Participatory Resource and Socio-economic Assessment of Leyte Gulf, Matarinao Bay and Maqueda Bay

(Terminal Report)

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Executive Summary

To address the lacking current data on the fishery and biophysical aspect of the fishing grounds that include Leyte Gulf, Matarinao Bay, and Maqueda Bay, BFAR VIII, along with its project Fish-CORAL, initiated the implementation of the *Participatory Resource and Socio-economic Assessments (PRSA)* last December 2018. The PRSA serves two main purposes: (i) to establish accurate baseline information on a number of key indicators related to the extent and state of coastal resources and social and socio-economic conditions and activities, to feed into the project's monitoring and evaluation and management information system so that the impacts of the Project can be assessed at the end of the project; (ii) provide information and data that will assist with the project's planning and targeting of its work in support of bay-wide coastal resource management plans, strengthening of organizations supporting coastal resource management (e.g. FARMCs, BMCs, FLETs, etc.), habitat rehabilitation, and the establishment of livelihood projects for Peoples' Organizations in selected barangays.

The scope of the PRSA thus supports and covers both component 1 and component 2 of the project, and is correspondingly extensively covers natural resource, institutional, and socio-economic issues. The PRSA also provides summary and analysis of the prevailing situation in the Bays with respect to: (a) status and utilization of fisheries and related coastal resources/habitats and existing management arrangements (both formal and informal/traditional) and related institutional structures; (b) threats, impacts, and stresses on the resources and livelihoods; and (c) preliminary implications of the prevailing situation in terms of key needs and opportunities for natural resource management and livelihood improvements.

Although all preliminary legal documents have been accomplished at the latter part of 2018, it was not until the following year that the fund was finally released, and the first of the outings were carried out. As for the targeted bio-physical components, sampling areas were established and surveyed in each bay from January/February to June 2019. More often than not, these identified areas are located adjacent to communities and industries representing disturbed areas in need of utmost management measures, e.g., near mouths of bays and river systems, inside and outside portions of identified/priority MPAs, etc. After the completion of the PRSA, these same areas will also serve as the sampling sites of future monitoring activities by the BFAR Staff. The following summarizes the various components of the project.

This volume of the paper presents the results on the Socio-Economic Assessment of the fisherfolks, as well as the assessment of the mangrove vegetation in the communities near Leyte Gulf, Maqueda Bay, and Matarinao Bay.

The first part of this paper describes the socio-economic conditions of the fisherfolk in the three fishing grounds. Basic information of the fishing households at the family level were recorded and summarized. Data revealed that most fisherfolk are deeply rooted in their present location hardly ever moving from place to place. A closer look into their fishing activities involved scrutiny of their fishing boats and gears. Most fishers own their fishing boats that are mostly motorized, suggesting that fish may no longer be available near the coast. This is also coupled by the low catch of most of the fishermen, indicative of the diminishing quantity of fish in these bays. Perceptions about illegal fishing, coastal resource management, their participation in decision-making processes, role of women and their possible roles in CRM were also tackled, but the most alarming issue is their negative attitude towards law enforcement. The study proposes the strengthening of fisherfolk organizations for better engagement with the LGUs and BFAR, more technical and financial assistance from the LGUs and BFAR and the establishment of long-term stewardship agreements among fisherfolk organizations and the BFAR/DENR to make the fisherfolk responsible for the protection and nurturing of their fishing resources.

Biophysical studies start with the mangrove rapid assessment that was done using the Transect Line Plot method in order to determine the extent of mangrove vegetation along the coastal areas of the three fishing grounds. Total mangrove cover for these three fishing grounds amounted to 6,276 hectares. Species diversity revealed 16 major and nine minor mangrove species, plus three associated species. The density of each species varied at different sites ranging from 467-1,351 tree/ha, 477-1,847 tree/ha, and 550-1,600 tree/ha for Leyte Gulf, Maqueda Bay, and Matarinao Bay, respectively. However, zonation patterns were not evident due to massive reforestation of mostly monospecific Rhizophora across mangrove forests. This is also brought about by anthropogenic activities like construction of coastal roads, conversion to fishponds, and encroachment all of which disrupted the would be typical mangrove zontation. Dominant species varied in different locations, with *Avicennia marina, Rhizophora apiculata,* and *Sonneratia alba* as the overall dominant species. In general, regenerative capacity per municipality varied, ranging from 30-2, 577, 297-1, 730, and 24-551 seedling and sapling/ha for Leyte Gulf, Maqueda Bay, and Matarinao Bay, respectively. The most common mangrove fauna observed are crustaceans and mollusks. Mangrove forests provide livelihood and services to adjacent coastal communities. Local people depend on mangrove trees and palms for fuel, tannin, timber, wine and other products. Mangrove forests host a wide variety of edible fauna such as crabs, shrimps, and mollusks. Mangrove associated fauna especially the edible ones like 'pangti-on' are harvested as food for adjacent coastal community locals. Shells such as bivalves for example are used as food especially when fish is difficult to source during inclement weather. Threats to mangrove ecosystems include pollution, conversion to fishponds, human encroachment and settlement, and overharvesting of the mangroves as firewood and construction materials. In addition, mangroves are highly sourced for their tannin in the sampled areas. Usually, the species of 'barok', *Ceriops decandra*, is debarked for their tannin. However, in some municipalities, since the barok is hard to find or scarce in number, they use other species as substitutes, e.g. *Bruguiera gymmnorhiza* and *Rhizophora apiculata*. Various mangrove management programs are implemented by different organizations mostly focused on reforestation. However, science-based protocols were not followed in most areas resulting in observed seedlings on seagrass beds and a high seedling mortality. Some areas have established mangrove ecoparks to highlight the variety of species in their areas and at the same time, to generate income. This study recommends the establishment of mangrove reserves in every coastal municipality, strong enforcement of existing mangrove laws and zoning mangrove in Municipal Comprehensive Land Use Plans (CLUPs), and establishment of Community-based Mangrove Forest Management Agreements (CBFMA) that entails active participation from the community and the local government unit.

1. Socio-Economic Assessment

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Abstract

This paper describes the socio-economic conditions of the fisherfolk in the three fishing grounds, namely: Leyte Gulf, Maqueda Bay and Matarinao Bay. It starts with the study of the fishing households and their families, their family members, levels of education, economic activities and income. It also asks questions on migration patterns among fisherfolk. Here we understand that fisherfolk are not the migratory types. But a closer look into their fishing activities comes with an examination of their fishing boats and gears. Most fishermen own their fishing boats and that these are mostly motorized, hinting that fish may no longer be available near shorelines. The small amount of fish caught by the majority of the fishermen is also indicative of the diminishing quantity of fish in the bays.

At some point, the questions shifted to their perceptions about illegal fishing, coastal resource management, their participation in decision-making processes, role of women and their possible roles in CRM. Their attitude towards law enforcement is generally negative, and because of that they see no hope against illegal fishing. Likewise, their understanding of CRM is limited to components of CRM.

The paper proposes the strengthening of fisherfolk organizations for better engagement with the LGUs and BFAR, more technical and financial assistance from the LGUs and BFAR and the establishment of long-term stewardship agreements among fisherfolk organizations and the BFAR/DENR to make the fisherfolk responsible for the protection and nurturing of their fishing resources.

Keywords: Socio-economic conditions, CRM, illegal fishing.

Introduction

A study done by the Coastal Conservation and Education Foundation (CCEF), a non-stock, non-profit organization supported by the USAID, says that the current condition of fisheries in the Philippines, let alone worldwide, is bleak. Several conditions contribute to this depressing situation. Overfishing, illegal fishing and habitat destruction, combined with increased demand for fish and population growth, continue to drive fisheries production into a deeper abyss.

The CCEF has summarized its findings into two groups labeled as “core problems” and “contributing factors.” Listed under “core problems” are the loss of marine biodiversity, declining fish stocks, loss of revenue and benefits from fisheries and coastal resources. Their “contributing factors” cited overfishing, illegal and destructive fishing, coastal and habitat degradation, siltation and pollution, post-harvest losses and inefficient marketing.

Another study by the Food and Agriculture Organization (FAO), a United Nations affiliate, says that due to neglect, widespread destruction and abuse of fishery resources, the fishing industry contributes a measly 5-6% of the gross national product (GNP). This accounts for the widespread poverty and poor living standards of about a million fishing families in the coastal villages. And yet the country is known for its rich aquatic resources and great potentials for economic recovery and growth through the development of its fishing industry.

The local picture is not too different from what is seen at the national scale. Previous fishery studies in the region have likewise pointed out the diminishing resources and fish catch and the decreasing incomes of the fisherfolk. Illegal fishing activities, like trawl and blast fishing, were also cited in the studies, causing further depletion of fishery sources. The present study shows the worsening of these conditions as indicated in the increasing poverty of the fisherfolk and the unrelenting presence of illegal fishing.

As in previous surveys, this study takes stock of the fisherfolk’s demography for a better and more thorough understanding of the families included here. It looks at the ethnic composition as well as religious affiliations of the respondents. It asks about their migration tendencies and probes at their geographical origins. It discusses the reasons for the change of residence of the respondents.

Then their respective households are also subjected to probing questions. What is their tenurial status? Do they own the lots they are built on? Are they renters, leases or non-paying residents? What are their houses made of? Permanent or non-permanent materials? Permanent materials can indicate a more stable sense of well-being.

Household sizes are also being looked into especially since these interact with the sizes of the houses and the number of rooms. Larger households in small houses and fewer rooms result in cramped situations.

Other household features, like the presence of toilets, access to potable water, use of electricity and their furniture and fixtures indicate the social status of the respondents. The absence of toilets can become a health problem for the community. The non-access to clean water sources can likewise be a problem for the families concerned.

With the study of the households is an investigation of its members. Who are their members? How old are they? What is their gender and civil status? Their levels of education and their employment? How much are they earning per month? Do they have secondary income sources? The total household income also includes incomes from its members.

A more detailed inquiry into the fishing activities of the respondents follow this portion. Do they earn from capture or mariculture? How many times a week do they go out fishing? Do they make bigger incomes if they fish more days? Do they own boats and fishing gears? How large or how small are these? Are these boats motorized or not? What do these say about the state of the fishing grounds? The use of motorized boats can only mean they have to fish farther out in the ocean.

Different fishing gears turn out different fishes. While it would be good to know exactly what kind of fish is caught by a particular gear and how many kilos, fishermen do not make a record of such catch or which occasions. To them what is important is the number of kilos they can catch on any fishing expedition. In this study, we are able to determine the catch per gear. We are also able to determine which gears are most popular based on the average gear output.

But more important, the study is also able to determine how many kilos fishermen catch on a normal outing. The figures are indicative of the scarcity of fish being captured from their fishing grounds, that result in decreasing incomes for the fisherfolk.

The study probes further into certain practices of the fishers in the disposition of their catch. How much of their catch do they consume while at sea? How much do they share with their fishing companions? How much do they leave with their families? It is interesting to note that contrary to expectations, most fishers leave nothing to their families. After all these have been factored into the fishing equation and other expenses calculated, how much did they earn at the end of the fishing day?

While monthly incomes are hard to estimate for the fishermen since they do not record their daily catch, ways were developed by the study to help fishers come up with a monthly figure. Their answers provide the study a clear idea how much each fishing family earns, especially as such incomes are measured against the prevailing NEDA poverty index. The findings here are very revealing.

The issue of fish processing also forms part of the long study. The study makes a short list of the kinds of fish being processed and another short list of the fishermen involved in processing. Note that the number involved is only a few hundreds who process on a small scale.

The second part of the study tries to probe into the subjective predispositions of the fisherfolk on trainings and sources of information, illegal fishing, coastal resource management, decision-making processes, involvement of women and their perception about their own economic conditions.

What kind of trainings do they want? The study asks the respondents. It is interesting to note that a large percentage of the respondents do not attend trainings. Likewise, the majority of fishermen do not rely on official information sources, such as the LGUs or BFAR.

The study also measures their awareness of illegal fishing. In fishing areas where illegal fishing is rampant, the poor awareness level is difficult to understand especially when such fishing activities happen right at one's front yard. Which of these are most destructive? From one fishing bay to another, the perceptions are different on this issue.

Why illegal fishing continues despite the presence of bantay dagat and ordinances prohibiting them form part of the questions. Probing further, the study asks why the ordinances are not being strictly followed.

The respondents are also queried on who is supposed to be responsible for the protection of their fishing grounds. It is interesting to note who the fishermen blame.

Then questions on their awareness and understanding of coastal resource management are asked, showing that fishers do not have a uniform understanding of CRM and that these are in segments. There is ample information on their involvement, describing what types and how many are involved.

While most fishermen declare that they are not aware of CRM, most would like to be involved in CRM activities.

On the role of women, most fisherfolk want women to be involved in community activities. The study outlines their specific involvement.

It is in the issue of decision-making where fisherfolk have plenty of misgivings. Are they involved in decision-making processes? Who really makes the decisions in the community? How eager are they to participate? How easy is it to arrive at a consensus? Whose responsibility is it to improve the coastal resources? How easy or difficult is it to work with others? Their answers give the study a good perspective on the fishers' attitudes insofar as CRM is concerned.

They also provide insights on their view of politicians and the LGUs. This is especially important if projects are implemented involving the fishing communities and engaging LGUs.

A summary comes at the end of this study. Discussion focuses on the central issues that emerged. There are proposals drafted here which can make a dent on efforts to restore the fishing grounds, improve fish catch and curtail illegal fishing.

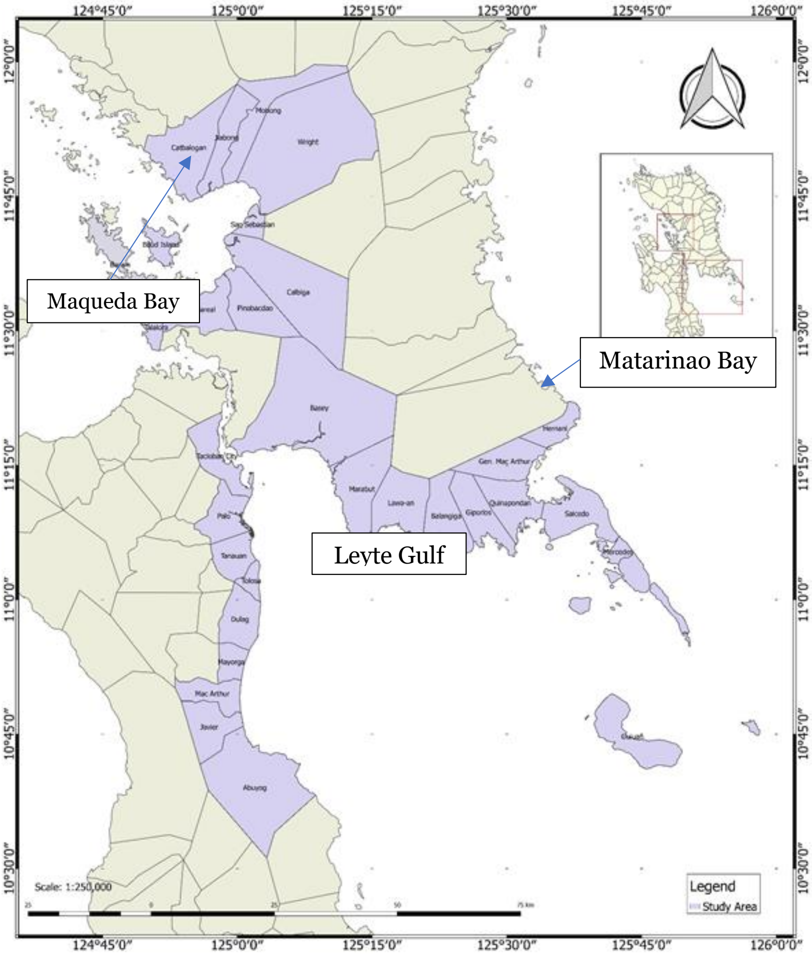

Figure 1-1. Socio-economic Assessment Study Area.

The survey covered 17 municipalities and 1 city around the Leyte Gulf, with a total of 260 coastal barangays, Matarinao Bay with 4 municipalities and 29 coastal barangays, and Maqueda Bay with 10 municipalities and 1 city and 151 coastal barangays (Figure 1-1).

This study is aimed at generating data and information on:

- Household, demographic, socio-economic data of the fisherfolk in the three aforementioned bays
- Inventory of fishing boats and gears
- Number of fishermen, full time or part time
- Mapping of fishing areas and fishing sites
- Preliminary estimates of catch and effort
- Problems and issues of the fisheries sector

Methodology

Data Collection

Three methods were employed for the collection of data, namely: (1) face-to-face interview with fisherfolk, (2) key informant interviews and (3) focus group discussion. Method 1 was conducted using the semi-structured interview (SSI) based on the standard forms. It is intended to provide, among others, information on the demographic and household characteristics, fishing boats and gears, fish species caught and volume, fishing related expenditure, perceptions on various cultural and fishing related issues, illegal fishing, coastal resource management and socio-economic assessment within and among different fisherfolk communities of Leyte Gulf, Matarinao Bay and Maqueda Bay.

The said survey tool was programmed into ODK Collect, an Android application, using the XLSForm standard thereby replacing traditional paper and pen survey. ODK Collect supports additional types of data input such as geo-locations, images and audio clips. It is designed to work offline during the data collection effort and supports submission of completed questionnaires when network connectivity is available.

The enumerators who conducted the interviews were recruited from barangays close to the survey sites. Most of them were college level who had a reasonable grasp of the English language. They were given training prior to deployment to orient them with the operations of the survey tool and uncover potential issues such as programming bugs and ambiguous questions and address them accordingly before actual fieldwork.

An ODK Aggregate Server was deployed and made available 24/7 to facilitate submission of finalized survey forms. The submissions are automatically stored by the server in a corresponding database which can later be downloaded and exported for subsequent analyses. The general architecture and flow of data collection and processing in the ODK setup is presented in Figure 1-2.

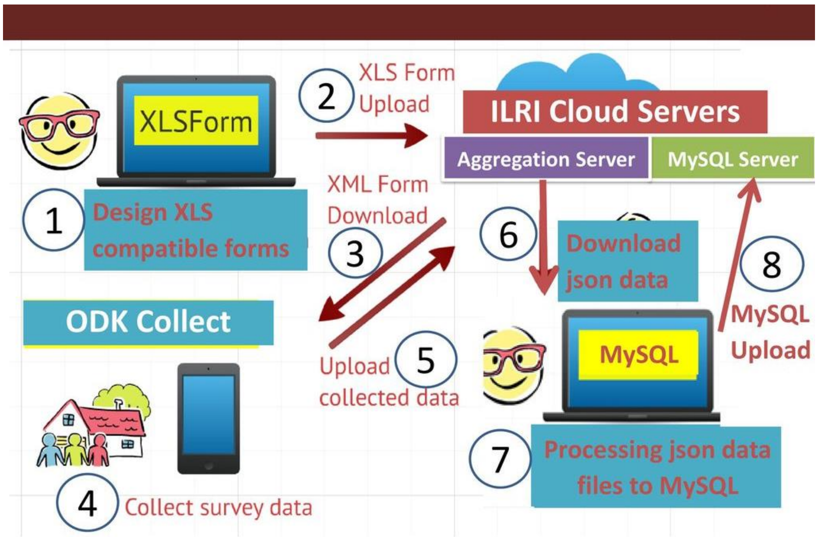

Figure 1-2. ODK Data Collection and Processing. Taken from: https://slideplayer.com/slide/11733513/.

Data Analysis and Visualization

Data extracted from the Aggregate server is analyzed using appropriate statistical tools such as the measures of central tendency: mean, median and mode. In addition, histograms and graphs are generated based on their suitability on the data collected. The richness of data allows for multilevel analysis starting from the municipality, followed by the individual bay, and finally, the entire study area.

Consequently, this allows us to look into the disparity between and among different municipalities, or look at how each municipality fare relative to the bay and overall average. In addition, municipal level data can be embedded into the DENR Municipal Boundaries Map to generate thematic maps that highlight specific parameters of interest. Finally, the associated geopoint information for each submission can be used to visualize individual instances which qualify specific criteria such as household with no access to electricity (Figure 1-3).

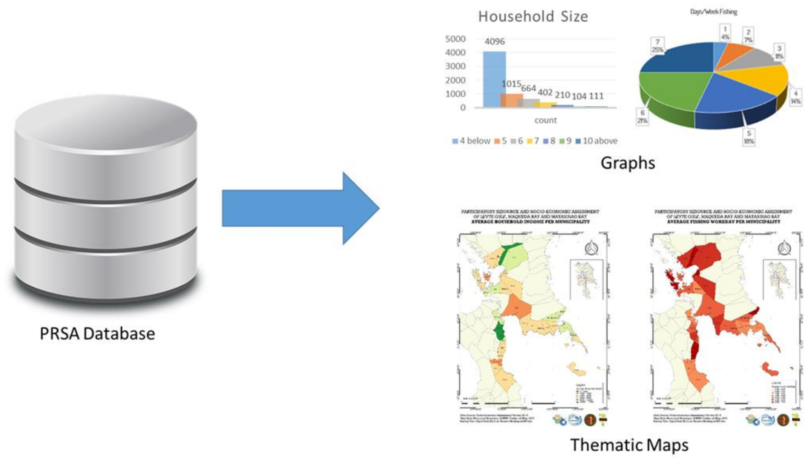

Figure 1-3. Generating Graphs and Thematic Maps from the PRSA Database.

Focus Group Discussions (FGD) and Key Informant Interviews (KII)

Additional information, such as perceptions, beliefs and ideas of the fishery trends, problems, gears, and patterns of fishing operations by 'outsiders' were collected during the FGDs and KIIs. The purpose was to probe deeper into the subjective world of fishers, fishing vessel operators, fish vendors, officers of local fisheries organizations, members of local Fishery Law Enforcement Teams (FLET) or Bantay Dagat and barangay officials.

The FGD participants and KII respondents were asked questions that were more or less similar to the survey questions, but were meant to describe contexts and processes, elicit anecdotes and stories, and determine the possible reasons why things are happening as they do in the fishery subsector and the lives of those living off the resources of the seas.

Since perceptions and opinions cannot be quantified or framed within static categories, these issues have been treated in FGDs and KIIs. Nine FGDs were conducted (3 in each bay) and 65 KIIs. Each FGD had at least 15 participants and lasted for around 2 hours. The KIIs chose respondents from communities along the Leyte Gulf, Maqueda Bay and Matarinao Bay.

Some features of the issues raised have surfaced from the discussions and interviews and were integrated into the report as stories and anecdotes that substantiate the trends or provide other angles to them. The photos these discussions and interviews are attached to this report as appendices. (See Appendix A-1 to Appendix A-5)

Results and Discussion

This section of the paper presents all the data gathered from the fisherfolk respondents in the communities around the Matarinao Bay, Leyte Gulf, and Maqueda Bay. The total number of fisherfolk respondents and the number of registered fisherfolks is shown in Table 1-1. Out of the 61124 registered fisherfolks according to the list from BFAR-8, 12701 of them were interviewed for their socio-economic conditions.

Table 1-1. Number of Fisherfolk Respondents for the Different Bays.

Bay / Municipality	Registered Fisherfolks (BFAR-8)	No of Fisherfolk Respondents
Matarinao Bay	**2386**	**421**
General Macarthur	1032	235
Hernani	1354	186
Leyte Gulf	**32509**	**5918**
Abuyog	1629	470
Balangiga	571	288
Basey	1323	452
Dulag	1064	312
Giporlos	1494	386
Guiuan	6510	1254
Javier	321	52
Lawaan	1062	322
Macarthur	2081	107
Marabut	1700	930
Mayorga	916	137
Mercedes	1449	147
Palo	6398	156
Tacloban	3497	398
Tanauan	1694	269
Tolosa	800	238
Maqueda Bay	**20992**	**5494**
Calbiga	835	265
Catbalogan	6424	834
Daram	4440	1028
Jiabong	1167	327
Motiong	266	107
Paranas	787	248
Pinabacdao	409	194
San Sebastian	517	337
Talalora	947	334
Villareal	2383	561
Zumarraga	2817	1259
Matarinao Bay and Leyte Gulf	**5237**	**868**
Quinapondan	1652	310
Salcedo	3585	558
Total Number of respondents	**61124**	**12701**

Note: Data on *Quinapondan* and *Salcedo* are separated as they encompass two bays.

Demographic Profile of Respondents

Ethnicity

The fisherfolk population are predominantly Warays, comprising 96.44% of the respondents. Maqueda Bay has the biggest concentration of Warays having 99.40%. Cebuanos have the second biggest number which got 3.23%. This has the highest concentration in Leyte wherein Cebuanos are 6.07%. The others, like Bicolanos, Tagalogs, Ilonggos and Tausugs, constitute 0.33%.

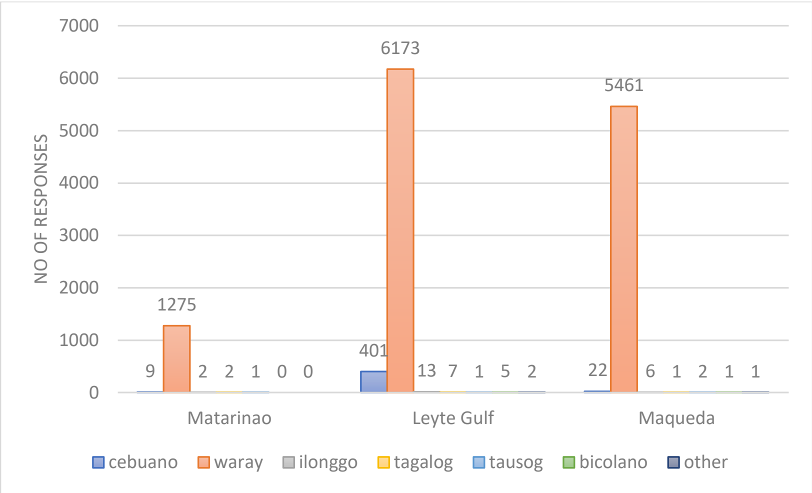

Figure 1-4. Ethnicity of fisherfolk respondents in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Religious Affiliation

Overall, 96.88% of the respondents say they are Roman Catholics. Maqueda Bay has the highest concentration with 98.22%, followed by Leyte Gulf at 96.12%. Other religious sects and denominations trail behind, which constitute 3.12% (Figure 1-5).

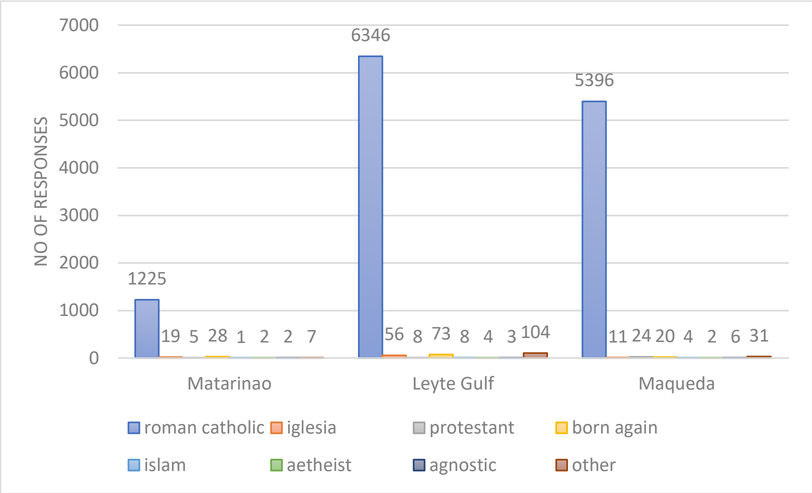

Figure 1-5. Religious affiliations of fisherfolk respondents in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Change of Residence

Around 90.45% of respondents said they have not changed residence, while another 7.07% said they changed once. In Maqueda Bay, 91.85% said they never changed residence, but in Matarinao only 76.73% did not change residence. 7.07% said they changed once, with Matarinao Bay having 16.14%.

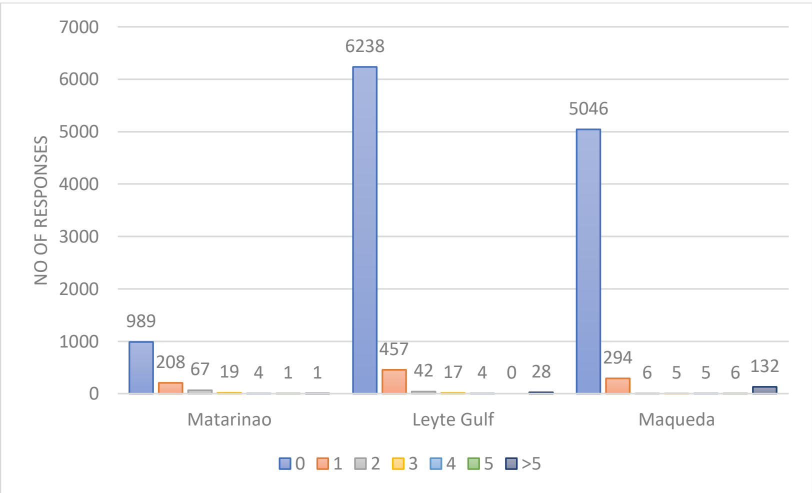

Figure 1-6. Number of times the fisherfolk respondents changed their residence.

Planning to leave

Overall, 94.07% said they have no plans to leave their current settlements, with Maqueda Bay having the highest number which got 98.23%, seconded by Leyte Gulf having 92.35%, and Matarinao Bay which got 85.42%. Around 1.70% said they have plans to leave while 4.23% were unsure.

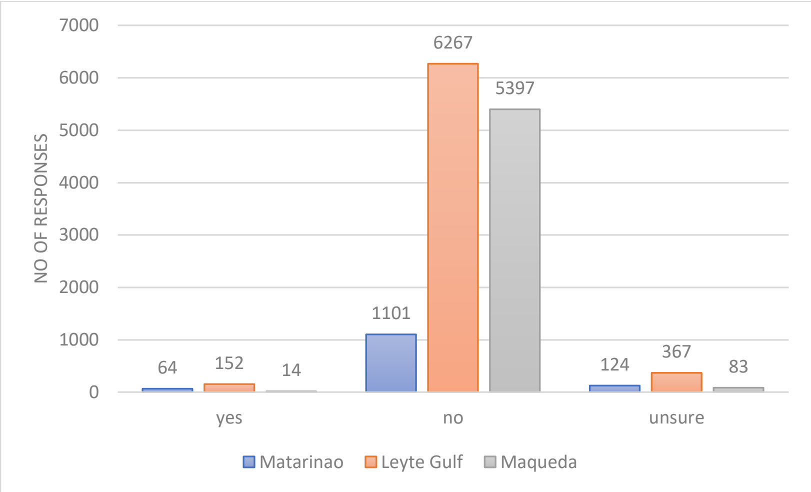

Figure 1-7. Fisherfolks of Matarinao Bay, Leyte Gulf and Maqueda Bay plans to leave.

Reasons for change

Overall, 32.02% said that livelihood is the main reason for changing residence. In Maqueda, livelihood also got the highest having 43.98% of the respondents, while school issues got the lowest having 2.07%. Similarly, in Leyte Gulf, livelihood got the highest while school issues got lowest having 28.25% and 4.53%, respectively. In Matarinao Bay, livelihood also got the highest which constitute to 26.58%. Overall, 4.70% answered other as their reason. See Figure 1-8.

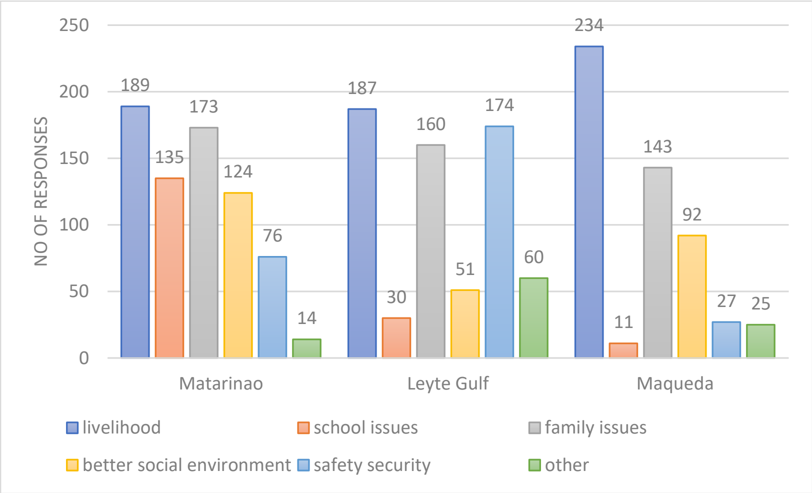

Figure 1-8. Reasons for changing residence.

Migration Details

Migration Status

Overall, 90.42% says they are no migrants from other places while 9.58% says they are. Highest percentage of migrants is from Matarinao Bay which got 23.27% of the respondents, followed by Maqueda Bay which got 8.15%, and lastly Leyte Gulf which got 8.09% (Figure 1-9).

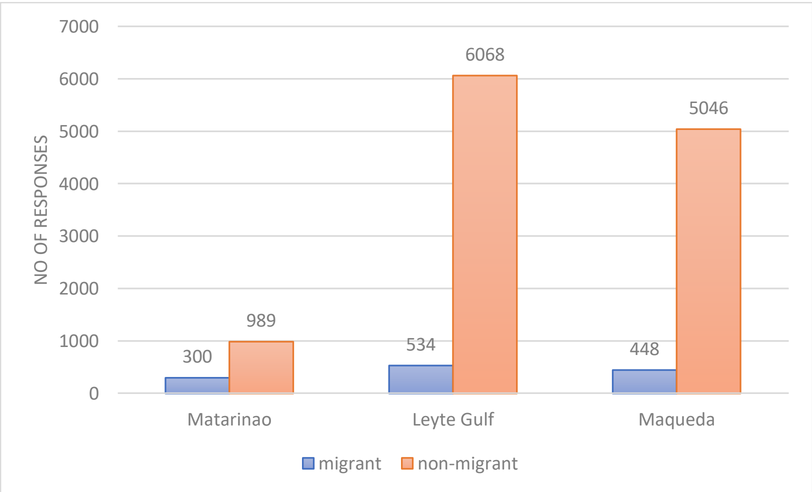

Figure 1-9. Migration status of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Migration Plan

Around 93.76% of all the respondents says that they have no plans on migrating to other places. This is highest in Maqueda Bay which got 95.96% of the respondents, and lowest in Matarinao Bay which got 85.42%. Overall, 1.71% said that they have no plans, while 4.53% were unsure.

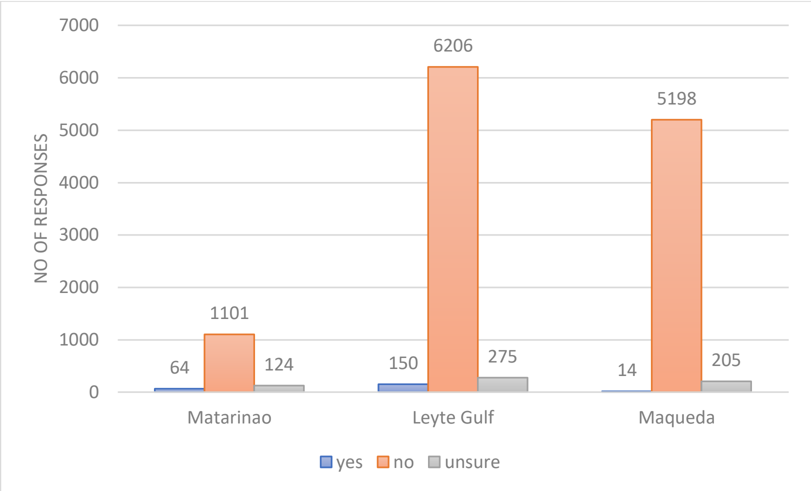

Figure 1-10. Migration plans of fisherfolks of Matarinao Bay, Leyte Gulf and Maqueda Bay.

Household Characteristics

Lot tenure and House types

Around 58.11% of the fisherfolks said they own the lot where their houses stand, which is highest in Leyte Gulf which have 64.84%, followed by Matarinao Bay which got 58.96%, and last is Maqueda Bay which have 49.82%. However, 3.15% said they do not pay any rent for the lots they are living in. Leaseholders constitute only 2.55% overall, while renters reach 9.20%.

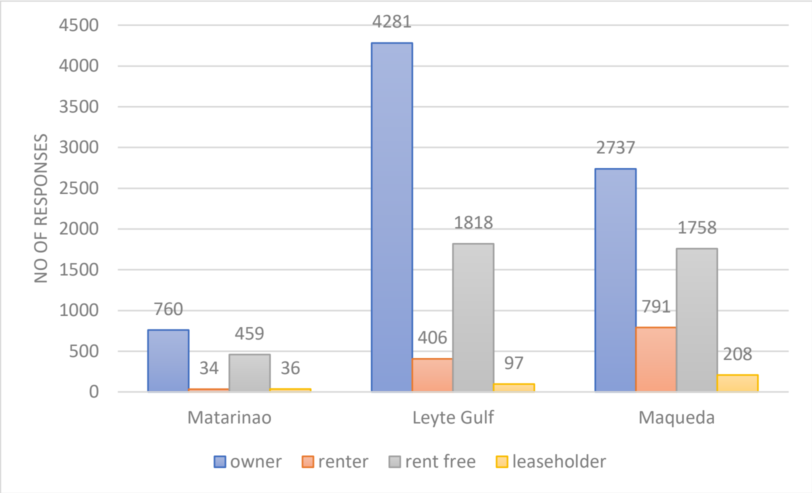

Figure 1-11. Tenure lot among fisherfolks households in Matarinao Bay, Leyte Gulf and Maqueda Bay.

The claim of the fisherfolks that they either own the lots or that they are rent-free easily translates into houses that are either permanent or semi-permanent. The permanent ones are usually made of concrete while the semi-permanent ones are combinations of concrete and wood or nipa. The non-permanent ones are made of bamboo and can easily be dismantled. Lot renters or leaseholders who have no claim to their lots have non-permanent houses too.

House Types

Generally, 42.24% of respondents live in permanent houses, while 30.04% in semi-permanent ones. Some 27.72% are in non-permanent houses. In Maqueda, 57.95% are in permanent houses, while 24.04% are in semi-permanent ones.

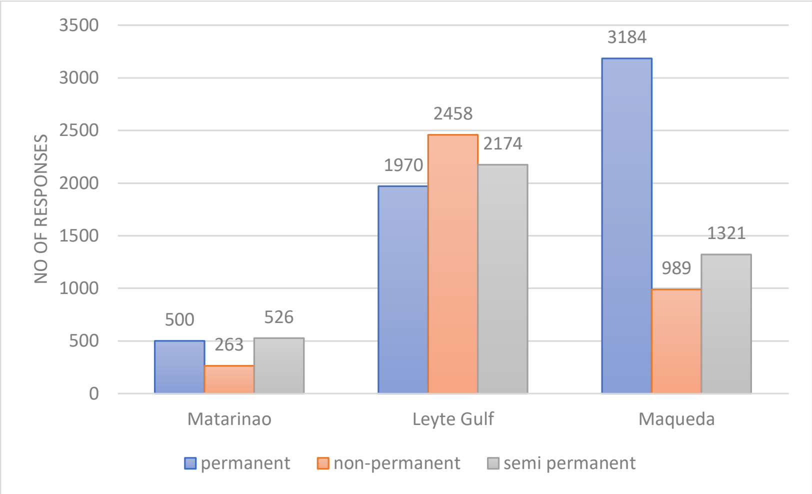

Figure 1-12. Types of houses of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Number of rooms

On the average, more than half of the houses (55.78%) of fisherfolk in the region have one room inside, a place where they keep their clothes and other things. In the Leyte Gulf, the concentration is highest at 58.29%. More than 25.61% have two rooms in their houses throughout the region, but in Matarinao 33.28% of the fishing household have two rooms.

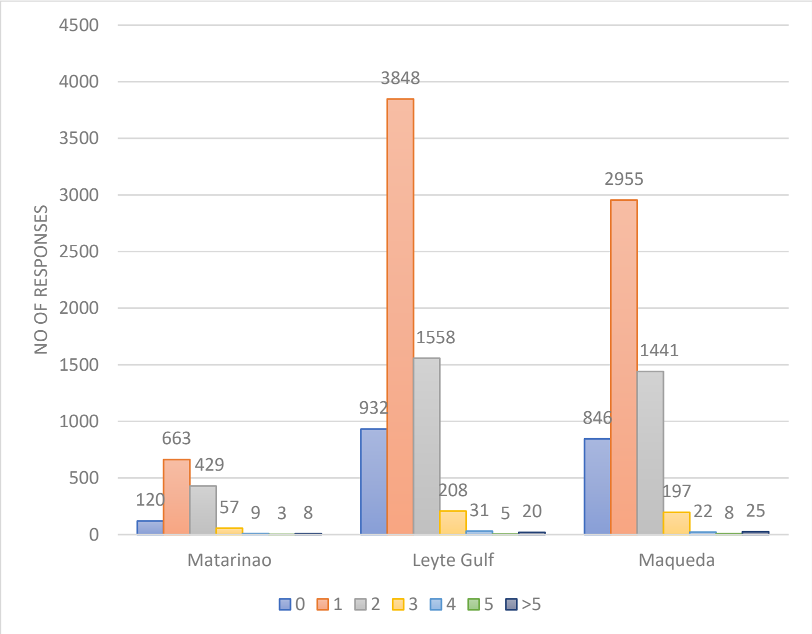

Figure 1-13. Number of rooms per fisherfolk household.

Toilet types

In the three fishing grounds, the number of households that do not have toilets totals to a 14.81%. It is in Maqueda Bay where the concentration is highest which is 30.01% of the respondents, compared to Matarinao Bay where it is only 2.56% or Leyte Gulf where it stands at only 4.54%. Open-pit toilets is also high in Maqueda Bay at 21.61%, followed by Matarinao Bay at 8.53%. As for those who have water-sealed toilets, the average is 68.30%, with the Matarinao Bay having the highest at 87.04%.

But some barangays, like Bucao in Guiuan, Eastern Samar are outliers. According to the FGD participants, mostly barangay officials, Bucao has been declared a Zero Open Defecation barangay by the municipal health office. Like Bucao, Barangay Cogon in Palo, Leyte has also been declared a ZOD community. Both barangays are located along Leyte Gulf.

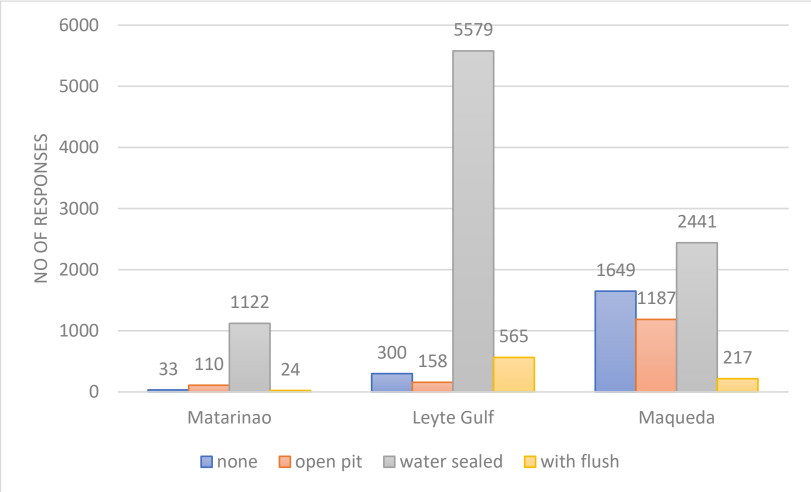

Figure 1-14. Toilet types in the houses of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Electricity provisions

This is an obvious indication that the electrification program has succeeded, with 95.47% of the fishing households throughout the fishing communities in the three bays availing of electricity. More than half of these (54.05%) however are into basic use of electricity, while 41.41% use electricity for assorted gadgets. Leyte Gulf is highest (60.15%) in the use of basic electricity at home, while Matarinao is the highest with gadgets with more 61.99%. Those with no electricity are only 4.53%. The highest percentage is in Leyte Gulf with 5.48% not using electricity. Matarinao has only 1.49% not using electricity.

The fishing households in Barangays San Joaquin and Cogon in Palo, Leyte are not part of the 5.48% not using electricity. All fishing households in the two Leyte Gulf communities are connected to the main grid. It is only recently in the case of Cogon, that households were connected to the grid through the free connection program of a political party, FGD participants revealed.

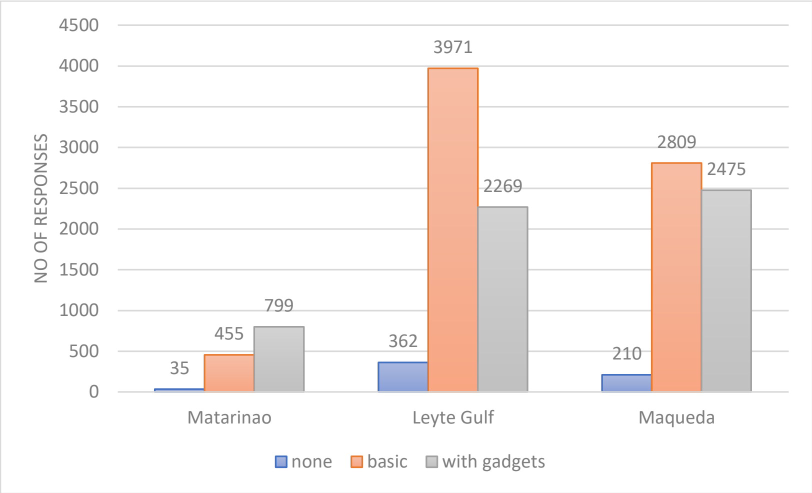

Figure 1-15. Accessibility of Electricity in every fisherfolk household in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Source(s) of water

On average, 61.45% of fishing communities in the three bays avail themselves of public water sources, either from public water pumps (21.51%) or public faucets (39.94 %). Those with water in the households constitute only 11.84 %, while those using open wells are almost the same number (12.42%). Among the three fishing grounds, Leyte Gulf has the highest number of users of public water sources, 66.46%. However, access to water inside the households is highest in Matarinao with 16.81%. Maqueda Bay fishing communities have the highest percentage of open-well sources at 17.97%.

Obtaining water from public water sources does not necessarily mean obtaining them without cost even if minimal. In Barangay San Joaquin, Palo, Leyte for example, residents get their water from communal faucets. Each household pays 10 pesos per month for their consumption. This information was provided by fishers who participated in an FGD as members of a local association.

The 12.42% who source out water from open wells, use the water for other household uses other than drinking, like in the case of the households of Sitio San Fernando, Barangay Cogon, Palo. For drinking, some households buy water from other households with water connections or they buy purified water from water stations.

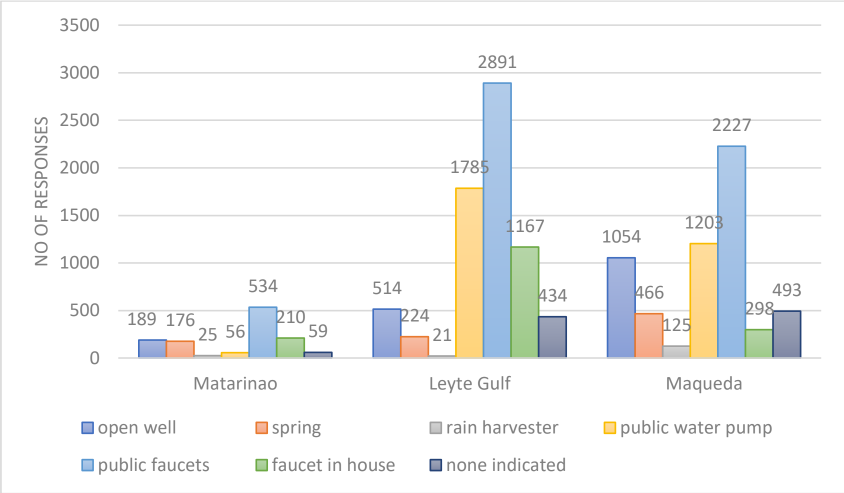

Figure 1-16. Water sources of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Furniture

A significant number of respondents (41.97%) did not make a statement about the furniture in their households. But more than 18.59% declared they have sala sets and other furniture, while more than 19% said they have dining sets. Figure 1-17 shows the other furnitures cited by the respondents.

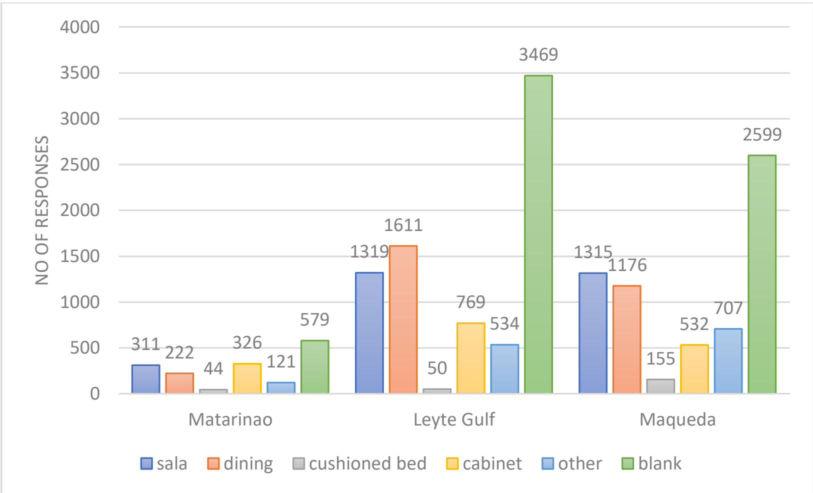

Figure 1-17. Furnitures owned by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fixtures and other properties

As for household fixtures, the TV seems to be popular with 42.58% of the respondent households declaring that they have televisions. 28.76% said that they have electric fans and some other items. Those who claimed that they have radios in the house numbers at 13.79%. The aircon does not seem to be that popular as 0.09% said they have it in the house. Other fixtures declared by the fisherfolks is presented in Figure 1-18.

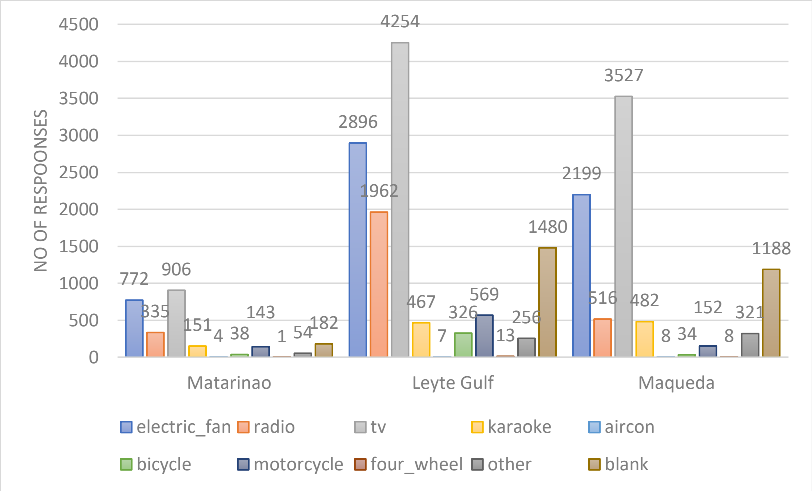

Figure 1-18. Fixtures and other properties owned by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Years of residence in barangay

The number of residents were bracketed into groups of 10 years' residence in the area, but the distribution of fisherfolk in the 10-year gaps appear to be almost even. 19.55% said they have been in the area from one to 10 years, while 17.15% claimed that they have resided in their present communities from 11 to 20 years. Also, 18.46% claimed that they have been residing in their present areas from 21 to 30 years. While only 15.36% said they have resided here from 31 to 40 years. 13.96% said they have been here from 41 to 50 years and 15.52% said they have been residing for more than 50 years.

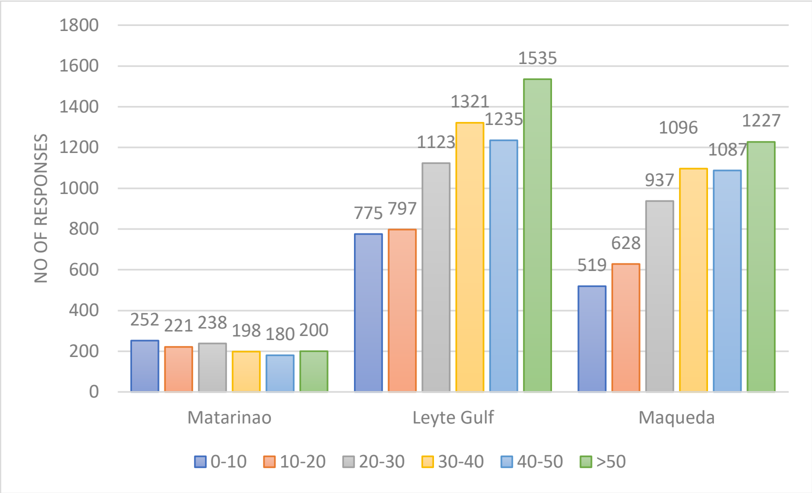

Figure 1-19. Years of residence of the fisherfolks in their respective barangays.

Household Income Range

Monthly poverty threshold for a family of five in Eastern Visayas in 2015 was estimated by the NEDA at Php 8,877. This represents the amount needed every month to meet the family's basic food and non-food needs.

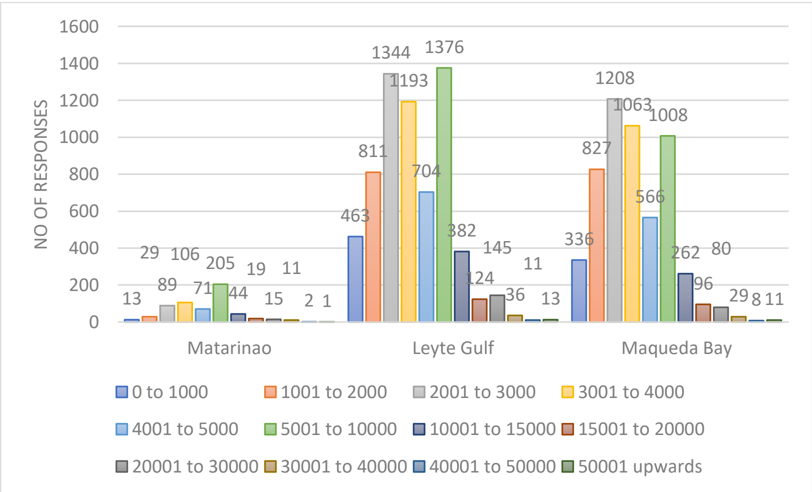

Figure 1-20. Household income distribution of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

In the entire fishing villages of the three bays, 87.01% are poor. Of the 87.01% who belong to segments below the poverty level, some 69.47% earn 5,000 pesos or less every month. We can easily say these are the poorest of the poor within the fishing communities in the region. This is particularly high in Maqueda Bay (72.81%). Leyte Gulf follows with 68.39%, while Matarinao Bay has only 50.91%. But whatever the percentages, it is clear that more than half the fishing population suffer from extreme poverty. In Matarinao, 490 out of 605 earn below the poverty threshold or 80.99%. In Leyte Gulf, 5,709 out of 6,602 fisherfolk are below the poverty threshold or 86.47%. In Maqueda Bay, 4,852 out of 5,494 or 88.31 % are poor.

Average Income vs Days Fishing

The question has been asked whether the number of days spent in fishing would also increase household income. The data gathered tell a different story. In Maqueda Bay, the average income of the fisher who goes to sea for only a day is bigger than those who go out 2 to 5 days a week. In Leyte Gulf, the fisher who goes out 2 days in a week earns more than any of those who go out more days. In fact, the smallest income earner is the fisher who goes out 7 days a week. But Matarinao tells another story altogether. While the one-day fisherman makes a bigger income than those going out 2 days a week, starting at 3 days a week, the average income increases until 6 days a week. Still the 7-day fisher makes an income comparable to the 4-day fisher. On overall average, the fishermen that goes out 1 day in a week got the highest average income. One of the probable reasons why the one-day fisher makes a bigger income is that they get their earnings from other sources, aside from fishing.

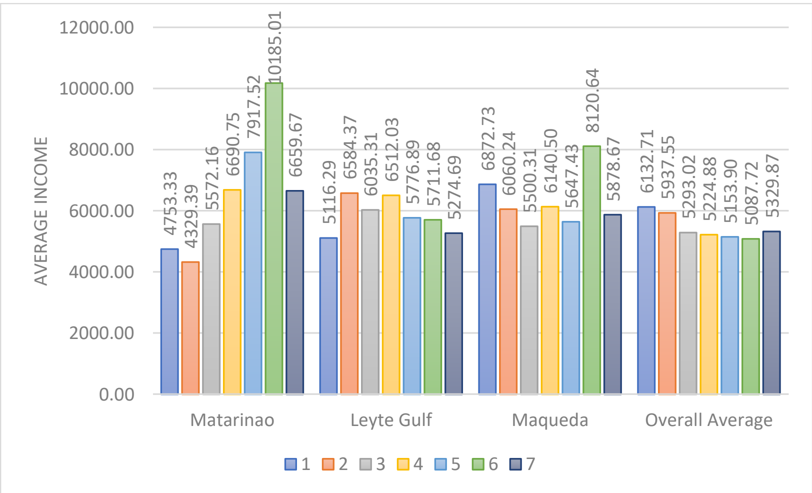

Figure 1-21. Average Income relative to the days spent on fishing per week of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

The information gathered from the FGDs tends to support the results of the survey. In Barangay Zone 5, Paranas, Samar for example, most fishers would only earn around 500 pesos in gross income. Less the cost of fuel and food, their take home income would only be between 150-200 pesos, or less than 5,000 pesos a month. The amount is barely enough to buy the family rice, they said. That they can still send their children to school is partly because of the scholarship grant provided by the municipal government and the subsidy some of them receive from the government's Conditional Cash Transfer program.

Most fishers from Sitio San Fernando, Barangay Cogon in Palo would be out at sea seven days a week. But each day they would only earn an average of 150-200 pesos a day. It is a big help, they said, that many of them are also beneficiaries of the Conditional Cash Transfer program. It's no different in the case of the fishers of Barangay Bucao in Guiuan. Among the fishers, only one earns between 5,000-7,000 pesos. The rest earn less than 5,000 pesos. Fishers spend an average of 100 pesos for the two liters of fuel they consume from their docking point to the fishing site.

The fishers in Barangay Baras, Palo, Leyte, earn less than 5,000 per month but not throughout the year. On rainy months, when the sea is unusually murky, they earn as much as 10,000 pesos per month, mainly because they catch a lot of shrimps, which command a high price in the market. The sizes they catch sell between 200-300 per kilo. Fishers in this community do not also spend on fuel as they only fish near the coastline and use only nets, boats and paddles. That they are also champion dragon boat paddlers should surprise nobody since they get to practice every day.

Household Membership

Total Population

Of the 12,701 fisherfolk respondents, a total of 54, 252 persons account for all the fishing households. Males (55.51%) outnumbered the females (45.28%). Leyte Gulf numbered 27,258 (50.24%), Maqueda Bay 24,101 (44.42%), while Matarinao 2,893 (5.33%).

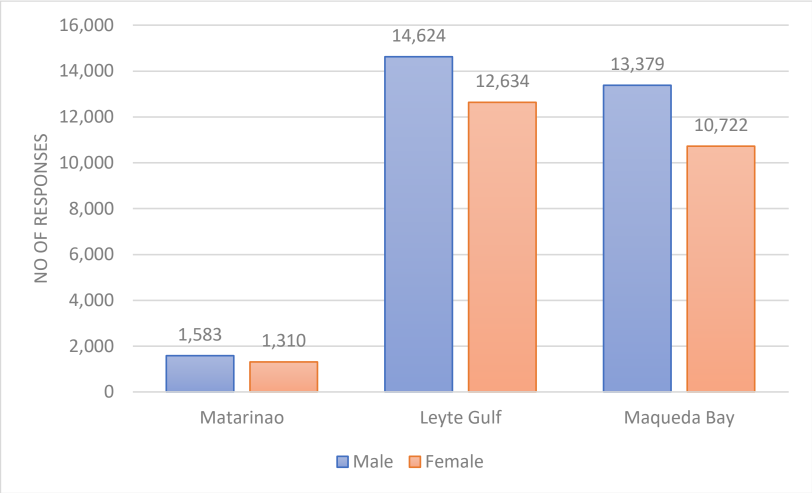

Figure 1-22. Sex Distribution of fisherfolk respondents in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Civil Status

Singles constitute the largest segment of the survey with 62.61%. Married persons numbered 35.33%. The biggest percentage on singles are in Maqueda Bay with 66.90%, while in Matarinao it is around 65.78%.

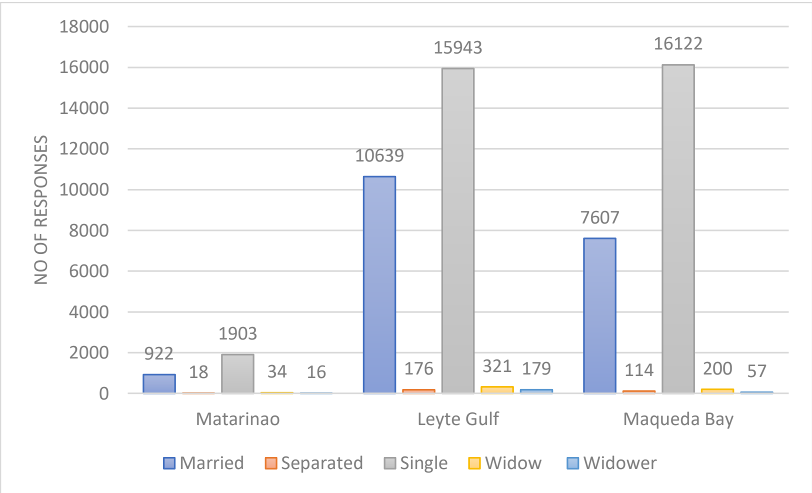

Figure 1-23. Civil status of fisher respondents in Matarinao Bay, Leyte Gulf and Maqeuda Bay.

Household Sizes

20.13% of the respondents say that they have four members in the household, 15.62% said they have 5 members in the household and 17.42% said they are 3 in the households. We can say that the typical fishing households have 3 to 5 members. 11.03% said they are 6 in the households, while 7.09% claimed that there are 7 of them in the household. See Figure 1-24.

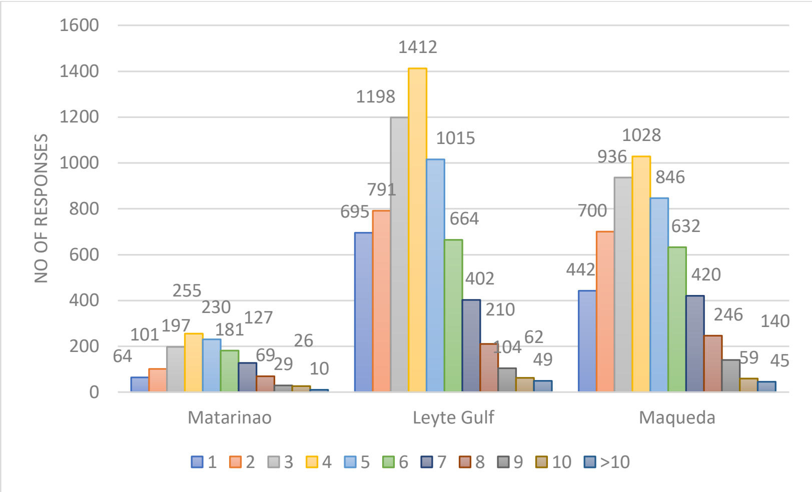

Figure 1-24. Household size of fisher families in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Education

This section shows the highest educational attainment of the fisherfolks and the members of their households. Around 40.57% of the population are only elementary school level, followed by high school level with 33.52%. Maqueda Bay tops the list with 44.43% of the members of fishing households attaining college level. The high school level is highest in Leyte Gulf with 36.60%. On average, 7.39% do not have education. Overall, 8.54% have attained college level, with Matarinao having the highest percentage at 10.75%. Generally, 4.62% are at preschool level, while senior high students also number around 4.74%. Those who have attained postgraduate level only number to 0.17% of the total members of the fishing households in the three bays. (See Figure 1-25.)

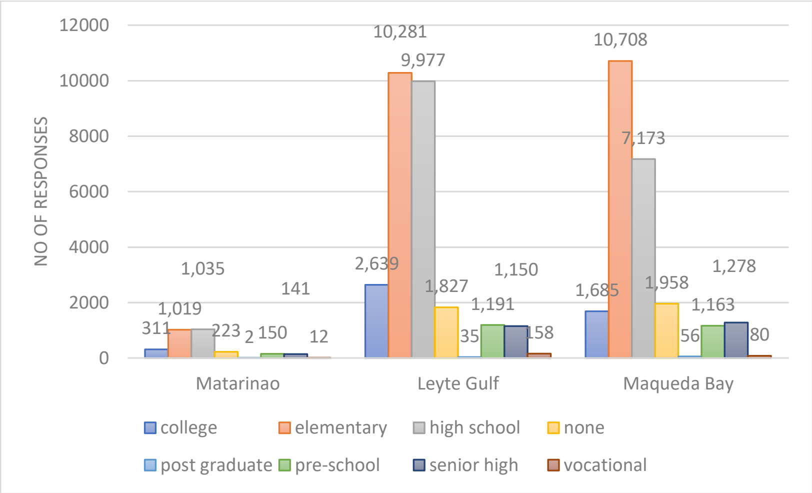

Figure 1-25. Educational attainment of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

But from the FGDs it appears there is an emerging trend on how fisherfolk and their children look at education. At a glance the reduced fish catch is a bane to fishers in Barangay Tigawon, but some of them think it is also the cause of something positive. When some of them were young, they said, their default occupation would be to follow their fathers and become fishermen themselves. Going to school, finishing a degree and finding a job outside fishery only comes as second priority.

Due to the considerable reduction in fish catch and the poor economic condition of fishing families in their community, children are now encouraged to finish school and make a living outside the fishery subsector. They no longer want to follow the path earlier taken by their fisherfolk fathers.

Asked how fishing families can afford to send children to school when income from fishing is not even enough to fund their basic needs, the FGD participants said that being 4Ps beneficiaries helps a lot and in the same manner the scholarship grant from the municipal government helps. The grant amounting to Php 5,000 covers tuition fee and transportation allowance per student per semester. The total amount they get, however, is dependent on the number of students they have in school.

The same information also came out in Zone 5, Paranas, another community facing Maqueda Bay. During their time, according to one fisherman from Zone 5, many would not pursue education because it was still easy to raise a family from fishimg. They go out to fish and hours later they would have kilos to sell. But it is no longer possible now. Thus, parents would really get mad when their children take schooling for granted.

Income sources of family members

Fishing is the main source of income of our respondents, but those who earn from it constitute only to 23.94% as a larger segment (69.31%) do not have any income. These are most likely the dependents, young and old, and those not gainfully employed. Of this segment, Maqueda has the highest with 71.62% with no income.

Other sources of income include business (0.82%), donations (0.08%), farming (0.41%), government employment (0.97%), labor (1.42%), private employment (1.25%), and pension (0.13%). Figure 1-26 shows the details of the primary income sources of the respondents from the three bays.

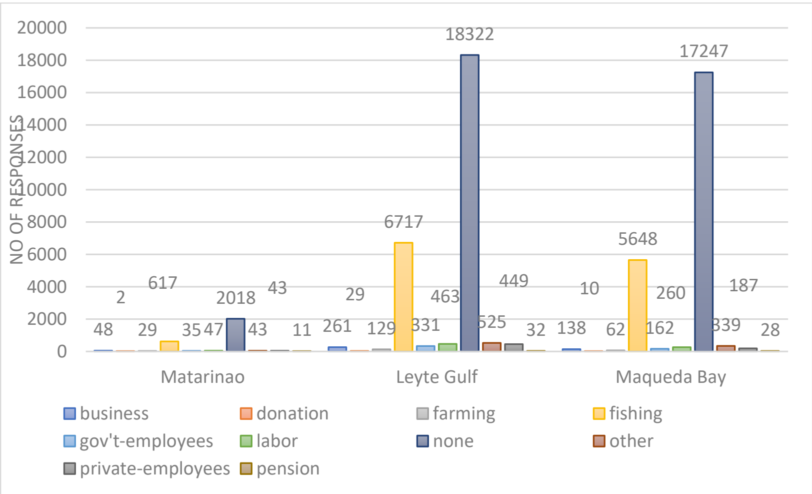

Figure 1-26. Primary Income Sources of fisherfolk households in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Primary Income Range

We have arranged incomes according to income ranges, starting with zero to ₱5,000 as the lowest ranged, then upwards up to ₱75,000 or more.

The great majority (94.88%) earn ₱5,000 or less a month. In Maqueda, this turns up to more than 95%. The next bracket is in the income range ₱5,001 to ₱10,000 earned by some 4.03%. The numbers diminish as the income bracket increases. But there is at least one person who earns more than ₱75,000 a month, a government employee.

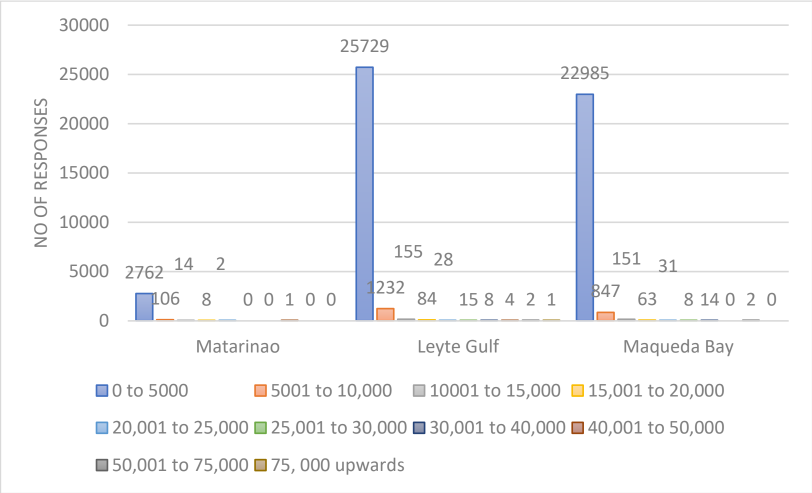

Figure 1-27. Average Primary Income Range of the fisherfolk households in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Secondary Income Source

Only around 4.6% have secondary income sources, such as business (0.18%), donations (0.06%), farming (1.18%), fishing (1.18%), government employee (0.17%), labor (1.14%), private employment (0.13%), pension (0.04%), and others (0.70%). On the other hand, 64.12% have none, while 31.13% left the question blank.

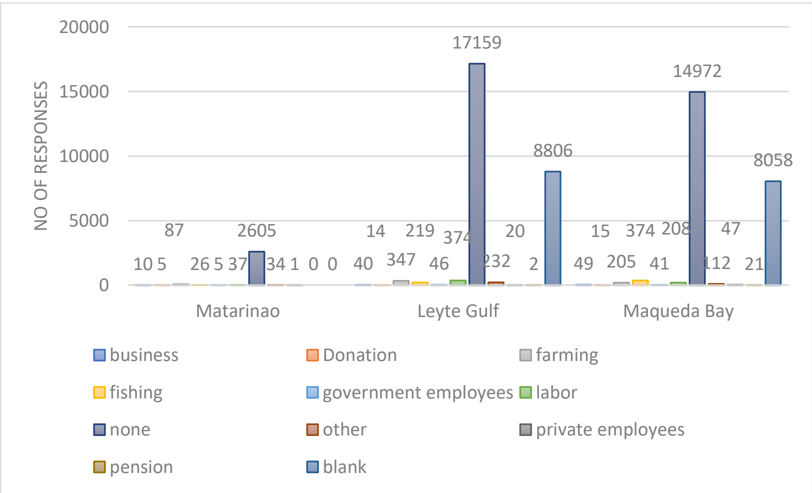

Figure 1-28. Secondary Income Sources of fisherfolk households in Matarinao Bay, Leyte Gulf and Maqueda Bay.Secondary Income Range

Among those who declared that they have secondary income sources, 99.44% earn ₱5,000 or less. Again, as in the case of primary income above, those earning more than ₱5,000 and above constitute around 0.56%.

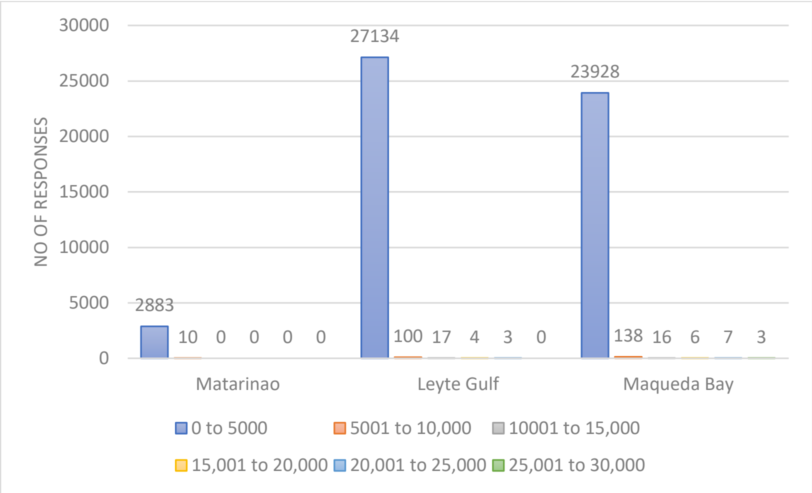

Figure 1-29. Secondary Income Range of the fisherfolk households in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fishing Related Information

No. of days a week fishing

Not all fishermen go out to fish every day. 3.21% fish one day in a week and 4.77% goes two days a week. The number of fishermen increases with the number of days spent fishing. Thus, those who fish 4-7 days a week number 78%. In absolute figures, there are 901 fishermen in Matarinao Bay, 4,623 in Maqueda Bay and 4,916 in Leyte Gulf who can be classified as full time fishers (those who fish for 4-7 days per week) whose major income source is from fishing. Those who do fishing three days or less would in all likelihood have other income sources to compensate for their absence from the sea. Where they go fishing was not specified in the questionnaire as fishermen normally shift from one fishing area to another, depending on where they think fish is abundant.

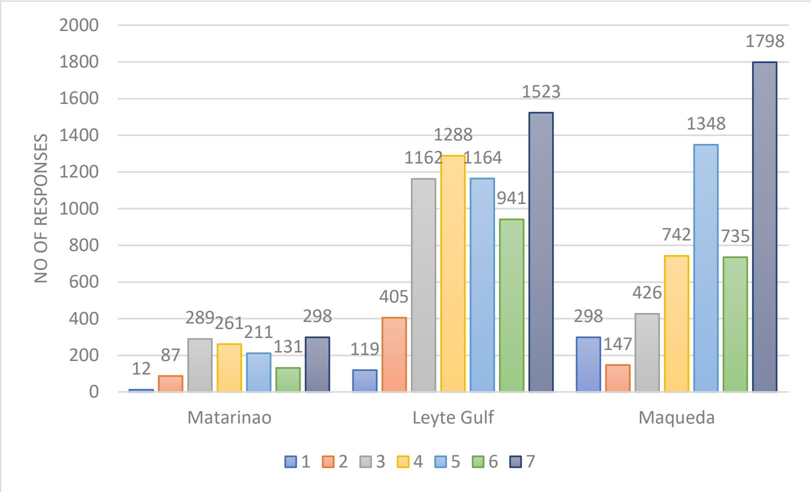

Figure 1-30. Days in a week fishing of fisherfolk respondents in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Years Fishing

Responses for this part were group by 10 years. For 0-10 years, 25.08% of the total respondents answered. 29.21% answered for 11-20 years, 22.06% for 21-30 years, 15.22% for 31-40 years, 6.85% for 41-50 years and 1.59% for greater than 50 years.

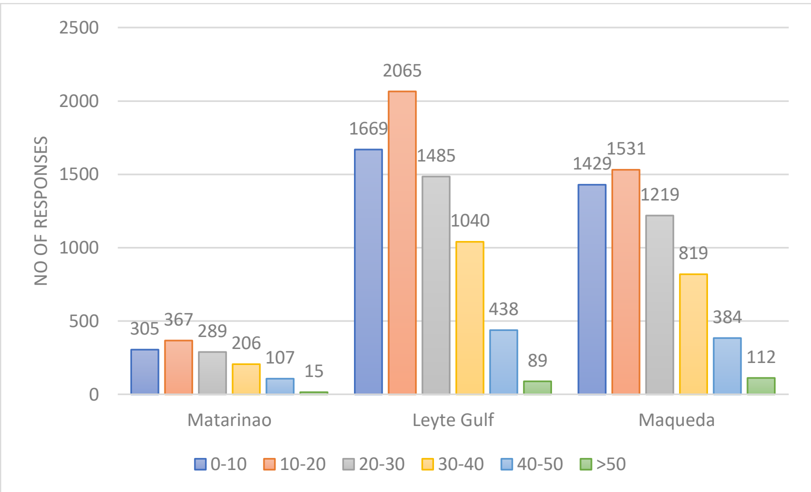

Figure 1-31. No of years fishing of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Boats and Fishing Gears

Boat Details

Boat Type

Of the boats owned by the fisherfolk respondents of the three bays, 72.85% are motorized, while 26.99% are manually operated. A small percentage (0.16%) of the fisherfolks uses bamboo raft. See Figure 1-32. Types of boats owned by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

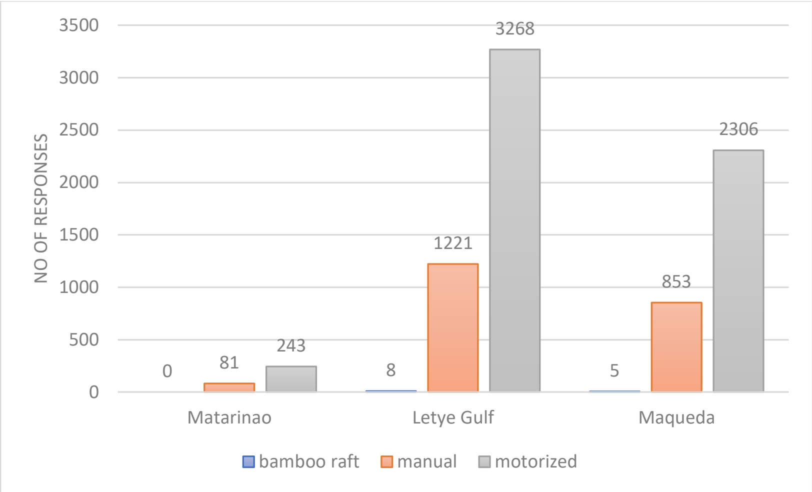

Figure 1-32. Types of boats owned by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Around 85.32% of the fisherfolks have their own boats. While 8.65% of them shares their boats. Another 4.32% only borrows the boats they use, while 1.70% are being rented.

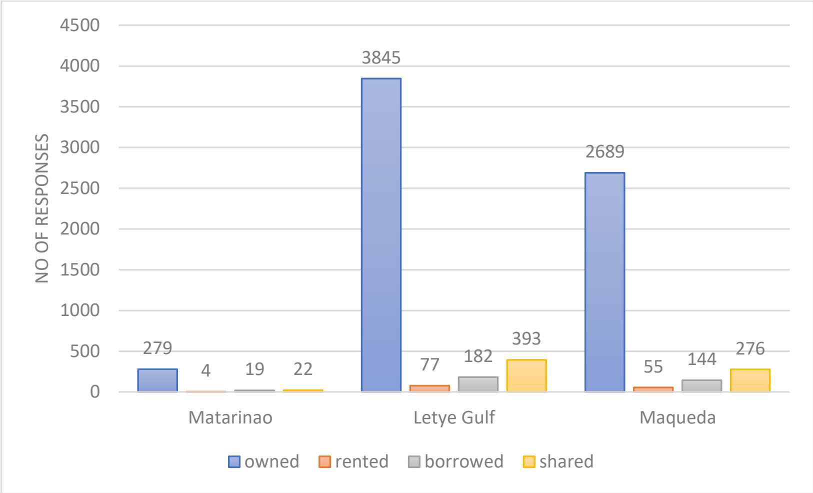

Figure 1-33. Boat Ownership of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

On average, 78.42% of boats owned by the fisherfolks were bought while 3.27% were loaned. Around 16.12% were gifted to them while 2.19% were inherited.

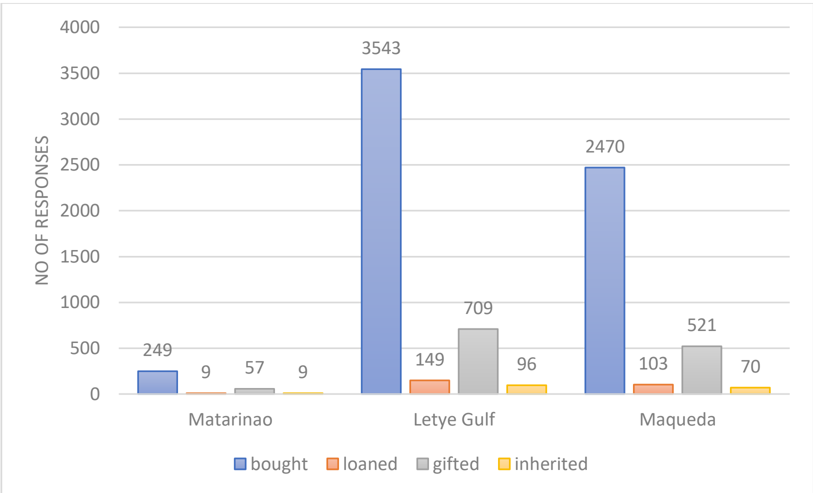

Figure 1-34. Acquisition of boats of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Boat Engines

Engine Gasoline Type

Generally, 79.71% of the motorized boats use gasoline to fuel their engines, while 20.29% use diesel.

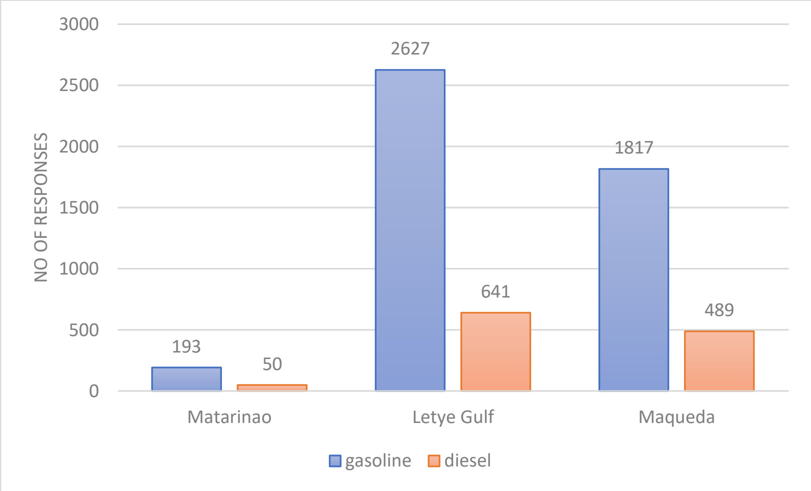

Figure 1-35. Boat Engine Gasoline Type used by the fisherfolks in Matarina Bay, Leyte Gulf, and Maqueda Bay.

Engine Ownership

On average, 87.78% of the engines are owned by the fisherfolks, while 8.46% shared. Around 1.43% of the engines are being rented, while 2.34% are borrowed.

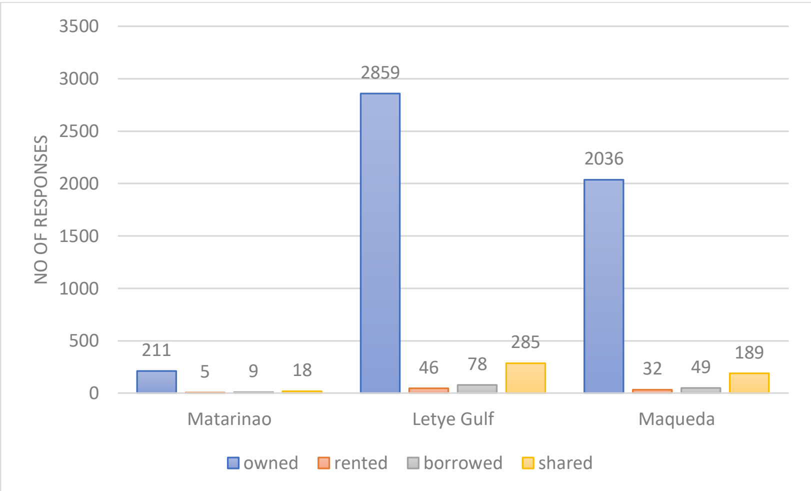

Figure 1-36. Engine Ownership.

Engine Mode of Acquisition

Around 80.25% of the engines are bought, while 3.85% are loaned. Another 14.01% of the engines are gifted to the fisherfolks, while 1.89% are inherited.

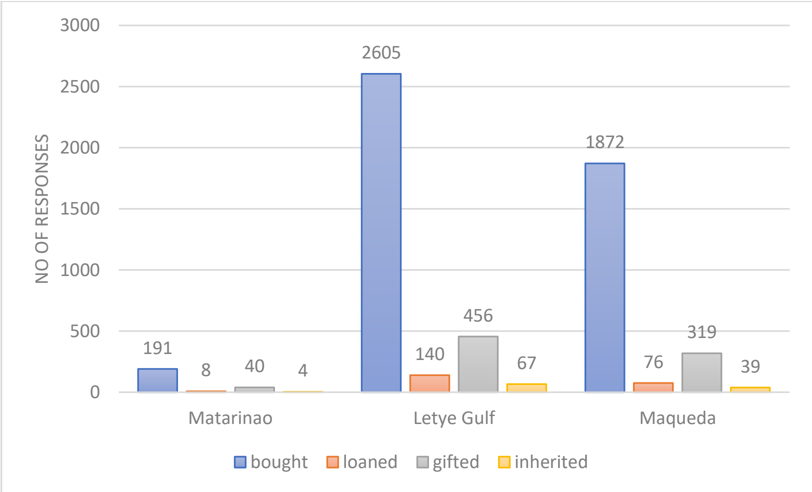

Figure 1-37. Engine Acquisition.

Engine Brand

There seems to be no preference for a particular brand of engine, although the numbers preferring Kenbo has reached 39.99%. Among the older brands in the market, Honda has not faded away with 19.17% fishers still using it.

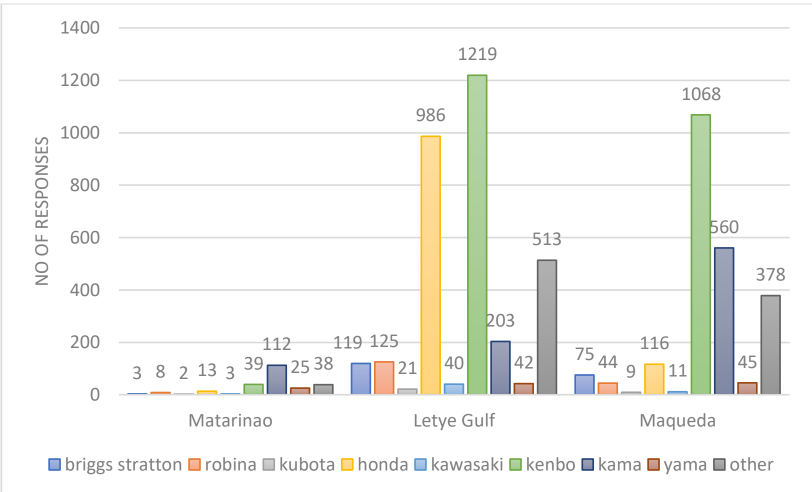

Figure 1-38. Engine brand used by the fisherfolks in Matarina Bay, Leyte Gulf, and Maqueda Bay.

Fishing Devices

Gear Type

The more popular types of gears being used by fisherfolk in the region are the hook and line (32.99%), traps (22.93%) and gill nets (12.29%). All in all, the three totals to a 68.22% of gear usage. Others like lift net (7.06%), falling gear (2.49%), dredge (1.6%) and scoop nets make up for other gear usage.

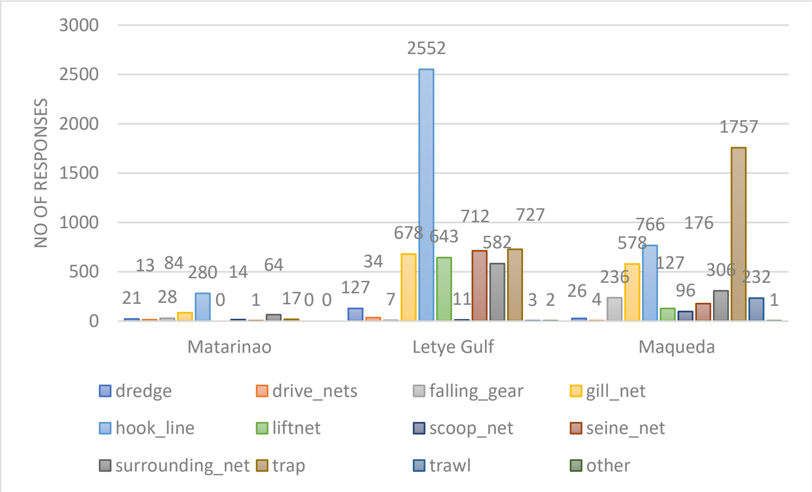

Figure 1-39. Gear Type used by the fisherfolks in Matarina Bay, Leyte Gulf, and Maqueda Bay.

Gear Ownership

Totally, 94.12% of the fishing gears are owned, while 4.28% are shared. Around 0.57% are rented and 1.03% are borrowed.

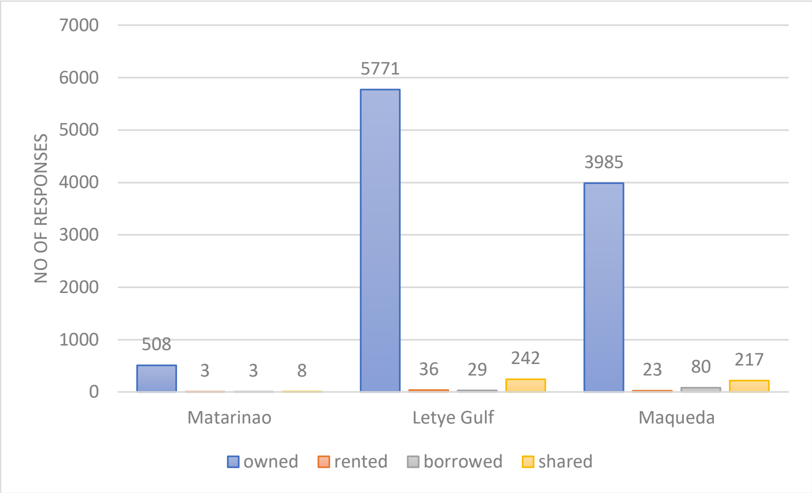

Figure 1-40. Gear Ownership.

Gear Acquisition

All in all, 93.75% of the gears are bought by the fisherfolks, while 1.62% are loaned. Around 3.61% of them are gifted while 1.02% are inherited.

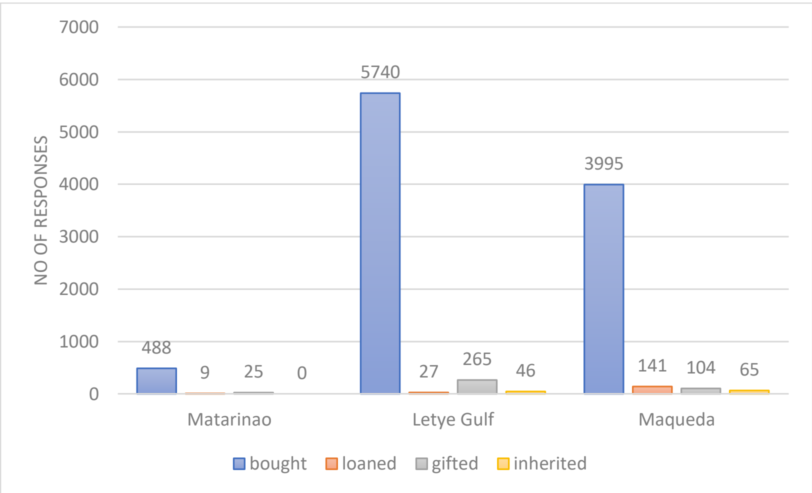

Figure 1-41. Gear Acquisition.

Fish Catch

The majority of the fishers (64.59%) derive their incomes from fish capture. More than 24.55% however said they are into mariculture, while aquaculture has 10.86% of fisherfolk involved.

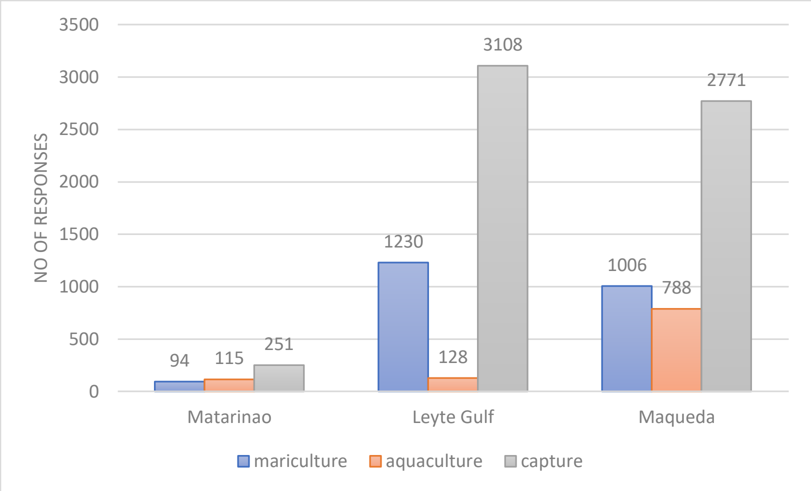

Figure 1-42. Fish catch source of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

It is near impossible to determine the kinds of fish each fisherman catches daily or weekly since the catch varies according to the season, the time of the day, the kind of devices used and a few other factors. Each fishing trip produces a set of catch different from the next. The best that can be seen from this survey is a list of fish (with local names) that are usually caught.

The kinds of fish caught in the 3 bays of Eastern Visayas with their corresponding local names, identified English names, and scientific names and the gear used to catch them is shown in Appendix A-6 and Appendix A-7.

Quantity of fish caught

Almost half of the respondent (46.33%) catches less than 3 kilos in an outing, while some 33.58% catch 4 - 6 kilos and another 9.91% catches 7-9 kilos per outing. These three segments add up to 89.92% of the fishermen. But there are big differences in catch among the bays. In Maqueda Bay, 64.11% said they can catch less than 3 kilos, while Matarinao fisherfolk said only about 34.60%% catch that quantity. In Leyte Gulf, only 35.52% can make that same quantity. Maqueda Bay fishermen have the lowest percentage of those who can catch from 3 to 4-6 kilos an outing (27.78%). This could be due to overfishing.

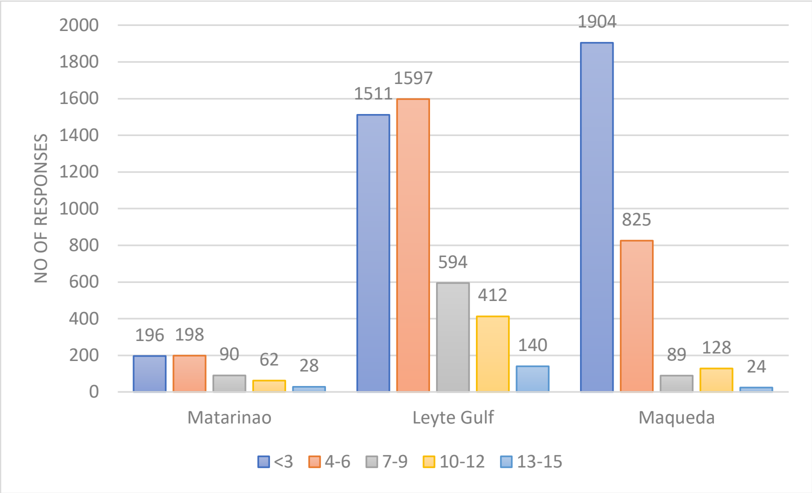

Figure 1-43. Fish catch quantity per outing of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Variety of Fish Catch Over Time

Data gathered from the FGDs reveal that the variety of fishes frequently caught has diminished over time.

A decade ago, fishers from Zone 5, Paranas, Samar could catch shrimps or pasayan, masag or blue crab, tabangungo. danggit, turos, gabilan, usu-os, and balanak. At present their catch would be mostly usu-os, balanak, pasayan and masag.

Ten years ago, fishers from Barangay Tigbawon also in Paranas, could catch ti-aw, danggit, usu-os, lusod, balanak, pating (though seasonal), parog, sapsap and parangan, among other fishes. These days they would often come home with only two species - danggit and balanak.

Fishing in Baras, Palo, Leyte nowadays is no longer as good as before. Ten years ago, their catch would include shrimps, balwak, langkoy, sagisi-on, tamban, lusod, bolinao, buraw, hasa-hasa, balo, sakatan, ti-aw, lusod, among others. These days the variety of fishes they catch has been reduced to balwak, langkoy, sagisi-on, ti-aw, and lusod. Shrimps are still included among the catch as they survive blast fishing.

San Joaquin fishers ten years ago would catch sagisi-on, buraw, dapa, gapas-gapas, tamban, ti-aw, sakalan, lumong, balanak, lusod, magkaagum and tawa-ay. They still do today but in greatly reduced volume.

Ten years ago the catch of fishers in Cogon would include langkoy, parotpot, lawayan, aguying, balwak,tingag, dapak, tangigue, buraw, burot and pasayan. These days the catch would consists mainly of parotpot, lawayan, pikay and pilas.

Fishers from Bucao ten years ago could easily catch mamad-as, sibog, hamol-od, adgawon, maya-maya, sakalan, tagomon, banagan, masag, bantol, manlalara ngan katambak. Five yeas ago they could still catch the same species though in smaller quantities. These days they could only catch sibog, manlalara and hamol-od when lucky, they said, probably because of the reduced quantity of fish in the sea.

FGD participants attribute the dwindling variety and volume of fish catch to the still rampant practice of trawl and blast fishing.

Price range

Generally, 41.23% sell their catch in the price range of 100 to 150 pesos a kilo, while about 33.08% are sold in the price range of 50 to 100 pesos a kilo. Some 20.89% sell their catch in the price range of 150 to 200 pesos a kilo. All in all, some 97.36% of the fishermen sell their catch in the price of less than 200 pesos a kilo. This varies with the kind of fish caught. The lower the fish classification, the lower the price.

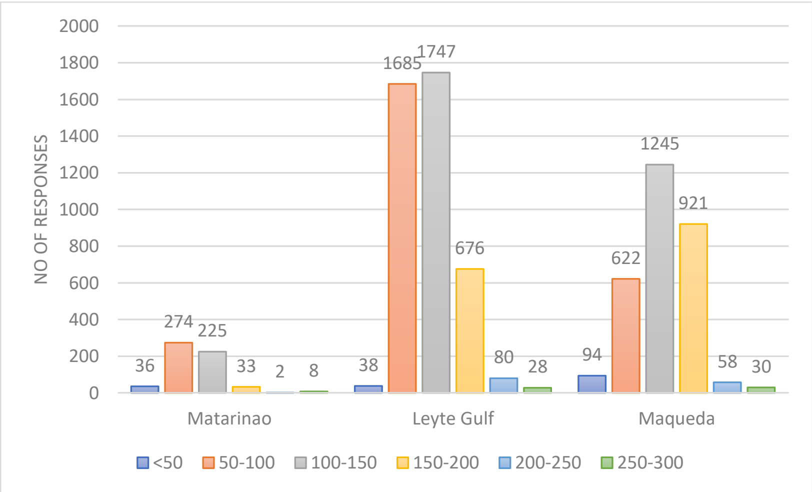

Figure 1-44. Price range of fish caught and sold by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fish Consumed at sea

Fishermen generally consumes their fish catch at sea by less than 3 kilos, as 99.27% of the respondents indicated. The figure is especially high in Leyte Gulf with 99.98% saying they eat less than 3 kilos of their catch at sea. 0.67% however said they consume 4 to 6 kilos of the fish they catch. The figure (4 to 6 kilos) reaches 1.68% in Maqueda Bay, while in Matarinao ithas 0.17%. The same volume of fish is consumed by only 0.02% in Leyte Gulf.

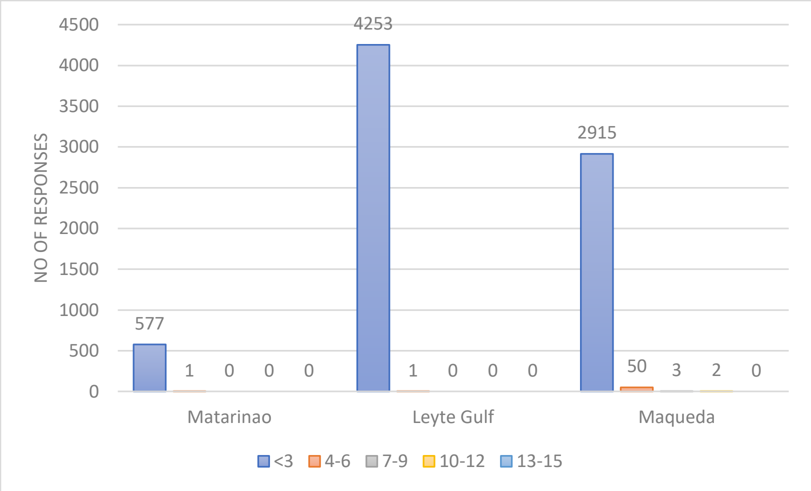

Figure 1-45. Fish consumed at sea by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fish shared with laborers

Bigger boats usually have laborers too. Some boat owners share part of their catches with their laborers, while others pay them cash. Around 99.37% of respondents said they share less than 3 kilos of their fish catch with their laborers. This is highest in Leyte Gulf (99.29%) and lowest in Matarinao with 98.96%.

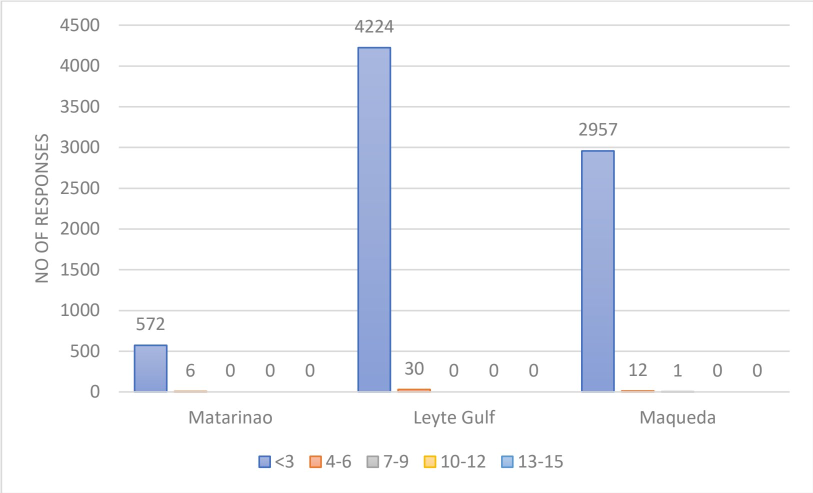

Figure 1-46. Fish shared with laborers of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fish given away

As for their catch given away, more than 99.49% said they give less than 3 kilos of their catch away. Again, this is highest in Leyte Gulf where more than 99.86% of the respondents saying so. Matarinao comes next with about 99.65%. In Maqueda, 98.92% said the same.

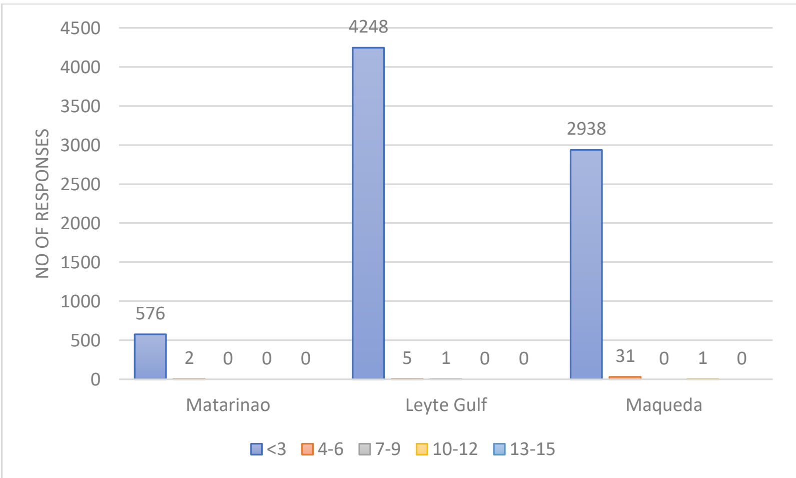

Figure 1-47. Fish given away by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fish processing

The fishes being processed in the three bays is shown in Table 1-2.

Table 1-2. Fishes being processed in fishing communities near Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fish Processed			
adgawon	hamul-od	masag	squid
agak-ak	hasa hasa	molmol	talad
alho	lagaw	noos	talho
arad-ad	lahing	pahut	tamban
bagaong	lambiyaw	pakol	tanige
barabaraan	langkoy	parotpot	tiaw
bisugo	lapas	pasayan	tingag
bolinao	latabon	pikas	turos
botlog	lawayan	sagision	utang-utang (small)
budlis	lusod	sapsap	
buraw	magburuho	sarad	
danggit	marabaraan	siri	

Processing technique

Around 96.75% of the respondents did not indicate any fish processing techniques. As for the other responses, 2.11% said that drying is their processing technique used. While 0.18% answered salting, 0.06% answered tinapa, and 0.90% indicated others.

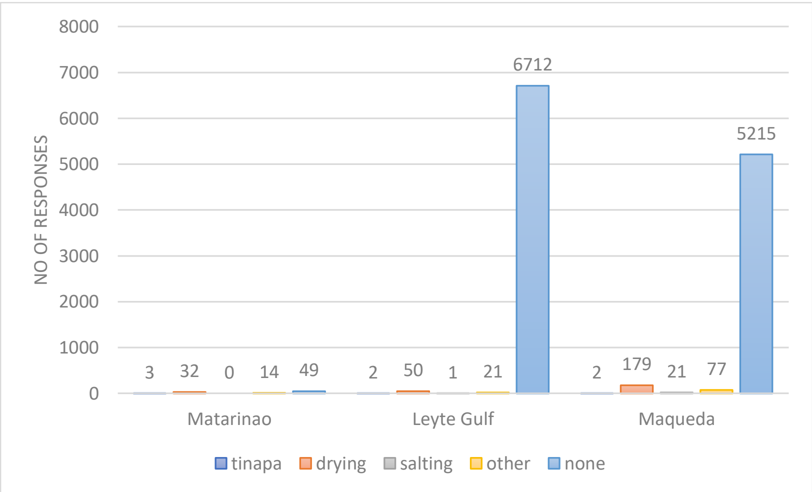

Figure 1-48. Fish processing techniques used by fisherfolks in Matarinao, Leyte Gulf and Maqueda Bay.

Fishing Expenses

Fuel

There are three types of fuel: crude oil, gasoline and diesel. Diesel fuels bigger engines on larger boats. 80.34% of the fisherfolks uses gasoline for their boats, 19.32% uses diesel, and 0.35% uses kerosene. Highest percentage of gasoline users are in Leyte Gulf which has 88.46% users. Next is Maqueda which has 73.16% gasoline users, and last is Matarinao which has 57.44%.

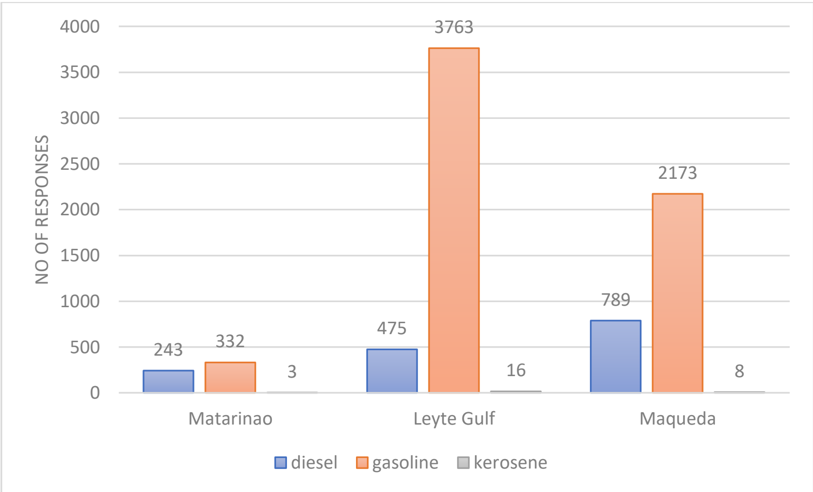

Figure 1-49. Fuel type of engines used by fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Fuel quantity

Overall, 34.88% said that the use 1 liter of fuel on their boats per outing. The biggest number came from Maqueda (46.97%), followed by Leyte Gulf (27.86%) and Matarinao by 24.39%.

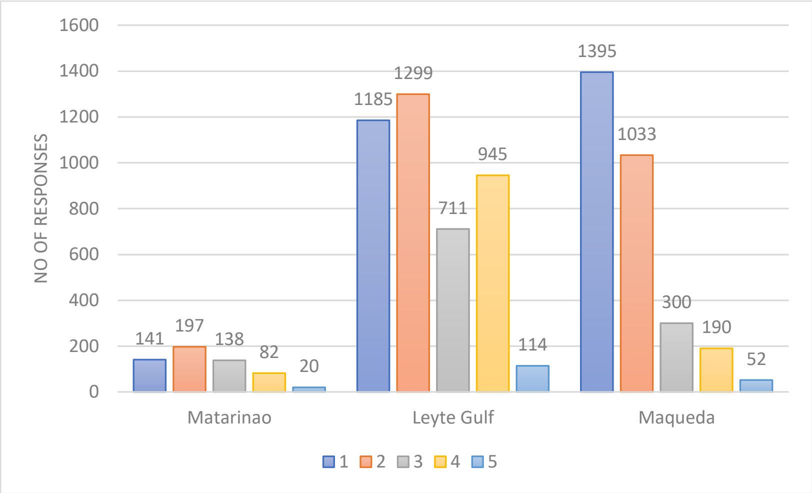

Figure 1-50. Fuel Quantity (Liters) used by the fisherfolks in Matarina Bay, Leyte Gulf, and Maqueda Bay..

Trainings

Attended Trainings

Overall, attendance at training is poor (15.30%), the biggest being in Maqueda Bay (19.49%). 84.70% do not attend trainings, with Leyte Gulf topping the list (88.31%).

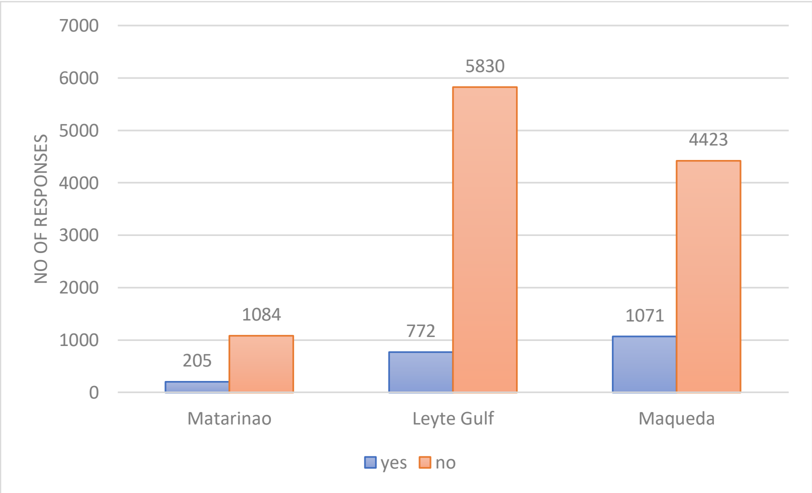

Figure 1-51. Did fisherfolks attend trainings?

Training needs

Around 34.28% did not answer or could not describe their training needs. Those who did said they need skills trainings (47.48%), around 11.98% said they need training in financial management. Some 2.74% said they need training in simple accounting. Almost half of the Matarinao (57.61%) and Leyte Gulf (51.52%) fisherfolk said they need skills training, and in Maqueda with 38.27%.

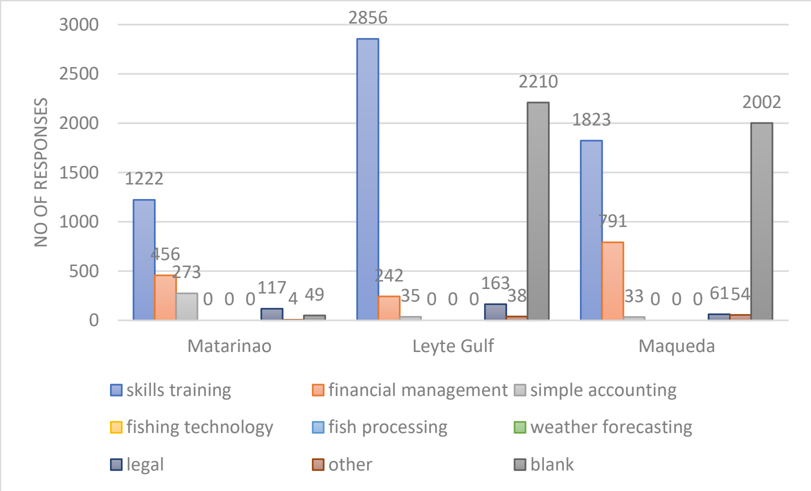

Figure 1-52. Trainings needed by the fisherfolks in Matarinao, Leyte Gulf and Maqueda Bay.

Management Support

Information Sources

Some 59.81% said that they get information from other fisherman, while only 18.78% indicated DA-BFAR as their information source. On the other hand, 10.94% said that their barangay LGU is their information source, and 0.55% indicated others. Some 9.92% left the question blank.

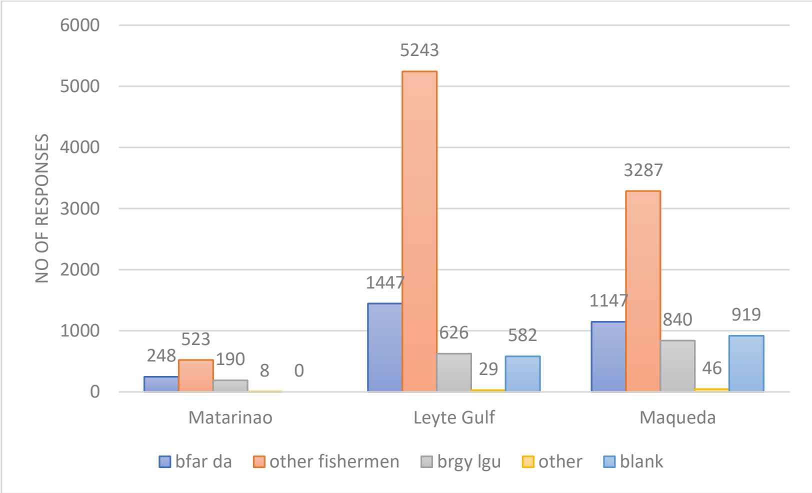

Figure 1-53. Management Support - Information sources of fisherfolks in Matarinao, Leyte Gulf and Maqueda Bay.

Information Sources Inside of the Community

Similarly, the fisherfolks indicated that other fisherman is the main source of information inside the community which got 78.21% of the responses, while 8.99% said DA-BFAR None indicated the barangay LGU. Some 12.42% left the question blank.

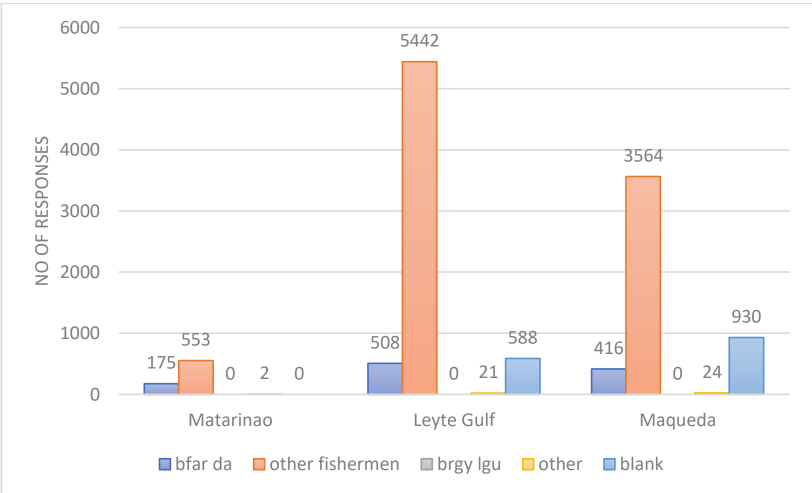

Figure 1-54. Management Support - Information sources of fisherfolks inside the community.

Information Sources Outside of the Community

Other fisherman got the highest percentage of information sources outside of the community as indicated by the fisherfolks, which got 67.51%. DA-BFAR goes second with 18.41%, while 0.38% indicated others. None indicated the barangay LGU as information source, while 12.42% has left the question blank.

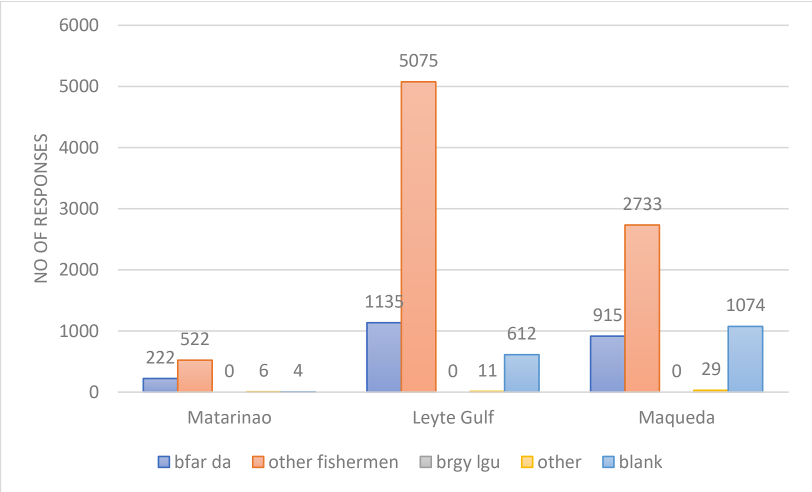

Figure 1-55. Management Support - Information sources of fisherfolks outside the community.

Information Sources

Fishing information needs

Of the four major concerns (technology, processing, pricing and market) of fishermen in the region, 37.45% want information on fishing technology and fish processing comes in second with 22.48% of the respondents saying. But for the case of Matarinao Bay, fishing technology also comes first, but fish pricing comes in second which got 27.46% of the communities saying so.

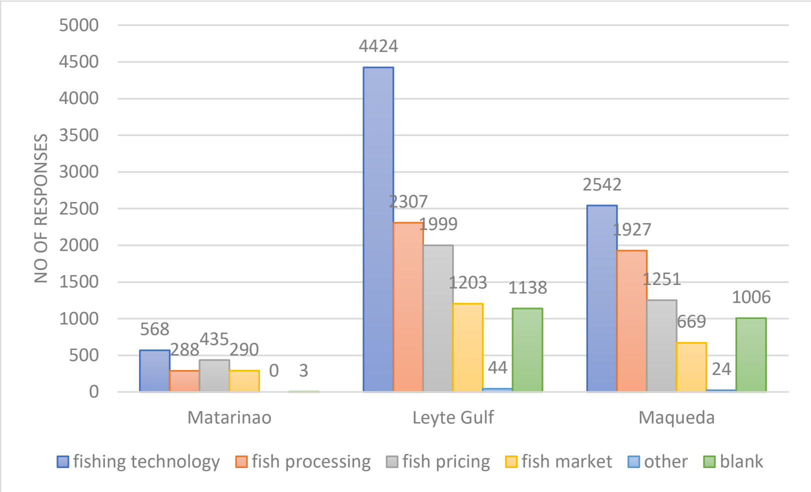

Figure 1-56. Fishing information needs of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

In the Maqueda Bay communities, the need for information on fishing technology is around 34.26%, while 39.80% is needed in the Leyte Gulf communities. Fish processing comes next for Maqueda Bay and Leyte Gulf with 26.97% and 20.76%, respectively. Figure 1-56 shows the data on other information needs.

Sources of information on fishing

In the entire region, most of the respondents (42.10%) identified the DA-BFAR as the source of information on all matters related to fishing, but 28.82% said their sources are the LGUs and barangays. Only 13.73% pointed to other fishermen as their sources of information. 10.59% did not answer the question.

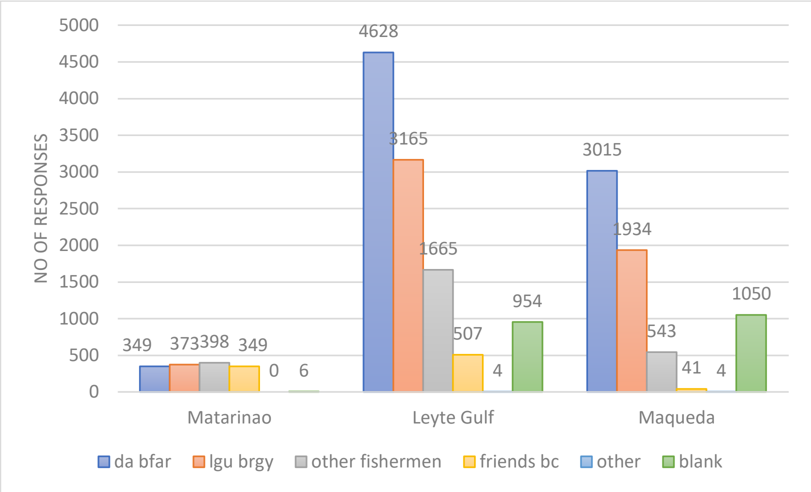

Figure 1-57. Sources of information on fishing of fisherfolks in Matarinao Bay, Leyte Gulf and Matarinao Bay.

Peer sources

Among peers and equals, fisherfolk in the region (35.42%) tend to rely on fellow fisherfolk as sources of information, while family members are considered by more than 23.50% as their sources of information. Relatives follow with 14.63%. Among the bays, it is in Leyte Gulf where other fisherfolk tend to be the most reliable sources of information (37.60%), with Maqueda Bay closely following at 33.95%. While Matarinao Bay comes at last with 26.13%. Around 7.31% did not answer the question. See Figure 1-58.

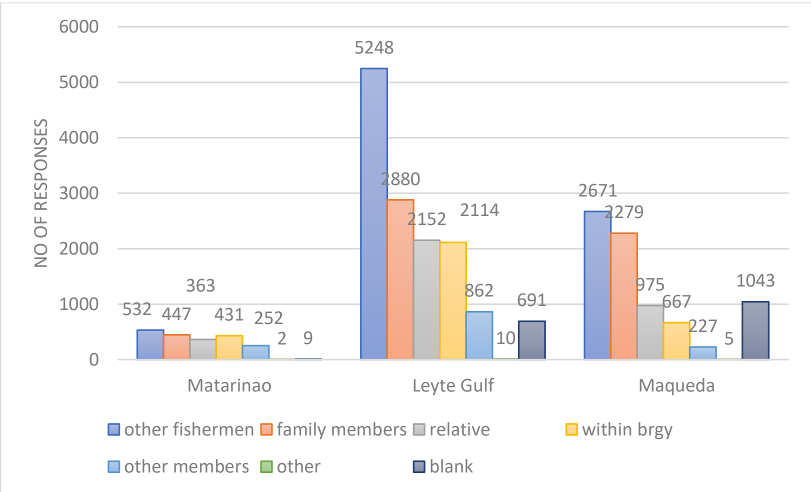

Figure 1-58. Peer sources of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Information sharing in the barangay

There is a very strong tendency among fisherfolk in the entire region to share information, with 95.77% saying 'yes', they do share information. This tendency is the highest in the Leyte Gulf villages where 97.74% said they share information. Next comes Maqueda where 94.92% share information, and Matarinao coming at last with 81.98%. 4.23% said 'no', they do not share information.

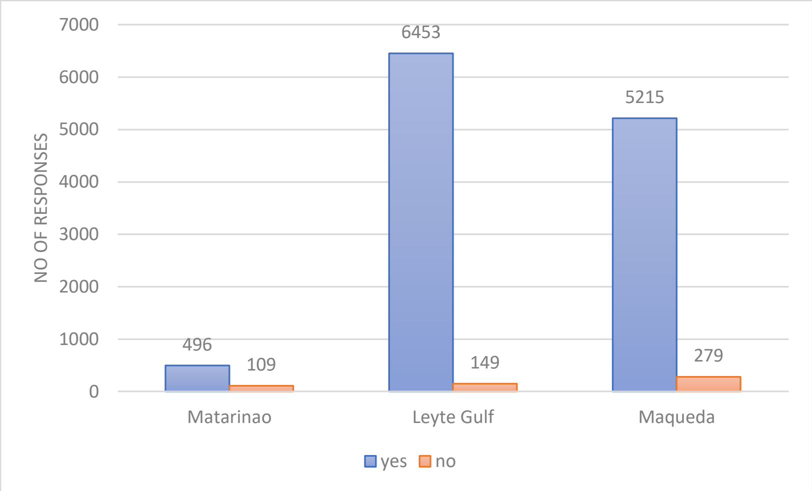

Figure 1-59. Information sharing in the fisherfolk community.

Sharing style

According to the large majority of the respondents (88.96%), they share information informally, i.e., in conversations, informal chats, but around 11.04% said they also use formal occasions. The biggest numbers are in Leyte Gulf (93.88%) who declared that their exchanges of information are done informally. In Maqueda Bay, 13.84% however say they use formal occasions to share information.

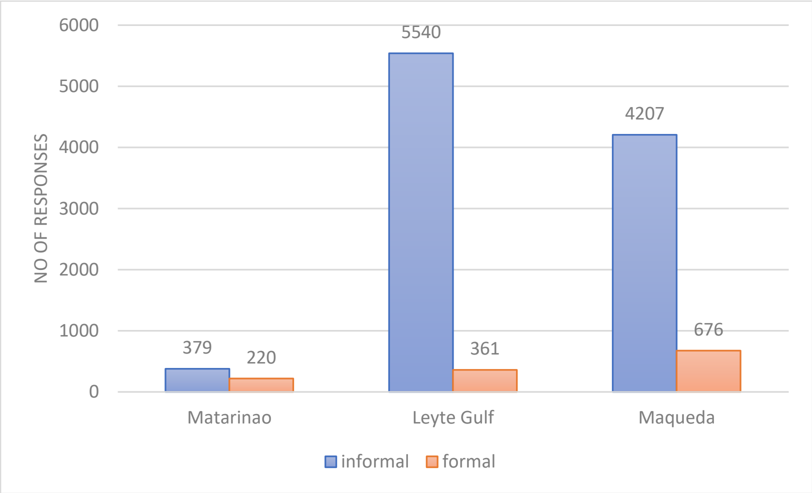

Figure 1-60. Information sharing style in the fisherfolk community.

Awareness of Illegal Fishing

Illegal fishing types

Among the five types of illegal fishing identified (compressor, blast/badil, trawl, commercial fishing and fish poisoning), trawl was pointed out by 42.67% of the respondents, while 23.09% said blast fishing was dominant. Some 12.34% mentioned compressor. Other identified illegal fishing activities is presented in Figure 1-61.

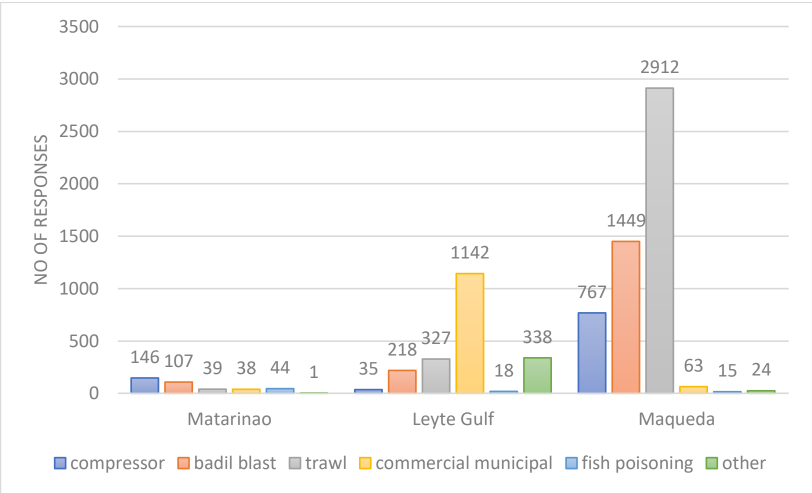

Figure 1-61. Illegal fishing types identified by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Perpetrators

As to who the perpetrators are, more than 45.77% of the respondents claimed that the illegal fishers come from outside their communities, with 76.67% of the fisherfolks from Maqueda Bay agreeing. Only 11.56% say that these perpetrators come from their own communities. Some 42.67% however said it is the commercial fishers who are the perpetrators, with 85.11% of the fisherfolks from Leyte Gulf agreeing to this.

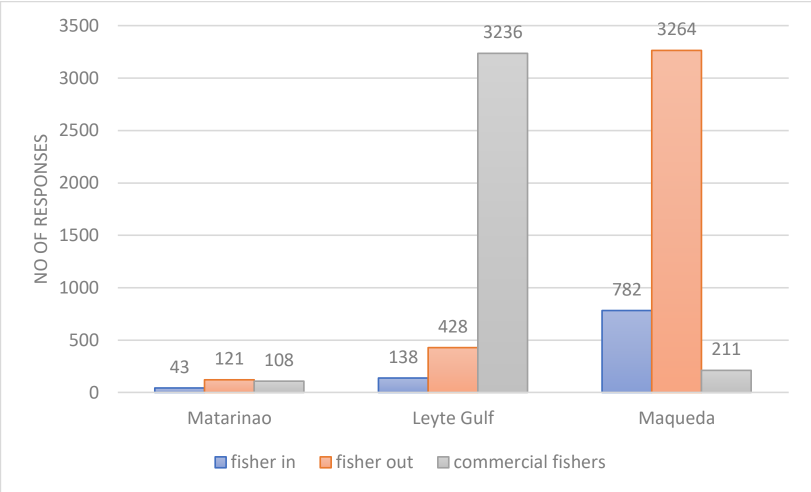

Figure 1-62. Illegal fishing perpetrators identified by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Most destructive

The respondents did not have a common perception about which types of illegal fishing is most destructive. This is most likely because of their varied experiences on this matter. Overall, 51.08% of the respondents said blast fishing is most destructive. This is particularly high in Matarinao where 73.55% said blast fishing is the most destructive. Likewise, the claim is true in Leyte Gulf where 60.51% said blast fishing is very destructive. But to Maqueda Bay fisherfolk (58.63%), trawl is the most destructive. Trawl fishing comes next with 38.46% of the fisherfolks saying that it is the most destructive.

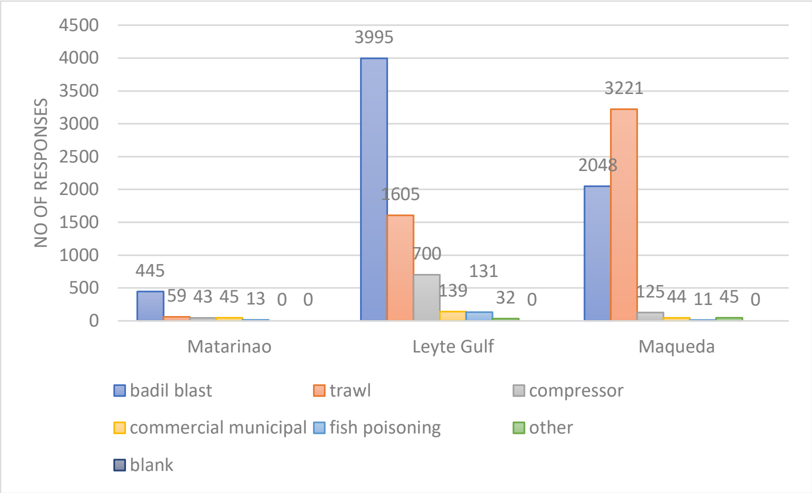

Figure 1-63. Most destructive illegal fishing identified by the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Participants of the FGDs confirmed the findings of the survey, though with higher awareness on the existence of illegal fishing in Maqueda Bay, Leyte Gulf and Matarinao Bay. Most FGD participants also said illegal fishing is rampant, particularly trawl and blast fishing.

According to members of the fishery law enforcement team (FLET) of Paranas, trawl fishers in the municipality are mostly from other places. Owners of bunoan or fish corrals in their municipal waters are also from a nearby municipality. Blast fishing is no longer practiced among fishers in Paranas, but from time to time they would still hear blasts originating from the coastline of Catbalogan City.

Months after the law enforcement team has dismantled fish corrals, they are back and are situated in the middle of the municipal waters where the current is strongest as this is also the spot where fishes abound. When owners were asked by the team to dismantle the corrals again, the team was told that owners have permits from the nearby municipality.

Fishers from Paranas have long avoided illegal fishing, according to members of the team. But the team's inability to stop illegal fishing by fishers from other municipalities in the waters of Paranas has emboldened locals to repair their sagad rather than leave violators to reap all the resources from the municipal waters leaving nothing for the locals, they said.

A story told by one FLET member illustrates that trawl fishing has not been stopped in Maqueda Bay and is in fact flourishing. According to him, a startup trawl owner they once caught operating in the municipal waters of Paranas now owns not just one but four trawl fishing boats, quoting a source.

The FLET of Paranas has been organized by BFAR and the municipal government. They act based on intelligence reports from ordinary citizens, barangay officials and other law enforcers. In many occasions the team was successful in apprehending trawl fishers and recently even illegal loggers. The team has also dismantled at least 8 fish corrals to date.

The team is composed of civilian volunteers, representatives of the PNP and also representatives from the Philippine Army. The municipal government provides the allowance of the civilian volunteers and also pays for the fuel of the boat. BFAR provided the boat the team is using. But the boat is already dilapidated and needs upgrading to catch up with the boats used by violators.

The practice of hulbot-hulbot and blast fishing by fishers from Samar and Tolosa, according to FGD participants, explains the scarcity of catch by fishers in Cogon. Enforcers would catch some violators only to be freed later. The violators would return to their illegal fishing practice as no penalties are imposed on them.

Aside from trawl fishing, blast fishing and hulbot-hulbot, they said, are the culprit behind their reduced fish catch and poor economic condition. The government should enforce the law that bans these destructive fishing practices. It should also offer alternative livelihood like putting up fish cages the association should own and manage. They said the fish cages will increase the income of members.

The issue of illegal fishing has been raised several times to the Bantay Dagat and the municipal government of Palo. But illegal fishing persists, and it has not been addressed until now, according to FGD participants. This is not to say the local government cannot do anything to help improve the plight of local fishers, they said. Aside from enforcing the law, the local government can also provide motorized boats and nets and help strengthen fisherfolk associations.

Illegal fishing is a complicated issue, said the barangay chairman of Bucao, Guiuan. What the barangay does is report violations to authorities and it is up to them to apprehend violators. But the Bantay Dagat can only do so much as they are often thinly spread across a vast area, not to mention they could not be at sea 24/7 but only for several hours a day. Members of the Bantay Dagat are all volunteers who also have families to feed, which is not possible if they rely on the meager honoraria they receive for their services.

Effectivity of fishing ordinances

On the question whether the fishing ordinances are effective or not, their experience with LGUs appear to be varied too. Matarinao fisherfolk (80.66%) said their ordinances are effective, while only 54.24% of the fisherfolk in Leyte Gulf could say that. 50.36% of Maqueda fisherfolk say so. A high 34.73% of all the fisherfolk respondents say these ordinances are not effective.

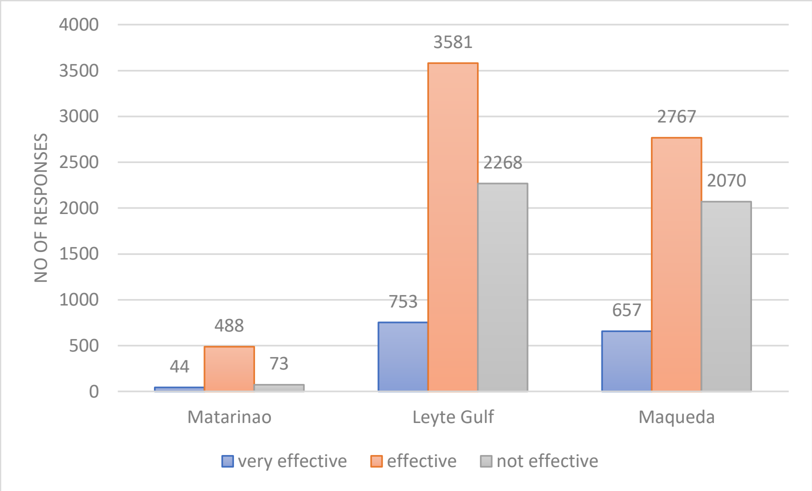

Figure 1-64. Sentiment of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay on the effectivity of fishing ordinances.

Why laws are ineffective

More than 34.73% of the Maqueda Bay fisherfolk said that the laws against illegal fishing are not effective. Only 11.45% said that they are very effective. In this question, the respondent is not limited to only one answer. These are the answers that cropped up: "No-care attitude, ineffective bantay dagat, collusion of perpetrators with the LGU, lack of patrol boats, and patrol boats do not have fuel. The no-care attitude and ineffective bantay dagat got the highest percentage of the answers which got 23.37% and 23.29%, respectively, while collusion with LGU and the lack of patrol come next with 9.08% and 9.52%, respectively. Those who did not answer (31.79%) is quite high. But at least more than half (68.21%) of the respondents came out with their opinions/impressions.

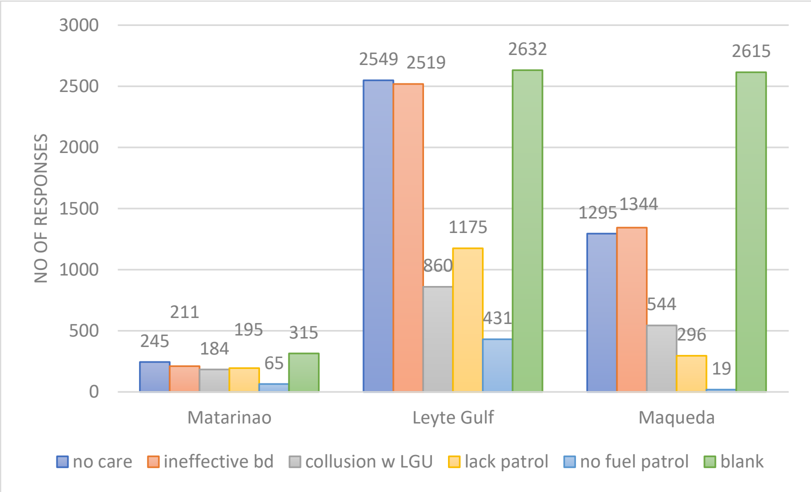

Figure 1-65. Sentiments of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqeuda Bay on the reason of the ineffectivity of fishing ordinances.

Possible interventions

As in the previous question, one respondent could give as many as answers if he/she wanted to. They were asked to give their ideas on possible interventions, such as activating the bantay dagat, provide fuel support, set up patrols, giving incentives to bantay dagat, strictly enforcing the laws and giving no leniency to offenders. Among these, activating the bantay dagat was more popular with 34.87% of all the fisherfolk respondents saying so. This was high in Maqueda Bay with 44.17%. Next was strictly enforcing the law with 29.24% rooting for it. Strictly enforcing the laws and giving no leniency to offenders came last with 6.46%.

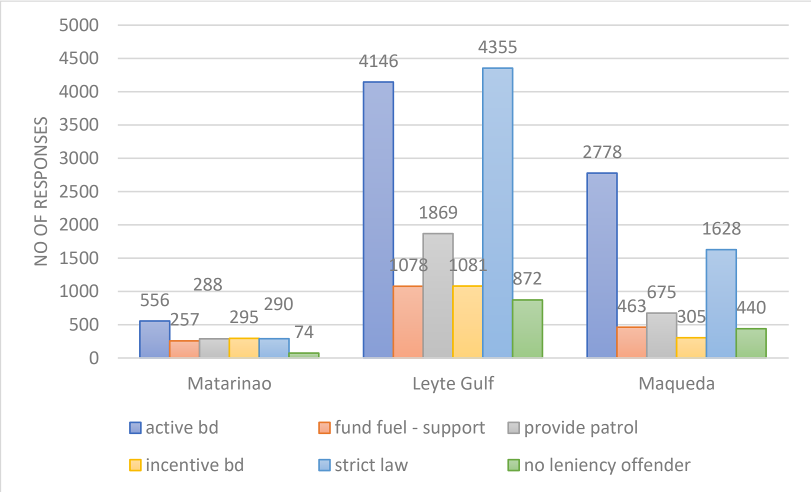

Figure 1-66. Sentiments of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay on the possible interventions to illegal fishing.

Responsibility for prevention

In this question, the respondents were allowed to give as many answers as they wanted. Who is supposed to be responsible for the prevention of illegal fishing? The barangay LGU, bantay dagat, all fishermen, the community? According to 43% of the answers, the barangay LGUs are supposed to be responsible. In Maqueda, 58.65% of the answers point at the barangay LGUs as responsible for the prevention of illegal fishing. 29.98% of the answers pointed at the bantay dagat, while 16.34% placed the responsibility of all fishers. Some 10.51% put the responsibility on the entire community.

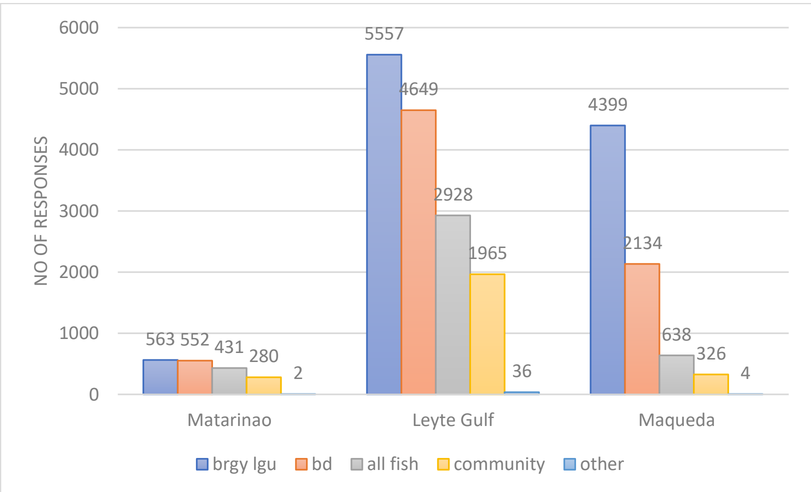

Figure 1-67. Sentiments of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay on to whom the responsibility for prevention of illegal fishing will fall.

CRM

CRM Awareness

There seems to be a very low awareness of coastal resource management among fisherfolk in the entire region as indicated by 81.84% of the respondents, while only 18.16% say that they are aware of CRM. The lowest awareness is in Maqueda bay where 85.93% of the fisherfolk said they are not aware of CRM. But the opposite seems to be true in Matarinao Bay where around 61.16% said they are aware of it, while 38.84 % said they are not.

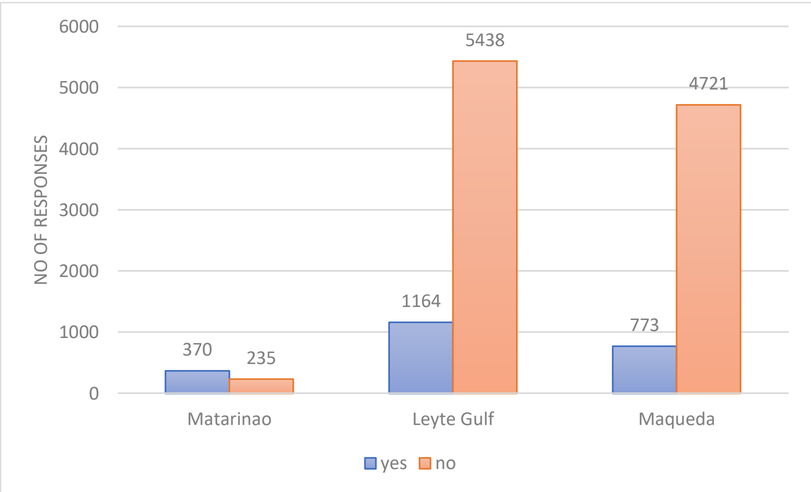

Figure 1-68. CRM awareness of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Involvement

Among those who professed involvement in CRM, numbering 3,022 respondents, 32.33% say they relay information, 21.34% say they acted as watchmen, 13.86% as information sources, and 19.36% as bantay dagat volunteers.

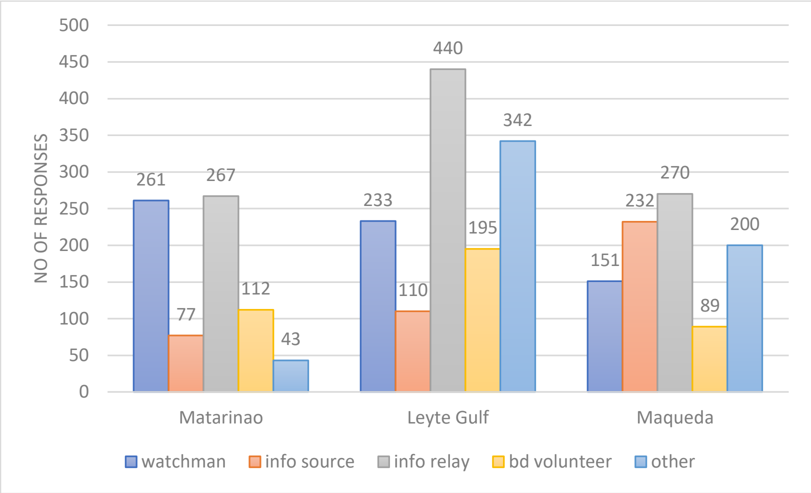

Figure 1-69. CRM involvement of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

BFAR CRM Awareness

Are they aware of CRM programs of BFAR? Overall, 78.36% said they are not, with only 21.64% saying they are. But in Matarinao, 69.42% said they are aware and only 30.58% said they are not. In Maqueda, around 83.95% of the respondents said they are not aware, while 78% answered no in Leyte Gulf.

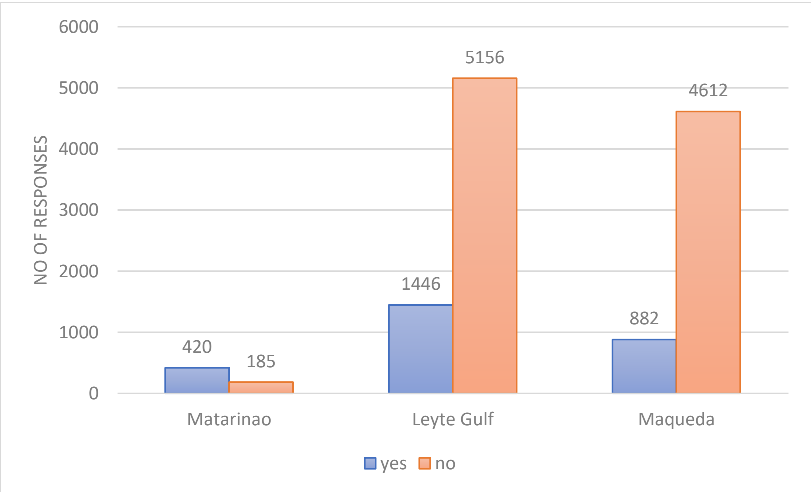

Figure 1-70. BFAR CRM awareness of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Involvement

66.45% of the answeres says that they are involved in CRM, while 33.55% says no. The highest percentage comes from Matarinao Bay with 78.10% of the respondents saying they are involved, followed by Maqueda Bay with 65.99% and lastly Leyte Gulf with 63.35%.

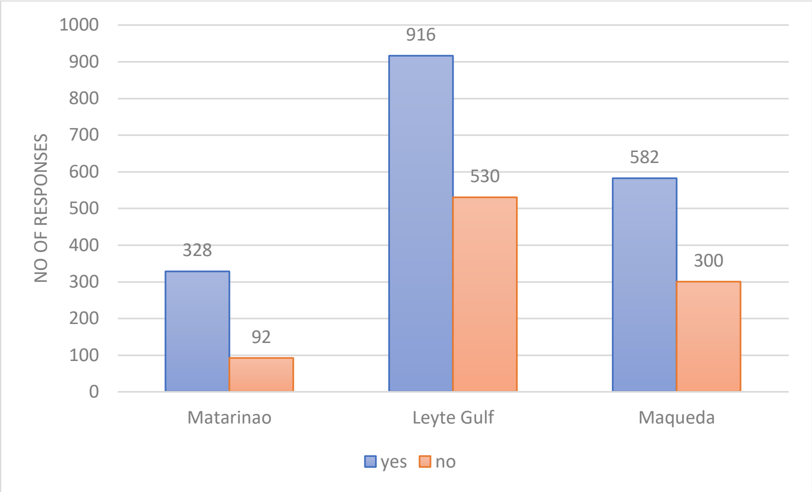

Figure 1-71. CRM BFAR involvement of fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

CRM Activities

Five major CRM activities have been pinpointed as areas of participation for fisherfolk in CRM. These are catching illegal fishers, fish protection, mangrove planting, increasing fish population and establishing fish sanctuaries. Among these, 36.67% said they have been involved in mangrove planting, 20.08% said they were involved in fish protection, 19.35% have been involved in catching illegal fishers, and 9.03% said they have been involved in the establishment of fish sanctuaries. Another 12.94% said they were involved in increasing fish catch projects, while 1.93% indicated others.

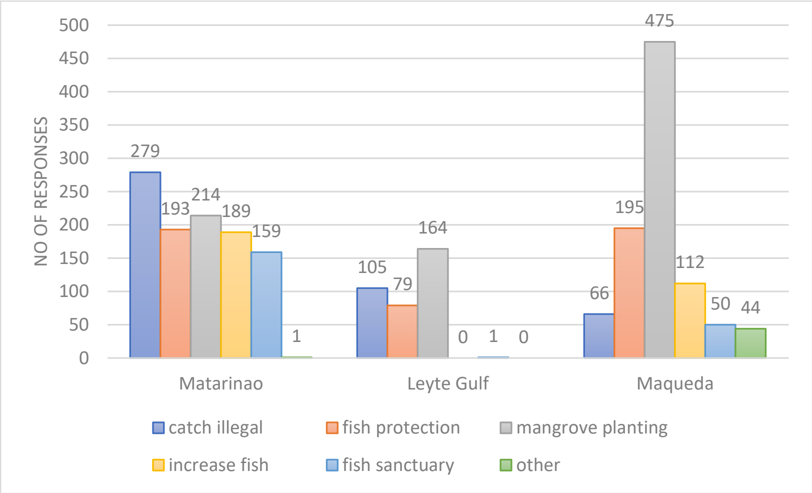

Figure 1-72. CRM activities of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Information source

Around 24.91% pinpointed the barangay LGU as their information source on BFAR's CRM program. Around 8.79% cited other fishermen as their information sources on CRM. While 11.11% cited the bantay dagat.

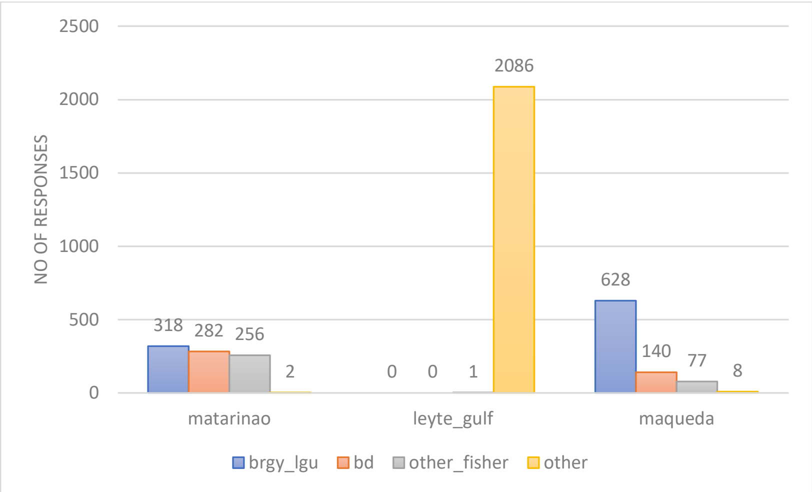

Figure 1-73. BFAR CRM information source of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Their involvement

Overall, 29.72% relayed information, 21.82% acted as watchmen, 16.87% were information sources, another 16.13% as bantay dagat volunteers. Around 15.47% acted in other capacities. In Matarinao, 34.96% relayed information, while some 32.93% acted as watchmen. In Maqueda, 28.48% acted as information sources. Information relay was highest in Leyte Gulf having 29.05%.

However, the answers came only from around 20% of the respondents as more than 80% did not answer the question. In all likelihood, they are not involved.

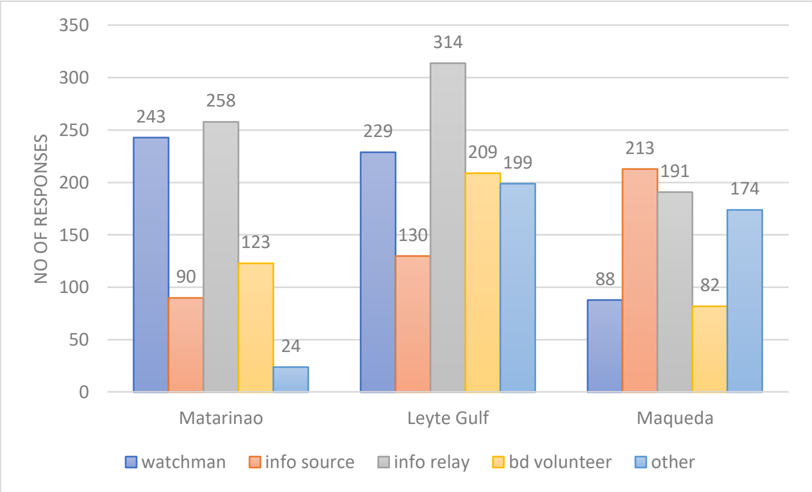

Figure 1-74. CRM involvement of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Reasons for non-involvement

Overall only around 8% provided reasons why they were not involved. Of those who answered, 39.05% said it is not their job. 10.47% said that it is the LGU's concern. Around 11.53% said there is no support for volunteers, while around 9.59% cited bantay dagat as responsible for CRM. 29.36% had various other reasons.

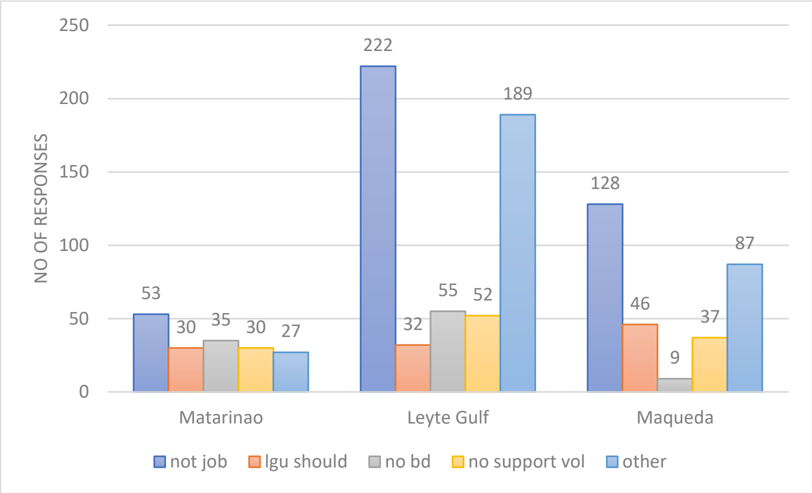

Figure 1-75. Non-involvement reason of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Interest in CRM

While there is a poor awareness of CRM among the survey respondents, 89.32% of the total respondents said yes, they are interested. This is very high in Matarinao where they have expressed 100% interest in the program. In Maqueda, about 89.86% are interested, while in Leyte Gulf, 87.88%.

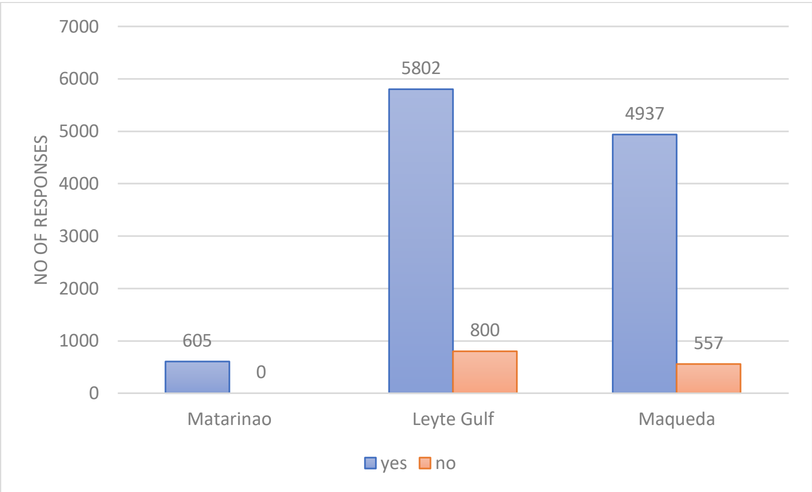

Figure 1-76. CRM interest of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

CRM concerns

Among the concerns raised on CRM, increasing fish catch appeared to be the most popular with 27.73% of the responses. Fish protection came next with more than 23.82%, while the catching of illegal fishers and mangrove plantation took 17.04% and 17.64%, respectively. The establishment of fish sanctuaries had only 13.45%.

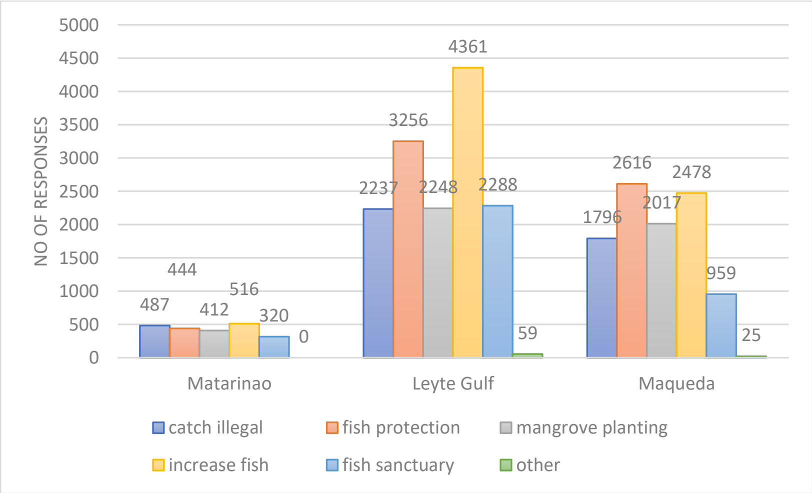

Figure 1-77. CRM concerns of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Optimism in CRM

Despite the non-involvement and low awareness of CRM throughout the region, 81.36% said that CRM will be successful. This optimism is very high in Matarinao Bay where 99.50% declared that the CRM will be successful here. Maqueda Bay fishers were also optimistic with 84.58% saying CRM will be successful, while in Leyte Gulf there was only 77.01%. The other 15.23% did not answer the question.

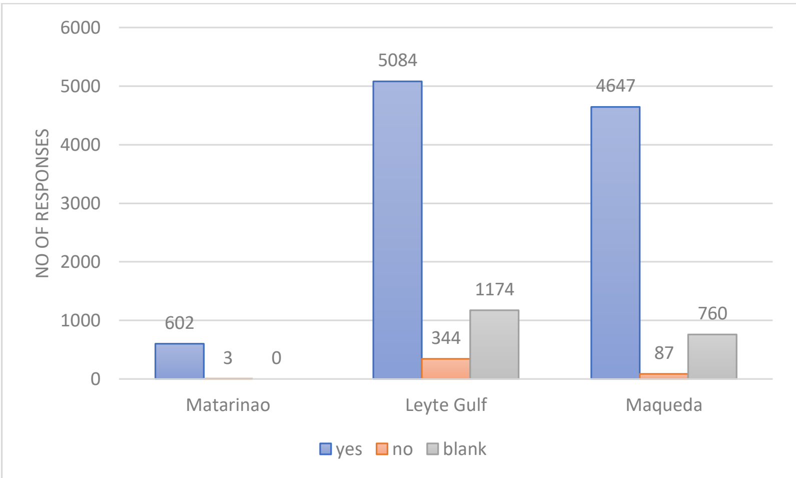

Figure 1-78. CRM BFAR assumed success of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay.

Role of Women

Role of women in fishing

As in the previous question, respondents could provide as many answers as they wanted to. About 46.81% of the answers said that women generally sell the catch of their husbands (labasera). This appeared to be the general trend. In Maqueda Bay, more than half (50.78%) of the respondents said that women sell their catch. Seconded by Leyte Gulf which got 44.81% and followed by Matarinao which got 42.02%. Some 22.12% of the answers says that women fixes the nets, while 11.93% said that women were into fish processing. 13.30% did not answer the question.

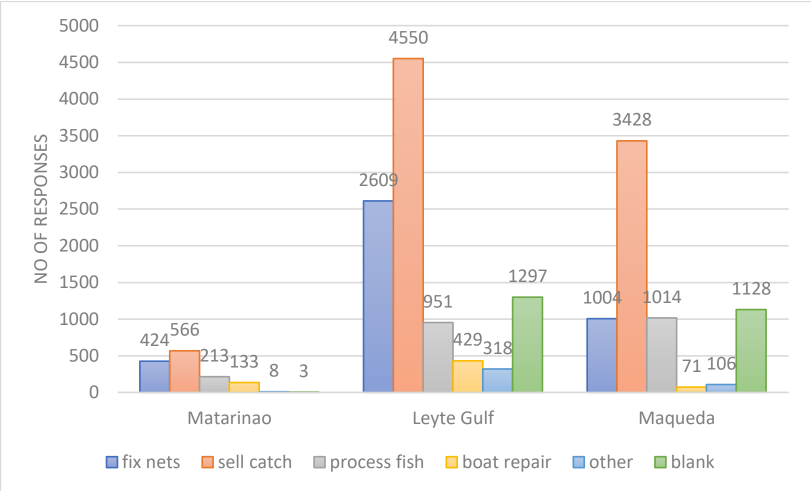

Figure 1-79. Perception of the fisherfolks on the role of women in fishing.

Women in community activities

Almost half of the answers (44.19%) said that women should attend barangay meetings, while 15.46% declared they should join collective activities like bayanihan. 31.83% say they should join organizations. Around 8.13% did not answer.

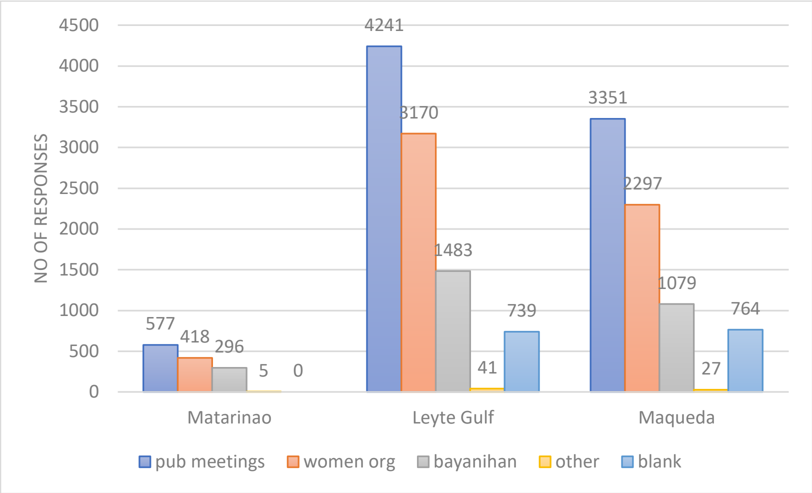

Figure 1-80. Perception of the fisherfolks on where women should participate in community activities.

Importance of the roles of women

In the three bays, majority of the fisherfolk respondents (80.43%) think that the roles of women are properly given importance. In Maqueda, 82. 24% of the fishers also said so. But in Matarinao, only 64.79% said that the role of women is properly given importance. 5.86% of the total respondents say that the role women is not important, while 13.72% of the respondents were not sure.

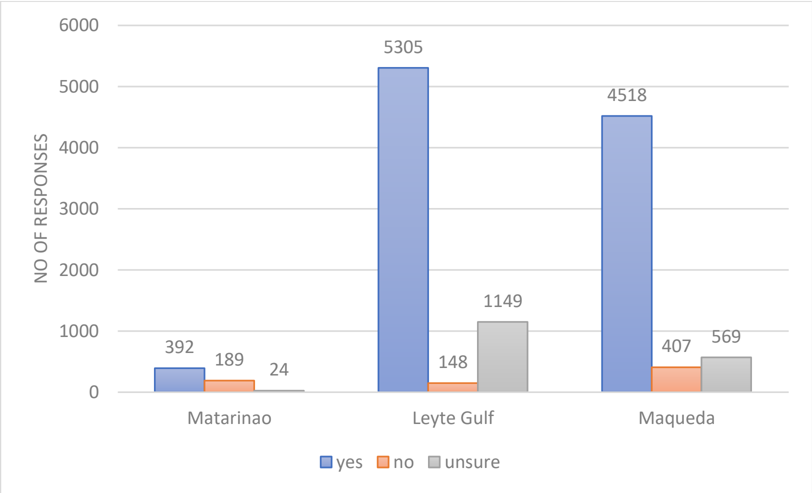

Figure 1-81. Perception of the fisherfolks in Matarinao Bay, Leyte Gulf and Maqueda Bay on the importance of the roles of women.

Involvement of women

Are women involved in the coastal management in their communities? Most respondents (78.12%) thought so. This perception was high in Leyte Gulf where it registered 81.16%. But a significant number (21.88%) said that women were not involved in the affairs of their communities.

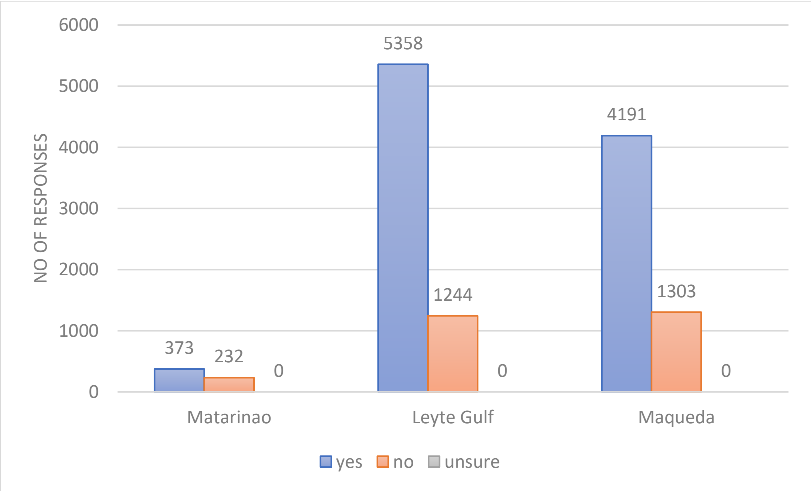

Figure 1-82. Perception of the fisherfolks on involving women in coastal management.

Encouragement of women

90.50% of the respondents think women's active participation should be encouraged. This was even higher in Leyte Gulf where 92.84% said so. A very small percentage (3.87%) thought otherwise. About 5.63% were unsure.

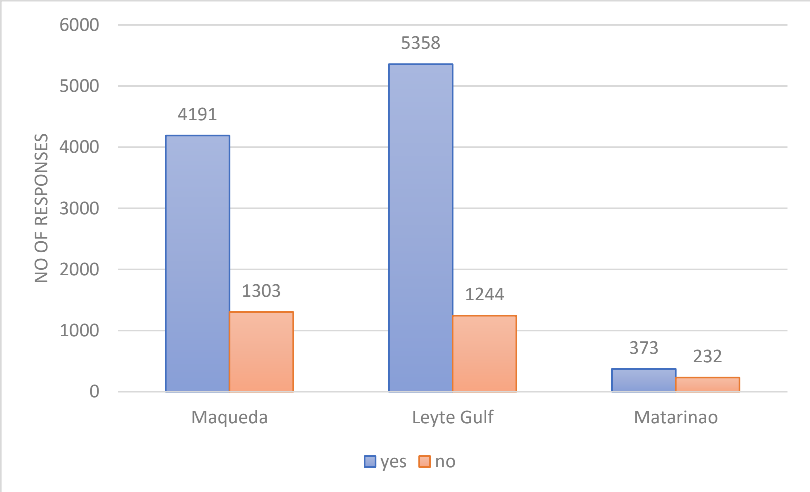

Figure 1-83. Perception of the fisherfolks in encouraging the active participation of women.

Involvement in coastal management

Are women involved in the coastal management in their communities? Most respondents (78.05%) thought so. This perception was high in Leyte Gulf where it registered 81.16%. But a significant number (21.95%) said women were not involved in coastal management

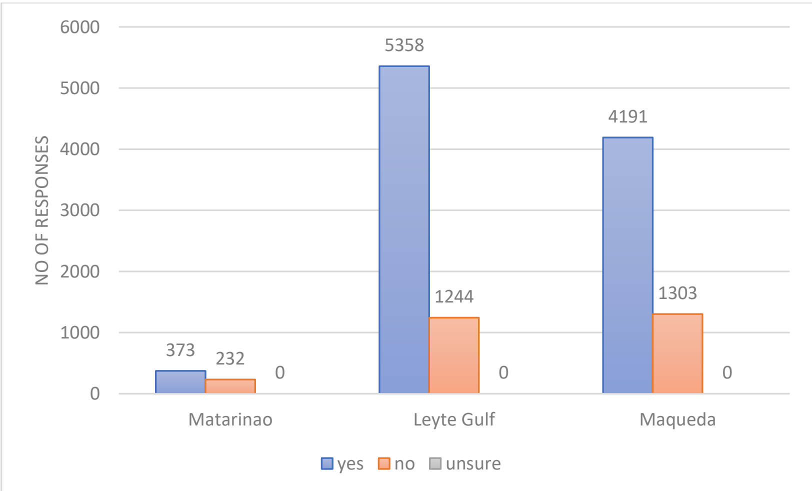

Figure 1-84. Perception of the fisherfolks in encouraging participation of women in coastal management.

How are they involved?

Generally, 36.36% of the responses leaned towards involving women as members of organizations. Around 22.58% were inclined to letting women actively participate in coastal resource management activities, while only 16.79% wanted them to be leaders of their organizations. Some 23.78% did not answer the question.

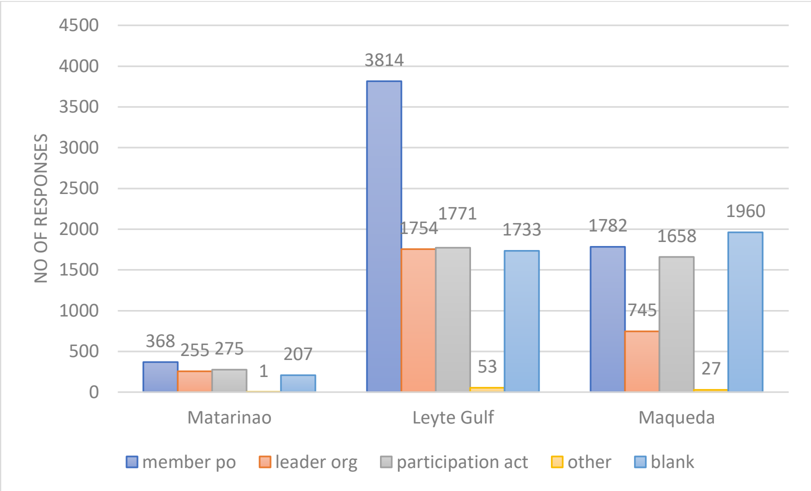

Figure 1-85. Involvement of women in coastal management.

Reasons for non-involvement

Overall, 51.63% of the responses cited the lack of time as reason for their non-involvement in coastal management, while 28.14% of the responses cited they had other activities. 18.56% cited no reason for the women's non-involvement.

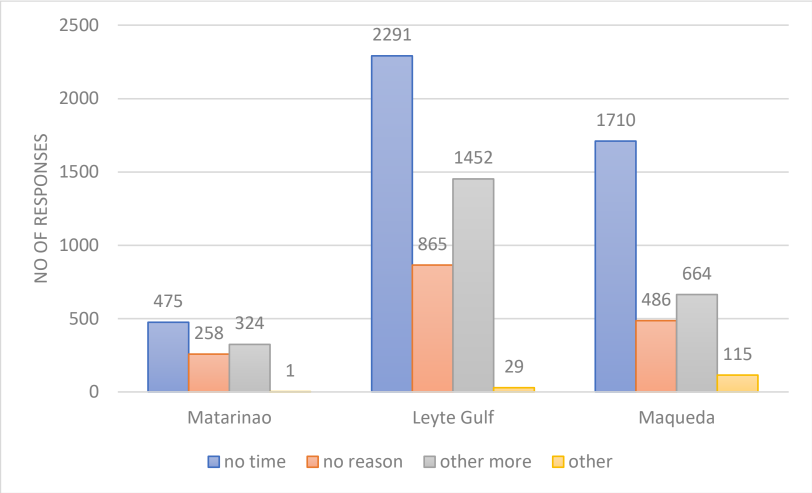

Figure 1-86. Reason for non-involvement of women in coastal management.

Do women need CRM training?

Given the opportunity, 78.17% of the respondents believed that women should participate in CRM trainings, 21.83% thought that they should not. This is the general trend in all the bays.

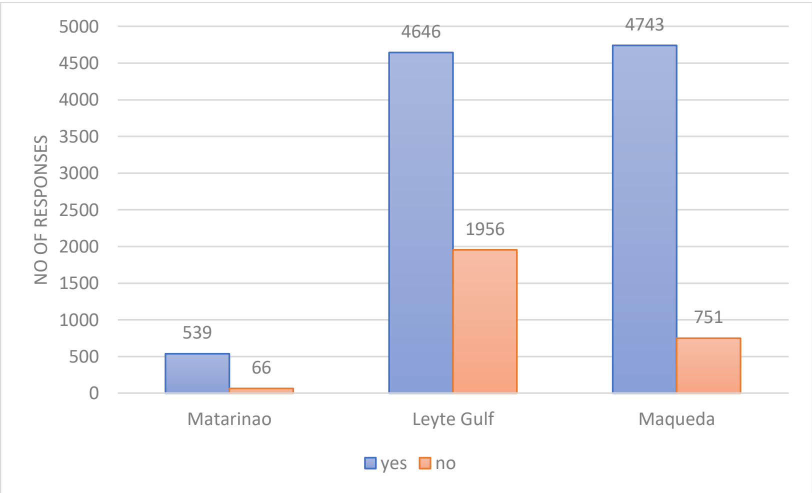

Figure 1-87. Do women need CRM training?

Decision Making

Participation

Only a few people in the barangay are involved in making decisions regarding major community issues. This was the opinion of 50.31% of the respondents, with 8.64% strongly agreeing. Some 23.75% disagreed, and 1.68% strongly disagreed. About 15.62% could not make up their minds.

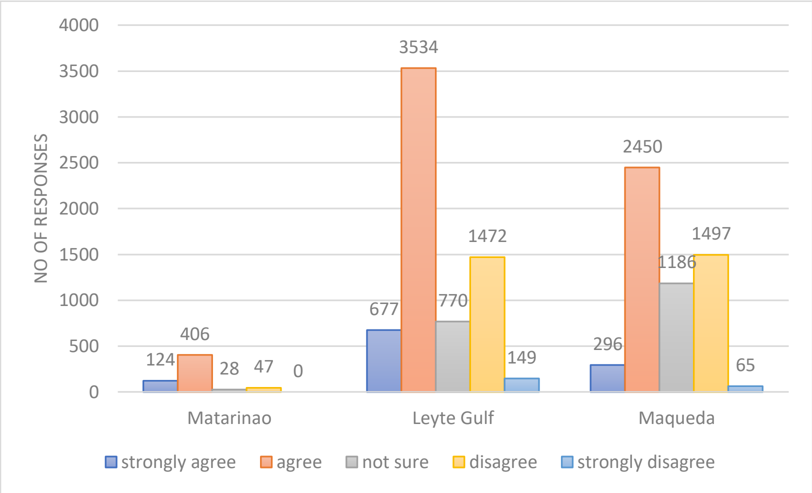

Figure 1-88. Perception of the fisherfolks on their participation on decision making.

Lukewarm

More than half (51.30%) of the responses claimed that people in the barangay are lukewarm towards participating in decision making, with 11.75% strongly agreeing to this perception. Only more than 22.42% disagreed, with 2.59% strong disagreeing. Around 11.94% were not sure.

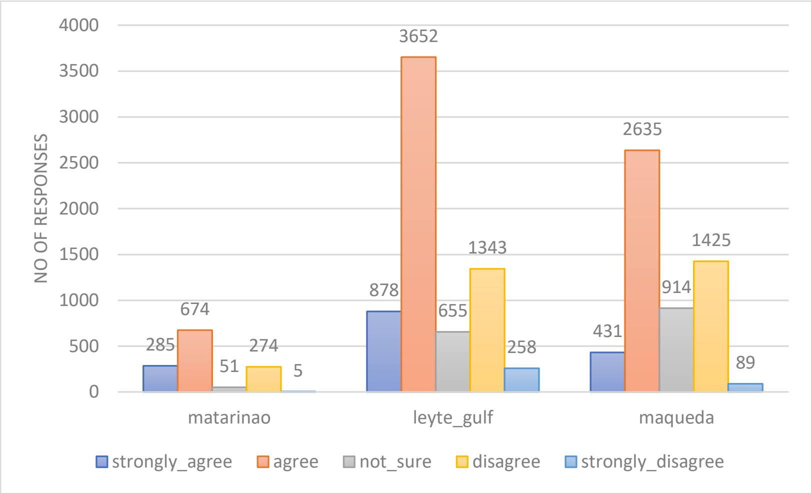

Figure 1-89. Perception of fisherfolks on people involvement in decision making.

Excluded from participation

More than half (51.61%) of the respondents perceived think that people in the barangay were excluded from participating in making decisions affecting the barangay, with 15.24% strongly agreed with the observation. Only 15.45% disagreed, and around 1.22% strongly supported this segment. But some 16.48% were not sure.

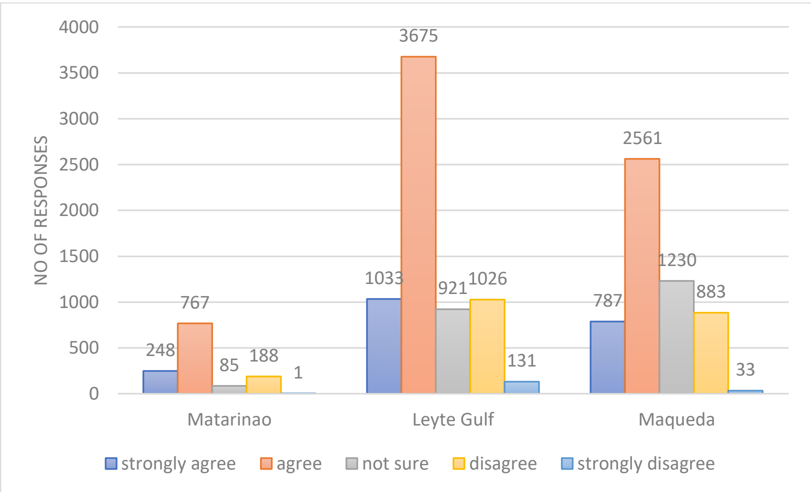

Figure 1-90. Perception of fisherfolks on excluded participation of people in decision making.

Difficulty of consensus

Most respondents (51.99%) believed that it is difficult to get a consensus on how to manage coastal resources in the barangay, and some 10.08% strongly agreed. Those who thought it is not that difficult reach a consensus was 20.62%, and these were backed by 1.05% who strongly disagreed. However, 16.25% were not sure of their stand.

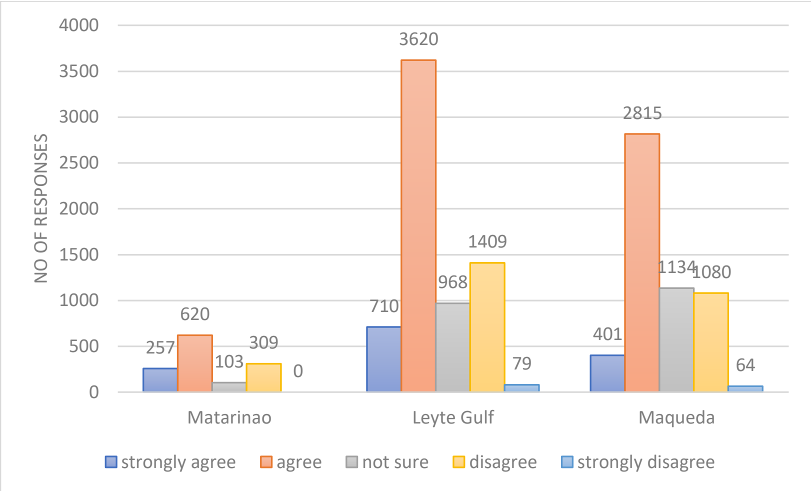

Figure 1-91. Perception of fisherfolks on the difficulty of consensus in managing coastal resources in the barangay.

Conflicts are normal

On average, 61.47% of the respondents have observed that conflicts related to fishing is a reality that people have learned to live with. Around 16.28% strongly concurred with this observation. Very few (6.54%) disagreed and 0.23% strongly disagreed. Some 15.48% were not sure about their stand.

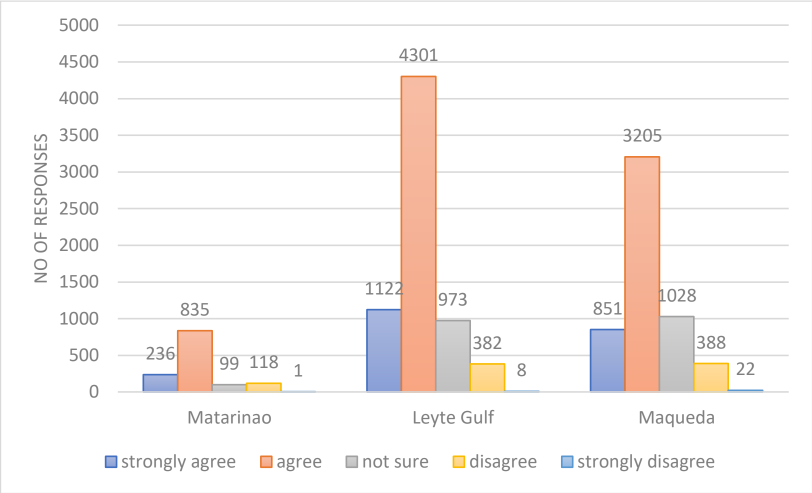

Figure 1-92. Perception of fisherfolks on conflicts arising in fishing are normal.

Improving coastal resources

More than half (50.69%) were of the opinion that improving the state of coastal resources is primarily a responsibility of the barangay, 10.80% strongly agreeing to this position. Some 19.65% however disagreed, with 1.41% saying they strongly disagreed. Around 17.44% were not sure.

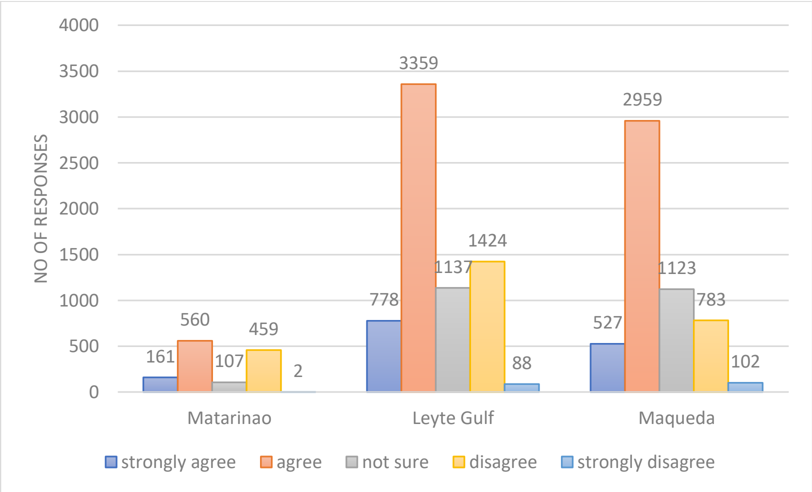

Figure 1-93. Perception of fisherfolk on improving coastal resources.

Working with others

It is the observation of most fisherfolk (57.31%) that it is difficult to work with different members of the barangay on the improvement of coastal resources due to differences in abilities and interest, with 14.38% also strongly supported this observation. But there are some 13.11% who disagreed with the majority, with 1.11% backing them. Some 14.01% have expressed uncertainty on this issue.

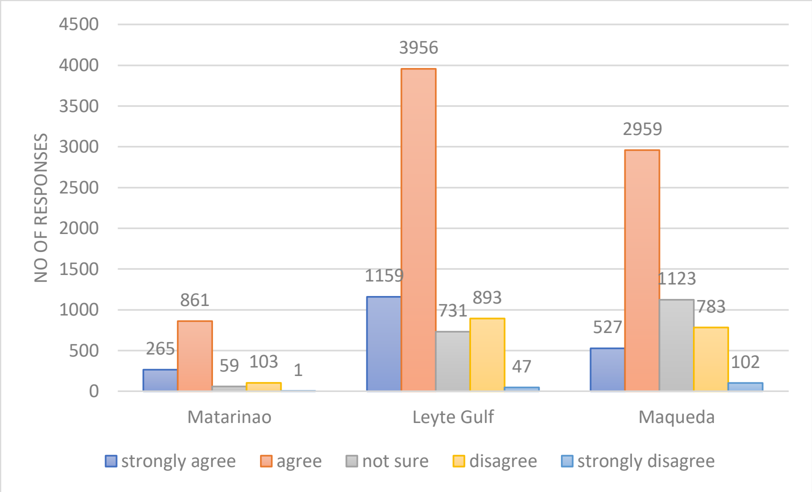

Figure 1-94. Perception of fisherfolks on the difficulty of working with others.

Hampered by politics

Compared to other issues raised so far, lesser number of fisherfolk (43.90%) perceived that the success of their fisher\s organizations is hampered by local politics, and 12.19% strongly supported this idea. Still, overall, more than 56.09% believed politics gets in the way of their organizations. 20.50% disagreed, with 1.79% disagreeing vehemently. Around 21.62% were not sure.

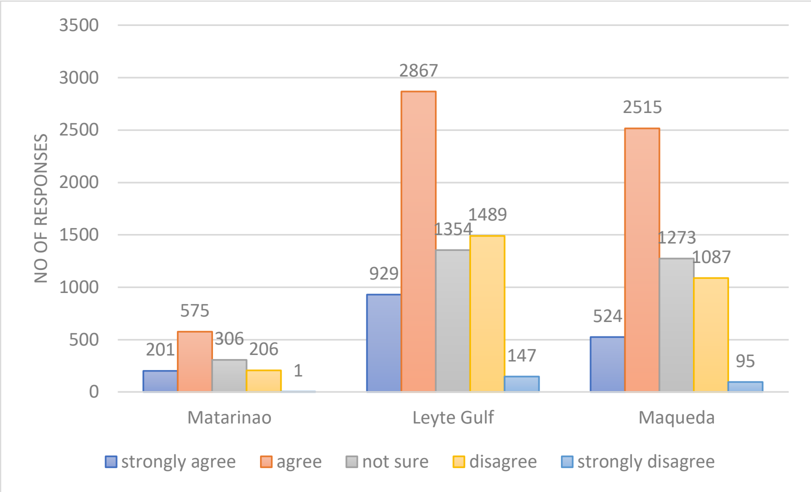

Figure 1-95. Perception of the fisherfolk on CRM being hampered by politics.

Awareness of other organizations

Around half (50.30%) of the respondents believed that people in the barangay are generally aware of the activities of different organizations. Some 10.60% strongly agreed to this observation. Word of mouth plus the physical closeness of neighbors and families could easily be the factors that explain this. Only 9.82% disagreed, with 0.42% strongly disagreeing. Still some 28.87% were not sure.

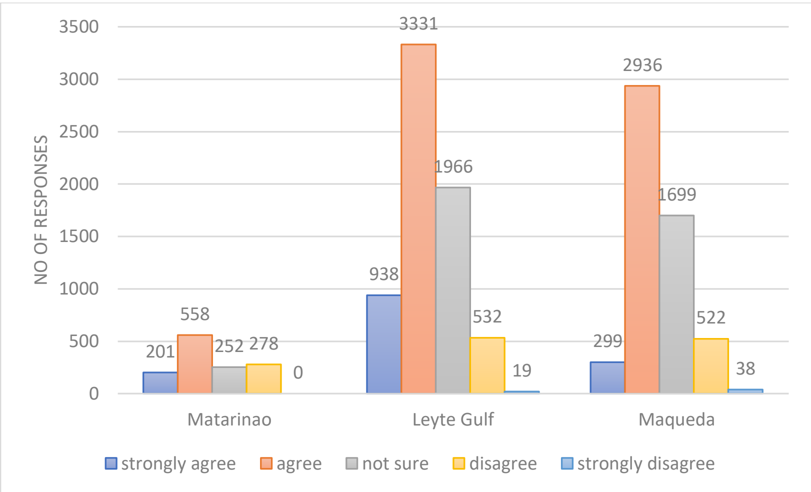

Figure 1-96. Perception of the fisherfolks on the awareness of activities of other organizations.

Active participation difficult

Majority of the respondents (53.10%) also agreed that it is difficult to get active participation from the barangay folk in the rehabilitation of damaged coastal environment, and some 9.12% strongly agreed. On the other hand, about 18.74% did not conform with this observation, with 0.71% backing them up. Likewise, 18.33% were unsure about it.

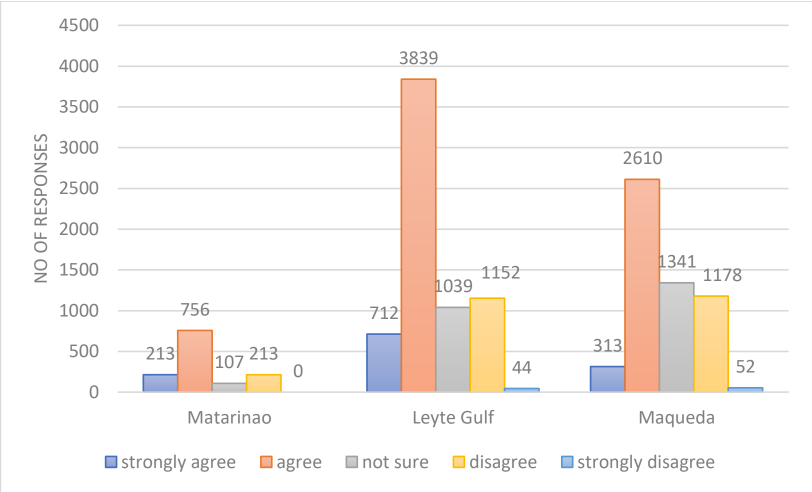

Figure 1-97. Perception of the fisherfolks on the difficulty of active participation in CRM.

No motivation

Around 59.67% of the respondents also noted that despite the available resources in the management of coastal resources, people were not motivated enough to take advantage of these opportunities, with 17.18% strongly supporting this view. Whereas only 7.24% took the opposite view, with 0.27% strong supporting them. Some 15.65% were not sure.

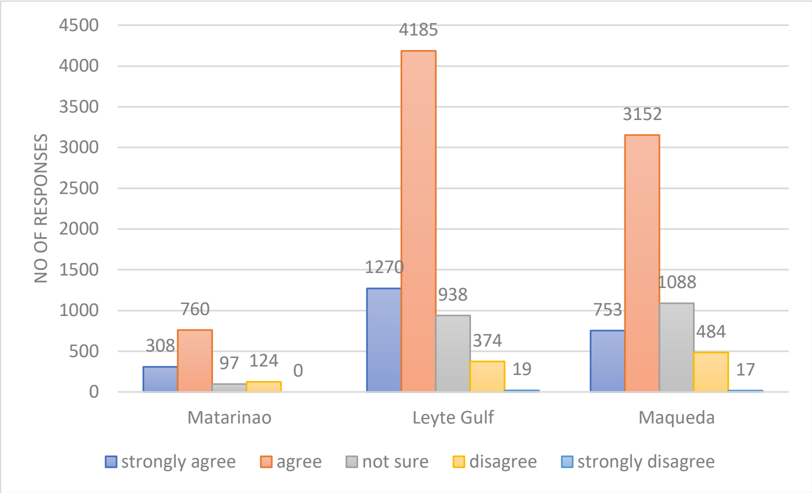

Figure 1-98. Perception of the fisherfolks on the non-motivation of people in participating in CRM.

In the hands of a few

Almost half the respondents (49.33%) believed that it is difficult to get people to participate in barangay-wide issues since decision making appears to be in the hands of the few. Around 11.44% strongly agreed to this. On the other hand, around 18.76% did not agree to this, and 1.20% strongly backed them up. Some 19.27% are not sure about this.

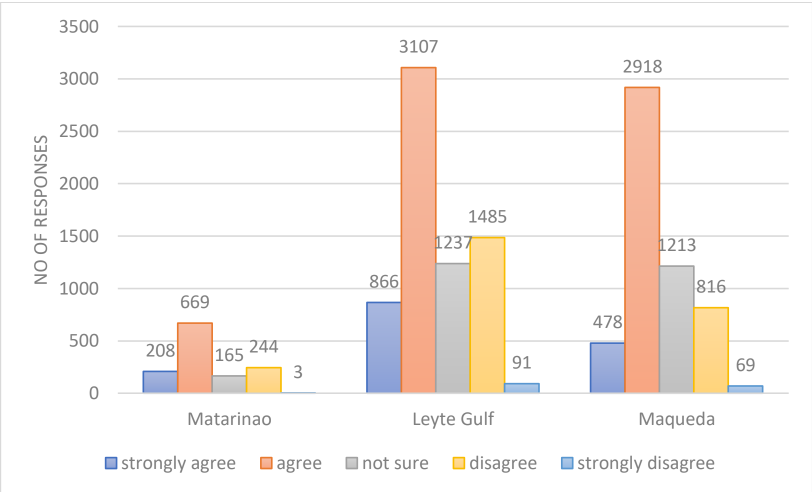

Figure 1-99. Perception of the fisherfolks on CRM decision making appearing to be only in the hands of few.

Importance of training

Generally, 59.53% of the respondents agreed and 27.36% strongly agreed that education and training are needed to make people take responsibility in managing and conserving coastal resources. On the other hand, very few disagreed, with 2.15% saying so, and 0.17% backing them. Some 10.79% were not sure about the issue.

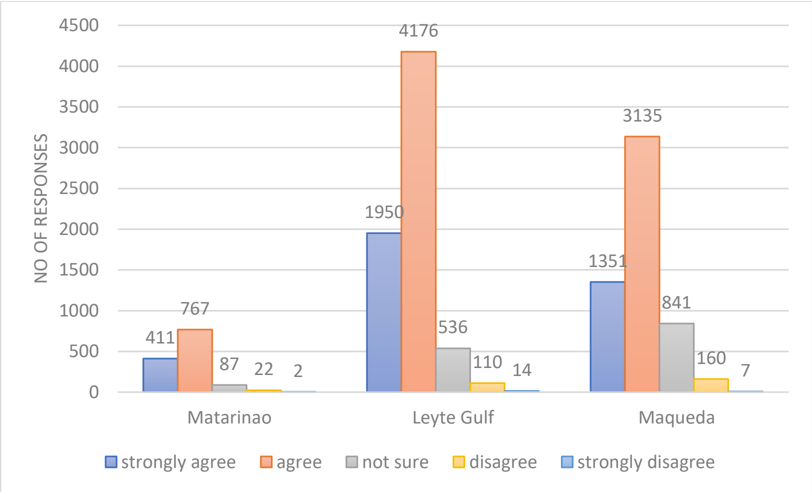

Figure 1-100. Perception of the fisherfolks on the importance of CRM training.

Values Orientation

Responsible management

Some 62.36% of the fisherfolk agreed that responsible management is a matter that is clear to the members of the community, and 18.65% strongly concurred. There were likewise a few disagreements here, with some 4.33% disagreeing and 0.15% strongly disagreeing. Some 14.50% expressed uncertainty.

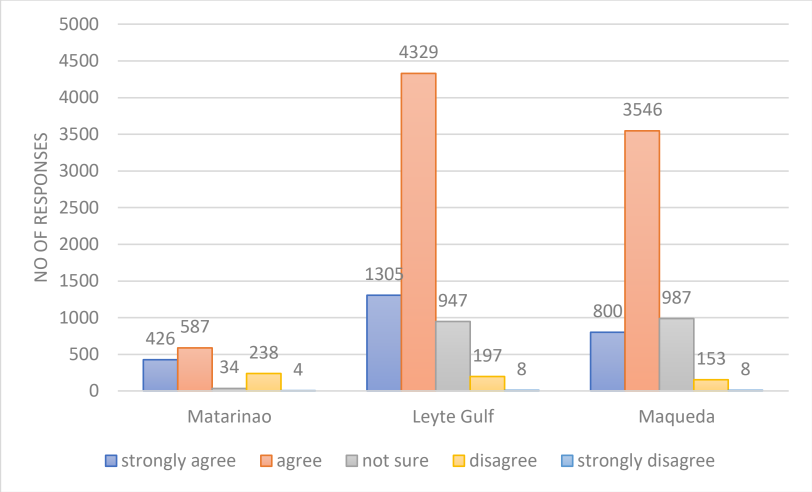

Figure 1-101. Perception of fisherfolk on responsible management.

Public accountability

Around 42.58% held the opinion people in the community should be accountable for the destruction of the coastal environment, with 11.66% strongly agreeing. But 23.67% disagreed and 2.64% strongly disagreed. Some 19.45% could not decide.

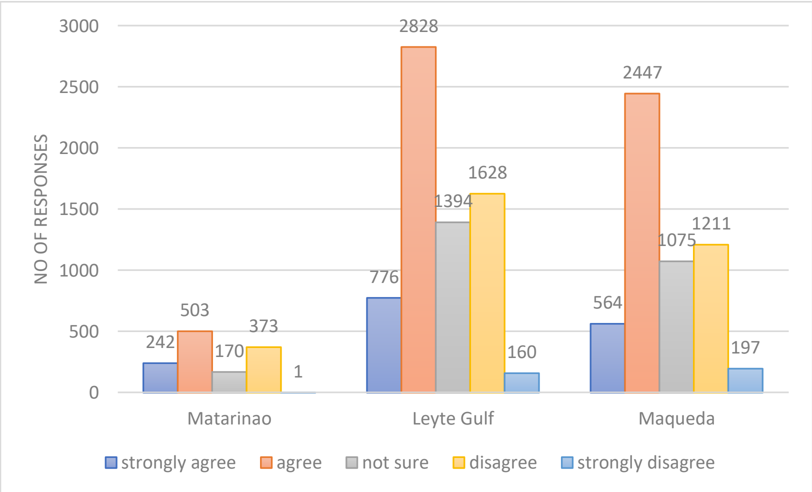

Figure 1-102. Perception of fisherfolks on accountability of the public on the coastal environment.

Trust

A good majority (67.17%) were having the opinion that trust among members of the community is important in coastal resource conservation, with 20.95% strongly backing them up. There was little disagreement among the respondents (1.82%), having 0.14% strongly disagreeing. Some 9.92% were not sure.

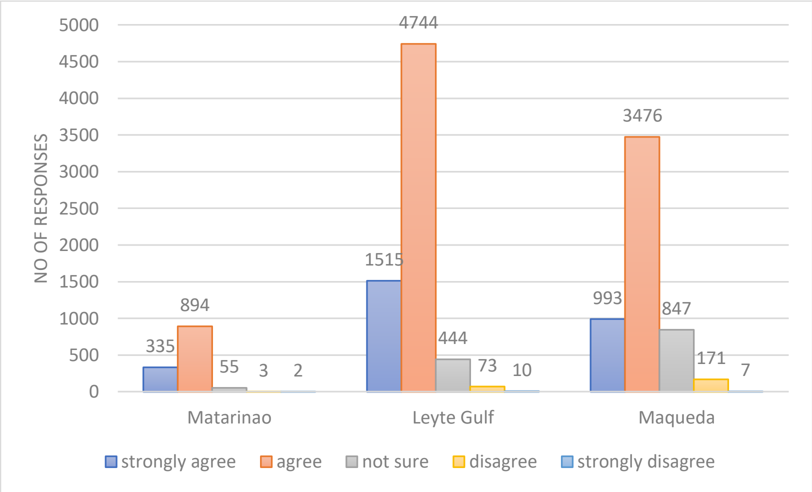

Figure 1-103. Perception of the fisherfolks on the importance of trust among members in coastal resource conservation.

Trust in public officials

All in all, 52.38% believed that the failure in coastal resources conservation is due to the people's luck of trust in the public officials up at the level of the LGUs. About 13.59% strongly supported this claim. However, some 14.11% disagreed, while 1.92% strongly supported them. Around 17.99% were not sure.

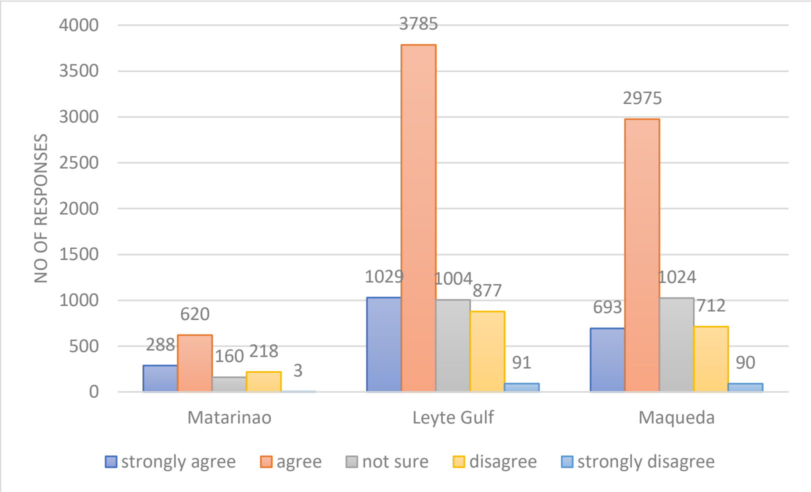

Figure 1-104. Perception of fisherfolks on the failure of coastal resource conservation due to the lack of trust in public officials.

Socio-Economic Ranking

Status 5 years ago

It appeared that in questions of ranking their economic conditions, on the scale of 1 to 10, respondents went for the safer averages (between 4 to 7 scales). Adding up those who opted for these numbers came up to 72.98%. Around 25.65% of the respondents chose 5, the middle ground. The extremes in the scale were chosen by fewer respondents, 1.63% for 1 and 0.80% for 10.

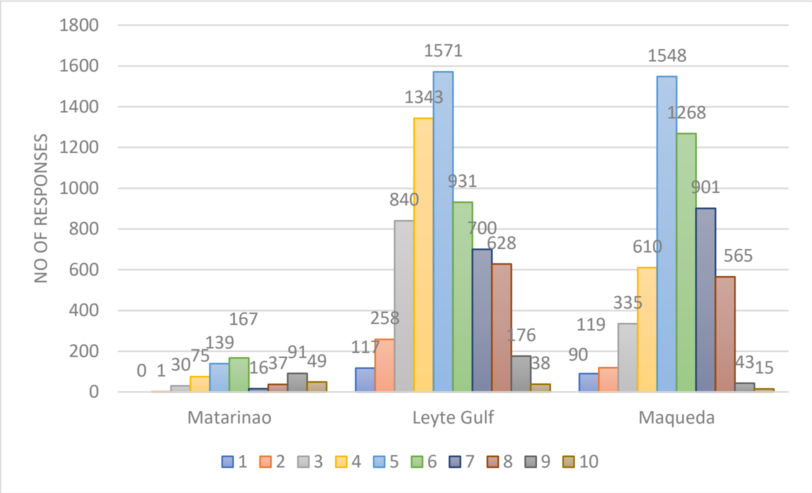

Figure 1-105. Perception of the fisherfolks on their SEA status 5 years ago.

Status now

For the present economic conditions, around 81.52% of the respondents ranked their economic status between 4 to 7, the highest percentage going for 5, with 31.08% saying that this is their status now. As in the previous question, 5 had a higher rating than the rest. The number 4 had 28.58%. The extremes in the scales, 1 and 10, got 0.48% and 0.13%, respectively.

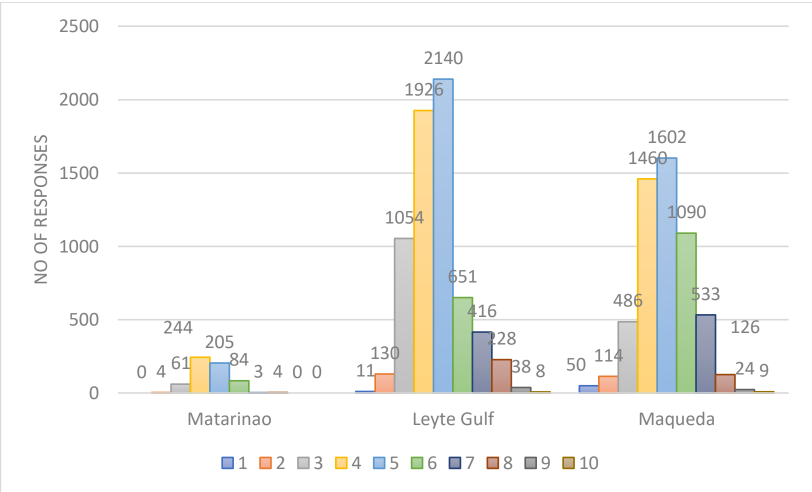

Figure 1-106.Perception of fisherfolks on their SEA status at the present time.

Status 5 years hence

Fisherfolk tend to take the middle ground even when predicting their economic status five years hence. The choices between numbers 4 and 7 added up to more than 68.80%, with the rank of 5 getting the highest percentage among them with 25.19%. The extremes, 1 and 10, on the scale got 0.93% and 0.84%, respectively.

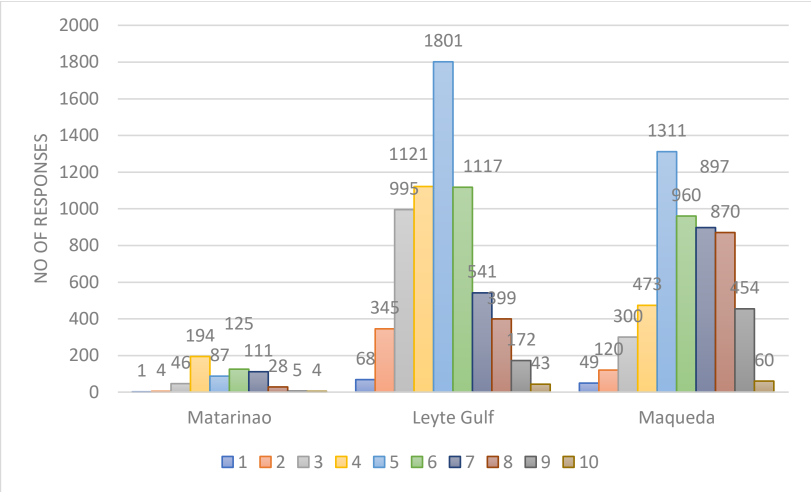

Figure 1-107. Perception of fisherfolks on their SEA status 5 years from the present.

Top SEA sentiments for each bay.

The sentiments of each fisherfolk on Matarinao Bay, Leyte Gulf and Maqueda Bay were clustered together according to their similarities between each other. A program which uses a clustering algorithm, namely, the K-Means clustering algorithm, was created. The sentiments were essentially fed into a program which performed various computations based on how close the sentiments are to each other. The output of the program was set to 5 clusters, with one cluster containing all the outlier sentiments. The top sentiment for each cluster is presented in Table 1-3. Top 4 representative sentiments of the fisherfolks in Matarinao Bay, Leyte Gulf, and Maqueda Bay on their Socio-economic status.

Table 1-3. Top 4 representative sentiments of the fisherfolks in Matarinao Bay, Leyte Gulf, and Maqueda Bay on their Socio-economic status.

	Overall	Maqueda	Matarinao	Leyte Gulf
SEA_PRE	-sakto la an nadadakop mga isda -medyo maupay kay may mga bulig -medyo makuri an pakabuhi -makuri. gamay la ang dakop sa isda	-maupay kay damu pa an isda hadto -maupay kay baga maupay an pangisdaan -makuri kay baga waray gud naiincome -damu la ay gihap kay maupay man an panahon	-damo pa adto an na dadakop nga isda ngan guti pala adto an paro pandagat -medyo maupay an pangita dara han ayuda han mga ngo -kay hadtu nga panahon diri pa damo it mga illegal fishing compressor overfishing han panagat ngan masagana pa an isda han panagat ngan paratu pa an isda ngan mga papliton hadtu baratu pa ngan dagdaramo pa an isda ngan mga paplito -han una maupay pa an dakupan han isda ngan barato pa an papliton	-makuri panahon -mas maupay han una kay damu an isda -makuri. gamay la ang dakop sa isda -sakto la an nadadakop mga isda
SEA	-guti la it isda nadadakop -maluya na panakop isda -makuri la gehap an panginabuhi -danay makuri ngan danay maupay it panginabuhi	-perme nala maluya it pandagat yana -natika kuri ky mahal papliton tas kulang na dakop -makuri an panginabuhi agi han panahon -maupay it kita yana	-yana nga panahon natika waray na isda ha dagat ngan diri na damo it nadadakop nga isda ngan dara liwat han mga illegal fishing badil magtitika waray na isda ha dagat -mahal naman yana iton presyo -damo na it nakaka bulig pagpa kabuhi ngan nakaka bulig na it am mga anak pamiling hin trabaho -asya la gihap dara pagmahal parapliton	-amo la gehapon makuri la gehapon -baga mas maupay naman yana -baga maluya naman an padakop isda -guti la it isda nadadakop
SEA_POST	-bangin mag maupay -amo la gehap siguro kay diri nagdadamo it isda ha brgy -dri pa gud kami maaram -depende sa panahon siguro, depende gihapon kun makabalo pa ang uban sa panagat	-basta maupay la perme it panlawas, maupay it pandagat, tapos mga programa ht gobyerno maka tagamtam kami, maasensohay pagad kami hini -ambot la ini it panahon -basta maupay l pirme lawas ngan kon tatagan pukot ha gobyerno -waray na isda	-unta mayda ayuda nga maihatag -makuri la gihap kay damo na ipag mapogngan paman an mga illegal fishing overfishing magtitika upay ngan posible pa mapa upay an panagat ngan masagana pa an isda ngan ha dagat -amu la gihap kay natika damo naman it mangirisda -waray kasiguraduhan dara hit climate change	-bangin mag maupay -dri pa gud kami maaram -depende sa panahon siguro, depende gihapon kun makabalo pa ang uban sa panagat -diri pa maaram kun anu it matatabo

Conclusions and Recommendations

The total number of respondents reached 12,701, mostly heads of households or their representatives. Leyte Gulf had 6,602 respondents with 27,258 household members. Maqueda had 5,494 respondents with 24,101 household members. Matarinao Bay had 605 respondents with 2,893 members.

By ethnic origins, 96.44% are Warays. By religious affiliation, 96.88% are Roman Catholics.

Singles constituted the largest segment of the survey at 62.61%. Married persons numbered 35.33%. 40.57% of the population were only elementary school level, followed by high school level with 33.52%. The numbers varied with each bay. The high poverty incidence could be probably attributed to these low levels of educational attainment. Such a condition made the respondents less employable.

Fishing is the main source of income of our respondents, but those who earned from it constituted only 23.94% as a larger segment (69.31%) did not have any income. These were most likely the dependents, young and old, and those not gainfully employed.

Based on the number of days spent fishing, income of the fishing households has not increased. In fact, the opposite was true in two fishing grounds.

Of all the municipal fishing boats used by the fisherfolk respondents, 72.85% are motorized, while 26.99% are manual. There are still some who uses bamboo raft which constituted to a 0.16% of the total fisherfolk respondents. 85.32% of these fishing boats are owned by the fisherfolks. While 78.42% of the boats are bought.

Among the 72.85% motorized boats, 79.71% of them uses gasoline as fuel, while 20.29% of them uses diesel. The most popular brand of engine used by the fisherfolks is kenbo, which totals to 39.99% of the total fisherfolk respondents. 87.78% of these engines are owned by the fishers themselves, 80.25% of the engines are bought.

The more popular types of gears being used by fisherfolk in the region are the hook and line (32.99%), traps (22.93%) and gill nets (12.29%). The majority of the fishers (60.70%) derive their incomes from fish capture. Majority of the fishers (46.33%) only catches less 3 kilos an outing. Around a third of the fishermen (33.58%) can catch up to 4-6 kilos in an outing. These two segments add to about 79.92% of the fishermen. The small quantity of fish caught further shows the depletion of the fishery resources.

Around 41.23% of the fisherfolks sell their catch in the price range of 100 to 150 pesos a kilo, while about 33.08% sell in the price range of 50 to 100 pesos a kilo. Some 20.89% sell their catch in the price range of 150 to 200 pesos a kilo. All in all, 97.36% of the fishermen sell their catch in the price less than 200 pesos a kilo. The relatively small price of the fish caught only shows the inferior quality of the fish caught.

A huge percentage of the fisherfolks (96.75%) did not indicate any fish processing technique. But among those who indicated they have, 2.11% said they mainly use drying. Salting only consists of 0.18% of the fishers while 0.06% uses tinapa. Around 0.90% of the respondents indicated other types of fish processing technique.

Considering the small fish catch, less the expenses incurred (such as fuel and oil) and less the amounts shared or given away, it is not a surprise that the net income of fisherfolks in the region would result in extreme poverty for the fisherfolk families. In 2015, the regional poverty threshold was estimated to be Php 8,877, the amount needed by a family to meet basic and non-food needs. According to our data, more than 82% of the fishing population belong here. Of this number, 69.47% earn Php 5,000 or less a month.

This is made worse by the existence of illegal fishing, the ineffective enforcement of fishery laws, and the general lack of involvement of the fisherfolk and the community in the coastal resource management programs of the BFAR. Under such conditions, fish catch can only diminish even as the fisherfolk continue to ravage the sea in their desperate attempts at survival. It may be said that illegal fishing is an offshoot of resource depletion. While it may be good to directly address the issue of illegal fishing in the short term, on the long-term resource depletion should be the focus of attention.

According to the more than half of the respondents, the following are the dominant types of illegal fishing: trawl, blast fishing, compressor, fish poisoning and commercial fishing that intrude inside the municipal fishing waters. Of these, blast fishing and trawl are the most destructive. Perceptions from different bays vary. In the Maqueda Bay, fishermen say trawl and similar contraptions (sudsud, etc.) is the most destructive and the fishermen can see with their own eyes how trawl, while in the Leyte Gulf and Matarinao Bay, blast fishing is. This is one big challenge to LGUs and the local law enforcement agencies. This is reinforced by perception of 34.73% that the fishing ordinances are not effective all over the region, again a big challenge to the LGUs. This is where political will matters. LGUs must not allow their political protegees to hinder the implementation of laws against illegal fishing.

Moreover, there is a general lack of awareness of coastal resource management even in the fishing communities as indicated by 81.84% of the respondents. In addition, there are organizational and cultural issues that work against community participation in CRM. Generally, few people are involved in decision making, and fisherfolk have observed that decision making is exercised only by a few. People have become lukewarm and very difficult to motivate even when circumstances are favorable for CRM and resources are available. They find it hard to work with others, and organizations are often riddled with personality conflicts. Consensus making is thus impossible. Worse, organizations are sometimes influenced by local politicians, which makes unity difficult as people become politically divided. Also, people have developed mistrust for government officials.

Still there are those who say they are involved in CRM, numbering 3,022 of the 12,701 respondents. They say they relay information (32.33%), they act as watchmen (21.34%), they are information sources (13.86%) and they are bantay dagat volunteers (13.10%). Likewise, more than 36.67% said they have been involved in mangrove replanting, 20.08% in fish protection, and 9.03% in the establishment of fish sanctuaries. The situation is not that hopeless. This can be a good starting point to increase participation in the CRM activities.

While there is a poor awareness of CRM among the survey respondents, 89.32% said yes, they are interested in CRM. 81.36% are optimistic that the CRM will be successful.

In an ideal situation, fishermen and their families should be deeply involved in CRM as fishing is their main source of income. They should be involved in fisheries protection, the replanting of mangroves and in programs that increase fish catch. Local government (barangay as well as municipal) should play an active role in leading their respective communities in CRM. But such situations are non-existent in fishing communities. Work has to be done to create the ideal.

- Strengthen organizations. It was seen during the FGDs that fisherfolk organizations are weak. Systems are not in place. It appears as if they have been hastily formed to respond to calls to organize themselves for reasons that were not internalized by their leaders and the general membership.
- Build capacities to engage LGUs. Due to such organizational weaknesses, their capacity to engage with the LGUs are very limited. They cannot properly articulate their problems and concerns before LGUs whose tendency is to dominate them.
- Initiate alternative income sources. Other than fishing, only 4% have secondary income sources. These generate little income. Land-based resources have not been adequately tapped for possible income-generating activities. This especially important if the fisherfolk are to be weaned from fishing to ease pressure on the fishing grounds. Fishermen must be kept aware of the need to restore their fishing grounds so that the fishes can spawn and be allowed to grow.
- Ensure local fishery programs are integrated in updated CDPs and ELAs. It appears that farming is given more importance in LGU programming compared to fishing.

Coastal Resource Management must stand out as the banner program in the effort to restore the municipal fishing grounds defined along needs of communities in their diets. Such programs must be part of their sustainable fishery goals.

- Increase LGU investment in fishery. With such thrust, it becomes imperative to allocate part of their annual budget amounts for the support of fishery programs. Without adequate fund support, such programs are bound to fail.
- Support alternative income sources for fisherfolk. If the fisherfolk are to cooperate in efforts to restore their fishing grounds and allow fishes to reproduce and grow, the fisherfolk must be given both financial as well as technical support in their efforts to develop other income sources. Technical support must be provided and skills training given since new skills have to be learned. Start-up capitals should also be given in the form of grants or loans.
- Stop illegal fishing now and enforce the laws. This is a challenge to the LGUs. Their record of apprehensions has been dismal. Ample support must be given the Bantay Dagat for patrol boats, gasoline and food allowance for the Bantay Dagat volunteers.
- Intensify technical assistance to LGUs on fishery programming. More information on CRM as well as marine science must be provided especially to those in the frontlines, the technicians, the barangay officials and the Bantay Dagat volunteers. The more they are equipped with knowledge, the better they will be able to confront issues related to fisheries.
- Strengthen inter-LGU coordination mechanism and determine priorities in the next 3 years. The problems and issues outlined above cannot be solved by a single municipality or barangay. Collaborative mechanisms must be put in place so that such issues and concerns can be regularly taken up, plans that detail collective actions drawn up and resources allocated not only in the combat against illegal fishing but more so in restorative activities, like science-based mangrove reforestation, protection and enhancement of seagrass beds among others.

It is hoped that these recommendations can be acted upon immediately as these concerns are urgent and imperative for the sustainability of the coastal fisheries and the livelihoods of the municipal fishers.

2. Mangrove Assessment

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Abstract

A rapid assessment to determine the extent of mangrove vegetation along Leyte Gulf, Maqueda Bay, and Matarinao Bay was done from February to June 2019 using the Transect Line Plot method. Total mangrove cover for these three areas amounted to 6,276 has. Species diversity revealed 16 major and nine minor mangrove species, plus three associated species. The density of each species varied at different sites ranging from 467-1,351 tree/has, 477-1,847 tree/has, and 550-1,600 tree/has for Leyte Gulf, Maqueda Bay, and Matarinao Bay, respectively. However, zonation patterns were not evident due to massive reforestation of mostly monospecific Rhizophora across mangrove forests. This is also brought about by anthropogenic activities like construction of coastal roads, conversion to fishponds, and encroachment. Dominant species varied in different locations, with Avicennia marina, Rhizophora apiculata, and Sonneratia alba as the overall dominant species. In general, regenerative capacity per municipality varied, with a range of 30-2, 577, 297-1, 730, and 24-551 seedling and sapling/ha for Leyte Gulf, Maqueda Bay, and Matarinao Bay, respectively. The most common mangrove fauna observed are crustaceans and mollusks. Mangrove forests provide livelihood and services to adjacent coastal communities. Local people depend on mangrove trees and palms for fuel, tannin, timber, wine and other products. Mangrove forests host a wide variety of edible fauna such as crabs, shrimps, and mollusks. Mangrove associated fauna especially the edible ones like 'pangti-on' are harvested as food for adjacent coastal community locals. Shells such as bivalves for example are used as food especially when fish is difficult to source during inclement weather. Threats to mangrove ecosystems include pollution, conversion to fishponds, human encroachment and settlement, and overharvesting of the mangroves as firewood and construction materials. In addition, mangroves are highly sourced for their tannin in the sampled areas. Usually, the species of 'barok', *Ceriops decandra*, is debarked for their tannin. However, in some municipalities, since the barok is hard to find or scarce in number, they use other species as substitutes, e.g. Bruguiera gymmnorhiza and R. apiculata. Various mangrove management programs are implemented by different organizations mostly focused on reforestation. However, science-based protocols were not followed in most areas resulting in observed seedlings on seagrass beds and a high seedling mortality. Some areas have established mangrove ecoparks to highlight the variety of species in their areas and at the same time, to generate income. This study recommends the establishment of mangrove reserves in every municipality, strong enforcement of existing mangrove laws and zoning mangrove in Municipal Comprehensive Land Use Plans (CLUPs), and establishment of Community-based Mangrove Forest Management Agreements (CBFMA) that entails active participation of the community and the local government unit.

Keywords: Mangrove cover, condition, species.

Introduction

Mangroves are characterized as trees, shrubs, palms, or ground ferns that exceed half a meter in height. They usually grow above sea level in intertidal zones, near marine coastal environments and estuarine margins (Hogarth, 2002). Mangrove forests are among the most productive ecosystems on earth, and serve many important functions, including water filtration, prevention of coastal erosion, coastal protection from storms, carbon storage, food, timber, and livelihood provision, and biodiversity protection, among others (Primavera et al., 2019; Alongi, 2018; Sinfuego and Buot, 2014).

Mangroves are forest communities with high salt tolerance and are found in tropical and subtropical areas of the world (Hamilton et al., 1989). Mangroves can survive in unpleasant environmental conditions through its adapting plant features such as salt-excreting leaves, exposed breathing root system, and viviparous propagules (Duke, 1992). The salt-excreting glands on the leaves present in most species are important for mitigating high salt concentrations. Because the substrates in mangrove ecosystems tend to be anaerobic, the exposed breathing structures are essential for gas exchange to occur. Also, the viviparous propagules that are dispersed are important for species diversity. Likewise, Kathiresan and Bingham (2001) observed these adaptations and added that some species have different modes of tolerating high salinity levels including the distribution of salt into the senescent leaves or in the bark or wood. As observed by Duke (1993), lateral roots are developed for structural support. Kathiresan and Bingham (2001) identified species-specific adaptations to the marine environment. These adaptations include the stilt roots of Rhizophora, the pneumatophores of *Avicennia, Sonneratia* and *Lumnitzera*, the root knees of Bruguiera, Ceriops and Xylocarpus, and the buttress roots of *Xylocarpus* and *Heritiera*.

Mounting evidence suggests that mangrove forests protect coastal communities from tropical storm events (Hochard et al., 2019; Menéndez et al., 2019; Primavera et al., 2019). With its spreading root system above-ground, mangroves act as a protective barrier that can withstand strong currents and winds (Srikanth et al., 2015). In the Philippines, it is estimated that without mangroves, flooding and damage to people, property and infrastructure would annually increase by 25% (Menéndez et al., 2019).

Mangrove ecosystems also serve as nursery areas for juvenile fishes from nearby seagrass beds and coral reefs, including some commercially important species and other aquatic organisms such as crustaceans and gastropods which are usually considered as resources and are consumed by humans (Sinfuego and Buot, 2014). This ecosystem provides habitat to benthic assemblages that are key to organic matter assimilation, degradation and directly influences a variety of ecosystem services (Kristensen et al., 2014). Mangrove trees increase sedimentary complexity, alter sediment grain size and provide additional organic resources to the estuarine fauna by increasing tidal trapping. This ecosystem can also sequester carbon and maintain the gaseous composition of the atmosphere that can help in mitigating climate change in the long run (Rogers et al., 2019). Leaves of mangrove species fall to the ground and help preserve and regenerate soil composition and recycle nutrients (Bouillon et al., 2004).

Global estimates of mangrove area vary. The Food and Agricultural Organization (FAO) of the United Nations inventoried mangroves and compared their estimates with previous inventories (FAO, 2007). Worldwide, they estimated the mangrove area at 157,050 km2 in 2005. By far, the largest areas are in Southeast Asia. Spalding et al. (2010) estimated mangrove area globally at 152,361 km2, slightly less than the FAO estimate. Giri et al. (2011) estimated total mangrove area of 137,760 km2. The largest extent of mangroves (42%) being in Asia (42%) followed by Africa (20%), North and Central America (15%), Oceania (12%), and South America (11%).

Areal extent and spatial distribution of mangrove forests in the Philippines is approximately 256,185 has circa 2000 (Long and Giri, 2011). The total mangrove cover has diminished to almost half (Field et al., 1998), from an estimation of 500,000 has (Brown and Fisher, 1918). The decline can be associated to brackish-water pond establishment (Primavera, 1995). The decline may also be related to overexploitation by the coastal population as well as the urbanizations and conversions of the forests to agriculture, salt ponds, industries and settlements (Primavera 2000) leading to the significant reduction in mangrove ecosystem services such as, but not limited to, fish production and carbon sequestration (Primavera, 1997). These anthropogenic impacts are likely to continue and worsen as human populations increase. Damage due to tropical cyclone, with landfalls steadily increasing over the years, also contributes to mangrove denudation. To counter the decline of mangrove forests, the Philippine government put a stop to fishpond development and promoted mangrove reforestation.

In 2011, the Department of Agriculture through the Bureau of Fisheries and Aquatic Resources (DA-BFAR) launched a P237.5-million program to develop new mangrove areas, establish aquasilvi, or mangrove fish farms, and put up multi-species hatcheries in coastal communities (Dieta and Dieta 2014). The program involved three major components, namely: planting of 11 million propagules to 3,667 has of new mangrove areas, worth P88 million (M); establishment of 1,000 aquasilvi techno-demo farms (P74.4M); and establishment of multi-species hatcheries in 62 municipalities (P68.2M). The remaining P6.9M was for project management and monitoring. Mangrove propagules were planted in abandoned, underutilized and unproductive fishponds as well as in suitable coastal areas nationwide (Dieta and Dieta, 2014).

Super Typhoon Haiyan, locally named “Super Typhoon Yolanda,” struck Eastern Visayas leaving on its wake 1.1 million damaged housing facilities, 4.1 million displaced people, and the death of over 6000 people (NDRRMC, 2013; USAID, 2014). In light of the damage caused, plans for the rehabilitation of mangroves were established all over the country. This was aimed to provide protection from typhoons as strong as Haiyan that could potentially happen in the future (DENR, 2013), and to expand natural buffer against future storm surges (Executive Order No. 193, S. 2015).

Following a series of before-and-after storm observations based on differences in eMODIS NDVI, mangroves were classified into three damage levels: minimal, moderate, or severe. Parts of Eastern Samar and Western Samar were greatly affected by ST Haiyan, the mangroves were heavily damaged in these places. The severity of damage decreased with distance from Eastern and Western Samar.

As of 2018, the National Mapping and Resource Information Authority (NAMRIA) reported that the Philippines has 303, 388 has of mangrove forest. This increase can be attributed to the various efforts on restoring mangrove areas. However, these efforts have mainly included afforestation of Rhizophora spp., converting mudflats, sandflats, and seagrass meadows into often monospecific mangrove forests, making the ecological gains of such efforts highly uncertain (Samson and Rollon, 2008).

Continued assessment of these remaining mangrove forests and plantations is very crucial in upgrading its management and conservation programs. Beyond understanding this ecosystem, the results of the assessment could be the basis for recommendations for a sustainable fishery management and livelihood development in coastal communities.

The present study, part of the Participatory Resource and Socio-economic Assessment under the Fisheries, Coastal Resources and Livelihood (FishCORAL) Project, was conducted to determine the extent and cover of mangrove areas of Leyte Gulf, Maqueda Bay and Matarinao Bay; determine some physico-chemical parameters of mangrove soils; determine species composition; evaluate the community structure; describe the zonation pattern, diversity, and regenerative capacity of mangrove forests; and to evaluate the utilization of the mangroves, as well as to identify the threats to the mangrove ecosystem.

Methodology

A rapid assessment of the mangrove areas along Leyte Gulf, Matarinao Bay, and Maqueda Bay followed the same protocols. Assessment was done on several field outings from February to June 2019. Mangrove forests considered for assessment were areas with existing and proposed mariculture sites as provided by the BFAR-FishCORAL Project, the recommended sites of the respective municipal agriculturists and community facilitators, and sites which have prior studies on their mangrove forests. A total of 56 sampling stations were established: 30 sites along the coasts of Leyte Gulf, 10 sites along Matarinao Bay, and 16 sites around Maqueda Bay (Figure 2-1, Figure 2-2, and Figure 2-3).

Courtesy calls and coordination were made at the municipal and barangay levels before field activities. Ocular inspections of proposed sampling sites were done to validate the secondary data/ satellite images.

For drone mapping, twenty-seven municipalities and 2 cities along Leyte Gulf, Matarinao and Maqueda Bays selected by BFAR were the subject of the study. Generally, the site for drone mapping were also the sites for the mangrove assessment.

In order to map the mangrove area, drone mapping was conducted using DJI Phantom 3 Professional, set to 200 to 300 m above ground. The flight height and camera result in an image resolution on the ground of approximately 15 cm to 30 cm per pixel. In terms of field coverage, the drone could cover approximately 30-50 has per flight, equivalent to 15 minutes per battery flight and depending on weather condition. The team had a total of 3 units drone batteries which could cover 150 has within 54 min flight time. The number of flights varied per barangay, depending on the mangrove cover. The team used a drone portable solar generator as drone battery charging unit. It could fully charge 1 battery unit in an hour, capable of providing power for 4-5 drone flights per day.

The drone unit was equipped with Glonass/GPS navigation satellite, with max speed 16 m/sec, sensor CMOS 12.76 million pixel, rated power 100 watts, 3 axis gimbals for stabilization. Garmin 64s receiver was also used to get the coordinates of the site/location. To further back up the data, geotagging was also done using an android phone.

Drone images were rectified and processed using Pix4D software. The images were digitized in QGIS. Google satellite images were used as background data for accuracy and validation purposes and to cover other barangays that were not included in the drone mapping. Area calculation of the mangroves and map layouting was done using QGIS 2.14.

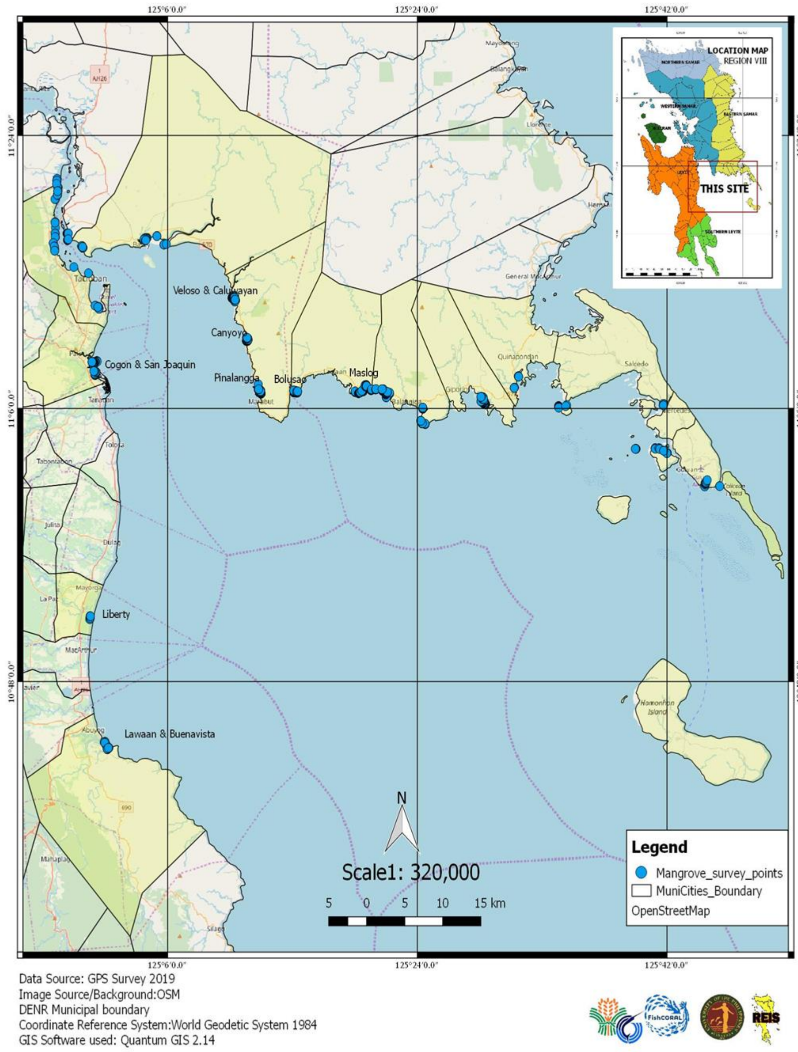


Figure 2-1. Location of mangrove sampling stations in Leyte Gulf.

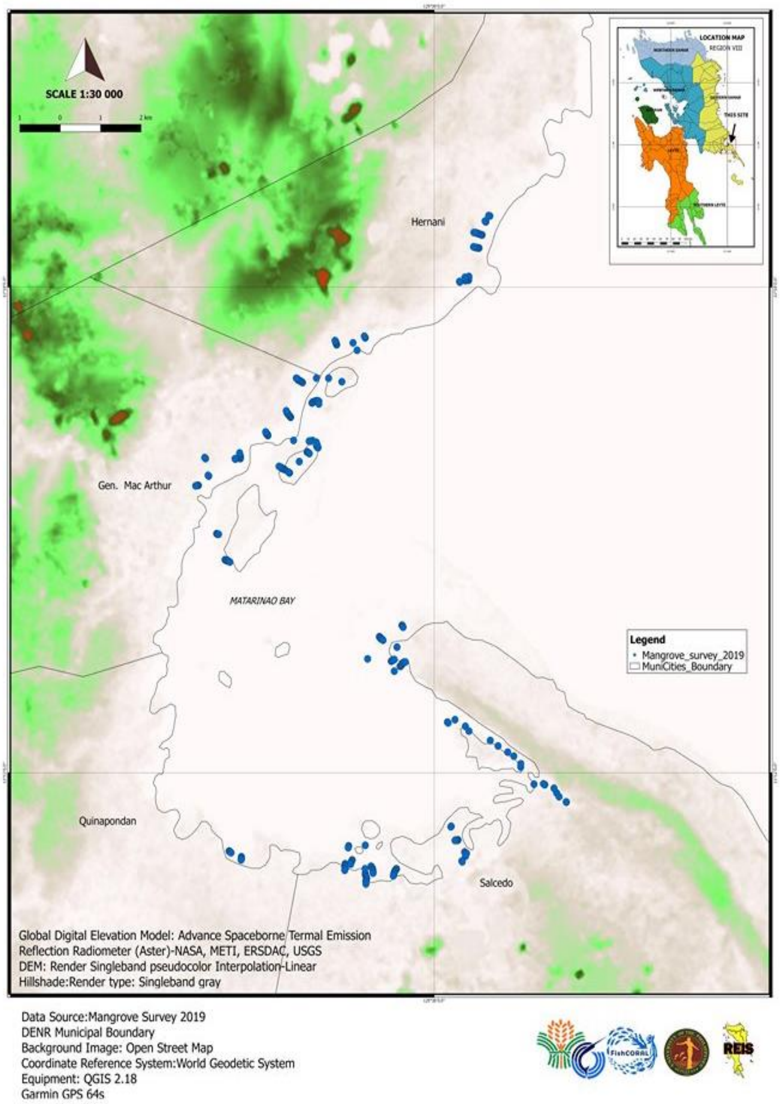


Figure 2-2. Location of mangrove sampling stations along Matarinao Bay

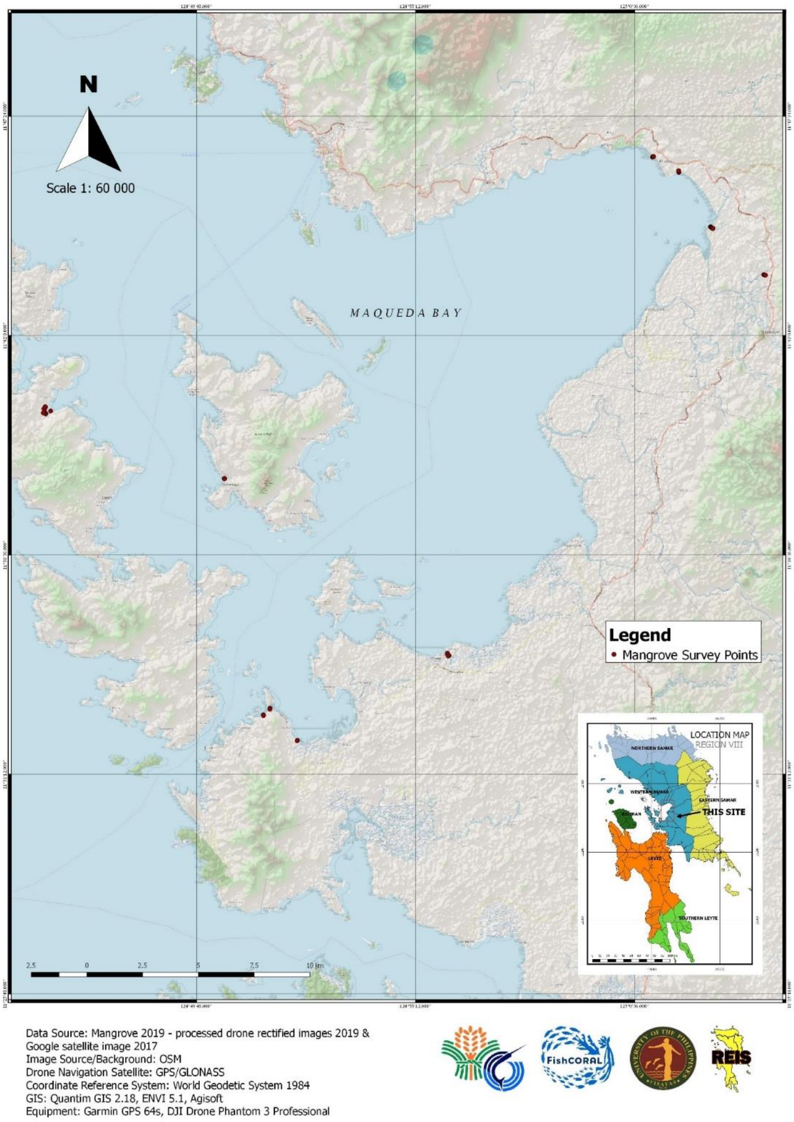


Figure 2-3. Location of mangrove sampling stations around Maqueda Bay.

Environmental variables (salinity, temperature and light penetration) were measured during the sampling period. Sediment samples were obtained from each site using a fabricated corer and then stored in a freezer. These samples were further processed in the laboratory to determine its particle size composition using a series of sieves with different mesh sizes (2000, 1000, 500, 250, 125, 63 and <63 µm).

The transect line-plot method (English et al., 1997) was employed in the assessment of mangrove vegetation. For each site, at least three transect lines were laid perpendicularly to the shore from the seaward margin of the mangrove to the landward margin. On each transect line, 10 m x 10 m plots were laid out with varying intervals, the number of such plots (e.g. 1-3) depended on the length of the transect line. Transect lines with a length of less than 50 m had uniform intervals between one transect line from another as laid perpendicularly (English et al., 1994; Kathiresan, 2000; Deguit et al., 2004). At each plot, all flora encountered were identified and counted and its girth breast height (GBH) was measured at 1.3 m from the ground. Mangroves were further classified as seedlings: < 1 m high and < 4 cm stem diameter; saplings: > 1 m high and < 4 cm stem diameter; and trees: > 1m high and > 4 cm stem diameter (English et al., 1997; Deguit et al., 2004).

Associated epibenthic fauna were collected from three randomly placed 1 x 1 m quadrat within the established 10 m x 10 m plots for flora assessment. All epibenthic fauna encountered were identified and counted. Mangrove resource utilization was determined by random survey/ interview with people from the coastal community at the vicinity of the mangrove area.

Data Analysis

Individual plants found within the plot were identified using various taxonomic sources (Primavera and Sadaba, 2012; Primavera et al., 2004, and Tomlinson, 1986). Basic vegetation parameters such as the diameter at breast height (DBH), basal area, and density were also computed.

Mangrove tree density is the number of trees per unit area and is reported as the number of trees per hectare.

$$\text{Density}\left(\frac{trees}{ha}\right) = \frac{Species\ density\ 1 + Species\ density\ 2 + \ldots Species\ density\ n}{\text{no. of quadrats} \times 100\ m^2\ \times \frac{1\ ha}{10,000\ m^2}}$$

Basal area is the cross-sectional area at breast height. Stand basal area is the basal area of all trees at breast height per hectare of forest (m2/ha). The equation below was used in calculating the basal area and stand basal area:

$$\text{BA}\ (\text{cm}^2) = \frac{\pi\ \text{DBH}^2}{4}$$

$$\text{Stand BA}\ (\text{m}^2/\text{ha}) = \frac{\text{total BA of trees}}{\text{no. of quadrats} \times 100\ m^2\ \times \frac{1\ ha}{10,000\ m^2}}$$

Percent crown cover, regeneration per square meter and average height were calculated according to Deguit et al. (2014) as per the following equations:

$$\text{Percent crown cover} = \frac{\text{Total crown cover of all trees}}{\text{Total area sampled}}$$

$$\text{Regeneration per m}^2 = \frac{\text{Total regeneration count}}{\text{Total number of regeneration plots}}$$

$$\text{Average height (m)} = \frac{\text{Total heights of trees recorded}}{\text{Total number of trees recorded}}$$

The condition of a mangrove area can be classified into four categories as shown in Table 2-1 with the corresponding criteria (Deguit et al., 2004).

Table 2-1. Criteria corresponding to the condition of a mangrove area.

Condition	Criteria
Excellent	76% and above in percent crown cover 1 regeneration per m^2 Above 5 m in average tree height Undisturbed to negligible disturbance
Good	51 – 75 % crown cover <1 – 0.76% regeneration per m^2 <5 m – 3 m average height of trees Slight disturbance and few cuttings
Fair	26 – 50 % crown cover 0.50 – 0.75 regeneration per m^2 <3 m – 2 m average height of trees Moderate disturbance and noticeable cuttings
Poor	0 – 25 % crown cover <0.50 regeneration per m^2 <2 m average height of trees Heavy disturbance/cuttings/pollution, rampant conversion to other uses, nearly destroyed

The importance of the contribution of each component species to the stand in terms of density, contribution to basal area (dominance) and probability of occurrence throughout the plot (frequency) are expressed by the following equations:

$$\text{Relative density} = \frac{\text{no. of individuals of a species}}{\text{total no. of individuals of all species}} \text{x } 100$$

$$\text{Relative dominance} = \frac{\text{total basal area of species}}{\text{total basal area of all species}} \text{ x } 100$$

$$\text{Relative frequency} = \frac{\text{frequency of species}}{\text{total frequency of all species}} \text{ x } 100$$

The importance value index (IVI) indicates the structural importance of a species within a stand of mixed species (Clintron and Novelli, 1984) and is expressed using the following equation:

$$\text{Importance Value Index (IVI)} = Relative\ Density + Relative\ Dominance + Relative\ frequency$$

Frequency is defined as the occurrence of a species in any one plot and can only be compared between plots of equal sizes (English et al., 1997).

For the evaluation of the mangrove forests' diversity, the following indices were used:

Species diversity was described according to the Shannon -Wiener index (H) as per the following equation:

$$\mathrm{H} = -\sum_{\mathrm{i}=1}^{\mathrm{S}} p_i \ln p_i$$

where p_i is the total number of species i and S is the total number of all species in the community.

Simpson's Index (D) is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, so diversity increases. Simpson's index (D) (Simpson 1949).

$$\mathrm{D} = 1 - \frac{\sum n\,(n-1)}{N\,(N-1)}$$

Where:

n = number of individuals of each species

N = total number of individuals of all species

The value of D ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity.

Evenness (*J'*) was computed using the formula below (Pielou 1966).

$$J' = \frac{H}{H_{max}}$$

$$H_{max} = \ln S$$

where H is the value of Shannon Diversity index and S is the number of species in that community. This index is constrained between 0 and 1.0. Larger J' reflects community with even distribution of species.

Results and Discussion

Leyte Gulf

Leyte Gulf is among the major fishing grounds on the Eastern Visayan region of the Philippines with a shelf area of 13, 147 km2 covering the islands of Samar and Leyte including San Pedro Bay (FSP 2015-2017). It has an average depth of 69 m in the central gulf and 15 m in the bay. The Philippine Fisheries Code of 1998 (Republic Act No. 8550) requires inter-LGU alliance especially to water ecosystem that traverse political boundaries of many LGUs. In addition, the establishment of Fisheries and Aquatic Resources Management Councils (FARMCs) at the provincial and municipal levels has established a legal commitment by the government to involve stakeholders in the development and management of the fisheries industry. Several bay-wide management councils and alliance exist within the gulf. These include Alliance of Local Fishery and Aquatic Resource Management and Development Council (ALFARMDC) on Leyte Island side, Alliance of Seven Municipalities for Integrated Coastal Zone Management (A7 for ICMZ) on Samar Island area, and San Pedro Bay Management Council. The ICMZ has been leading the process of formulating a comprehensive development and management plan for the Northern Leyte Gulf that would harmonize the local ordinances on fisheries.

Physicochemical Parameters

Physicochemical parameters play an important role in every ecosystem. There is a range of values in which a certain physical parameter must be met in order for the area to be habitable and ample for optimum growth. Temperature, salinity, pH, light penetration and soil particle size were the physicochemical parameters measured.

Table 2-2. Physicochemical parameters measured in different sampling stations in Leyte Gulf.

Municipality	**Soil Texture**	**Temperature (◦C)**			**Salinity (ppt)**		**pH**		**Light Intensity (lx)**
		Air	Water	Soil	Water	Soil	Soil	Water	
Abuyog	Fine sand	27	25	25	32	18	6.4	8.03	2315
Mayorga	Granule	26	26	26	33	16	6.3	7.8	3005
Tanauan	Fine sand	28	27	26	35	18	6.3	7.7	3450
Palo	Medium sand	27	26	25	35	20	6.6	7.1	2950
Tacloban	Medium sand	27	25	24	34	18	6.4	7.8	2963
Basey	Medium sand	25	24	23	32	18	6.3	7.9	2740
Marabut	Medium sand	26	25	25	33	18	6.3	8	2805
Lawaan	Medium sand	27	26	26	32	17	6.4	8.1	2435
Balangiga	Medium sand	27	26	25	35	17	6.3	8.1	3500
Giporlos	Medium sand	25	24	23	30	17	6.3	7.9	2910
Quinpondan	Medium sand	27	26	25	31	17	6.5	7.9	3500
Salcedo	Medium sand	26	26	26	33	17	6.3	7.9	3010
Mercedes	Medium sand	28	25	23	30	17	6.3	7.9	3180
Guiuan	Coarse Sand	26	24	25	31	17	6.3	8	3120

Soil and Water pH

Soil pH was obtained in the laboratory prior to analysis for particle size. Eutech pH meter was used to measure the pH of soil. A 1:2 ratio of soil to distilled water solution was employed to obtain the parameter. As observed in Table 2-2, the highest recorded soil salinity was in Palo while Guiuan had the lowest salinity. They had salinity values of 6.5ppt and 6.29ppt, respectively. All soil samples for the Leyte Gulf municipalities are in normal range for optimum growth. Normal range for soil pH is in between 2 to 6. Normal water pH for optimum mangrove growth is between 6 to 8.5 (Edokpayi et al., 2010; Wakushima et al., 1994).

Soil and Water Salinity (ppt)

Salinity is the amount of salt in a body of water. Soil salinity was measured in the laboratory prior to its analysis for soil particle size. Water salinity was measured in parts per thousand or “ppt” in situ using a refractometer. Normal values for salinity should be in range between 15 to 35 ppt (Uwadiae et al., 2009).

Soil salinity was measured lowest in Mayorga, Leyte while Palo, Leyte had the highest. These municipalities had 16 ppt and 20 ppt, respectively. Soil salinity is relatively lower than that of the water salinity. This is because salt in soil is also absorbed by the mangroves and later ejected as salt crystals on leaves. Tanauan had the highest water salinity of 35 ppt. Giporlos and Mercedes, Eastern Samar had had the lowest values for salinity with 30 ppt.

Generally, salinity is governed by the shifting height of tides. Less seawater reaches the landward zone of the mangal areas, whereas the seaward zone experiences extreme tides.

Temperature (°C)

Temperature was obtained in situ using a field thermometer. Air, water and soil temperatures were obtained. All temperatures observed were in normal range for optimum growth of mangroves. The optimum range for mangrove growth is between 25-30◦C (Kara, 2013).

Light Intensity

Light penetration is the amount of light that is able to penetrate from the canopy to the ground. It is important for light to be able to penetrate in order for mangroves seeking shade will also receive ample amount of sunlight without being directly hit. There are no studies indicating optimum ranges for light penetration. Table 2-2 shows the values of light penetration for each municipality. Both Eastern Samar towns of Balangiga and Quinapondan had the highest light penetration values of 3,500lx. Whereas, Abuyog, Leyte had the lowest light penetration value of 2,315lx.

Soil Texture

Appendix 1.1 shows the particle characteristics of each mangrove area of the municipalities. Most of the municipalities have medium sand. This is because most of the substrate are newly sedimented particles (Grogot, Kalimantan, and Sukardjo, 1994). Typical composition of mangrove soils is 35, 40 and 45% clay, silt, and sand, respectively. The study of Moreno and Calderon (2011) observed mangrove soils to have soil texture of sandy clay with 53.17% sand particles.

Mangrove Cover and Density

Mangrove Cover

Global estimates of mangrove area vary. The Food and Agricultural Organization (FAO) of the United Nations inventoried mangroves and compared their estimates with previous inventories (FAO, 2007). Worldwide, they estimated the mangrove area at 157,050 km2 in 2005. By far, the largest areas are in Southeast Asia. Spalding et al. (2010) estimated the mangrove area at 152,361 km2, which is slightly less than the FAO estimate. Giri et al. (2011) estimated total mangrove area of 137,760 km2. The largest extent of mangroves occurred in Asia (42%) followed by Africa (20%), North and Central America (15%), Oceania (12%), and South America (11%)

In 2011, global Landsat imaging done from 1990-2010 by Long and Giri estimated the total area of Philippine mangrove coverage at 256, 185 has, which was a bit higher than DENR's 2003 estimate of 247, 362 has. The report finds that 66 out of 82 (80%) provinces have mangroves and the top provinces with the most mangrove areas, proportionate to the total national percentage, are: Palawan (22.2%), Sulu (8%), and Zamboanga del Norte and Sur (9.86%); Surigao del Norte and Sur (6.8%), Eastern and Western Samar (6.1%), Quezon (5.5%), Tawi-Tawi (4.4%), Bohol (3.69%), and Basilan (2.97%). Moreover, the mangrove areal extent of provinces of Leyte and Eastern Samar are 5, 807.07 and 5, 595.03, respectively. In the present survey, the mangrove area of Leyte Gulf composed of 13 municipalities and 1 city is shown in Figure 2-4 and maps are provided in Appendix B-4 to Appendix B-17.

Municipality	MANGROVE COVER (has)			
	1994*	2002**	2016	2019****
Abuyog			316.5[a]	52.0
Mayorga				11.38
Tanauan	17	40.9		79.50
Palo	37.98	141.7		142.72
Tacloban	19.35	41.3		166.32
Basey	331.9	213.4	18.55***	124.68
Marabut	49.42	45.5		49.24
Lawaan		276		277
Balangiga				208.50
Giprolos				366.71
Quinapondan				381.79
Salcedo				65.60
Mercedes				556.65
Guiuan				415.34
Total				2,512.86

Table 2-3. Comparative distribution of mangrove cover (has) in Leyte Gulf.

Data Source: *FSP-REA Report, vol 4-B; **Post RSA San Pedro Bay, vol 3; ***Basey Municipal Fisheries Profile 2016; [a]Abuyog, Leyte Comprehensive Land Use Plan, 2016; ****Drone Mapping 2019, Satellite Image and GPS Ground Survey

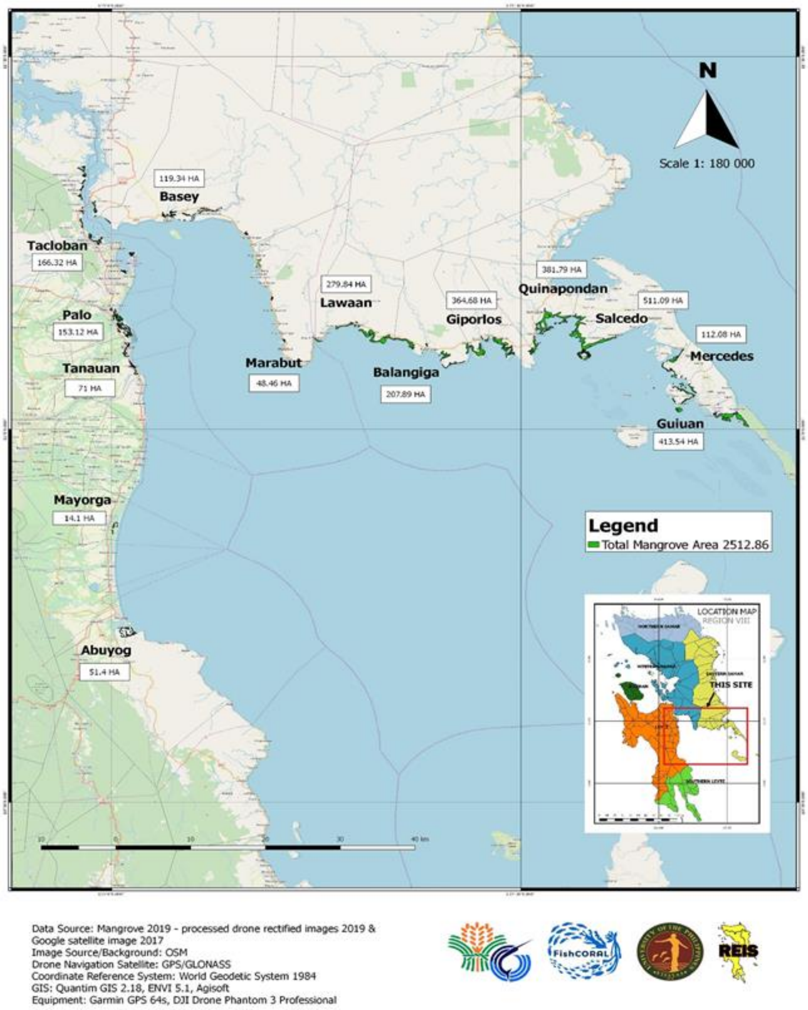


Figure 2-4. Mangrove cover of Leyte Gulf.

The majority of the municipalities had an increase in mangrove cover. This could be attributed to reforestation efforts in some areas like Tacloban. However, the widespread plantation of monospecific Rhizophora were mostly in areas that are not the natural habitat of mangroves, such as seagrass meadows and rocky substrates.

The changes in the mangrove cover over the years, however, is not conclusive because not all barangays were covered in this study. In Abuyog for instance, only two barangays were included in this research; hence, they only have 51 has as compared to the total mangrove area reflected in their Comprehensive Land Use Plan (CLUP) conducted in 2016 which recorded 316 has. An extensive survey per barangay would be more conclusive.

Moreover, no standard methods were used. It was reported that Basey had 18.5 has in their 2016 Fishery profile; but, it was only an estimate (Aclo, pers. comm.)

Some municipalities have no reliable baseline data as to their mangrove cover. Of the 14 municipalities studied, only Palo, Tanauan, Tacloban, Basey, and Marabut have baseline data. Lawaan had their CFRM in 2000 followed by LIECP in 2016 and this study. Tacloban updated its mangrove records recently through the PH Haiyan Project, a non-government organization.

An accurate and reliable baseline data and a comparison of the different mangrove cover could have been beneficial for planning purposes in order to minimize conversion /encroachment and for the proper planning and management of mangrove areas.

As of this study, there were not enough data available. The limited data available from different sources may have used different methodologies and equipment, hence an extensive and standardized methodology is necessary.

Mangrove Density

Density refers to the number of individual mangrove species sampled per hectare. Generally, the higher the value for density, the denser the mangrove forest is. Mangrove forests with high density has high soil surface accretion, positive elevation change, and tree survival especially in coastal areas susceptible to sea-level rise (Kumara et al., 2010). Additionally, high density conditions can also improve mangrove growth and facilitate faster stand regeneration (Gedan and Silliman, 2009). Leyte Gulf from Abuyog to Guiuan in general has an average mangrove tree density value of 1,050 number of individuals per hectare sampled. Figure 2-5 shows that the sampling station in Basey is the densest mangrove area with a total number of 1,351 individuals per ha. while the sampling station established in Tanauan is the least dense with a total number of 466 individuals per ha. Appendix B-33. Mangrove Tree Density of the different Municipalities in Leyte Gulf. summarizes the tree density of mangrove tree species across different sampling stations in Maqueda Bay.

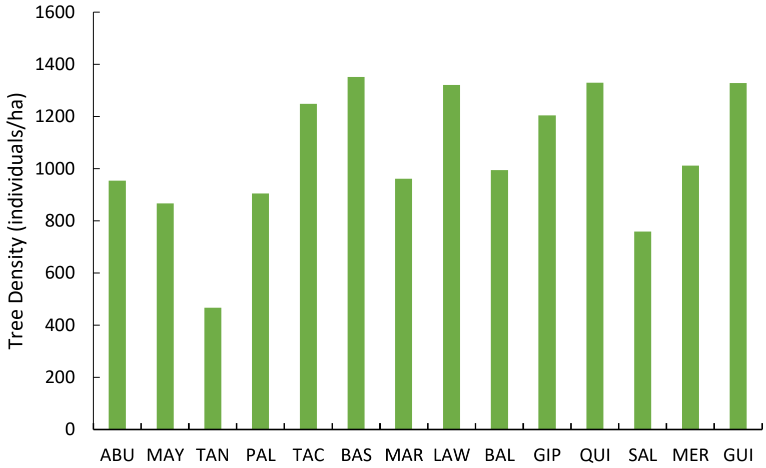
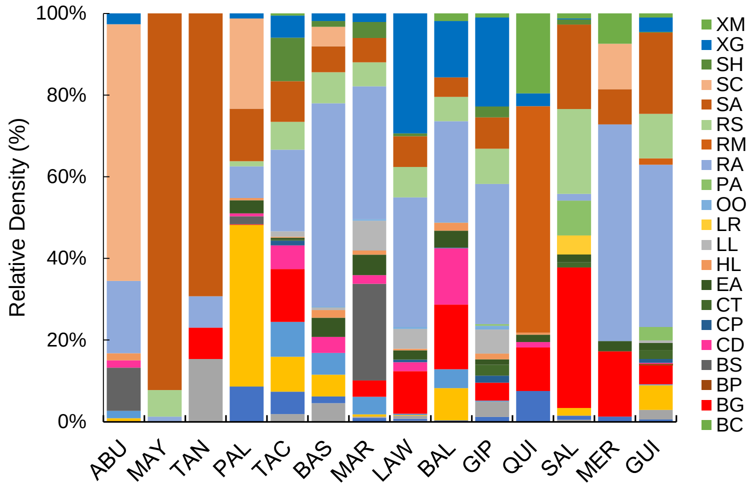


Figure 2-5. Mangrove tree density in different municipalities along Leyte Gulf.

Relative Mangrove Tree Density

Figure 2-6 shows the relative density of the different species of mangrove tree at the different sampling sites along Maqueda bay. Relative density refers to the relative number in percentage of each species in different sampling stations. All of the sampling sites were observed to have Avicennia marina, Sonneratia alba, and Rhizophora apiculata. The mangrove species S. alba was observed in all of the sampling sites with the highest relative density in Mayorga (92%). Along with S. alba that was observed in all sites is also a frontier species R. apiculata that has the highest relative density in Mercedes with 52.6%. Relative tree density per site per municipality is shown in Appendix B-36 and Appendix B-37.



Note: XM-Xylocarpus moluccensis,XG-Xylocarpus granatum, SA-Sonneratia alba, SH-Scyphiphora hydrophyllacea, RM-Rhizophora mucronata, RS-Rhizophora stylosa, RA-Rhi

Figure 2-6. Relative density of the different species of mangroves across sampling sites in Leyte Gulf

Stand Basal Area

Structural features e.g. the tree diameter at breast height (dbh), stand basal area, and density differed among mangrove zones along the gulf. Trees of larger DBH and stand basal area were in Guiuan, Lawaan, and Basey (Table 2-4). It can be noted that Salcedo has low stand basal area. This is due to the severe damage brought by Typhoon Yolanda with 73% damage as reported by Primavera et al. (2016).

Table 2-4. Some structural features of mangroves along Leyte Gulf. DBH stands for Diameter at Breast Height.

Municipality	DBH range (cm)	Stand Basal Area (m^2/ ha)
Abuyog	4.1-79.3	52.87
Mayorga	4.8-82.4	27.73
Tanauan	5.7-82.1	42.40
Palo	4.1-66.8	16.31
Tacloban	4.1-86.9	35.08
Basey	4.1-143	48.65
Marabut	4.1-118	22.62
Lawaan	4.1-137.8	49.30
Balangiga	4.1-178.9	32.28
Giporlos	4.1-113.9	31.45
Quinapondan	4.1-73.9	31.27
Salcedo	4.1-49.8	9.79
Mercedes	4.1-128.6	44.83
Guiuan	4.1-133.1	86.45

Community Structure

Species Composition

Mangrove forests contain a variety of plant species. A number of problems are related to mangrove taxonomy; the majority of which are based on hybridization between described species. Tomlinson (1986) recognized 34 major mangrove species 19 genera and 5 families and 20 minor species for a total of 54 mangrove species. Duke (1992) on the other hand, identified 69 mangrove species belonging to 26 genera in 20 families. Spalding et al. (2010) identified 73 mangrove species worldwide including several Pteridaceae or ferns of the genus Acrostichum, highlighting the evolving addition of species to this diverse forest community. Rhizophoraceae is the largest family, with 16 genera, including Rhizophora, Bruguiera, Kandelia, and Ceriops (Dawes, 1998). Out of the world's more than 70 salt-tolerant mangrove species, at least 50 % of these mangrove species exist in the Philippines (Garcia et al., 2013).

In the Philippines, Primavera et al. (2004) recognized 39 species of true mangroves belonging to the following genera: Acanthus, Camptostemon, Lumnitzera, Excoecaria, Pemphis, Xylocarpus, Aegiceras, Osbornia, Nypa, Aegialitis, Bruguiera, Ceriops, Kandelia, Rhizophora, Scyphiphora, and Sonneratia. In Western Leyte, 25 mangrove species belonging to 16 families were recorded by Sebidos and Galinato (1996).

The taxonomic composition of true mangroves and associated species is summarized in Table 2-5 and Appendix B-41 to Appendix B-43. A total of 33 species were identified (18 major, 12 minor, and 3 associated species). These were classified into major, minor and associated species as suggested by Tomlinson (1986). Major species are those that are strictly found in mangrove areas and never extend into terrestrial communities. Minor species only occupy peripheral habitats while associates are not regular inhabitants of mangal areas and may occur only in transitional zones. The 1994 and 2002 assessments recorded a lower number of major and minor species than the present survey. This difference in number is due to the different sampling sites chosen and additional sites that were assessed, including the A7 municipalities and Abuyog in the present survey.

Table 2-5. Taxonomic composition of true mangroves and associated species along San Pedro Bay (1994, 2002, and 2019), and entire Leyte Gulf (2019).

Family/ Species	Local Name	1994	2002	2019
I. Major Species				
Avicenniaceae				
Avicennia alba	bungalon, miapi	✓		✓
A. lanata	bungalon, miapi		✓	
A. marina	bungalon, miapi	✓	✓	✓
A. officinalis	bungalon, miapi	✓	✓	✓
A. rumphiana	bungalon, miapi			✓
Combretaceae				
Lumnitzera littorea	tabao, kulasi	✓	✓	✓
L. racemosa	sagasa	✓		✓
Palmae/ Arecaceae				
Nypa fruticans	nipa, sasa	✓	✓	✓
Rhizophoraceae				
Bruguiera cylindrica	pototan, busain		✓	
B. gymnorrhiza	pototan, busain	✓	✓	✓
B. parviflora	pototan, busain	✓		✓
B. sexangula	pototan, busain		✓	✓
Ceriops decandra	baras-baras		✓	✓
C. tagal	tungog, tangal	✓	✓	✓
Rhizophora apiculata	bakhaw lalaki	✓	✓	✓
R. mucronata	bakhaw babae	✓	✓	✓
R. stylosa	bakhaw bato	✓	✓	✓
Sonneratiaceae				
Sonneratia alba	pagatpat		✓	✓
S. caseolaris	pagatpat	✓	✓	✓
S. ovata	pagatpat			✓
II. Minor species				
Bombacaceae				
Camptostemon philippinense	Gapas gapas		✓	✓
Euphorbiaceae				
Excoecaria agallocha	lipata, buta-buta	✓	✓	✓
Lythraceae				
Pemphis acidula	bantigi			✓
Meliaceae				
Xylocarpus granatum	tabigi	✓	✓	✓
X. mollucensis	piag-ao			✓
Myrsinaceae				
Aegiceras corniculatum	saging-sanging	✓	✓	✓
A. floridum	saging-saging		✓	✓
Myrtaceae				
Osbornia octodonta	tawalis			✓
Pteridaceae				
Acrostichum aureum	palaypay/ paypay			✓
A. speciosum	palaypay/ paypay			✓
Rubiaceae			✓	✓
Scyphophora hydrophyllacea	nilad			
Sterculiaceae				
Heritiera littoralis	dungon	✓	✓	✓
III. Associated species				

Acanthaceae					
Acanthus ebracteatus	lagiwliw		✓	✓	✓
A. ilicifolius	lagiwliw		✓		✓
A. volubilis	lagiwliw				✓
		Total	**19**	**22**	**29**

The conservation status of the species appeared in IUCN Red List Category of Species. Of the 29 species recognized by IUCN (Table 2-6), one is considered Endangered (E), 1 Vulnerable (VU), and two Near Threatened (NT). The ndangered species is Camptostemon philippinensis while the Vulnerable species is Avicennia rumphiana. The Near Threatened species are Aegiceras floridum and Ceriops decandra.

Table 2-6. Mangrove species composition along Leyte Gulf.

Family	**Scientific Name**	**Common Name**	
Acanthaceae	*Acanthus ebracteatus*	Lagiwliw	Least Concern
Acanthaceae	*Acanthus ilicifolius*	Lagiwliw	Least Concern
Acanthaceae	*Acanthus volubilis*	Lagiwliw	Least Concern
Arecaceae	*Nypa fruticans*	Nipa	Least Concern
Avicenniaceae	*Avicennia marina*	Bungalon	Least Concern
Avicenniaceae	*Avicennia officinalis*	Api-api	Least Concern
Avicenniaceae	*Avicennia rumphiana*	Miapi	Vulnerable
Bombacaceae	*Camptostemon philippinensis*	Gapas-gapas	Endangered
Combretaceae	*Lumnitzera littorea*	Tabao	Least Concern
Euphorbiaceae	*Excoecaria agallocha*	Lipata	Least Concern
Meliaceae	*Xylocarpus granatum*	Tabigi	Least Concern
Meliaceae	*Xylocarpus moluccensis*	Piag-ao	Least Concern
Myrsinaceae	*Aegiceras corniculatum*	Saging-saging	Least Concern
Myrsinaceae	*Aegiceras floridum*	Saging-saging	Near Threatened
Myrtaceae	*Osbornia octodonta*	Tawalis	Least Concern
Pteridaceae	*Acrostichum speciosum*	Palaypay	Least Concern
Rhizophoraceae	*Bruguiera gymnorrhiza*	Busain	Least Concern
Rhizophoraceae	*Bruguiera cylindrica*	Pototan	Least Concern
Rhizophoraceae	*Ceriops decandra*	Malatangal	Near Threatened
Rhizophoraceae	*Ceriops tagal*	Tangal	Least Concern
Rhizophoraceae	*Rhizophora apiculata*	Bakhaw lalaki	Least Concern
Rhizophoraceae	*Rhizophora mucronata*	Bakhaw babae	Least Concern
Rhizophoraceae	*Rhizophora stylosa*	Bakhaw bato	Least Concern
Sonneratiaceae	*Sonneratia alba*	Pagatpat	Least Concern
Sterculiceae	*Heritiera littoralis*	Dungon	Least Concern

Diversity and Taxa Evenness

Diversity is the difference in species relative to the number of individuals observed in a certain area. The diversity index used were Shannon-Weiner diversity index and Simpson's Diversity Index. The Shannon-Weiner diversity index is sensitive to species richness. On the other hand, Simpson's Index is sensitive to dominance. The two diversity indices are coupled due to their sensitivities to population count and class. If the index values are near zero, there is little diversity or only a few species are observed relative to the number of individuals. On the other hand, when diversity values are near, equal to or more than 1, a diverse population exists in the area. This range applies to both the Shannon-Weiner diversity index and Simpson's Index.

Table 2-7 shows the diversity indices for each of the municipalities in Leyte Gulf. Tacloban City had the highest values for both Shannon-Weiner Index and Simpson's Index, with values of 2.4 and 0.8, respectively. Mayorga had the lowest values for both indices with values 0.3 and 0.1, respectively. High diversity values in Tacloban could be accounted for the city's management of the mangal areas. Some barangays in the city practice net fencing, which is somewhat similar to aquasilviculture where the mangrove forests in the area have nets that cover the frontal part of the forest, thus preventing trash from entering the area. It is coupled with community activities like active barangay management, coastal clean-up activities and the like to collect the trapped trash on the nets. In addition, the accounts of mangrove reforestation greatly contribute to the diversity of mangrove flora.

Taxa evenness refers to the distribution of species throughout the assessed area. The values for taxa evenness ranges between 0 to 1. The nearer the value is or equal to 1, the more evenly distributed the species. The closer it is to zero indicates that there is low distribution of species throughout the area.

Table 2-7 shows the taxa evenness for the Leyte Gulf sites. High species evenness was observed in Tacloban while Mayorga had the lowest. Each municipality had values of 0.8 and 0.2, respectively.

Table 2-7. Shannon-Weiner and Simpson's Diversity Index values and taxa evenness values of mangrove areas in Leyte Gulf.

Municipality	Shannon-Weiner Index (H')	Simpson's Index (D)	Evenness (J)
Abuyog	1.7	0.6	0.7
Mayorga	0.3	0.1	0.2
Tanauan	1.2	0.5	0.7
Palo	1.7	0.7	0.6
Tacloban	2.4	0.8	0.8
Basey	2.0	0.7	0.6
Marabut	2.2	0.8	0.7
Lawaan	1.9	0.7	0.6
Balangiga	2.2	0.8	0.7
Giporlos	2.0	0.8	0.7
Quinapondan	1.3	0.6	0.6
Salcedo	1.8	0.8	0.7
Mercedes	1.5	0.7	0.7
Guiuan	2.0	0.8	0.6

Diversity is important in every ecosystem. In the case of the mangrove ecosystem, diversity accounts for high fish catch yield and higher occupational diversity. The study of Sarathchandra et al. in 2018 concluded that mangrove floral diversity highly accounted for the high fish catch yield and income diversification.

Species Dominance and Importance

The relative density, dominance and frequency determine species comprising the density, dominance and frequency of a mangrove area. Appendix B-46.

Relative density is measured by the total number of individual trees over the total area assessed. R. apiculata has the highest density.

Relative dominance measures the stand basal area of a species over the total stand basal area of all species. In Leyte Gulf, S. alba had the highest relative dominance value.

Frequency is calculated by the percentage of the number of plots a particular species observed over the total number of plots assessed. A total of 576 plots were assessed in Leyte

Gulf with R. apiculata having the highest relative frequency. The species occurred in 290 plots out of the total 576 plots sampled.

The Importance Value Index (IVI) is the value which determines the species with the highest influence in the mangrove ecosystem in terms of density, dominance and frequency. The relative density, relative dominance and relative frequency of each species is added to obtain the IVI. The score for each species ranges between 0-300. The nearer the value to 300, the higher the species' influence in the mangrove forest.

In Leyte Gulf, R. apiculata has the highest IVI. R. apiculata had the highest relative density and relative frequency. This is due to its mass introduction during mangrove tree planting activities. On the other hand, S. alba had the highest relative dominance

Mangrove Zonation Patterns

Mangrove zonation patterns refers to the distribution patterns of species in the mangrove forest. These zonation patterns play a vital role in determining biomass and productivity of the mangrove forest (Komiyama, Eong, and Poungparn, 2008) and faunal assemblages that interact within the mangrove forest (Krause, 2004). Main driving factors for the zonation patterns include salinity and tides.

The standard zonation of mangroves is divided into three zones; landward, middle or intermediate zone, and seaward zones. There were no definite distances that differentiate the three zones. Figure 2-7 shows the standard zonation pattern for a mangrove forest (Sreelekshmi et al., 2018). However, patterns on the distribution of species may differentiate the three zones.

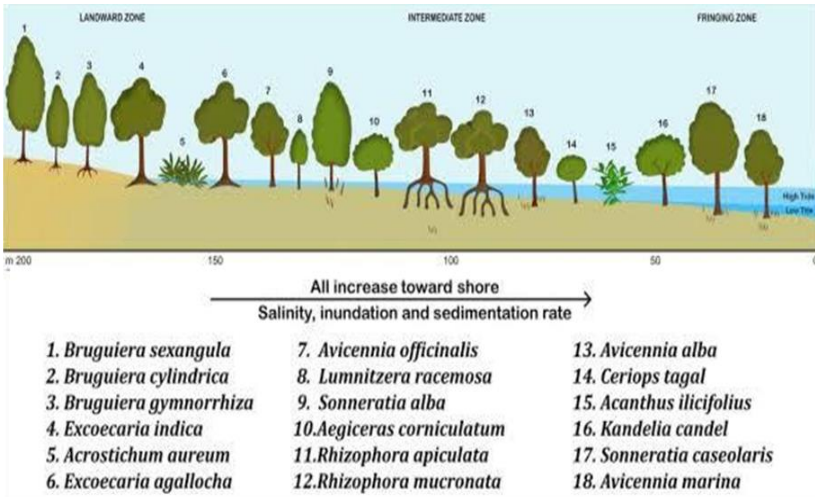


Figure 2-7. Standard zonation pattern.

In the mangrove assessment conducted, there were mixed species in all zones. R. apiculata was widely distributed throughout the mangrove area. There were species which were observed outside of their typical zones. For example, Sonneratia alba, which is typically found in the seaward zone, was still found in the mid and landward zone as seen in Figure 2-8. This mixing of species could be due to the shifting tides. Seeds of mangroves may have been washed and distributed to the different regions of the mangal forest. In some cases, human intervention is another factor that could cause disarrangement of zonation patterns. Mangrove tree planting is one of the human activities that contribute to the mixing of species in one area. Some organizers of these events lack the knowledge and do not follow science-based protocols. Protocols such as proper distancing and site selection must be observed in order for the mangrove seedlings to propagate. Mangrove rehabilitation projects mostly aim for socio-economic impacts over the area's ecology (Barnuevo et al, 2016).

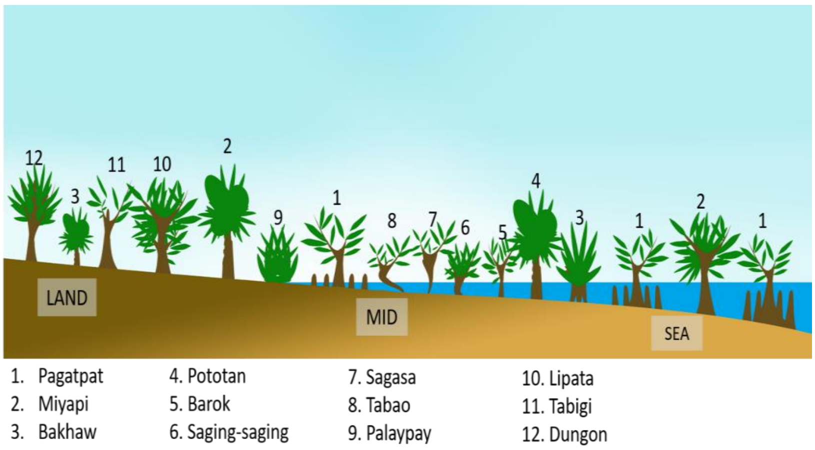


Figure 2-8. Observed zonation pattern in Leyte Gulf.

Regenerative Capacity

Regenerative capacity is the count of the seedlings and sapling divided by the area sampled. Marabut had the highest seedling-sapling count per hectare observed for the Leyte Gulf municipalities. On the other hand, Tanauan had the lowest count per hectare. Marabut and Tanauan had 2577 seedling-sapling count/ha and 30 seedling sapling count/ha, respectively. Figure 2-9, Figure 2-10, and Figure 2-11 shows seedling-sapling count of Leyte Gulf municipalities and per site is illustrated in Appendix B-51. Seedling and Sapling Count in Different Sampling Stations in Leyte Gulf.The percentage of alive and dead trees were also measured to find out the regenerative capacity of the area as shown in Figure 2-12 and Appendix B-54.

In the past nine years, the DENR has planted in approximately 1,362ha (DENR, 2019). Shown in Table 2-8 is the list of municipalities with natural mangrove stands and records of reforestation This may have contribute to the municipalities with high values for regenerative capacity. However, there are municipalities that reflected low regenerative capacity. This could have been due to the improper methods and protocols followed during mangrove rehabilitation activities. Also, seedlings introduced may not have thrived because of their soil preference, absence of mature trees, and presence of anthropogenic disturbances near the mangrove forest (Hamad et al, 2014; Mchenga, 2015). Nearby human settlements were observed in some mangrove areas. In addition, some of the seedlings were planted in rocky substrates where seedlings cannot optimally grow.

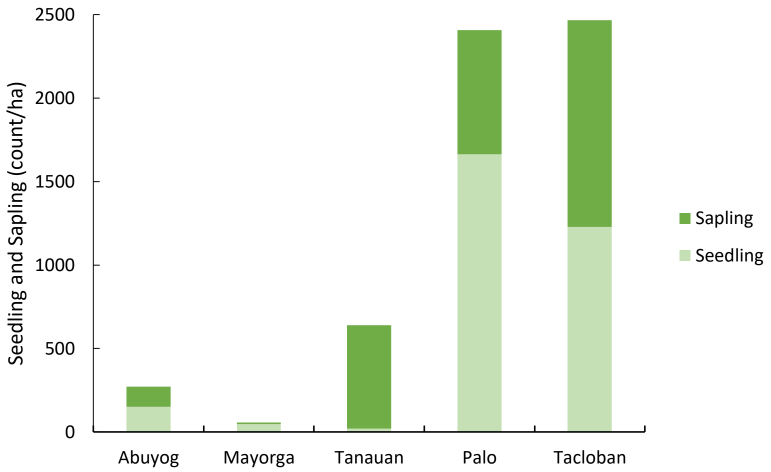


Figure 2-9. Seedling-sapling count of Leyte Gulf- Leyte sites

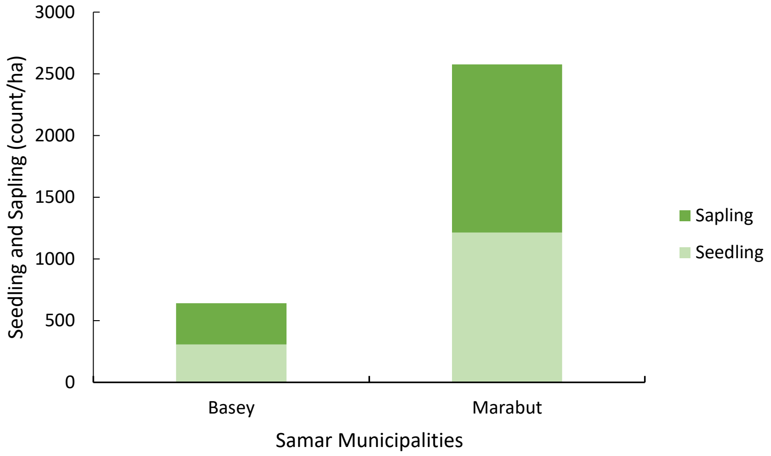


Figure 2-10. Seedling-sapling count of Leyte Gulf- Samar sites.

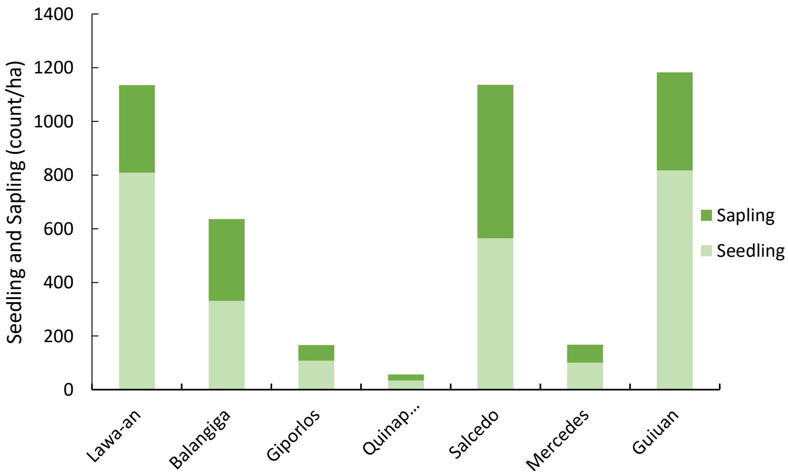


Figure 2-11. Seedling-sapling count of Leyte Gulf- Eastern Samar sites.

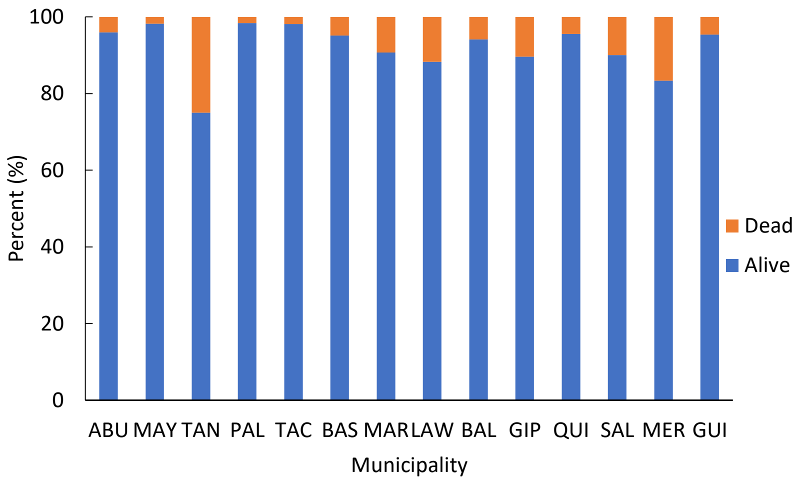


Figure 2-12. Percentage of alive and dead trees.

Table 2-8. Records of natural stand and reforestation in each municipality along Leyte Gulf, (DENR,2019).

Municipality	Natural Stand	Records of Reforestation
Abuyog	√	√
Mayorga	√	√
Tanauan	√	√
Palo	√	√
Tacloban	√	√
Basey	√	√
Marabut	√	√
Lawaan	√	√
Balangiga	√	√
Giporlos	√	√
Quinapondan	√	√
Salcedo	√	√
Mercedes	√	√
Guiuan	√	√

Although there have been efforts to rehabilitate the areas devastated by Typhoon Yolanda since 2013, various issues observed by research and concerned locals have been key factors in the half failure and success of rehabilitation programs. These factors are not new to the Philippine setting as these are prevalent all throughout the country. These include the locals' lack of awareness, complexity of interactions between natural and social systems, and human values across temporal and spatial scales, weak and inadequate manpower, and lack of political will to enforce the laws (Esteban, 2008; Farley, Batker, De, and Hudspeth, 2009).

Mangrove-Associated Fauna

Mangrove associated fauna are faunal species found in mangrove ecosystem. Since mangrove ecosystem becomes a nursery and home for different wildlife, a diverse spectrum of fauna is observed in the mangrove community.

Invertebrates comprise approximately 88% of the mangrove faunal density. Particularly, karas (*Hemigrapsus nudus*), or purple shore crab, was the most abundant species found in Leyte Gulf. In total there are 17 species of invertebrates, 5 species of avifauna, 2 species of mangrove associate fish and 2 mangrove reptiles. Observed mangrove fauna were either found in the transect plot or within the mangrove area. Mangrove fauna with economic importance include tuway, banisil, pangti-on, bo-o and mudcrabs. Composition and density of common mangrove fauna in Leyte Gulf municipalities are presented in Appendix B-57.

Mangrove Status Condition

Generally, Leyte Gulf mangrove condition is "Fair". This is due to the low regeneration and barren areas in the middle of mangrove forests dating from the Typhoon Yolanda onslaught. Table 2-9 shows the status of each municipality in Leyte Gulf. Following the guidelines of Deguit et al, 2004, the status of the mangrove sites was assessed.

Table 2-9. Mangrove condition in different municipalities of Leyte Gulf.

Site	Regeneration (count/ha)	Average Height (m)	Crown Cover (%)	Status
Abuyog	0.21	8	38	Fair
Mayorga	0.09	6	6	Poor
Tanauan	0.10	4	11	Poor
Palo	0.35	4	23	Fair
Tacloban	0.50	4	30	Fair
Basey	0.17	7	42	Fair
Marabut	0.21	5	36	Fair
Lawaan	0.18	3	27	Fair
Balangiga	0.10	5	26	Fair
Giporlos	0.04	4	25	Fair
Quinapondan	0.08	2	94	Fair
Salcedo	0.21	3	20	Fair
Mercedes	0.21	3	18	Fair
Guiuan	0.34	3	27	Good

The "Poor" and "Fair" mangrove forest condition in each municipality is directly influenced by the regeneration parameter. Low to moderate regeneration indicates the slow-paced growth of seedlings. The ability of the seedlings and saplings to cover a forest is multifactorial. Seedling growth is dependent on their preferences of substrate and the height of tide.

Mangrove Resource Utilization

Mangroves have been part in the shaping of human civilizations especially in coastal areas. They have been sources of food for daily sustenance and construction materials.

Figure 2-13

Figure 2-14

Figure 2-13 and Figure 2-14 are eco-parks built in mangrove areas. People benefit from these eco-parks as a means of earning a living. Also, it establishes and strengthens ecotourism in the locality. The establishment of eco-parks in mangrove areas was mainly observed in Tacloban City in Leyte Gulf.

Figure 2-15. Harvested nipa fronds.

Though nipa is a mangrove-associated species, it is also harvested by man as shown in Figure 2-15. The large fronds of the nipa palm are harvested and weaved into roofing materials called pawod. The harvesting of nipa fronds was observed in Abuyog, Basey, and Marabut.

Figure 2-16. Mangrove trunks are used as posts for fish cages.

Figure 2-17. Dead mangroves used by locals for fuelwood.

Since Typhoon Yolanda wreaked havoc in Eastern Visayas in 2013, mangrove areas have been heavily damaged. Mangrove areas were greatly affected since they served as natural barriers from the large waves of the storm surge. Up to date, some devastated mangrove areas are still composed of the dead trees and cut branches since the typhoon as shown in Figure 2-16 and Figure 2-17. Some locals cut down portions of these dead trees. They are mainly used as fuelwood in households. The use of dead mangroves as a substitute to commercial fuel has been found to be economical and efficient by locals (K. Garcia, 2013). The cutting and clearing of the devastated areas of these dead trees also help the new generation of mangroves to propagate properly.

Figure 2-18. Debarked R. apiculata.

Mangroves are also harvested for their tannin. Tannins are used as additives or food coloring to the local drink, tuba. Usually, the barok, *Ceriops decandra*, is skinned off for their tannin. However, in some municipalities, since the barok is hard to find or scarce in number, they use other mangroves species as a substitute. Substitute species include Bruguiera gymnorrhiza and Rhizophora apiculata as shown in Figure 2-18. Although they are good substitutes for coloration, some locals report feeling some side effects after drinking.

Threats to Mangrove Ecosystems

Conversion

Some threats to mangrove species are the conversion of mangrove areas into fishponds and/or mud crab farms. The conversion of these mangrove areas thins down the density and cover. The study of Sinfuego and Buot (2014) suggests the degradation of species composition of the mangal forests in Ajuy and Pedada Bays of Panay Island due to mass conversion of area into fishponds and shrimp ponds. According the study, the authors added that the locals are well aware of the potentials of Avicennia, Rhizophora and

Sonneratia for multiple utilizations beneficial to man. If such scenario happens in Leyte Gulf, there would be rampant exploitation of such mangal species, thus, resulting in the decline in species richness. Figure 2-19 and Figure 2-20 were mangrove areas converted to fishponds

Figure 2-19

Figure 2-20

Encroachment

Figure 2-21

Figure 2-22

Encroachment of human settlements towards mangrove areas is one of the major threats observed in different mangrove areas in Leyte Gulf. Figure 2-21. is an example of encroachment in Lawaan and Abuyog where a cement bridge traverses in the middle of the mangrove forests. The bridge connects the barangay to another. Figure 2-22 shows a house within the mangrove area. The house used C. *decandra* as a fence. Some barangays in Abuyog, Basey, Lawaan, Marabut and Tacloban encroach into mangrove areas.

Pollution

These settlements, as mentioned above, also practice improper garbage disposal. As a result, trash accumulates in the mangrove areas, it pollutes, contaminates, and severally detrimental to mangroves.

Trash was observed in mangrove areas of some municipalities in Leyte Gulf. Figure 2-23. is one of the sampling sites in Tacloban City.

Figure 2-23. Trash beside the mangrove area.

Overharvesting

Overharvesting of mangroves includes the debarking of the tree trunk. Removal of excessive bark is detrimental to the tree, consequently killing the whole tree. Rampant harvest was observed in Marabut where during the assessment, the researchers found a day-old debarked. B. gymmnorhiza shown in Figure 2-24.

Figure 2-24. Excessively debarked B. gymmnorhiza.

These threats to mangrove areas are not only an eyesore to the locals but also harms the natural habitat of mangrove associated fauna. The mangal habitat of these mangrove fauna are continually destroyed due to habitat loss and degradation(Tidwell and Allan, 2001), over exploitation(FAO, 2008), coastal degradation and climate change(S. M. Garcia and Rosenberg, 2010), organic pollution and contamination (S. M. Garcia and Rosenberg, 2010; Naylor et al., 2000). As a consequence, food and nutrient for wildlife species becomes scarce and nursery grounds are destroyed due to these disturbances (Rajpar and Zakaria, 2014).

Matarinao Bay

Matarinao Bay is a semi-enclosed 7, 500-has expanse of water, not more than 40m in depth, with a coastline of more than 40 kilometers. The bay is located around 45 km north from the track of Typhoon Haiyan (Japan Meteorological Agency, 2013). The bay mouth opens eastward and dimensions of the bay are around 10 km in the latitudinal direction and 8 km in the longitudinal direction. Width of the bay mouth is around 6 km, and the coastline is fronted by fringing reef with width of around 1500 m on the southern side and 500 m on the northern side of the bay mouth, respectively (Tajima et al., 2016).

Physico-chemical parameters

Many environmental factors, such as, the quality of water and characteristics of the soil, affect the productivity of a mangrove ecosystem (English, 1994). The physicochemical parameters measured were; soil temperature, salinity, pH, and particle size, water temperature, salinity, and pH, as well as air temperature and light penetration.

Table 2-10. Air, water, and soil temperature, soil pH and salinity, water salinity, substrate type, and light penetration in the different sites along Matarinao Bay.

Sites	Temperature (°C)			Light Penetration (lx)	Texture	pH		Salinity (ppt)	
	Air	Water	Soil			Soil	Water	Soil	Water
Quinapondan	26	25	24	3345	Sandy	6.83	8.01	17.54	33.00
Salcedo	28	25	23	3583	Gravel	8.65	7.82	19.49	31.33
GenMac	27	27	26	3195	Gravel	7.04	7.99	19.17	35.00
Hernani	26	26	25	3417	Sandy	7.09	8.00	18.36	32.00

Soil and Water pH

Soil and water pH were measured using Eutech pH meter. The chemical transformation of most nutrients and their availability to plants is influenced by the acidity of the soil and water. Protons tend to be released depending on the pH of the soil and water. An extremely acidic soil tends to lose cations rapidly, which makes the soil relatively poor. On the other hand, the presence of too few protons result in slow release of cations in alkaline soil (Smith, 1980). A suitable condition for mangrove growth has soil and water pH ranging from 6 to 7. Most mangrove soils are well buffered, having a pH ranging from 6 to 7, but some have a pH as low as 5 (English et al., 1997). The recorded soil and water pH of the different municipalities along Matarinao Bay as shown in Table 2-10, is ideal for the growth and development of the different species.

Soil and Water Salinity (ppt)

Mangroves are known to have high tolerance to changing salinities enabling them to grow in the marine and estuarine habitats. They use a combination of salt exclusion, salt excretion, and salt accumulation to avoid heavy salt loads (Kathiresan and Bingham, 2001). Salinity affects the productivity and growth of mangrove forests (Sylla, Stein and van Mensvoort, 1996; Chen and Twilley, 1998) as well as the distribution of species within the ecosystem (Ball, 1998). In general, Kathiresan, Rajendran and Thangadurai (1996), indicated that mangrove vegetation thrives better in lower salinities (25 ppt). Mangrove seedlings require low salinity (Smith, Yang, Kamiya, and Snedaker, 1996), however, their salt tolerance increases as they grow (Bhosale, 1994). Seeds germinate favorably in salinities below 5 ppt and a salinity level of 15 ppt could decrease seedling establishment rate to 37% (Chen and Ye, 2014).

Variance in the water and soil salinity was observed in the mangrove areas along Matarinao Bay. Salcedo has the highest average recorded soil salinity of 23.33 ppt while Quinapondan has the least average soil salinity of 20 ppt. Salcedo has the lowest average water salinity of 24.67 ppt while General MacArthur has the highest average water salinity of

26.5 ppt. The mangrove area in General MacArthur is flooded by tide whereas the low water salinity and high soil salinity in Salcedo could be attributed to encroachment of the stream adjacent to the mangrove ecosystem.

Temperature (^0C)

The recorded air, water, and soil temperature of the sites does not vary greatly. The temperature ranges from 23.33°C – 27.67°C and is within the optimum range (25-30◦C) for growth and development of mangroves (Kara, 2013). Area exposed to sunlight have higher temperatures whereas portions shaded by canopy tend to be cooler (Lim, Morghany, Sviasothi, Ng, Soong and Tan, 2001). Mangroves are intolerant of frost but can withstand air temperatures as low as 5°C. Conversely, there is a tremendous effect in the growth and metabolic processes if the temperatures exceeded 60°C (Saha and Choudhury, 1995).

Light Penetration (lx)

Light is an important factor in the growth of all plants. Mangroves are long-day plants which require high intensity full sunlight; thus, sub-tropical and tropical areas wherein light intensity is high, are ideal habitats for mangroves (Kathiresan and Bingham, 2001). Shade tolerance differs among mangrove species. Some species show good resistance to high sunlight. An example of which is the species Avicennia marina, which could adopt in hot and dry as well as in arid zones. Some species prefer low light shading such as Avicennia germinans (McKee, 1995). However, intense sunlight (Cheeseman et al., 1991) and shading (Koch, 1997) can damage the growth and productivity of the mangrove.

It was observed from the data collected that light penetrates deeper at 3583 lx in the mangrove ecosystem along Salcedo. This could be attributed to the crown diameter of the trees in the area as the majority of the mangroves in Salcedo are still saplings. There is low light penetration (3195 lx) in General MacArthur, specifically in Brgy. Vigan. The majority of the trees found in the area are tall and have wide crown diameter thus shading the lower canopy.

Soil Texture

Sediment is made up of loose particles of sand, silt, and clay. Grain size reflects the nature of the sediments and the hydrodynamic condition of deposition. Generally, erosion prevails towards the seaward reach of the estuary with high wave energy and deposition dominates in the landward reaches of relatively quieter environment. Thus, finer muddy sediments are deposited on the estuarine banks, flanks of the mid channel bars and point bars with low depositional energy (Das, 2015). The majority of the sampling stations have a substrate of sand and gravel ranging from 4000 to 125 microns (Appendix B-2). All areas are however ideal for mangrove growth and development.

Mangrove Cover and Density

Mangrove Cover

Different studies have different estimates of the global mangrove area. Worldwide estimation in 2005 by the Food and Agricultural Organization (FAO) of the United Nations was 157,050 km2 (FAO, 2007) with Southeast Asia as the largest area. On the other hand, Spalding et al. (2010) estimated 152,361 km2, slightly less than the FAO estimate. Giri et al. (2011) gave an even lesser area estimate at 137, 760 km2 with Asia having the largest mangrove extent (42%), followed by Africa (20%), North and Central America (15%), Oceania (12%), and South America (11%).

In 2003, DENR estimated the total area of Philippine mangrove cover to be 247, 362 has. The values were a bit lower compared to the estimated Philippine mangrove cover by Long and Giri in 2011, which was 256,185 has using global Landsat imaging done from 1990-2010.

According to reports, 66 out of 82 (80%) provinces have mangroves, with Palawan having the highest mangrove area of 22.2% of the Philippine total national area. The mangrove areal extent of the provinces of Leyte and Eastern Samar are 5, 807.07 ha and 5, 595.03 ha respectively.

Figure 2-25 shows the total mangrove cover of the different sampling sites along Matarinao Bay. The total mangrove area in Matarinao Bay is 1,260 has with Salcedo having the highest mangrove cover of 605 has. A comparative distribution of mangrove cover per municipality is shown in Table 2-11 and Appendix B-18 to Appendix B-21.

Table 2-11. Distribution of mangrove cover in Matarinao Bay.

Municipality	**Cover (ha)**
Quinapondan	226
Salcedo	605
GenMac	355
Hernani	74
Total	1,260

The high mangrove cover in Salcedo can be attributed to the wide crown diameter of the trees, specifically in Brgy. Caridad, and the Rhizophora apiculata and Avicennia marina planted in the area. On the other hand, the low mangrove cover in Hernani can be attributed to the low crown cover of the trees, specifically in Brgy. Batang. Moreover, most of the mangrove forests in Hernani is rocky and not suitable for mangrove growth.

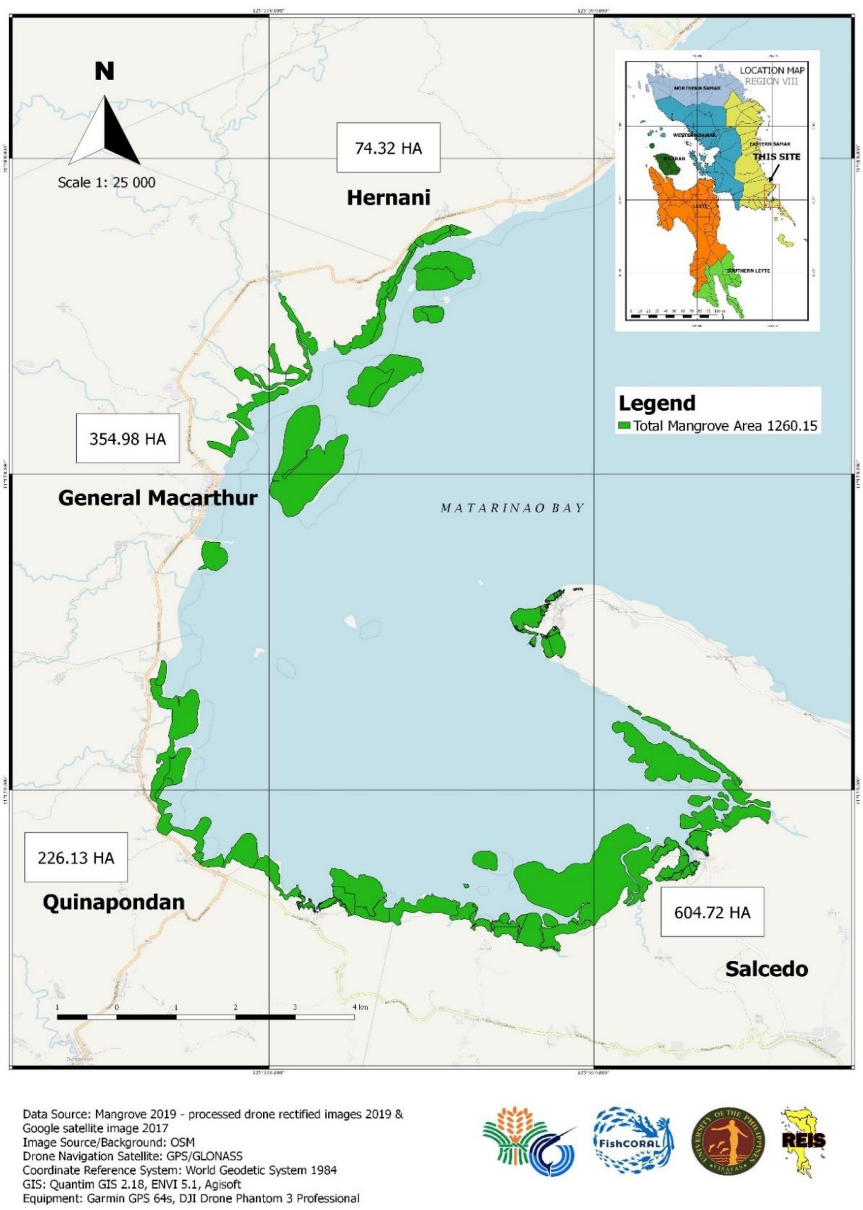


Figure 2-25. Extent of mangrove cover in Matarinao Bay.

Mangrove Density

Density refers to the number of individual mangrove species per unit area. The more trees in the area, the higher the density. Figure 2-26 shows the number of individual mangrove trees per hectare along Matarinao Bay. In general, Matarinao Bay has a tree density of 1,220/ha. Quinapondan has the highest tree density at 1847/ha while Hernani has the lowest density at 477/ha. Summary of mangrove density per stations in each municipality is shown in Appendix B-34.

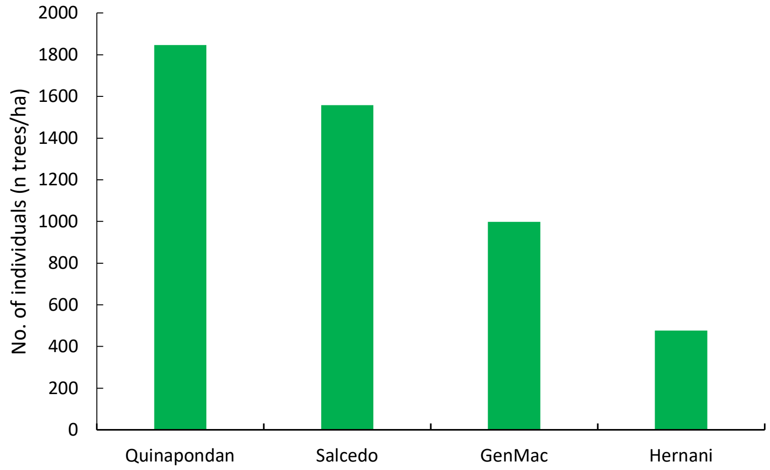
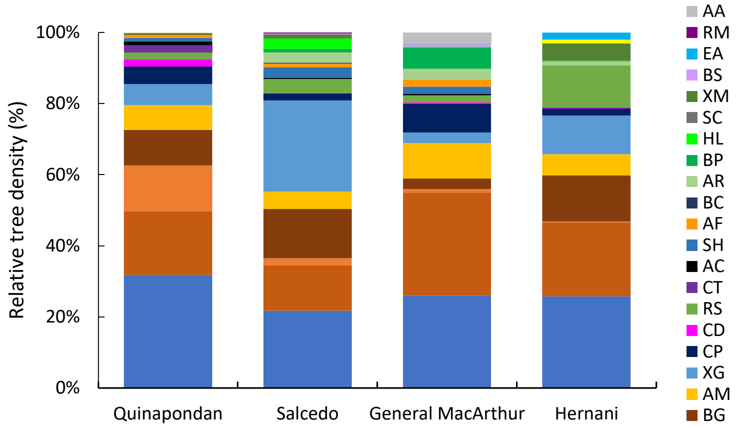


Figure 2-26. Mangrove Tree Density in the different municipalities along Matarinao Bay.

Relative Mangrove Tree Density

Relative density refers to the relative number of each species in percentage in different sampling stations. A. marina, Sonneratia alba, and R. apiculata were observed in all sampling stations. In Quindapondan, 16 species were identified with R. apiculata having the highest density (32%) as shown in Figure 2-27 and Appendix B-38. In Salcedo, Xylocarpus granatrum had the highest density (26%) among the 25 species found in the area. S. alba was the most abundant species (29%) among the 20 species observed in General MacArthur. There were 14 species of mangrove trees identified in Hernani and R. apiculata had the highest density (26%).



Note: AA – *A. alba*, AM – *A. marina*, AR – *A. rumphiana*, CP – *C. philippinense*, LL – *L. littorea*, EA – *E. agallocha*, XG -*X. granatum*, XM – *X. moluccensis*, AC – *A. corniculatum*, AF – *A. floridum*, RA – *R. apiculata*, RM – *R. mucronata*, RS – *R. stylosa*, BG – *B. gymnorrhiza*, BC – *B. cylindrica*, BP – *B. parviflora*, BS – *B. seangula*, CD – *Ceriops decandra*, CT – *C. tagal*, SA – *Sonneratia alba*, SC – *S. caseolaris*, SH – *Scyphiphora hydrophyllacea*, HL – *Heritiera littoralis*

Figure 2-27. Relative Tree Density of each species in different municipalities along Matarinao Bay.

Stand Basal Area

Table 2-12 shows the stand basal area and the diameter at breast height (DBH) of the mangrove trees in each municipality. The DBH of a tree could be used to measure the basal area (m^2) of that specific tree. Basal area is the sum of the cross-sectional area at breast height (usually 1.3 m aboveground) of an individual tree stem approximately weighted to reflect a particular unit area (English et al., 1997). Basal area is directly correlated with an increasing stand growth and age (Temple et al., 1997). In a mangrove ecosystem, a relatively high basal area is an indication of a mature and healthy mangrove community. Moreover, basal area is an important forest measurement which could describe the density of the forest stands by measuring the stand basal area of the mangrove forest (Glover and Barlow, 2009). Stand basal area is simply the cross-sectional area of all the trees at breast height per hectare (m^2/ha).

Table 2-12. Some structural features of mangrove along Matarinao Bay.

Municipality	DBH (cm)	Stand Basal Area (m^2/ ha).
Quinapondan	4.1 – 117	56.73
Salcedo	4.1 – 291	72.37
General MacArthur	4.1 – 102	43.67
Hernani	4.1 – 179	21.25

As observed in Table 2-12, Salcedo has the highest stand basal area at 72.37m^2/ha. This could be attributed to the high number of individual trees per hectare in the area. In addition, it should also be noted that the densest species in Salcedo is X. granatum which has the characteristic of a wide trunk. On the other hand, Hernani had the lowest stand basal area at 21.25m^2/ha. Also, Hernani had the lowest mangrove cover of 74 has and R. apiculata dominated the sampling stations. A thin trunk is one of the characteristics of this species, thus resulting in of the low stand basal area of Hernani.

Community structure

The ecological features, such as species composition, diversity, zonation, relative frequency, relative dominance and important value of the mangrove communities along Matarinao Bay were analyzed in each sampling station.

Species composition

Mangroves are distributed circumtropically, occurring in 112 countries and territories (Katherisan, 2001), including the Philippines. Duke (1992) identified 69 mangrove species under 26 genera in 20 families. In the Philippines, a total of 39 species and 1 variety of mangrove tree distributed in 26 genera and 23 families are known (Fernando and Pancho, 1978; Primavera, 2000). Sebidos and Galinato (1996) observed and documented 25 mangrove species from 16 families in Western Leyte.

Mangroves could be classified into three groups. According to Tomlinson (1986), the major mangroves include 34 species in 9 genera and 5 families while the minor species contribute 20 additional species in 11 genera and 11 families for a total of 54 mangrove species in 20 genera and 16 families. Species recognized as major mangrove possess features, such as, complete fidelity to the mangrove environment, major role in the structure of the community and the ability to form pure stands, morphological specialization that allows them to adapt to the fluctuating environment, physiological mechanism for salt exclusion, and taxonomic isolation from terrestrial relatives. On the other hand, minor species are distinguished by their inability to form a conspicuous element of the vegetation and may occupy peripheral habitats and only rarely form pure communities. In contrast, mangrove associates are never inhabitants of strict mangrove communities and may occur only in transitional vegetation (Tomlinson, 1986).

Table 2-13. Taxonomic composition of mangrove flora in different municipalities along Matarinao Bay.

Mangrove Species	Local Name	Municipality			
		Quinapondan	Salcedo	General MacArthur	Hernani
I. Major species					
Avicennia					
Avicennia alba	Miapi			✓	
A. marina	Pagatpat	✓	✓	✓	✓
A. rumphiana	Miapi		✓	✓	✓
Combretaceae					
Lumnitzera littorea	Tabao	✓	✓	✓	✓
Palmaceae/Arecaceae					
Nypa fruticans	Nipa, sasa		✓	✓	
Rhizophoraceae					
Rhizophora apiculata	Bakhaw-lalaki	✓	✓	✓	✓
R. mucronata	Bakhaw babae		✓		
R. stylosa	Bakhaw bato	✓	✓	✓	✓
Bruguiera gymnorrhiza	Pototan	✓		✓	✓
B. cylindrica	Pototan		✓		
B. parviflora	Pototan	✓	✓		
B. seangula	Pototan	✓	✓	✓	
Ceriops decandra	Barok – barok	✓	✓	✓	✓
C. tagal	Barok	✓	✓		
Sonneratiaceae					
Sonneratia alba	Miapi	✓	✓	✓	✓
S. caseolaris	Pedada		✓		
II. Minor species					
Bombacaceae					
Camptostemon philippinensis	Gapas-gapas	✓	✓	✓	✓
Euphorbiaceae					
Excoecaria agallocha	Lipata		✓		✓
Meliaceae					
Xylocarpus granatum	Tabigi	✓	✓	✓	✓
X. moluccensis	Piag-ao		✓		✓
Myrsinaceae					
Aegiceras corniculatum	Saging-saging	✓	✓	✓	
A. floridum	Saging-saging	✓	✓	✓	
Pteridaceae					

Acrostichum speciosum	Palaypay		✓	✓	
Sterculiaceae					
Heritiera littoralis	Dungon		✓	✓	✓
Rubiaceae					
Scyphiphora hydrophyllacea	Sagasa	✓	✓	✓	
III. Associated species					
Acanthaceae					
Acanthus ebracteatus	Lagiwliw		✓	✓	✓
A. volubilis	Niyo-tiyo		✓		

Table 2-14. Mangrove Species conservation status in Matarinao Bay.

Family	Scientific Name	Common Name	Category
Acanthaceae	*Acanthus ebracteatus*	Lagiwliw	Least concern
	A. volubilis	Niyo-tiyo	Least concern
Arecaceae / Palmaceae	*Nypa fruticans*	Nipa, sasa	Least concern
Avicenniaceae	*Avicennia alba*	Miapi	Least concern
	A. marina	Pagatpat	Least concern
	A. rumphiana	Miapi	Vulnerable
Bombacaceae	*Camptostemon philippinense*	Gapas – gapas	Endangered
Combretaceae	*Lumnitzera littorea*	Tabao	Least concern
Euphorbiaceae	*Excoecaria agallocha*	Lipata	Least concern
Meliaceae	*Xylocarpus granatum*	Lipata tabigi	Least concern
	X. moluccensis	Piag-ao	Least concern
Myrsinaceae	*Aegiceras corniculatum*	Saging-saging	Least concern
	A. floridum	Saging-saging	Near-threatened
Pteridaceae	*Acrostichum speciosum*	Palaypay	Least concern
Rhizophoraceae	*Rhizophora apiculata*	Bakhaw-lalaki	Least concern
	R. mucronata	Bakhaw-babae	Least concern
	R. stylosa	Bakhaw-bato	Least concern
	Bruguiera gymnorrhiza	Pototan	Least concern
	B. cylindrica	Pototan	Least concern
	B. parviflora	Pototan	Least concern
	B. seangula	Pototan	Least concern
	Ceriops decandra	Barok-barok	Near-threatened
	C. tagal	Barok	Least concern
Sonneratiaceae	*Sonneratia alba*	Miapi	Least concern
	S. caseolaris	Pedada	Least concern
Rubiaceae	*Scyphiphora hydrophyllacea*	Sagasa	Least concern
Sterculiaceae	*Heritiera littoralis*	Dungon	Least concern

A total of 27 species belonging to 13 families were identified in Matarinao Bay. Table 2-13 and Appendix B-44 show the taxonomic composition of the mangrove flora in Matarinao Bay. The five major families all have representative species in each sampling station except in Quinapondan and Hernani wherein N. fruticans was not observed. A total of 16 major species under 5 families, 9 minor species under 7 families, and 2 mangrove associates under one family was observed in Matarinao Bay. The difference in the number of major and minor species may be due to the different sampling stations chosen. The species composition of the forest depends on many factors in which water inundation, nutrients, and soil type are the most essential (Calumpong and Menez, 1997).

To address the global rapid decline of mangrove areas, species-specific information on global distribution, population status, life history traits, and major threats were compiled for each of the 70 known species of mangroves worldwide (Polidoro et al., 2010). Each species' probability of extinction was assessed under the Categories and Criteria of the IUCN Red List of Threatened Species. Table 2-14 shows the assessment of mangrove species found in Matarinao Bay based on the IUCN Red List Categories (Duke et al., 2010).

In Matarinao Bay, there is one endangered species, Camptostemon philippinense which is endemic to the Philippines; one vulnerable species, Avicennia rumphiana; two near-threatened, Aegiceras floridum and Ceriops decandra; and 23 least concern species under 13 families.

Diversity and Taxa Evenness

Species diversity is used as one of the indices to describe community structure. A measure of both species' richness, which is a measure of the number of species in the community, and evenness, which indicates the relative distribution of the community is termed as diversity. A community with a higher diversity values means many equally or nearly equally abundant species are present (Smith, 1980).

In this study, two common indices were used to measure community diversity, Simpson's Index (D) and Shannon-Weiner Index (H). In the Simpson Index, if there is a high probability that the two individuals drawn at random from a population belong to the same species, then the diversity of the community sample is low. The value of (D) ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity. Index (H) varies greatly with the degree of species diversity, such that higher (H) means a greater diversity of species (Ludwig and Reynolds, 1988). Another index is used to measure evenness, the J' of Peilou. J' expresses H' relative to the maximum value that H' can obtain when all the species in the sample are perfectly even with one individual per species (Ludwig and Reynolds, 1988). The lower the J', the lesser evenness in communities between the species.

Table 2-15 compares the species diversity and evenness of the different municipalities along Matarinao Bay. Among the municipalities, General MacArthur had the highest diversity index at 1.04 (H), 0.85 (D) and highest evenness index at 0.35. On the other hand, Quinapondan had the lowest diversity and evenness index at 0.58 (H), 0.83 (D), and 0.21, respectively. The low evenness in Quinapondan could be attributed to the high relative density of R. apiculata (32%).

Table 2-15. Species diversity and evenness at the different municipalities along Matarinao Bay.

Municipality	**Shannon-Weiner Index (*H*)**	**Simpson's Index (D)**	**Evenness (J')**
Quinapondan	0.58	0.83	0.21
Salcedo	1.02	0.84	0.31
General MacArthur	1.04	0.85	0.35
Hernani	0.88	0.84	0.33

Species Dominance and Importance

Organisms which could control or influence biologically the nature of a community are called dominants (Smith, 1980). Dominance in mangrove forests is measured by its biomass. However, to determine the overall estimate of the influence or importance of a species in the forest, the importance value of each species should be considered. The importance value of a dominant species could be calculated by getting the sum of its relative frequency, relative density, and relative dominance. In all municipalities, S. alba was the most influential species having the highest importance value (Appendix B-47 and Appendix B-48).

Mangrove Zonation pattern

Zonation can be a structural feature of mangrove forests (Smith, 1992). The zonation pattern describes the pattern of occurrence of the different species in a particular site. It shows the arrangement and distribution in zones of the different species (Sebidos and Galinato, 1996). Using this as a guide in mangrove reforestation makes it easier to determine which species are suitable to be rehabilitated in a particular habitat. In addition, mangrove association and zonation are usually determined by tidal elevation (Primavera et al., 2012).

The standard zonation pattern of mangrove communities found commonly in the Philippines has A. marina and S. alba found in the seaward region (Figure 2-28). Some mangrove species under families Avicenniaceae, Myrsinaceae, and Rhizophoraceae such as A. alba, A. *floridum*, R. *apiculata*, and B. *cylindrica*, are situated in the middle zone. On the other hand, dominant species in the landward zone are: species under families Arecaceae such as N. fruticans, Combretaceae such as L. littorea, Euphorbiaceae such as E. agallocha, Meliaceae such as X. *granatum*, Rhizophoraceae such as C. tagal, and H. littoralis under family Sterculiaceae (Agaloos, 1994).

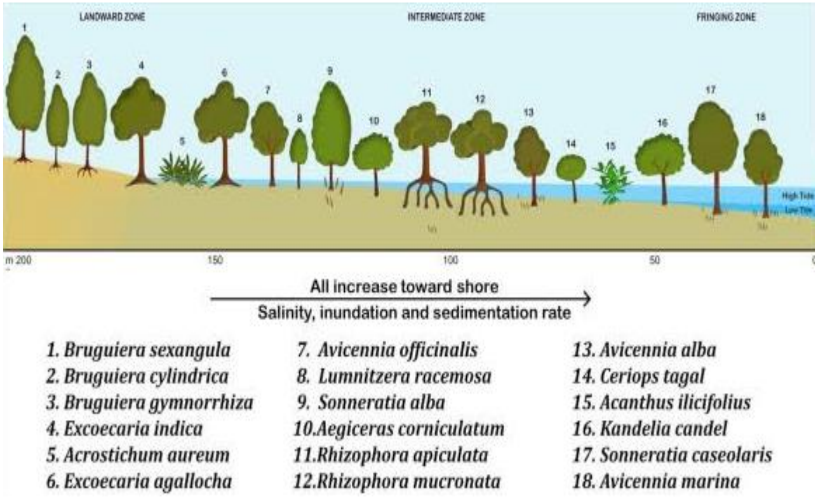


Figure 2-28. Standard zonation pattern of mangrove community (Sreelekshmi et al. 2018).

In all sampling stations, no general zonation pattern was observed. Each species could be found in any zone and varies from one station to the other. However, A. marina was highly observed in the frontage (seaward) and R. *apiculata* was dominant in the middle zone which is similar to the standard zonation pattern of mangrove communities found in the Philippines (Agaloos, 1994). However, high elevation species such as Bruguiera gymnorrhiza and Heritiera littoralis were found in the landward zone.

Potential causes of mangrove zonation are the differential ability of propagules to establish at different tidal heights (Kathiresan, 1999) and the interspecific differences in tolerance for physiological stress.

Regenerative capacity

The ability of a mangrove community to continue growing could be measured directly through its regenerative capacity. There is a high probability of sustaining its existence if the seedlings and saplings are more than 50% of the mature trees. This could be measured by dividing the number of seedlings with the number of mature trees left undisturbed. The regenerative capacity of a mangrove forest could be used as a basis by the local community to determine if there is a need to rehabilitate or enhance the condition of the forest. Calculating the regenerative capacity of the mangrove forests along Matarinao Bay was considered insignificant since all the sampling stations were observed to have records of reforestation. Figure 2-29 and Appendix B-52 display the seedling-sapling ratio of each municipality and Table 2-16 shows the natural stand and records of reforestation in each municipality. Figure

2-30 shows the percentage of dead and alive trees in each municipality and Appendix B-55 with sites per municipality. Hernani had the highest number of dead mangroves, higher than the alive trees in the area. This could be attributed to the large areas with dead mangroves trees which are still remnants of Super Typhoon Yolanda. If not denuded immediately, trees could not grow naturally in the area.

Table 2-16. Records of natural stand and reforestation in each municipality along Matarinao Bay.

Municipality	Natural Stand	Records of Reforestation
Quinapondan	✓	✓
Salcedo	✓	✓
GenMac	✓	✓
Hernani	✓	✓

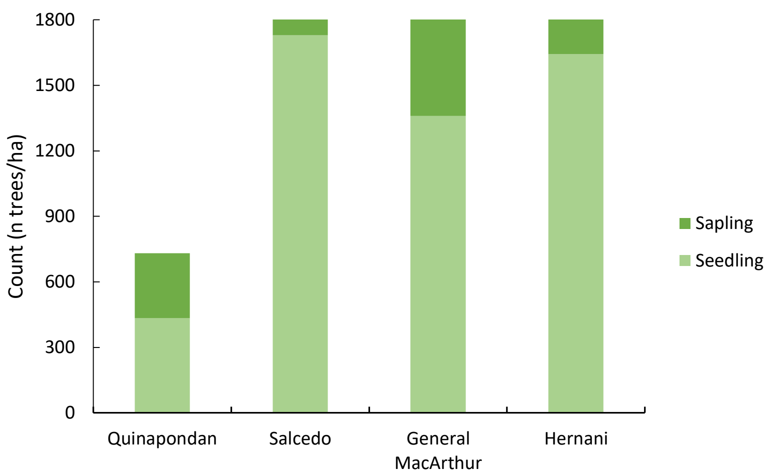


Figure 2-29. Number of seedling and sapling per hectare in each municipality along Matarinao Bay.

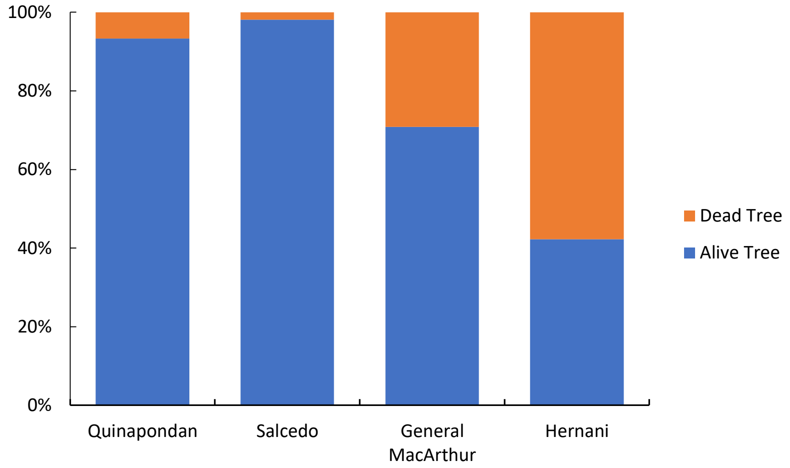


Figure 2-30. Number of dead and alive trees per hectare in each municipality along Matarinao Bay.

Mangrove-Associated Fauna

The muddy or sandy sediments of the mangrove forests may be home to a variety of epibenthic, infaunal, and meiofaunal invertebrates. The most successful benthic species in the mangal are those that can adapt to the salinity and temperature stresses that are characteristics of these environments (Ferraris et al., 1994). The major faunal residents of mangrove forests along Matarinao Bay are the mollusks and crustaceans such as banisil, tuway, and mud crabs, found in the muddy substratum and on the prop roots and trunks of the trees (Appendix B-58). These organisms are harvested by the residents for daily consumption and also to augment their income.

Figure 2-31. Banisil (Faunus ater).

Mangrove Status Condition

The condition of a mangrove forest could be assessed using regenerative capacity, average height, and crown cover as parameters. A mangrove forest could have an excellent, good, fair, or poor status based on the criteria used by Deguit et al. in 2014. The average mangrove condition of Matarinao Bay is fair. This could be attributed to the reforestation projects in the stations. Table 2-17 shows the status of each municipality in Matarinao Bay.

Table 2-17. Mangrove condition in different municipalities along Matarinao Bay.

Site	Regeneration (%/m2)	Average height (m)	Average crown (%)	Status
Quinapondan	0.003	6.79	42.01	Fair
Salcedo	0.01	11.03	29.18	Fair
General MacArthur	0.003	8.26	20.34	Fair
Hernani	0.01	12.88	13.09	Fair

Mangrove Resource Utilization

Mangrove forests provide livelihood and services to adjacent coastal communities. Local residents depend on mangrove trees and palms for fuelwood, tannin, timber, local wine and other products. Mangrove forests also serve as resource for food such as fish, shrimps and crabs and mollusks. These resources are also sold in the local market to increase income. Some mangrove forests, however are converted for industrial and domestic purposes.

Figure 2-32. Mangrove forest in Capopocanan Islands with dead mangrove trees.

Mangrove utilization was observed in all stations. A random survey was done in the coastal communities near the mangrove wetlands to determine how mangrove resources are utilized along Matarinao Bay.

Wood for firewood and poles could be derived from mangrove forests. Cutting of dead mangroves and using it as fuelwood is practiced in the Barangays of Hernani. In Brgy. San Miguel, branches and trunks are used for the construction of houses and in making fish pens and fishing posts.

Figure 2-33. Traps set in the deeper part of the rivers adjacent to mangrove area.

Encroachment in mangrove forests were visible in Brgy. Matarinao, Brgy Naga, and Brgy. Abejao wherein houses were built at the center of the mangrove forest or along the no build zone area. In Brgy. Caridad, an ecopark was built traversing the mangrove forest's length from the sea to the land.

Figure 2-34. Mangrove Eco Park in Brgy. Caridad, Salcedo eastern Samar.

Residents near the mangrove forests utilize edible shellfish (mollusks). In Brgy. Caridad, mud crabs are being harvested by some local fishers with the use of traps set known as bobo in the deeper parts of the rivers adjacent to mangrove areas and in channels that cut through the mangrove forest. In Brgy. Naga, Faunus ater, commonly known as banisil is highly utilized as food especially when fish is scarce during bad weather. Tuway is consumed as food and sometimes sold to augment their income in Brgy. San Miguel, Brgy. Vigan, and in Brgy. Anahao and Capopocanan Islands.

The mangrove forest in Brgy. Abejao is not highly utilized by the local residents because of the fear of crocodiles sited around the area. Reforestation was observed in the stations. Specifically, in Brgy. Caridad, Salcedo Eastern Samar, there is a mangrove reforestation of R. apiculata and A. marina. The saplings were planted 97 meters along seashore. There is also mangrove reforestation in Brgy. Batang Hernani Eastern Samar.

Figure 2-35. Mangrove reforestation in Brgy. Batang Hernani Eastern Samar.

Threats to Mangrove Ecosystems

According to Feller and Sitnik (2006), 75% of the world's tropical coastlines used to be dominated by mangroves. Unfortunately, due to excessive human activities in the coastline zone, mangrove extent has been significantly reduced. Anthropogenic activities which may have negative impacts to the mangrove forest such as pollution due to improper waste management, conversion of mangrove forest to private land, human encroachment or settlements, and overharvesting, were observed in the sampling stations in Matarinao Bay.

Pollution

The presence of a community beside the mangrove area, specifically in Brgy. Buenavista, Brgy. Naga, Brgy. Abejao, and Brgy. Matarinao and improper solid waste disposal could pose a problem to the mangrove ecosystem. Being adjacent to communities makes mangrove forests a dumping site of wastes. These wastes results in organic pollution and contamination (Garcia and Rosenberg, 2010; Naylor et al., 2000) which harm both the mangrove ecosystem and the species living in it. A large volume of rubbish in tidal channels can be detrimental to near-shore habitants and can also inhibit tidal flushing leading to increase in salinity levels which in turn stresses the mangrove habitat. However, an adjacent community need not necessarily be detrimental to the mangrove forest. In Brgy. Caridad, even though there are residential houses near the mangrove ecosystem, improper waste management was not observed due to the strict implementation of ordinances since the mangrove forest was also an Eco park.

Figure 2-36. Informal settlers in Matarinao, Salcedo E. Samar.

Conversion

The major threats to the mangrove area have been urban development, aquaculture, mining, (Alongi, 2012) as well as continuous human pressure like conversion to settlements and other uses. One major cause of dwindling mangrove forest is its conversion to an aquaculture site since it is situated along the coastline or estuaries. The establishment of ponds result in loss of important ecological and socio-economic functions of the mangrove ecosystems, change in hydrology, salinization, introduction of non-native species and diseases, and pollution of effluents. A study by Sinfuego and Buot in 2014 suggested that the degradation of species composition of the mangal forests in Ajuy and Pedada Bays in Panay Islands was due to mass conversion of mangrove areas into fishponds and shrimp ponds. In Matarinao Bay, there is no recorded aquaculture near or situated in mangrove forest zones. The aquaculture sites are situated approximately 300 m away from the mangrove forest such as the one in Brgy. Caridad. One major threat found in Matarinao Bay is the conversion of the mangrove forest into private land, specifically in Anahao and Capopocanan Islands. As shown in Figure 2-37, trees were cut down in order to clear the area for the establishment of a structure.

Figure 2-37. Mangrove area converted to private land in Anahao and Capopocanan Islands, General MacArthur Eastern Samar.

Human encroachment/settlements

At present, the mangrove forests of Matarinao Bay are facing another threat common to other Bays, human encroachment or settlements. In Brgy. Naga and Brgy. Matarinao, houses were built inside the mangrove forest by denudation of mangroves around the area. Human encroachment on coastal ecosystems and competition of land for agriculture, infrastructure and tourism are among the major causes of reported decrease in mangrove forest areas over time. Continued human encroachment can lead to alteration of forest structure and species composition.

Overharvesting

Mangrove trees provide fuel wood, lumber for construction, and tannin. Dead trees are commonly used as fuel wood. However, some cut down live trees for fuel as well as for lumber. This excessive cutting results in the reduction of the density and diversity of a mangrove stand. Tannins are used as additives or food coloring to a locally know alcoholic drink “tuba” and is obtained by skinning off the mangrove trunk. The common species exploited for tannin is Barok, scientifically known as C. decandra. Excessive debarking leads to the death of the tree. In some mangrove forests where C. decandra is scarce to none, other mangrove species is used as a substitute. Substitute species include B. gymnorrhiza and R. apiculata. This is the case in Brgy. Buenavista, Quinapondan where B. gymnorrhiza where debarking is evident.

Maqueda Bay

Maqueda Bay is a 650 km2 semi-enclosed body of water with average depth of 14 m at around 33 % of the total area while the deeper portion (i.e. 21-28 meters) make up 18 % of the area. The current patterns and water circulation of the bay is generally influenced by the prevailing wind direction (i.e. southwesterly from April to August and northeasterly from October to March). Wind borne water masses coming from Carigara Bay and Samar Sea determine the general water circulation. The coastal fringe is characterized by extensive multi-species of seagrasses and mangroves covering an estimated area 8, 476.6 has. Rock and a patchy reef formation line the islands in Maqueda Bay that constitute only about 5 % of the total area of the bay (Diocton, 1999).

Physicochemical Parameters

In order for a mangrove community to continuously sustain its biophysical processes, environmental factors surrounding the community must be suitable for their growth and development. These factors which include sediment type, soil and water salinity, temperature and light intensity penetrating into the mangrove forest, are important in maintaining the stability of the ecosystem. Table 2-18 shows the summary of the physicochemical conditions of the different sampling stations around Maqueda Bay.

Municipality/		**Salinity (ppt)**		**pH**		**Temperature(ºC)**		**Light**
City	**Soil Texture**	**Soil**	**Water**	**Soil**	**Water**	**Air**	**Water**	**Intensity (lx)**
Calbiga	Medium sand	19	32	8	6	27	31	4325
Catbalogan	Medium sand	24.67	33	6.99	6.6	32	31	5361
Daram	Medium sand	19	40	7.13	6.6	35	33	1280
Jiabong	Medium sand	22.92	36	6.38	7	34	33	6154
Motiong	Medium sand	21.17	35	6.78	6.9	28	31	2423
Paranas	Granule	18.37	29	7.14	6.2	29	30	7800
Pinabacdao	Medium Sand	21	35	6.87	6.4	30	33	4568
San Sebastian	Medium sand	24.25	37	6.98	6.6	31	34	8732
Talalora	Medium sand	22.11	36	7.59	6	35	33	7286
Villareal	Medium sand	25.75	35	7.27	6.4	29	32	7800
Zumarraga	Medium sand	18.50	36	7.58	6.2	33	35	4378

Table 2-18. Physicochemical parameters measured in different sampling stations around Maqueda Bay.

Soil and Water pH

Soil and water pH are measures of the acidity and alkalinity in soils and water which pH ranges from 0 to 14, with 7 being neutral, below 7 is acidic and above 7 is alkaline. It also corresponds to the concentration of free protons in the soil and water. In soils, extreme acidity tends to loss of cations leading to poor soil condition. The soil and water values for pH in the surveyed mangrove areas ranges from 6-7, a condition suitable for mangrove growth. Additionally, according to Lim (2001), mangrove soils are of this range because of the acidic clays or the presence of Sulphur-reducing bacterial agents. Nevertheless, as shown on Table 2-18, the soil and water pH of the different sites along Maqueda Bay have pH values within the suitable range ideally favoring growth of different mangrove species.

Soil and Water Salinity (ppt)

Mangroves thrive along coastal saline environment. They are considered as salt tolerant; however, the level of tolerance relatively varies among species. Spalding et al. (1997) observed that a mangrove community is affected by the levels of salinity in soils and in surrounding water. Kathiresan (2000) observed that mangrove vegetations seem to be luxuriant on areas with lower soil and water salinity, particularly landward. This is why zonation patterns are very much observable on some sites where salt-loving species such as S. alba and A. marina are observed seaward and a more diverse mangrove flora landward. Mangroves thrive along an environment with salinity values ranging between 15 to 35 ppt (Uwadiae et al., 2009).

In Maqueda Bay, soil and water salinity vary among different sampling stations shown in Table 2-18. The sampling site with the highest value for water salinity is Daram with 40 ppt while the site with the lowest water salinity was in Paranas with 29 ppt. The municipality of Daram is characterized as two islands that lies within the western part of Samar Sea and the Zumarraga Channel which is always inundated by higher water tides (Diocton, 1999). The Paranas sampling station, on the other hand is directly bounded to rivers and drainage systems that contribute to fresh water inputs.

Soil texture

Soil texture pertains to the relative proportion of silt, sand and clay present in the soil. Natural soils especially on mangrove ecosystems are comprised of varying soil particles. This component is important as it will determine the extent and limitations of water intake rates, aeration of specialized root systems of mangroves and soil fertility. The majority of the sampling sites in this study have substrate of medium sand. Only Paranas is composed of a granule-type substrate. Nevertheless, substrate containing higher sand particles and silt are ideal factors for mangrove growth and development (Clough, 1992). Grain size categorization of mangrove sediments in every municipality is summarized in Appendix B-3.

Temperature (^{0}C)

The temperature requirement in mangrove communities usually varies with species. In general, the temperature required for optimal growth of mangrove species ranges from 18^{0}C to 36^{0}C. In the different sampling stations, temperature ranged from 28^{0}C-35^{0}C. It is well within the optimum temperature required for mangrove growth and development. Extreme temperatures exceeding 60^{0}C have tremendous effects on the mangrove species and its metabolic processes (Saha and Choudhurry, 1995). Ideally, areas exposed to sunlight have higher temperatures and portions shaded by canopy tend to be cooler. Mangroves are also intolerant of frost, but can tolerate air temperatures as low as 5°C (Lim, 2001).

Light Intensity (lx)

Mangroves are intertidal plants widely distributed in sub-tropical and tropical environments where light is abundant and at higher intensity. The photosynthetic rates of these plants tend to be affected at relatively low light intensity. Additionally, intense sunlight (Field, 1995), and shading (Koch, 1997) can damage the growth and productivity of the mangrove. Light tolerance and absorbance differ among mangrove species. Some can tolerate higher light intensity such as A. marina whereas some can only tolerate low light such as A. germinans (McKee et al., 2002).

Along the coasts of Maqueda Bay, it was observed that light penetrates deeper in the mangrove ecosystem of San Sebastian (8732 lx). Though San Sebastian was observed to have high tree canopy, spatial separation of trees from one another can be the reason why light was able to penetrate deeper allowing shrubs to absorb some of it. On the other hand, low light penetration was observed in the sampling stations established in Motiong with light penetration of 2423 lx and Daram with 1280 lx. The majority of the trees found in these areas are tall, and have high crown diameter thus shading the lower canopy.

Mangrove Cover and Density

Mangrove Cover

According to Long and Giri (2010), the world's mangrove forest as of 2000 is estimated at roughly 137,760 km2, which is equal to 13, 776, 000 has. The largest extent of mangrove forests is found in Asia (42%) followed by Africa (20%), North and Central America (15%), Oceania (12%) and South America (11%). Additionally, 75 % of the world's mangrove forests is concentrated in just 15 countries. In the Philippines, a total mangrove cover of 256, 185 has was estimated since the year 2000. This is minimally higher compared to the previous estimates conducted by FAO (2005).

The data gathered in the Maqueda Bay mangrove assessment study revealed a total mangrove cover of 2, 056 has. The municipality of San Sebastian has the highest mangrove cover with 500 has while Zumarraga has the lowest with only 1.2 has. Figure 2-38 shows the map of Maqueda Bay with the mangrove area. A comparative distribution of mangrove per municipality is shown in Table 2-19 and illustration in maps per municipality is shown in Appendix B-22 to Appendix B-32.

Comment [AA1]: appendix

Table 2-19. Distribution of mangrove cover around Maqueda Bay.

Municipality	Mangrove Cover (ha)
Calbiga (CAL)	425.06
Catbalogan (CAT)	26.78
Daram (DAR)	6.99
Jiabong (JIA)	69.14
Motiong (MOT)	24.29
Paranas (PAR)	355.14
Pinabacdao (PIN)	340.93
San Sebastian (SAN)	500.38
Talalora (TAL)	46.99
Villareal (VIL)	259.80
Zumarraga (ZUM)	1.21
	Total: 2, 009 has.

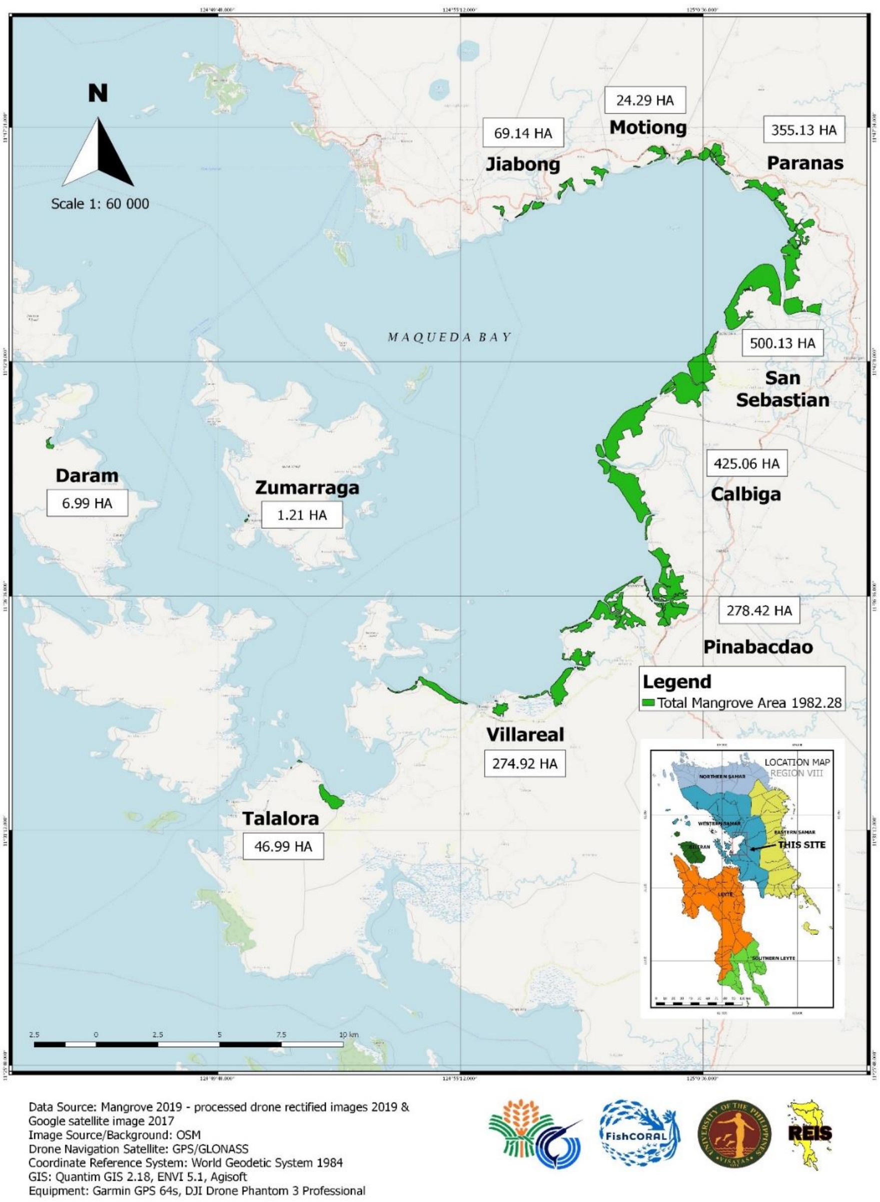


Figure 2-38. Mangrove cover of Maqueda Bay.

Mangrove Density

Density refers to the number of individual mangrove species sampled per hectare. Generally, the higher the value for density, the denser the mangrove forest is. Mangrove forests with high density have high soil surface accretion, positive elevation change, and tree survival especially in coastal areas susceptible to sea-level rise (Kumara et al., 2010). Additionally, high density conditions can also improve mangrove growth and facilitate faster stand regeneration (Gedan and Silliman, 2009). Maqueda Bay in general has an average mangrove tree density value of 950 number of individuals per hectare sampled. Figure 2-39 shows that the sampling station in Daram is the densest mangrove area with a total number of 1,600 individuals per ha. while the sampling station established in Pinabacdao is the least dense with a total number of 550 individuals per ha. Appendix B-35 summarizes the tree density of mangrove tree species across different sampling stations in Maqueda Bay.

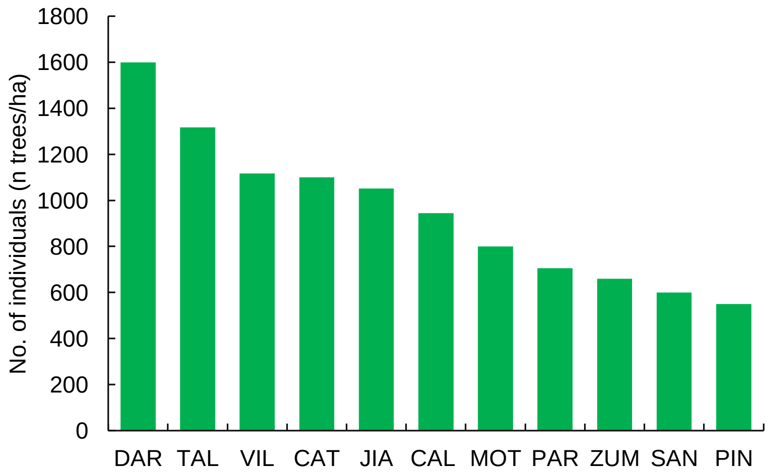
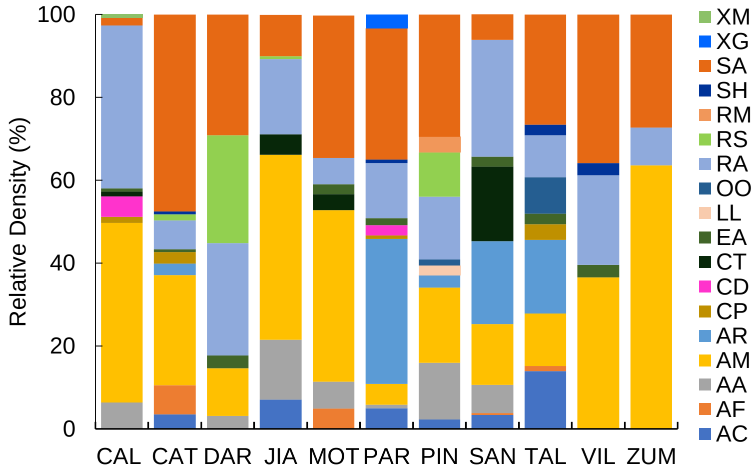


Figure 2-39. Density of mangrove species across different stations in Maqueda Bay.

Relative Mangrove Tree Density

Figure 2-40 shows the relative density of the different species of mangrove tree at the different sampling sites along Maqueda bay. Relative density refers to the relative number in percentage of each species in different sampling stations. All of the sampling sites were observed to have Avicennia marina, Sonneratia alba, and Rhizophora apiculata. The mangrove species A. marina was observed in all of the sampling sites with the highest relative density in Zumarraga (63.63%) and lowest in Paranas (5%). Along with A. marina that was observed in all sites is also a frontier species S. alba that has the highest relative density in Villareal with 35.8% and lowest in Calbiga with 1.9%. Additionally, R. apiculata is relatively densest in Calbiga (39.32%) and is least in Motiong (6.3%). Only Calbiga was observed with Xylocarpus mollucensis (1.14%), a mangrove species thriving nearest to land in a mangrove community. Catbalogan City has 14 species with S. alba having the highest relative density (47.45%). Relative tree density per site per municipality is shown in Appendix B-38 and Appendix B-39.



Note: XM-*Xylocarpus* moluccensis,XG-*Xylocarpus granatum*, SA-*Sonneratia alba*, SH-*Scyphiphora hydrophyllacea*, RM-*Rhizophora mucronata*, RS-*Rhizophora stylosa*, RA-*Rhizophora apiculata*, OO-*Osbornia octodonta*, LL-*Lumnitzera littorea*, EA-*Excoecaria agallocha*, CT-*Ceriops tagal*, CD-*Ceriops decandra*, CP-*Camptostemon philippinenses*, AR-*Avicennia rumphiana*, AM-*Avicennia marina*, AA-*Avicennia alba*, AF-*Aegiceras floridum*, AC-*Aegiceras corniculatum*

Figure 2-40. Relative density of the different species of mangroves across sampling sites in Maqueda Bay.

Stand Basal Area

Stand basal area is the summation of the cross-sectional area at breast height (usually 1.3 m aboveground) of an individual tree stem approximately weighted to reflect a particular unit area. In a study conducted by Saha and Choudhury (1995) in tropical rain forests, basal area is directly correlated with an increasing stand growth and age. In mangrove ecosystems, a relatively high stand basal area is an indication of a mature and healthy mangrove community. San Sebastian has the highest DBH range of 4 - 191 cm and stand basal area of 87.44 m2/ha. Trees inside the fringing mangrove community are mostly *S. alba* and *Avicennia* species which are also trees of larger girth and corresponding DBH indicative of a higher stand basal area value (Dangan-Galon et al., 2016). DBH and stand basal area of different municipalities are shown in Table 2-20.

Table 2-20. Structural features of mangroves around Maqueda Bay: DBH stands for Diameter at Breast Height, Stand basal area.

Municipality	DBH range (cm)	Stand basal area (m^2/ha)
Calbiga	4.1-16	3.07
Catbalogan	4.1-103	48.00
Daram	4.1-27	13.76
Jiabong	4.1-88	57.69
Motiong	4.1-104	74.24
Paranas	4.1-66	22
Pinabacdao	4.1-31	6.83
San Sebastian	4.1-191	87.44
Talalora	4.1-47	21.06
Villareal	4.1-64	38.03
Zumarraga	4.1-19	5.04

Community Structure

Species Composition

According to Serrano and Fortes (1987), there are 83 species of mangroves distributed all throughout the world. This number of plant species is composed of trees, shrubs, palms and ferns. Tomlinson (1986) classified mangroves as major, minor and associates. Major species are those that have complete fidelity to mangrove area and never extend into terrestrial communities. Minor species are identified by their inability to form a conspicuous component of the vegetation and are occurring on peripheral habitats. On the other hand, associate mangroves are not the regular inhabitants of mangrove community and are also found in terrestrial zones. According to Tomlinson (1987), there are 54 mangrove species in 20 genera, 34 species of which are major in nine genera and five families, and 20 are minor species in 11 genera and 11 families. The Philippine mangrove forest is one of the most biologically diverse mangrove ecosystems in the Indo-Pacific region (Alongi, 2002). The archipelago harbors 39 mangrove species distributed in 23 families and 26 genera (Fernando and Pancho, 1980)

During the Maqueda Bay mangrove assessment, a total of 24 mangroves composed of 12 major species, 9 minor and 3 associates were recorded. All of the 24 mangrove species recorded were observed in Pinabacdao (Table 2-21, Appendix B-45).

Table 2-21. Taxonomic composition of mangrove flora around Maqueda Bay.

Mangrove Species	Local Name	Municipality										
		CAL	CAT	DAR	JIA	MOT	PAR	PIN	SAN	TAL	VIL	ZUM
I. Major Species												
Avicenniaceae												
Avicennia alba	miapi	✓		✓	✓	✓	✓	✓	✓			
A. marina	miapi	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A. rumphiana	miapi	✓	✓				✓	✓	✓	✓		
Arecaceae (form. Palmae)												
Nypa fruticans	nipa, sasa	✓	✓		✓			✓	✓		✓	
Combretaceae												
Lumnitzera littorea	tabao, kulasi							✓				
Rhizophoraceae												
Bruguiera gymnorrhiza	pototan	✓						✓				
Ceriops decandra	baras-baras	✓					✓	✓				
C. tagal	tungog, tangal	✓			✓	✓		✓	✓			
Rhizophora apiculata	bakhaw lalaki	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
R. stylosa	bakhaw bato	✓	✓	✓				✓				
R. mucronata	bakhaw babae							✓				
Sonneratiaceae												
Sonneratia alba	pagatpat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
II. Minor Species												
Bombacaceae												
Camptostemon philippinenses	gapas-gapas	✓	✓					✓		✓		
Euphorbiaceae												
Excoecaria agallocha	lipata	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Lythraceae												
Pemphis acidula								✓				
Meliaceae												
Xylocarpus granatum	tabigi	✓					✓	✓				
X. mollucensis	piag-ao	✓						✓				
Myrsinaceae												
Aegiceras corniculatum	saging-sanging	✓	✓		✓		✓	✓	✓	✓		
A. floridum	saging-saging		✓	✓		✓		✓	✓	✓		
Myrtaceae												
Osbornia octodonta	tawalis							✓		✓		
Rubiaceae												
Scyphiphora hydrophyllacea	Nilad	✓	✓				✓	✓		✓	✓	
II. Associated species												
ACANTHACEAE												
Acanthus ebracteatus	lagiwliw	✓	✓					✓				
A. ilicifolius	lagiwliw	✓	✓					✓	✓			
A. volubilis	lagiwliw	✓	✓					✓				
Total no. of species		19	14	7	7	7	10	**24**	11	10	6	3

To address the global rapid decline of mangrove areas, species-specific information on global distribution, population status, life history traits, and major threats were compiled for each of more than 80 known species of mangroves worldwide (Serrano and 1987). Along the coast of Maqueda Bay, there is one endangered species, C. philippinense that is endemic to the Philippines, one vulnerable species, A. rumphiana, two nearly-threatened, A. floridum and C. decandra, and 21 least concern species. Table 2-22 shows the assessment of mangrove species found in Maqueda Bay based on the IUCN Red List Categories.

Table 2-22. Mangrove conservation status in Maqueda Bay.

Mangrove Species	Status
I. Major species	
Avicenniaceae	
Avicennia alba	Least concern
A. marina	Least concern
A. rumphiana	Vulnerable
Arecaceae (form. Palmae)	
Nypa fruticans	Least concern
Combretaceae	
Lumnitzera littorea	Least concern
Rhizophoraceae	
B. gymnorrhiza	Least concern
Ceriops decandra	Near-threatened
C. tagal	Least concern
Rhizophora apiculata	Least concern
R. stylosa	Least concern
R. mucronata	Least concern
Sonneratiaceae	
Sonneratia alba	Least concern
II. Minor Species	
Bombacaceae	
Camptostemon philippinense	Endangered
Euphorbiaceae	
Excoecaria agallocha	Least concern
Lythraceae	
Pemphis acidula	Least concern
Meliaceae	
Xylocarpus granatum	Least concern
X. mollucensis	Least concern
Myrsinaceae	
Aegiceras corniculatum	Least concern
A. floridum	Near threatened
Myrtaceae	
Osbornia octodonta	Least concern

Rubiaceae	
Scyphiphora hydrophyllacea	Least concern
III. Associated species	
Acanthaceae	
Acanthus ebracteatus	Least concern
Acanthus ilicifolius	Least concern
Acanthus volubilis	Least concern

Source: www.iucnredlist.org

Diversity and Taxa Evenness

The mangrove community situation can be evaluated through species diversity. Diversity sometimes termed as species heterogeneity, is a measure of both species' richness (the number of species present in a particular community) and evenness (the relative abundance of the different species) (Yeom and Kim, 2011). A mangrove community is said to be diverse, if there exists many equally or nearly equally abundant species. Relatively high species diversity is always correlated with community stability, the ability of a community to be undisturbed by disturbance of its components such as herbivory, typhoons and sea level rise (Smith III, 1987). Additionally, high diversity of mangroves in an area would mean the occurrence of a diverse array of mangrove-associated fauna of mariculture importance (Dangan-Galon, 2014).

For mangrove community diversity analysis, two diversity indices are used- Shannon-Weiner and Simpson's Indices. A diversity index is the measure of species diversity in a given community. Shannon-Weiner Index denoted as H' gives the measured diversity index that takes into account both abundance and evenness of species present in the community. Typical (H') values are generally between 1.5 and 3.5 rarely 4 in most ecological studies. On the other hand, Simpson's Index (D) measures the diversity which takes into account the number of species present as well as the relative abundance of each species. As the species richness and evenness increase, diversity (D) increases. As Simpson's value D approaches 1, diversity increases. Most studies have D values between 0 and 1, with 1 represents high diversity (Stilling, 1996).

Table 2-23 shows the comparison of species diversity and evenness of the different sampling sites along Maqueda Bay. Maqueda Bay has an overall diversity index of 0.68 which is relatively closer to 1, indicative of a high diversity of species in the community. The data show that Calbiga has the highest (H') diversity index and evenness value which is 1.48 among the 11 sampling stations in Maqueda Bay. It has also the highest evenness value which is 1.38 J. Zumaragga was recorded with the lowest diversity index (H') value which is 0.43 while San Sebastian has the lowest evenness value which is 0.27.

Table 2-23. Diversity and Evenness of mangrove community in Maqueda Bay.

Municipality/City	Shannon-Wiener Index (H')	Simpson's Index (D)	Evenness (J')
Calbiga	1.48	0.65	1.38
Catbalogan	0.69	0.70	0.30
Daram	0.69	0.77	0.39
Jiabong	0.49	0.67	0.35
Motiong	0.59	0.64	0.30
Paranas	0.54	0.76	0.37
Pinabacdao	0.84	0.83	0.36
San Sebastian	0.58	0.72	0.27
Talalora	0.85	0.85	0.37
Villareal	0.60	0.69	0.37
Zumarraga	0.43	0.53	0.37

Species Dominance and Importance

The mangrove community of Maqueda Bay is composed of an assemblage of diverse mangrove flora fringing along its coasts. Each mangrove species can be evaluated according to its relative density, relative frequency, relative dominance to determine its specific importance in the mangrove forest. Relative density is the number of individuals of each species encountered in the sampling area while relative frequency measures the percentage of total quadrats or plots that contains at least one rooted individual of a given species. On the other hand, relative dominance reflects the relative influence of the species to the community. In order to express the ecological success of any species, the Importance Value Index (IVI) is used. The overall importance of a species to its heterogeneous community can be obtained from the sum of the relative density, relative frequency, and relative dominance. It usually ranges from 0 to 300. Usually, a high importance value for a specific species indicates its well influential representation in a mangrove stand as well as its abundance, density and basal area (Kimmerer, 2015). These parameters usually determine the status and change in structure, canopy biomass, growth and survival rate and production capacity in a mangrove community. (Ellison, 2015).

Overall, S. alba followed by A. marina are the two most important species in Maqueda Bay mangrove community. According to Field (1998), these two species are always dominant and abundant in the Indo-Pacific region because of their dispersal capabilities. Chakraborty (2013) also reported that these are also important vegetative factors of a mangrove forest. A. rumphiana, a close relative of A. marina was found to be the most important species in the mangrove community of San Sebastian. Appendix B-49 and

Appendix B-50 shows the summary of relative density, relative frequency, relative dominance as well as the importance value of each mangrove species around Maqueda Bay.

Mangrove Zonation Pattern

Zonation pertains to the distribution or arrangement of mangrove species in zones in a community. This describes the pattern of different species occurrences in a particular area (Sebidos and Galitano, 1996). With knowledge of the type of zonation pattern existing in a mangrove area, this can serve as basis in mangrove reforestation and in determining the suitability of each species to the particular habitat to be restored or replanted. In the present study, there is no distinct zonation pattern particularly on the central and landward zones observed among the different sampling stations along the mangrove community of Maqueda Bay. However, most of the stations of every mangrove community were observed with S. alba and A. marina in the frontline (seaward) similar to the standard zonation pattern shown (Agaloos, 1994). Figure 2-41 shows the summarized standard zonation pattern published by Agaloos (1994).

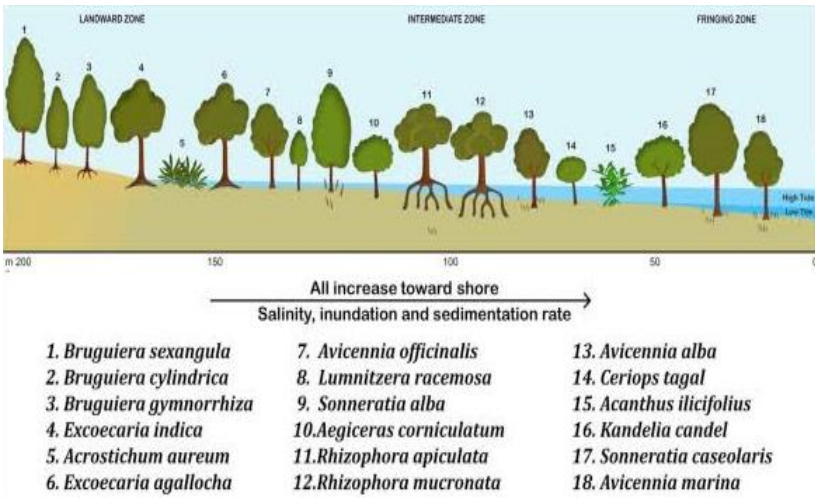


Figure 2-41. Standard zonation pattern of mangrove communities of the Philippines (Agaloos 1994).

The sampling station established in Pasigay, Calbiga was abundant with R. apiculata extending into the landward zone. However, mangrove fringes were dominated with A. marina, C. decandra and C. tagal in the middle zones. The same patterns were observed in sampling stations established in Jiabong, Motiong and Paranas. San Sebastian, Catbalogan, Jiabong and Villareal were observed to have N. fruticans dominating the middle region. The reason why R. apiculata was abundant in all zones of every sampling station is because of the observed reforestations where R. apiculata is the most used species for replantation projects. According to Alongi (2002) fringes of mangroves inundated by tides and wave can be observed with scattered distribution of mangrove seedlings all throughout the mangrove stand. This may be one reason why there was no observable mangrove zonation pattern observed around Maqueda Bay.

Regenerative Capacity

A mangrove community just like any other type of ecosystem has the ability to sustain and maintain its existence, and can be measured directly through its regenerative capacity. Generally, a forest with seedlings and saplings of more than 50% of the mature trees has a higher probability of sustaining its existence if left undisturbed (Deguit et al., 2004). This can be a basis of community-based mangrove rehabilitation or enhancement project for the community. Table 2-24 shows sampling stations with records of reforestation observed. Calbiga has the highest number of planted Rhizophora seedlings along its mangrove community. All sites sampled were observed with reforestation as well.

Table 2-24. Mangrove reforestation status in naturally occurring mangrove stands around Maqueda.

Municipality/ City	Natural Stand	Reforestation **	Planted Mangrove**	Remarks**
Calbiga	✓	✓	*R. apiculata*, *R. mucronata*, *Avicennia* spp.	Reforested area management merged into 1, new contract to continue maintenance
Catbalogan	✓	✓	*Avicennia* spp. *Rhizophora* spp.	Area established, no more fund for maintenance and protection activities
Daram	✓	✓	*Avicennia* spp. *Rhizophora* spp.	N/A
Jiabong	✓	✓	*Avicennia* spp. *Rhizophora* spp.	Area established, no more fund for maintenance and protection activities
Motiong	✓	✓	*R. apiculata*, *R. mucronata*, *Avicennia* spp.	Area established, no more fund for maintenance and protection activities
Paranas	✓	✓	*Avicennia*, *Rhizophora* spp.	N/A
San Sebastian	✓	✓	*X. granatum*, *Avicennia* spp. *Rhizophora* spp. *S. alba*	MOA includes Seedling Production, Social Mobilization and Maintenance & Protection thru CDD
Pinabacdao	✓	✓	*Avicennia* spp. *S. alba*	N/A
Talalora	✓	✓	*Avicennia* spp. *Rhizophora* spp. *S. alba*	MOA includes Seedling Production, Social Mobilization and Maintenance & Protection thru CDD
Villareal	✓	✓	*Avicennia* spp. *Rhizophora* spp. *S. alba*	MOA includes Seedling Production, Social Mobilization and Maintenance & Protection thru CDD
Zumarraga	✓	✓	*Avicennia* spp. *Rhizophora* spp.	N/A

**Source: DENR-VII

Figure 2-42 and Appendix B-53 summarize the count of seedling and sapling among different sapling stations. The two neighboring municipalities Motiong and Jiabong have the greatest number of seedling and sapling proportion while Talalora has the lowest. The mangrove sampling sites on these first two mentioned municipalities is situated at a distance from the human settlement area. This may be the reason why the mangrove community is continuously regenerating on its own. Some sites like Paranas and Villareal, had human settlements encroaching into the mangrove areas with their pigpens and fishponds. This could be a factor why the mangrove seedlings and saplings are unable to grow and develop.

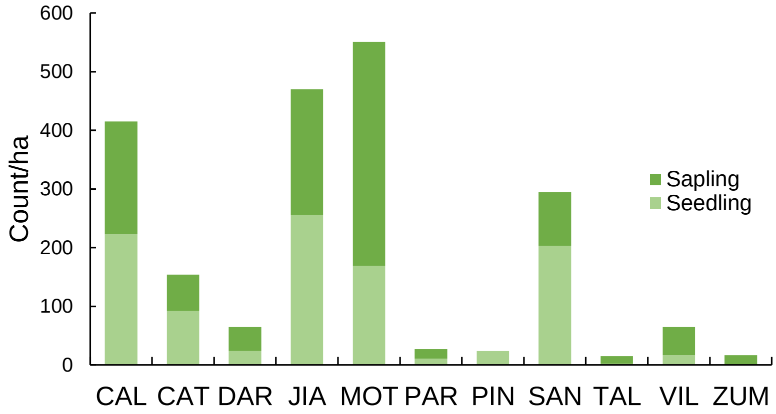


Figure 2-42. Seedling-sapling count in different sampling stations around Maqueda Bay.

Natural regeneration of a typical mangrove community depends on whether the mangrove forest is degraded on not (Mchenga and Ali, 2014). Figure 2-43 summarizes the proportion of dead and alive trees in different sampling stations along the coast of Maqueda Bay. Most of the fringing mangrove stands around the bay were not severely affected by ST Haiyan last 2013. Additionally, observed mangrove utilization that involves harvesting and cutting of mangrove trees are still tolerable and have minimal effects on the community. In this case, although there were anthropogenic activities and evident damaged caused by natural causes, the mangrove stands around Maqueda Bay still have a higher number of alive mangroves than dead ones (Appendix B-56). Calbiga has the highest percentage of alive trees than dead ones.

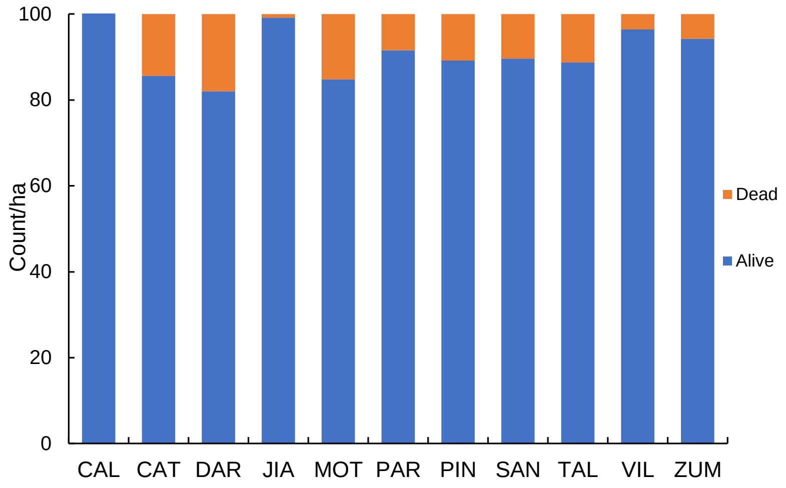


Figure 2-43. Percentage of dead and alive trees in different sampling stations around Maqueda Bay.

Mangrove-Associated Fauna

Mangroves are known to support a wide variety of organisms because of its high productivity. Leaf and wood litters when decomposed are source of food for many living organisms. Detritus form the base of the food web in mangrove ecosystems (Smith, 1987). The majority of faunal residents in mangrove forests around Maqueda Bay are mollusks, insects and crustaceans. Many are epiphytic, found clinging on prop roots and trees. Insects of the genus *Oecophylla* or the weaver ants are the most abundant found in colonies attached to fruits of S. alba where they usually feed on. The mangrove ecosystems of Maqueda Bay were also observed with several marine organisms like prawns, crabs, and mollusks of economic importance (Appendix B-59). These animal communities utilize mangrove areas for their daily activities such as foraging, breeding, and loafing. In addition, these faunal assemblages play a significant role in the management of mangrove forests and in balancing nature in and around the mangrove areas (Spalding, 2010; Nyanti, Ling and Jongkar, 2012).

Figure 2-44. Fiddler crab "karas" in mangrove sediment.

Mangrove Status Condition

Mangrove community condition can be rated in terms of (1) regeneration capacity, (2)% crown cover, (3) average height of mature trees, and (4) environmental condition. In this study, the mangrove condition was evaluated according to the criteria set by Deguit et al. (2004) (Table 2-1).

Using the criteria set by Deguit et al. (2004) and based on the data obtained for each site, the average mangrove community condition of Maqueda Bay is good. Maqueda Bay was not greatly affected by the devastation of ST Haiyan last November 2013 compared to Leyte Gulf and Matarinao Bay (www.philstar.com/nation/2013/11/07/1254016/list-areas-be-affected-monster-typhoon-yolanda). Catbalogan City for example maintained its good mangrove community condition. Motiong, Paranas, San Sebastian, Pinabacdao and Zumarraga all show an excellent mangrove condition indicating a healthy and productive ecosystem. In Brgy. Pasigay, Calbiga, the low measured average height of trees and percentage of crown cover can be attributed to the Rhizophora plantations in the seaward portion of the mangrove forests. Plantations, especially of species that do not belong to a particular portion of the mangrove forest resulted a less diverse community and the reduction of naturally-growing species (Diop et al., 1997). Table 2-25 summarizes the mangrove community condition of different municipalities facing Maqueda bay.

Table 2-25. Mangrove condition in different municipalities around Maqueda Bay.

Municipalities	Crown Cover (%)	Average Height	Mangrove Condition
Calbiga	54.97	6.22	Good
Catbalogan	67.31	4.03	Good
Daram	69.5	5.92	Good
Jiabong	52.08	4.42	Good
Motiong	71.23	6.42	Excellent
Paranas	72	7.9	Excellent
Calbiga	52.11	5.08	Good
San Sebastian	74.4	7.19	Excellent
Pinabacdao	79.63	6.39	Excellent
Talalora	38.79	3.79	Fair
Villareal	49.5	4.46	Fair
Zumarraga	83.27	10.4	Excellent

Mangrove Resource Utilization

Mangrove forests provide livelihood and services to adjacent coastal communities. Local people depend on mangrove trees and palms for fuel, tannin, timber, wine and other products. Mangrove forest wood, host a wide variety of edible fauna such as crabs, shrimps, and mollusks.

Figure 2-45. Nypa fronds in San Sebastian, Samar.

Along the coastal community of Maqueda Bay, mangroves were utilized in many ways. In some of the municipalities assessed such as Pinabacdao and Paranas, mangroves were observed to be slightly debarked. Local anecdotes explain that the removed barks are used as ingredient in making the local wine “tuba”. Downed or dead wood are also harvested as fuels. Some of these are used as support for housing. In San Sebastian, since Nypa palms are quite extensive, locals utilized Nypa fronds to make nipa shingles that are used as roofing materials. Paranas, Pinabacdao, Villareal, Jiabong and Motiong were observed to have aquaculture sites for bangus and tilapia in the mangrove areas. Mangrove associate fauna especially the edible ones are utilized as food for adjacent coastal community locals. Shells such as bivalves for example are used as food especially when fish is scarce during bad weather. Small scale harvesting of these edible shells “pang-tion” are used for food consumption while relatively larger amount of the harvests serves as source of income for the coastal inhabitants. In Paranas, there were observed mud crab traps in mangrove stands indicative that mud crabs are also harvested for economic purposes.

Figure 2-46. Edible bivalves “pan-tion” found in Maqueda Bay.

Threats to Mangrove Ecosystems

The Philippines is regarded as one of the 17 mega biodiversity countries because of its geographical location and diverse habits. It houses 5% of the world’s flora and is ranked fifth globally in terms of the number of plant species. The country holds at least 50% mangrove species of the world’s 65 species (Fernando and Pancho, 1980). However, the country’s mangrove forest is gradually declining due to anthropogenic activities and natural disturbances.

Pollution

Several human trashes were observed on mangrove forest along Maqueda bay. Mangrove areas are often used for dumping waste especially near human settlements. These wastes especially biodegradable wastes harm both the mangrove ecosystem and the species living there. Trash debris can cause the death of animals in the mangrove and suppresses the habitat. A large volume of rubbish in tidal channels can be detrimental to nearshore habitats and their associated species. Rubbish can also inhibit tidal flushing leading to increase in salinity levels, stressing the mangrove habitat.

Figure 2-47. Mangrove area being dumped with trash in San Sebastian (left) Rhizophora entangled with garbage in Buri, Catbalogan(right).

Conversion

Establishment of fish ponds leads to the depletion of mangrove forests. Major issues include loss of important ecological and socio-economic functions of the mangrove ecosystems, change in hydrology, salinization, introduction of non-native species and diseases, and pollution from effluents. The use of fertilizers on fish ponds creates nutrient loading of effluent waters into surrounding mangroves. When this reaches the recommended mangrove-pond ratio, it has a negative impact on the ecosystem's flora and fauna. These negative impacts include reduced light penetration and smothering of benthic fauna; reduction of water quality; and bioaccumulation of residues and possible alteration of phytoplankton communities that will lead to algal bloom (Costanzo et al., 2001; Walton et al., 2016).

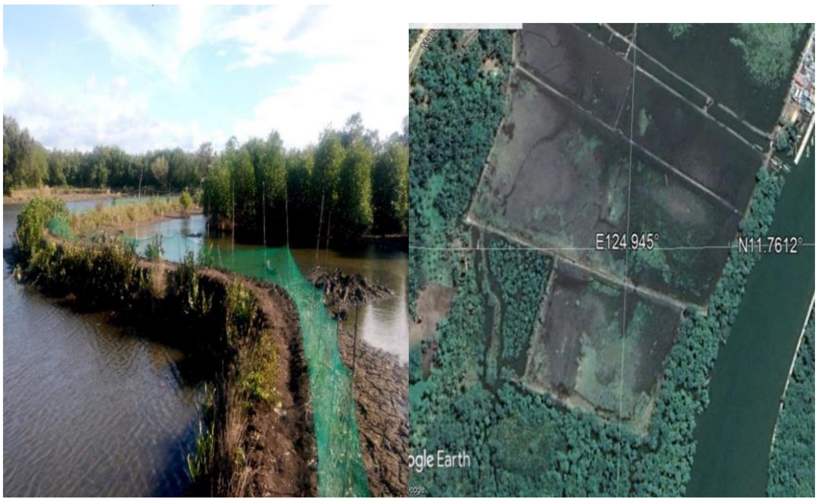


Figure 2-48. Mangrove ponds in Paranas (left) and satellite image of fish ponds in Jiabong (right) (Source: Google).

In Maqueda Bay, there are over 407 has of aquaculture sites or fishponds established in mangrove communities. Some of these fishponds are already reverted back to mangrove areas such as the 2.086 has of fishpond in San Sebastian that naturally reverted back to thick mangrove stand. In Calbiga, San Sebastian, and Villareal, a total of 100.27 has area of fishpond on mangrove community was already left abandoned (BFAR R.O VIII, 2019). The abandonment of these fishponds may be due to the temporary or permanent cancellation of renewal of Fishpond Lease Agreements (FLAs) title either due to lessees' failure to submit the necessary requirements or violation of the proper aquaculture site management set by BFAR. Table 2-26 shows municipalities with fish ponds in mangrove forests and present situation as of June 2019.

Table 2-26. Status of Fish Ponds in Maqueda Bay as of June 2019.

Municipality	Total Area (ha)	Developed	Not developed/Abandoned (ha)	Remarks
Calbiga	131.57	No data available	90.5827 has	Lessee of abandoned area cannot be contacted anymore, 89.8503 ha cancelled for renewal.
Catbalogan	14.72	No data available	No data available	Titled under OCT. No. 17450 on August 21, 1979
Motiong	29.05	21 has of 1984 report	No data available	Cancelled
Paranas	36.08	No data available	No data available	31 has cancelled, 3.5 has currently operational but for cancellation and termination of lease if lessee fails to take appropriate action within a reasonable period of time.
Pinabacdao	22.01	22.01 has as of December 1987	No data available	Applied for renewal and fishpond rentals were updated and paid by present occupants.
San Sebastian	86.74	10.0 has functionally operating, 49.98 has has no development	2.81	Fishpond in abandoned area is no longer suitable for bangus fingerlings production due to thick stand of mangroves so it was recommended for cancellation.
Villareal	86.88	estd. 80 has	estd. 6.88	Partially operating and rental is not updated.

Source: BFAR-RO8 Status of fish ponds in Maqueda Bay Western Samar as of June 2019

Human Encroachment and Settlement

Some mangrove areas around Maqueda Bay were converted to human settlement as a response to the increasing human population. Human encroachment on coastal ecosystem and competition for land for aquaculture, agriculture, infrastructure and tourism are among the major causes of reported decrease in mangrove forest areas over time. Continued human encroachment can lead to alteration of forest structure and species composition.

Figure 2-49. Human encroachment in mangrove stand.

Overharvesting

Mangrove trees are used for firewood, lumber for construction and charcoal production. Mangrove areas along Maqueda Bay are at a high risk from unsustainable practices of overharvesting that will eventually lead to their destruction and depletion of the mangrove forest.

Conclusions and recommendations

The physicochemical parameters in all sampling stations in Leyte Gulf, Matarinao Bay, and Maqueda Bay, are in range for the mangrove optimum growth and development. Leyte Gulf has a mangrove area coverage of 2,959 has with a total of 29 species. The mangrove forests along Matarinao Bay has a total mangrove cover of 1,260 has with 27 mangrove species. Maqueda Bay has a total mangrove cover of 2,056 has with 24 species. The overall condition of the mangrove forests in Leyte Gulf, Matarinao Bay, and Maqueda Bay is “fair” to "good” condition. This overall condition is attributed to the high mangrove density and diversity of the mangrove forests. One endangered species, Camptostemon philippinense, which is endemic to the Philippines, was found in the Gulf and Bays. Moreover, one vulnerable species, Avicennia rumphiana, and two near-threatened, Aegiceras floridum and Ceriops decandra, were found in the mangrove ecosystems along Matarinao Bay. Mangrove resources in Leyte, Gulf, Matarinao and Maqueda Bay are utilized widely for industrial, domestic, and economic uses. Wood for firewood and poles could be derived from mangrove forests. Residents near the mangrove forests utilize edible shellfish (mollusks). However, the excessive utilization of mangrove resources practiced in Leyte Gulf and in Matarinao and Maqueda Bay such as encroachment and conversion to aquaculture site as well as pollution and overharvesting, pose a threat to the mangrove community.

Thus, the research presents the following recommendations to the different components of the community and its governing bodies:

- To BFAR and other government agencies concerned, there should be an updated record of the mangrove database at the barangay level. In order to meet this, the agencies concerned must conduct trainings in the community to enable them to conduct regular assessment of the mangrove area. The mangrove assessment should be conducted at least twice a year to update existing data and check for threats to the mangrove area in the community. The establishment of mangrove reserves is also recommended.
- To the LGUs, ordinances and policies must have strict implementation for the protection and rehabilitation of the mangrove ecosystem. Though there are corresponding sanctions and penalties to violations, these are not properly executed. Enforcing existing mangrove laws and zoning mangrove in Municipal Comprehensive Land Use Plans (CLUPs) is highly recommended. The promotion of Aquasilviculture to the community could prevent cutting down of trees to convert the area into an aquaculture site.
- To the community, a community-based seminar is recommended to raise awareness and address concerns regarding the status and health of the

mangroves and its associated ecosystems. This could also shed light on the implemented policies and ordinances done by the governing bodies of the community (e.g. LGU and Barangay Council). Communities should also formulate and enforce policies and establish Community-based Mangrove Forest Management Agreements (CBFMA) wherein active participation of the community and the local government unit is very vital.

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Appendix A

Photos on the FGD's

Appendix A-1. FGD with fisherfolk at Barangay San Joaquin, Palo, Leyte.

Appendix A-2. FGD with women members of the Cogon Fisherfolk Association in Barangay Cogon, Palo, Leyte.

Appendix A-3. FGD with members of Baras Fisherfolk Organization at Barangay Baras, Palo, Leyte.

Appendix A-4. FGD with FLET members and fisherfolk of Zone 5, Paranas, Samar.

Appendix A-5. FGD with fisherfolk in Barangay Tigbawon, Paranas, Samar.

Fish Catch

Local Name	English Name	Scientific Name
abuhan	Wavy-lined grouper	Epinephelus undulosus
adgawon	Green jobfish	Aprion virescens (Valenciennes)
adlo	Bluefin	Thunnus thynnus
agak-ak	*no available data*	-
agumaa	Short Mackerel	Rastrelliger brachysoma
aguyong	*no available data*	-
alagad	*no available data*	-
alagba-ay	*no available data*	-
alapion	*no available data*	-
alho	Great barracuda	Sphyraena barracuda
alimango	Mangrove Crab	Scylla serrata
alimasag	Crab	-
angsohan	*no available data*	-
apahan	Snubnose pompano	Trachinotus blochii (Lacepède, 1801)
arad-ad	*no available data*	-
badila	*no available data*	-
bag-angan	*no available data*	-
bagaong	*no available data*	-
baghak	Longfin grouper	Epinephelus quoyanus (Valenciennes, 1830)
bagulan	*a variety of Crab*	-
bahaulo	Lattice monocle bream	Scolopsis taenioptera (Cuvier, 1830)
balanak	Flathead grey mullet	Mugil cephalus (Linnaeus, 1758)
balat	Sea Cucumber	-
baliling	Yellowfin tuna	Thunnus albacares (Bonnaterre, 1788)
balu	Hound needlefish	Tylosurus crocodilus (Péron & Lesueur, 1821)
bangus	Milkfish	Chanos chanos
barabaraan	*no available data*	-
bariles	Tuna	-
batagon	Blue-barred parrotfish	Scarus ghobban (Forsskål, 1775)
bisogo	*no available data*	-
bolinao	Devis' anchovy	Encrasicholina devisi (Whitley, 1940)
bonti	*no available data*	-
boraw	Mackerel	-
boringon	Jack	-
botlog	*no available data*	-
budlis	Skipjack tuna	Katsuwonus pelamis (Linnaeus, 1758)
bugaong	Fourlined terapon	Pelates quadrilineatus (Bloch, 1790)
buhi	*no available data*	-
bukaw	Purple-spotted bigeye	Priacanthus tayenus Richardson, 1846
bukawel	Sea Snail	-

bun-ak	Blue-barred parrotfish	Scarus ghobban (Forsskål, 1775)
bungalan	*no available data*	-
buntil	*no available data*	-
burit	*no available data*	-
but-o	*no available data*	-
butlog	Monogrammed monocle bream	Scolopsis monogramma (Cuvier, 1830)
danggit	Rabbit fish	Siganidae
dapak	Humpback red snapper	Lutjanus gibbus (Forsskål, 1775)
dapaw	*no available data*	-
daragbago	Mottled spinefoot / a variety of Siganid	Siganus fuscescens (Houttuyn, 1782)
durado	Common dolphinfish	Coryphaena hippurus (Linnaeus, 1758)
duhaw	*no available data*	-
galunggong	Indian scad	Decapterus russelli (Rüppell, 1830)
hamol-od	Rabbit fish	Siganidae
hasa hasa	Short Mackerel	Rastrelliger brachysoma
hilos	*no available data*	-
ieto	Striped eel catfish	Plotosus lineatus (Thunberg, 1787)
kalapi-on	*no available data*	-
kasili	Eel	Anguilliformes
katambak	*no available data*	-
kawayanon	*no available data*	-
kikiro	Spotted scat	Scatophagus argus (Linnaeus, 1766)
kinis	Mangrove Crab	Scylla serrata
kirawan	*no available data*	-
kitong	Rabbit fish	Siganidae
kubalan	*no available data*	-
kugita	octopus	Octopoda
kulabutan	cuttlefish	Sepiida
lagaw	*no available data*	-
lahing	*no available data*	-
lambiyaw	Yellowstripe scad	Selaroides leptolepis (Cuvier, 1833)
langkoy	Largehead hairtail	Trichiurus lepturus (Linnaeus, 1758)
lapas	Shell/Abalone	-
lapu-lapu	Grouper	Epinephelinae
latabon	*no available data*	-
lawayan	Common ponyfish	Leiognathus equulus (Forsskål, 1775)
lawihan	*no available data*	-
lubayan	*no available data*	-
lumbiyaw	*no available data*	-
lumok	*no available data*	-
lusod	Greater lizardfish	Saurida tumbil (Bloch, 1795)
magburuho	*no available data*	-

magud	*no available data*	-
malimno	Japanese scad	Decapterus maruadsi (Temminck & Schlege l, 1843)
mamad-as	Longspine emperor	Lethrinus genivittatus (Valenciennes, 1830)
mangagat	Snapper	Lutjanidae
mangnay	Goby	Gobiidae
mangudlo	Oxeyed Scad	Selar boops (Cuvier, 1833)
manlalara	White-spotted spinefoot	Siganus canaliculatus (Park, 1797)
marabaraan	Golden threadfin bream	Nemipterus japonicus (Bloch, 1791)
marapati	*no available data*	-
maryaning	*no available data*	-
masag	Blue Swimming Crab	Portunus armatus
maya-maya	Five-lined snapper	Lutjanus quinquelineatus (Bloch, 1790)
mol-mol	Blue-barred parrotfish	Scarus ghobban (Forsskål, 1775)
moong	Bridled cardinalfish	Pristiapogon fraenatus (Valenciennes, 1832)
noos	Squid	Decapodiformes
oring	*no available data*	-
oso-us	Whiting	Merlangius merlangus
pahut	*no available data*	-
pak-an	*no available data*	-
pakol	Starry triggerfish	Abalistes stellaris (Bloch & Schneider, 1801)
palang	*no available data*	-
parog	*no available data*	-
parotpot	Slipmouth	Leiognathidae
pasayan	Shrimp	Caridea
payod	*no available data*	-
pikas	*no available data*	-
pugot	*no available data*	-
sagision	Japanese threadfin bream	Nemipterus japonicus (Bloch, 1791)
sapsap	Slipmouth	Leiognathidae
sibog	Sixbar grouper	Epinephelus sexfasciatus (Valenciennes, 1828)
silay	Lattice monocle bream	Scolopsis taenioptera (Cuvier, 1830)
siri	Monogrammed monocle bream	Scolopsis monogramma (Cuvier, 1830)
sulusugi	Marlin	Istiophoridae
suno	Darkfin hind	Cephalopholis urodeta (Forster, 1801)
surahan	Bluespine unicornfish	Naso unicornis (Forsskål, 1775)
tabango-ngo	*no available data*	-
tahong	Asian Green Mussel	Perna viridis
takpuon	*no available data*	-
talad	*no available data*	-
talho	Brushtooth lizardfish	Saurida undosquamis (Richardson, 1848)
talikokod	Goatfish	Mullidae

talugitok	*no available data*	-
tamban	*no available data*	-
tangigui	Narrow-barred Spanish mackerel	Scomberomorus commerson (Lacepède, 1800)
tanhok	*no available data*	-
tilapia	Tilapia	Oreochromis niloticus
ti-aw	Goldband goatfish	Upeneus moluccensis (Bleeker, 1855)
tingag	Grouper	Epinephelinae
turingan	Bullet tuna	Auxis rochei (Risso, 1810)
turos	*no available data*	-
turubay	*no available data*	-
tuwakang	Anchovy	Engraulidae
ubakan	*no available data*	-
yellowfin	Yellowfin tuna	Thunnus albacares

Appendix A-6. Fishes caught in the Matarinao Bay, Leyte Gulf and Maqueda Bay with their corresponding local, English, and scientific names.

Local Name	Gear
abuhan	hook line, trap, surrounding net
adgawon	Fish corral, gillnet
adlo	dredge, falling gear, hook line, liftnet, seine net, surrounding net, trap, trawl
agak-ak	hook line, trap
agumaa	trawl, net
aguyong	gill net, hook line, trap
alagad	falling gear, hook line, liftnet, seine net, surrounding net, trap
alagba-ay	hook line, seine net, trap
alapion	hook line
alho	hook and line
alimango	bintol, crabpot, trap
alimasag	seine net
angsohan	gill net, liftnet, trap
apahan	gill net, hook line, surrounding net, trawl
arad-ad	gill net, hook line, trap
badila	trap
bag-angan	gill net, hook line, surrounding net, trap
bagaong	hook and line,
baghak	hook and line,
bagolan	gill net, hook line, seine net, trap
bahaulo	hook and line,
balanak	hook and line, drive nets
balat	hand picking
baliling	hook and line

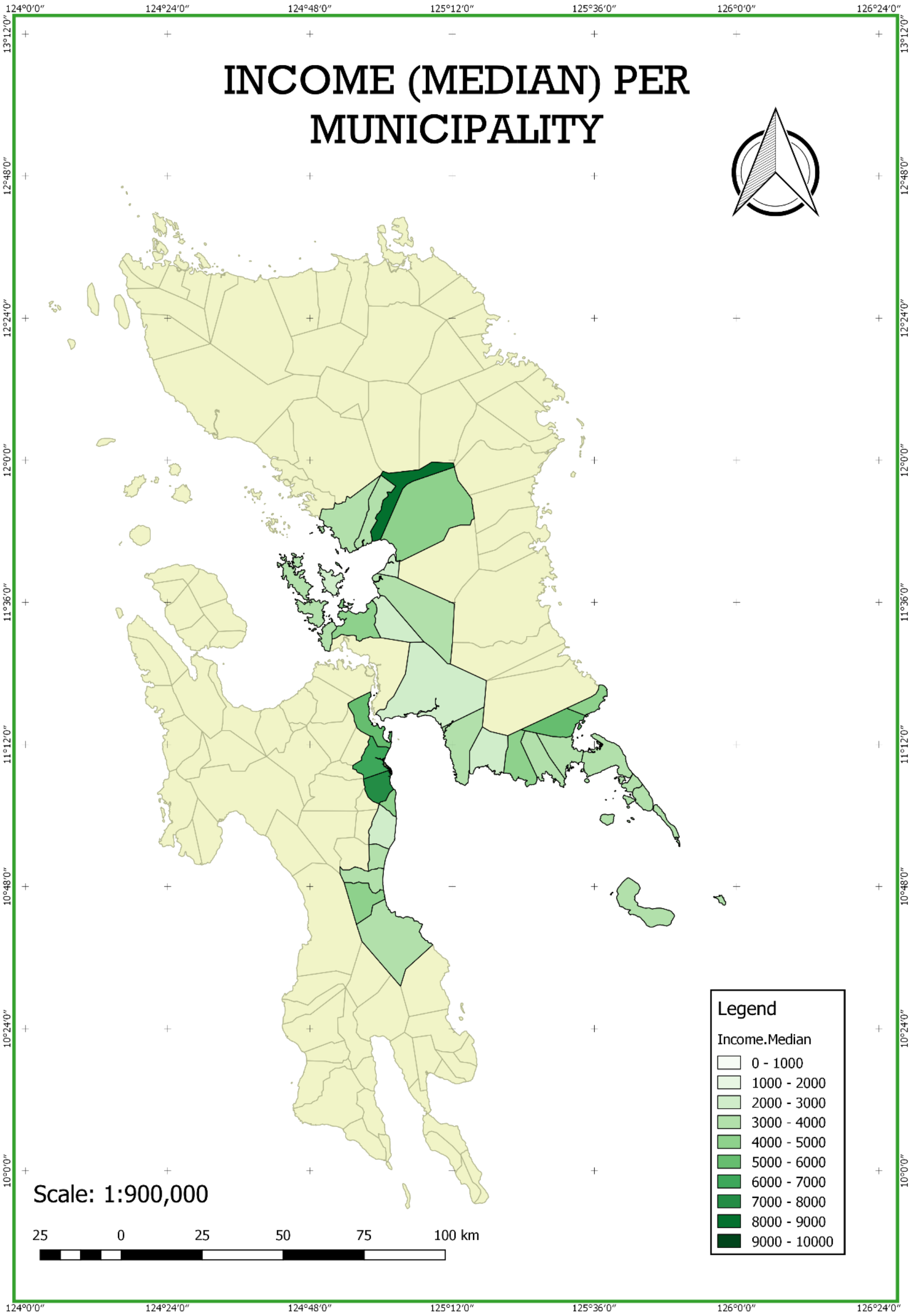
balu	gill net "balu-an"
bangus	culture
barabaraan	hook and line, net
bariles	hook and line,
batagon	hook and line
bisogo	hook and line, net, trawl
bolinao	bagnet
bonti	drive net, gill net
boraw	gill net, fish corral
boringon	hook and line
botlog	hook and line, net
budlis	hook and line, surrounding net
bugaong	gillnet
buhi	hook and line, fish trap
bukaw	hook and line
bukawel	hand picking
bun-ak	drive net, gill net
bungalan	trap
buntil	trap
burit	net, fish corral
but-o	net
butlog	trawl
danggit	Gill net, fish corral
dapak	Gill net, fish corral
dapaw	Gill net, fish corral
daragbago	Gill net, fish corral
durado	long line
duhaw	falling gear, hook line, liftnet, surrounding net, trap
galunggong	gill net, hook line, liftnet, seine net, trawl, trap
hamol-od	gillnet, fish corral
hasa hasa	trawl, bag net, surrounding net
hilos	dredge, falling gear, gill net, hook line, liftnet, seine net, surrounding net, trap, trawl
ieto	hook and line, gill net
kalapi-on	gillnet, trawl, fish corral
kasili	hook and line
katambak	spear, hook and line
kawayanon	hook line
kikiro	gill net, hook and line
kinis	trap net, crab pot,
kirawan	hook and line, net
kitong	gillnet, fish corral
kubalan	liftnet

kugita	hook with artificial bait, spear
kulabutan	spear, fish corral
lagaw	dredge, falling gear, gill net, hook line, liftnet, scoop net, seine net, surrounding net, trap, trawl
lahing	trawl, net
lambiyaw	gill net
langkoy	trawl, net
lapas	hand picking
lapu-lapu	fish trap, spear, hook and line
latabon	net,trawl
lawayan	net,trawl
lawihan	liftnet
lubayan	hook and line
lumbiyaw	fish corral
lumok	falling gear, hook line, liftnet trap
lusod	fish corral, hook and line
magburuho	spear, drive net, hook and line
magud	net, hook and line
malimno	hook and line, fish corral
mamad-as	gill net, hook and line
mangagat	gill net, push net,
mangnay	gill net, fish corral
mangudlo	gill net, fish corral
manlalara	trawl, hook and line
marabaraan	seine net, bag net
marapati	seine net, bag net
maryaning	crab pot, crab net, hand picking
masag	hook and line, fish corral
maya-maya	spear, hook and line, fish corral
mol-mol	spear, hook and line, fish corral
moong	gathering, culture
noos	spear, hook and line, fish corral
oring	gill net, fish corral
oso-us	Trawl, fish corral
pahut	spear
pak-an	spear
pakol	gill net, spear
palang	gill net, trawl, fish corral
parog	dredge, falling gear, gill net, hook line, liftnet, scoop net, seine net, surrounding net, trap, trawl
parotpot	fish corral, sudsod
pasayan	gill net, liftnet, seine net, trap
payod	drive-in net, gillnet

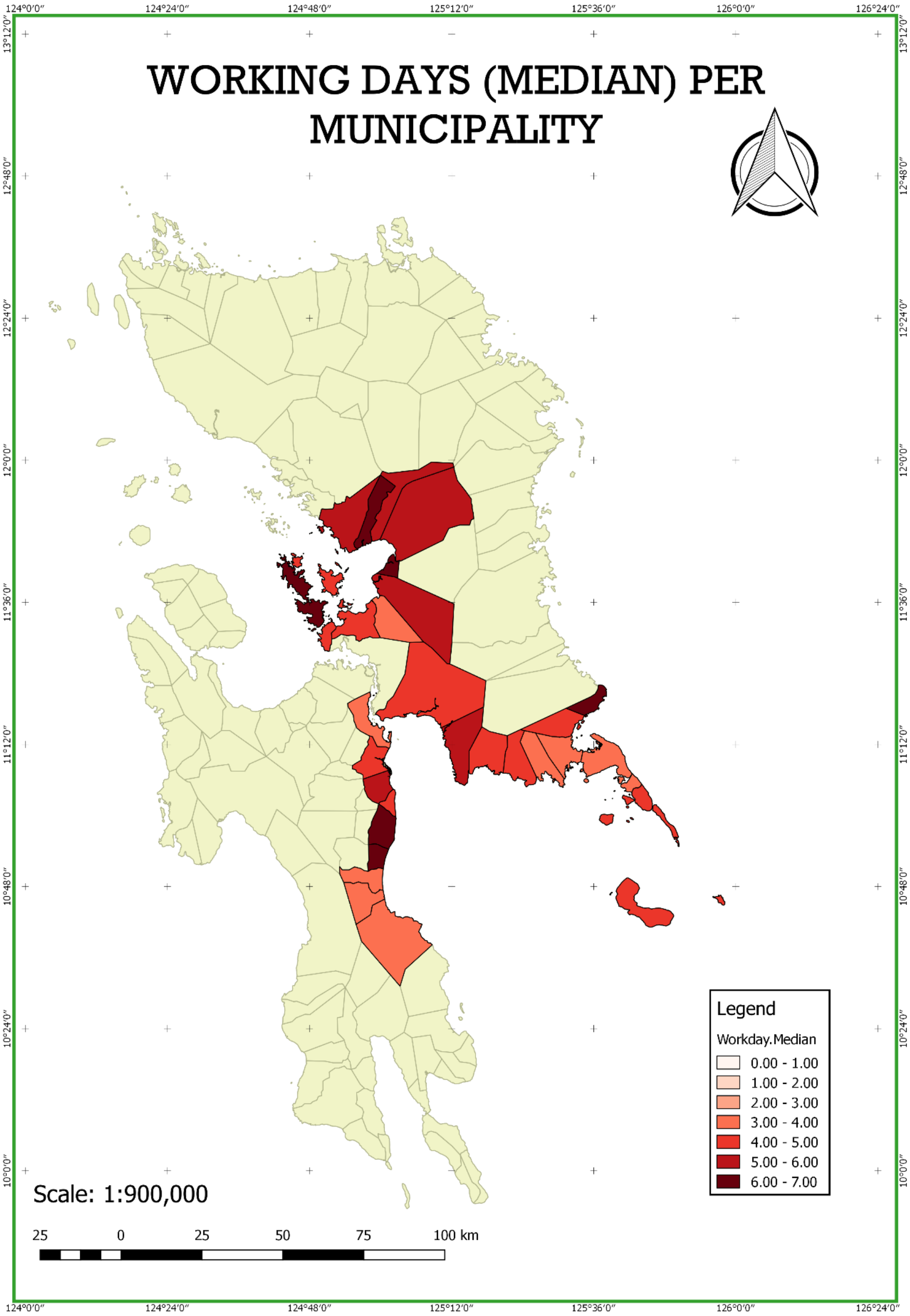
pikas	gill net, hook line, scoop net, seine net, trap
pugot	hook and line, fish corral
sagision	Trawl, fish corral, gillnet
sapsap	spear, fish trap
sibog	hook and line, fish corral, trawl
silay	hook and line, trawl, fish corral
siri	long line
sulusugi	hook and line
suno	spear, hook and line
surahan	net, hook and line
tabango-ngo	net, hook and line
tahong	bag net, fish corral
takpuon	net, hook and line
talad	net, hook and line
talho	trawl, fish corral
talikokod	trawl, drive nest, fish corral
talugitok	gillnets
tambong	hook and line, fish corral
tangigui	gill net, hook line
tanhok	hook and line, gill net
tilapia	gill net, trawl
ti-aw	hook and line
tingag	dredge, falling gear, gill net, hook line, liftnet, scoop net, seine net, surrounding net, trap, trawl
turingan	hook and line
turos	gill net, fish corral
turubay	gill net
tuwakang	bagnet
ubakan	falling gear, gill net, hook line, liftnet, trap, trawl
yellowfin	long line

Appendix A-7. Fishes caught in the Matarinao Bay, Leyte Gulf and Maqueda Bay with the corresponding gear used to catch them.

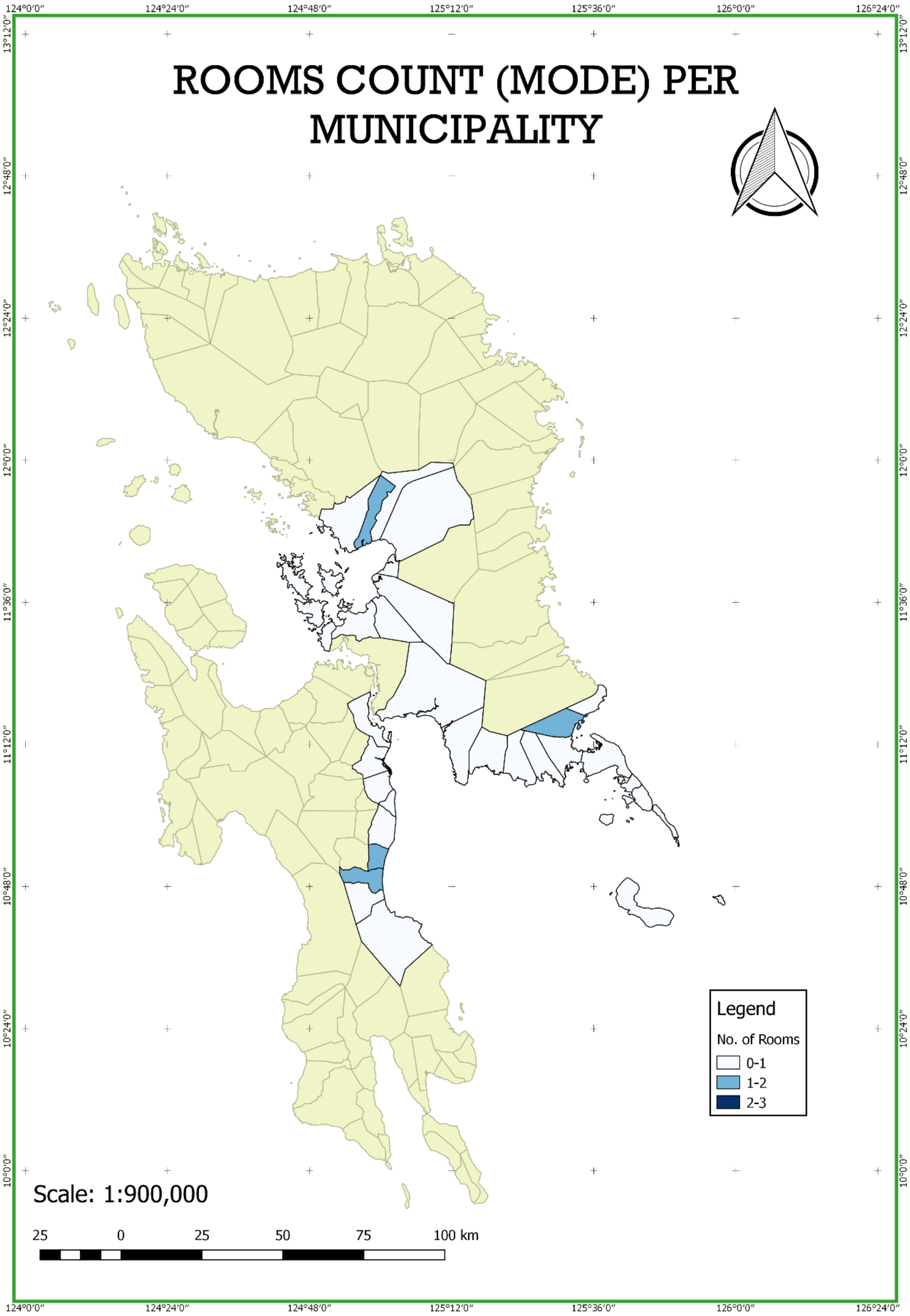
SEA Maps



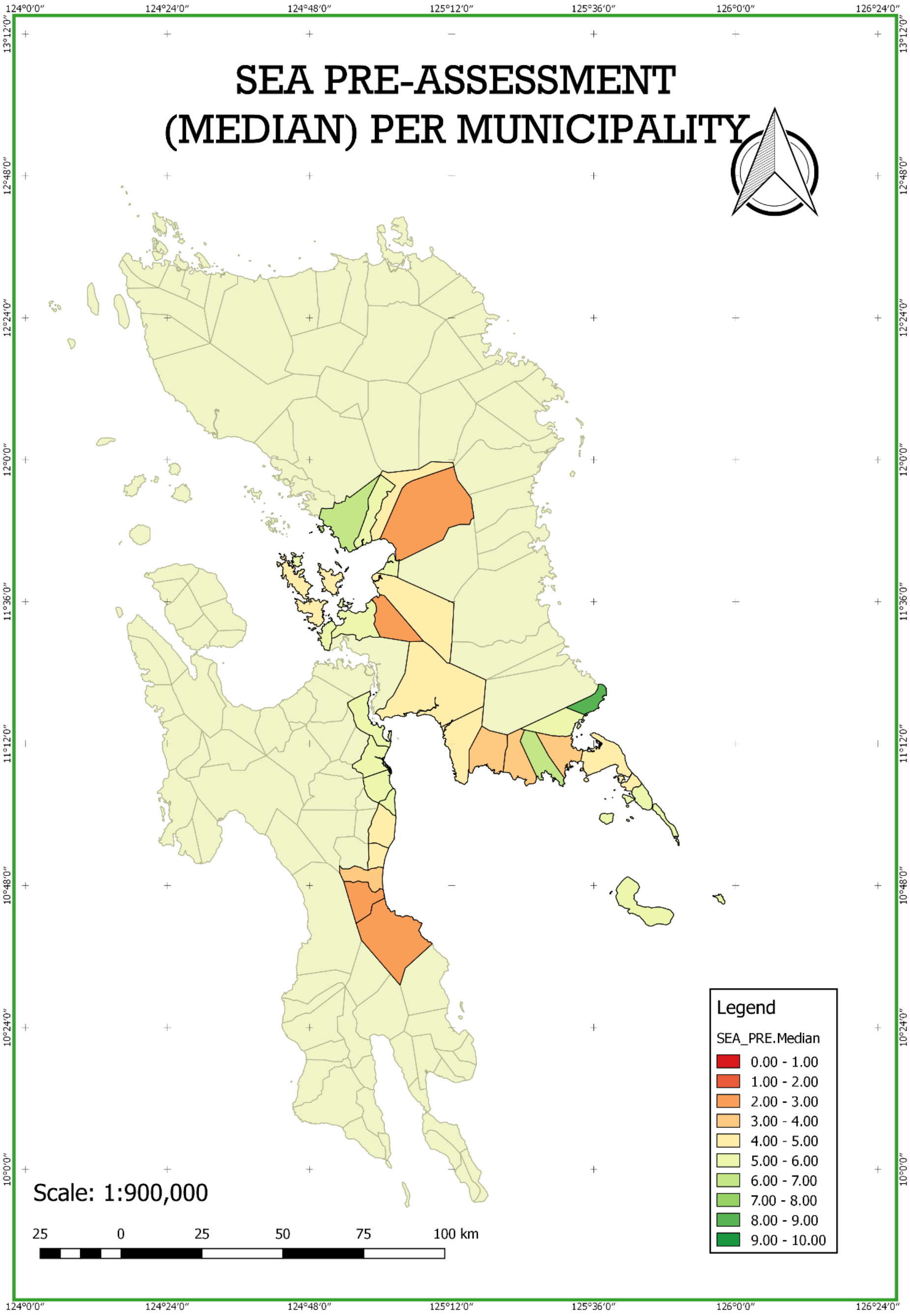
Appendix A-8. Median Income per Municipality.



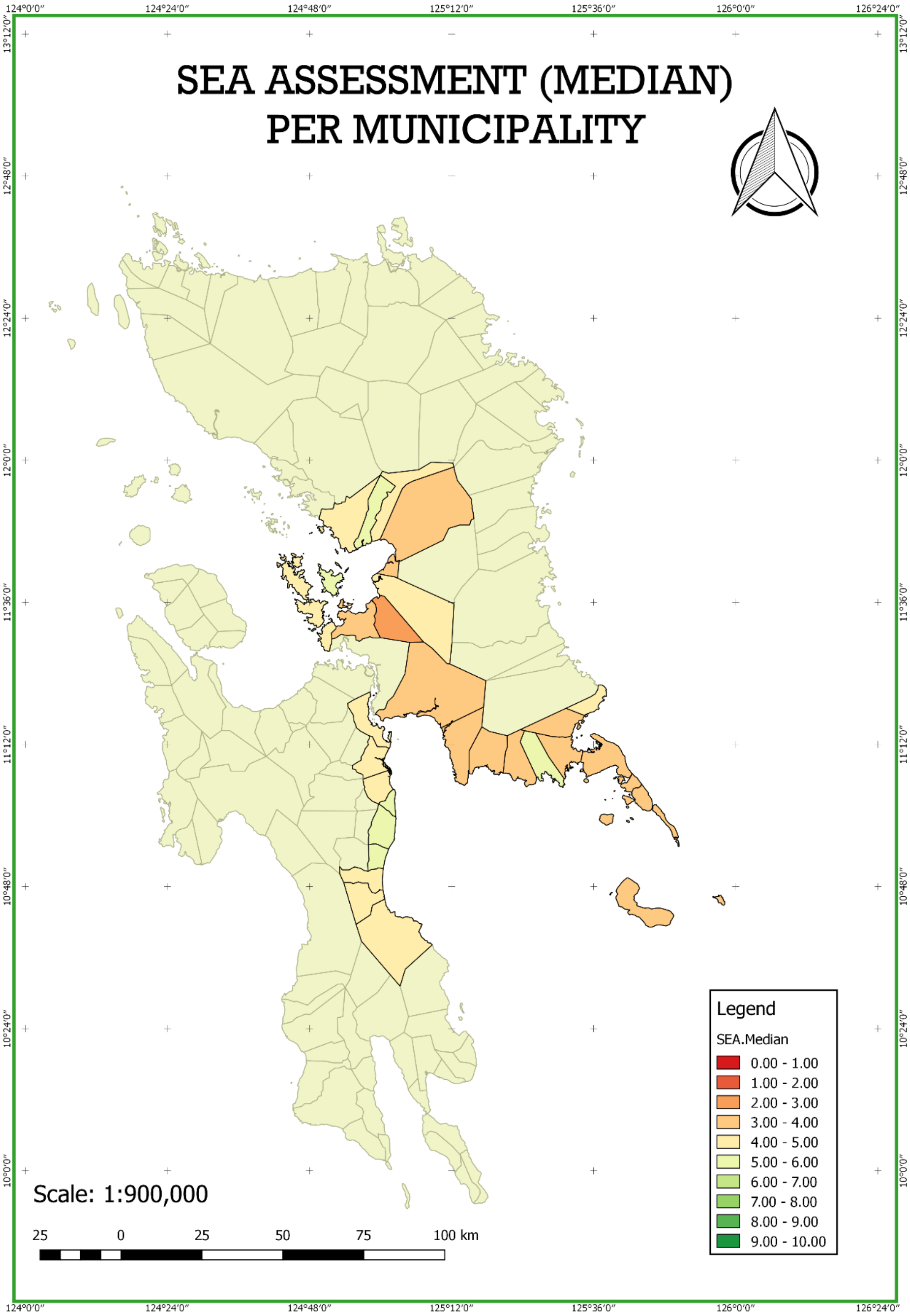
Appendix A-9. Median Workdays per Municipality.



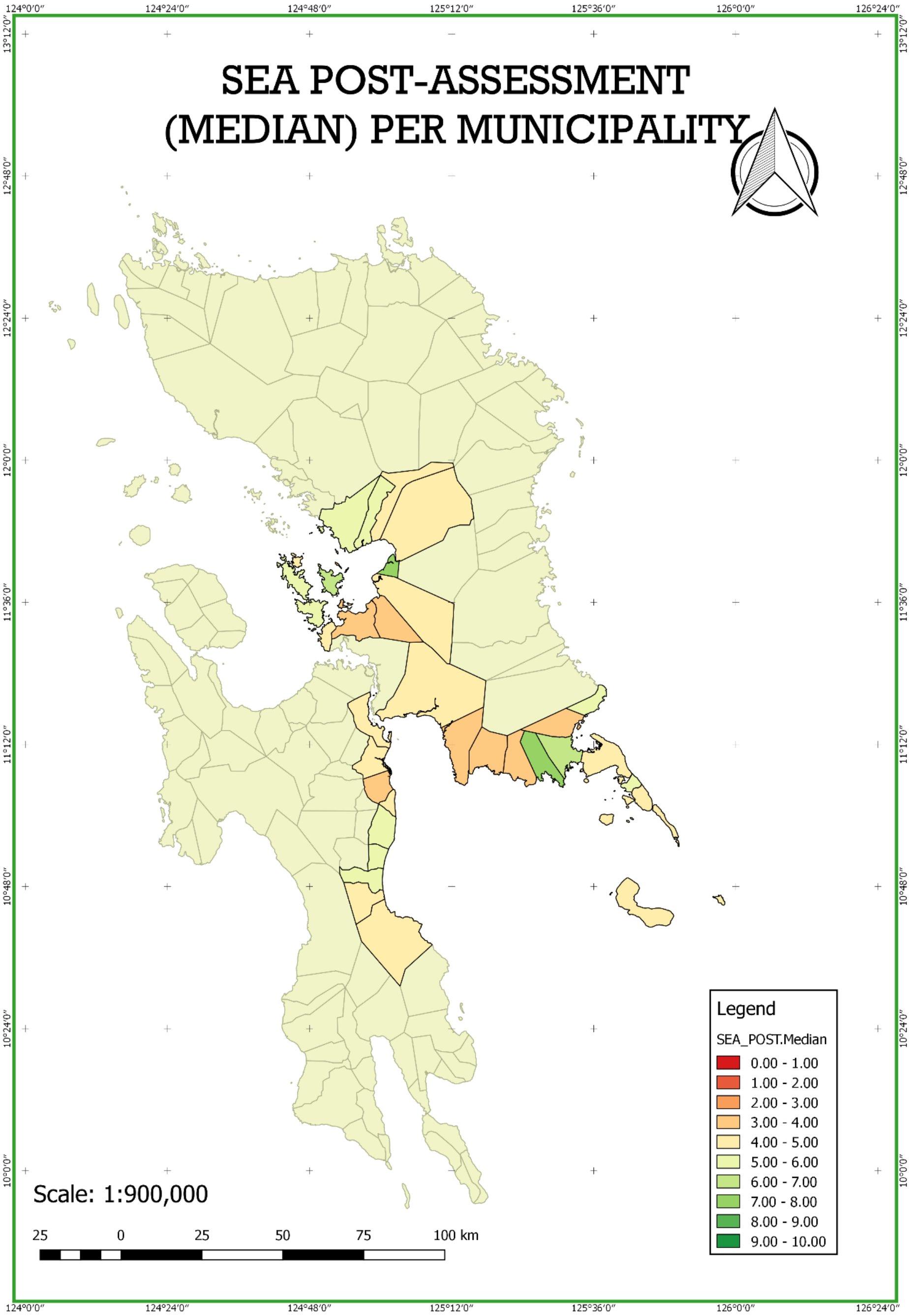
Appendix A-10. Mode Rooms per Municipality.



Appendix A-11. Median SEA Pre-Assessment per Municipality.



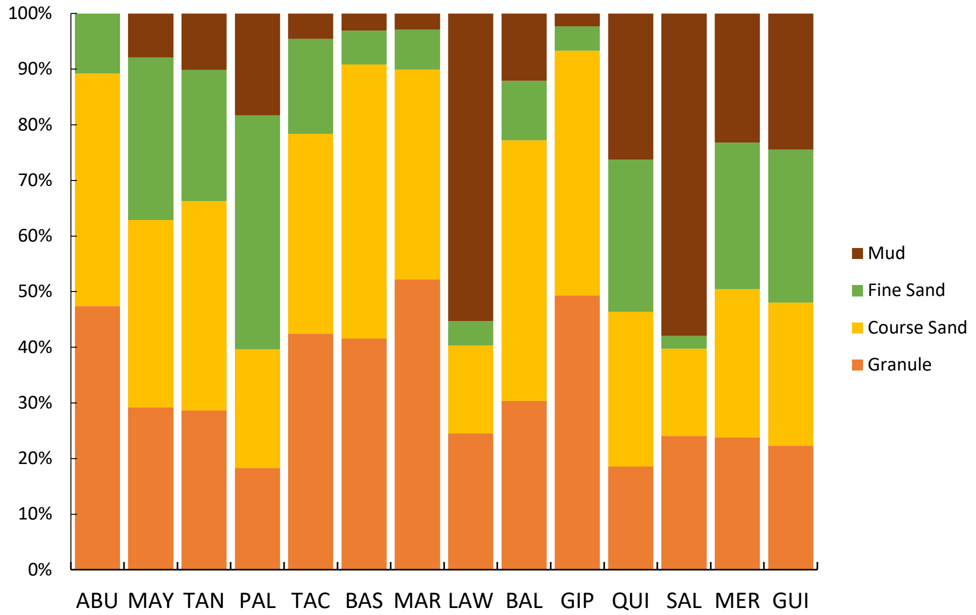
Appendix A-12. Median SEA Assessment per Municipality.



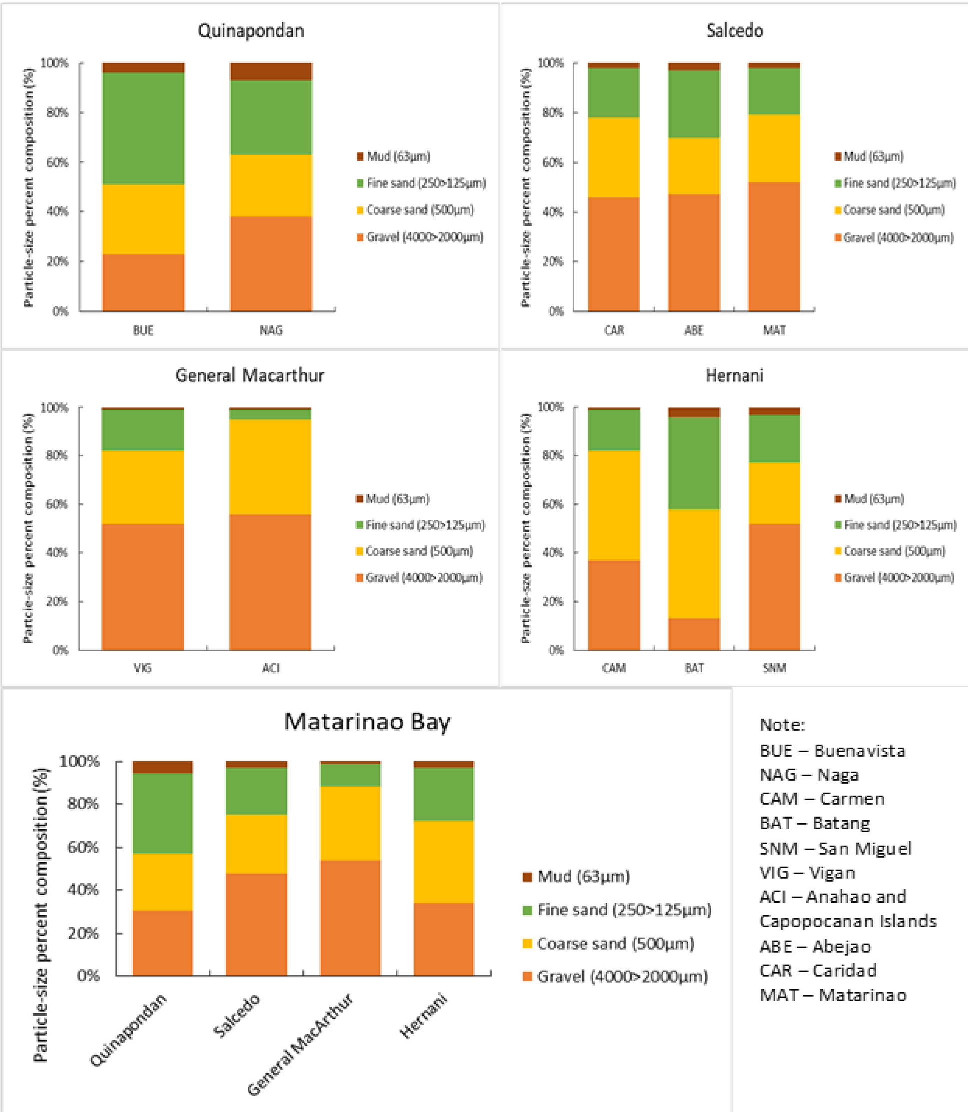
Appendix A-13. Median SEA Post-Assessment per Municipality.

Appendix B

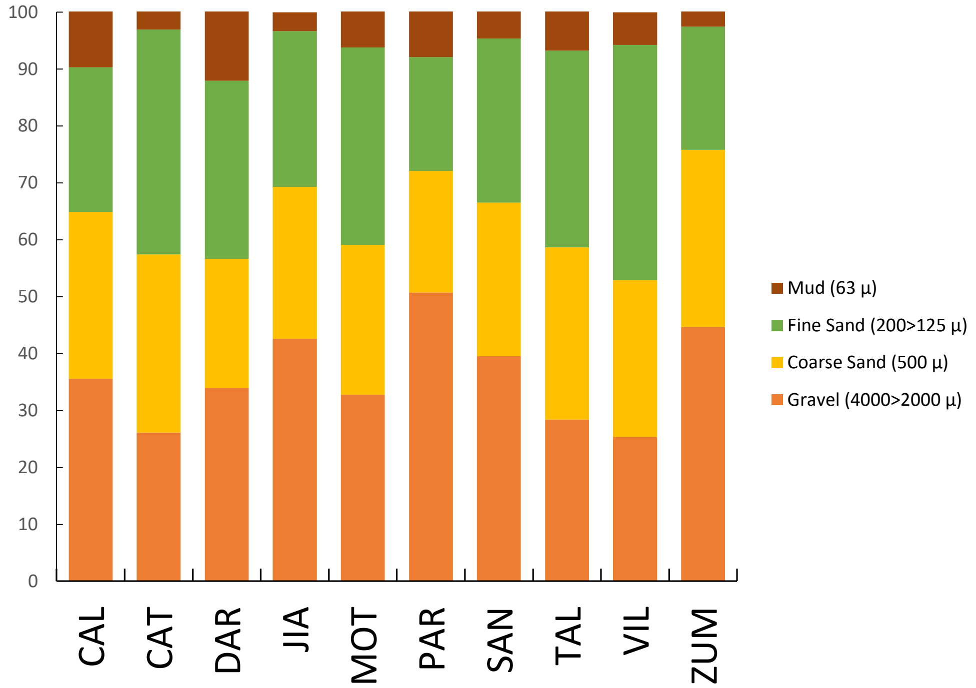
Particle Size Categorization of the Sediments in Different Sampling Stations in Leyte Gulf, Matarinao Bay and Maqueda Bay



Appendix B-1. Particle size categorization of sampling stations in Leyte Gulf.

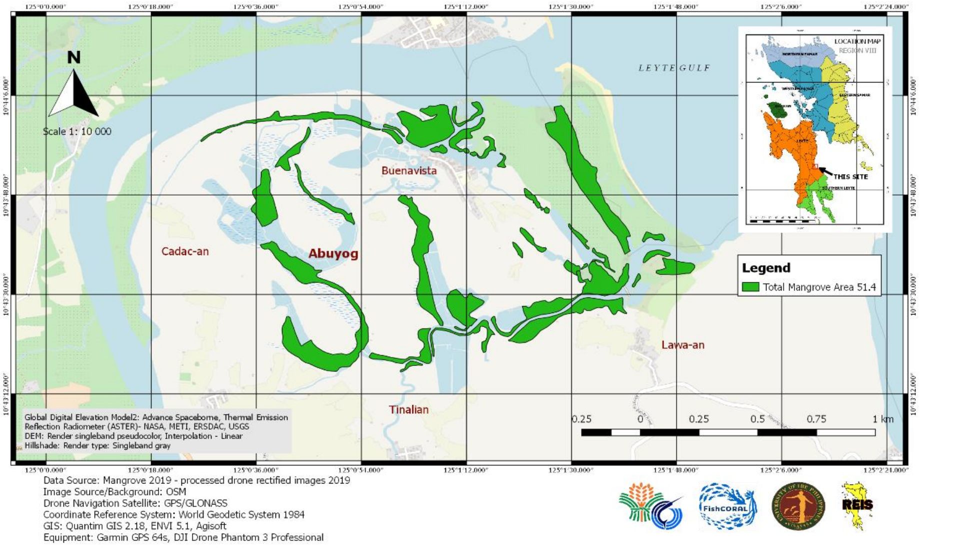


Appendix B-2. Particle size categorization of sampling stations in Matarinao Bay.

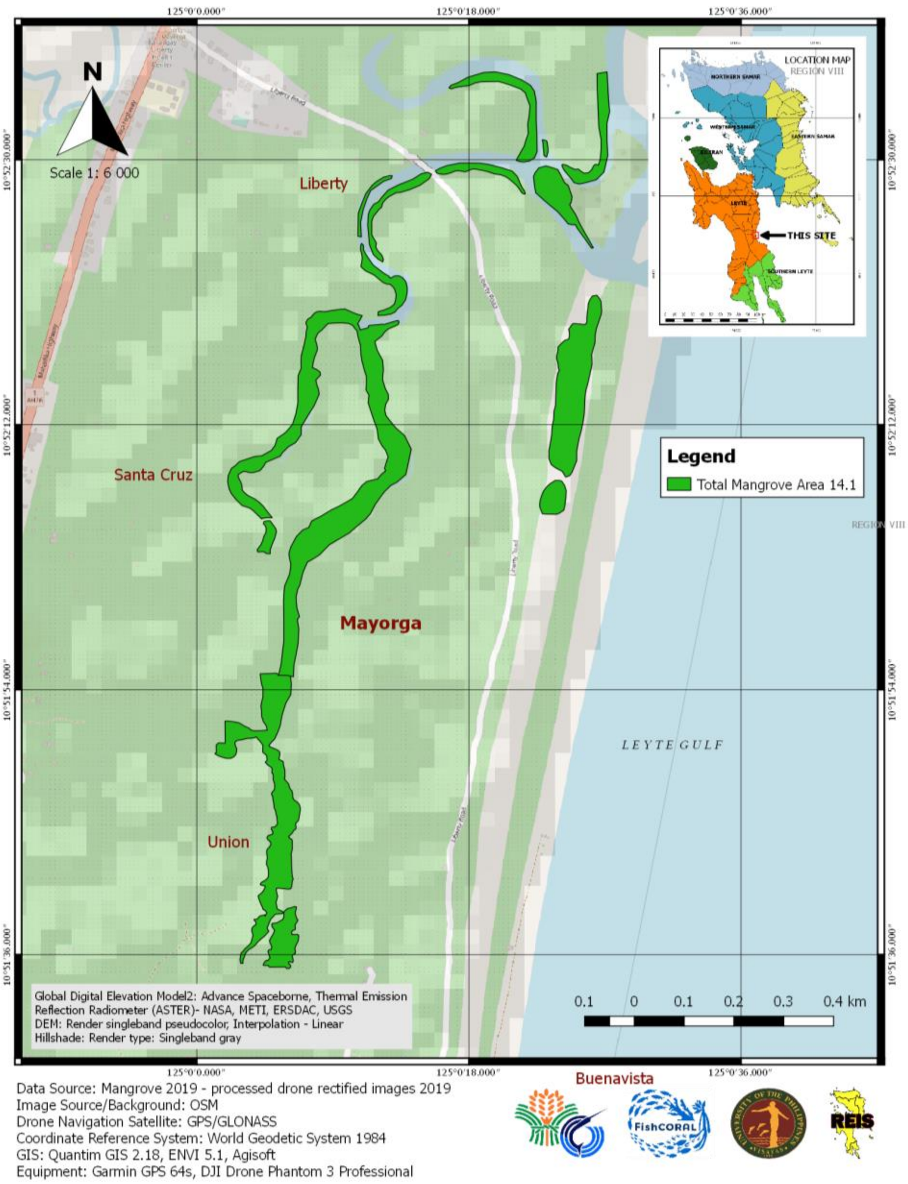


Appendix B-3. Particle size categorization of sampling stations around Maqueda Bay.

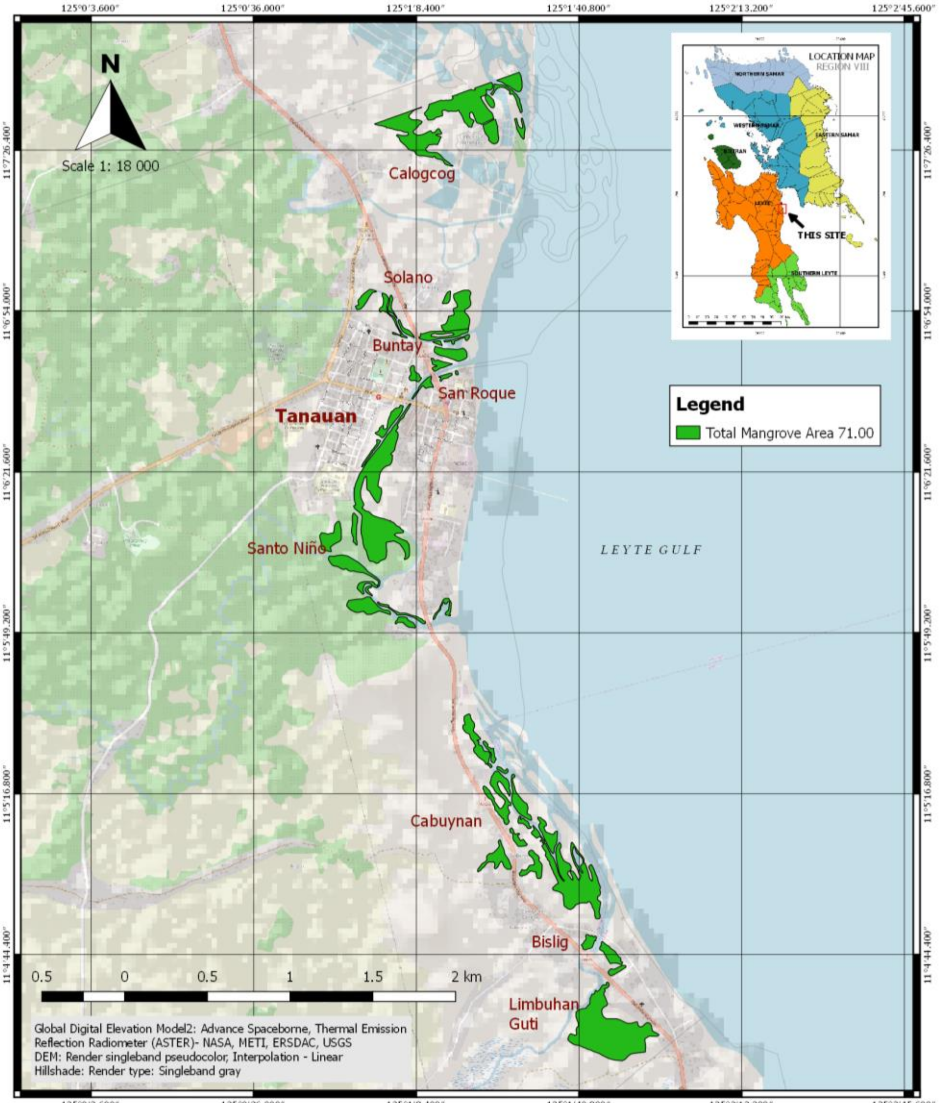
Comparative Distribution of Mangrove Cover in Leyte Gulf, Matarinao Bay and Maqueda Bay



Appendix B-4. Mangrove Cover in Abuyog, Leyte.

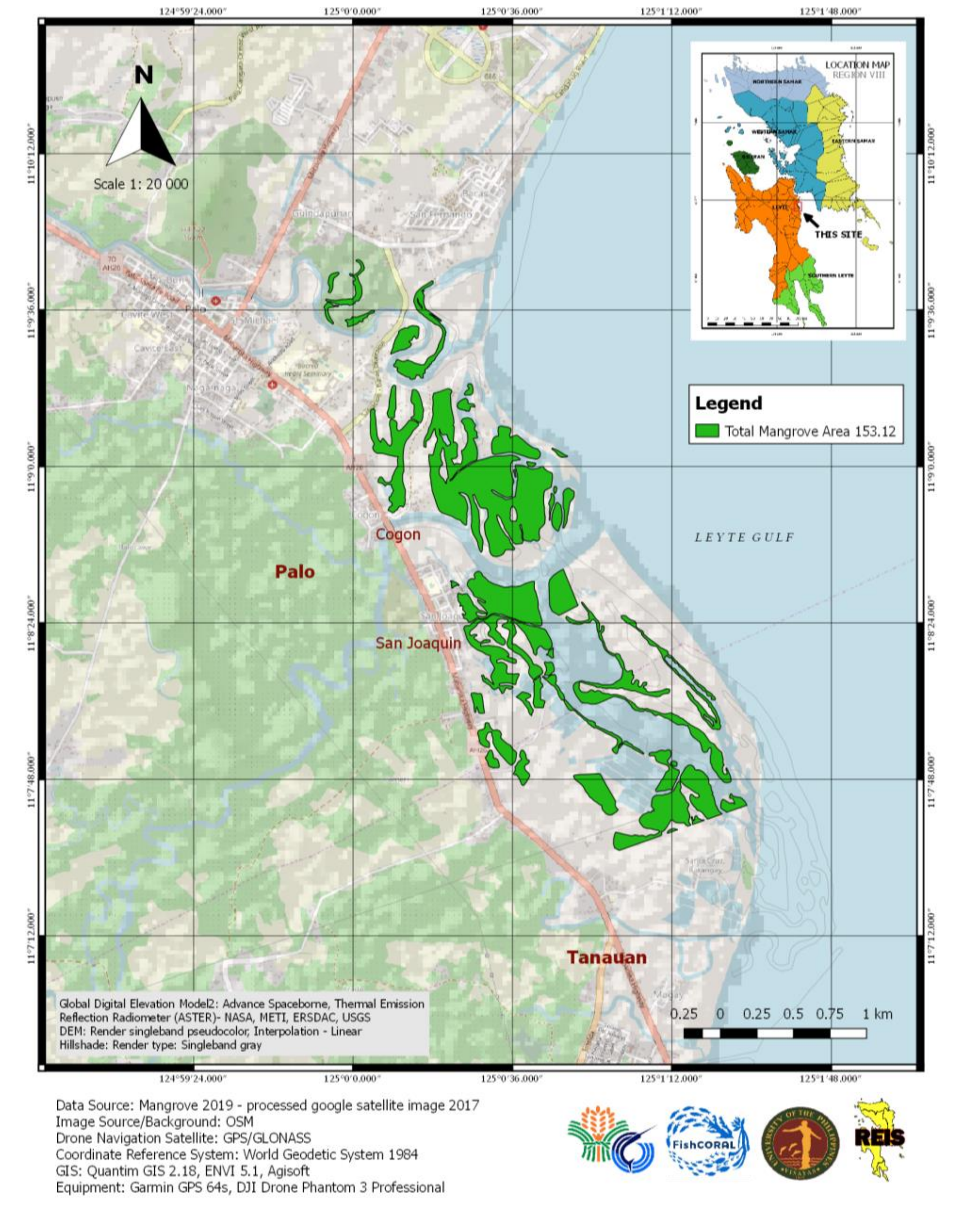


Appendix B-5. Mangrove cover in Mayorga, Leyte.

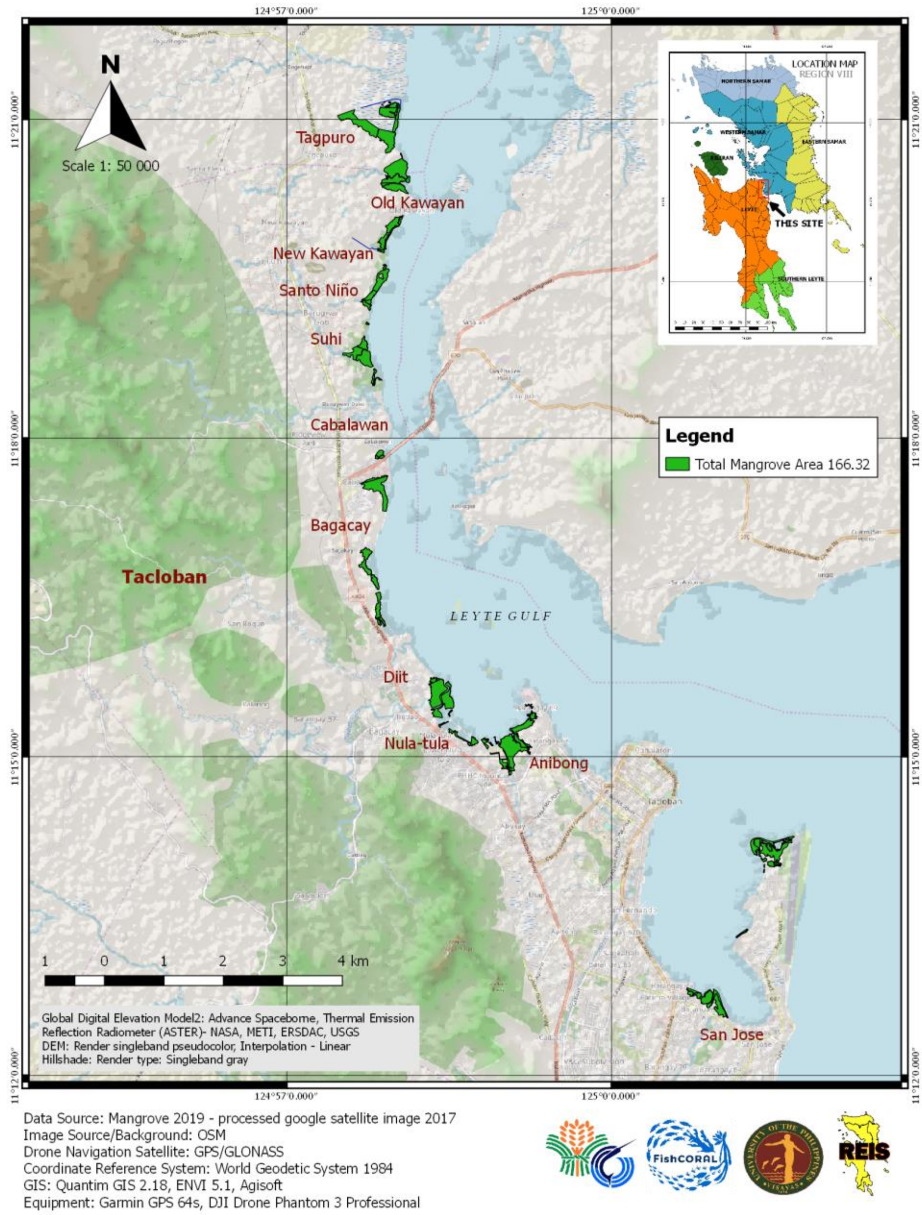


Data Source: Mangrove 2019 - processed google satellite image 2017
Image Source/Background: OSM
Drone Navigation Satellite: GPS/GLONASS
Coordinate Reference System: World Geodetic System 1984
GIS: Quantim GIS 2.18, ENVI 5.1, Agisoft
Equipment: Garmin GPS 64s, DJI Drone Phantom 3 Professional

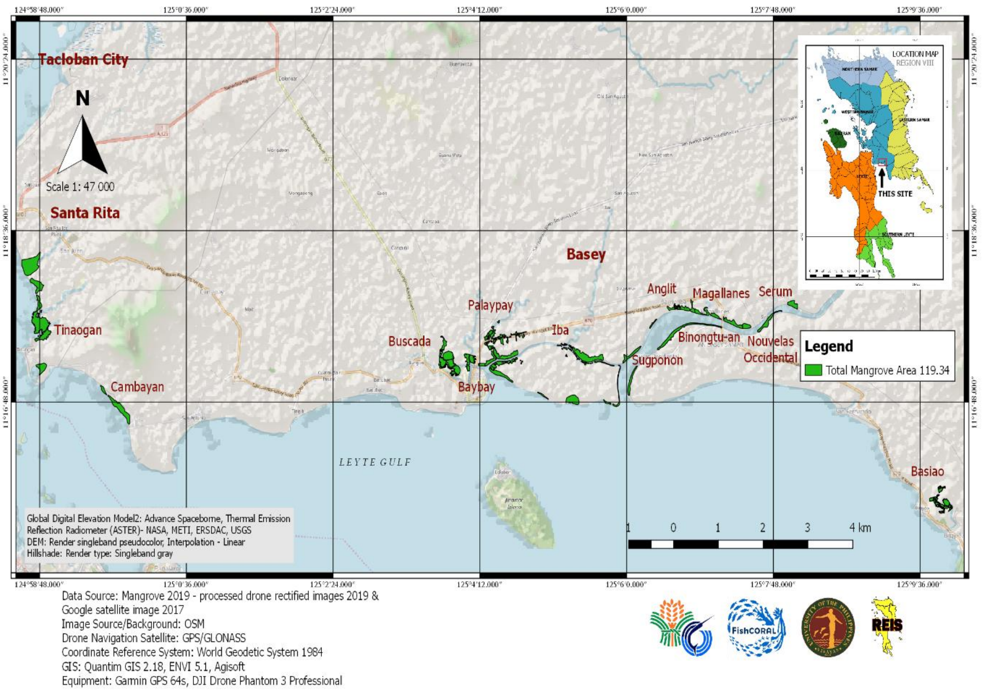
Appendix B-6. Mangrove cover in Tanauan, Leyte.



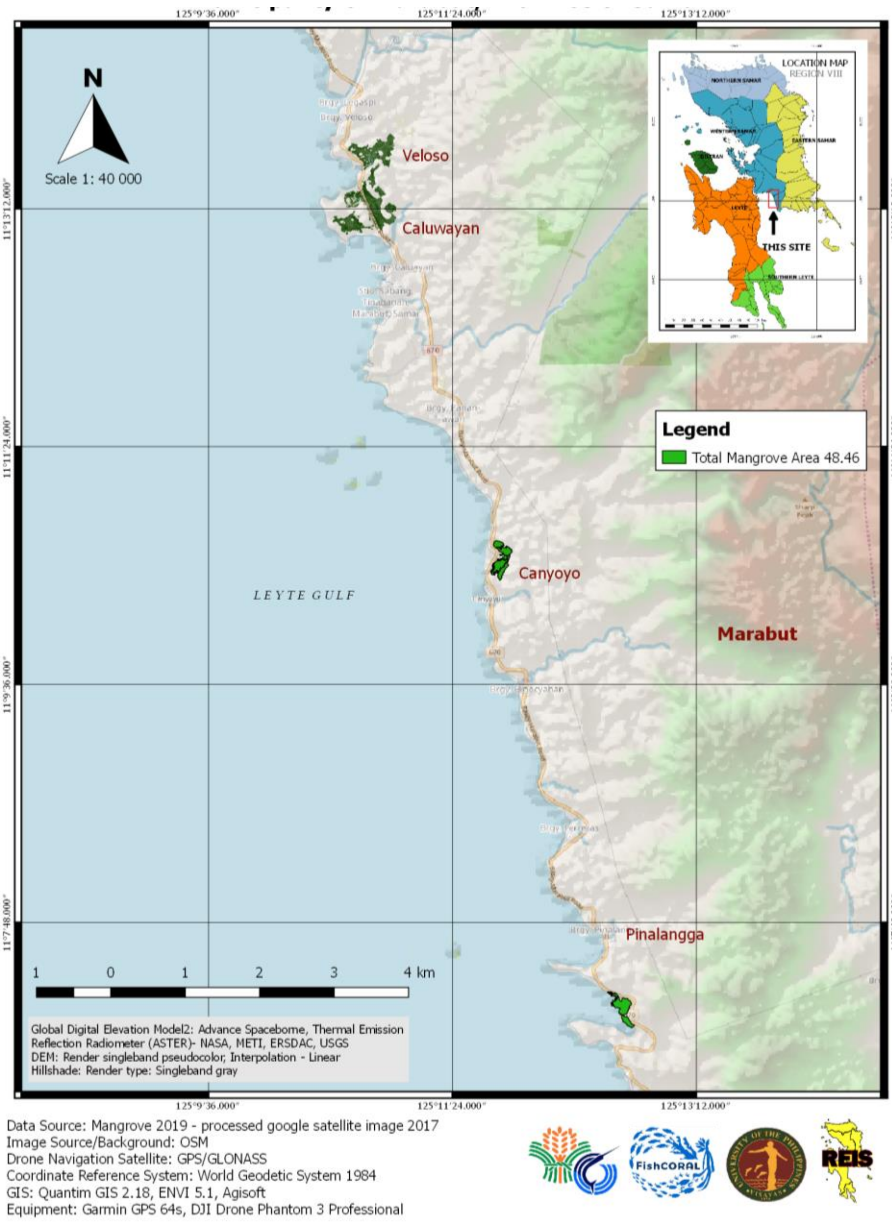
Appendix B-7. Mangrove cover in Palo, Leyte.



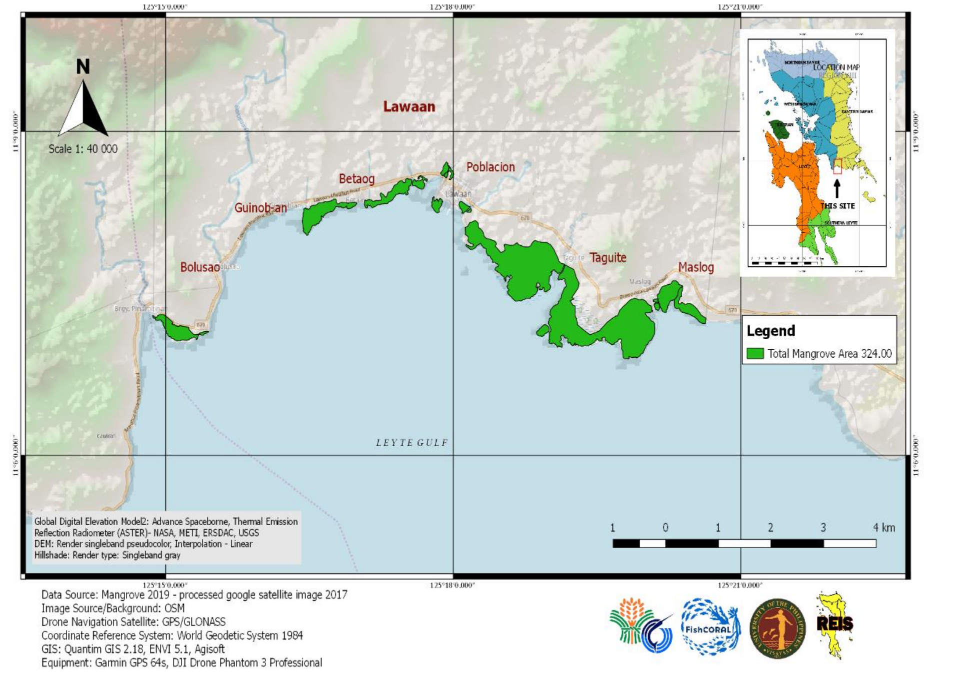
Appendix B-8. Mangrove Cover in Tacloban City, Leyte.



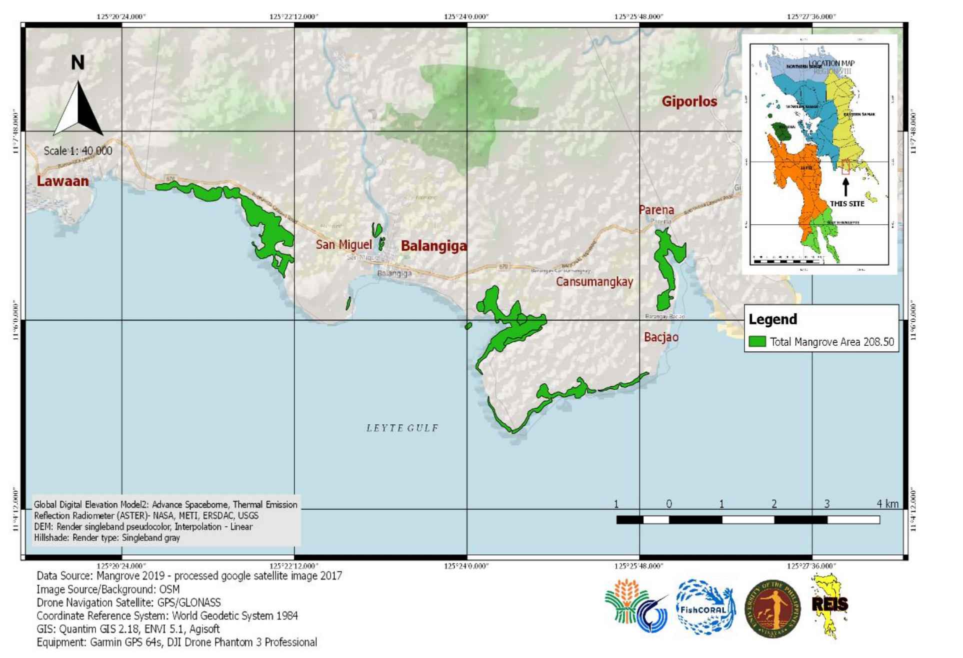
Appendix B-9. mangrove cover in Basey, Samar.



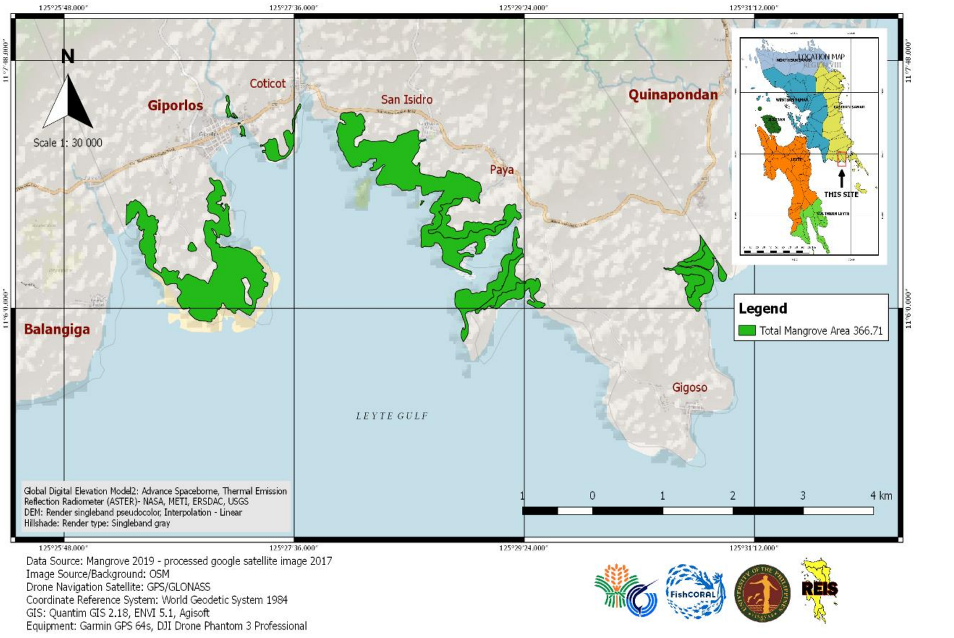
Appendix B-10. Mangrove cover in Marabut, Samar.



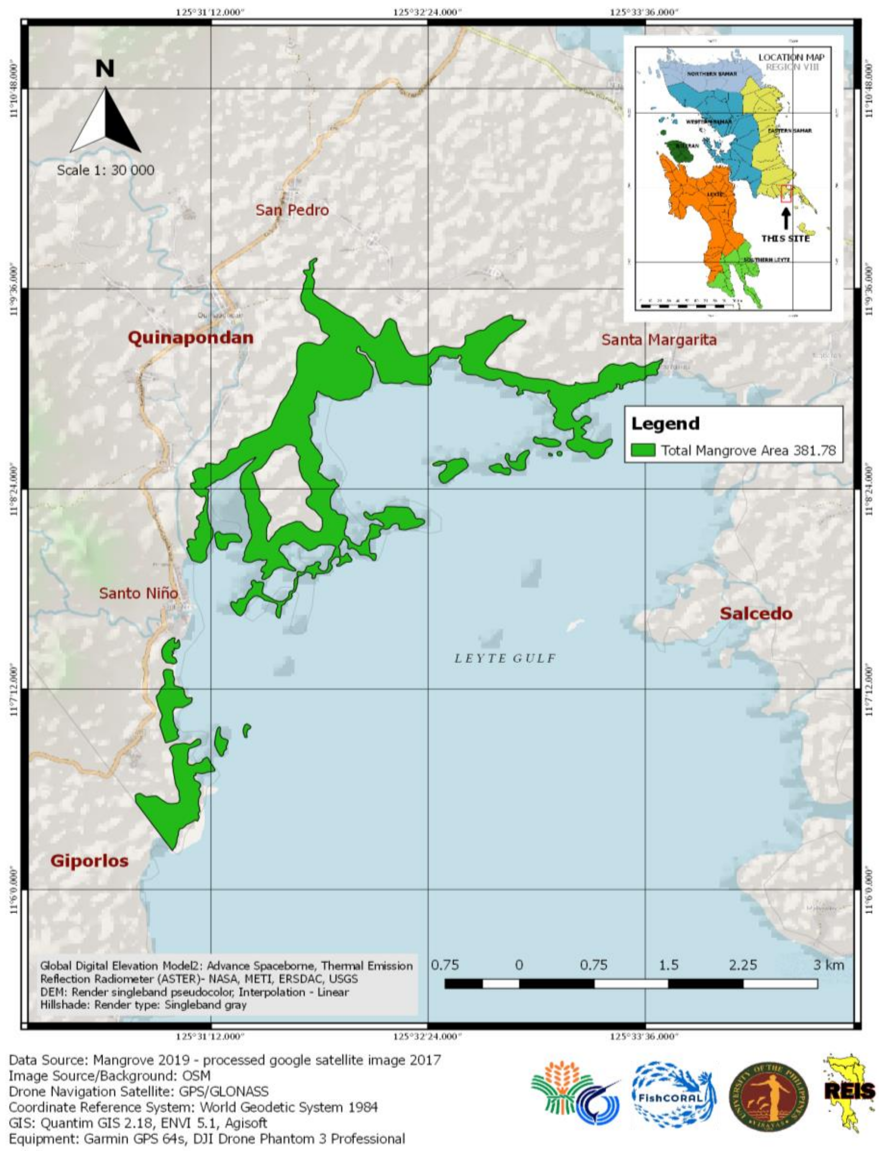
Appendix B-11. Mangrove cover in Lawaan, Eastern Samar.



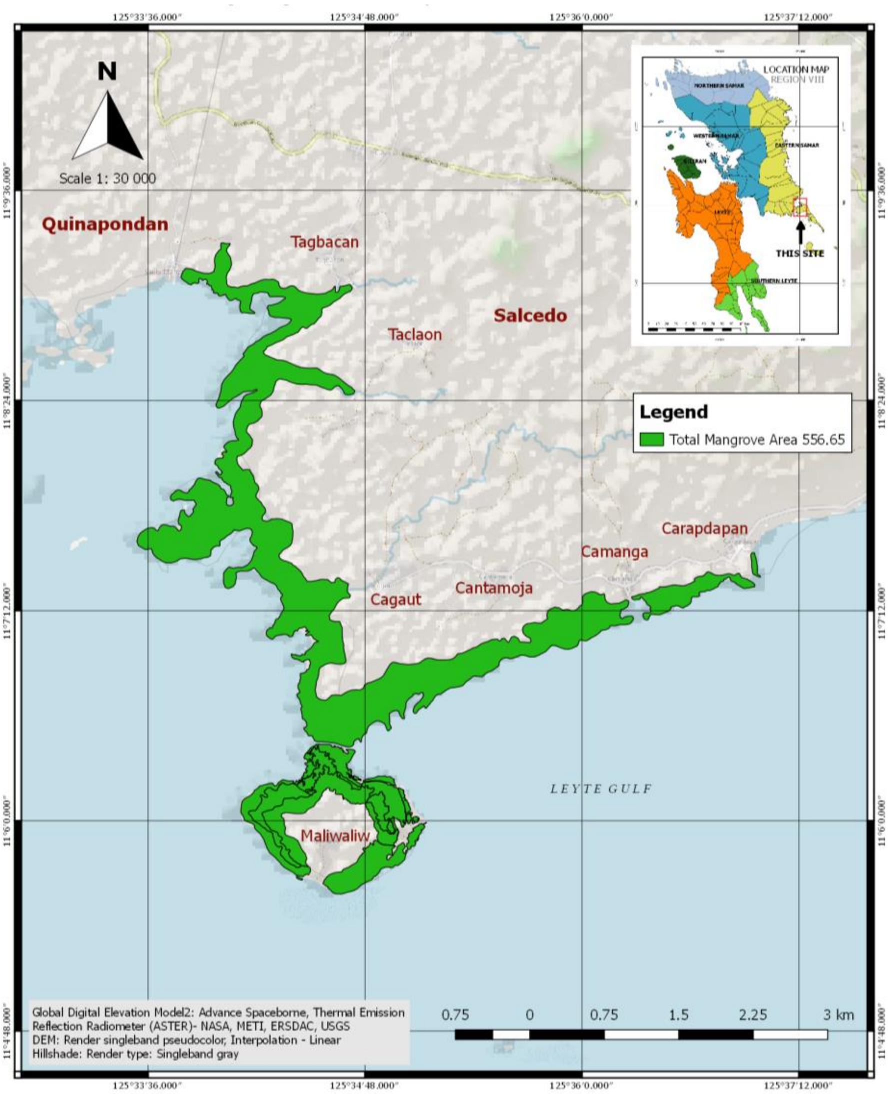
Appendix B-12. Mangrove Cover in Balangiga, Eastern Samar.



Appendix B-13. Mangrove cover in Giporlos, Eastern Samar.

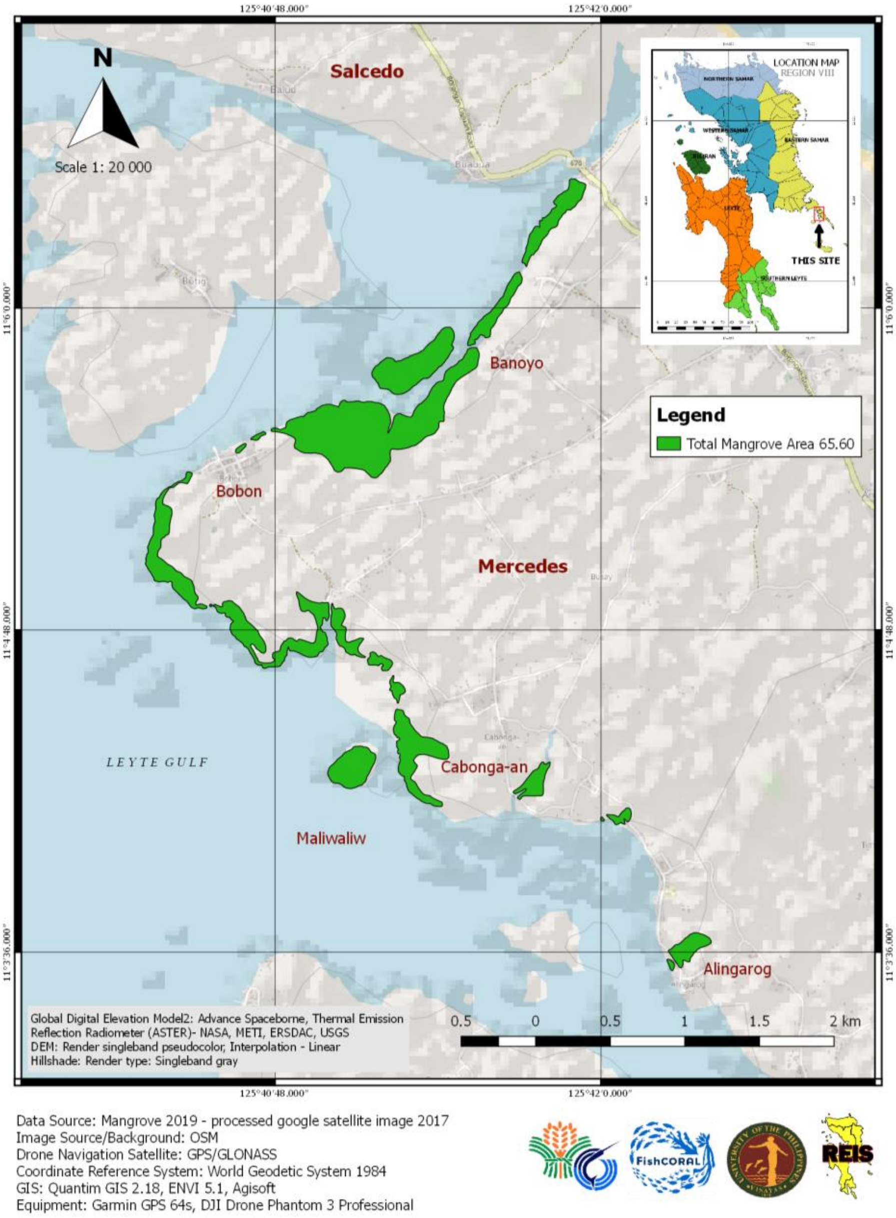


Appendix B-14. Mangrove cover in Quinapondan, Eastern Samar (facing Leyte Gulf).

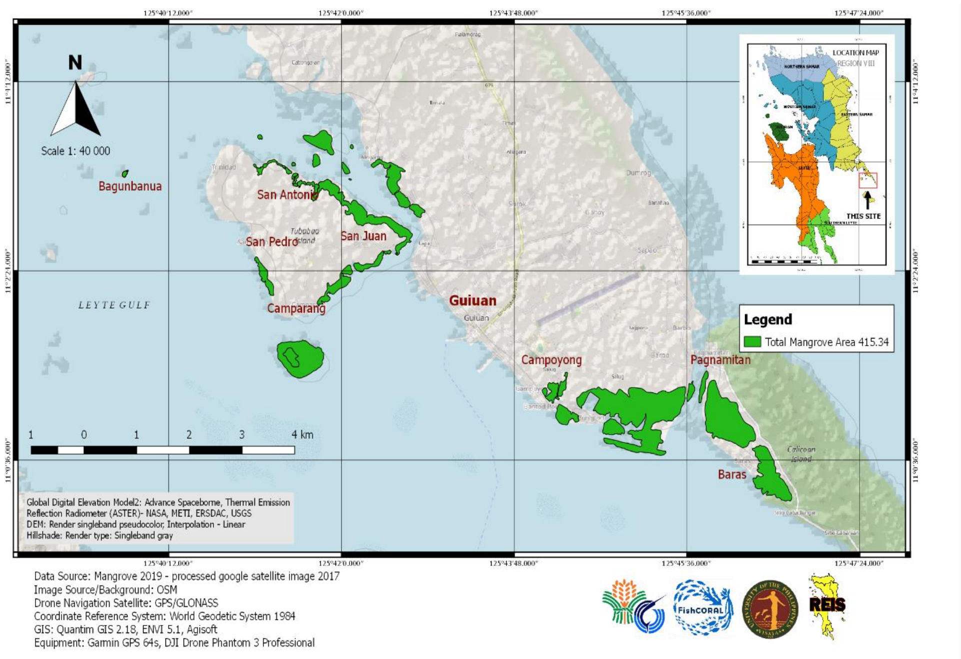


Data Source: Mangrove 2019 - processed google satellite image 2017
Image Source/Background: OSM
Drone Navigation Satellite: GPS/GLONASS
Coordinate Reference System: World Geodetic System 1984
GIS: Quantim GIS 2.18, ENVI 5.1, Agisoft
Equipment: Garmin GPS 64s, DJI Drone Phantom 3 Professional

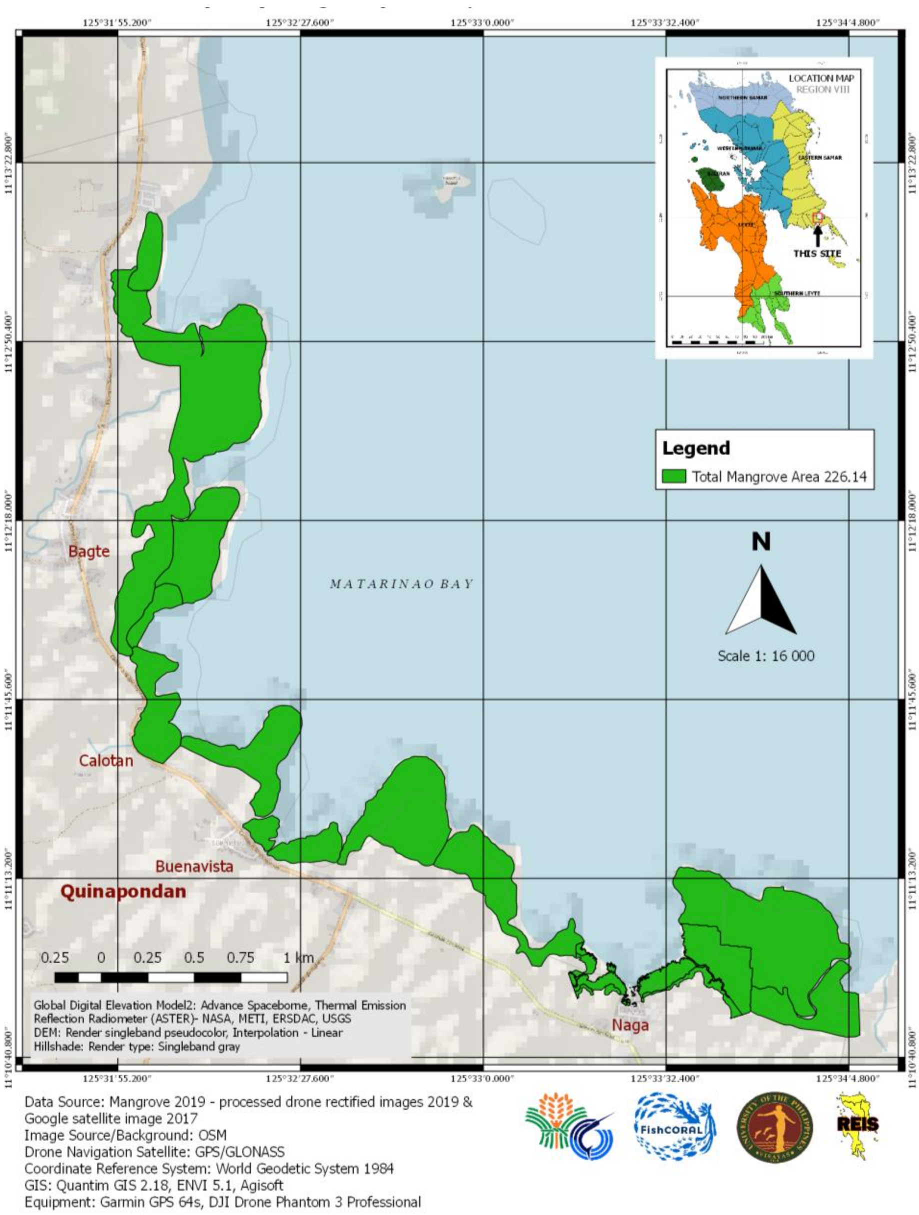
Appendix B-15. Mangrove cover in Salcedo, Eastern Samar (facing Leyte Gulf).



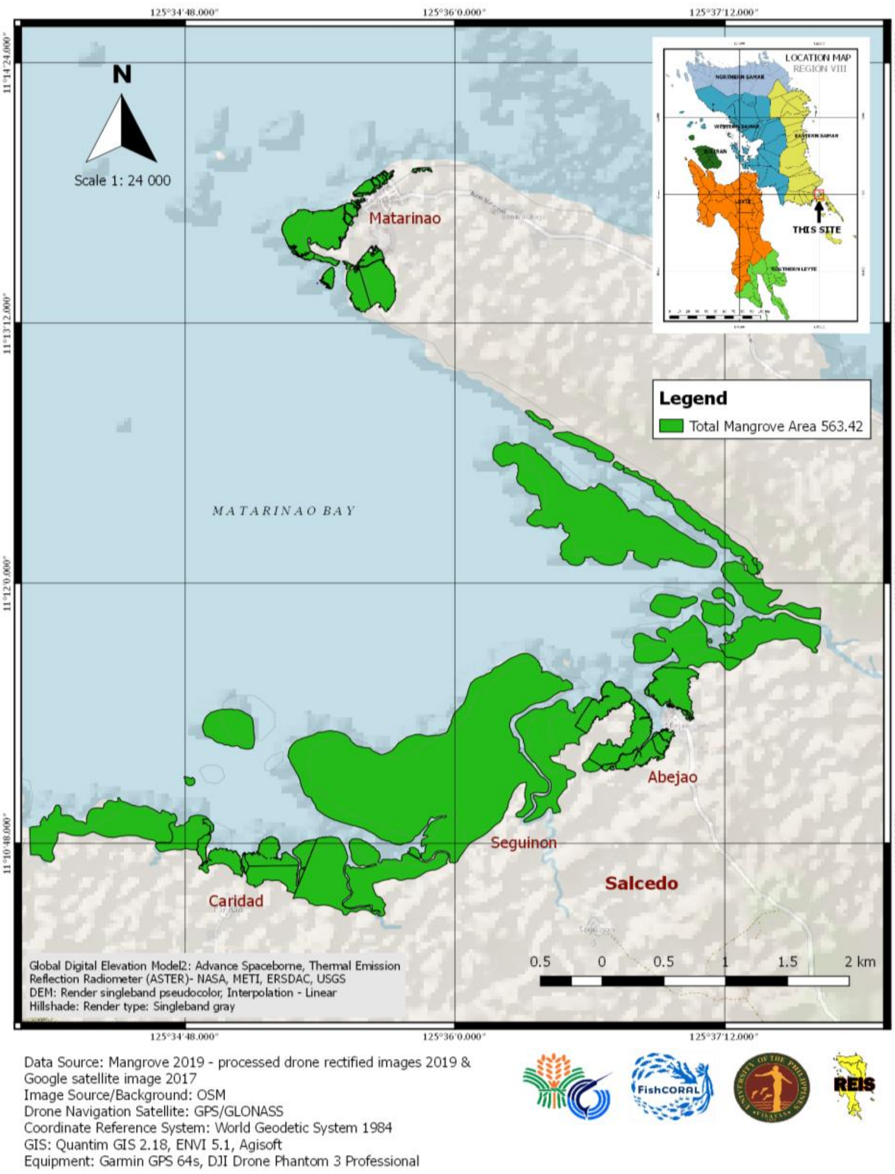
Appendix B-16. Mangrove cover in Mercedes, Eastern Samar.



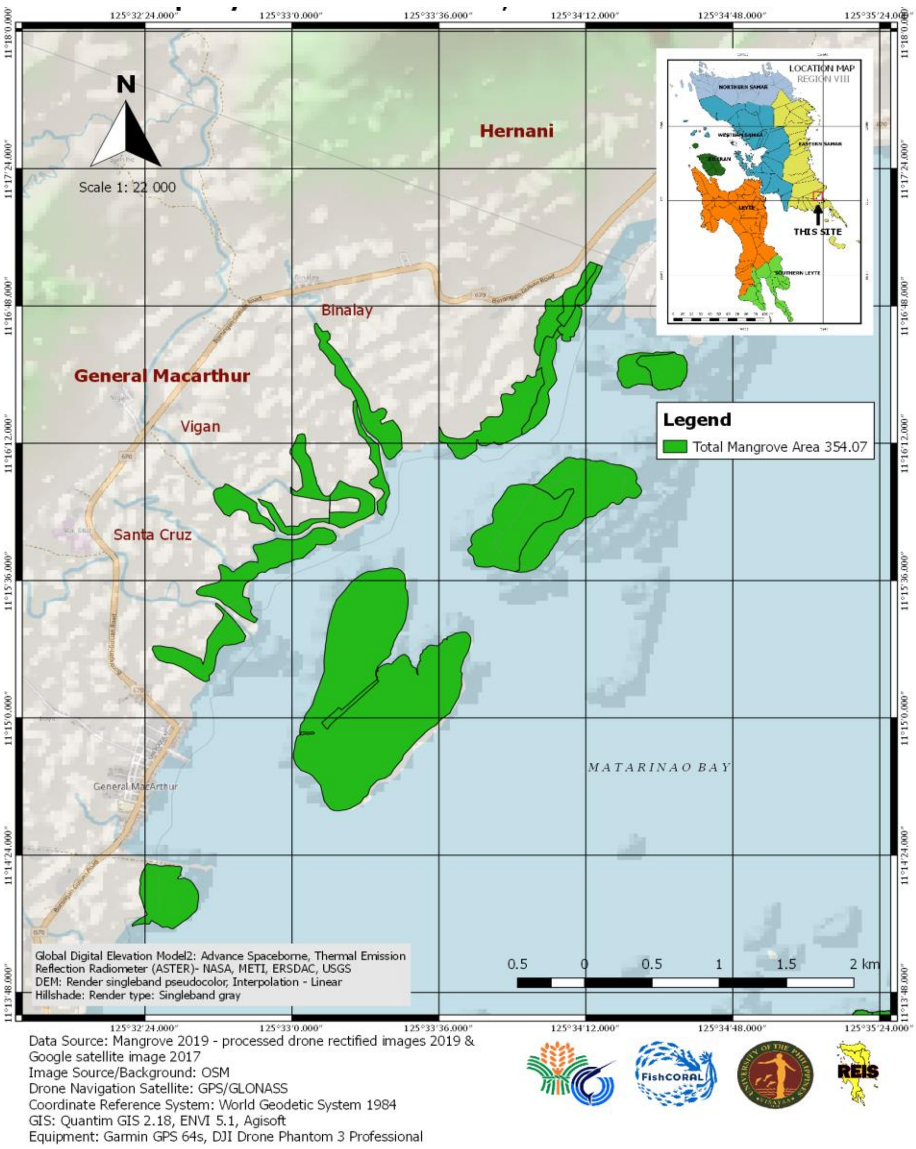
Appendix B-17. Mangrove cover in Guiuan, Eastern Samar.



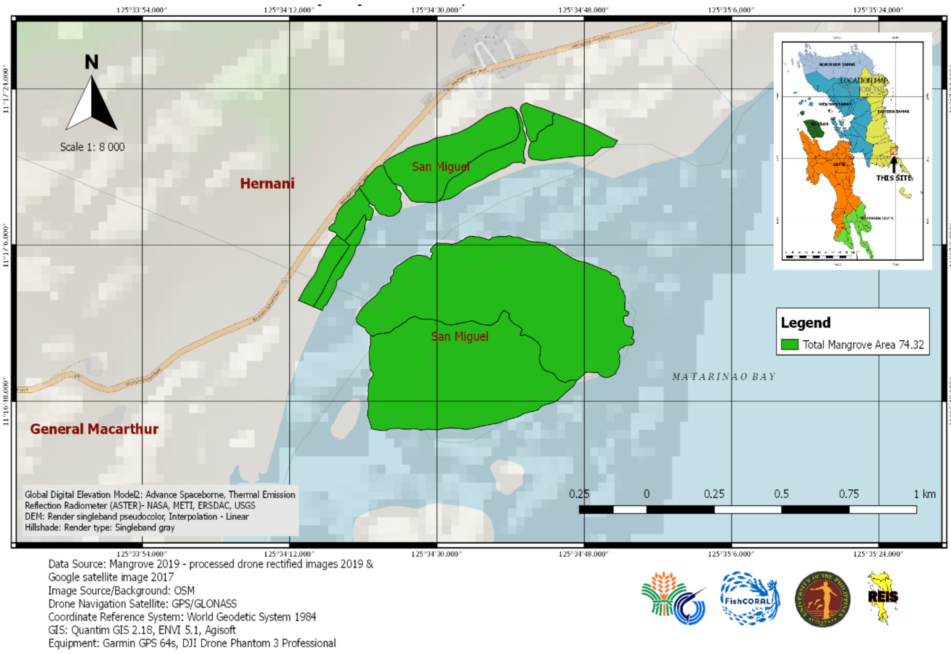
Appendix B-18. Mangrove cover in Quinapondan, Eastern Samar (facing Matarinao Bay).



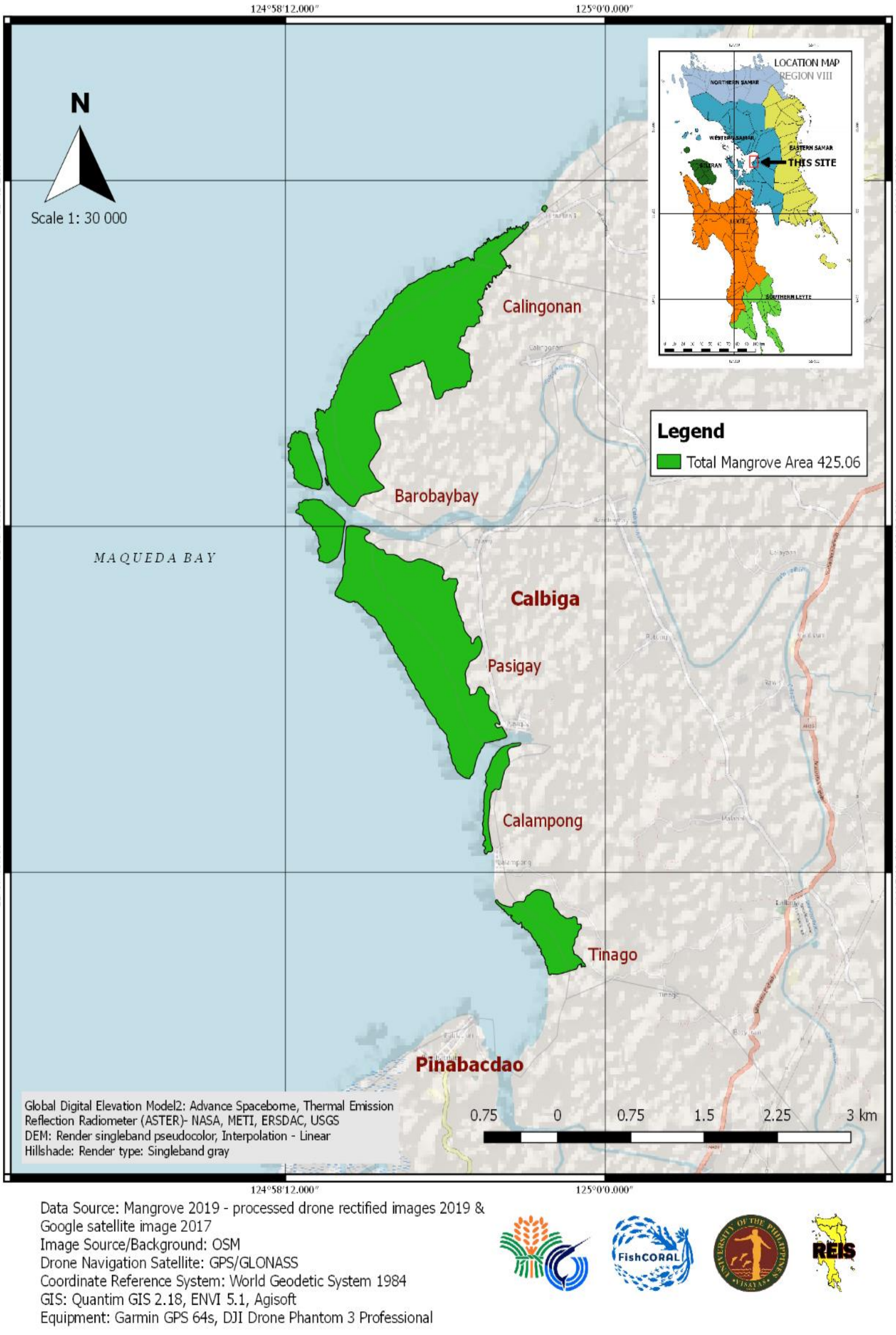
Appendix B-19. Mangrove cover in Salcedo, Eastern Samar (facing Matarinao Bay).



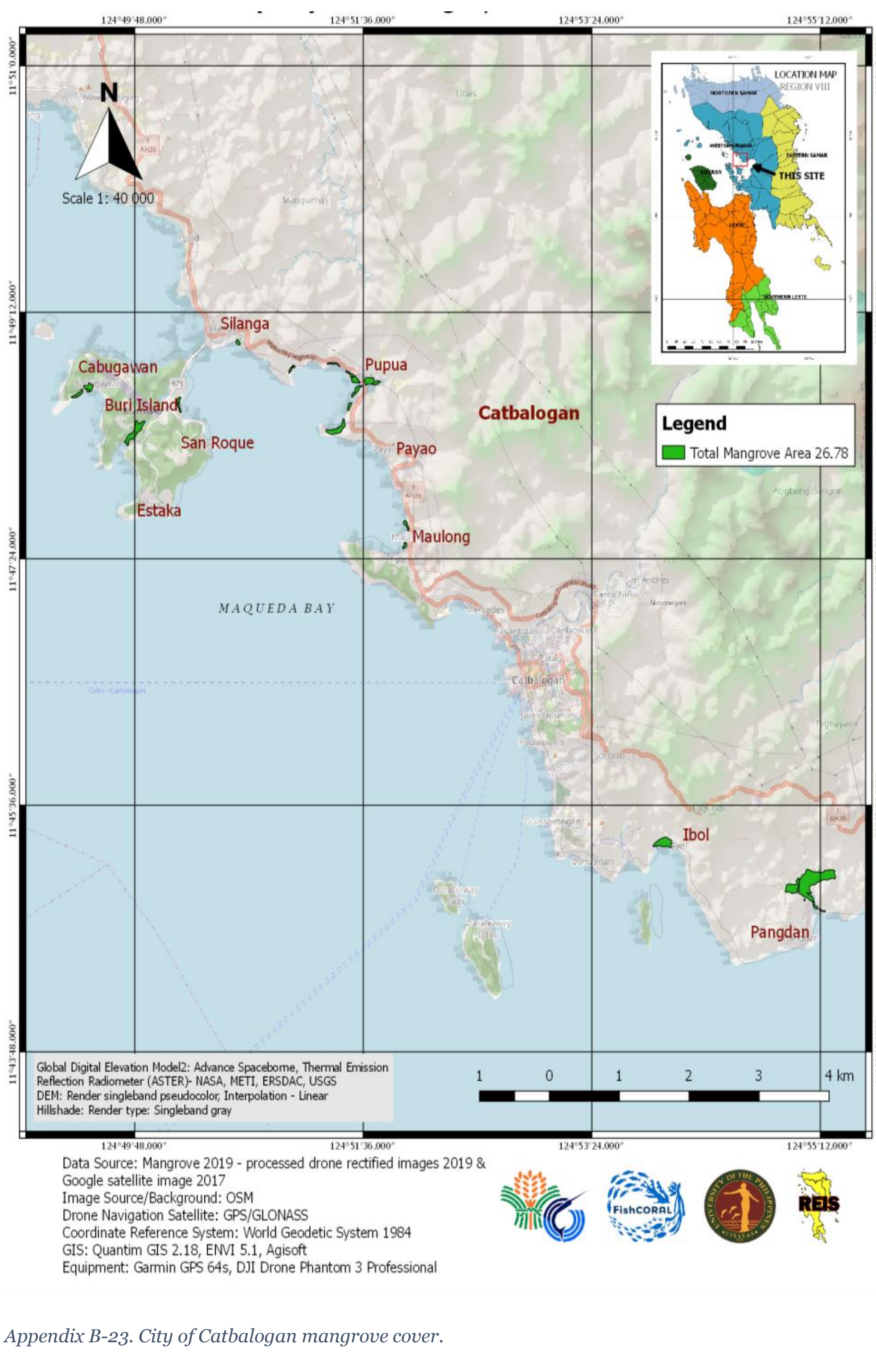
Appendix B-20. Mangrove cover in General Mcarthur, Eastern Samar.



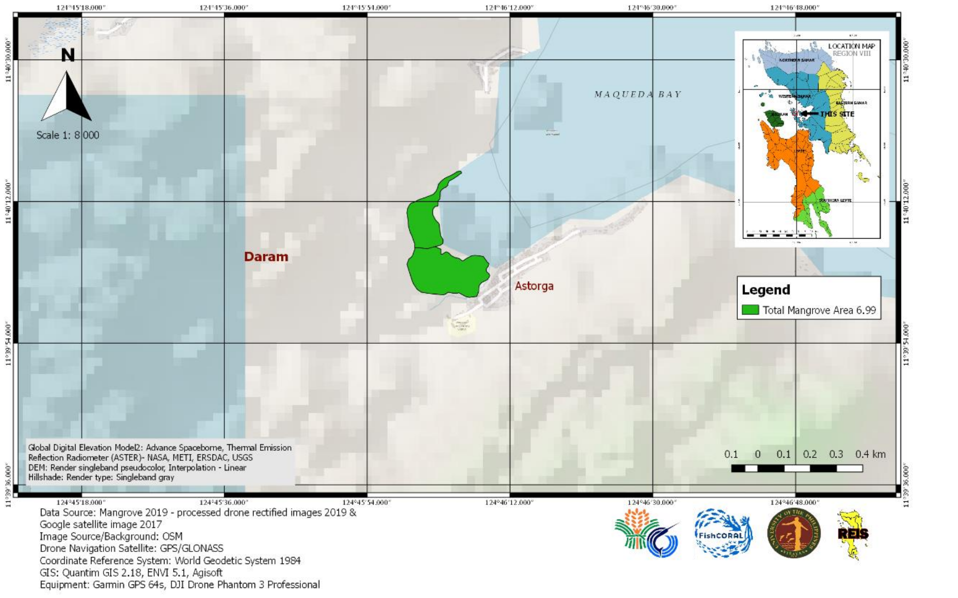
Appendix B-21. Mangrove cover in Hernani, Eastern Samar.



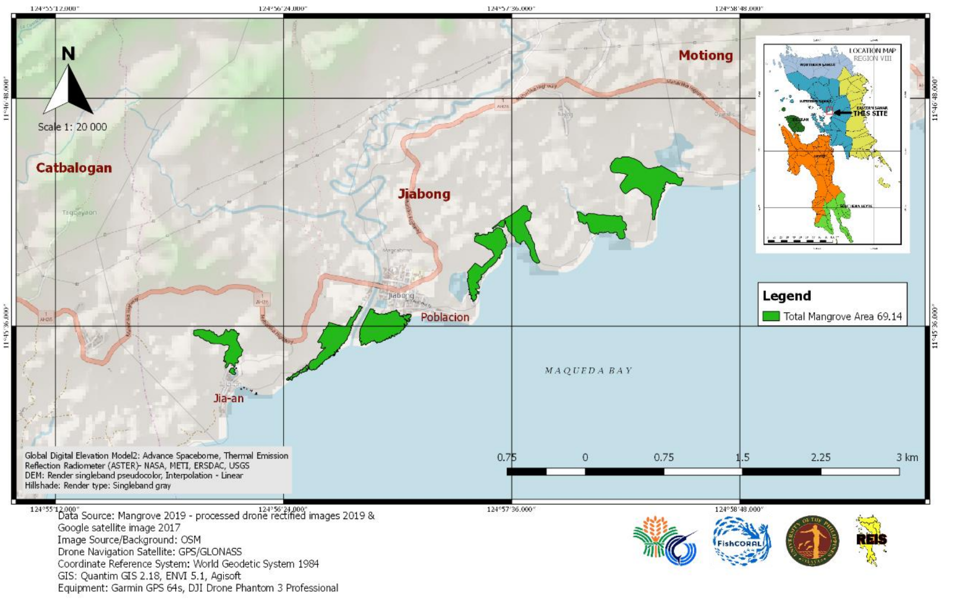
Appendix B-22. Municipality of Calbiga mangrove cover.



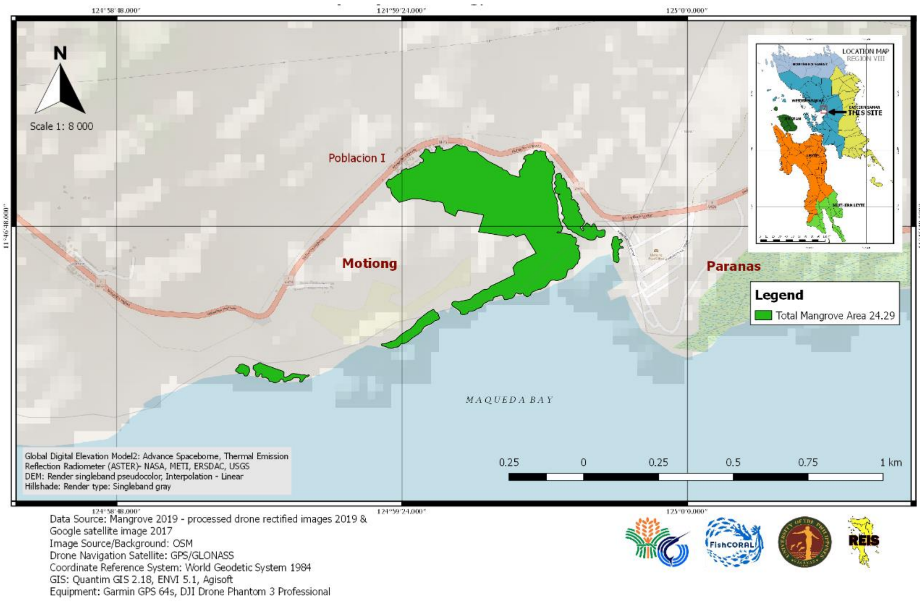
Appendix B-23. City of Catbalogan mangrove cover.



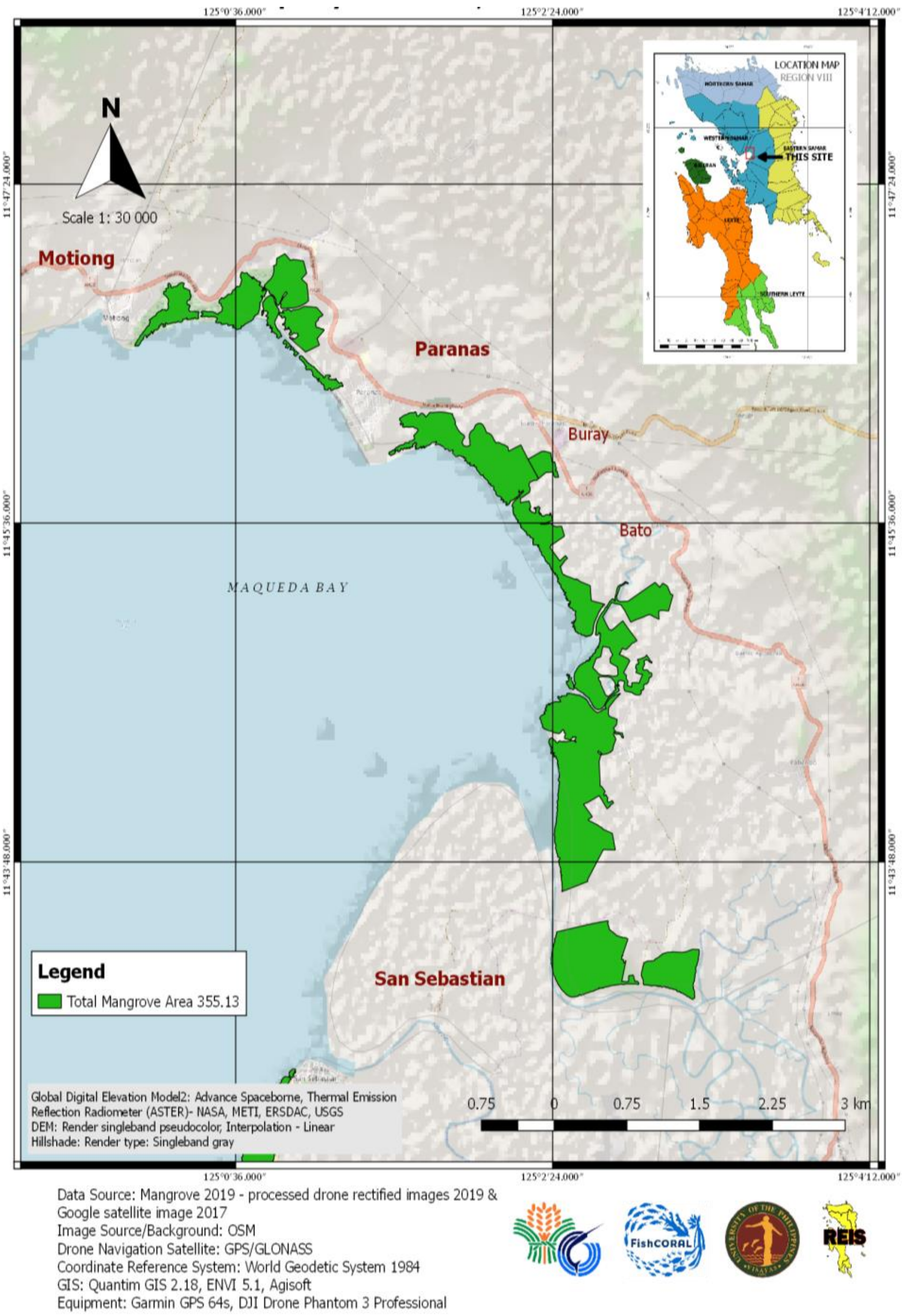
Appendix B-24. Municipality of Daram mangrove cover.



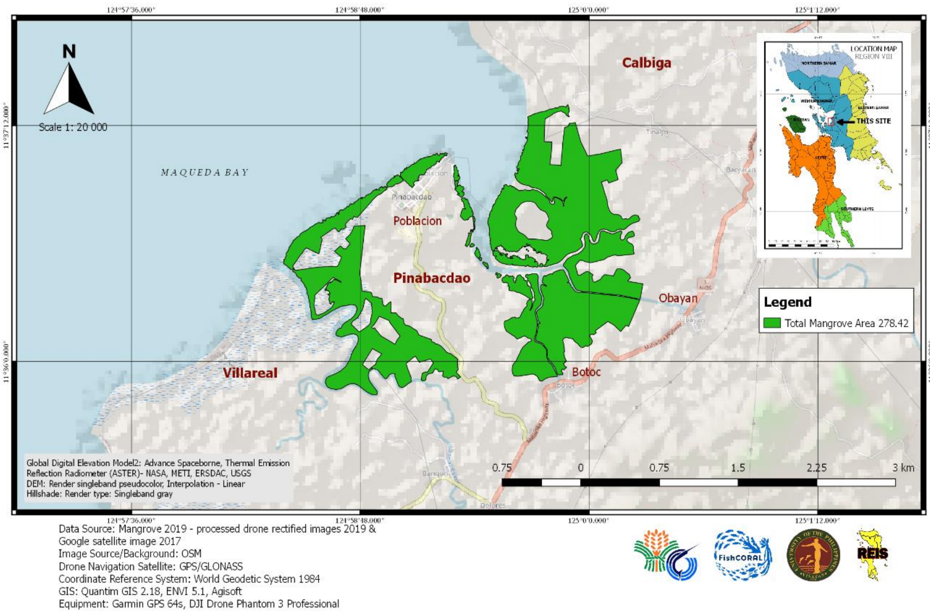
Appendix B-25. Municipality of Jiabong mangrove cover.



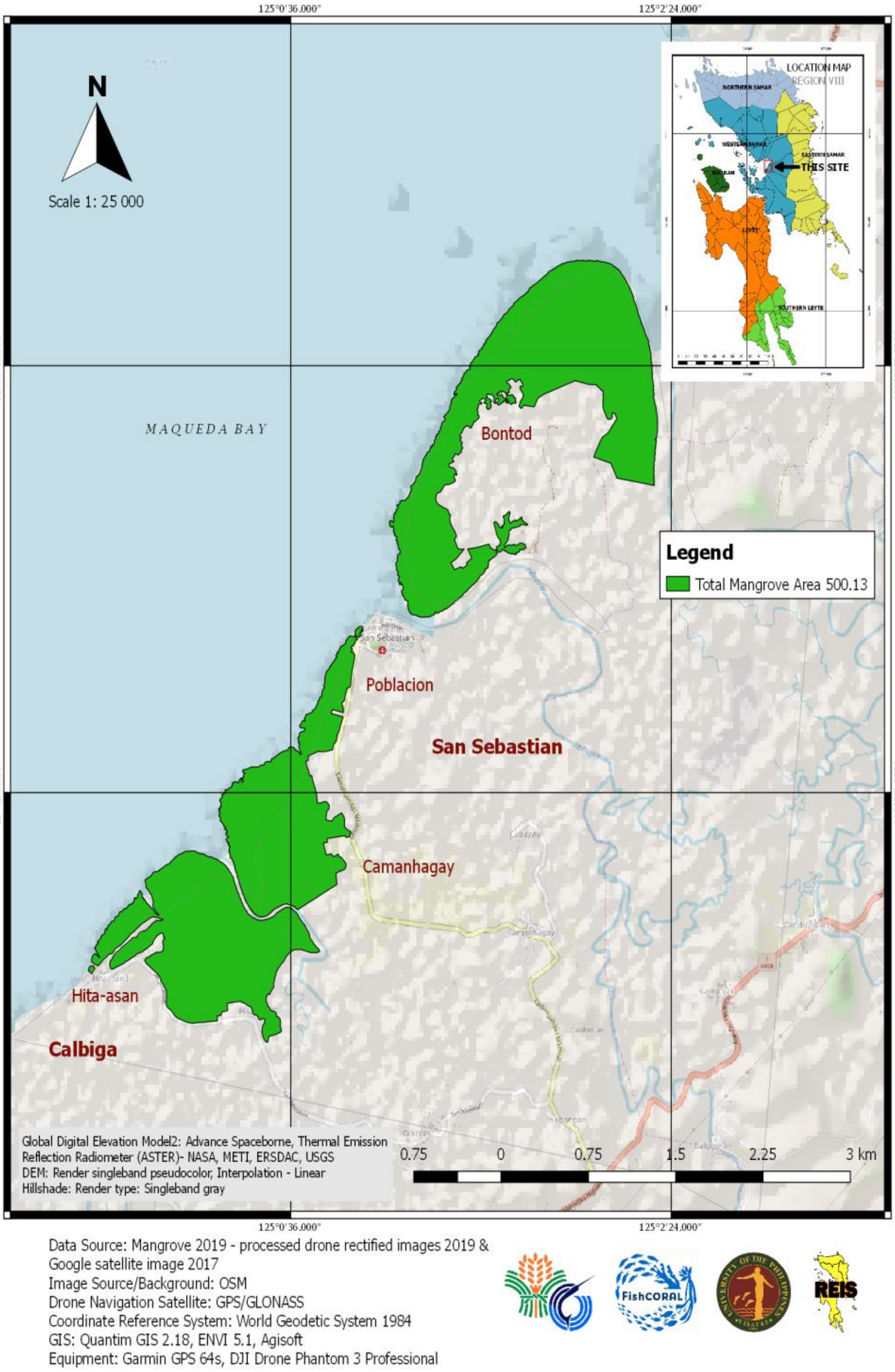
Appendix B-26. Municipality of Motiong mangrove cover.



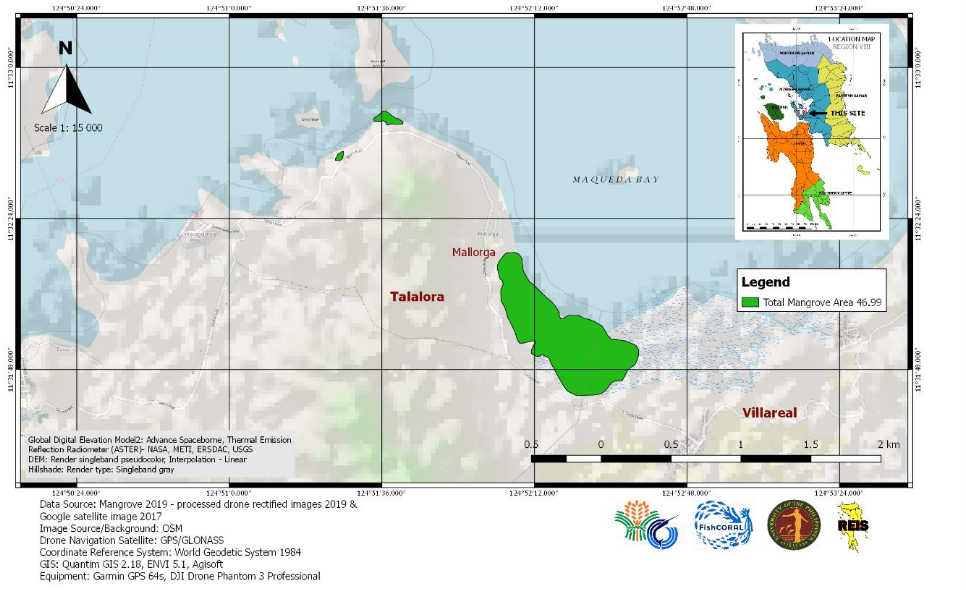
Appendix B-27. Municipality of Paranas mangrove cover.



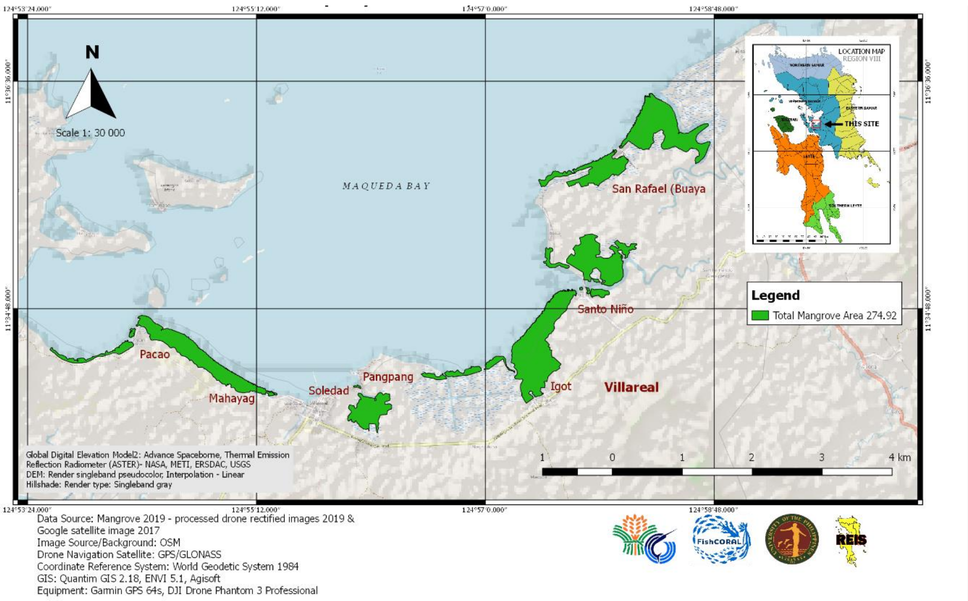
Appendix B-28. Municipality of Pinabacdao mangrove cover.



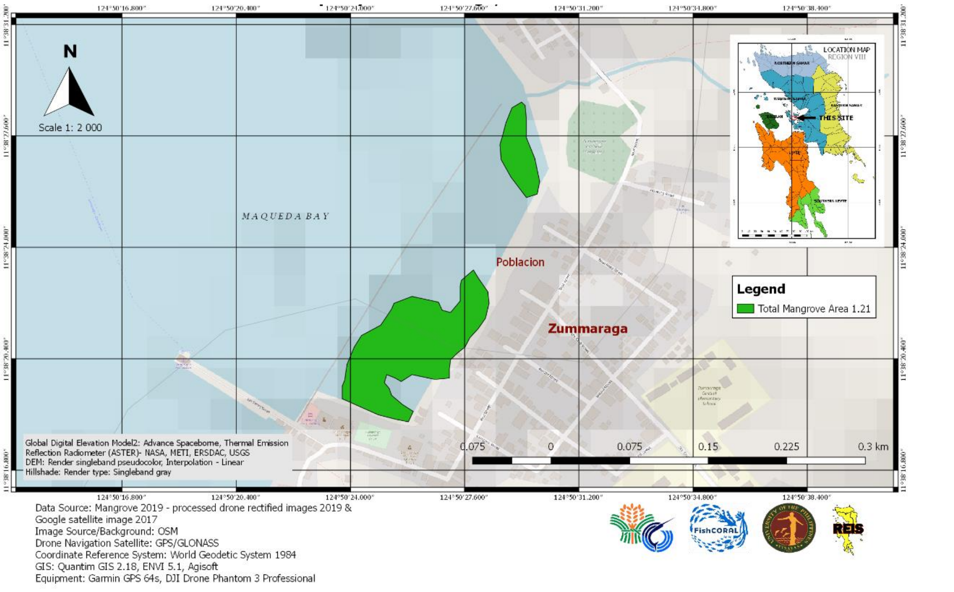
Appendix B-29. Municipality of San Sebastian mangrove cover.



Appendix B-30. Municipality of Talalora mangrove cover.

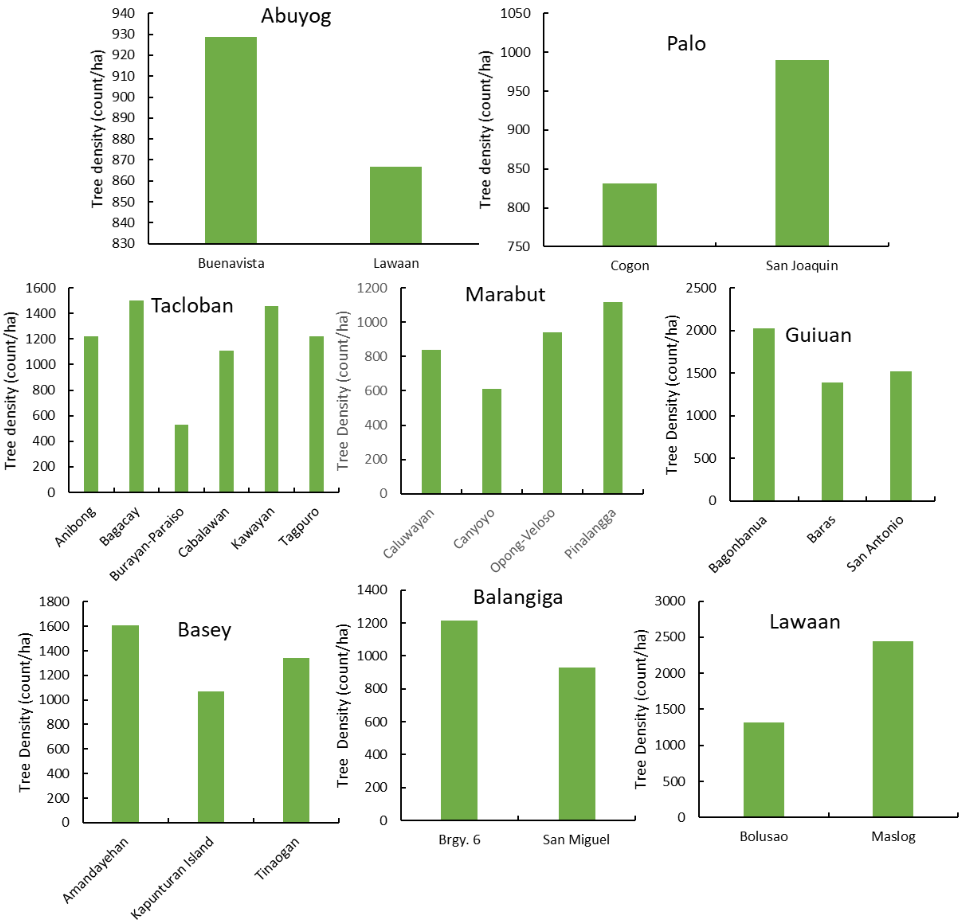


Appendix B-31. Municipality of Villareal mangrove cover.

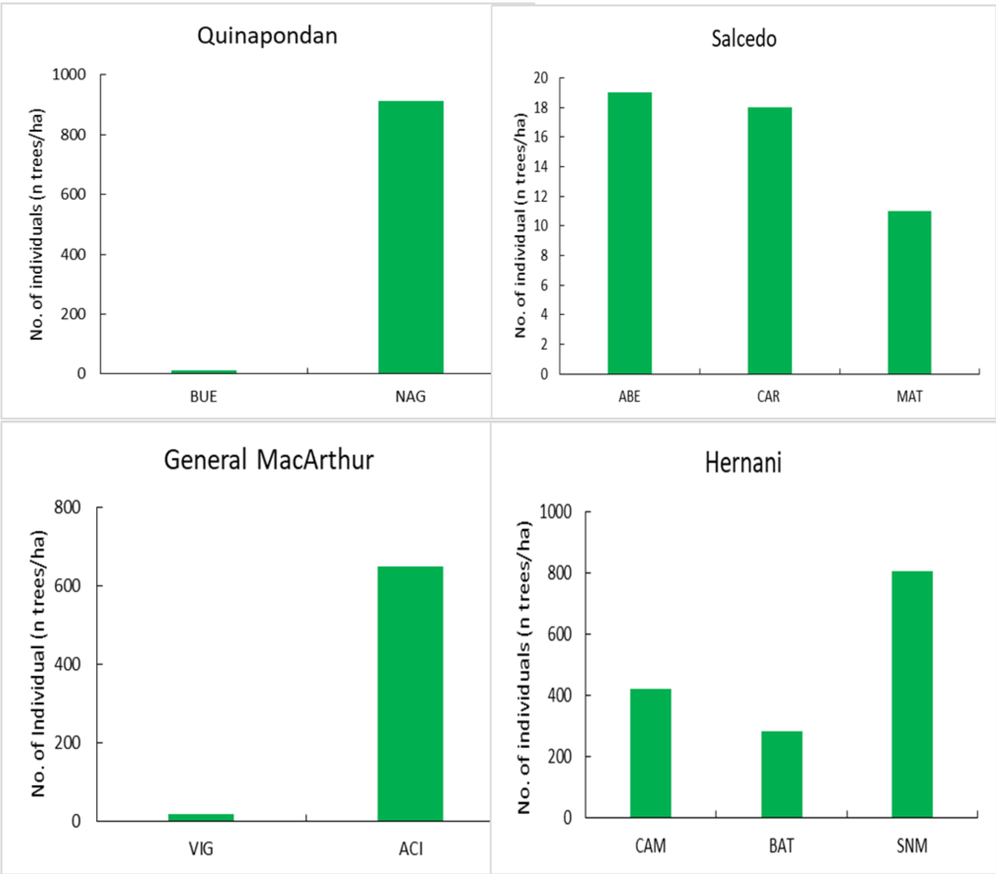


Appendix B-32. Municipality of Zumarraga mangrove cover.

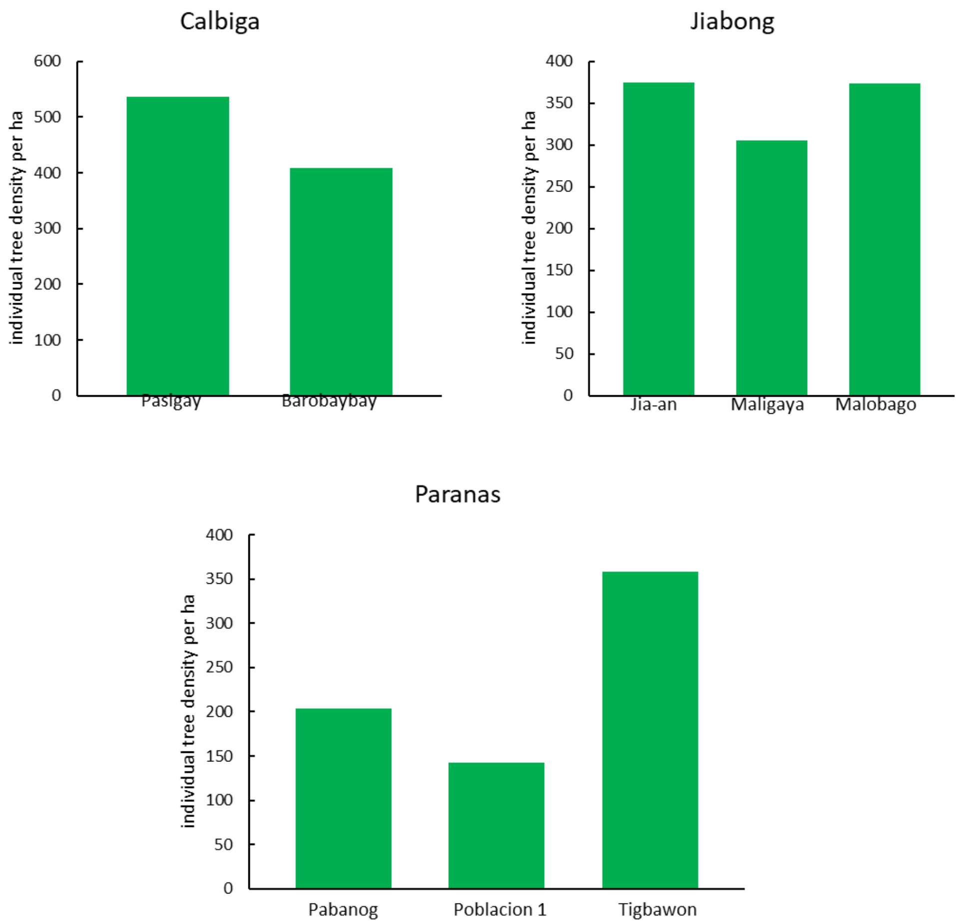
Mangrove Tree Density of Sampling Stations in Leyte Gulf, Matarinao Bay and Maqueda Bay



Appendix B-33. Mangrove Tree Density of the different Municipalities in Leyte Gulf.



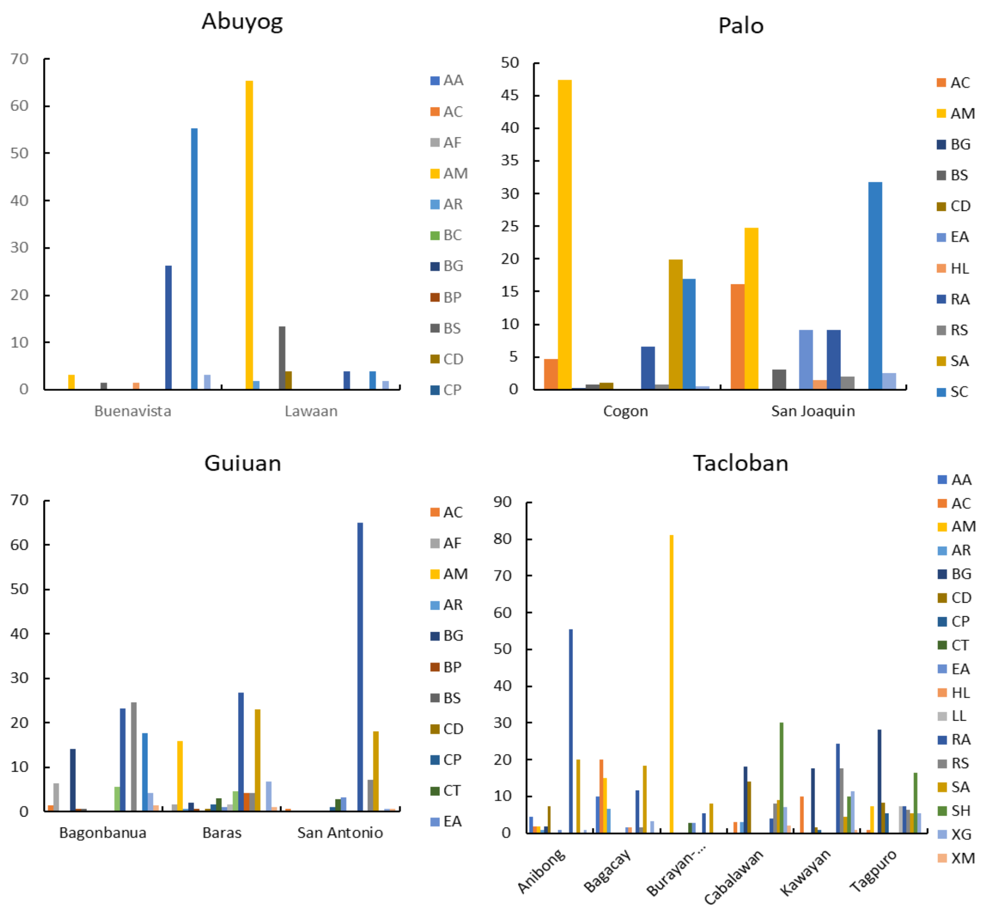
Appendix B-34. Mangrove Tree Density of the different Municipalities along Matarinao Bay.



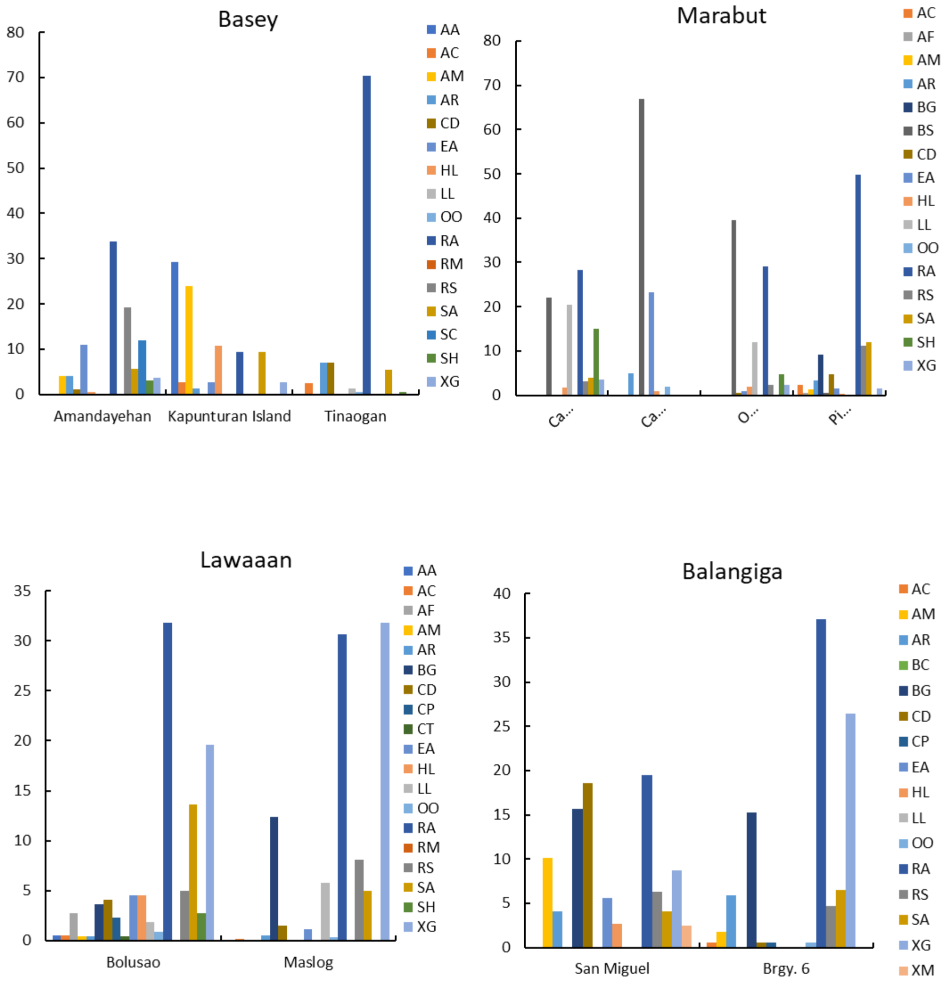
Note: municipality or city around Maqueda Bay not included has only one site or sampling station.

Appendix B-35. Mangrove Tree Density of the different Municipalities around Maqueda Bay.

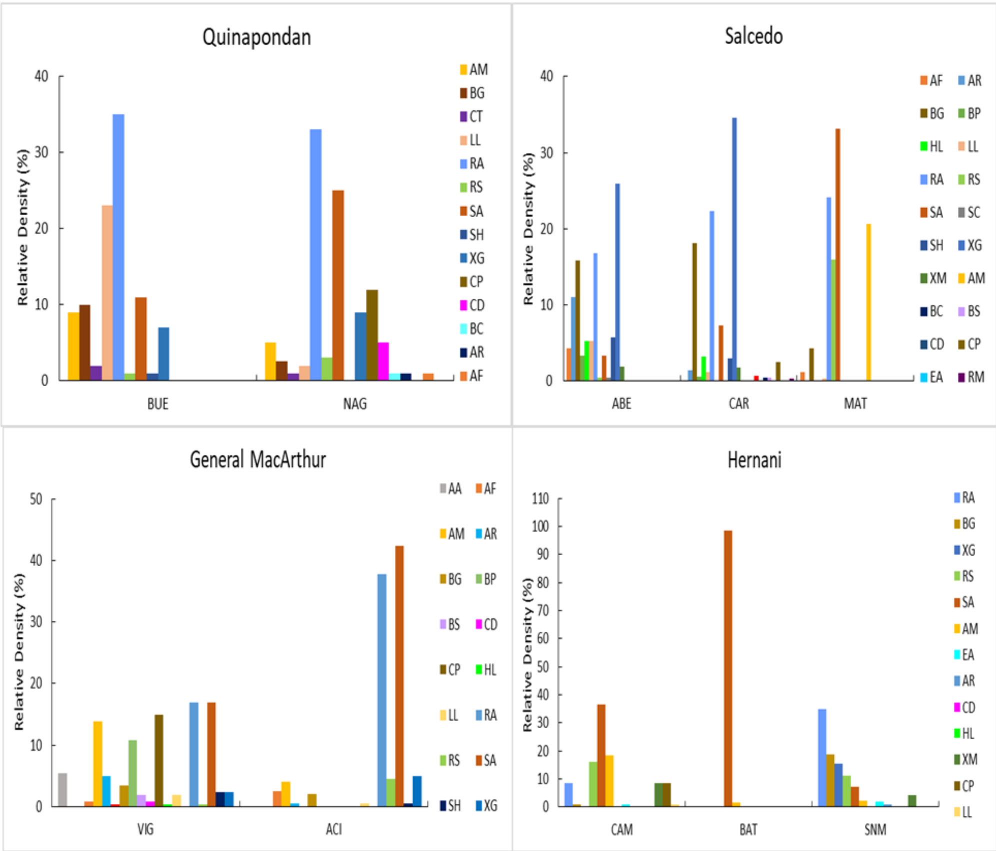
Relative Tree Density of Sampling Stations in Leyte Gulf, Matarinao Bay and Maqueda Bay



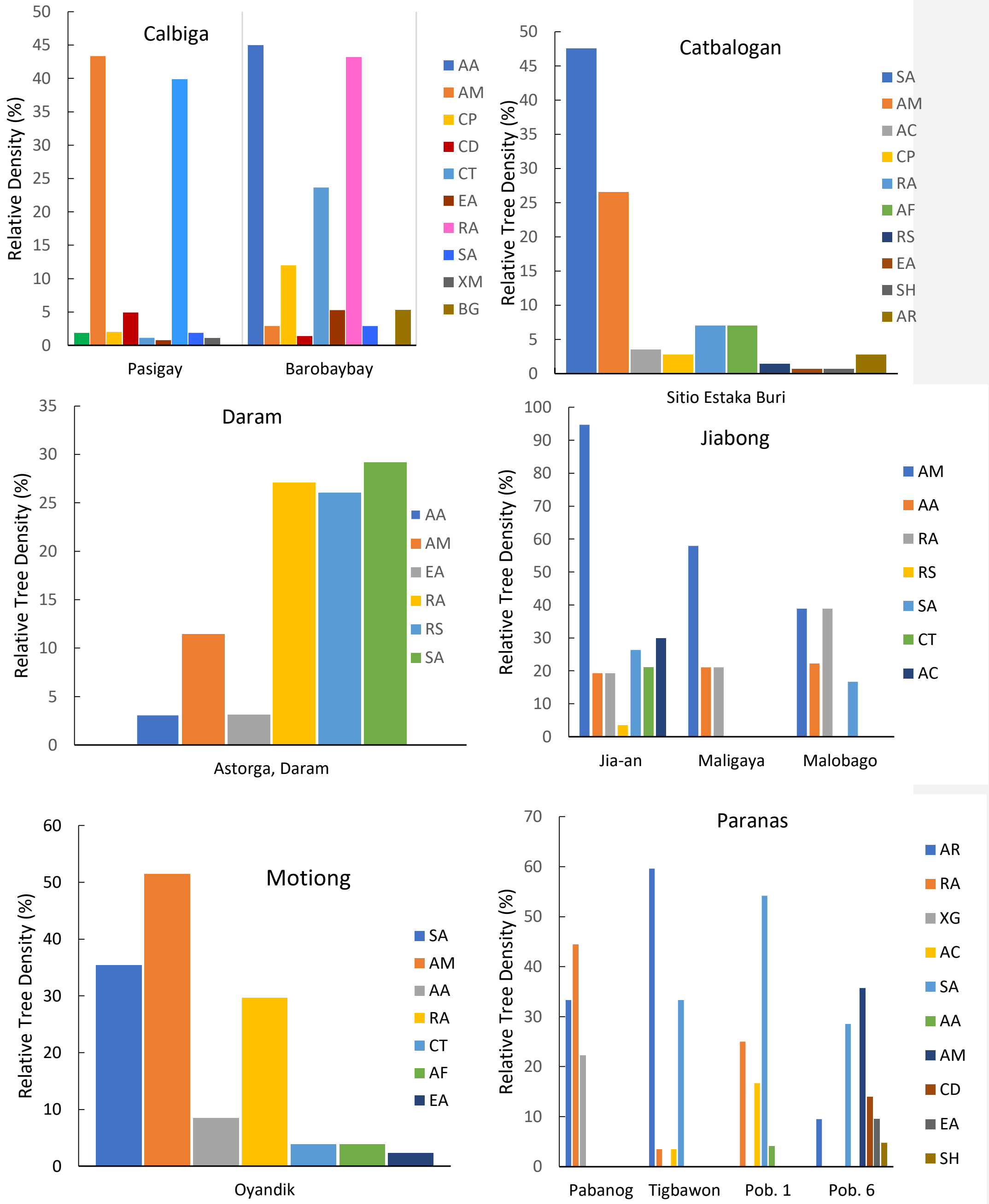
Appendix B-36. Relative Tree Density of the different Municipalities along Leyte Gulf.



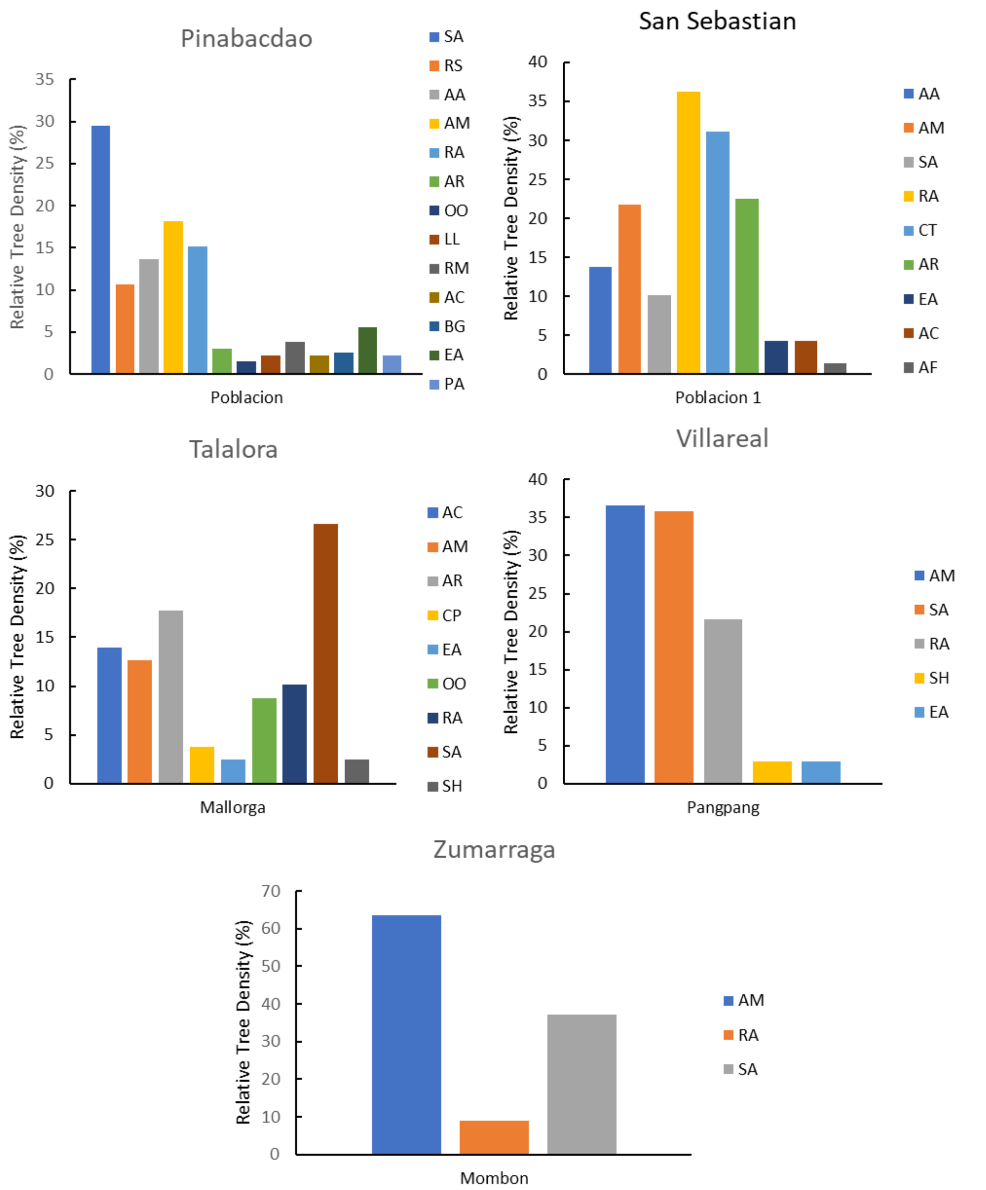
Appendix B-37. Relative Tree Density of the different Municipalities along Leyte Gulf.



Appendix B-38. Relative Tree Density of the different Municipalities along Matarinao Bay.



Appendix B-39. Mangrove Tree Density of the different Municipalities around Maqueda Bay.



Appendix B-40. Relative Tree Density of Sampling Stations around Maqueda Bay.

Taxonomic composition of mangrove flora in Leyte Gulf, Matarinao Bay and Maqueda Bay

Common Name	Scientific Name	BUE	LAW	LIB	CAU	COG	SJQ	ANI	BAG	BPS	CAB	KAW	TAG
Bakhaw babayi	*Rhizophora mucronata*												
Bakhaw bato	*Rhizophora stylosa*			✓		✓	✓		✓		✓	✓	✓
Bakhaw lalaki	*Rhizophora apiculata*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bantigi	*Pemphis acidula*												
Baras-baras	*Ceriops decandra*		✓								✓	✓	✓
Dungon	*Heritiera littoralis*	✓					✓		✓				
Gapas-gapas	*Camptostempon philippinensis*											✓	✓
Lipata	*Excoecaria agallocha*						✓		✓	✓			
Miapi	*Avicennia alba*				✓			✓	✓				
	Avicennia marina	✓	✓			✓	✓	✓	✓	✓			✓
	Avicennia oficinallis												
	Avicennia rumphiana	✓	✓					✓	✓		✓		
Niyo-tiyo	*Acanthus ebracteatus*		✓						✓		✓		
	Acanthus illicifolius	✓											
	Acanthus volubilis	✓							✓				
Nipa	*Nypa fruticans*	✓	✓	✓	✓	✓		✓	✓			✓	✓
Pagatpat	*Sonneratia alba*			✓	✓	✓		✓	✓	✓	✓	✓	✓
Palaypay	*Acrostichum aureum*	✓						✓			✓		
	Acrostichum speciosum										✓		
Pedada	*Sonneratia caseolaris*	✓	✓			✓	✓						
Piag-ao	*Xylocarpus molluccensis*							✓			✓	✓	
Pototan	*Bruguiera gymnorrhiza*				✓	✓		✓			✓	✓	✓
	Bruguiera parviflora												
	Bruguiera sexangula	✓	✓			✓	✓						
Sagasa	*Scyphiphora hydrophyllacea*							✓			✓	✓	✓
Saging-saging	*Aegiceras corniculatum*					✓	✓	✓	✓		✓	✓	✓
	Aegiceras floridum												
Tabao	*Lumnitzera littorea*												✓
	Lumnitzera racemosa												
Tabigi	*Xylocarpus granatum*	✓	✓			✓	✓	✓	✓		✓	✓	✓
Tangal	*Ceriops tagal*									✓			
Tawalis	*Osbornia octodonta*							✓					

Appendix B-41. Taxonomic composition of mangrove flora in Leyte Gulf (Leyte Sites).

Common Name	Scientific Name	AMA	KAI	TIN	CAL	CAN	OPV	PIN
Bakhaw babayi	*Rhizophora mucronata*							
Bakhaw bato	*Rhizophora stylosa*	✓			✓		✓	✓
Bakhaw lalaki	*Rhizophora apiculata*	✓	✓	✓	✓		✓	✓
Bantigi	*Pemphis acidula*							
Baras-baras	*Ceriops decandra*	✓		✓			✓	✓
Dungon	*Heritiera littoralis*	✓	✓		✓	✓	✓	✓
Gapas-gapas	*Camptostempon philippinensis*							
Lipata	*Excoecaria agallocha*	✓	✓			✓	✓	✓
Miapi	*Avicennia alba*		✓					
	Avicennia marina	✓	✓					✓
	Avicennia oficinallis							
	Avicennia rumphiana	✓	✓	✓		✓		✓
Niyo-tiyo	*Acanthus ebracteatus*	✓					✓	
	Acanthus illicifolius							
	Acanthus volubilis							
Nipa	*Nypa fruticans*	✓	✓	✓	✓	✓	✓	✓
Pagatpat	*Sonneratia alba*	✓	✓	✓	✓			
Palaypay	*Acrostichum aureum*	✓						
	Acrostichum speciosum		✓		✓	✓	✓	✓
Pedada	*Sonneratia caseolaris*	✓						
Piag-ao	*Xylocarpus molluccensis*							
Pototan	*Bruguiera gymnorrhiza*							✓
	Bruguiera parviflora							
	Bruguiera sexangula				✓	✓	✓	✓
Sagasa	*Scyphiphora hydrophyllacea*	✓		✓	✓			
Saging-saging	*Aegiceras corniculatum*		✓	✓				✓
	Aegiceras floridum							✓
Tabao	*Lumnitzera littorea*			✓	✓	✓	✓	
	Lumnitzera racemosa							
Tabigi	*Xylocarpus granatum*	✓	✓		✓		✓	✓
Tangal	*Ceriops tagal*							
Tawalis	*Osbornia octodonta*			✓	✓	✓		

Appendix B-42. Taxonomic composition of mangrove flora in Leyte Gulf (Samar sites).

Common Name	Scientific Name	BOL	MAS	BRGY6	SMG	PAY	STN	MAL	SRQ	BGB	BAR	SAT
Bakhaw babayi	*Rhizophora mucronata*											
Bakhaw bato	*Rhizophora stylosa*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Bakhaw lalaki	*Rhizophora apiculata*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bantigi	*Pemphis acidula*					✓				✓	✓	
Baras-baras	*Ceriops decandra*	✓	✓	✓	✓		✓				✓	
Dungon	*Heritiera littoralis*	✓			✓	✓	✓					
Gapas-gapas	*Camptostempon philippinensis*	✓		✓		✓					✓	
Lipata	*Excoecaria agallocha*	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Miapi	*Avicennia alba*	✓						✓				
	Avicennia marina	✓		✓	✓			✓			✓	
	Avicennia oficinallis											
	Avicennia rumphiana	✓	✓		✓	✓					✓	✓
Niyo-tiyo	*Acanthus ebracteatus*	✓	✓		✓	✓	✓				✓	✓
	Acanthus illicifolius											
	Acanthus volubilis					✓						✓
Nipa	*Nypa fruticans*	✓	✓			✓		✓			✓	
Pagatpat	*Sonneratia alba*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Palaypay	*Acrostichum aureum*											
	Acrostichum speciosum	✓				✓					✓	
Pedada	*Sonneratia caseolaris*											
Piag-ao	*Xylocarpus molluccensis*				✓	✓		✓	✓	✓	✓	✓
Pototan	*Bruguiera gymnorrhiza*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Bruguiera parviflora										✓	
	Bruguiera sexangula											
Sagasa	*Scyphiphora hydrophyllacea*	✓	✓			✓	✓	✓				✓
Saging-saging	*Aegiceras corniculatum*	✓	✓			✓	✓	✓	✓	✓		✓
	Aegiceras floridum	✓				✓				✓	✓	
Tabao	*Lumnitzera littorea*	✓	✓		✓							
	Lumnitzera racemosa							✓				
Tabigi	*Xylocarpus granatum*	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Tangal	*Ceriops tagal*	✓				✓		✓			✓	✓
Tawalis	*Osbornia octodonta*	✓	✓	✓		✓		✓				

Appendix B-43. Taxonomic composition of mangrove flora in Leyte Gulf (Eastern Samar sites).

Mangrove Species	Local Name	BUE	NAG	ABE	CAR	MAT	VIG	ACI	CAM	BAT	SNM
Major species											
Avicennia											
Avicennia alba	Miapi						√				
A. marina	Pagatpat	√	√		√	√	√	√	√	√	√
A. rumphiana	Miapi			√	√		√	√			√
Combretaceae											
Lumnitzera littorea	Tabao	√	√	√	√	√	√	√	√		
Palmaceae/Arecaceae											
Nypa fruticans	Nipa, sasa				√		√	√			
Rhizophoraceae											
Rhizophora apiculata	Bakhaw-lalaki	√	√	√	√	√	√	√	√		√
R. mucronata	Bakhaw babae				√						
R. stylosa	Bakhaw bato	√	√	√	√	√	√	√	√		√
Bruguiera gymnorrhiza	Pototan	√	√		√		√	√	√		√
B. cylindrica	Pototan		√		√						
B. parviflora	Pototan			√	√		√				
B. seangula	Pototan				√		√				
Ceriops decandra	Barok – barok		√		√		√				√
C. tagal	Barok	√			√						
Sonneratiaceae											
Sonneratia alba	Miapi	√	√	√	√	√	√	√	√	√	√
S. caseolaris	Pedada			√							
Minor species											
Bombacaceae											
Camptostemon philippinense	Gapas-gapas		√		√		√		√		
Euphorbiaceae											
Excoecaria agallocha	Lipata				√				√		√
Meliaceae											
Xylocarpus granatum	Tabigi	√	√	√	√		√	√	√		√
X. moluccensis	Piag-ao			√	√						√
Myrsinaceae											
Aegiceras corniculatum	Saging-saging		√		√		√				
A. floridum	Saging-saging		√	√			√	√			
Pteridaceae											
Acrostichum speciosum	Palaypay				√		√				
Sterculiaceae											
Heritiera littoralis	Dungon			√	√		√				√
Rubiaceae											
Scyphiphora hydrophyllacea	Sagasa	√		√	√		√	√			
Mangrove associates											
Acanthaceae											
Acanthus ebracteatus	Lagiwliw				√		√		√		√
A. volubilis	Niyo-tiyo				√						

Appendix B-44. Taxonomic composition of mangrove flora along Matarinao Bay.

Mangrove Species	Local Name	Sampling Stations CALBIGA		JIABONG			PARANAS		
		Pas	Bar	Jia	Mali	Malo	Pab	Pob 1	Tig
I. Major Species									
Avicenniaceae									
Avicennia alba	miapi	✓	✓	✓	✓	✓	✓	✓	✓
A. marina	miapi	✓	✓	✓	✓	✓	✓	✓	✓
A. rumphiana	miapi	✓	✓	✓	✓	✓	✓	✓	✓
Arecaceae (form. Palmae)									
Nypa fruticans	nipa, sasa	✓	✓	✓	✓	✓			
Combretaceae									
Lumnitzera littorea	tabao, kulasi								
Rhizophoraceae									
Bruguiera gymnorrhiza	pototan	✓							
Ceriops decandra	baras-baras	✓	✓				✓	✓	✓
C. tagal	barok	✓	✓	✓	✓				
Rhizophora apiculata	bakhaw lalaki	✓	✓	✓	✓	✓		✓	✓
R. stylosa	bakhaw bato	✓	✓						
R. mucronata	bakhaw babae								
Sonneratiaceae									
Sonneratia alba	pagatpat	✓		✓	✓	✓	✓	✓	✓
II. Minor Species									
Bombacaceae									
Camptostemon philippinenses	gapas-gapas	✓							
Euphorbiaceae									
Excoecaria agallocha	lipata	✓	✓					✓	✓
Lythraceae									
Pemphis acidula									
Meliaceae									
Xylocarpus granatum	tabigi	✓					✓		✓
X. mollucensis	piag-ao	✓							
Myrsinaceae									
Aegiceras corniculatum	saging-sanging	✓	✓		✓	✓	✓	✓	✓
A. floridum	saging-saging								
Myrtaceae									
Osbornia octodonta	tawalis								
Rubiaceae									
Scyphiphora hydrophyllacea	Nilad	✓	✓				✓	✓	✓
II. Associated species									
Acanthaceae									
Acanthus ebracteatus	lagiwliw	✓	✓						
A. ilicifolius	lagiwliw	✓							
A. volubilis	lagiwliw								
Total no. of species		19			7			10	

Note: municipality or city around Maqueda Bay not included on Appendix 5.3 has only one site

Appendix B-45. Taxonomic composition of mangrove flora around Maqueda Bay.

or sampling station.

Species Dominance, Frequency, Density and Importance

Municipality	Mangrove Species	Relative Density	Relative Dominance	Relative Frequency	IVI
ABU	*A. marina*	0.8	15.8	2.3	19.0
	A. rumphianna	1.6	15.9	4.7	22.2
	B. sexangula	9.7	0.3	11.6	21.7
	C. decandra	1.6	0.02	4.6	6.3
	H. littoralis	1.6	0.3	4.6	6.6
	R. apiculata	16.1	0.6	18.6	35.4
	S. caseolaris	57.3	16.3	23.3	96.8
	X. granatum	2.4	51	4.7	57.7
MAY	*R. apiculata*	1.3	9.4	6.3	16.9
	R. stylosa	6.4	0.7	31.2	38.3
	S. alba	91	89.9	56.3	237.2
TAN	*A. alba*	13	2.6	13.3	28.4
	B. gymmnorhiza	7	0.7	6.7	19.9
	R. apiculata	6	0.6	6.7	19.8
	S. alba	60	95.4	60	192.9
PAL	*A. corniculatum*	8.6	2.6	8.5	20.0
	A. marina	39	26.3	29.1	94.6
	B. gymmnorhiza	0.2	0.03	0.7	0.9
	B. sexangula	1.9	0.2	5	7.1
	C. decandra	0.7	4	1.4	6.2
	E. agallocha	3.2	6.4	3.5	13.1
	H. littoralis	0.5	0.3	0.7	1.6
	R. apiculata	7.7	4.3	2.8	24.7
	R. stylosa	1.2	0.8	2.1	4.2
	S. alba	12.8	16.3	11.3	40.5
	S. caseolaris	21.9	37.8	19.9	79.6
	X. granatum	1.2	0.6	2.1	4.0
TAC	*A. alba*	1.9	7.3	1.6	10.8
	A. corniculatum	5.3	1.8	1.6	11.8
	A. marina	8.3	7.3	3.1	18.8
	A. rumphianna	8.3	8.9	3.1	20.4
	B. gymmnorhiza	12.6	8.6	13.5	34.8
	C. decandra	5.6	4.9	7.8	18.4

	C. philippinense	1.0	1.2	2.1	4.3
	C. tagal	1.2	1	0.5	0.7
	E. agallocha	0.2	0.01	1.0	4.9
	H. littoralis	0.5	3.3	0.5	0.7
	L. littorea	0.2	0.02	0.5	3.4
	R. apiculata	1.9	18.3	4.7	50.7
	R. stylosa	6.6	4.7	13.0	20.7
	S. alba	9.7	17.7	9.4	37.8
	S. hydrophyllacea	10.3	9.1	10.4	29.4
	X. granatum	5.3	4.9	9.9	20.6
	X. moluccensis	0.5	0.3	10.4	2.3
BAS	*A. alba*	4.4	5.1	1.6	11.1
	A. corniculatum	1.6	0.5	4.0	6.1
	A. marina	5.2	4.2	3.1	14.2
	A. rumphianna	5.2	8.9	3.1	33.8
	C. decandra	3.8	1.1	5.6	10.5
	E. agallocha	4.6	16.5	4.8	25.9
	H. littoralis	1.8	2	2.4	6.2
	L. littorea	0.6	0.5	1.6	2.7
	O. octodonta	0.2	0.02	0.8	1.0
	R. apiculata	48.4	23.8	16	88.2
	R. stylosa	7.4	1.8	16	25.2
	S. alba	6.2	6.5	9.6	22.3
	S. caseolaris	4.6	12.3	9.6	26.5
	S. hydrophyllacea	1.4	1.3	3.2	5.9
	X. granatum	1.8	0.4	4	6.2
MAR	*A. corniculatum*	0.9	0.3	1.5	2.8
	A. floridum	0.3	0.5	0.6	1.4
	A. marina	0.6	0.3	0.9	1.8
	A. rumphianna	4.1	2.1	5.5	11.8
	B. gymmnorhiza	3.8	1.4	4.6	9.8
	B. sexangula	22.8	16	16.1	55.0
	C. decandra	2	0.6	3.4	6.0
	E. agallocha	4.8	13	6.4	24.2
	H. littoralis	1	0.7	3	4.8
	L. littorea	7	9.3	9.8	26.1

	O. octodonta	0.3	0.1	0.6	1.0
	R. apiculata	31. 3	30.9	16.2	78.4
	R. stylosa	5.7	5.7	4.6	15.9
	S. alba	5.7	10.4	4.6	20.8
	S. hydrophyllacea	3.7	3.8	4.3	11.8
	X. granatum	2	4.4	5.8	12.2
LAW	*A. alba*	0.2	0.01	0.9	1.1
	A. corniculatum	0.5	0.2	1.8	2.5
	A. floridum	0.7	0.3	2.2	3.3
	A. marina	0.2	0.01	0.4	0.6
	A. rumphianna	0.4	0.2	0.9	1.4
	B. gymmnorhiza	10.1	2.5	11.5	24.1
	C. decandra	2.2	0.2	4.4	6.8
	C. philippinense	0.6	0.1	0.9	1.6
	C. tagal	0.1	0.01	0.4	0.6
	E. agallocha	2.1	6.8	3.1	12.0
	H. littoralis	0.4	0.2	0.9	1.5
	L. littorea	4.8	1.3	4.9	11.0
	O. octodonta	0.5	0.02	1.8	2.3
	R. apiculata	31	7.4	23.5	61.8
	R. stylosa	7.3	1	5.8	14.0
	S. alba	7.3	57.5	8.8	73.6
	S. hydrophyllacea	0.7	0.1	1.8	2.6
	X. granatum	28.7	22	18.1	69.0
BAL	*A. corniculatum*	0.3	0.02	0.5	0.8
	A. marina	7.8	20.6	6.9	35.2
	A. rumphianna	4.5	6	4.4	15.0
	B. gymmnorhiza	15.5	11.2	14.2	41.0
	C. decandra	13.6	1.9	12.3	27.8
	C. philippinense	1.2	0.02	0.5	0.7
	E. agallocha	4	4.1	11.8	19.9
	H. littoralis	1.9	0.1	3.4	5.5
	O. octodonta	0.2	0.04	0.5	0.7
	R. apiculata	24.3	9.8	14.7	48.8
	R. stylosa	5.8	2.9	8.3	17.1

	S. alba	4.7	29.7	6.4	40.8
	X. granatum	13.6	12.6	7.8	34.1
	X. moluccensis	1.8	0.9	3.4	6.1
GIP	*A. corniculatum*	1.1	0.3	2.7	4.1
	A. floridum	3.8	1.3	3.4	8.4
	A. rumphianna	0.2	0.2	0.7	1.1
	B. gymmnorhiza	4.3	0.8	8.7	13.9
	C. philippinense	1.7	0.3	2.0	4.0
	C. tagal	2.6	0.3	7.4	10.3
	E. agallocha	1.3	6.6	2.0	9.9
	H. littoralis	1.3	1.1	2.0	4.4
	L. littorea	5.8	3.8	6.7	16.4
	O. octodonta	0.9	0.3	2.0	3.3
	P. acidula	0.4	3.4	0.7	4.5
	R. apiculata	33.8	12.9	22.8	69.5
	R. stylosa	8.5	2.3	4.7	15.5
	S. alba	7.5	30.4	10.1	48.1
	S. hydrophyllacea	2.6	0.9	3.4	6.9
	X. granatum	21. 5	32.8	14.1	68.4
	X. moluccensis	0.9	2.1	1.3	4.4
QUI	*A. corniculatum*	7.5	1.4	7.0	15.9
	B. gymmnorhiza	10.6	18.9	23.3	52.7
	C. decandra	1.3	0.1	2.3	3.7
	E. agallocha	1.8	10.2	4.7	16.6
	H. littoralis	0.4	0.2	2.3	3.0
	R. apiculata	55.3	22.1	23.3	100.7
	X. granatum	3.1	1.4	11.6	16.1
	X. moluccensis	19.5	45.7	23.3	88.5
SAL	*A. alba*	0.5	13.5	0.7	14.6
	A. corniculatum	1	0.2	2.7	3.9
	A. marina	2	3.8	2.7	8.6
	B. gymmnorhiza	34.4	24.4	21.1	79.8
	C. tagal	1.2	0.3	2.0	3.5
	E. agallocha	2	0.3	2.7	9.7
	L. racemosa	4.6	5	4.1	9.9

	P. acidula	1.7	3.5	23.8	7.2
	R. apiculata	1.7	1.2	23.8	58.9
	R. stylosa	20.7	7.2	10.2	51.7
	S. alba	20.7	19.8	1.4	38.5
	S. hydrophyllacea	1.2	0.2	0.7	2.8
	X. granatum	0.2	3.6	0.7	4.5
	X. moluccensis	1.2	3.1	2.0	6.4
MER	*A. corniculatum*	1.2	1.1	4.0	6.3
	B. gymmnorhiza	16	2.2	12.0	30.3
	E. agallocha	2.5	7.6	8.0	18.1
	R. apiculata	53	10.4	32.0	95.5
	R. stylosa	20.7	0.8	14.0	25.4
	S. alba	8.6	77.1	14.0	104.2
	X. granatum	11.1	0.6	12.0	20.0
	X. moluccensis	7.4	0.1	4.0	5.4
GUI	*A. corniculatum*	0.6	0.04	3.0	3.6
	A. floridum	2.3	0.4	4.0	6.7
	A. marina	6	4.7	9.9	20.6
	A. rumphianna	0.2	0.5	1.0	1.7
	B. gymmnorhiza	4.6	0.6	4.0	9.1
	B. parviflora	0.4	0.01	2.0	2.4
	C. decandra	0.2	0.008	1.0	1.2
	C. philippinense	1	0.09	3.0	4.0
	C. tagal	2.1	0.1	5.0	7.2
	E. agallocha	1.7	11.2	5.0	17.9
	L. littorea	0.6	0.3	1.0	1.9
	P. acidula	3.3	2.2	5.0	10.4
	R. apiculata	39.4	5.9	25.7	71.0
	R. mucronata	1.5	0.2	3.0	4.7
	R. stylosa	10.8	0.9	8.9	20.7
	S. alba	19.7	72	1.0	92.7
	S. hydrophyllacea	0.2	0.02	1.0	1.2
	X. granatum	3.5	0.5	6.9	10.9
	X. moluccensis	1	0.4	5.0	6.3

Appendix B-46. Species Dominance, Frequency, Density and Importance of mangroves in Different Sampling Stations in Leyte Gulf.

Municipality	Barangay	Species	RD (%)	RF (%)	RDom (%)	IVI
Quinapondan	Buenavista	*A. marina*	8.35	7.41	8.35	24.73
		B. gymnorrhiza	9.87	16.67	2.56	29.09
		C. tagal	2.24	3.60	2.40	8.34
		L. littorea	23.32	16.67	43.59	83.58
		R. apiculata	34.98	24.07	11.24	70.29
		R. stylosa	1.35	1.85	0.11	3.30
		S. alba	11.21	14.81	30.93	56.96
		S. hydrophyllacea	1.35	3.70	0.15	5.20
		. granatum	6.73	11.11	0.67	0.06
	Naga	*A. corniculatum*	1.83	3.08	0.08	4.98
		A. floridum	1.22	1.54	0.15	2.91
		A. marina	4.88	3.08	0.90	8.86
		A. rumphiana	1.22	3.08	1.30	5.60
		B. cylindrical	0.61	1.54	0.03	2.18
		B. gymnorrhiza	1.22	13.85	6.30	21.37
		C. decandra	4.88	6.15	0.67	11.71
		C. philippinense	11.59	10.77	8.09	30.45
		C. tagal	1.22	1.54	3.27	6.03
		L. littorea	1.83	1.54	1.82	5.19
		R. apiculata	32.93	21.54	10.455	64.91
		R. stylosa	3.05	3.08	0.45	6.58
		S. alba	25	20	64.78	109.78
		. granatum	8.54	9.23	1.69	19.46
Salcedo	Caridad	*A corniculatum*	0.42	0.57	0.02	1.01
		A. ebracteatus	0.42	0.57	1.78E	0.99
		A. marina	0.14	0.57	0.01	0.72
		A. rumphiana	1.40	2.30	16.84	20.53
		A. speciosum	0.70	2.87	2E	3.57
		A. volubilis	0.70	2.87	4.39E	3.57
		B. cylindrical	0.42	1.15	0.02	1.59
		B. gymnorrhiza	18.07	17.82	8.45	44.34
		B. parviflora	0.56	1.15	0.07	1.78
		B. seangula	0.42	0.57	0.15	1.15
		C. decandra	0.14	0.57	0.02	0.73
		C. philippinense	2.52	3.45	0.46	6.43
		E. agallocha	0.14	0.57	0.17	0.89
		H. littoralis	3.22	6.32	0.75	10.30
		L. littorea	1.12	2.87	0.82	4.81
		N. fruticans	0.42	1.72	1.13E	2.14
		R. apiculata	22.27	17.82	10.24	50.33
		R. mucronata	0.28	1.15	0.29	1.72
		S. alba	7.28	7.47	22.09	36.84
		S. hydrophyllacea	2.94	5.17	1	9.12
		. granatum	34.59	19.54	38.06	91.19
		. moluccensis	1.82	2.87	0.55	5.24
	Abejao	*A. floridum*	4.33	1.69	0.21	6.23

		A. rumphiana	11.06	10.17	26.18	47.41
		B. gymnorrhiza	15.87	11.86	3.64	31.38
		B. parviflora	3.37	3.39	0.43	7.18
		H. littoralis	5.29	10.17	18.95	34.40
		L. littorea	5.29	10.17	18.78	34.23
		R. apiculata	16.83	16.95	16.10	49.88
		R. stylosa	0.48	1.69	0.01	2.19
		S. alba	3.37	5.08	7.87	16.32
		S. caseolaris	0.48	1.69	0.29	2.46
		S. hydrophyllacea	5.77	6.78	1.23	13.78
		. granatum	25.96	15.25	5.15	46.37
		. moluccensis	1.92	5.08	1.16	8.17
	Matarinao	*A. corniculatum*	0.39	1.54	0.01	1.94
		A. floridum	1.17	3.08	0.06	4.31
		A. marina	20.62	9.23	2.27	32.12
		B. gymnorrhiza	4.28	9.23	0.69	14.20
		L. littorea	0.39	1.54	0.17	2.10
		R. apiculata	24.12	27.69	1.62	53.44
		R. stylosa	15.95	18.46	19.55	53.96
		S. alba	33.07	29.23	75.64	137.95

Appendix B-47. Species Dominance, Frequency, Density and Importance of mangroves in Different Sampling Stations along Matarinao Bay.

Municipality	Barangay	Species	RD (%)	RF (%)	RDom (%)	IVI
General MacArthur	Vigan	*A. alba*	5.38	6.10	17.53	29.01
		A. corniculatum	0.77	2.44	0.08	3.29
		A. ebracteatus	0.38	1.22	9E	1.60
		A. floridum	0.77	2.44	0.10	3.31
		A. marina	13.85	8.54	3.76	26.14
		A. rumphiana	5	8.54	13.15	26.68
		A. speciosum	0.38	1.22	4E	1.60
		B. gymnorrhiza	3.46	8.54	7.36	19.35
		B. parviflora	10.77	8.54	1.12	20.42
		B. seangula	1.92	1.22	1.41	4.55
		C. decandra	0.77	1.22	0.18	2.17
		C. philippinense	15	4.88	5.12	25
		H. littoralis	0.38	1.22	0.02	1.62
		L. littorea	1.92	2.44	8.65	13.01
		N. fruticans	0.38	1.22	6E	1.60
		R. apiculata	16.92	14.63	3.86	35.42
		R. stylosa	0.38	1.22	0.21	1.81
		S. alba	16.92	15.85	28.58	61.36
		S. hydrophyllacea	2.31	3.66	6.77	12.74
		. granatum	2.31	4.88	2.11	9.29
	Anahao and Capopocanan Islands	*A. floridum*	2.49	6.07	3.17	11.72
		A. marina	3.98	4.55	15.29	23.82
		A. rumphiana	0.50	1.52	10.31	12.32
		B. gymnorrhiza	1.99	3.03	3.06	8.08
		L. littorea	0.50	1.52	11.19	13.21
		N. fruticans	0.50	1.52	1E-05	2.01
		R. apiculata	37.81	40.91	2.72	81.44
		R. stylosa	4.48	4.55	0.84	9.86
		S. alba	42.49	27.27	35.61	105.17
		S. hydrophyllacea	0.50	1.52	14.52	16.53
		. granatum	4.98	7.58	3.29	15.84
Hernani	Carmen	*A. marina*	18.28	20.51	11.18	49.98
		B. gymnorrhiza	1.07	2.56	0.23	3.87
		C. philippinense	8.60	5.13	2.38	16.11
		E. agallocha	1.07	2.56	0.30	3.94
		L. littorea	1.08	2.56	2.06	5.70

	R. apiculata	8.60	10.26	2.55	21.41
	R. stylosa	16.13	17.95	5.95	40.03
	S. alba	36.56	25.64	21. 08	83.28
	. moluccensis	8.60	12.82	54.26	75.68
Batang	*A. marina*	1.61	20	0.46	22.07
	S. alba	98.39	80	99.54	277.93
San Miguel	*A. ebracteatus*	2	4.04	1.40	7.44
	A. marina	2.4	5.05	54.01	61.46
	A. rumphiana	0.8	1.01	0.61	2.42
	B. gymnorrhiza	18.8	19.19	38.19	76.19
	C. decandra	0.40	1.01	0.12	1.53
	E. agallocha	2	3.03	0.08	5.11
	H. littoralis	0.4	1.01	0.04	1.45
	R. apiculata	34.8	23.23	0.20	58.24
	R. stylosa	11.2	13.13	0.14	24.47
	S. alba	7.2	10.10	3.78	21.08
	. granatum	15.6	10.10	1.25	26.95
	. moluccensis	4.4	9.09	0.18	13.67

Appendix B-48. Species Dominance, Frequency, Density and Importance of mangroves in Different Sampling Stations along Matarinao Bay.

Municipality	Species	RD (%)	RF %	RDom (%)	IVI
Calbiga	*A. alba*	5.32	20.00	38.15	63.47
	A. marina *	43.35	25.71	47.33	116.39
	C. philippinense	1.52	5.71	0.79	8.02
	C. decandra	4.94	5.71	0.51	11.17
	C. tagal	1.14	2.86	0.11	4.10
	E. agallocha	0.76	5.71	0.43	6.91
	R. apiculata	39.92	25.71	10.52	76.16
	S. alba	1.90	2.86	1.36	6.12
	X. mollucensis	1.14	5.71	0.80	7.65
Catbalogan	*A. corniculatum*	3.50	5.13	0.16	8.79
	A. floridum	6.70	10.26	0.34	17.60
	A. marina	26.57	30.77	17.38	74.72
	A. rumphiana	2.56	2.80	9.33	141
	C. philippinense	2.80	2.56	4.00	9.36
	E. agallocha	2.56	0.70	0.32	3.59
	S. alba *	47.55	25.64	67.89	141
	S. hydrophyllacea	2.56	0.70	0.02	3.28
	R. apiculata	6.70	12.82	0.46	20.28
	R. stylosa	1.40	5.13	0.16	6.60
Daram	*A. alba*	3.13	5.56	10.98	19.66
	A. marina	11.46	22.22	4.38	38.06
	E. agallocha	3.13	5.56	2.33	11.01
	R. apiculata	27.08	22.22	21.90	71.91
	R. stylosa	26.04	22.22	12.35	60.62
	S. alba *	29.17	22.22	48.04	99.44
Jiabong	*A. alba*	14.46	16.67	21.55	52.68
	A. marina *	44.63	33.33	50.53	128.49
	A. corniculatum	7.02	6.06	0.45	13.54
	C. tagal	4.96	4.55	0.28	9.79
	R. apiculata	18.18	24.24	3.73	46.16
	R. stylosa	0.83	1.51	0.1	2.44
	S. alba	9.92	13.64	23.36	47.0
Motiong	*A. alba*	8.60	12.12	27.61	48.33

Appendix B-49. Species Dominance, Frequency, Density and Importance of mangroves in Different Sampling Stations around Maqueda Bay.

Municipality	Species	RD (%)	RF %	RDom (%)	IVI
Paranas	*A. alba*	0.83	2.78	0.71	4.32
	A. corniculatum	5.0	5.56	2.02	12.58
	A. marina	5.0	8.33	2.88	16.21
	A. rumphiana	3.5	27.78	31.08	31.08
	C. decandra	2.5	2.78	0.26	5.54
	E. agallocha	1.67	2.78	5.18	9.62
	R. apiculata	13.33	13.89	17.14	44.37
	S. alba *	31.67	27.78	32.66	92.10
	S. hydrophyllacea	0.83	2.78	1.45	5.06
	X. granatum	3.33	2.78	5.94	12.04
Pinabacdao	*A. alba*	13.64	13.51	13.50	40.65
	A. corniculatum	2.27	2.70	0.80	5.78
	A. marina	18.19	18.92	18.76	55.86
	A. rumphiana	3.03	2.70	1.29	7.02
	L. littorea	2.27	2.70	1.11	6.08
	O. octodonta	1.52	2.70	1.27	5.48
	R. apiculata	15.15	13.51	9.00	37.67
	R. mucronata	3.79	8.11	3.85	15.74
	R. stylosa	10.61	13.51	10.17	34.30
	S. alba *	29.5	21.62	40.26	91.53
San Sebastian	*A. alba*	13.77	10.81	16.89	41.47
	A. corniculatum	4.35	5.41	0.95	1.70
	A. floridum	1.45	2.70	0.03	4.19
	A. marina	21.74	21.62	12.31	55.67
	A. rumphiana *	22.46	27.03	88.64	138.13
	C. tagal	31.16	29.73	1.26	62.15
	E. agallocha	4.34	5.41	4.51	14.26
	R. apiculata	36.23	29.73	4.60	70.56
	S. alba	10.14	13.51	12.05	35.70
Talalora	*A. corniculatum*	13.92	12.5	2.46	28.89
	A. floridum	1.27	4.17	0.20	5.64
	A. marina	12.66	20.83	10.84	44.33
	A. rumphiana	17.72	12.5	22.14	52.36
	C. philippinenses	3.80	4.17	2.19	10.16
	E. agallocha	2.53	4.17	1.26	7.96
	O. octodonta	8.86	8.33	1.60	18.87
	R. apiculata	10.13	12.5	8.62	31.35
	S. alba *	26.58	66.67	49.62	92.87
	S. hydrophyllacea	2.53	4.17	1.08	7.78

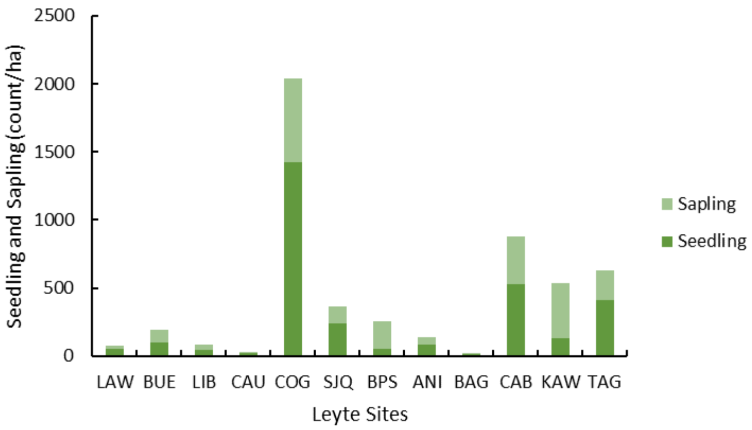
Villareal	*A. marina*	36.57	30.77	21.63	88.97
	E. agallocha	2.99	3.85	22.74	29.58
	R. apiculata	21.64	23.08	6.51	51.23
	S. alba *	35.82	34.62	48.82	119.26
	S. hydrophyllacea	2.99	7.69	0.29	10.97
Zumarraga	*A. marina* *	63.64	40	50.01	153.65
	R. apiculata	9.09	10	20.90	39.99
	S. alba	27.27	50	29.09	106.36

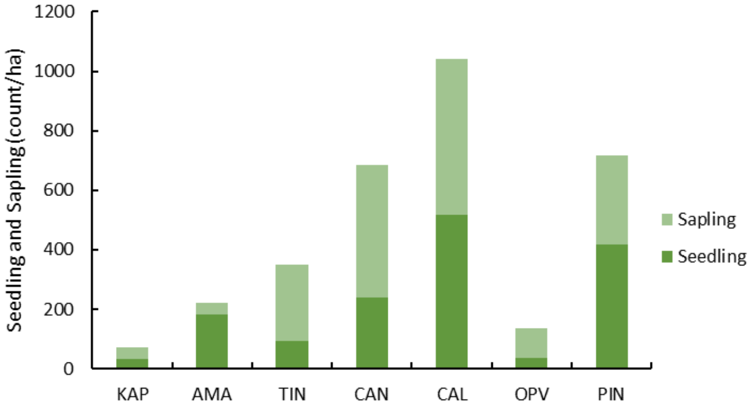
Note: Relative Density (RD); Relative Dominance (Rdom); Relative Frequency (RF); Importance Value Index

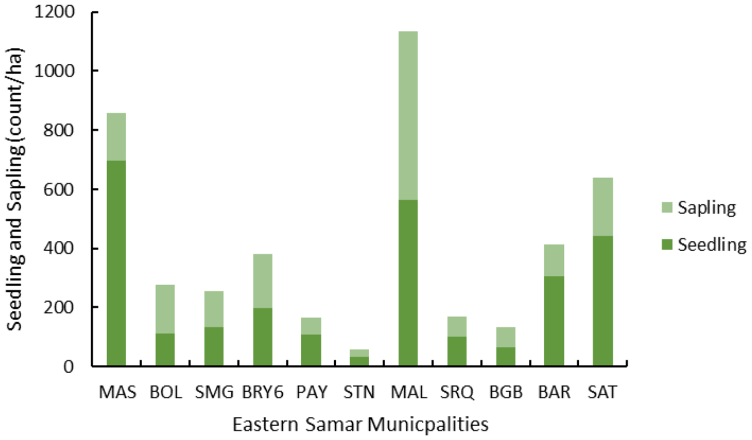
Appendix B-50. Species Dominance, Frequency, Density and Importance of mangroves in Different Sampling Stations around Maqueda Bay.

(IVI); * most influencial species

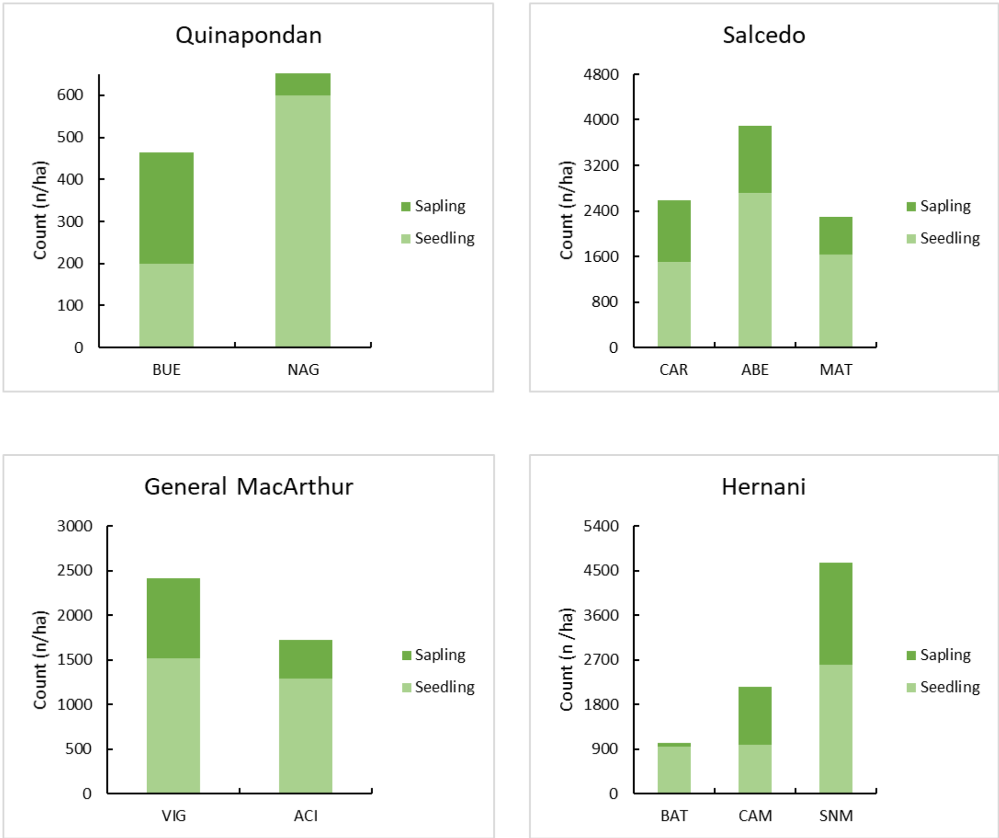
Seedling and Sapling Count in Different Sampling Stations in Leyte Gulf, Matarinao Bay and Maqueda Bay



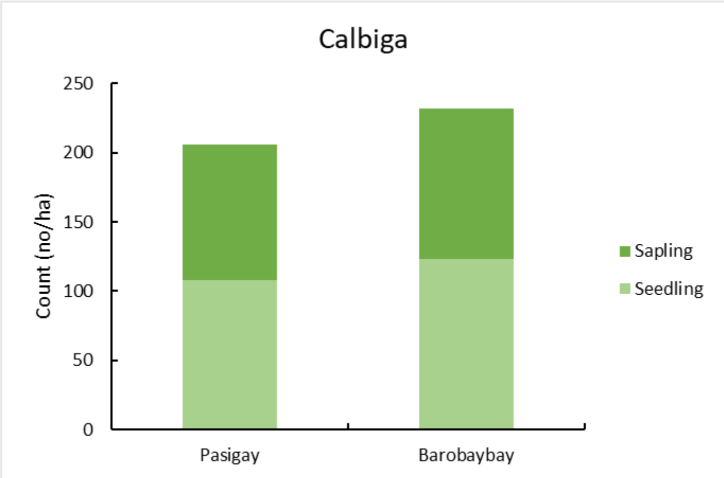


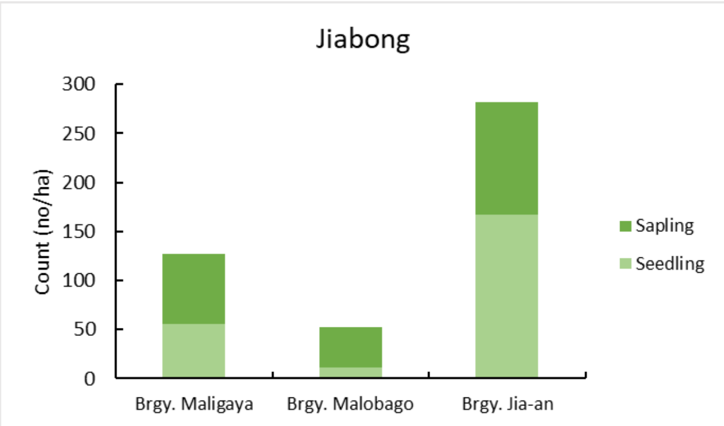


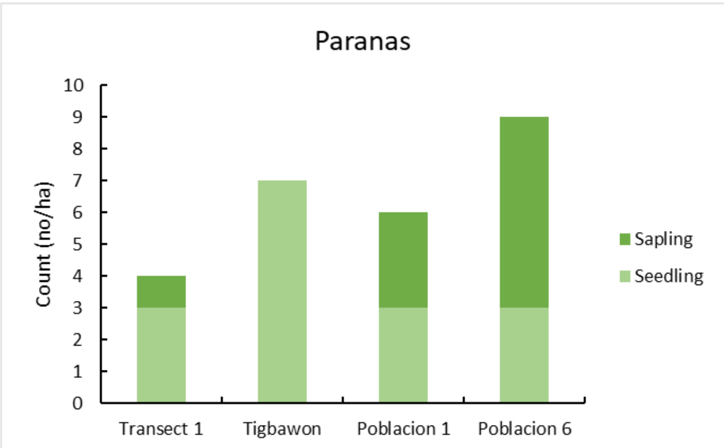
Appendix B-51. Seedling and Sapling Count in Different Sampling Stations in Leyte Gulf.



Appendix B-52. Seedling and Sapling Count in Different Sampling Stations along Matarinao Bay.



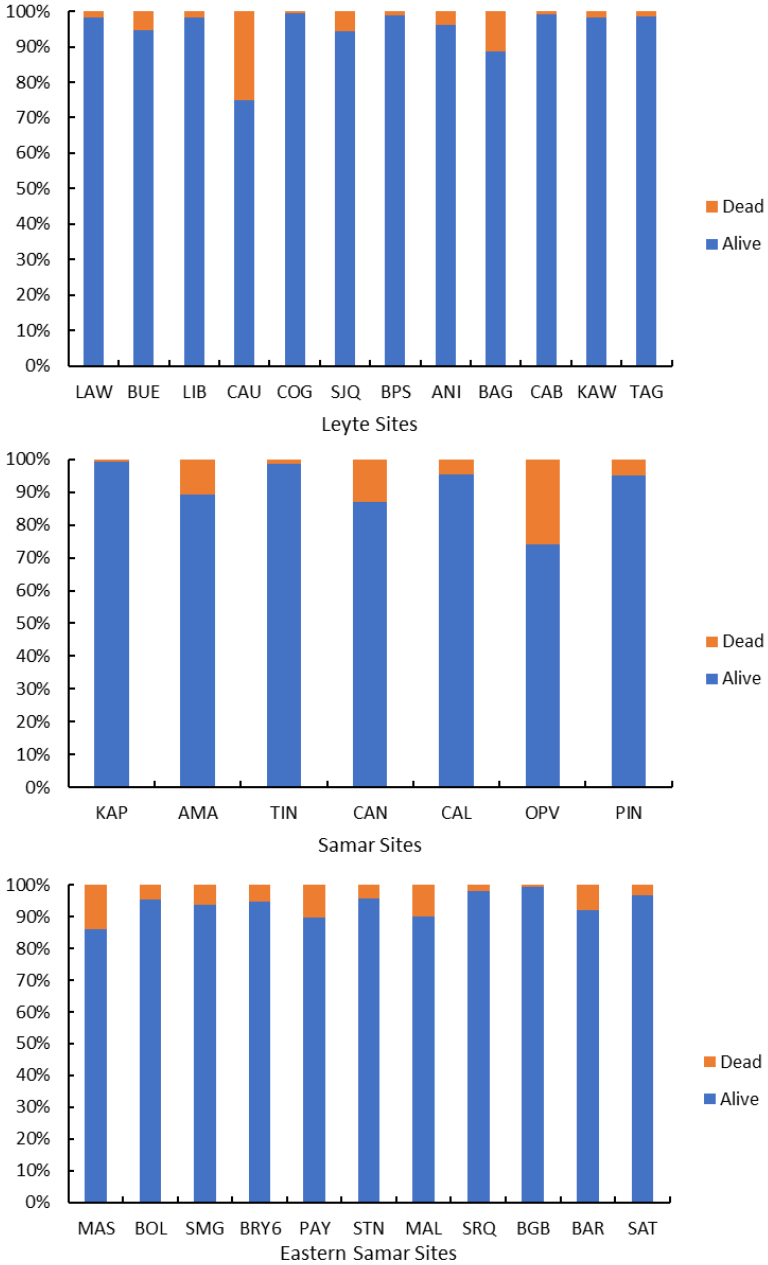




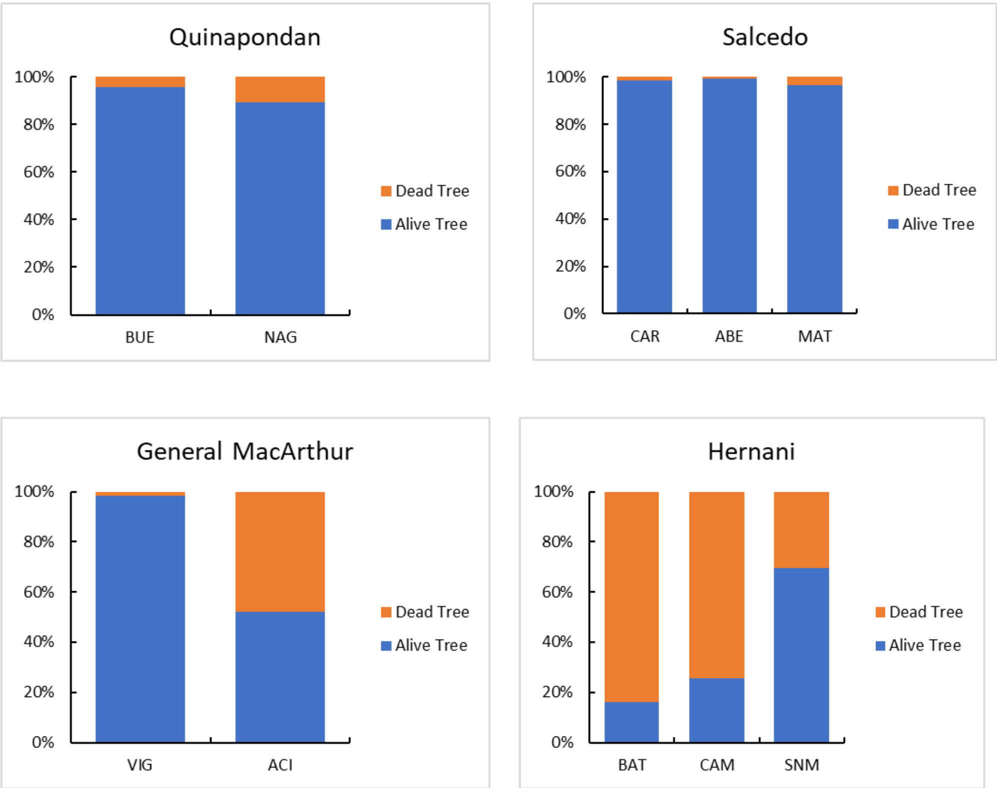
Note: municipality or city around Maqueda Bay not included on Appendix 7.3 has only one site or sampling station

Appendix B-53. Seedling and Sapling Count in Different Sampling Stations around Maqueda Bay.

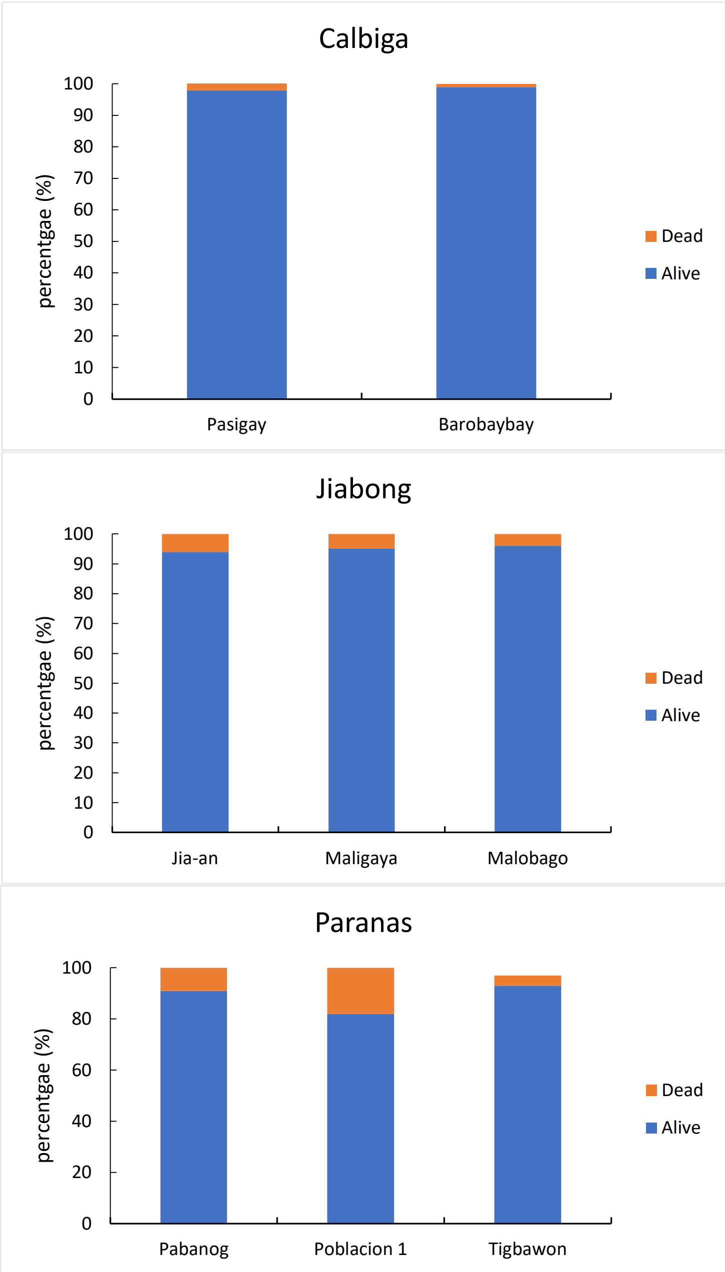
Percentage of Dead and Alive Mangroves in Different Sampling Stations in Leyte Gulf, Matarinao Bay and Maqueda Bay



Appendix B-54. Percentage of Dead and Alive Mangroves in Different Sampling Stations in Leyte Gulf.

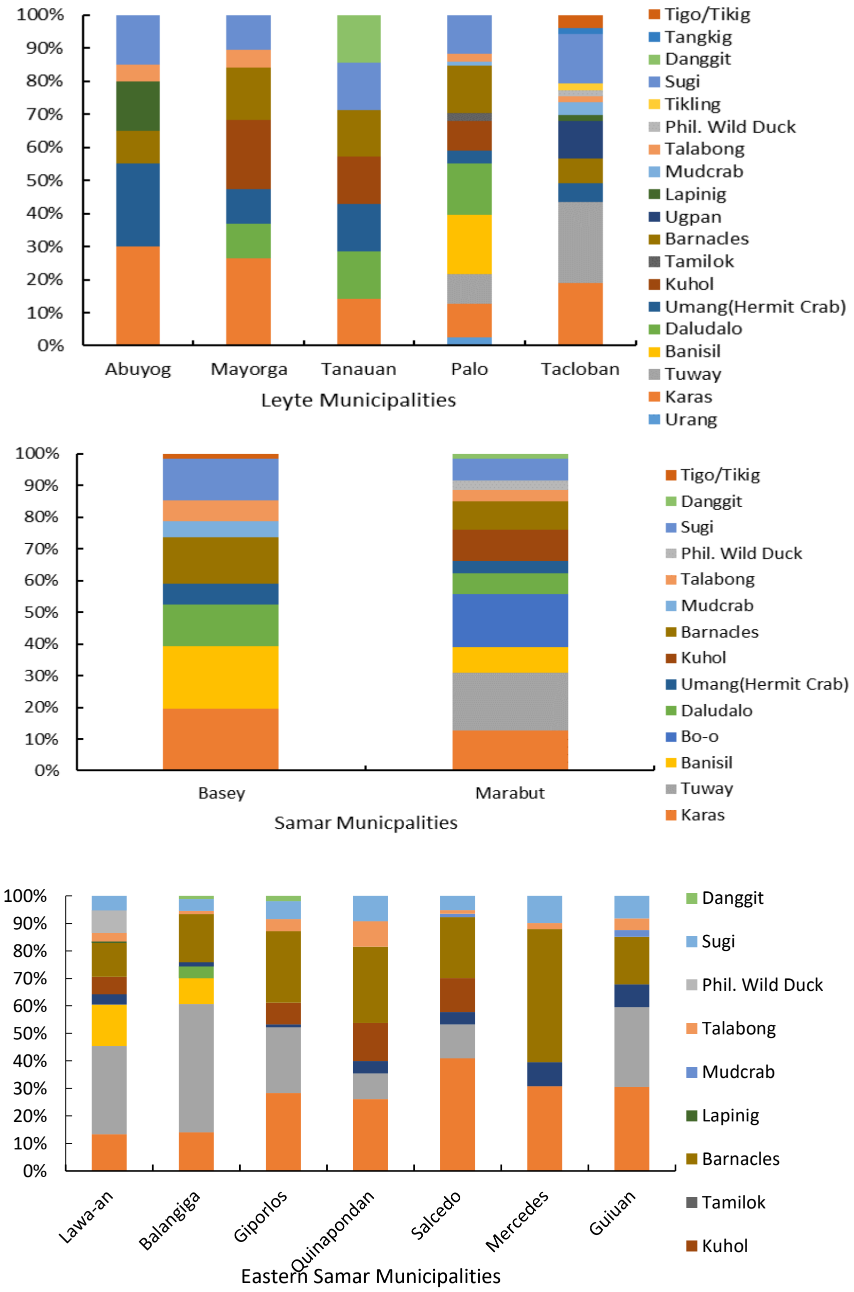


Appendix B-55. Percentage of Dead and Alive Mangroves in Different Sampling Stations along Matarinao Bay.



Note: municipality or city around Maqueda Bay not included on Appendix 8.3 has only one site or sampling station.

Appendix B-56. Percentage of Dead and Alive Mangroves in Different Sampling Stations around Maqueda Bay.



Appendix B-57. Mangrove Associated Fauna in Mangrove Ecosystems of Leyte Gulf.

Site	Species	No. of Individuals	Density (n sp/ha)	RD (%)
Buenavista	Talabong	27	122.73	25.96
	Karas	19	86.36	18.27
	Tuway	11	50	10.58
	Banisil	12	54.55	11.54
	Dalu-dalo	8	36.36	7.69
	Hermit Crab (Umang)	4	18.18	3.85
	Barnacle	8	36.36	7.69
	Mud crab	3	13.64	2.88
	Sugi	12	54.55	11.54
Naga	Talabong	5	27.78	3.22
	Philippine wild duck	10	55.56	6.45
	Karas	30	166.67	19.36
	Tuway	24	133.33	15.48
	Banisil	24	133.33	15.48
	Boo	3	16.67	1.94
	Dalu-dalo	9	50	5.81
	Hermit crab (Umang)	5	27.78	3.23
	Kuhol	13	72.22	8.39
	Barnacle	10	55.57	6.45
	Sugi	9	50	5.81
	Danggit	3	16.67	1.94
Caridad	Talabong	6	15.39	4.05
	Philippine wild duck	15	38.46	10.14
	Karas	25	64.10	16.89
	Tuway	18	46.15	12.16
	Banisil	28	71.80	18.92
	Hermit crab (Umang)	7	17.95	4.73
	Kuhol	12	30.77	8.11
	Barnacle	27	69.23	18.24
	Sugi	10	25.64	6.76
Abejao	Talabong	3	27.27	1.99
	Karas	36	327.27	23.84
	Tuway	30	272.73	19.87
	Banisil	24	218.18	
	Dalu-dalo	11	100	

		Hermit	crab	4	36.36		15.8
	(Umang)			29	263.64	9	
		Barnacle		11	100		7.29
		Sugi		3	27.27		2.65
		Danggit					19.2
						1	
							7.29
							1.99
							6.23
		Talabong					39.8
				9	39.13		
		Karas				6	
				57	247.83		
		Tuway					8.39
				12	52.17		
		Hermit	crab				1.40
				12	8.70		
Matarinao	(Umang)						11.1
				16	69.57		
		Kuhol				9	
				30	130.43		
		Barnacle					20.9
				13	56.52		
		Sugi				8	
				4	17.39		
		Danggit					9.09
							2.80
							12.3
						7	
		Talabong					15.0
				12	85.71		
		Karas				5	
				34	242.86		
		Hermit	crab	6	42.86		6.19
Vigan	(Umang)						18.5
				18	128.57		
		Kuhol				6	
				15	107.14		
		Barnacle					15.4
				12	85.71		
		Sugi				6	
							12.3
						7	
							1.87
		Talabong					
				2	6.45		58.8
		Karas					
				63	203.23	8	
		Hermit	crab				
Anahao				7	22.58		6.54
	(Umang)						
and Capopocanan				19	61.29		17.7
		Kuhol					
Islands				6	19.35	6	
		Barnacle					
				2	6.45		5.61
		Mad crab					
				8	25.81		1.87
		Sugi					
							7.48
							6.67
		Talabong					16
				5	22.73		
		Karas					46.6
				12	54.55		
		Tuway				7	
				35	159.09		
Batang		Hermit	crab				13.3
				10	45.45		
	(Umang)					3	
				3	13.63		
		Mud crab					4
				10	45.45		
		Sugi					13.3
						3	
Carmen		Talabong		1	4.55		1.96
		Karas		16	72.73		31.3

	Boo	3	13.64	7
	Dalu-dalo	4	18.18	5.88
	Hermit crab	6	27.27	7.84
	(Umang)	12	54.55	11.7
	Kuhol	9	40.91	6
	Sugi			23.5
				3
				17.6
				5
				22.1
				3
	Karas	27	87.10	28.6
	Tuway	35	112.90	9
	Boo	5	16.13	4.10
	Dalu-dalo	6	19.35	4.92
San	Hermit crab	7	22.58	5.74
Miguel	(Umang)	16	51.61	13.1
	Kuhol	13	41.94	1
	Barnacle	10	32.26	10.6
	Sugi	3	9.68	6
	Danggit			8.20
				2.46

Appendix B-58. Mangrove Associated Fauna in Mangrove Ecosystems along Matarinao Bay.

Municipality	Mangrove Fauna	Relative Density (%)	Relative Frequency (%)
Calbiga	weaver ants	34.79	12.57
	pangtion (shells)	47.87	26.94
	mangrove snake	1.48	1.19
	bayawak	0.14	1.19
	mangrove lizzard	2.40	0.60
	mangrove bird	0.85	8.38
	fiddler crabs	3.81	40.12
	mangrove bees	8.68	8.98
Catbalogan	weaver ants	46.87	19.17
	pangtion (shells)	24.05	37.5
	mangrove lizzard	1.85	17.5
	mangrove bird	1.13	10
	fiddler crabs	23.74	8.33

	mangrove bees	2.36	7.5
Daram	weaver ants	61.93	16.46
	pangtion (shells)	29.22	15.19
	mangrove bird	2.95	40.51
	fiddler crabs	5.90	27.85
Jiabong	weaver ants	24.05	26.31
	pangtion (shells)	47.40	18.71
	mangrove lizzard	5.18	20.09
	mangrove bird	3.77	10.28
	fiddler crabs	12.73	7.47
	mangrove bees	6.84	26.16
Motiong	weaver ants	30.03	32.56
	pangtion (shells)	27.17	13.37
	mangrove snake	0.27	0.58
	mangrove bird	1.63	38.95
	fiddler crabs	13.86	1.16
	mangrove bees	27.04	13.37
Paranas	weaver ants	32.05	68.12
	pangtion (shells)	35.88	17.39
	fiddler crabs	32.05	14.49
Pinabacdao	weaver ants	23.18	30.14
	pangtion (shells)	15.57	21.92
	mangrove snake	0.34	1.37
	bayawak	0.69	2.74
	mangrove lizzard	4.15	10.96
	mangrove bird	2.07	2.74
	fiddler crabs	30.80	13.70
	mangrove bees	23.18	16.43
San Sebastian	mangrove bird	6.67	4.76
	fiddler crabs	50.26	54.76
	mangrove bees	43.08	40.48
Talalora	pangtion (shells)	55.47	53.66

	mangrove bird	3.64	2.44
	fiddler crabs	40.86	43.90
Villareal	weaver ants	18.84	17.64
	pangtion (shells)	32.11	21.96
	mangrove snake	0.38	0.39
	bayawak	0.19	0.39
	mangrove lizzard	3.26	3.13
	mangrove bird	0.57	0.39
	fiddler crabs	27.30	30.58
	mangrove bees	17.30	25.49
Zumarraga	pangtion (shells)	72.72	68.18
	fiddler crabs	27.27	31.82

Appendix B-59. Mangrove Associated Fauna in Mangrove Ecosystems around Maqueda Bay.