SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCHMARK FOR POLICY REDIRECTIONS

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APPROVAL SHEET

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DEDICATION

I dedicate this project to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this program and on His wings only have I soared; My homeland Philippines, for its well-known natural beauty, the "Pearl of the Orient Seas"; The Samar State University, my school; My great parents, who never stop giving of themselves in countless ways; My dearest wife, who leads me through the valley of darkness with light of hope and support, my love for you all can never be quantified; My beloved brothers and sisters, who stands by me when things look bleak; To my children Mae, Dwayne, and Denisse who have been affected in every way possible by this quest; To all my family, the symbol of love and giving, my friends who encourage and support me, all the people in my life who touch my heart, I dedicate this research. Thank you.

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ABSTRACT

The types of sedimentation as physical characteristics of the coastal waters of Carigara Bay vary between stations. Primary and Secondary productivity in the soft bottom are chlorophyll A, plankton, and zooplankton while it was observed that the biological characteristics, mollusc-bivalve (such as punaw (*Paphia amabilis),* barinday (*Tellina radiate),* dunker indo pacific (*Pteria levanti*), and *Nerita planopira*), is dominant among the organisms. In terms of the potential sources of water pollution as an environmental condition, the following are noticeable: there is an inner input of pesticides from farms, and mangroves deforestation still exists. In terms of the condition of fisheries municipal ordinances, there is no policy or ordinance developed except for Fishery Laws for active gear however; there is a weak implementation of this existing policy. On the other hand, there is still availability of valuable natural resources in the coastal waters of Carigara Bay.

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Chapter I

THE PROBLEM AND ITS SETTING

Introduction

Extensive soft bottom coastal environments exit throughout tropical regions of the world, include places such as mud flats, beaches, shoals, holes and sand bars. Soft-bottom communities are diverse and play an important role as support system for many coastal resources. These include large mobile invertebrates, such as *penaeid* shrimps, which are the basis of important commercial fisheries, and higher tropic groups which feed on soft-bottom communities, such as fin fish (Longhurst & Pauly, 1987).

The soft bottom communities near the coast are subject to increasing effects of domestic and industrial pollution and, since many of the organisms of these communities are sessile, they provide useful indicators of habitat quality. Treat to soft bottom habitat disturbance from dredging, filling and fishing gear. Degradation and loss of habitat from construction of docks, jetties and bulkheads. Removal of habitat by excavation mining and beach nourishment. Not only are coastal fisheries threatened, but also coastal economies built around a high quality natural environment (NCDEQ, n.d.).

Most soft bottom subtidal communities are dominated by infaunal (burrowing), organisms, invertebrates such as polychaetes worms. However, other organisms such as crustaceans, echinoderms and mollusks may be locally abundant. Common epifauna (found on the sediment surface) can include species of shrimp, crabs, snails, bivalves, sea cucumbers, and sand dollars which has a commercial value. Sand and mud from dredging projects are sometimes deposited over soft bottom habitats. Soft bottom subtidal habitats could also soon be utilized for siting renewable energy projects and their associated infrastructure.

Commercial and recreational harvest of Dungeness crab, surf perch, and species of nearshore flatfish are the principal human uses of the soft bottom subtidal habitat. Sand and mud from dredging projects are sometimes deposited over soft bottom habitats. Soft bottom subtidal habitats could also soon be utilized for siting renewable energy projects and their associated infrastructure. Soft bottom subtidal offers many opportunities for scientific research (Schaeffen, McGourty, & Cosentino-Manning, 2007).

Soft-bottom communities have often been used in studies of pollution in tropical (Chang, Steimle, Reid, Fromm, Zdanowics & Pikanowski, 1992 ;Gray, McIntyre, & Stern, 1992). The effects of pollution in tropical soft-bottom communities are poorly documented compared with comparable temperate environments (Pearson & Rosenberg, 1978; Alongi, 1990). Soft bottom communities have been considered relatively unimportant since they appear barren and unpopulated, hence assumed unproductive (Peterson, 1981). However, the dominance of polychaetes in the gut of fishes collected from soft bottom communities have been reported (Dolar, 1986).

Soft bottom areas store, supply, and recycle sand and sediment for other habitats. The sediment found in soft bottom habitats is constantly moving from one area to another and from one habitat to another. Intertidal flats and sand bars buffer wave energy, reducing shoreline erosion. In addition, soft bottom habitat provides an area for marine animals to burrow, forage and spawn. Soft bottom may change into another habitat type if submerged aquatic vegetation grows or if oysters settle there (NCDEQ, n. d.).

Carigara Bay as the site of this study is identified as an area for expansion of trawlers from other neighbouring areas as far as Manila began to fish in the bay. Since then, trawling operations never stopped. Fishing and other related activities such as infrastructure (e.g. wharf, reclamation) led to the depletion of the bay's resources. The catch of municipal fishermen were reduced thereby decreasing the earnings of the fishermen from their fishing activity. The bay is now being exploited by more than 20 kinds of fishing gears. However, destructive fishing methods such as dynamite and cyanide fishing greatly reduced fish recruitment and species diversity.

Major cause of damage to soft bottom habitats is commercial fishing with heavy bottom trawls. The trawls disturb the sediments and damage or kill many non-target animals as they are dragged along to catch fish that live on or near the bottom (Ocean Health Index, n. d.). Bottom trawling, is one of the most severe anthropogenic impacts on marine environments (Dayton, Thrush, Agarde, &

Hofman, 1995; Jennings & Kaiser, 1998; Thrush & Dayton, 2002). Bottom trawling has two major impacts on benthic communities: (i) a direct physical effect that causes sediment disturbance and resuspension (Jennings *et al.*, 2001b; Watling *et al.*, 2001) as well as dislocation, damage and mortality of benthic organisms (e.g. Bergman and van Santbrink, 2000; Ramsay *et al.*, 2000); and (ii) an indirect trophic impact through fishery bycatch and discards which become a significant additional food source for scavengers and predators (Arntz & Weber, 1970; Groenewold & Fonds, 2000; Rumohr & Kujawski, 2000). Long-term bottom trawling pushes benthic communities towards smaller, short-lived and fast growing species.

Soft- bottom communities' studies has been limited especially in Carigara Bay and its vicinity. Due to scarcity of the literature this study will be first of its kind, it will provide new insights on soft- bottom assemblage including infauna and epifauna. Soft- bottom studies has been identified as research gap in the locality. Further, results or findings will establish the benchmark on the organisms that thrives of the said study site. To address the issue, this study will shade light and provide baseline information on the status of soft-bottom communities and environmental parameters in Carigara Bay, Leyte Philippines.

Statement of the Problem

The study sought to assess soft bottom communities in the coastal water of Carigara Bay, a benchmark for policy redirection. Specifically, this study sought to answer the following questions:

1. What are the characteristics of soft-bottom communities in terms of:
   - 1.1 Physical;
   - 1.2 Biological; and
   - 1.3 Chemical?
2. What is the primary and secondary productivity in the soft bottom communities?
3. What is the environmental condition of the soft bottom communities in terms of:
   - 3.1 existing valuable resources;
   - 3.2 degree of pollution; and
   - 3.3 Potential and sources of pollutants?
4. What is the level of the implementation of existing policies that preserve, control, and conserve marine resources?
5. What management policy framework may be developed for soft bottom communities in coastal waters?

Theoretical framework

Soft bottom habitats include environments where the seabed consists of fine grain sediments, mud and sand (Ocean Health Index, n. d.). Soft bottom harbors most of the benthic organisms (Schaeffer *et al.* , 2007).

On the study of the structure and diversity of shallow soft-benthic macrofauna in the Gulf of Lions (NW Mediterranean) (Labrume, Gremare, Amouroux, Sarda, Gil, & Taboada, 2008). Samples of soft-sediment macrobenthos from 92 sites between 10 and 50 m depth were used to assess (1) the main soft-bottom macrofauna communities in the Gulf of Lions, (2) the different components of the diversity of benthic macrofauna in this area, and (3) the relevance of the use of major taxonomic groups as surrogates for the analysis of the structure and diversity of total macrofauna.

Biodiversity is commonly defined as the variety of life (Gaston & Spicer, 1998) from the genomic to the ecosystem scale. There are thus many ways to measure biodiversity and there is no single scale in which it should be measured (Levin, 1992). As far as spatial scales and species diversity are concerned, this led to the classic distinction between α (i.e., the diversity of species occurring at a single site) and γ (i.e., the diversity of species occurring at the regional scale) diversity (Whittaker, 1960). The α-diversity accounts both for species richness and dominance (number of species per site) an ecosystem is a community of living organisms in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system (Tansley, 1934).

Most soft bottom subtidal communities are dominated by infaunal (burrowing) invertebrates such as polychaetes worms, crustaceans, echinoderms and mollusks (Subtidal soft bottom). Common epifauna (found on the sediment surface) can include species of shrimp, crabs, snails, bivalves, sea cucumbers, and sand dollars.

Soft bottom biodiversity and productivity vary depending upon depth, light exposure, temperature, sediment grain size and abundance of microalgae and bacteria (Ocean Health index, n. d.). Potentials damage to soft bottom communities are illegal fishing activities such as trawl, dynamite, cyanide fishing, and uncontrolled harvesting.

Conceptual Framework

The working process of this study is presented in figure 1. The study was conducted along the coast of Carigara Bay soft bottom communities. The focus of the study was on the characteristics of soft bottom communities, environmental condition, level of implementation of the existing policies on fisheries, and establishment/management of soft bottom communities.

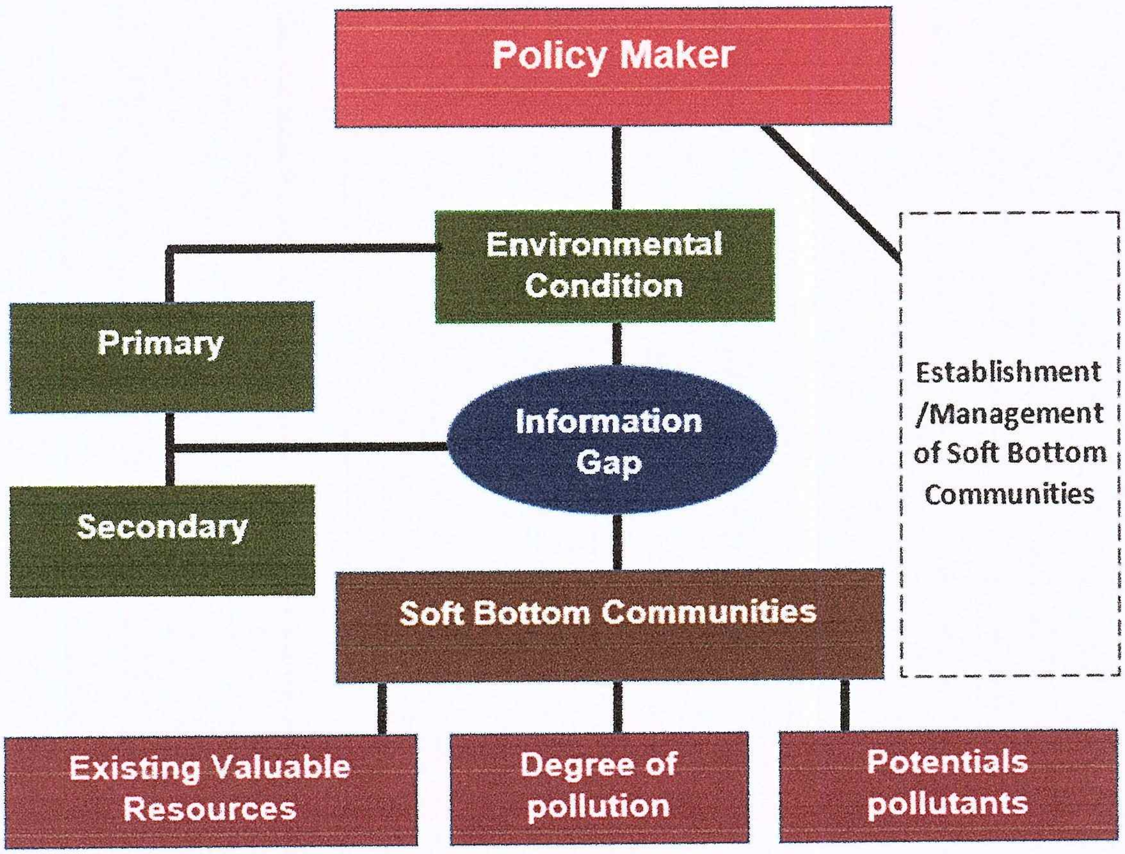

Figure 1. The conceptual framework of the study.

Significance of the Study

The findings of this study redound to the benefit of the community considering that the soft bottom communities play an important role in marine ecosystem.

Fisherfolks. The findings of this study shed light to the fisherfolks on the importance of soft bottom communities as a resource. Hence, proper and wise utilization is necessary.

Communities. Findings of this study provide information to the community on the essentiality of the soft bottom community as a resource, hence, redirect the mind-set from unwise exploitation to sustainable used of the resource.

Researchers. Results of this study provide baseline information for the researchers who wanted to conduct further study on the soft bottom communities of coastal waters of Carigara Bay.

Students. This study provides useful data that encourage students to pursue research work, hence, enhance their knowledge on soft bottom communities in coastal waters.

School. This study provides useful information that help school encourage their students to conduct research activities particularly on soft bottom communities, which are the habitats of different kinds of benthic organisms with economic value.

sediment traps which were installed across the isobath with 50 meters distance using transect line.

Definition of Terms

To give better understanding to the readers, the following terms are conceptually and operationally defined in this manuscript.

Babatngon,Leyte. It is a municipality in the province of Leyte, Philippines. According to the 2015 census, it has a population of 27,797 people (Census of Population, 2015). Babatngon, Leyte is located in the northern part of the island of Leyte, along the shore of Carigara Bay, 33 kilometres (21 mi) north-west of Tacloban City and about 10 kilometres (6.2 mi) north of the town of San Miguel, Leyte. In this study Babatngon, Leyte was one of the chosen study site among the municipalities abutting Carigara Bay.

Barugo, Leyte. It is a municipality in the province of Leyte, Philippines. According to the 2015 census, it has a population of 32,745 people (Census of Population, 2015). Barugo is a town in the northern coastal part of Leyte facing Carigara Bay, 50 kilometres (31 mi) north-west of Tacloban City, whose history dates back to the early days of Spanish colonization. Residents of a few coastal barangays are engaged in small-scale fishing and aquaculture. In this study Barugo, Leyte was one of the chosen study site among the municipalities abutting Carigara Bay.

Benchmark. A benchmark is a test used to compare performance between multiple things, either against each other or against an accepted standard (Lifewire, n. d.). In this study, benchmark refers to the baseline of policy redirection on the soft bottom communities.

Benthic. Is a region of the ocean begins at the shore line (intertidal or eulittoral zone) and extends downward along the surface of the continental shelf out to sea (Walag & Canencia, 2016). As used in this study benthic is a coastal zone serves as habitat of different kinds of bottom organisms.

Carigara,Leyte. It is a 2nd class municipality in the province of Leyte, Philippines. According to the 2015 census, it has a population of 51,345 people (Census of Population, 2015). It is a town in northern Leyte located right on the shore of Carigara Bay, and surrounded by wide rice fields fanning out towards the mountains in the distance. In this study, Carigara, Leyte was one of the chosen study site among the municipalities abutting Carigara Bay.

Coastal waters. Coastal waters are the regions of the oceans that are in direct contact with the continents. Coastal waters are where ocean life is most concentrated and is a place where many species find shelter and food for their young (G115, 2007) . As used in this study coastal waters covered the soft bottom communities during high tide and exposed the soft bottom during ebb.

Demersal fishes. Demersal fish live on or near the seabed and feed on bottom-living organisms and other fish (BETA, 2018). In this study, demersal fishes found in the sea bottom which harbor soft bottom habitat.

Epifauna. Epifauna live attached to hard surfaces such as rocks, shells and pilings or directly on the surface of the Bay's bottom (Chesapeake Bay program, 2018). In this study, epifauna is an organisms found on the sediments surface of the study area.

Posthole digger. is a hand tool used to manually dig deep and narrow holes in order to install posts, such as ones for fences or signs.

In this study, posthole digger was used to gather sampled sediments and sand on the study area.

Infauna. Infauna burrows into bottom sediments. Worms, clams and other infauna form their own communities that are connected to the water by tubes and tunnels. A healthy infaunal community contains many different species (Chesapeake Bay program, 2018). As used in this study infauna was the organism found in the soft bottom communities.

Meiofauna. The term meiofauna is derived from the Greek meio meaning "smaller". It refers to the fauna smaller than what has been defined as the lower size limit for macrofauna, those organisms that are retained on a 1 mm size (Higgins & Thiel, 1988). As used in this study, it is an aquatic organisms used to determine the biological structure of the area of study.

Policy. A definite course or method of action selected (by government, institution, group or individual) from among alternatives and in the light of given conditions to guide and, usually, to determine present and future decisions (FAO, 2009). As used in this study policy refers to the policy that was formulated on the protection and conservation of soft bottom habitat based on the result of this study.

Pollution. It means the introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of seawater, and reduction of amenities (Pravdic, 1981). In this study, pollution is an indicator of the environmental condition of the area of study.

Redirection. Is the switching of a standard stream of data so that it comes from a source other than its default source or so that it goes to some destination other than its default destination (LINFO, n. d.). As used in this study redirection means to develop the existing policies on fisheries which give emphasis on the protection of soft bottom communities.

Sediments traps. These are containers that scientists place in the water to collect particles falling toward the sea floor. The traps collect tiny sediment or larger accumulations called marine snow - made up of organic matter, dead sea creatures, tiny shells, dust and minerals (Honjo, Manganini, Buesseler, & Valdes 2018). As used in this study sediment traps were installed across the isobaths of the coastal waters of Carigara Bas as the site of the stud.

Sieve. It is a utensil that is a mesh placed over a frame (SKWIRK, n. d.). In this study, it was used to separate large particles from suspensions.

Soft-bottom habitat. Includes sediments that range in size from clay (0.001- 0.0039 mm) to silt (0.0039-0.0625 mm), and sand (0.0625-2 mm) (soft bottom) (Schaeffer, *et al*, 2007). As used in this study, soft bottom habitat was the area for data gathering.

Local Government Executive. This study provides useful data to the local executive in municipality abutting Carigara Bay on the status of soft bottom communities which has been overlooked, since there are economically and commercially important organisms resides beneath the soft sediment. Data provided as a benchmark for policy redirections on the protection, conservation, and management of soft bottom resources.

Investors/Development Planners. This study provides data for the investors and development planners to use the soft bottom resource wisely and sustainably.

Designers. This study provides information to the designers utilizing resources properly and wisely.

Scope and Delimitations

This study was descriptive in nature focused on the characteristics of soft bottom communities in terms of physical; biological; and chemical, primary and secondary productivity, environmental condition in terms of; existing valuable resources; degree of pollution; and potential and sources of pollutants, level of implementations of existing policies, and development of management framework on the protection, and conservation of soft bottom communities. Further, it was limited in three municipalities surround coastal waters of Carigara Bay. Data gathering used were posthole digger and improvised

Chapter II

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter provides an overview of previous research on knowledge sharing and intranets. It introduces the framework for the descriptive study that comprises the main focus of the research described in this thesis.

Related Literature

Soft bottom is used to some extent by almost all coastal fishes. On shallow intertidal flats planktivores, like anchovy and menhaden, feed on benthic microalgae and organisms that are suspended in the water column by wave action. Many Rays, flatfish, drums, sturgeon and crabs forage in soft bottom sediment for invertebrates. Flounder, sharks, drum and sea trout prey on smaller fish, shrimp and crabs in estuarine soft bottom habitat. Soft bottom represents an important spawning environment for many fish (NCDEQ, n. d.). Different kinds of invertebrates harbor soft bottom which has economic and commercial value.

Intertidal or shallow soft bottom habitats include mudflats and seagrass meadows, which are economically and ecologically important. Soft bottom habitats are inhabited by burrowing animals such as worms, snails, clams, and some anemones, shrimps and crabs, among others. Sand dollars, brittle stars and sea cucumbers roam the muddy surface, feeding on the sediments and their inhabitants, including great numbers of copepods, nematodes and other animals that live in spaces between sediment particles. Fluke, founder, haddock, sculpin, skates, rays and other fish feed on all of these tasty populations. (Ocean health index, n. d.).

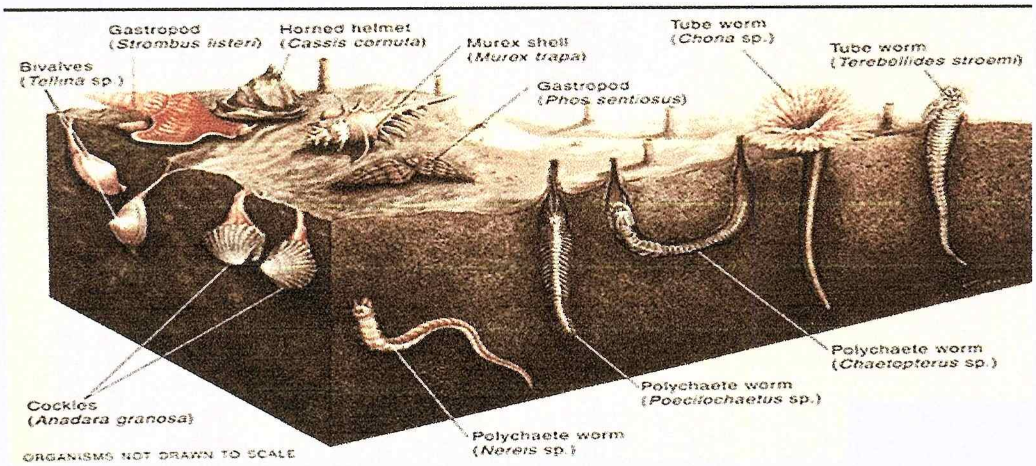

Figure 2. Soft bottom communities viewed in three dimension.

Soft-bottom habitat includes sediments that range in size from clay (0.001–0.0039 mm) to silt (0.0039–0.0625 mm), and sand (0.0625–2 mm). “Mud” refers to clay and silt together. All of these particles can readily be moved by tidal currents. Larger particles such as gravel (2–64 mm) and cobble (64– 256 mm), are somewhat mobile and are also included in this category. Deposits of bivalve shells can be mobile and are also considered in this section. Most of the soft sediment in the estuary is fine material (Keller A, 2009), particularly on shoals.

Soft bottom is the ocean's largest benthic habitat, forming the bottom of most of the continental shelves as well as vast expanses at depths of 3,000 to 6,000 m, which cover more than 60 percent of Earth's surface (Snelgrove, 2010; Ausubel, Crist, & Waggoner, 2010). The major cause of damage to soft bottom subtidal habitats is commercial fishing with heavy bottom trawls.

Benthic organisms, moreover serve as food items for commonly important fish species. Thorson (1957) explained that the size of an economic fish stock is to large extent determined by the density of the benthic marcofauna. Soft-bottom organisms are also useful as indicators of environmental conditions (Wass, 1967, Reish, 1972). Sotf-bottom organisms are known as accumulation of suspended or deposited particles; they are likewise supposed to play a crucial role in the transfer and storage of pollutants in the food chain.

In Bais Bays Philippines, soft bottom communities were surveyed using a Ponar grab (0.02 m^2). One hundred nineteen species were collected and classified into six groups: polychaetes, crustaceans, molluscs, nematodes, unknown organisms, and other organisms. Polychaetes comprised the majority of organisms collected in all stations at all sampling times. Of the polychaetes, members of family Spionidae (13 species) were the most common. Echinoderm and some chordate species were also collected but not consistently. Of the species collected, Prionnospio had the highest mean abundance in the south bay in June 1988 with values ranging from 4.67-39.67 organism per station. Density ranged from 216 to 6383 organsims/m^2 with the highest values obtained from the south bay in June 1988, where most organisms belonged to the smaller size classes. Species richness was consistently highest in the deep (Estacion & Oñate, 1988).

Nearly 40% of the total open ocean and 30% of the continental shelf in the world oceans lie within the tropical belt (Alongi, 1990). Pollution, urbanization, and human population are increasing rapidly along tropical coastlines. Soft-bottom communities (macrobenthos) are a key elements of a marine ecosystem (Lu, 2005). In marine sediments macrobenthos plays an important role in ecosystem processes such as nutrient cycling, pollutant dispersion, and burial and in secondary production (Snelgrous, 1998).

According to WWF Global (2014) soft-bottom habitats that are of principal concern, in terms of persistence and maintenance, which threatened by erosion and encroachment of cord grass. Increases in ferry travel on the bay would increase erosion along soft shorelines due to wakes- a waves that a boat leaves behind as it slices through the water. Establishing buffer zones or other methods to minimize the impact of wakes or to manipulating sediments to encourage growth and maintenance of soft bottom or mudflats.

Another example of successful management of marine community is the Australia: Better choices at the Great Barrier Reef. The Great Barrier Reef is rare in that most of its threats come in the form of onshore industry. Before the recent push to expand coal ports, the main industry in the firing line was agriculture. Rainwater falls inland, travels across farms picking up pesticides, dirt and fertilizer, and washes down the rivers, through deltas and out onto the reef where it leads to increased pollution and nitrogen levels in the water.

Agriculture, however, has taken huge strides in both accepting its responsibility for deteriorating water quality and in trying to do something about it. Project Catalyst is one example where, government agencies, the Coca-Cola Foundation and WWF have been working together to develop new farming methods that limit the run-off from farms in order to protect the reef. The added benefit is increased farm productivity.

The Philippines farming leopards at sea is another example of successful marine community management, found in Taytay, Palawan Philippines. It has 2,000 fish cages, where various species of grouper are grown to feed a ballooning export trade. For the Philippines, this is the center of the LRFFT: the live reef food fish trade. What began in the 1980s as an experiment now employs over 100,000 people in Palawan alone. Palawan's annual grouper exports exceed US$40 million. Overharvesting has been a huge problem. Fishers were catching five times more than what could be sustained. Spawning aggregations were targeted, depleting brood-stock. Fortunately local governments and fishing communities have embraced conservation efforts," says WWF-Philippines Project Manager Mavic Matillano. WWF is now leading efforts to facilitate the recovery of *suno* stocks by establishing marine protected areas, plus enhanced enforcement, licensing and education (WWF Global, 2015).

The Council of Ministers, however, according to WWF Global (2015), often disregards these recommendations because, as a rule, the priority for these ministers seems to protect jobs in the short term, not to maintain sustainability. As a consequence, the annual catch agreed to by the Council of Ministers is generally around 48 per cent more than the scientists' recommended figure. The fact that 88 per cent of European fish stocks, measured against maximum sustainable yield (MSY), are overexploited is due in part to these excessively high catch quotas.

Furthermore, the minimum sizes of fish that may be landed are often so small that 50 per cent of the fish have no chance of ever spawning before they are caught. The minimum legally permissible mesh sizes of fishing nets also allow fish smaller than the minimum landing size to be caught. These fish – amounting to as much as 40 per cent of the catch – die as a result of capture and are generally discarded overboard. There is very little incentive for a Member State to impose stringent controls on its fishing fleet if neighbour states fishing the same waters fail to do so. A further problem is that bycatch is not recorded or sanctioned. This means that fishermen can fish above their quota and simply discard the surplus by dumping it overboard (World Ocean, 2018).

In the sandy environment, a mollusc-*Littorina*–*Cresis*community that dominated during the premonsoon period changed to a *Tellina*–*Mactra* community during the postmonsoon period. In the fine sediment, in which the fauna was dominated by deposit feeders such as *Prionospio pinnata*, no obvious change in the community was observed during the two seasons (Alongi, 1990).

Related Studies

On the study, "Size structure of marine soft-bottom macrobenthic communities across natural habitat gradients: implications for productivity and ecosystem function", size structure of soft-bottom macrobenthic communities is clearly a complex response to the three habitat variables investigated here. Macrobenthic size structure tends to respond to water depth and sediment percent fines in a mostly graduated manner, with shallow, coarse sediments containing a proportionally high amount of organic biomass in small organisms, and deep, fine sediments containing a relatively high proportion of biomass in larger organisms. Communities between these two extremes tend to exhibit intermediate size structure. Of these two factors, size distributions respond to depth in the most linear way. Size distributions respond in a more punctuated way to organic flux and quality (Macdonald, Burd, & Roodselaar, 2012).

On the study conducted by Trimoreaua, Archambaulta, Brind'Amourb, Lepagec, Guittona, and Le Pape (2013), entitled "A quantitative estimate of the function of soft-bottom sheltered coastal areas as essential flatfish nursery habitat", revealed a higher influence of wave height and interannual variability on positive densities than on probability of presence. These two factors appeared more influent in modulating density than spatial extent of juvenile flatfish. Wave induces currents and bed stress, which can alter survival during larval settlement and metamorphosis and also nursery habitat structure and complexity, with consequences on suitability for juvenile flatfish. (Polte, Schanz, Asmus, 2005)

Another study conducted by Oug, (2017) on the "Structural and functional changes of soft-bottom ecosystems in northern fjords invaded by the red king crab (*Paralithodes camtschaticus*) diversity and composition of soft bottom species assemblages". It was found that fauna in the three fjords was dominated by mostly small (polychaetes typically 0.5–5 cm in length, bivalves 0.2–0.5 cm in diameter), burrowing species. The number of species per station varied from 27 to 91, with the highest number of species recorded in 1994. The abundances were generally between 1500 and 5000 ind m^{-2}, but in Kobbholmfjord even higher densities (6500 ind m^{-2}) were found. Polychaetes and bivalves constituted the most important groups, whereas crustaceans and echinoderms were rather poorly represented. Faunal diversity (Shannon-Wiener H') decreased from 1994 to 2007–09, but increased slightly in 2012.

According Estacion *et al.*(1998) on their study of soft bottom fauna of Bais Bay, Negros Oriental, Philippines that benthic organisms such as polychaetes, crustaceans, molluscs, and nematodes were consistently collected in all the stations establish in the Bais Bay. Polychaetes were consistently the dominant

group, the most commonly represented families being Spionidae (*Prionospio*), Nephtyidae (*Aglaopbamus*), and Capitellidae (*Mediomastus*). *Prionospio* had the highest abundance in South Bais Bays in June 1998.

Thorson (1957, 1968) argued that the number of infaunal specie of soft-bottom was roughly the same in arctic, temperate, and tropical seas. Community characteristics of tropical water are lacking in general, and off the pacific subcontinent particular the western side of the Pacific Ocean subcontinent has many characteristics feature in its oceanography. The opening of many small and big rivers makes the coastal belt of the west coast of Carigara bay a unique biological habitat. Coastal area show high marine biodiversity and are unique with regard to the flora and fauna of Carigara bay continental shelf.

Pura, Cinco, Sia, and Alducente (1999), studied on the Assessment of the fisheries resources of Carigara Bay as cited by FAO (2000), found that a total of 280 fish species identified distributed among 147 genera and 55 families, and 8 invertebrate species belonging to 2 classes and 66 families, and 33 invertebrate species. The total annual fish production of the Bay was estimated at 7,706 t indicating a decline from about 9,841 t. Of the 34 fishing gears, the Danish seine (24.9%) has the major contribution in the estimated annual production. This is followed by the bottom set gill net (21.0%), fish trap/fish pot (16.8%), multiple handline (12.1%), drift gill net (10.1%), ring net (9.7%), and jigger (2.2%) with the Danish seine constituting around 97% of the landed catch in the Bay. Eight trawl fishing stations were fished on a monthly basis using an 85-hp baby trawler operating in the area. Forty valid hauls from 10 trawl trips were sampled. Mean catch rate was 12 kg/hrs. and the catch consisted of 60 species/group distributed among 31 families.

Carigara Bay has surrounded by different river systems and belt with long coastal, where most people especially community reside along the bay has greatly rely on capture fisheries. The bay is protected by big mountain and water current is influence by the water current from Samar Sea.

Chapter III

METHODOLOGY

This chapter covers the research design, instrumentation, sampling procedure, data gathering, and statistical treatment.

Research Design

Carigara Bay is one of the most important fishing grounds in the country. Its approximate location is at Latitude 11° 28′00″ N and Longitude 124° 30′00″ E. The bay has an area of about 512 km^2 with an average depth of 54 meters. The bay's substratum is soft mud; however, some areas are sandy with coralline rock.

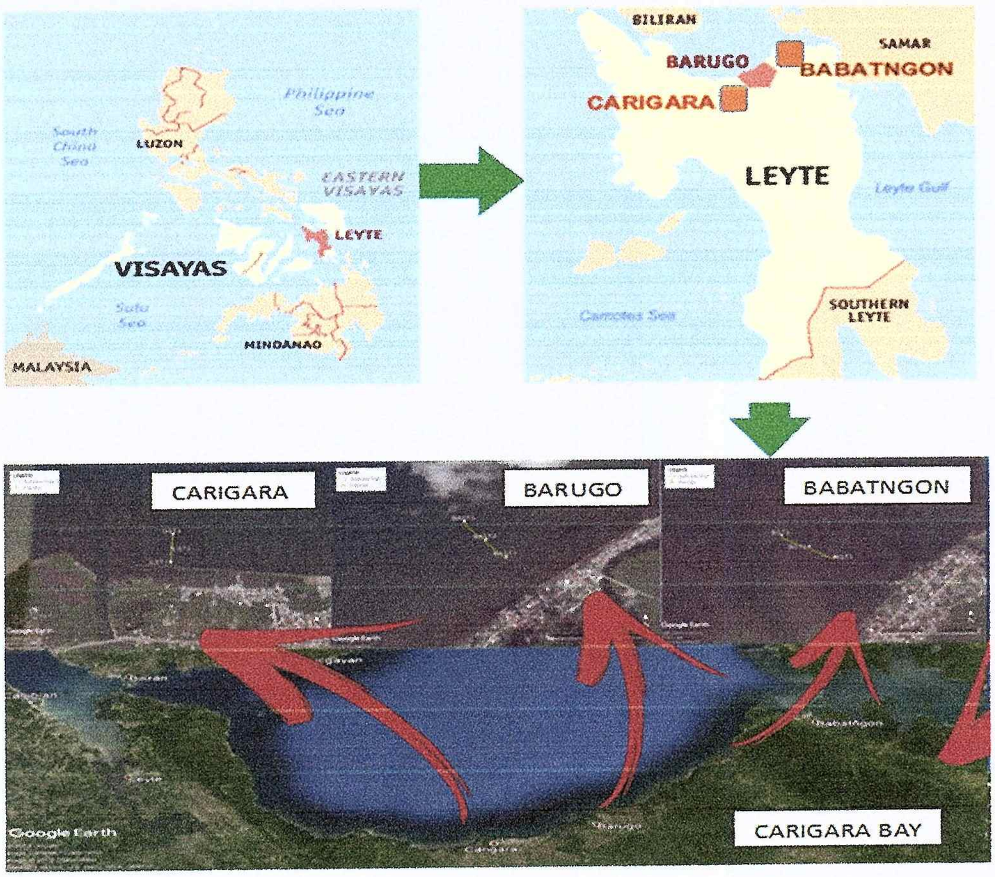

Figure 3. Chart shows the study site and sampling station.

Three sampling site were pre-identified as coastal shore. Stations were

Lined from shallow to deeper water to cover the isobath at 50 meters interval between stations. Coordinates were written in order according to the form of stations. Carigara, Leyte station 1, 2, 3 with coordinates of Lat.11°18'13.92"N Long. 124°40'39.23"E, Lat.11°18'17.23"N Long.124°40'39.44"E, Lat.11°18'20.46"N Long.124°40'39.61"E respectively. Barugo, Leyte station 1,2,3, with coordinates of Lat.11°20'22.13"N Long.124°45'18.83"E, Lat.11°20'24.51"N Long.124°45'16.76"E, Lat.11°20'27.14"N Long.124°45'14.47"E respectively. Babatngon, Leyte station 1,2,3 coordinates Lat.11°22'49.56"N Long.124°47'55.56"E, Lat.11°22'51.09"N Long.124°47'52.80"E, Lat.11°22'52.83"N Long.124°47'49.73"E respectively. Descriptive design was utilized to describe the characteristics, primary and secondary productivity, environmental condition, and implementation of existing policies that preserve, control, and conserve marine resources in soft bottom communities of the coastal waters of Carigara Bay.

Finally, the grain size analysis between station and between sampling site were subjected to test of normal distribution using Kolmogoroft- Smiruff Test to determine if the frequency of size was in normal distribution. This was followed by H-test or the Kruskal-Wallis test, test of difference and to detect whether the means are significantly different. With the use of MS Excel spread sheet data gathered was noticed in graphs and table to draw a picture for discussion.

Instrumentation

To gather pertinent data, several instruments were used and the techniques in the conduct of sampling protocols including documentation were listed below:

Posthole digger - The act or an instance of applying force on something so that it moves in the direction of the force.

Fig. 4. Posthole digger used to sample soil from soft bottom communities.

Formalin 10%- a buffered colourless solution of formaldehyde in water, used chiefly as a preservative for biological specimens.

GPS- GPS, which stands for **Global Positioning System**, is a radio navigation system that allows land, sea, and airborne users to determine their exact location, velocity, and time 24 hours a day, in all weather conditions, anywhere in the world. (Garmin. n. d.).

Improvised sediments trap- A sediment trap is a temporary containment area that allows sediment in collected storm water to settle out during infiltration or before the runoff is discharged through a stabilized spillway/dewatering pipe. (Honjo, Mangnini, Buesseler, Valdes, 2018).

Fig. 5. Improvised sediment trap used to catch sediments installed near the soft bottom.

Sorting box- with sieve size of 0.5 micron. It is used to separate sediment and organisms.

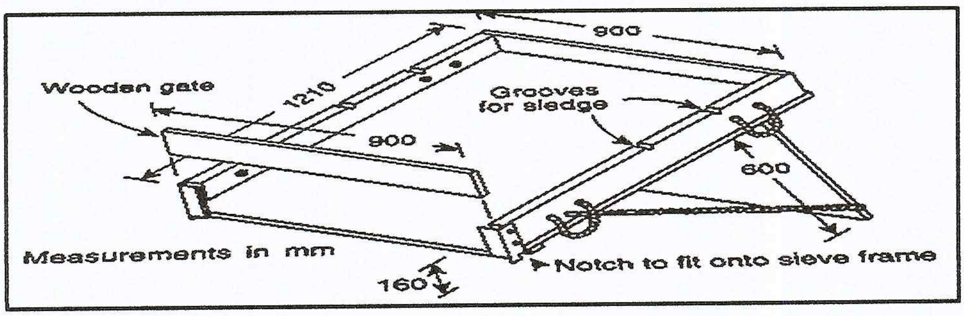

Fig. 6. sorting box used to separate organisms from the soil.

Wire-mesh sieves- various sieve size (.5 mm, 3 mm, 2 mm and 0.5 mm). Sieves should be made from stainless steel or bronze gauze.

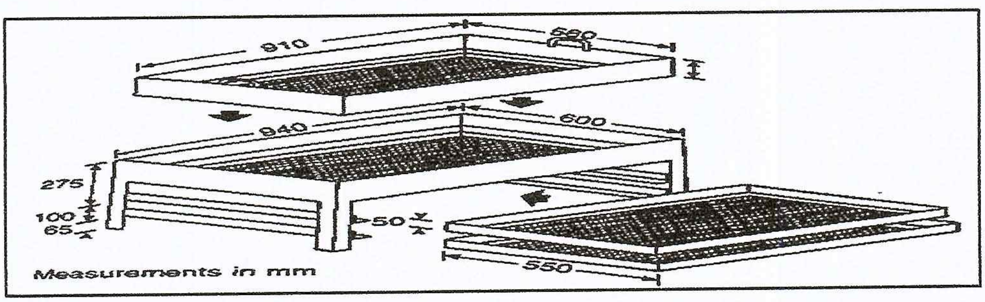

Fig. 7. Various sieve size used to determined passing percentage of sediments.

Plastic specimen jars-used to secure organisms collected from sampled sediments.

Papers and pencils- Pre-printed labels ensure that all relevant information is recorded and speed up sample processing time on packing.

Soft touch forceps- used to pick up live organisms found during sampling.

Cell phone/camera- used for picture taking for documentation.

Vials- used as container of the sediments taken from sediments traps.

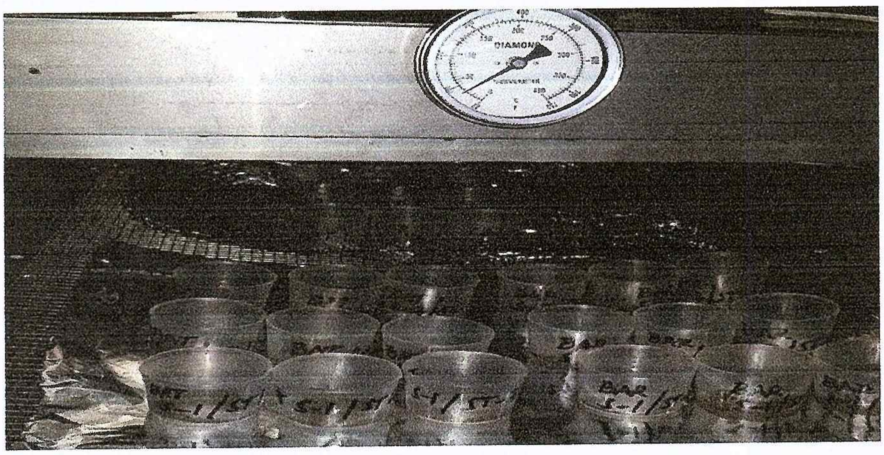

Fig. 8. Vials with sediments inside the ignite muffle furnace.

Sampling Procedure

Survey methodologies describe here was after the standardized method by English, Wilkinson, Baker (1997) a typical survey manual for tropical marine resources, it includes the improvised sediments traps, . A sampling program commenced on February and March, 2018 including the improvise sediment trap and posthole digger are consider to be the minimum requirements for characterising nearshore habitats. The improvise sediment trap is describe as an alternative sampler to the grab haul in areas which have very soft substratum. If improvise sediment trap sampling indicates the presence of soft bottom communities, the grab haul should be carried out to sample more species. Equipment selected specifically for nearshore soft bottom operation. The selected study site are Babatngon, Leyte, Barugo, Leyte, and Carigara, Leyte. The sites are selected due to its strategic locations from the researcher, it sets along the coast of Carigara Bay and fishing ground for the trawlers (bottom trawlers) local and from neighbouring island of Region 8, Philippines, and surrounded by different river system.

Data Gathering

A total of 9 sampling stations were established across the isobath in selected coastal waters of Carigara Bay with 50 meters distances using coordinates. The sampling commenced from February to March 2018 by means of posthole digger, dugged to its maximum (6 inches) and come up full. A small sub-sample of the sediment was remove through a window in the top of the digger before to open the digger and washed the contents through a sieve of 0.5 mm aperture. The animals retain are pick out live and fix in 10% formalin. After 24 h, placed in alcohol for preservation. Dry-tissue weights are obtain for a t0-grab haul from a single station (Station OHS) after decalcification with dilute

HCI and drying at 100° C. All the animals collected were sorted into their major taxa. Because of the inadequacy of much of the Caribbean taxonomic literature, it was impossible to identify most of the species. However, since the interpretation of the data in this study was based on identification, meristic using books, references. Soil chemical test methods used were; Potentiometric 1:1 H□O; Walkley & Black; Olsen/Bray; Ammonium Acetate; Nansen Bottle; KDS water quality reader.

Figure 9. Photos on the left side and the upper right was taken during the installation of the improvised sediment traps done by the researcher on different study site. Lower right picture was taken during the construction of improvised sediment traps.

Soil Testing Methods

The following are the methods for soil analysis; potentiometric 1:1 H_2O-use to test e pH level; Walkey & Black-use to test organic matter; Olsen/Bray-use to test available phosphorus (mg/kg); Ammonium Acetate-use to test exchangeable potassium (cmo1/kg); Nansen Bottle & KDS water quality reader-use to test chlorophyll A.

Statistical Treatment

Shannon-Wiener index (H)- essentially a measure of how difficult it would be to correctly predict the species of the next individual collected from the community under study. it is a measure of uncertainty, so the larger the value, the greater the uncertainty. Values of

the Shannon-Wiener index are dependent both on species richness (i.e. the number of species) and equitability (see below).

Where *pi* is the proportion of the ith species.

For practical application the formula can be expanded to:

Where *N*= total number of individuals;

$n_{i=}$ number of individuals in the ith species;

C= conversion factor $\log_{10} \log_2$.

Rarefaction- allows comparison of diversity measurements from different surveys in which samples of different sizes were collected. This is done by using the shape of species abundance curves rather than the absolute number of species in the sample. Hurlebert has derived an analysis expression {E (S_1)} to enable calculation of the expected number of species in a 'rarefied' sample.

Where S_I = expected number of species in a sample of I individuals;

S =total number of species in original species;

I = total number of individuals in hypothetical sample;

I_c = total number of individuals in origin sample;

I_j = number of individuals in species j of original species.

Equitability (j) refers to the evenness with which individuals are distributed amongst species (Pielo 1966)

Where H' = measured Shannon-Weiner diversity;

S = total number of species.

Margalef's species richness index (d)- is a measure of species richness which depends on the straight line relationship between species number and logarithm of the area sampled.

Where d= diversity;

S= total number of species;

N= total number of individuals.

Finally, the grain size analysis between station and between sampling site were subjected to test of normal distribution using Kolmogoroft- Smiruff Test to determine if the frequency of size was in normal distribution. This was followed by H-test or the Kruskal-Wallis test, test of difference and to detect whether the means are significantly different. With the use of MS Excel spread sheet data gathered was noticed in graphs and table to draw a picture for discussion.

Chapter 4

PRESENTATION, ANALYSIS, AND INTERPRATATION OF DATA

Presented in this chapter are the findings of the study based on the data gathered; the biological, physical characteristics, available resources, potentials damage, and extent of policies on the protection and conservation of soft bottom communities in coastal waters of Carigara Bay.

1. **Physical characteristics of soft-bottom communities of Carigara Bay**

1.1 Physical

The general characteristics of the soft bottom of Carigara Bay is primarily due to it geological configuration a dynamic bay primarily influence by water masses from Samar Sea. Surface current is generally demonstrated by Northeast monsoon, (amihan) that wind stress drive towards the coast. This process was called down welling where surface sea water moves from the nearby coast towards the deeper waters. Via internal waves, during low tide when soft bottom exposed to air bottom form small series of undertaking soft bottom brought about by interned waves during flooding tide until the low tide.

Table. 2. Types of sediments in coastal waters of Babatngon, Leyte.

SEDIMENTS TYPE	Sampling 1 (g)	Sampling 2 (g)	Sampling 3 (g)	Total (g)
Coarse	2	3	3	8
Medium	0.5	4	4	8.5
Fine	1.6	3	3	7.6
Very Fine	5	6	7.5	18.5
Total (g)	9.1	16	17.5	42.6

Table shows the types of sediments in coastal waters of Babatngon, Leyte. Very fine sediments show the most dominants among the types of sediments, seconded by medium, and next is coarse, and fine sediments. There about 43 tributaries around Carigara Bay. The river systems bring large amount of silt from nearby denuded forests. High siltation and sedimentation reduce water productivity. Poor agriculture and aquaculture practices contribute to water pollution. Grain size of the bottom sediments was tested using the Kolmogoroff-Smirnoff Test for normal distribution and result showed that grain size classification of the three sampling site were normal. Applying the H-Test or Kruskal Wallis Test revealed that from station 1 of the three sampling sites null hypothesis was reject since the computed value was 32.5146 which was greater than tabulated value of 5.99, therefore we can conclude that three means of grain size of the three site were not equal. On the other hand, all station 2 followed the same trend, we reject the null hypothesis because H value of 25. 99 was greater than tabulated value of 5.99 and we can say that means of sorted grain size were significantly different. For all station 3 the result also revealed the same conclusion we reject the null hypothesis. The homogeneity of the grain size of the sediment along the Carigara Bay was brought about the along shore current system driven from huge influence of water mass from Samar Sea and dissipate to small body of water like Carigara Bay, Maqueda Bay and Janabatas Channel.

In general, Carigara Bay has a westward circulation from induced forcing of water coming from the two channels namely Biliran Strait and Samar Sea and Maqueda Bay. This current carries to the coastal shore down welling movement of surface water mass that influence the bottom current and gyre with the general direction towards west of the bay (Pickard, 1978). Looking at the residence time of water in Carigara Bay seems to be dynamical where regular flooding and receding can be influence by wind stresses from the northeast vectors. Bottom sediments can be agitated by internal wave forcing that carries some larvae to disperse along the bay.

Hence variation on the distribution of organism in the bay was driven by physical forcing due to configuration as shallow embayment. The farmlands and fishponds use different kinds of pesticides, herbicides, mullocides, and fertilizers, which, when dumped in large quantities, harm water quality. Ride tide blooms occur annually in Carigara Bay, and the most serious outbreak in 1992 lasted for about four months (Muñoz, 2009).

Table.3. Types of sediments in coastal waters of Barugo,Leyte

Sediment types	Sampling 1 (g)	Sampling 2 (g)	Sampling 3 (g)	Total (g)
Coarse	4	4	4	12
Medium	3	3	6	12
Fine	0.6	3	4	7.6
Very Fine	6	4	7	17
Total (g)	13.6	14	21	48.6

Table above shows the types of sediments in the coastal waters of Barugo, Leyte. It shows that very fine sediments has the biggest number while coarse and medium sediments are in the same number in terms of weight and placed in second, while fine sediments are the smallest in amount. Most coastal habitat in Carigara Bay has been damaged. Only 22% of the coral reefs are healthy. Major mangrove stands have been converted into fishpond and beach resorts. Sea grass beds have been damaged by trawling and blasting activities. Only patches are left of what was a luxurious growth of different species (Muñoz).

Table. 4. Types of sediments in coastal waters of Carigara, Leyte.

Sediment types	Sampling 1 (g)	Sampling 2 (g)	Sampling 3 (g)	Total (g)
Coarse	8	8.57	12.1	28.67
Medium	10	19.2	21.3	50.5
Fine	10	7	9.6	26.6
Very Fine	3.9	11.3	13.7	28.9
Total (g)	31.9	46.07	56.7	134.67

particle passing of 99 percent with 179.4 grams of soil from the original of 181.0 grams and with a sieve size number 40 passing percentage was 95% with 172.4 grams. Weight with 109.6 passing is 61% with sieve size of no. 100. And 39% passing weight with 69.9 grams sieve size of no. 200. It is noted that at station 2 the highest sieved grain was 84.9 which mean the middle station was disturb by shifting current brought about by tide undulation.

Table 5. Soil Analysis of Soft Sediment in Barugo, Leyte

Sieve Size (inch)	Sta. 1	Sta. 2	Sta. 3	Ø opening (mm)	Wt. passing (gram)	% passing
4	0	0	0	4.25	163.6	100
10	0.8	0	0.2	2.99	162.8	100
20	1.0	1.0	1.5	1.495	161.8	99
40	12.2	18.3	28.9	0.425	149.6	91
100	81.4	87.6	76.0	0.15	68.2	42
200	36.6	37.5	36.2	0.075	31.6	19

Table 5 shows the percentage of passing of soil from the coastal area of Barugo, Leyte, using different standard sieve sizes. Sieve size no. 20 passing percentage is 99% with 161.8 weights in grams from the original of 163.6 weights in grams. In sieve size no. 40 a passing of 91% with 149.6 weights in grams. In sieve size no.100 42% passing with 68.2 grams remain. In addition, sieve no. 200 passing was 19% with 31.6 weights in grams.

Table 6. Soil Analysis of Soft Sediment in Carigara, Leyte

Sieve Size (inch)	Sta. 1	Sta. 2	Sta. 3	Ø opening (mm)	Wt. passing (gram)	% passing
4	0	0	0	4.25	176.6	100
10	0	1.1	1.3	2.99	176.6	100
20	4.3	2	6.6	1.495	171.8	98
40	39.7	20.2	40.3	0.425	132.1	75
100	76.0	48.4	56.9	0.15	86.1	32
200	19.1	37.4	25.0	0.025	37	21

Table 6 shows the percentage of passing of soil from coastal area of Carigara, Leyte using different sieve sizes. Sieve size no. 20 with a passing of 98% with 171.8 weight in grams from the original weight of 176.6 with sieve size no. 10. And 75% passing in sieve size no. 40 with 132 weight in grams. 32% passing using sieve size no. 100 with 86.1 weight in grams. And 21% passing with 37 weight in grams using no. 200 sieve size.

1.2. Biological characteristics of soft bottom communities in Carigara Bay.

Species composition

The common species thrives in soft bottom communities of coastal waters of Carigara bay are sponges (*Poriferans*), polychaetes, saltwater clam (*Venerupis philippinarum*) and some species of mollusc, specie of echinoderm like sun dollar, crustaceans and cnidarian.

Table 7. Diversity of organism by phyla

	Mollusc	Cnidaria	Crustacia	Porifera	Echinodermata	Annelida
Babatngon	15	3	2	10	2	2
Barugo	40	2	7	2	2	6
Carigara	6	4	9	4	1	2

Table 7 shows the distribution of major phyla identified in the three sampling sites. Mud flats in Carigara Bay are dominated by molluscs which population constitute 61 species. While 18 species belong to crustaceans, meanly fiddler crabs, small edible crabs, blue swimming crab's juveniles, shrimp larvae, sea mantis. Next dominant group is Poriferans, which is a form of coral rubbles, fragments scoured from adjacent coralline ecosystem. Cnidaria fragments of jellyfishes and particle polyps. While less of number found on the area of the study is the annelids.

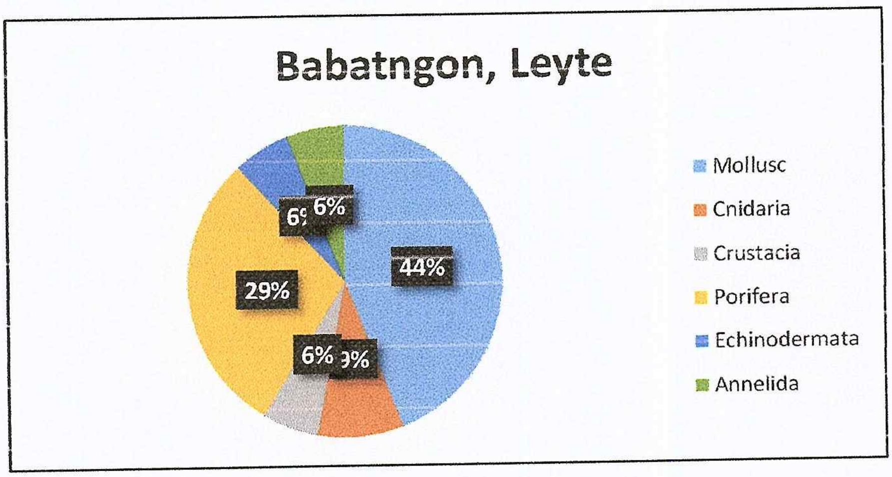

Figure 11. Diversity of major phyla in Babatngon, Leyte.

Figure 11 shows the distribution of the major phyla on soft bottom communities of Babatngon municipal waters. Mollusc shows dominant (44%) among the organisms. Next dominant group is Poriferans which is remnants of debris from sponges followed by cnidarians; while echinoderms, annelids, and crustacean has the same number of populations.

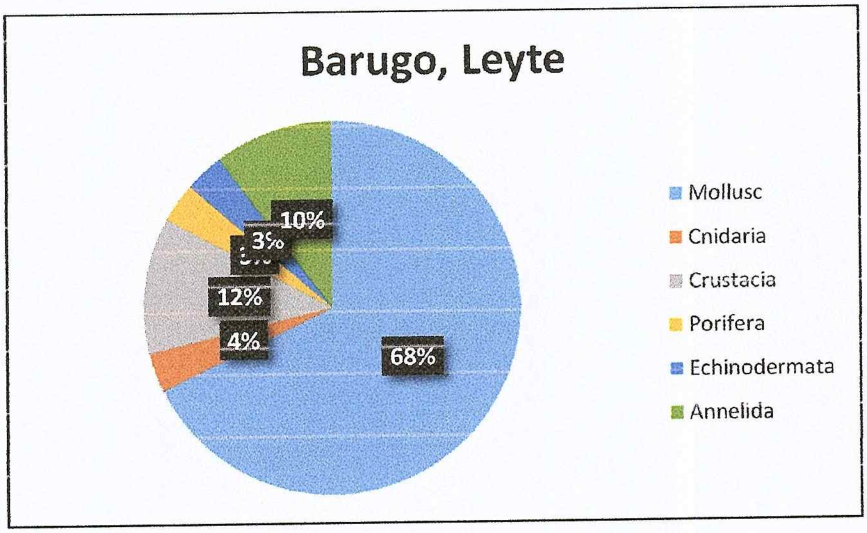

Figure 12. Diversity of major phyla in municipal waters of Barugo, Leyte.

Molluscs are dominant among the species found on the study site. Next is crustaceans followed by annelids. And the least are cnidarians, poriferans, and echinoderms. Detritus derived from weathering and tributaries contributes huge amount of nutrient to bivalves that thrives in the soft-sediments of coastal shore of Barugo.

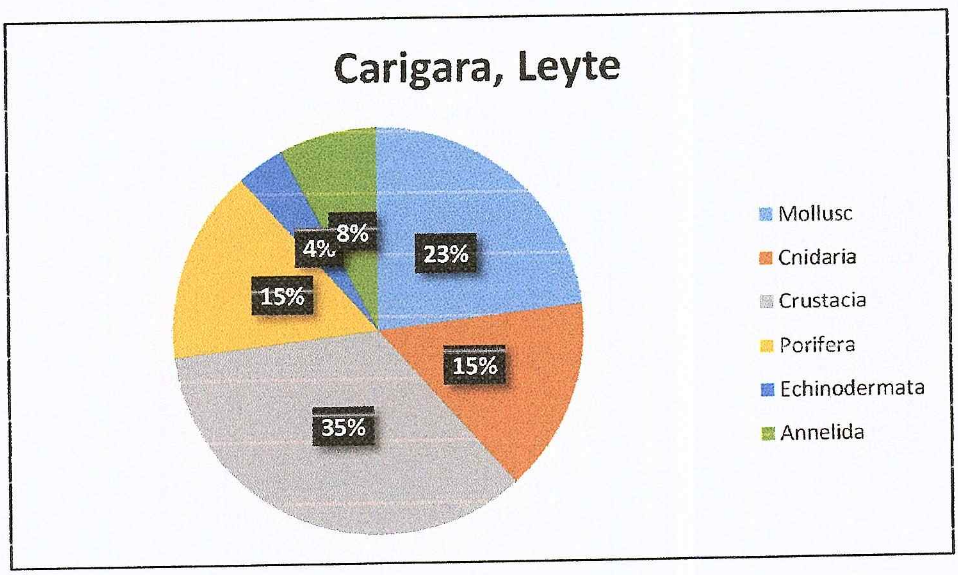

Figure 13. Diversity of major phyla in Carigara coastal waters.

Distribution of major phyla in coastal waters of the municipality of Carigara is dominated by crustaceans followed by molluscs. Diversity of crustacean has increased due to presence of discarded juvenile fish from trawl fishing. This provides opportunistic behaviour of crustaceans to feed within the soft-bottom communities while cnidarian and poriferans showing the same number of population. The last two are annelids and echinoderms.

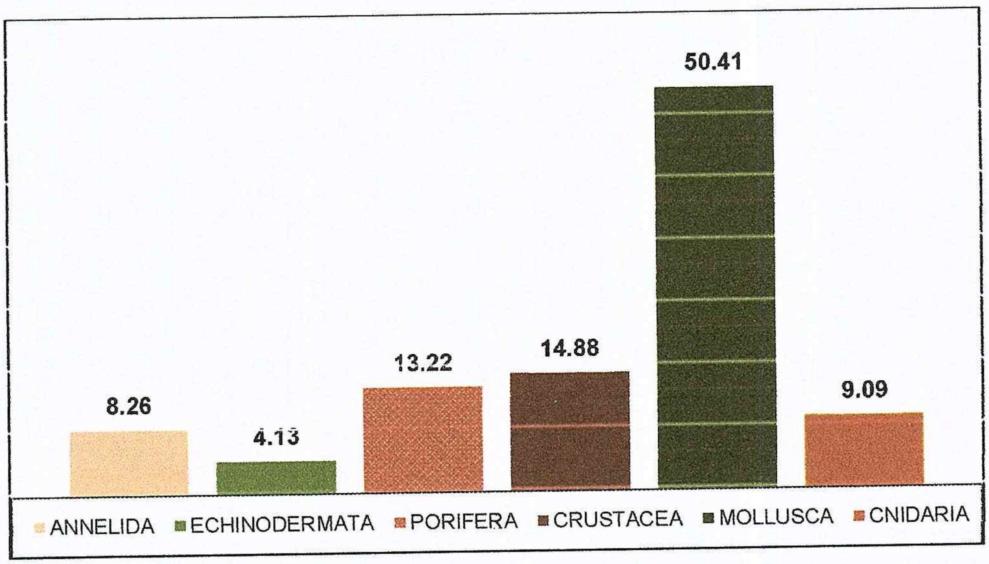

Figure 14. Diversity of major phyla in Carigara Bay.

Figure 14 showed the total number of species found in soft bottom communities in coastal waters of Carigara Bay. Collected species in three municipalities abutting Carigara Bay, molluscs showing the greatest number among the groups of species, next crustacean followed by poriferans which also shows the greatest in number compared to the cnidarian, annelids and the least is echonodermata. This study is also consistent with the result on the study of *the abundance and spatial distribution of soft sediment Communities in Tanjung Bungah,* *Malaysia,* (Darif *et. al.* 2016). A total of 110 individuals belonging to 7 groups of macrobenthos (Annelida, Bivalvia, Crustacea, Gastropoda, Nematoda, Nemertea, and Polychaeta) were recorded in this study. Crustaceans represent 29.1% of the total individuals and it has the highest relative abundance compared to other groups of macrobenthos. Structure of the benthic community is now frequently use as an index in pollution monitoring programmes (Warwick & Ruswahyuni, 1987). The classic work of Sanders (1968) showed that within the habitat, marine benthic diversity in the soft-bottom was higher in the tropics than in the boreal region, Warwick and Ruswahyumi, (1987) compared the softbottom macrobenthos communities of tropical and temperate regions and suggested that abundance and biomass of tropical regions are low compared with temperate regions. which was a suitable habitat for crustaceans. The trawls disturb the sediments and damage or kill many non-target animals as they are dragged along to catch fish that live on or near the bottom. Many fishes, decapoda, crustaceans, and cephalopods of high economic value feed on benthic organisms, predominantly macrobenthos. The abundance and large biomass of this benthic fauna indicate overall aquatic fertility.

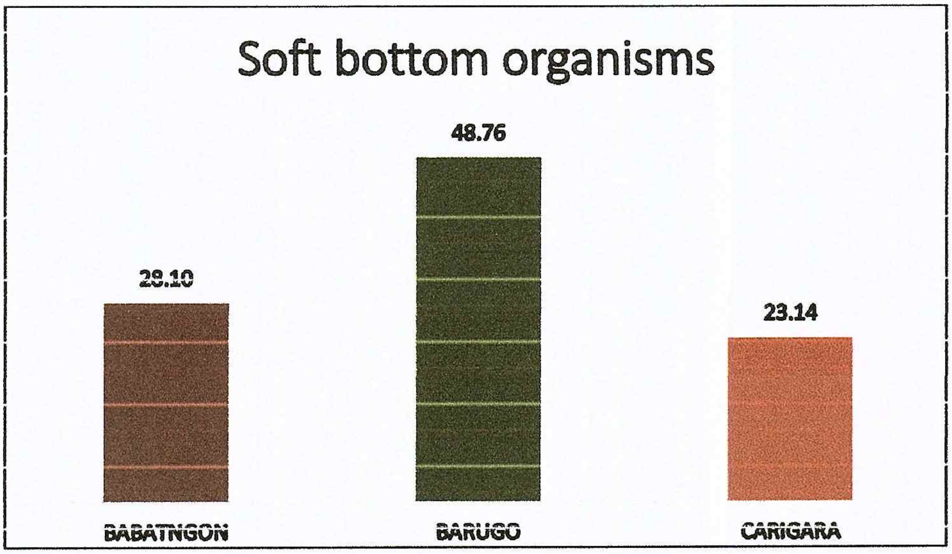

Figure 15. Diversity of major phyla of Soft Bottom Communities in municipal waters of Babatngon, Leyte, Barugo, Leyte, and Carigara, Leyte Carigara Bay.

The distribution of soft bottom organisms per municipalities are as follows: Municipality of Barugo, Leyte showing high abundance of soft bottom organisms, followed by municipality of Babatngon, Leyte and the least is the municipality of Carigara. Mean benthic abundance is high in the shallow and intermediate depths and decreased toward deeper areas. Diversity increased with depths up to 100 m during both seasons and decreased beyond 100 m depth. The dominant benthic group was Polychaetes during both seasons. Species richness and diversity are higher during premonsoon compared with postmonsoon. Shallow depths are dominated by deposit-feeding polychaetes, and deeper depths are dominated by deposit and filter feeders such as crustaceans and molluscs. Diversity is high in the medium grain-sized sediment.

Mean benthic abundance is high in the shallow and intermediate depths and decreased toward deeper areas. Diversity increases with depths up to 100 m during both seasons and decreased beyond 100 m depth. The dominant benthic group is Polychaetes during both seasons. Species richness and diversity are higher during premonsoon compared with postmonsoon. Shallow depths are dominated by deposit-feeding polychaetes, and deeper depths were dominated by deposit and filter feeders such as crustaceans and molluscs. Diversity is high in the medium grain sized sediment. Factors explaining trends in abundance would decrease exposure to water turbulence again linked to the greater depth of the outermost station. Due to their shallowness, the other stations would be expected to experience a significantly higher degree of instability and scouring which could limit meiofuana settling.

Over all faunal composition and the relative abundance is characterized by the dominance in the meiofauna of polychaetes and crustaceans, with the former outnumbering the latter. Such trend has already been reported and maybe the rule for shallow near shore sites, at least in the topics. Other groups may dominate the meiofauna in different regions. In temperate areas like the Baltic, the dominant role of ostarcods (Crustacea) is evident in salinity-stressed mud bottom communities with nematodes also playing an important part (Ankar 1975). Rudnik *et al,* (1985) found a predominance in Narragansett Bay (Rhode Island).

`The grouping pattern derived from the macrobenthos benthic fauna seemed to confirm that initial hypothesis that the similarity of the three sampling stations could be decided by the degree of influence of the sea and the proximity of the sites from one another.

1.3 Chemical characteristics of soft bottom communities in Carigara Bay.

Primary productivity was the rate at which energy was stored by photosynthesis and chemosynthesis activity of producer organism (algae) in the form organic substance that can be used as food materials (Odum, 1971).

Table 8. Soil nutrients in coastal waters of Carigara Bay.

Determination	Test Method	Adequate Value	Laboratory No.		
			3043	3044	3045
			Field No.		
			Carigara	Barugo	Babatngon
			Results of Soil Analysis		
pH	Potentiometric 1:1 H_2O	5.5 – 8.5	6.52	6.48	6.54
Organic Matter (%)	Walkley & Black	>4.5	0.19	0.13	0.18
Available Phosphorus (mg/kg)	Olsen/Bray	>20	0.15	8.21	0.94
Exchangeable Potassium (cmol/kg)	Ammonium Acetate	>0.25	1.86	0.66	0.60
Chlorophyll A	Nansen Bottle KDS water quality reader	0- 7	0.20µg/L @ 10m depth	0.15 µg/L @ 10m depth	0.25 µg/L @ 10m depth
		4-8	6.26 DO(ml/L @ surface water	6.55DO(ml/L @ surface water	6.45DO(ml/L @ surface water

Table 8 showed the chemical characteristics of soft bottom habitat of coastal zone in three municipalities abutting Carigara Bay namely; Babatngon, Leyte; Barugo, Leyte; and Carigara, Leyte. Babatngon, Leyte result pH of 6.54 which is normal based on adequate value stated on the result, the organic matter of 0.18 which lower of adequate value. Available phosphorus is 0.94 lower than the adequate value. Phosphorus in a form of cellular phosphorus as a total water phosphorus has been used been used to estimate phytoplankton standing crop.

The quantity of cellular phosphorus has been quite variable the amount absorbed by growing phytoplankton cells on the phosphorus content of the surrounding sediment or medium. The highest phosphorus content is in Barugo, Leyte this is being confirmed with highest phytoplankton in the area and with higher diversity of bivalves that thrives in the soft-bottom communities. Exchangeable potassium of 0.60 shows higher than the adequate value.

In Barugo, Leyte pH result 6.48 which normal in range which means the soft bottom habitat is not acidic. While organic matter result is 0.13 which lower than the adequate value which means lower also of the microorganisms. The available phosphorus is 8.51 which still lower than the adequate value. And the exchangeable potassium of 0.66 is higher than the adequate value.

While the soil analysis results from the coast of Carigara, Leyte, pH value is 6.52 which is normal. Organic matter is 0.19 which is lower than the adequate value. Available phosphorus is 0.15 also lower than the adequate value. Exchangeable potassium is 1.86 which showed greater than the adequate value.

2. **The primary and secondary productivity in the soft bottom communities.** In Carigara Bay is based on plankton and zooplankton community structure. Chlorophyll to organic carbon, where F= 30 for marine culture and natural populations known to be without nutrient deficiencies. F= 60 for mixed freshwater lake populations. Phosphorus (mg) = 0.75 (+0.2) x chlorophyll

(mg). Nitrogen (mg)= 7 (+3) x chlorophyll (mg). Gross primary productivity (mg c/m^3)/ hour= (30+20) x I x (mg chlorophyll a/m^3).

Table 9. Nutrient distribution of soft bottom communities in coastal waters of Carigara Bay.

Nutrients	Babatngon	Barugo	Carigara
pH	6.54	6.48	6.52
Organic matter	0.18	0.13	0.19
Potassium	0.94	8.21	0.15
Phosphorus	0.60	0.66	1.86

3. Environmental condition of the soft bottom communities

3.1. Existing valuable resources

Carigara Bay is characterized by a highly diversified multispecies fishery resource being exploited by a multiplicity of fishing gears. A total of 34 fishing gears, 13 of which are not included in the Carigara Bay REA have been sampled. A total of 280 fish species identified distributed among 147 genera and 55 families, and 8 invertebrate species belonging to 2 classes and 66 families, and 33 invertebrate species. The total annual fish production of the Bay is estimated at 7,706 t indicating a decline from about 9,841 t. Of the 34 fishing gears, the Danish seine (24.9%) has the major contribution in the estimated annual production. This is followed by the bottom set gill net (21.0%), fish trap/fish pot (16.8%), multiple hand line (12.1%), drift gill net (10.1%), ring net (9.7%), and jigger (2.2%) with the Danish seine constituting around 97% of the landed catch in the Bay. Eight trawl fishing stations were fished on a monthly basis using a 85-hp baby trawler operating in the area. Forty valid hauls from 10 trawl trips are sampled. Mean catch rate is 12 kg/hr and the catch consisted of 60 species/group distributed among 31 families. The growth parameters (L sub ao and k) of the von Bertalanffy growth formula and mortality coefficients (M, F, and Z) are also estimated using ELEFAN 1 and 2 routine of FiSAT, for the most abundant species composition.

Six commercially bivalves are found in the study area, *Paphia undulata* (mayahini), *Anadara granosa*(liboo) ,*Scapharca sp*(udpan). *Modiolus metcalfe*(bahong), *Paphia amabilis*(punaw) and Placune placenta (tipay). The most *Paphia amabilis* was the most commercialy important in Babatngon and Barugo in the inner part of the bay the substratum was fine silt and fine mud to fine sand where they inhabit at 1-2m depth.

3.2 Degree of pollution

Red tide blooms periodically occur in Carigara Bay, resulting in economic loss and dislocation of fishermen. The occurrence has been attributed to heavy sedimentation, siltation and pollution. Furthermore, poor water quality has contributed to lower coral reef productivity owing to poor light penetration. Red tide blooms occur annually in Carigara Bay, and the most serious outbreak in 1992 lasted for about four months.

3.3. Potential source of pollution

Improper waste disposal along the coastal waters of the bay causes water quality degradation. Besides unsightly dumping areas, there is an increase in the amount of coliform bacteria which affect the health of the entire coastal community.

There are about 210 hectares of fishponds in near shore areas of the bay: about 156 hectares acquired through the 25-year fishpond lease agreement (FLA); 144 hectares privately owned; and 10 hectares acquired by a school of fisheries for extension and research. Species cultured are prawn and milkfish. Conventional and semi-intensive methods are used. Poor agriculture and aquaculture practices contribute to water pollution. The farmlands and fishponds use different kinds of pesticides, herbicides, mullocides and fertilizers, which, when dumped in large quantities, harm water quality

4. Level of implementation of existing policies that preserved the control the conserved marine reserved.

Issues affecting Carigara Bay are categorized into resource and environmental degradation, socioeconomics, legal and institutional and information, education and communication. Overfishing in the bay is caused by excessive fishing effort. Although the Local Government Code of 1991 delineates boundary between municipal **(0** - 15 kilometers) and commercial **(>I5** kilometers) waters, there are reports of commercial fishermen encroaching on municipal waters. Furthermore, fishing boats have not been properly registered and boats of more than **3** GT are registered as municipal boats. Damage to bottom habitats by trawler and modified Danish seine operations has become increasingly common. The catch composition of these gears shows a large portion of juveniles. Most baby trawlers are based at Capoocan, Leyte. The use of destructive fishing methods affects both resources and the environment. The use of dynamite to catch high-priced fish and cyanide in aquarium fish collection has impacts not only on fish but also on the various marine habitats. There is continuous access to ammonium nitrate as a material for dynamite making. Using fine-meshed nets also affects recruitment of fish stocks.

5. Management policy framework

In 1991 passage of Fisheries Administrative Order (FAO, 179) establishment of Babatngon Fish Sanctuary, in Calangawan Island Babatngon, Leyte, in June 27,1991 by BFAR Central Office. Also in 1991, FAO 180 establishment of "Barugo Fish Sanctuary" in Jalaba Point Brgy Balud Barugo Leyte. The devolution of resource management to the local government under the Local Government Code of 1991 did not foresee the need to build LGU capability to ensure that adequate and qualified manpower implement the resource management programme. On the national scene, Executive Order 116 streamlined the bureaucracy, diffising the fisheries extension service of the Department of Agriculture and affecting programme implementation at the grassroots level. While some staff of the LGUs have a technical background in fisheries, implementing EAFM programmes and projects goes beyond technical knowledge. There should be a knowledge of the concepts and principles of EAFM.

There is a weak judicial support especially on prosecution. There are very few cases against illegal fishing which have been successfully prosecuted. Furthermore, local politics override the proper functioning of the judicial system. This makes apprehension of violators with political connections extremely difficult for law enforcers. One of the most important functions of the LGUs is the enactment of a unified basic municipal ordinance for fishery management. Each of the five municipalities along Carigara Bay have enacted basic fishery municipal ordinance. However, only that of Capoocan did not include provision for banning trawlers within the municipal waters.

Most coastal communities lack knowledge on marine ecology and environmental conservation and management. The open access nature of Philippine fisheries makes it possible for fishermen go from one place to another when the traditional fishing ground runs out of its valuable fish species. Barangay Visoria in Carigara is being inhabited by transient fishermen who have chosen to stay for good. Fishermen also think that marine resources are inexhaustible even if they have observed negative biological changes on the fisheries. Corollary to this, formal education is inadequate to impart resource management concepts. Occasionally, lectures on management and conservation of marine resources are conducted in elementary school. However, this is not enough and the effort is not sustainable. Poor information dissemination and education on marine resource management result to poor participation of the community in resource management.

Chapter 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings with the corresponding conclusions based on the findings of the study and the recommendations on the conclusions drawn from the findings of the study.

Summary Findings

The following are the salient findings of the study:

1. It was observed that the sedimentation level of the physical characteristics of municipal waters of Carigara Bay is minimal.
2. Primary and secondary productivity in the soft bottom are chlorophyll A, plankton, and zooplankton.
3. Environmental condition of the soft bottom communities;
   - 3.1. Mollusk- bivalve- punaw (*Paphia amabilis*), barinday (*Tellina radiate*),

     Dunker indo-pacific (*Pteria levanti*), *Nerita planospira* .
   - 3.2. Pollutant-domestic waste, solid water drawn from river systems.
   - 3.3. Inner inputs, pesticides from farms.
4. Weak implementation of existing policies. Mangroves deforestations still exist. No policies developed except for Fishery Laws for active gear.

5. It was observed that the biological characteristics of municipal waters of Carigara Bay, molluscs has dominant among the organisms in soft bottom communities.
6. It was observed that there is availability of valuable natural resources in municipal waters of Carigara Bay.
7. It was observed that the degree of pollution in municipal waters of Carigara Bay has not observable based on the findings on the accumulation of sedimentations.
8. Potentials and sources of pollutants was found through the density of population who resides along the coastal area of Carigara bay, the rampant of illegal fishing activities that dredged the soft bottom communities that damage the habitat, urbanization and the entry of tourisms can damage also the coastal habitat.
9. It was observed that although there is no direct policies mentioned on the following municipalities' fisheries ordinances on the protection and conservation of soft bottom habitat but the policies convey on the protection of all marine habitat and species.

Conclusions

From the aforecited summary of findings, the conclusions were drawn:

1. Physical characteristics of soft bottom communities in municipal waters vary on the level of sedimentation.

2. Biological characteristics of soft bottom communities in municipal waters molluscs are a dominant species of thrive in soft bottom habitat.
3. The degree of pollution of soft bottom communities in municipal waters of Carigara Bay is not observable.
4. Potentials damage are the population density along the coastal area, rampant of illegal fishing activities and less but can damage also the habitat is the sedimentations.
5. There are no direct sections on the municipal fisheries ordinance state for the protection of soft bottom communities and habitat.

Recommendations

1. Policies review is necessary for the LGUs to develop and enhance for soft bottom communities in coastal waters of Carigara Bay.
2. Maintain the protection of the aquatic environment. Good farm practices to avoid sedimentation on the coastal habitat specifically the soft bottom habitat.
3. There should have a policy stating about the conservation and protection of soft bottom communities.
4. Sustainable use of the resources to have a continuous supply of food for present generation and in the future.

Chapter 6

POLICY ON POTECTION AND CONSERVATION ON SOFT BOTTOM

This chapter presents the general policies on protection and conservation on soft –bottom communities. From the field data and secondary data extracted from different LGUs along Carigara Bay. This general observation was benchmark for formulating new direction and policies in the protection of the dynamic environment like the soft-bottom and mudflats and sustainability of the valuable resources.

Table 9. Municipal Fisheries Ordinance Salient Feature of per LGU.

Babatngon, Leyte	Barugo, Leyte	Carigara, Leyte	San Miguel, Leyte
Year- 2011	2002	2009	2002
Se. 33. Ban of muro-ami illegal fishing gear.	Section 21. Pollution of municipal waters.	Section 29. Ban of illegal fishing activities.	Section 4. Aquatic pollution.
Article B. Calangawan fish anctuary.		Section 33. Regulation on gathering of under size and grabed crabs, fingerlings and juvenile fish species.	
Article C. Babatngon marine reserve.		Section 34. Regulation on the pushed net and gathering of marine organisms in tidal flats for fish bait.	

Table shows the different municipal fisheries ordinances from different municipalities along the Carigara Bay. Babatngon, Leyte showed protection and conservation of marine resources among the four municipalities mentioned due it's establish marine reserve and sanctuary. While the municipality of Carigara, Barugo, and San Miguel showed also in their MFO the protection of marine resources.

Strategies and Policies for Baywide Management along Carigara Bay

1. Shoreline habitat rehabilitation and management.

There is a need to address the issues related to coastal forest degradation. The implementation of reforestation of denuded mangrove forests is one of the strategies to resolve these issues. DENR was mandated to protect and manage the mangrove resource of the country. Through the awarding of stewardship scheme and the integrated social mangrove reforestation program, coastal communities are involved in the reforestation projects to ensure a long-term management and protection of the area.. This strategy also involves the conduct of land use mapping that would support the zonation scheme which designates the zones, boundaries, uses and means of implementation mangroves reforestation and protection. Aside from DENR, NGOs, LGUs, and the bay management council are also involved in this strategy.

2. Marine habitat protection and rehabilitation

One the most important projects of the coastal community of Carigara Bay to rehabilitate the depleted fishery resources of the bay was the establishment of fish sanctuaries (FS) and marine reserved. With the assistance of DA regional staff the local government staff and NGOs, resource management committees were formed in each site to oversee the fish sanctuaries. The RMCs have formulated management plans for the sanctuaries and are responsible in protecting the area against violators. While no activity (fishing or passage) is allowed inside the sanctuary, traditional fishing (hook and line and gill net) is allowed at about 200 metros away. This strategy establishes fish sanctuaries, artificial reef projects and conducts mangrove reforestation which are being implemented through community-based organizations (CBOs). The CBOs which are based in barangays take charge in demarcating zones, enforcing fishery rules and regulations and conducting training and education of the fisherfolks. The CBOs also work in coordination with concerned government agencies and NGOs. Furthermore, research institutions are also involved in the resource and ecological assessment of the bay to come up with updated status of the bay.

3. Strategy on Zonation plan for shoreline areas.

The land-use zonation is under the jurisdiction of the HLRB. The National Mapping Resources and Information Authority of DENR is also involved in terms of mapping the coastal area. In conjunction with shoreline habitat and management, a land use zonation plan which designates areas for intensive use, ecotourism and recreation, mangrove reserve reforestation and agricultural use were prepared by the municipal governments along Carigara Bay. Abandoned fishponds, degraded mangrove habitats, dumping sites, fish ports, beaches and other coastal uses were identified to resolve conflicts. Criteria for land-use schemes were also acceptable to the majority of the coastal community.

4. Water quality monitoring

The conduct of water quality monitoring has been delegated to DA regional office. Initially, a research institution conducted hydrobiological assessment of Carigara Bay. BFAR also assisted the regional office in water quality monitoring especially during red tide occurrences. The problem of water quality degradation is addressed by this strategy. Water pollution usually comes from shoreline, inland, agricultural and upland activities. Sources of pollution's in the bay were identified and measures were formulated to minimize the effects of pollution. This strategy is coordinated with reforestation program of DENR. With partnership EVSU-CC, BFAR may forge MOA to collaborate this strategy.

5. Promotion on economically viable alternative livelihood project

There is a need to assist the coastal community in exploring other avenues for alternative livelihood projects. Recognizing the problems of overfishing of marine resources and poverty among coastal communities. The strategy to identify and promote economically viable livelihood projects was launched. These projects are compatible with the EAFM approach. Existing livelihood projects were be evaluated by conducting cost-benefit studies on their impact to the socioeconomic situation in the area. Fishermen cooperatives and organizations need to be strengthened to effectively initiate credit arrangements. NGOs play important role in assisting fishermen avail of credit facilities to start alternative livelihood projects. Under FSP, credit is available to fishermen through the Land Bank of the Philippines and the Development Bank of the Philippines.

SOME LESSONS LEARNED IN THE IMPLEMENTATION OF ICRM/CRM/CB-CRM IN CARIGARA BAY LAST 3 DECADES

The issue of sustainability is very important when planning for the long-term management of coastal resources. This issue needs to be addressed by a strong organization that is capable of implementing coastal resource management.

- Ecosystem Approach to Fisheries Management (EAFM) should be anchored on ***community based resource management.*** Success is ensured when the community participate in the plan, implementation and monitoring of pilot projects and or activities. It has been observed that fishermen are now more active and more vocal on what they want done in their fishing communities.
- ***Institutional; strengthening*** is an integral part of management. There is a need to determine and assign responsibility to all agencies, institutions and, offices tasked to implement programmes. There must be qualified and able personnel, both from the national and local levels, to implement programmed activities and perform extension services. Logistical support, infrastructure and human sources development should be made available. Moreover, legal mandates should be vested in agencies entrusted with management implementation.
- There is a need for continuous education and information dissemination for government officials, local government officials, nongovernmental organization members and fisherfolks. Education and information dissemination play a vital role in introducing CRM to all sectors.
- Considering the holistic approach in management, a ***baywide management*** of the area is deemed appropriate. All factors affecting the environment and its people should be viewed as one affecting the others

(i.e. deforestation effect on coastal area). Even if problems are site-specific, management should consider the bay as one ecological unit.

- Recognizing the limitation of the government sector in terms of time and personnel involvement, NGOPO participation in management had been effective. The NGOs, being area-based, have better perception of community wishes and aspirations.
- In the planning process, ***research as support to management goals*** is necessary to have scientifically-based management options. Research results should be made available and these results should be translated to language that coastal managers understand.
- The Philippine Local Government Code states that local government units shall share with the national government the responsibility in the management and maintenance of their municipal waters. In effect, the national government has limited jurisdiction over municipalities.
- Municipal governments can legislate management measures for the purpose of enhancing the right of its people to a balanced ecology. ***Political will and commitment*** are the necessary tool for implementing management at the local government level.
- ***Linkages and networking*** provide the local fisherfolks access to logistics and other assistance in the implementation of the various EAFM activities. For better and efficient implementation of management options, ***social***

and political acceptability lessens potential conflicts between and among the fisherfolks and the local government units.

- Law enforcement is a very important component of bay-wide ICRM. Often, an ***effective and efficient enforcement*** of fishery laws, rules and regulations, resolves most issues and problems of ICRM implementation.

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APPENDICES

APPENDIX A

Soft bottom organisms by phyla in coastal waters of Carigara Bay

APPENDIX A

Babatngon, Leyte Station 1

Test on Sieve Analysis on Soil (ASTM D-422)

SIEVE SIZE (INCHES)	DIAMETER OF OPENING (millimetre)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	181	100
1"	25	0	181	100
3/4"	19	0	181	100
1/2"	12.5	0	181	100
3/8"	9.5	0	181	100
#4	4.75	0	181	100
#10	2.99	0.4	180.6	100
#20	1.495	1.2	179.4	99
#40	0.425	7	172.4	95
#100	0.15	62.8	109.6	61
#200	0.075	39.7	69.9	39
ORIGINAL DRY Wt. : 181.00 Soil Classification (ASTM): SM-Light Gray (silty sand)				

APPENDIX A

Babatngon, Leyte Station 2

Test on Sieve Analysis on Soil (ASTM D-422)

SIEVE SIZE (INCHES)	DIAMETER OF OPENING (MM)	Wt. Retained (grams)	COMMULATIVE Wt. Passing in grams	% Passing
11/2"	37.5	0	186.8	100
1"	25	0	186.8	100
3/4"	19	0	186.8	100
1/2"	12.5	0	186.8	100
3/8"	9.5	0	186.8	100
#4	4.75	0	186.8	100
#10	2.99	0.2	186.8	100
#20	1.495	1.3	185.3	99
#40	0.425	10.1	175.2	94
#100	0.15	84.9	90.3	48
#200	0.075	39.2	51.1	27
ORIGINAL DRY Wt. 186.80 SOIL CLASSIFICATION (AASHTO): SM Light Gray (silty sand)				

APPENDIX A

Babatngon, Leyte Station 3

Test on Sieve Analysis on Soil (ASTM D-422)

Sieve size (inches)	DIAMETER OF OPENING (mm)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	186.3	100
1"	25	0	186.3	100
3/4"	19	0	186.3	100
1/2"	12.5	0	186.3	100
3/8"	9.5	0	186.3	100
#4	4.75	0	186.3	100
#10	2.99	1.1	185.2	99
#20	1.495	1	184.2	99
#40	0.425	10.2	174	93
#100	0.15	65.1	108.9	58
#200	0.075	54.2	54.7	29
ORIGINAL DRY WET, : 186.30 SOIL CLASSIFICATION (AASHTO) : SM- Light Gray (silty sand)				

APPENDIX A

Barugo, Leyte Station 1

Test on sieve analysis on soil (ASTM D 422)

SIEVE SIZE (INCHES)	DIAMETER OF OPENING (millimetres)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	163.6	100
1"	25	0	163.6	100
3/4"	19	0	163.6	100
1/2"	12.5	0	163.6	100
3/8"	9.5	0	163.6	100
#4	4.75	0	163.6	100
#10	2.99	0.8	162.8	100
#20	1.495	1	161.8	99
#40	0.425	12.2	149.6	91
#100	0.15	81.4	68.2	42
#200	0.075	36.6	31.6	19

APPENDIX A

ORIGINAL DRY Wt. : 163.60
Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

Barugo, Leyte Station 2
Test on sieve analysis on soil
(ASTM D-422)

SIEVE SIZE (INCHES)	DIAMETER OF OPENING (millimetres)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	176	100
1"	25	0	176	100
3/4"	19	0	176	100
1/2"	12.5	0	176	100
3/8"	9.5	0	176	100
#4	4.75	0	176	100
#10	2.99	0	176	100
#20	1.495	1	175	99
#40	0.425	18.3	156.7	89
#100	0.15	87.6	69.1	39
#200	0.075	37.5	31.6	18

Original Dry Wt. : 176.00

Soil Classification (AASHTO) : SM- Light Gray (Silty Sand)

APPENDIX A

Barugo, Leyte Station 3
Test on sieve analysis on soil (ASTM D-422)

SIEVE SIZE (INCHES)	DIAMETER OF OPENING (MM)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	174	100
1"	25	0	174	100
3/4"	19	0	174	100
1/2"	12.5	0	174	100
3/8"	9.5	0	174	100
#4	4.75	0	174	100
#10	2.99	0.2	173.8	100
#20	1.495	1.5	172.3	99
#40	0.425	28.9	143.4	82
#100	0.15	71.5	71.9	41
#200	0.075	36.2	35.7	21
ORIGINAL DRY Wt. : 174.00				
on (AASHTO) : SM- Light Gray (Silty Sand)				

Carigara, Leyte Station 1
Test on sieve analysis on soil (ASTM D-422)

SIEVE SIZE (INCHES)	DIAMETER OF OPENING (MM)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	176.1	100
1"	25	0	176.6	100
3/4"	19	0	176.6	100
1/2"	12.5	0	176.6	100
3/8"	9.5	0	176.6	100
#4	4.75	0	176.6	100
#10	2.99	0	176.6	100
#20	1.495	4.3	171.8	98
#40	0.425	39.7	132.1	75
#100	0.15	76	56.1	32
#200	0.075	19.1	37	21

ORIGINAL DRY Wt. : 176.1

Soil Classification (AASHTO) : SM- Light Gray (Silty Sand)

APPENDIX A

Carigara, Leyte Station 2
Test on sieve analysis on soil (ASTM D-422)

SIEVE SIZE (inches)	DIAMETER OF OPENING (millimetres)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	164.6	100
1"	25	0	164.6	100
3/4"	19	0	164.6	100
1/2"	12.5	0	164.6	100
3/8"	9.5	0	164.6	100
#4	4.75	0	164.6	100
#10	2.99	1.1	163.5	99
#20	1.495	2	161.5	98
#40	0.425	20.2	141.3	86
#100	0.15	48.4	92.9	56
#200	0.075	37.5	55.4	34

ORIGINAL DRY
Wt.164.60
Soil Classification (AASHTO): SM- Light Gray (Silty Sand)

APPENDIX A

Carigara, Leyte Station 3

Test on seive analysis on soil (ASTMM D-422)

SIEVE SIZE (INCHES)	DIAMETER OF OPENING (MM)	Wt. Retained (grams)	COMMULATIVE	
			Wt. Passing in grams	% Passing
11/2"	37.5	0	169.9	100
1"	25	0	169.9	100
3/4"	19	0	169.9	100
1/2"	12.5	0	169.9	100
3/8"	9.5	0	169.9	100
#4	4.75	0	169.9	100
#10	2.99	1.3	168.6	99
#20	1.495	6.6	162	95
#40	0.425	40.3	121.7	72
#100	0.15	56.9	64.8	38
#200	0.075	25	39.8	23

Original Dry Wt. 169.90

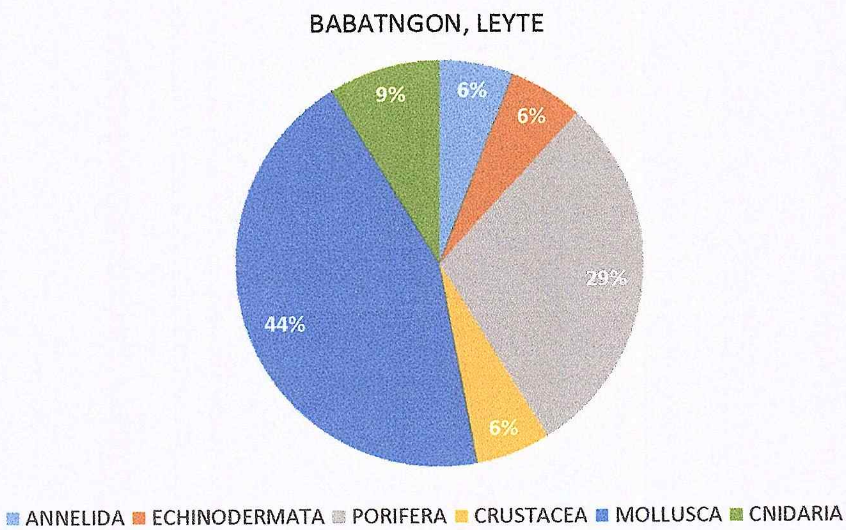
Soil classification (AASHTO): SM-Light Gray (Silty Sand)

APPENDIX A

Soft bottom organisms by phyla in coastal waters of Carigara Bay

Babatngon, Leyte.

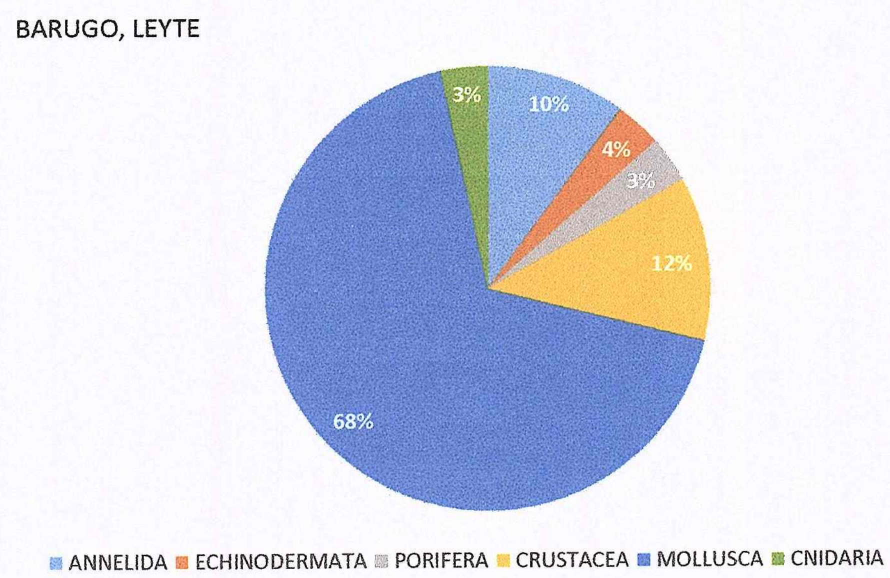
Annelida	Echinodermata	Porifera	Crustacea	Mollusca	Cnidaria
2	2	10	2	15	3



APPENDIX A

Barugo, Leyte.

Annelida	Echinodermata	Porifera	Crustacea	Mollusca	Cnidaria
6	2	2	7	40	2

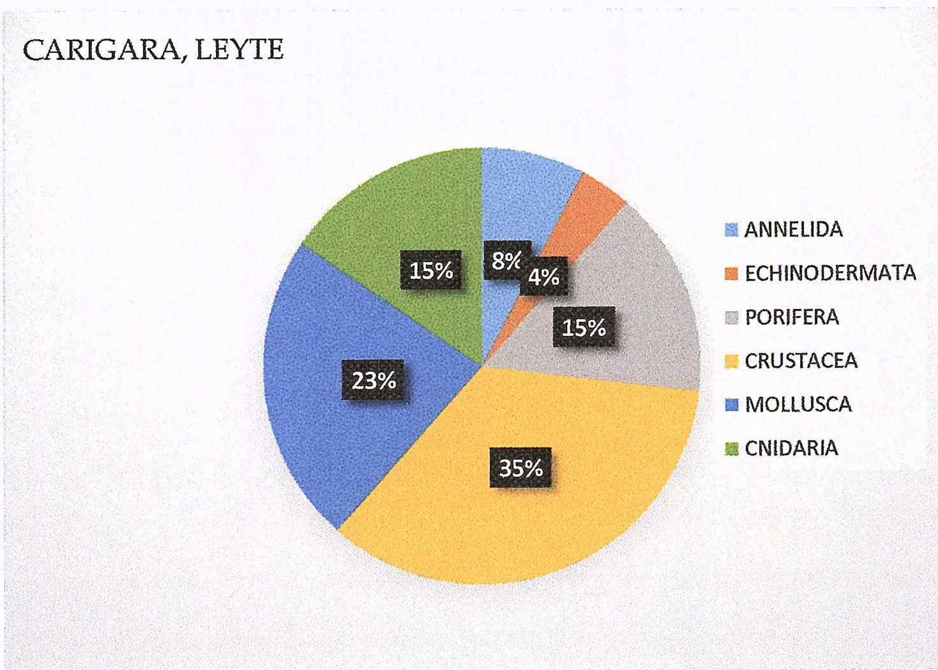


APPENDIX A

Soft bottom organisms by phyla in coastal waters of Carigara Bay

Carigara, Leyte.

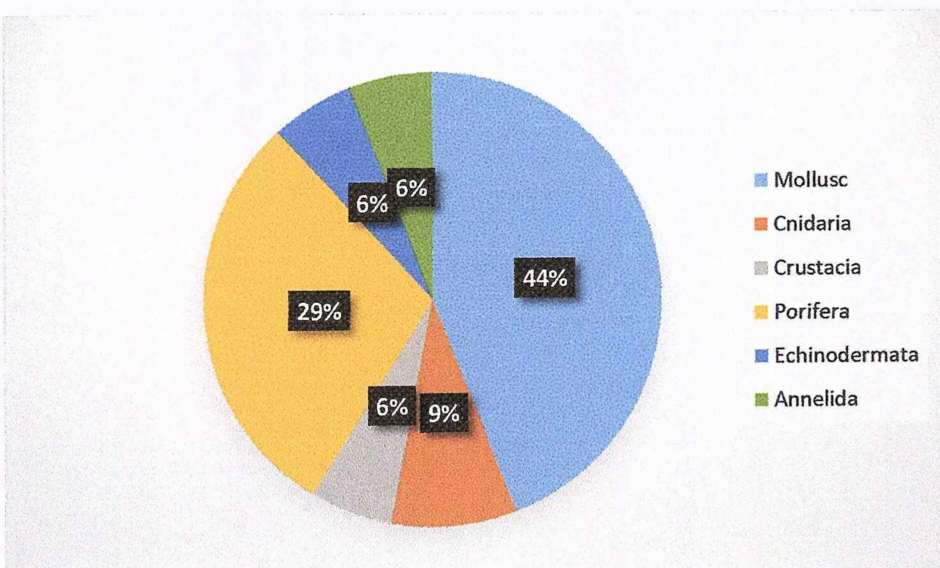
Annelida	Echinodermata	Porifera	Crustacea	Mollusca	Cnidaria
2	1	4	9	6	4



APPENDIX A

Soft bottom organisms from three municipality abutting Carigara Bay

Study Area	Mollusc	Cnidaria	Crustacea	Porifera	Echinodermata	Annelida	Total
Babatngon	15	3	2	10	2	2	34
Barugo	40	2	7	2	2	6	59
Carigara	6	4	9	4	1	2	26

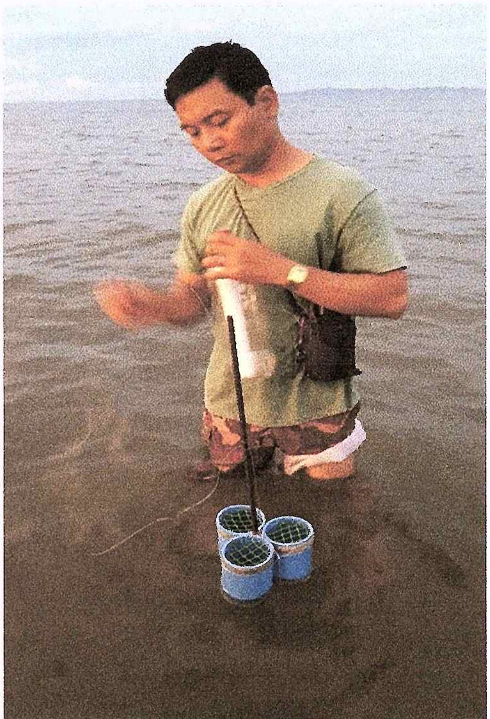


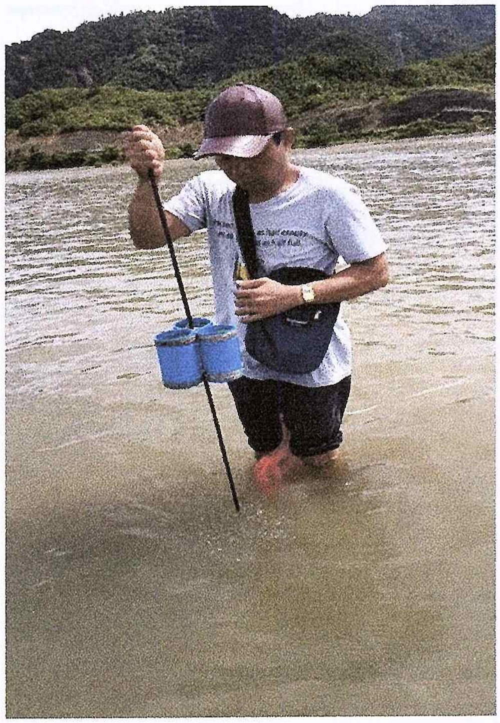
APPENDIX B

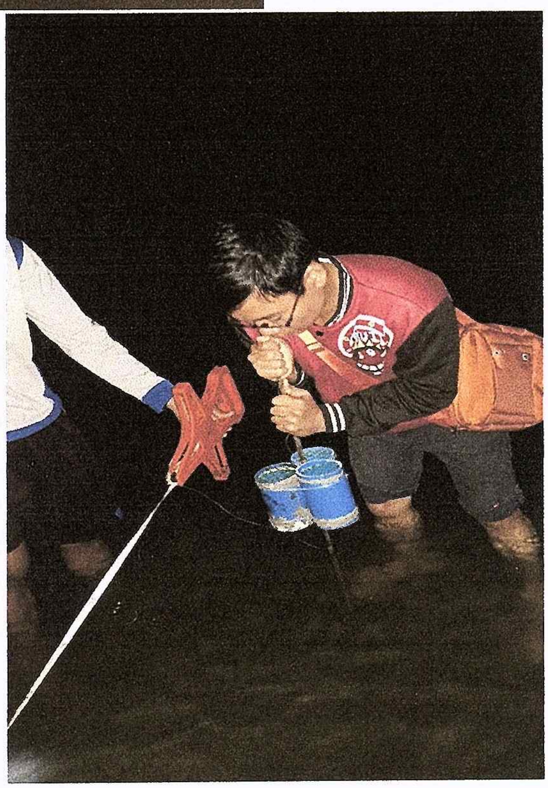
Photos during the implementation of the study

APPENDIX B

Installation of sediment traps in coastal waters of Carigara Bay

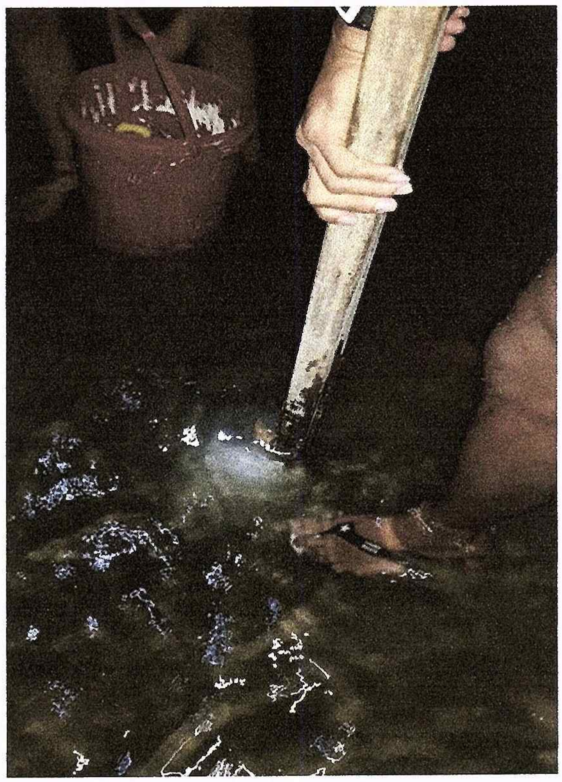






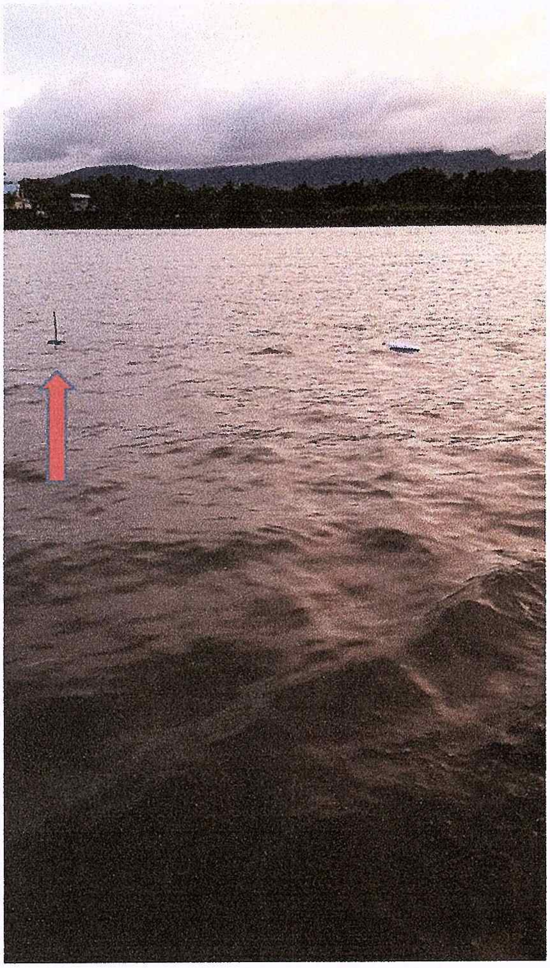
APPENDIX B

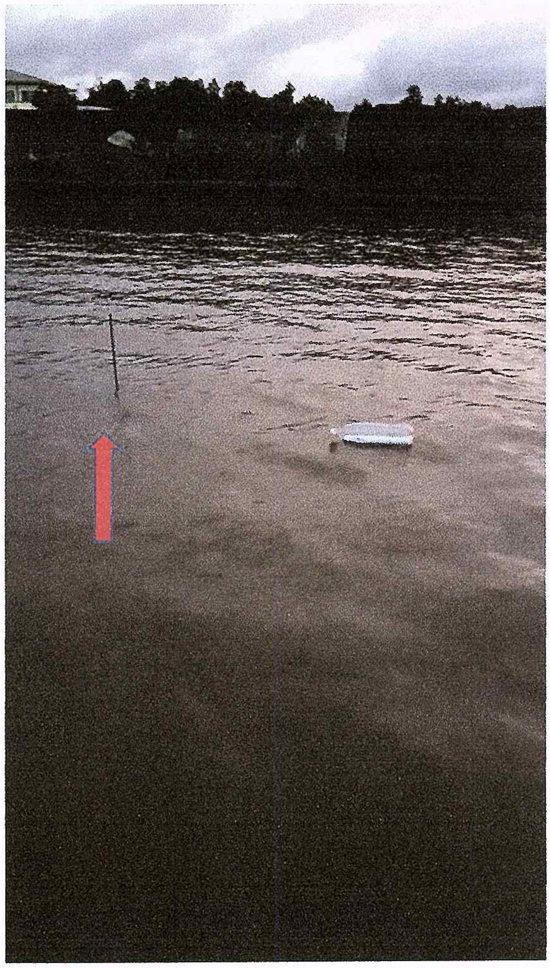
Collection of sediments using improvised sediment traps and posthole digger



APPENDIX B

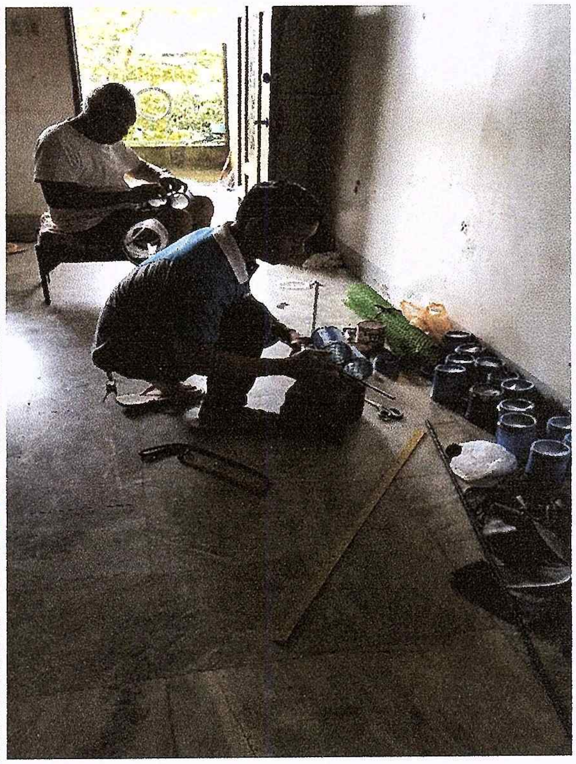
Installed sediment traps across the isobath in coastal waters of Carigara Bay

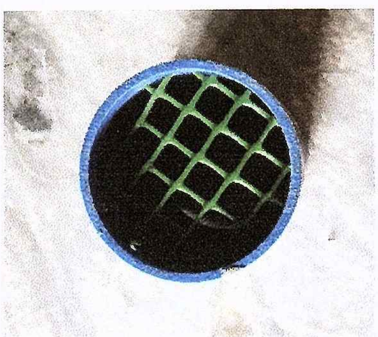




APPENDIX B

Making of improvised sediment traps

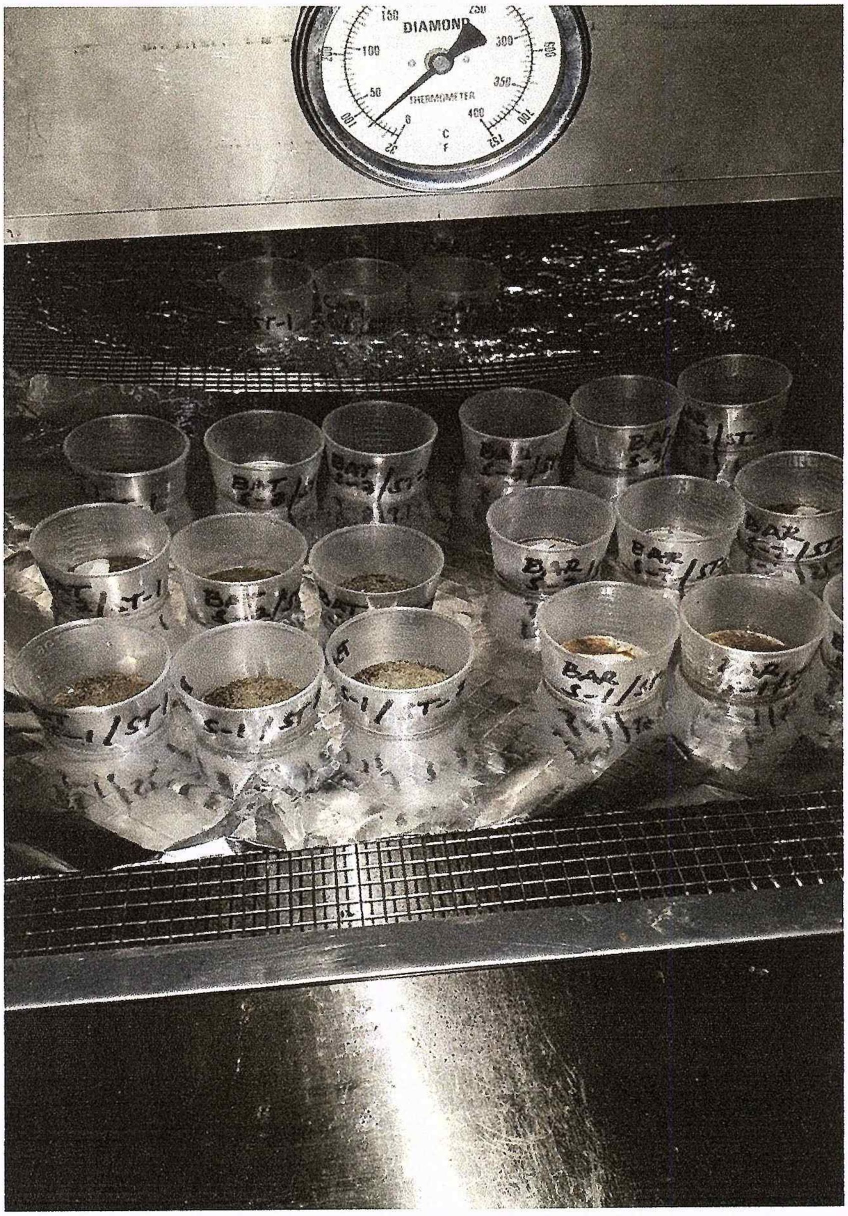




APPENDIX B

Collection of sediments using posthole digger and improvised sediment traps.

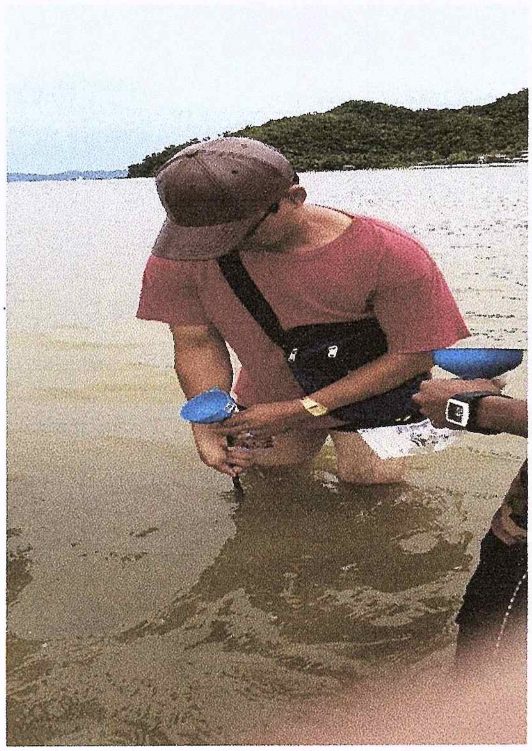
APPENDIX B

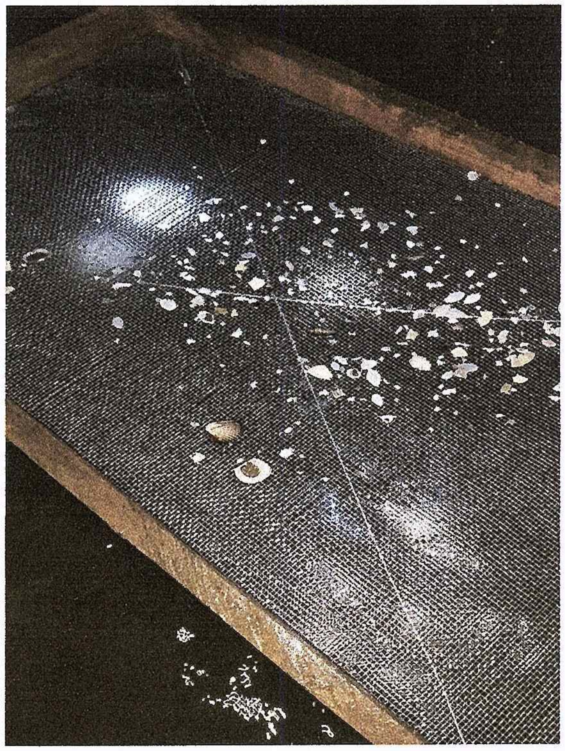
Vials with sediments inside the ignite muffle furnace



APPENDIX B

Collection of sediments and organisms in soft bottom communities in coastal waters of Carigara Bay.



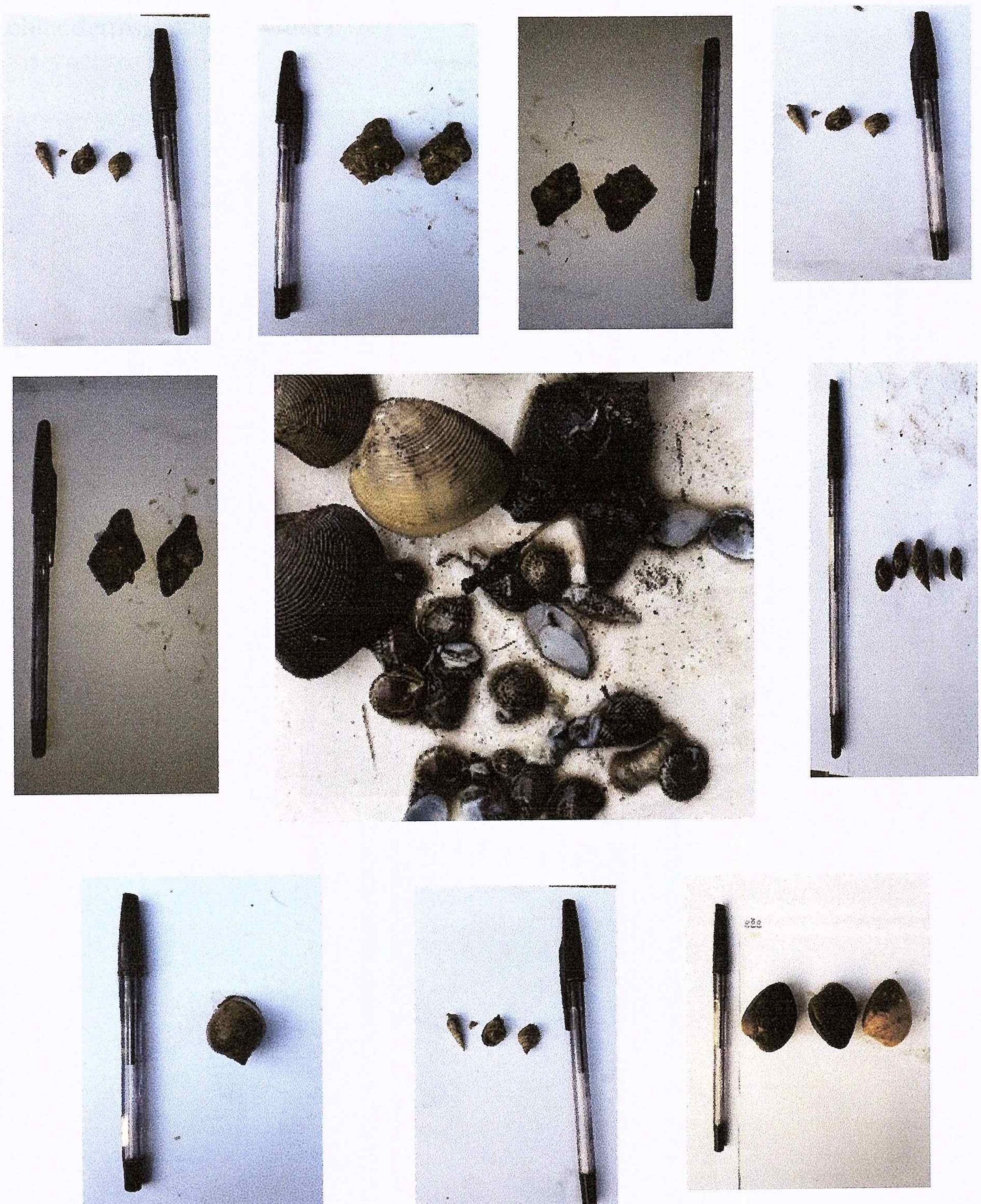


APPENDIX C

Soft bottom organisms in coastal water of Carigara Bay

APPENDIX C

Molluscs found in soft bottom in coastal waters of Carigara Bay



APPENDIX D

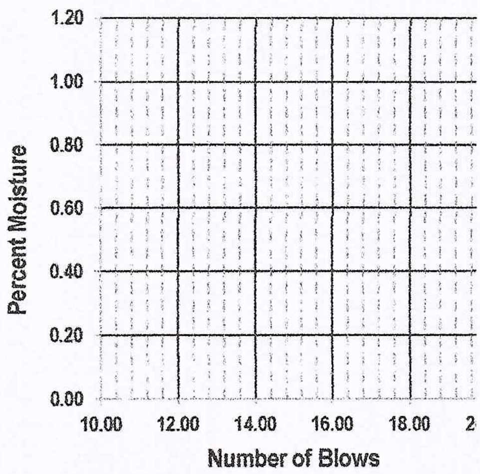
Soil analysis results from laboratory

E.B. TESTING CENTER, INC.
MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY
DPWH - BRS ACCREDITED LABORATORY
No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines
Tel. No. (02) 633-6098; Telefax (02) 636-8827;
email: ebtestingcenter@yahoo.com

Project : SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.
Lab. Report No : LR-TAC-180228-(
Sample ID : BABATNGON-1
Location : Carigara, Barugo & Babatngon
Date Tested : February 26, 2018
Contractor : -
Date Finished : February 28, 2018
Sampled By : Romil T. Dandan
Submitted By : Romil T. Dandan
Kind of Materials : Soil Sample
Quantity Represented : Not Specifie

NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

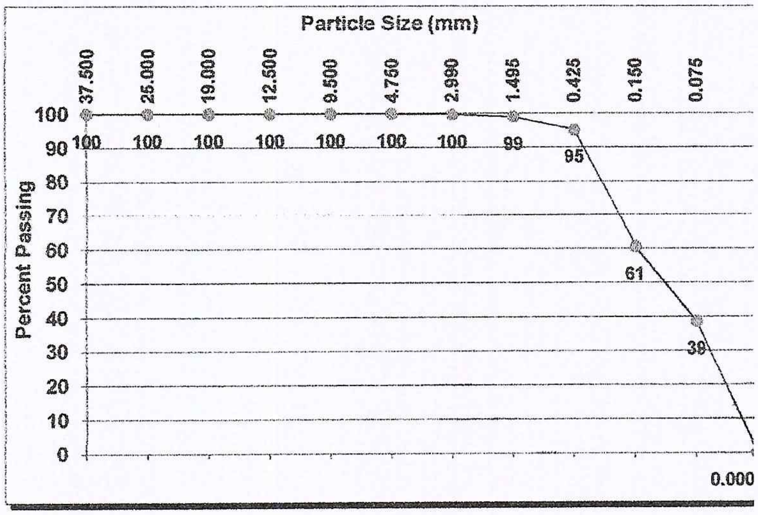
LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE Wt. Passing in grams	CUMMULATIVE % Passing
1 1/2"	37.500	0.00	181.0	100
1"	25.000	0.00	181.0	100
3/4"	19.000	0.00	181.0	100
1/2"	12.500	0.00	181.0	100
3/8"	9.500	0.00	181.0	100
#4	4.750	0.00	181.0	100
#10	2.990	0.40	180.6	100
#20	1.495	1.20	179.4	99
#40	0.425	7.00	172.4	95
#100	0.150	62.80	109.6	61
#200	0.075	39.70	69.9	39
-	-	-	-	-

Original Dry Wt.: 181.00



Soil Classification (ASTM) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

E.B. TESTING CENTER, INC.

MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY

DPWH - BRS ACCREDITED LABORATORY

No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines

Tel. No. (02) 633-6098; Telefax (02) 636-8827;

email: ebtestingcenter@yahoo.com

Project : SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.

Lab. Report No : LR-TAC-180228-(

Sample ID : BABATNGON-2

Location : Carigara, Barugo & Babatngon

Date Tested : February 26, 2018

Contractor : -

Date Finished : February 28, 2018

Sampled By : Romil T. Dandan

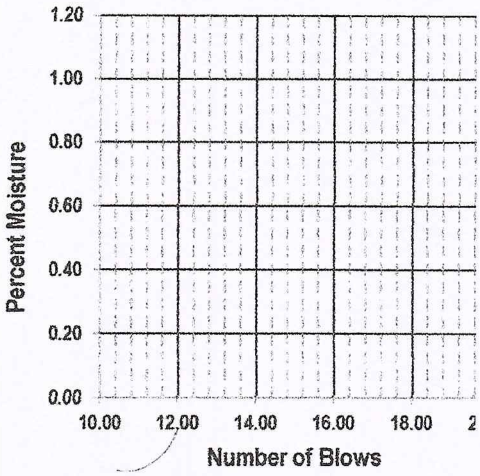
Submitted By : Romil T. Dandan

Kind of Materials : Soil Sample

Quantity Represented : Not Specifi

NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

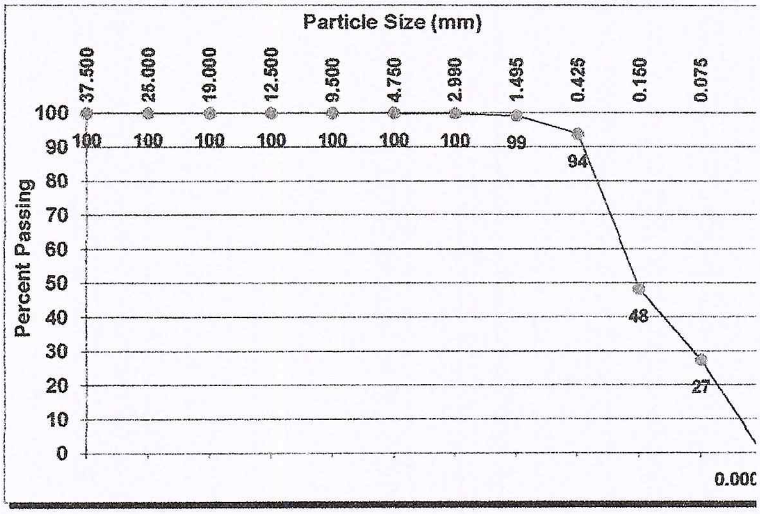
LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	186.8	100
1"	25.000	0.00	186.8	100
3/4"	19.000	0.00	186.8	100
1/2"	12.500	0.00	186.8	100
3/8"	9.500	0.00	186.8	100
#4	4.750	0.00	186.8	100
#10	2.990	0.20	186.6	100
#20	1.495	1.30	185.3	99
#40	0.425	10.10	175.2	94
#100	0.150	84.90	90.3	48
#200	0.075	39.20	51.1	27
-	-	-	-	-

Original Dry Wt.: 186.80



Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

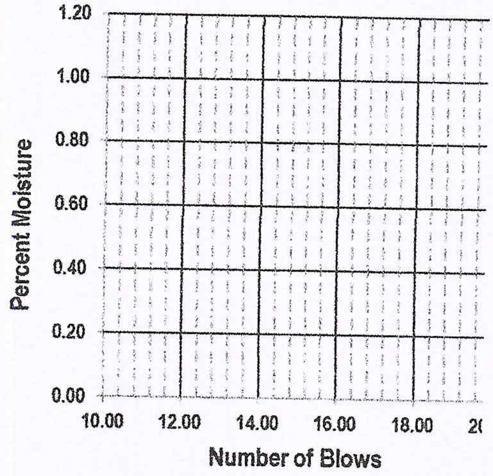
E.B. TESTING CENTER, INC.
MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY
DPWH - BRS ACCREDITED LABORATORY
No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines
Tel. No. (02) 633-6098; Telefax (02) 636-8827;
email: ebtestingcenter@yahoo.com

Project : **SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.**
Location : Carigara, Barugo & Babatngon
Contractor : -
Sampled By : Romil T. Dandan
Kind of Materials : Soil Sample

Lab. Report No : **LR-TAC-180228-0**
Sample ID : **BABATNGON-3**
Date Tested : February 26, 2018
Date Finished : February 28, 2018
Submitted By : Romil T. Dandan
Quantity Represented : Not Specifie

NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

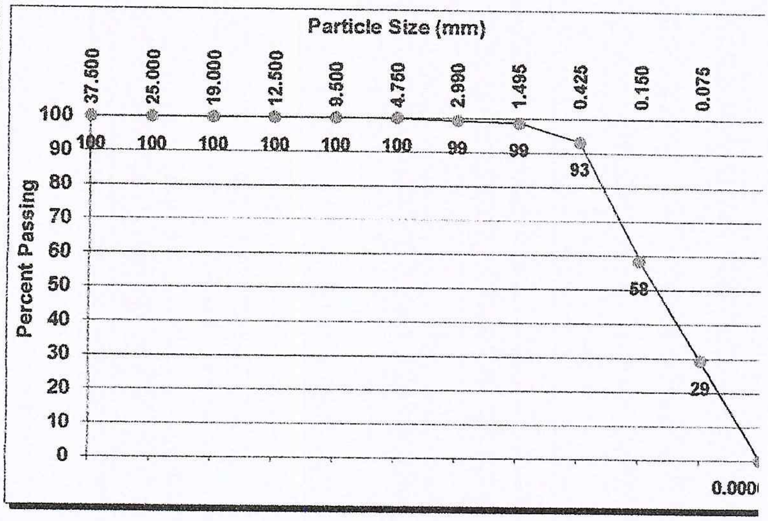
LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE	
			Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	186.3	100
1"	25.000	0.00	186.3	100
3/4"	19.000	0.00	186.3	100
1/2"	12.500	0.00	186.3	100
3/8"	9.500	0.00	186.3	100
#4	4.750	0.00	186.3	100
#10	2.990	1.10	185.2	99
#20	1.495	1.00	184.2	99
#40	0.425	10.20	174.0	93
#100	0.150	65.10	108.9	58
#200	0.075	54.20	54.7	29
-	-	-	-	-

Original Dry Wt.: 186.30



Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

E.B. TESTING CENTER, INC.

MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY

DPWH - BRS ACCREDITED LABORATORY

No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines
Tel. No. (02) 633-6098; Telefax (02) 636-8827;
email: ebtestingcenter@yahoo.com

Project : SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.

Lab. Report No : LR-TAC-180228-

Sample ID : BARUGO-1

Location : Carigara, Barugo & Babatngon

Date Tested : February 26, 2018

Contractor : -

Date Finished : February 28, 2018

Sampled By : Romil T. Dandan

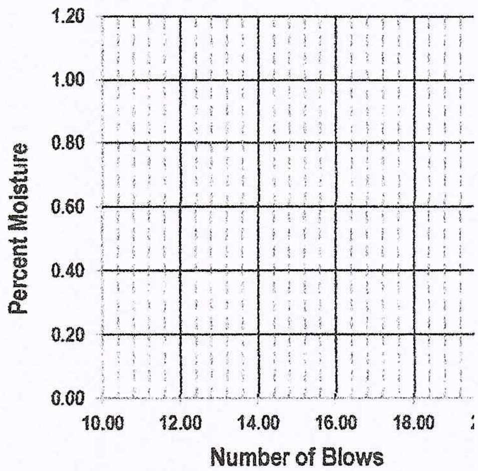
Submitted By : Romil T. Dandan

Kind of Materials : Soil Sample

Quantity Represented : Not Specifi

NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

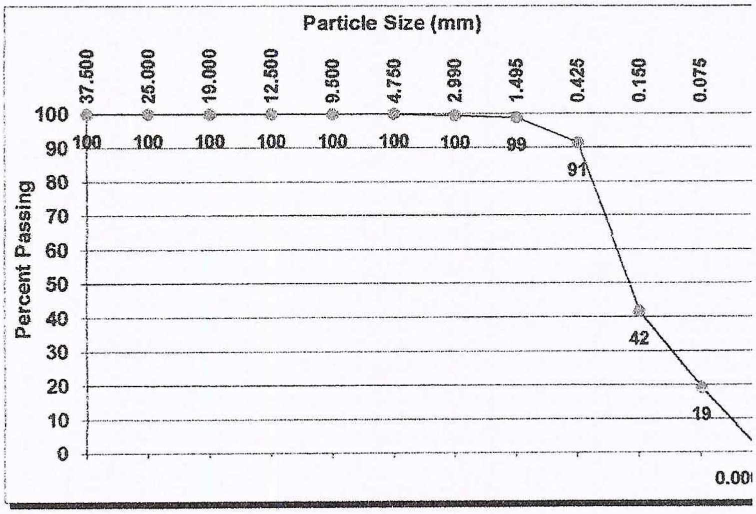
LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE	
			Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	163.6	100
1"	25.000	0.00	163.6	100
3/4"	19.000	0.00	163.6	100
1/2"	12.500	0.00	163.6	100
3/8"	9.500	0.00	163.6	100
#4	4.750	0.00	163.6	100
#10	2.990	0.80	162.8	100
#20	1.495	1.00	161.8	99
#40	0.425	12.20	149.6	91
#100	0.150	81.40	68.2	42
#200	0.075	36.60	31.6	19
-	-	-	-	-

Original Dry Wt.: 163.60



Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

E.B. TESTING CENTER, INC.
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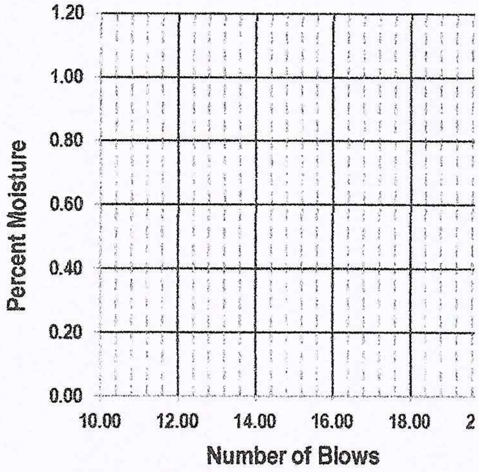
No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines
Tel. No. (02) 633-6098; Telefax (02) 636-8827;
email: ebtestingcenter@yahoo.com

Project : SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.
Lab. Report No : LR-TAC-180228-(
Sample ID : BARUGO-2
Location : Carigara, Barugo & Babatngon
Date Tested : February 26, 2018
Contractor : -
Date Finished : February 28, 2018
Sampled By : Romil T. Dandan
Submitted By : Romil T. Dandan
Kind of Materials : Soil Sample
Quantity Represented : Not Specifi

NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

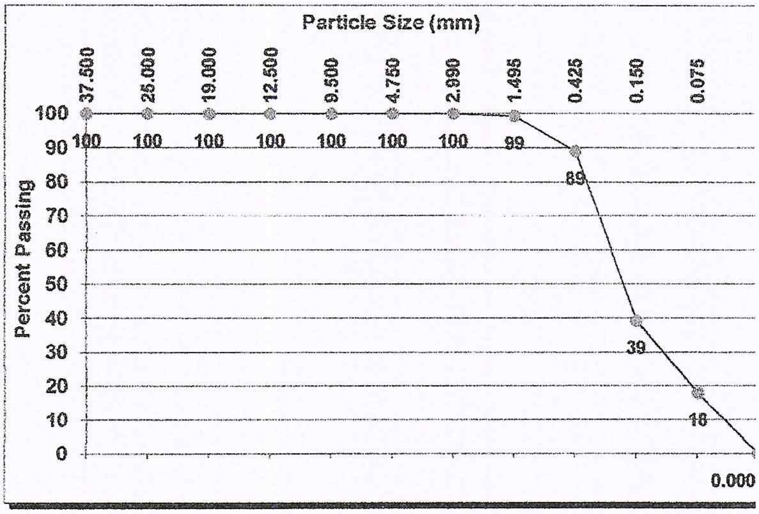
LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	176.0	100
1"	25.000	0.00	176.0	100
3/4"	19.000	0.00	176.0	100
1/2"	12.500	0.00	176.0	100
3/8"	9.500	0.00	176.0	100
#4	4.750	0.00	176.0	100
#10	2.990	0.00	176.0	100
#20	1.495	1.00	175.0	99
#40	0.425	18.30	156.7	89
#100	0.150	87.60	69.1	39
#200	0.075	37.50	31.6	18
-	-	-	-	-

Original Dry Wt.: 176.00



Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

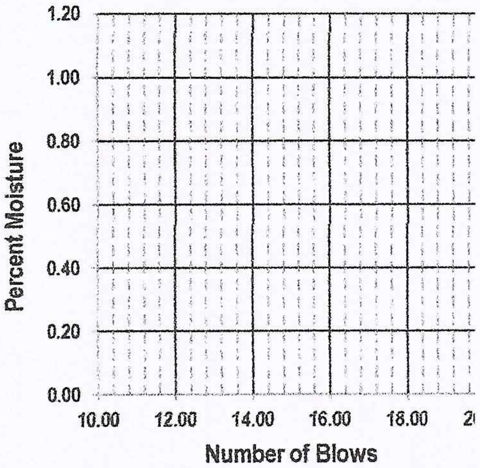
RONALD A. ANGEL
Laboratory Head

E.B. TESTING CENTER, INC.
MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY
DPWH - BRS ACCREDITED LABORATORY
No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines
Tel. No. (02) 633-6098; Telefax (02) 636-8827;
email: ebtestingcenter@yahoo.com

Project :	SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.	Lab. Report No :	LR-TAC-180228-0
		Sample ID :	BARUGO-3
Location :	Carigara, Barugo & Babatngon	Date Tested :	February 26, 2018
Contractor :	-	Date Finished :	February 28, 2018
Sampled By :	Romil T. Dandan	Submitted By :	Romil T. Dandan
Kind of Materials :	Soil Sample	Quantity Represented :	Not Specifie

NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

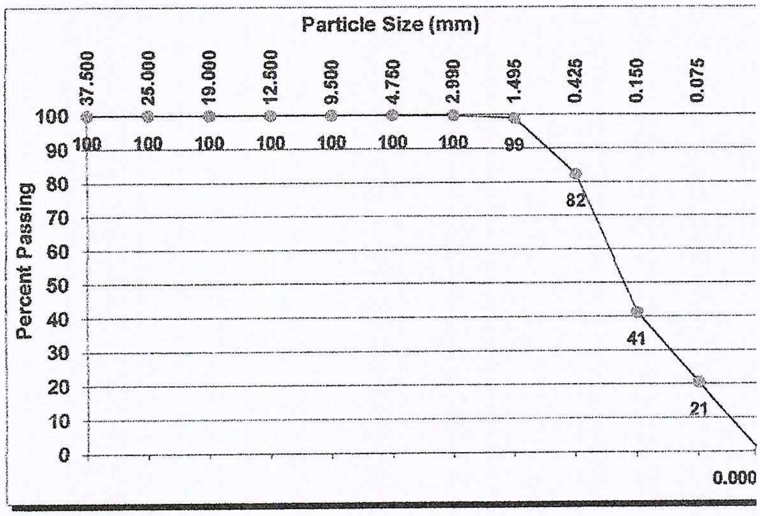
LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE	
			Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	174.0	100
1"	25.000	0.00	174.0	100
3/4"	19.000	0.00	174.0	100
1/2"	12.500	0.00	174.0	100
3/8"	9.500	0.00	174.0	100
#4	4.750	0.00	174.0	100
#10	2.990	0.20	173.8	100
#20	1.495	1.50	172.3	99
#40	0.425	28.90	143.4	82
#100	0.150	71.50	71.9	41
#200	0.075	36.20	35.7	21
-	-	-	-	-

Original Dry Wt.: 174.00



Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

E.B. TESTING CENTER, INC.

MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY

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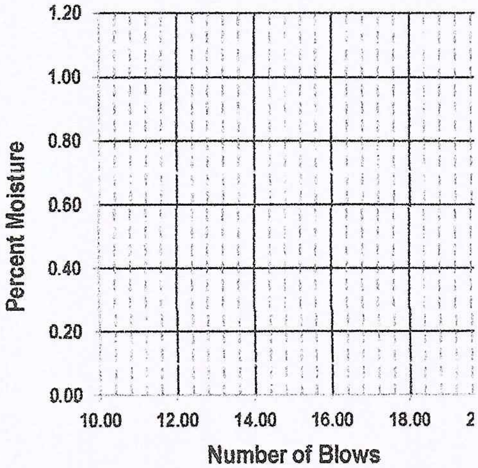
No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines
Tel. No. (02) 633-6098; Telefax (02) 636-8827;
email: ebtestingcenter@yahoo.com

Project : **SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.**
Lab. Report No : **LR-TAC-180228-(**
Sample ID : **CARIGARA-1**
Location : Carigara, Barugo & Babatngon
Date Tested : February 26, 2018
Contractor : -
Date Finished : February 28, 2018
Sampled By : Romil T. Dandan
Submitted By : Romil T. Dandan
Kind of Materials : Soil Sample
Quantity Represented : Not Specifie

NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

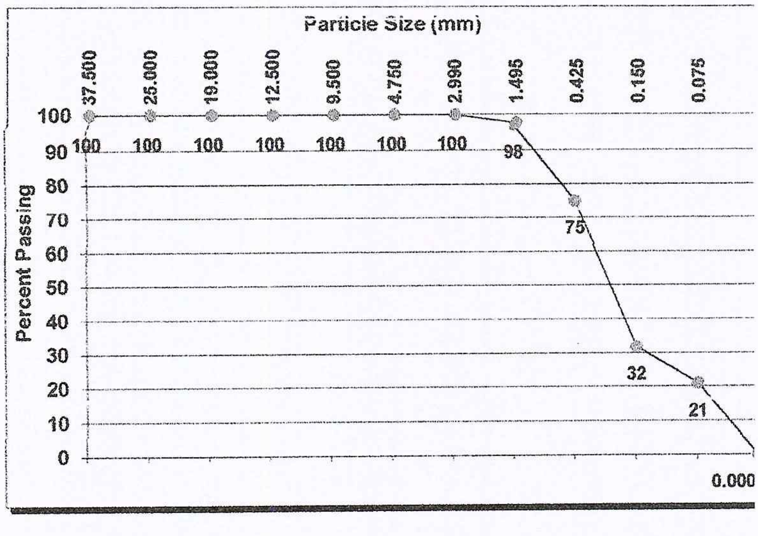
LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE	
			Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	176.1	100
1"	25.000	0.00	176.1	100
3/4"	19.000	0.00	176.1	100
1/2"	12.500	0.00	176.1	100
3/8"	9.500	0.00	176.1	100
#4	4.750	0.00	176.1	100
#10	2.990	0.00	176.1	100
#20	1.495	4.30	171.8	98
#40	0.425	39.70	132.1	75
#100	0.150	76.00	56.1	32
#200	0.075	19.10	37.0	21
-	-	-	-	-

Original Dry Wt.: 176.10



Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

E.B. TESTING CENTER, INC.

MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY

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No. 22 Sta. Rosa Street, Bo. Kapitolyo, Pasig City, Philippines

Tel. No. (02) 633-6098; Telefax (02) 636-8827;

email: ebtestingcenter@yahoo.com

Project : SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.

Lab. Report No : LR-TAC-180228-(

Sample ID : CARIGARA-2

Location : Carigara, Barugo & Babatngon

Date Tested : February 26, 2018

Contractor : -

Date Finished : February 28, 2018

Sampled By : Romil T. Dandan

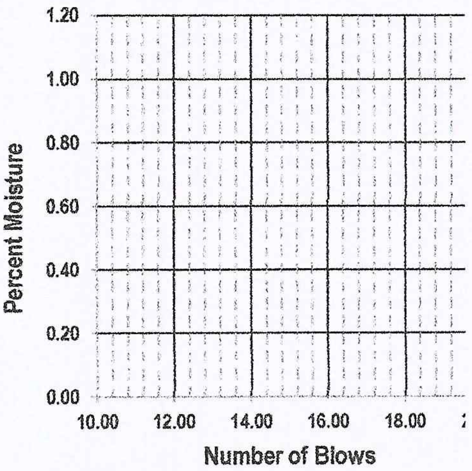
Submitted By : Romil T. Dandan

Kind of Materials : Soil Sample

Quantity Represented : Not Specifi

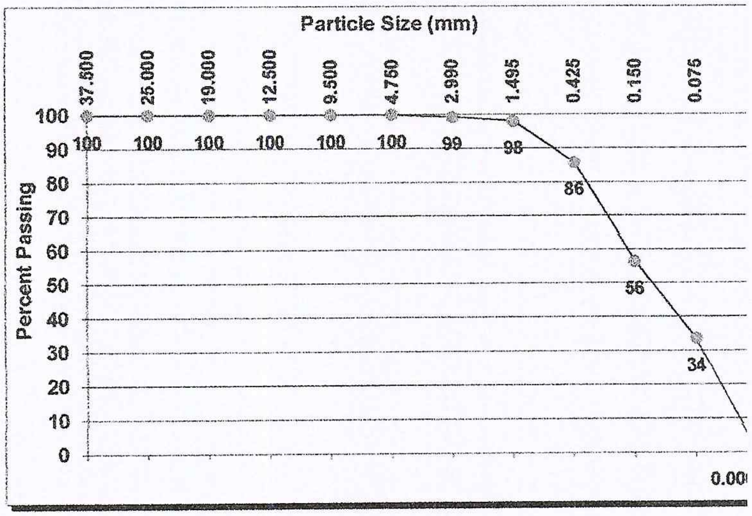
NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE	
			Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	164.6	100
1"	25.000	0.00	164.6	100
3/4"	19.000	0.00	164.6	100
1/2"	12.500	0.00	164.6	100
3/8"	9.500	0.00	164.6	100
#4	4.750	0.00	164.6	100
#10	2.990	1.10	163.5	99
#20	1.495	2.00	161.5	98
#40	0.425	20.20	141.3	86
#100	0.150	48.40	92.9	56
#200	0.075	37.50	55.4	34
-	-	-	-	-



Original Dry Wt.: 164.60

Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

E.B. TESTING CENTER, INC.
MATERIALS TESTING AND GEOTECHNICAL ENGINEERING LABORATORY
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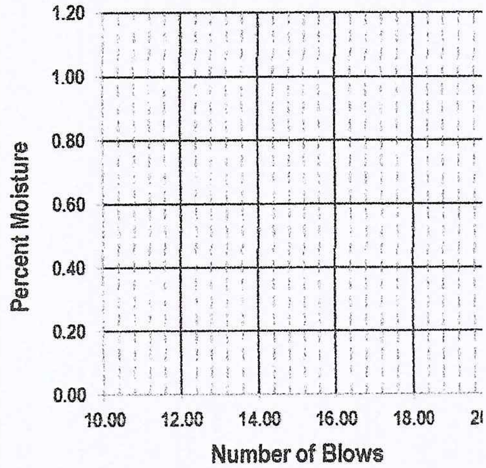
Tel. No. (02) 633-6098; Telefax (02) 636-8827;
email: ebtestingcenter@yahoo.com

Project : SOFT BOTTOM COMMUNITIES IN COASTAL WATERS: A BENCH-MARK FOR POLICY REDIRECTIONS.
Lab. Report No : LR-TAC-180228-0
Sample ID : CARIGARA-3
Location : Carigara, Barugo & Babatngon
Date Tested : February 26, 2018
Contractor : -
Date Finished : February 28, 2018
Sampled By : Romil T. Dandan
Submitted By : Romil T. Dandan
Kind of Materials : Soil Sample
Quantity Represented : Not Specifie

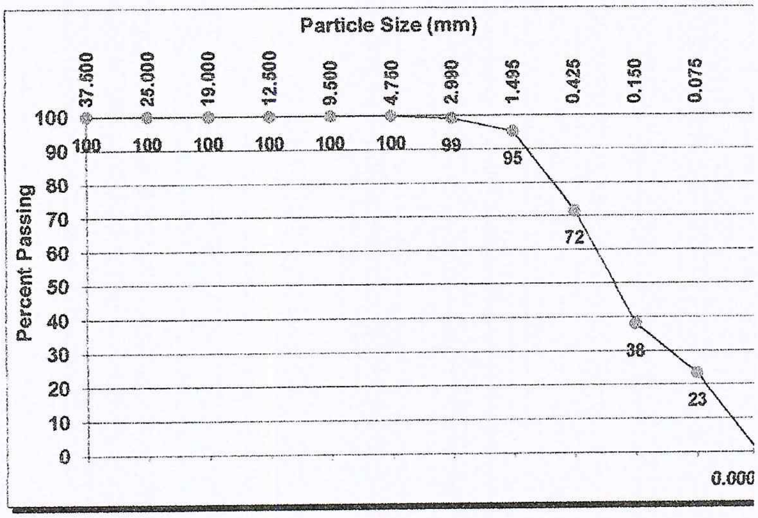
NATURAL MOISTURE CONTENT (ASTM D 2216) / ATTERBERG LIMIT (ASTM D4318)

LIQUID LIMIT - PLASTIC LIMIT - PLASTICITY INDEX					
	PLASTIC LIMIT		LIQUID LIMIT		
Trial No.	1	2	1	2	3
Dish No.					
No. of Blows Required					
No. of Blows					
1. Weight of dish + wet soil		NON-PLASTIC			
2. Weight of dish + dry soil					
3. Weight of dish					
4. Weight of water (1-2)					
5. Weight of dry soil					
6. % Moisture (4/5 x 100)					
7. Average Plastic Limit					



TEST ON SIEVE ANALYSIS OF SOIL (ASTM D-422)

Sieve Size (inches)	Diameter of Opening (millimeter)	Wt. Retained (grams)	CUMMULATIVE	
			Wt. Passing in grams	% Passing
1 1/2"	37.500	0.00	169.9	100
1"	25.000	0.00	169.9	100
3/4"	19.000	0.00	169.9	100
1/2"	12.500	0.00	169.9	100
3/8"	9.500	0.00	169.9	100
#4	4.750	0.00	169.9	100
#10	2.990	1.30	168.6	99
#20	1.495	6.60	162.0	95
#40	0.425	40.30	121.7	72
#100	0.150	56.90	64.8	38
#200	0.075	25.00	39.8	23
-	-	-	-	-



Original Dry Wt.: 169.90

Soil Classification (AASHTO) : SM - Light Gray (Silty Sand)

LIQUID LIMIT (LL)	NP	PLASTIC LIMIT (PL)	NP	PLASTIC INDEX (PI)	NP

Checked by :

EARL JHON MICHEL S. DISU
Sr. Laboratory Technician

Certified by :

RONALD A. ANGEL
Laboratory Head

Republic of the Philippines
DEPARTMENT OF AGRICULTURE
Regional Soils Laboratory
Region VIII
Magsaysay Blvd., Tacloban City

Soil Sample Information:

Name: **Romil T. Dandan**
Address: Carigara, Leyte
Field Identification No:
Water Supply: _ Rainfed _Irrigated
Crops to be fertilized: Results of Soil Analysis only
Yield Ordinary Years (Cavans/Hectare):
Sampled by:

Date Submitted: March 1, 2018
Date Finished: March 5, 2018
Submitted by:
Site of Farm: Carigara, Barugo & Babatngon, Leyte
Area Represented:
Cropping Season: _ Wet _ Dry
Previous Crops:

Soil Test Data

Determination	**Test Method**	**Adequate Value**	**Laboratory No.**		
			3043	3044	3045
			Field No.		
			Carigara	Barugo	Babatngoi
			Results of Soil Analysis		
pH	Potentiometric 1:1 H_2O	5.5 – 8.5	**6.52**	**6.48**	**6.54**
Organic Matter (%)	Walkley & Black	>4.5	**0.19**	**0.13**	**0.18**
Available Phosphorus (mg/kg)	Olsen/Bray	>20	**0.15**	**8.21**	**0.94**
Exchangeable Potassium (cmol/kg)	Ammonium Acetate	>0.25	**1.86**	**0.66**	**0.60**

Certified by:

ANNA PERLA C. COSTINIANO
Chemist III

NUTRIENT REQUIREMENT:

Field No.	Lab. No.	Lime Requirement	Nutrient Requirement: grams/plant/year			
			Crops	**N**	**P**	**K**

Note: Results of soil analysis only.

Approved by:

MELECIA C. GORDILLO
Laboratory In-charge

CURRICULUM VITAE

CURRICULUM VITAE

Name	: **ROMIL TADEFA DANDAN**
Address	: Brgy. Ponong, Carigara, Leyte
Date of Birth	: May 03, 1977
Place of Birth	: Carigara, Leyte
Religion	: Roman Catholic
Status	: Married
Height	: 167 cm
Weight	: 65 kg
Tin	: 187-240-198
Prof. License No.	: 1458459
Driver's License No.	: H09-10-000081
E-mail Address	: romildandan@yahoo.com
Telephone/Cel No.	: 53-331-11-71/ 09306768702
Skills	: Very Good Communication skill, Interpersonal skill, Collaborative, Creativity and Presentation skill, Basic Technological skill.

EDUCATIONAL BACKGROUND

Elementary

Nauguisan Elementary School
Carigara, Leyte
SY 1984- 1990

Secondary

Carigara National High School
Carigara, Leyte
SY 1990-1994

College

Leyte Institute of Technology Carigara Campus
Carigara, Leyte
Course- Bachelor in Fishery Technology
SY 1999-2003

Vocational

SM Colegeo De Leyte
Palo, Leyte
Course: Machine Shorthand
SY November 2003- June 2004

Master

Samar State University Mercedes Campus
Catbalogan, City
Course- Master in Fisheries Technology (Aquaculture)
SY April 2016- 2018

WORK EXPERIENCE

Instructor
Eastern Visayas State University Carigara Campus
Carigara, Leyte
CY June 2016- Present
Nature of Work : Provide high quality teaching, create effective opportunities for learning and enable all learners to achieve to the best of their abilit

Fiber Technician
Al Sharq Office Co.
TES Department Riyadh K.S.A.
CY April 2011-August 2012
Nature of Work : Fiber technician FTTx in STC, Zain and Mobily. Assemble splice enclosure, terminates fiber optic cables for indoor and outdoor cable line, perform cable preparation for ODF, Central, FDT cabinet, ODB customer side to terminate and prepare fusion and mechanical splicing. Test and trouble shoot fiber optic cables and fiber optic system.

Digital Subscriber Line Technician (DSL)
Al Sharq Office Co.
DSL Department Riyadh K.S.A.
CY March 2010- April 2011
Nature of Work :Installation and maintenance of DSL and telephone lines, trouble shooting, repair and configuration of all IP & DSL modem router in both hardware and software.

Highway Maintenance

Department of Public Works and Highways
Carigara, Leyte
CY July 2007- March 2009
Nature of works : Repair fences, paint traffic sign's, cut weeds and trees along the highways.

Office Aide

Municipal Agriculture Office
Carigara, Leyte
CY January 2005-February 2006
Nature of Work : Assist in typing, filing, taking inventory, keeping records of documents. Help in facilitating clients farm farmer, for farmer and worker. Member of the Fishery Law Enforcement Team.

TRAININGS/SEMINARS

Seminar on Thesis & Dissertation Writing
Conducted by:
Samar State University, Catbalogan Samar
January 13 & 20, 2018

Paralegal Training on Fishery Law, Rules and Regulations
Conducted by:
Bureau of Fisheries and Aquatic Resources
Regional Office 8 Tacloban, City
PNP Carigara, Leyte
September 5-6, 2013

Farmer Field School (FFS) for Rice
Conducted by:
Department of Agriculture Regional Office 8 Tacloban, City
National Agriculture and Fishery Council &
Provincial Government of Leyte

Coast Watch "Bantay Baybay" Training
Conducted by:
Bureau of Fisheries and Aquatic Resources
Regional Office 8 Tacloban, City
Social Preparation Seminar and Entrepreneurship Appreciation Course
Conducted by:
Department of Labor and Employment
Regional Office 8 Tacloban, City

REFERENCES:

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Fishery Department Head
EVSU CC
Carigara, Leyte
Contact No. 09152348673

I, the undersigned, certify that the data reflected in this curriculum vitae are true and correct.

Romil T. Dandan
Applicant

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