as provided in respective ordinances. In the case of Mercedes and Siruma, the low catches can be explained by few fisherfolks who targeted *O. ruber* especially from those barangays near the mouth of the Bay and Pacific Ocean. The regular patrolling of the *bantay dagat* of Mercedes may also be the reason of low catch wherein commercial fishing vessels which are using trawls were prohibited in the Bay. *O. ruber*, which is a demersal fish, is common catch in trawls that largely operate at the bottom of the sea.

Prices of *O. ruber* varied from one municipality to another and for every season. Calabanga, Cabusao and Sipocot accounted with high prices both for fresh and dried *O. ruber* while Siruma and Tinambac were noted with low prices. Change of prices and the option to sell as fresh or processed as dried fish is dictated by the supply and seasonality of fish. Tinambac, Siruma, Sipocot and Cabusao are composed of small-scale fish processors while medium to large scale processors are usually found in Calabanga. The presence of more GAs like Department of Science and Technology and Department of Trade and Industry contributed to the large production in Calabanga, unlike other municipalities where support from these GAs are very limited.

CONCLUSION AND RECOMMENDATIONS

Decades after the passage of the local government and fisheries codes, the fisheries management in San Miguel Bay was still in established and strengthened levels of development. This means that fisheries management needs improvement, particularly along management planning, law enforcement, and monitoring and evaluation policies. The limited fund allocations and staff assigned to perform fisheries management functions were the major concerns.

A mixed of government and private organizations were helping LGUs, MFARMCs, and local communities managing the Bay's fishery resource. IFARMC serves as venue for inter-municipality cooperation and collaborations among multi- stakeholders. MFARMCs played significant role in fisheries management planning, local legislation, and law enforcement as they are required by law to be consulted by the local governments in matters related to management, conservation, development, protection, utilization and disposition of all fish and fishery/aquatic resources within the municipal waters like San Miguel Bay. MFARMCs, however, need to be strengthened and equipped in terms of capacities and logistical supports to fully perform their institutional and tenurial roles.

Tenurial rights over the Bay were preferentially given to municipal fisherfolk, however, encroachment and continued operations of commercial fisherfolk within it was still observed. This resulted to persistence of resource-use conflicts and competition between municipal and commercial fisherfolk for space and gear use. In terms of fishing efforts, small-scale fisherfolk usually conduct daily fishing for a longer period which was a consequence of having too many fisherfolk and continued encroachment and operations of commercial fishers. *O. ruber* catch were also getting smaller probably due to significant changes in coastal habitats. The *O. ruber* only contributed about 2% to 2.5% to the total catch and the trend is declining year-on-year. Income and other economic opportunities from *O. ruber* may also be at stake if these trends will sustain.

Basically, there is a direct relationship among number of fisherfolk, fishing effort and security of income. The greater the number of fisherfolk means an expanded fishing effort and higher potential catch and/or production, which can ultimately transform into a higher income for the local fishing families. The extent and type of fishing efforts may likewise be dependent on the ecological conditions of the Bay as well as the common practices observed by other fisherfolks. However, the catch or production may also be influenced by some environmental factors, such as the prevailing local weather, calamities, siltation and seasonality of species.

In particular, destruction of coastal habitat and fisheries resources would occur later. Stock of important commercial fishes including *O. ruber* may be depleted anytime since number of fisherfolk and expanding fishing efforts are not regulated wherein most catches were composed of juveniles or were caught before they can grow and add more weight. For future research, a comprehensive study of fishery resources and their management is essential to assess the biophysical characteristics and fishery status of the Bay over a period of time. An impact evaluation of the conservation management and development policies can be undertaken to determine the impact to the local economy, social well-being, and sustainable fishery and resources of the Bay.

Adoption and institutionalization of unified fisheries ordinance were still lacking among the municipalities which resulted to weak law enforcement and uncoordinated efforts of LGUs. LGUs and MFARMCs have many plans but due to funding and logistics constraints, these were all just confined and implemented in papers. In addition, inaction among the authorities and local fishing communities would aggravate thecurrent problems within the Bay like inequities in resource access and distribution of benefits.

The collaboration and efforts of various government and private entities to help the LGUs and MFARMCs are not enough to resolve the various and long-time fisheries management issues of the Bay. Active and serious participation from the local communities are vital. Political agenda and will from the local government officials are also necessary so that fisheries management policies and initiatives can be sustained and people may be encouraged to follow fishery rules and regulations and be involved in sustainable fishery-related activities.

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ACKNOWLEDGMENT

We wish to thank all the persons who supported and participated in the study: DOST-SEI, 7 San Miguel Bay municipalities, BFAR NSAP 5, Ms. Rosvilinda B. Intia, Ms. Catalina Rowelia S. Delos Reyes, Mr. Jogie Sagales, Engr. Joey T. Moral, Mr. Hector P. Magana, Ms. Lorna V. Avellana, Mr. Arnulfo B. Hermoso, the 6 MFARMC Chairmen and fisherfolks of San Miguel Bay coastal barangays, Mr. Gil B. Ramos, Ms. Consuelo A. Sempuego, Dr. Noemi SB. Lanzuela, Ms. Alexandra A. Tenajeros, Ms. Oshin Lorico, Mr. Victor P. Sayangco, Ms. Tinay San Andres, Mr. Jeremy Jansalin.