FISHCORAL PROJECT

Participatory Resource and Socio-Economic Assessment (PRSA) OF ASID GULF

TERMINAL REPORT

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ACKNOWLEDGMENTS

EXECUTIVE SUMMARY

Socio-economic, livelihood, and coastal resources management. Results of the socio-economic survey reveals that the fishers in Asid Gulf were getting older. Seven of every 10 fishers were 40 years old and older. In terms of sex, 86.77% of the interviewed respondents were males. Household size of 59.92% of the respondents was 6 to 10 members while 37.74% have household size of below 5 members. The predominant cause of morbidity among coastal households was hypertension (21.74%), viral infection (19.13%) such as influenza, common cold, chicken pox, mumps, and measles, and disease symptoms such as headache, fever, back pain, and stomach ache (17.39%).

In terms of house ownership, more than half (50.97%) of the households own their house and lot, 32.68% of the households who own their house that was built on another person's lot, and 3.89% of the households stay in houses that they do not own for free. More than one-third (38.91%) have houses made of nipa, 29.18% have concrete houses, and 30.74% have houses made of wood or bamboo with galvanized iron roof.

Deep well / artesian well was the primary source of drinking water as reported by 45.14% of the respondents, 10.98% obtain their drinking water from their own faucet through community water system or NAWASA, 24.90% bought bottled water from water refilling stations. Since almost all households have access to electricity, it becomes inevitable for them to own appliances such as television (68.87%), electric fan (43.19%), cellphone (50.97%), and radio (34.63%). Aside from appliances, they also own transportation assets or vehicles such as boat (58.30%) and motorcycle (18.72%).

Bottom-set gill net is the most common fishing gear used by the fishers in Asid Gulf as reported by 124 respondents. In terms of ownership, 82.26% of the respondents owned their bottom-set gill net while 19.35% share the fishing gear with other fishers. Simple handline / hook & line is also a common fishing gear as reported by 48 respondents. Almost all (87.20%) of the fishers owned their simple handline / hook and line while the remaining 5 respondents either use shared or leased fishing gear. Fish/crab/squid pots, scoop net with light, and bottom-set long line were also used by the respondents.

Fishing industry in Asid Gulf is market driven. Fishers moved away from the traditional subsistence fishing in which they catch fish to sustain the need for food of their families. Seventy-eight percent of the respondents catch fish that are intended to be sold for cash. Selling of fish was performed by 64.95% of the husbands while 20.62% reported that it is the wife of the fisher that sells fish.

Fishing, being the primary livelihood activity in the coastal municipalities of Asid Gulf, provides an average household income of Php10, 271.26 per month as reported by 231 respondents. Ninety households responded that aside from fishing they earned income from regular employment which amounts to Php10,990.00 per month on the average. Fish marketing was also a supplemental source of income of households. Instead of selling the fish caught to the traders 26 respondents revealed that they sell their fish to their neighbors which provided them an average income of Php4,560.77 per month. In cases when there were surplus fish 12 households process the fish through drying which provided them supplemental income of Php4,625.83 per month. Chicken and hog raising were common agriculture-based livelihood of the fishers which provided supplemental income to 26 households amounting to Php5, 705.77 per month.

The other sources of household income were wage income from labor, rice production, business, remittance of OFWs, siblings and children, preparation of gears, root crop production, and vegetable production. It was also revealed by 100 respondents that the transfer payments from 4Ps, pension, and unconditional cash transfer provided supplemental income for the household.

The sampling performed was intended to provide a picture of the poverty situation in coastal communities in Asid Gulf and not for each municipality surrounding the gulf. Php2,257.00 was the per capita poverty threshold per month based on the Family Income and Expenditure Survey (FIES) for a

household with five members. Using this threshold, 64% of the households in Asid Gulf can be classified as poor. This is high compared to the average poverty incidence in Masbate which reduced from 33% in 2015 to 29.4% in 2018. In terms of distribution, the income of households from fishing and from all sources is skewed. Even if the mean annual income per capita is Php16, 492.89, the median income is only Php10, 000.00 per capita per year. Median annual per capita income provides better estimate of average income of households in Asid Gulf because of the presence of few respondents with very high income compared to most of the households. Among the municipalities covered, respondents from Milagros have the highest median annual per capita income of Php14, 200.00 followed by Esperanza (Php10, 075.00), Placer (Php9, 800.00), Balud (Php8, 725.00) and Cawayan (Php7, 100.00). Median income from fishing was also highest in these municipalities. The baseline poverty threshold was even higher compared to the 42% baseline of the FishCORAL project. Nonetheless, this figure could be used for monitoring activities as the project progresses to be able to establish trend and potentially provide estimate of the project's impact.

Coastal resources management study reveals that 76% of the respondents perceived that the fish they caught years ago were large only, 7% perceives that the size of fish that they caught is better at present. Eighty percent observed that fish is more abundant years ago while only 10% of the respondents perceive that fish is more abundant at present. The perceived declining volume and size of fish caught were attributed to anthropogenic factors particularly overfishing and catching of fish even before they reach the size when they are sexually mature to reproduce, illegal use of destructive fishing practices (35%), intrusion of commercial fishing vessels in municipal waters, damaged fishing gears, and lack of fishing gears. Natural factors such as typhoon was also cited as cause for the declining volume of fish caught because, in the short run, it reduces the frequency of trips of the fishers to the sea.

Among the illegal fishing methods used in Asid Gulf as reported by the respondents include Dynamite fishing (44%), trawl fishing (18%), fine mesh net (17%), Danish seine and compressor fishing (6%) and cyanide and commercial fishing (2%). These activities are destructive to coral reefs and marine habitats. Commercial fishing vessels are prohibited in most of Asid Gulf because it is comprised of municipal waters. These imply that illegal fishing activities in Asid Gulf are common and prevalent.

There was limited level of awareness on CRM activities. Only 86 or 33.46% of the respondents were aware of the projects or activities related to fishing in Asid Gulf. Livelihood projects, resource conservation initiatives, and enforcement of fishery laws were the projects/activities of which the respondents were familiar. There were twelve respondents who rated the livelihood projects very effective and eleven of the respondents rated the projects effective. These livelihood projects included provision of fishing gears either from the LGU or BFAR, piggery in Cawayan and welding and seaweed farming as the other alternative livelihood projects in Esperanza and Placer. These livelihood projects were identified only by the fishers in the municipalities of Balud, Cawayan, Esperanza, Milagros and Placer.

The enforcement of fishery laws by the *bantay dagat* was identified by the fishers in the municipalities of Balud, Cawayan, Esperanza, Milagros and Placer. Six of the respondents rated the activity very effective while ten rated it effective and two rated the activity as moderately effective. *Bantay dagat* is an initiative of the municipal local government unit, barangay LGU, and, in some, cases by the fishers' organization. This CRM activity was moderately effective because the presence of *bantay dagat* in municipal waters, particularly in areas with Marine Sanctuary and Fisheries Reserve (MSFR), is not constant.

Among the identified CRM projects/activities, resource conservation was rated very effective by more than half of the respondents who were familiar of this initiative. Eleven respondents rated it very effective, while four rated it effective, three rated it moderately effective. Another resource conservation initiative was mangrove planting. Despite the existence of illegal fishing in the municipal

waters, 34% of the respondents believed that their municipal ordinances are effective. The extent of illegal fishing activities could be higher if there were no ordinances in place.

Status of Corals, coral reef fishes, seagrass-seaweeds and mangroves. This assessment can be considered as the first comprehensive bio-ecological and social assessment made in Asid Gulf. Although it has been a part of the Integrated Coastal Resources Management Project (ICRMP) before, it only focused then on selected coastal habitats and fisheries assessments. Likewise, sporadic initiatives prior to the ICRMP, such as the routine Participatory Coastal Resource Assessments of the Department of Environment and Natural Resources and the Bureau of Fisheries and Aquatic Resources Region V, were undertaken, collating these vital benchmarks is in itself a challenge. Despite the limitations resulting from security and bad weather, the Participatory Resource and Socioeconomic Assessment was able to gather important information vital for the long-term utilization and management of Asid Gulf's rich resources.

Only 91% of the 2,261 km^2 statistical area is municipal, as a small portion south of Balud waters can be considered offshore water under RA 8550. Cawayan and Milagros cover more than half of these coastal waters (52%). Reef areas in the gulf are commonly seen fringing coastal zones and the dozens of islands of varied sizes within. Around 14 marine protected areas (MPAs) were completed in this assessment. The MPA coverage in the gulf totaled 3,113.13 hectares (31.13 km^2). This represents protection to 1.51% of the municipal waters, which is slightly better than the 0.88-0.89% protection in Ragay Gulf. This is, however, way below the 15% prescribed under RA 8550 and the 25-40% under the Masbate Environment Code.

The status of the corals in Asid Gulf are mostly poor to fair. This is very pronounced in all MPA reef stations. Ironically, the situation was better in the non-reef station (Guinlobngan) used as reference. The progressive deterioration of the reef condition can be gleaned from sporadic baselines from 2001, 2013, and 2015. Among the assessed reef systems, the one in Guinlobngan stood out as the only location with fair to near to good coral cover. The reef system is not an MPA, but protection was carried out by a family who claim ownership of the scenic islet. The proliferation of macroalgal beds encroaching the shallow denuded reef systems was commonly observed in all sampling stations except for the one in Guinlobngan. Dominated by *Sargasum, Padina,* and *Turbinaria*, these seaweeds were seen to cover 46-66% of the transects made in all stations, except for the ones in Guinawayan and Guinlobngan. These macro algal communities now thriving in coral reef systems are using dead coral hard substrates. This will have some serious implications to the recolonization and recovery of the coral reefs.

The reef fishes in 2017 were more abundant and denser than in the present. They are also more diverse (16-39 species) then than in the present (18-32 species). An exception is Guinlobngan, which is showing improvement in diversity. Fish biomass in this reef area also improved significantly, while it considerably diminished in the Recodo MPA reef. The biomass estimates in Asid Gulf are comparably lower than the estimates in other nearby Bicol locations.

The reef fish groupings are again heavily dominated by those from major groups (72%), while target and indicator species represent 17% and 11%, respectively. The lower proportion of fishes from target species may be an offshoot of intense fishing pressure challenging the regenerative capacity of the fish population.

Indicator species are also minimal in fish count, representing just 11%. This is better than the 4% in Ragay Gulf in 2019 and 7% in 2005. Fewer fishes from indicator species may mean some degree of deterioration of habitats.

The bulk (72%) of the fishes encountered belong to major groups. Fish assemblage dominated by major groups have less to offer to fisheries, but they are still ecologically important.

Earlier reports observed that most of the reef fishes were plankters and algal feeders of low commercial value. This is still true but a significant reduction of herbivores, which were just at 17% of all observed reef fishes, was glaring. While omnivores were high (31%) and could substantially help in the herbivorous feeding system, the fact remains that the representation of fishes based on feeding mechanism is strongly tilted toward carnivores (52%). There seems to be an imbalance between the feeding groups as carnivores outnumber those at the lower trophic levels, such as herbivores and omnivores. The very low count of herbivore fishes will directly connect to the significant elimination of grazers by fishing. This could have partly caused the macro algal growth along reef systems.

Seven species of seagrasses were observed in the selected municipalities of Asid gulf, and these were *Cymodocea serrulata, Halodule pinifolia, Halodule uninvervis, Syringodium isoetifolium* of family Cymodoceaceae and *Enhalus accoroides, Halophila ovalis,* and *Thalassia hemprichi* of family Hydrocharitaceae. While 12 species were noted for seaweeds namely, *Halimeda macroloba*, *Bornetella spherica Chlorodesmis fastigiata, Codium sp., Ulva expansa, Caulerpa racemosa, Ulva lactuca,* and *Ulva reticulata* of Chlorophyta group. *Euchema sp. Gracillaria sp*. of Rhodophyta group and *Sagassum sp. and Padina sp.,* of Phaeophyta.

The highest number of species of seagrass was recorded both in Cawayan and Esperanza where five species were observed. The lowest number of seagrass species was found in Placer wherein only *Thalassia hemprichii, Syringodium isoetifolium* and *Enhalus acoroides* were seen. Also, it was in Cawayan where the highest number of species (11) for seaweeds was observed. The lowest number of seaweeds encountered in the transects was in Milagros, wherein only *Ulva lactuca* was present. The most extensive seagrass and seaweeds beds in Asid gulf was found in Cawayan while the narrowest was identified in Placer. Moreover, the seagrass and seaweeds beds of Asid gulf were fairly diverse compared to nearby locations and they were in good condition.

The observed human disturbance along seagrass and seaweeds beds in the gulf are boat anchorage, gleaning, operation of fishing gears with fine mesh nets (beach seine), near shore human settlements and unsanitary disposal of solid waste. These are frequently encountered in the sampling stations in Cawayan and Milagros. These disturbances may hamper the growth and recovery of this ecologically-important coastal habitat.

Mangroves of Asid Gulf covers around 686 hectares. Most of these mangrove areas are in Placer (61%) and in Cawayan (21%). Only five sites were successfully assessed as the sampling actions in the gulf were hampered by security reason (election time) and by the onset of the South West monsoon. Species composition of mangroves in the assessed locations are fairly diverse as 11 species (including *Nypa fruticans*) were encountered. Most of these mangrove areas are reduced to thin stretch of remaining trees as a result of fishpond conversion. Most of these mangroves are natural stands. The thin mangrove assemblage are the ones with very low regenerative capacities. Solid wastes, fishpond conversion and human habitation near the mangrove areas are the common disturbances seen in the five assessed locations.

The following are recommended for coral reef ecosystem enhancement in Asid Gulf: (1) Revalidation of the location and expanse of the MPAs. (2) Networking of the MPAs. (3) Careful rehabilitation efforts for degraded corals. (4)Curbing coral ecosystem disturbances.

Seagrass/seaweeds cover and diversity can be improved through strict implementation of management measures such as coastal use zoning to conserve marine ecosystem. A permanent monitoring site could be established to determine whether the seagrass /seaweeds beds resource is stable, improving or declining. However, with the steady population increase along coastal areas, strong political is needed to effectively implement management schemes.

Moreover, the seagrass areas should be included in the management plans in every municipality. Integrated management plans should be prepared gulf wide including seagrass beds inside the managed areas. Periodic monitoring of their status is needed. Also, local awareness on the economic and ecological benefits of the seagrass beds must be conducted.

In case of mangroves, there is a need to put in check the cases of cuttings that are still happening. Rehabilitation has obviously been started but there is a need to intensify the efforts by direct targeting of candidate locations for rehabilitation of the appropriate species. Solid waste disposal of nearby communities shall be looked into.

Water quality assessment of Asid Gulf. There were 25 established stations for in-situ measurements, while six stations were identified as water quality sampling stations, in Asid Gulf. These stations were prioritized based on the locations of marine protected areas, aquaculture projects, ecotourism facilities, and proximity of potential discharging industries. Primarily, sampling stations in Asid Gulf covered the municipalities of Balud, Milagros, Cawayan, Placer, and Esperanza.

The physico-chemical characteristics of the waters in the identified gulf was measured using multiparameter water quality meter. Water temperature can affect the metabolic rates and biological activity of aquatic organisms. The temperature in the water quality stations ranged from 29.60 to 32.20 ^{0}C, a slightly higher value compared to the limit set by the standard, 25-31.00 ^{0}C. This means that as far as water temperature is concerned, Asid Gulf is in good condition. pH was similar in all stations. ranging from 8.11 to 8.47. All recorded values fell within the standard allowable pH value for Class SB marine waters, which indicates good condition and buffering capacity of Asid Gulf water. If the pH is too high or low, the aquatic organism living within the area would eventually die. Apart from this effect, pH can also affect the solubility and toxicity of chemicals and heavy metals present, if any, in water.

With regard to DO, all stations had normal readings with a narrow range of 6.48-8.51 ppm. The highest DO was encountered at T. Pag Island. These values even surpassed the 6 ppm DO level set as the standard—an indication of good water condition to support the survival of all aquatic organisms. Adequate DO is necessary for good water quality and oxygen is a necessary element to most forms of life. When dissolved oxygen concentration drops, major changes in the aquatic environment can occur. For TDS, recorded values exhibited slight variations ranging from 23.97 ppt as the minimum value to 22.41 ppt as the highest recorded value. There is no standard value for TDS in DAO 2016-08. These recorded values, however, are still acceptable for seawater since a constant level of minerals in water is necessary for aquatic life.

Total suspended solid (TSS) values recorded among the water quality sampling stations in Asid Gulf ranged from 18.33 to 60.00 ppm, the highest of which was obtained from a seaweed farm while the lowest was recorded at the water quality station in Pangui, Balud. Comparing these obtained values with DAO 2016-08, it can be noted that the seaweed farm in Balud exceeded the TSS limit for SB classification of marine water. These suspended particles can come from soil erosion, runoffs, and even discharges.

Nitrate levels in Asid Gulf ranged from 7.73 to 14.35 mg/L (ppm). Comparing these obtained values with the standard limits set by DAO 2016-08, it can be deduced that two stations (Milagros Aquaculture and Asid River Exit) exceeded values for SB classification. Nitrates also come from the earth. Soil contains organic matter, which contains nitrogen compounds. Although nitrates occur naturally in soil and water, an excess level of nitrogen can be considered contaminants. Like DO, temperature, and pH, the amount of nitrate concentrations in water is determined by both natural processes and human interventions. A body of water may be naturally high in nitrates or have elevated nitrate levels as a result of human activities. Although nitrates can occur naturally, excess levels can be considered contamination. Most sources of excess nitrates come from human activities and can be traces to agricultural activities, human wastes, or industrial pollution. The nitrates in nitrogen fertilizers can be washed by rainwater into streams or rivers. This run-off problem is serious, especially when the fertilizer is animal waste or manure. In addition to animal waste, untreated human sewage can also contribute to high nitrate levels.

On the other hand, the phosphate levels measured along the Asid Gulf water quality stations ranged from 0.14 to 5.04 mg/L (ppm). These values suggest a strong variation among the stations. The majority of the stations showed higher phosphate levels compared to the limit set by the standard for SB classification. Some stations exceeded the phosphate concentration limits for class SB of marine water, which is 0.5 mg/L. Phosphorous generally gets into the water through urban and agricultural settings. It tends to attach to soil particles and move into surface water bodies from run-off. This excess phosphates in water, as can be observed from the values obtained for the water quality stations near the opening of rivers, can affect water quality by excessive algal growth. Fertilizers containing phosphates can also be a factor in elevated levels of phosphates in water systems. Applying chemical fertilizers to soil that has been already saturated with phosphates and spreading excessive amounts of manure on land causes phosphates to run off during heavy rainfall through rivers and streams.

While fecal coliform levels within the water quality stations in Asid Gulf, Milagros Aquaculture and Asid River Exit had the highest fecal coliform and exceeded the 100 MPN/100 ml limits for SB classification of marine water. This could possibly mean that the presence of fecal coliform bacteria in aquatic environment indicated that the water has been contaminated with the fecal material of humans or other animals. At the same time, the water may have been contaminated by pathogens or disease-producing bacteria or viruses that can also exist in fecal matter.

In general, water quality in Asid Gulf is compliant to the standards set by DAO 2016-08, based on physico-chemical characteristics, such as pH, dissolved oxygen, temperature, and salinity. However, the nutrient levels (nitrates and phosphates) and the fecal coliforms recorded within the identified water quality stations obviously surpassed the limits for class SB for these parameters. The high nitrate and phosphate concentration can be ascribed to agricultural runoff, in addition to the nutrient load of the seawater. On the other hand, the high levels of fecal coliform values from the identified stations compared to the limits can be attributed to sources like runoffs, waste discharge, domestication of animals, and poor sanitation.

Given the same water quality conditions prevailing in Asid Gulf in comparison with DAO 2016-08, more stringent water quality monitoring is recommended especially for the stations that exhibited irregular values for important water quality parameters. This can be done through regular monitoring as directed by regulatory guidelines. In addition, the high levels of nutrients, such as nitrates and phosphates in some of the water quality stations within the gulf, which can be attributed mainly to agricultural contributions, calls for a need for the local government to revisit its conditions and management for sustainable agriculture. The solid waste management and proper household and industry sanitation initiatives of the municipalities along Asid Gulf should also be enhanced, taking into consideration the seemingly alarming fecal coliform levels in areas near rivers and aquaculture sites.

Capture fisheries and production of Asid Gulf. Fishing is not only an industry but a way of life for the communities located within Asid Gulf. The study utilized different methodologies, such as structured interview and reports, in collecting primary and secondary data from the key officers. Key informant interview technique was also used to gather necessary data from the fishermen and officers of the local fishing organizations in the municipalities of Balud, Cawayan, Esperanza, Milagros, and Placer. The study estimated 23,574.44 mt of fisheries production in Asid Gulf. It also revealed that the gulf is rich in crabs and squids resources. The dominance of cephalopods and fast growing invertebrates in the fisheries was suspected by experts to be attributed to changing water environment as offshoot of changing climate. This can also be a result of intense fishing pressure. Entangling nets have the largest production (30.90%) compared to other fishing gear categories, with a 7,284.28 metric-ton annual catch. Other gear categories with large production are handlines and impounding nets that produce 5,473.89 (23.22%) and 5,305.09 (22.50%) metric tons a year, respectively. From the production estimate and in consideration of the 2261 km2 area, extraction rate of fisheries in Asid Gulf could translate into 10.43 mt/km^2. Experts stated that extraction rate of about 15-20 km^2 catch per unit area is an indicative sign of overfishing. Other gears were also observed and some of these were identified as illegal. It was observed that fishing is a family activity where the spouse and children helped in the preparation stage, like mending the fishing gears during lean season.

The fishery in Asid Gulf is characterized by the use of multiple gears. An abundance of crabs and squids were observed, as justified by the volume of production and number of fishing activities associated to it. Weather conditions and seasonality of gear types were evident and were species dependent. Trawls, compressor, sodium cyanide, and blast fishing observed in some parts of the gulf. The catch rates and fishing efforts manifested a high exploitation level in the gulf area, which needs to be addressed. Fishing operations and fish catch in the gulf will continue to decline if the community and other stakeholders will not respond proactively to the issues of overfishing and illegal fishing.

Mapping and development of PRSA information system. The development of the system provided an opportunity to have a reliable and systematic information storage, archiving, and management system for socio-economic, fisheries, and coastal resource management. The socio-economic, aquatic ecology, water quality, and capture fishery components have successfully developed the interface and tested test cases based on program structures. Also, system access and privileges were successfully validated and provided security procedures for user requests. The results and findings are encouraging. Thus, there should be a more comprehensive data gathering tool that should be introduced to capture a wider range of parameters that affect coastal habitats and fisheries in different seasons, use data mining to analyze the reports of socio-economic trends and other components depending on given or acquired datasets, and develop a real-time collection of data through system integrated hardware devices.

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SOCIO-DEMOGRAPHIC AND ECONOMIC ASSESSMENT OF COASTAL COMMUNITIES IN ASID GULF

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ABSTRACT

The sociodemographic and economic characteristics of the coastal communities in Asid Gulf were studied to provide useful baseline information. Lessons were drawn from 257 samples from 57 barangays in five municipalities in Masbate facing Asid Gulf through sample survey. Results revealed that the fisheries sector confronts a multitude of problems that suppress its growth. Among these are declining volume of fish caught, aging fishers, unsecured property rights, limited access to proper water and sanitation facilities, and over-all above-dismal poverty situation. On the other hand, improvements are noted in access to public health services, availability of vehicle for information dissemination, and alternative sources of livelihood that can potentially be utilized to boost the fisheries sector. This can be done through the provision of alternative sources of income through value addition to lessen the pressure of overexploitation of coastal resources to support the growing population.

Keywords: sociodemographic, economic, assessment, FishCORAL, Asid Gulf

INTRODUCTION

Asid Gulf is one of the sources of fresh fish in the Philippines. It covers an area of 619 hectares, which makes it the eighth largest gulf in the country (PSA, 2019). The gulf is bounded on the north, east, and west by the province of Masbate. The population density of the province was 171 persons/km^2 according to the 2000 census and increased to 216 persons/km^2 in the 2015 census (PSA, 2016). This figure is below the regional average population density of 320 persons/km^2 and the national average population density of 337 persons/km^2 in 2015. The increase in population density puts pressure on the natural resources to provide food for the growing number of people.

Figure 1. Map of Asid Gulf showing municipal waters

This can be observed in the decreasing fisheries production in Masbate from 707,668 metric tons in 2002 to 58,461.55 metric tons in 2015 (PSA, 2018). More recent data from the Philippine Statistics Authority show that fisheries production continues to increase from 60,959.51 metric tons in 2016, to 65,494.99 metric tons in 2017, and 63,620.25 metric tons in 2018.

The population dependent on farming and fishing belong to the vulnerable groups. Although they serve as the country's lifeline in ensuring food security, farmers and fishers are the top sectors with an alarming poverty incidence of 38.3% and 39.2%, respectively (PSA 2012). Existing documents attribute this to big family size and low educational level (Reyes et al., 2012). Depletion of fish stocks and the continuing deterioration of the coastal habitats have also been demonstrated to be the cause of dismal economic status of fishing families. To address the alarming poverty incidence in fishing communities, as well as protect and conserve coastal resources, the Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR) launched the Fisheries, Coastal Resources, and Livelihood (FishCORAL) Project. This United Nations International Fund for Agricultural Development (UN-IFAD)-funded project prioritizes 11 target fishing grounds to enable coastal communities to sustainably manage their fishery and coastal resources, as well as generate livelihood benefits for fishing households. At the end of the project, it is expected that poverty incidence in the coastal communities will be reduced by 5% from the baseline of 42%, child malnutrition will be reduced by 4% from the baseline of 24.4%, and employment of women shall increase to 40% from the baseline of 20%. The project also intends to increase the annual income of fishing households by 10% and asset ownership by 20%, based on the baseline to be identified at the local level.

This study intends to provide a localized baseline of socioeconomic indicators for the FishCORAL Project. Specifically, the paper aims to:

1. describe the socio-demographic and economic profiles of coastal communities,
2. analyze the sociodemographic characteristics of the fishers, and
3. evaluate the economic situation of the households engaged in the fishing sector.

METHODOLOGY

This research employed the descriptive research method through the conduct of a sample survey in identified project sites of FishCORAL. This section presents the population where the samples were identified, method of data collection, and method of data analysis.

Population and sample. According to the 2019 FishR data of the Bureau of Fisheries and Aquatic Resources Region V, there are 8,062 registered fishers that are involved in capture fisheries in the municipalities of Balud, Milagros, Cawayan, Placer, and Esperanza. They are distributed in 53 coastal barangays. The sample size was 265 households based on a 95% confidence level (Z=1.96), with a margin of error of 0.0602 and a sample proportion of 0.5. For each barangay, there was a target of five households. The number of respondents per municipality is presented in Table 1.

Table 1. Coastal barangays covered along Asid Gulf: 2019

Municipality	Coastal Barangays	No. of Respondents
Balud	Baybay (Lumocab), Bongcanaway, Calumpang, Casamongan, Jangan, Jintotolo, Panguiranan, Pulanduta, GuinyanganDiotay, Salvacion, and San Antonio de Padua	55
Cawayan	Begia, Divisoria, Mahayahay, Naro, and Poblacion	25
Esperanza	Agoho, Domorog, Iligan, Labangtaytay, Libertad, Masbaranon, Poblacion, Potingbato, Rizal, Santiago, Sorosimbajan, and Villa	56
Milagros	Bangad, Bara, Calumpang (Taisan), Capaculan, Jamorawon, Magsalangi, Narangasan, Pamangpangon, Poblacion East, Poblacion West, Sawmill, and Tigbao	60
Placer	Camayabsan, Daanglungsod, Daraga, Guin-Awayan, Katipunan, Luna, Nagarao, Nainday, Naocondiot, Pasiagon, Quibrada, Taboc, and Villa Inocencio	61
	Total Respondents	**257**

Method of data collection. The research instrument used in this study was patterned after the Participatory Coastal Resource Assessment Training Guide developed by Deguit et al. (2004). The questionnaire was pre-tested in Sto. Domingo, Albay on March 2-3, 2019 before it was refined through the assistance of FishCORAL Technical Committee members. The training of the field interviewers immediately followed. To facilitate the data collection, coordination with the municipal and barangay officials was done prior to the activity. Then, simultaneous data collection was conducted. The questionnaire utilized in the study was divided into eight parts: (1) socio-demographic profile, (2) household members, (3) property ownership, (4) economic characteristics, (5) coastal resources management, and (6) community involvement.

Each field interviewer was assigned to conduct face-to-face interviews with the respondents for approximately 25-30 minutes. In each barangay, the purok with the greatest number of fishers was selected as the sampling unit. With the assistance of the assigned barangay official, households were randomly selected with an interval of one household after each qualified household. Replacements were done in cases of outright refusal or when there was no member engaged in fishing. In cases when the member of the household primarily engaged in fishing activities was not available during the day of the visit, other members "directly or personally and physically engaged in taking and/or culturing and processing fishery and/or aquatic resources" (R.A. 8550) served as the respondent. Data collection was conducted in June-August 2019.

Figure 2. Photo documentation during data collection in Asid Gulf

Method of data analysis. The data were analyzed using descriptive statistics. For the socio-demographic characteristics, frequency and percentage distribution were illustrated using figures and tables. Income and expenditure data, on the other hand, were reported using mean and range as numerical measures.

RESULTS AND DISCUSSION

This section is divided into four parts: socio-demographic characteristics of the respondents, household and health profile, housing profile, and the respondents' economic profile.

Socio-demographic characteristics of respondents. The fishers in Asid Gulf are getting older. Seven of every 10 fishers are 40 years old and above, with a mean age of 45 years old (see Table 2). This is higher compared to the national average age of fishers, which is 41 years old, according to Campos et al. (2006). This implies that the younger generation is not interested to engage in fishing activities. In terms of sex, 86.77% of the respondents were males as fishing is predominantly an activity of men. The researchers were able to interview the fishers' spouses when they were not around during the data gathering. Almost 94% of the respondents were married, while 4.67% were single on the day of the interview.

Table 2. Distribution of respondents by socio-demographic profile, Asid Gulf: 2019

Socio-demographic profile	Frequency	Percent
Age		
21-30	22	8.56
31-40	81	31.52
41-50	67	26.07
51-60	57	22.18
61-70	26	10.12
71-80	4	1.56
Sex		
Male	223	86.77
Female	34	13.23
Civil Status		
Single	12	4.67
Married	241	93.77
Widower	3	1.17
Divorced	1	0.39
Highest Educational Attainment		
No formal schooling	4	1.56
Elementary Level	54	21.01
Elementary Graduate	82	31.91
High School Level	42	16.34
High School Graduate	54	21.01
College Level	8	3.11
College Graduate	7	2.72
No Response	6	2.33
Religion		
Roman Catholic	211	82.10
Philippine Independent Church (Aglipay)	14	5.05
Iglesia ni Cristo	7	2.72
Others	11	4.28

Around half (53%) of the respondents were elementary school graduates, 16.34% were able to earn secondary education, 21.01% were able to complete secondary education, and 5.83% were able to enter tertiary education. It is common in coastal communities for families to send their children to primary school to learn to read and write. Afterwards, they join their fathers in fishing activities to earn a living. Another explanation for the education data is the limited number of secondary schools in coastal areas, which hinders the families from sending their children to pursue further studies beyond the primary level. Meanwhile, the religious affiliation of the respondents is reflective of the Philippines' being a predominantly Roman Catholic country. A significant majority (82.10%) of the respondents are Roman Catholics while 5.05% belong to the Philippine Independent Church, and 2.72% are members of *Iglesia ni Cristo*.

Household and health profile. At least 59.92% of the households have 6-10 members, while 37.74% have household size of below 5 (see Table 3). Households in coastal communities are comprised of extended families because even if the children get married, they tend to stay in their parents' house. A typical coastal community household is composed of a couple, their children, and their children's children. This is supported by the fact that 32.99% of the household members are below 20 years old.

Table 3. Distribution of respondents by household profile, Asid Gulf: 2019.

Household size	Frequency	Percent
Below 5	97	37.74%
6 to 10	154	59.92%
10 and above	5	1.95%
No Response	1	0.39%
TOTAL	**257**	**100**

Household members experience various illnesses, predominantly hypertension (21.74%; see Table 4). This is followed by viral infections (19.13%); disease symptoms such as headache, fever, back pain, and stomachache (17.39%); and bacterial infection (13.91%).

Table 4. Distribution of respondents by illness experienced in the past 12 months and to whom they consulted, Asid Gulf: 2019

Illness	Consulted with						Percent
	Local Hilot	BHW	RHU	Private Physician	None	Frequency	
Hypertension	2	14	7	2	0	25	21.74
Viral infection	1	15	4	2	0	22	19.13
Disease symptoms	4	12	3	1	0	20	17.39
Bacterial infection	1	5	4	6	0	16	13.91
Asthma/respiratory diseases	0	1	4	3	0	8	6.96
Heart disease and other organ complications/ disorders	1	1	1	4	0	7	6.09
Inflammatory illnesses	2	2	0	1	0	5	4.35
Others	4	4	2	2	0	12	0.87
TOTAL	**15**	**54**	**25**	**21**	**0**	**115**	**100**

It can be observed that the household members consult barangay health workers (BHW) and rural health units (RHU) more than the traditional hilot. This is a good indicator that health care services of the government can now reach the marginalized groups in geographically isolated areas. Hypertension, viral infection, disease symptoms, and bacterial infection are among the causes of morbidity consulted with BHW and RHU. More complicated illnesses, such as asthma/respiratory diseases and heart disease, are referred to private physicians.

Housing profile. It was a notable observation in Asid Gulf that more than half (50.97%) of the households own their house and lot (see Table 5). Around 36.57% of households own their houses but were built on another person's lot, mostly the land of relatives. Lastly, 9.34% of the households stay for free in houses that they do not own. There were 19 respondents who revealed that they stay in the property of their landlords who own big fishing boats and whom they join to catch fish.

Table 5. Distribution of respondents by housing profile, Asid Gulf: 2019

Housing profile	Frequency	Percent
Ownership of House		
Owner, owner-like possession of house and lot	131	50.97
Own house, rent-free lot with owner's consent	84	32.68
Own house, rent-free lot without owner's consent	10	3.89
Rent-free house including lot	8	3.11
Rent-free house and lot with owner's consent	20	7.78
Rent-free house and lot without owner's consent	2	0.78
No Response	2	0.78
Type of dwelling		
Nipa/cogon hut	100	38.91
Concrete (cement)	75	29.18
Wood/bamboo with galvanized iron roof	79	30.74
Mixed	1	0.39
No response	2	0.78

The type of dwelling varies among households. More than one-third (38.91%) have houses made of nipa/cogon, 29.18% have dwellings made of concrete, and 30.74% have wooden or bamboo homes with galvanized iron roofs. The type of dwelling is dependent on the ability of the households to purchase durable materials that can withstand the typhoons and monsoon winds that usually hit their place.

Coastal barangays surrounding Asid Gulf have limited access to electricity, with only 63.42% of the households having access (see Table 6). There were 12.84% who reported that they use solar power. The remaining households use kerosene (5.84%), generator set (5.06%), and petromax (1.56%). Out of the 163 respondents who have access to electricity, only 112 have their own electric connection. The remaining 49 use shared electric connection with their neighbors and only pay the minimum amount per electric bulb for their lighting needs, especially at night.

Deep/artesian well is the primary source of drinking water as reported by 45.14% of the respondents. The rest buy bottled water from water refilling stations (24.90%), draw directly from bodies of water such as rivers and streams (7.39%), and get from barangay faucets (3.11%). Only 10.89% of the households obtain their drinking water from their own faucets or through the community water system. A clean source of water is necessary to ensure the good health of household members. It was noted previously that respondents reported that bacterial infection is among the causes of illnesses in their household.

Similar to the necessity of having a safe source of drinking water is the need to have hygienic toilet facilities. Two-thirds (66.54%) of the respondents reported that they have water-sealed toilets in their households. In a coastal community, it is relatively expensive to have a septic tank for human excreta. It is further constrained by lot ownership. Only half (50.97%) of the respondents own their lots. Open field (12.06%), drop/overhang (7.78%), and pit toilet/ latrine (2.72%) are among the toilet facilities that can expose the members of the households to different diseases.

Since four out of five households (80.55%) have access to electricity, it becomes inevitable for them to own appliances (see Table 7). Television (60.87%), cellphone (50.97%), electric fan (43.19%), and radio (34.63%) are the most common appliances owned. These are important sources of information and comfort for the household members. The television, cellphone, and radio can be vehicles for knowledge transfer and information dissemination to the residents of the coastal communities. Other appliances owned by the respondents are refrigerator (9.73%) and gas stove (6.61%). Some respondents also reported that they own bed (26.85%) and sala set (5.06%).

Table 6. Distribution of respondents by utility and health facilities, Asid Gulf: 2019

Utility and health facilities	Frequency	Percent
Lighting Facility		
Electricity	163	63.42
Solar	33	12.84
Kerosene lamp	15	5.84
Generator-operated	13	5.06
Petromax/gas-operated	4	1.56
No response	29	11.28
Source of Electricity		
Electricity with own connection	112	43.58
Electricity with shared connection	49	19.07
Solar/battery	33	12.84
Generator	13	5.06
None	21	8.17
No Response	38	14.79
Source of drinking water		
Deep/artesian well	116	45.14
Bottled water	64	24.90
Own water faucet	28	10.89
River, stream,,and other bodies of water	19	7.39
Barangay faucet	8	3.11
No response	22	8.56
Toilet Facility		
Water-sealed	171	66.54
Open field	31	12.06
Drop/overhang	20	7.78
Pit toilet/latrine	7	2.72
Flush type	6	2.33
Others	5	1.95
No response	17	6.61

Table 7. Distribution of respondents by furniture and appliances owned, Asid Gulf: 2019

Furniture/appliance owned	Frequency	Percent
Television	177	68.87
Cellphone	131	50.97
Electric fan	111	43.19
Radio	89	34.63
Bed	69	26.85
Refrigerator	25	9.73
Gas stove	17	6.61
Sala set	13	5.06
Others	12	4.67

Aside from appliances, the respondents were also asked if they own transportation assets or vehicles. Boat is the most common vehicle owned by the households (58.30%) because it is primarily used in their fishing activities to earn for a living (see Table 8). Those who do not own a boat join other fishers and share from the sales of the fish they caught. Motorcycle is also a common transportation asset of the household, as reported by 18.72% of the respondents. In the absence of well-paved roads in coastal barangays, motorcycles are useful in transporting people from one place to another. They are also used by the households as alternative sources of income as *habal-habal* whenever the weather bad, preventing the fishers from going out to sea. Some (2.98%) own tricycles and bicycles (0.85%).

Economic profile. The primary economic activity of the respondents is fishing because they live in coastal barangays. On average, the households earn ₱10,271.26 from fishing activities per month, as reported by 231 respondents who revealed details of their income from fishing activities (see Table 9). There are 90 households that, aside from fishing, earn income from regular employment that amounts to ₱10,990 per month on average.

Table 8. Distribution of respondents by transportation asset owned, Asid Gulf: 2019

Transportation asset owned	Frequency	Percent
Boat	137	58.30
Motorcycle	44	18.72
Tricycle	7	2.98
Bicycle	2	0.85
Others	2	0.85
None	43	18.30

Table 9. Distribution of respondents by source of income and average household income, Asid Gulf: 2019

Source	No. of HH Reporting	Total Income	Average HH Income
Fishing	231	2,372,660.00	10,271.26
Regular employment	90	989,100.00	10,990.00
Fish marketing/selling	26	118,580.00	4,560.77
Animal husbandry	26	148,350.00	5,705.77
Laborer	13	134,100.00	10,315.38
Fish processing	12	67,510.00	5,625.83
Preparation of gears	3	4,500.00	1,500.00
Business	3	12,000.00	4,000.00
4Ps benefits	99	290,100.00	2,930.30
Unconditional cash transfer benefits	1	2,200.00	2,200.00
Others	13	79,480.00	6,113.85

Fish marketing is also a supplemental source of income of households. Instead of selling to traders, 26 respondents revealed that they sell fish to their neighbors, which provides them an average income of ₱4,560.77 per month. In cases when there is a surplus fish catch, 12 households dry the fish, which provides them a supplemental income of ₱4,625.83 per month. Chicken and hog raising are common agriculture-based livelihood of the fishers, which provides supplemental income to 26 households amounting to ₱5,705.77 per month. The other sources of income are wages from labor, preparation of gears, business and vegetable production, rice production, business, overseas remittance, siblings and children, and vegetable production. It was also revealed by 99 respondents that the transfer payments from 4Ps, pension, and unconditional cash transfer provide supplemental income for the household.

Considering the differences in the sources of income and household size of the respondents in the study, the mean and median per capita income was estimated and is presented in Table 10. Income from sources aside from fishing constitutes ₱5,550 of the total household income, while only ₱5,450 can be attributed to fishing activities. This result, however, should not be used to characterize the entire coastal barangay because of the limited sample size. The sampling that was performed is intended to provide a picture of the poverty situation in coastal communities in Asid Gulf and not for each municipality surrounding the gulf. ₱2,257 is the per capita poverty threshold per month, according to the Family Income and Expenditure Survey for a household with five members. Using this threshold, it can be seen that 64% of the households in Asid Gulf are poor. This is high compared to the average poverty incidence in Masbate, which slightly reduced from 33% in 2015 to 29.4% in 2018. The baseline poverty threshold is higher compared to the 42% baseline of the FishCORAL project. Nonetheless, this figure can be used for monitoring activities as the project progresses to be able to establish trend and provide estimate of the project's impact.

Table 10. Average annual per capita income and poverty incidence per covered municipality, Asid Gulf: 2019

Municipality	Sample size*	Mean annual per capita income		Median annual per capita income		Poverty incidence
		All sources	Fishing only	All sources	Fishing only	
Balud	53	13,594.81	7,086.11	8,725.00	3,280.00	72%
Cawayan	25	7,104.00	4,759.20	7,100.00	5,000.00	76%
Esperanza	55	14,594.11	9,087.86	10,075.00	5,625.00	53%
Milagros	57	28,413.67	14,115.67	14,200.00	9,660.00	61%
Placer	60	12,924.10	8,356.89	9,800.00	7,200.00	65%
Total	**250**	**16,492.89**	**9,247.11**	**10,000.00**	**5,450.00**	**64%**

*Sample size differs from 257 because of non-disclosure of income by 7 respondents.

CONCLUSION

The growth of the fisheries sector in Asid Gulf is constrained by several problems despite the increasing volume of fish caught in the province, based on official statistics. These problems include aging fishers relative to the national average, unsecured property rights, limited access to proper water and sanitation facilities, and over-all above-dismal poverty situation compared to provincial statistics. On the other hand, there were improvements in access to public health services, availability of assets for information dissemination, and alternative sources of livelihood that can potentially be utilized to boost the fisheries sector by providing alternative sources of income through value addition to lessen the pressure of overexploitation of coastal resources to support the growing population.

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LIVELIHOOD PROFILE OF COASTAL COMMUNITIES IN ASID GULF

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ABSTRACT

The sociodemographic and economic characteristics of the coastal communities in Asid Gulf were studied to provide useful baseline information. Lessons were drawn from 257 samples from 57 barangays in five municipalities in Masbate facing Asid Gulf though a sample survey. Results revealed that the fishing and farming activities are primarily performed by the male members of the household. Women are involved in fish processing and preparation of fishing gears. Bottom-set gill net, simple handline/hook and line, drift gill net, fish/crab/squid pots, scoop net with light, and bottom-set long line are the common fishing gears used by the fishers in Asid Gulf. They spend for fuel, food, consumables, and repair of fishing gears for every trip. Fishers have moved away from the traditional subsistence fishing and have become more market-oriented by selling fish to their neighbors, assemblers, and in local markets. However, fishing as the primary source of income is insufficient for the household to move out of poverty. Additional livelihood opportunities through training and provision of complementary inputs are necessary to address the income gap of the households in Asid Gulf.

Keywords: livelihood assessment, FishCORAL, Asid Gulf

INTRODUCTION

Asid Gulf is one of the sources of fresh fish in the Philippines. It covers an area of 619 hectares, which makes it the eighth largest gulf in the country (PSA, 2019). The gulf is bounded on the north, east, and west by the province of Masbate. The population density of the province was 171 persons/km^2 according to the 2000 census and increased to 216 persons/km^2 in the 2015 census (PSA, 2016). This figure is below the regional average population density of 320 persons/km^2 and the national average population density of 337 persons/km^2 in 2015. The increase in population density puts pressure on the natural

Figure 1. Map of Asid Gulf showing municipal waters

resources to provide food for the growing number of people. This can be observed in the decreasing fisheries production in Masbate from 707,668 metric tons in 2002 to 58,461.55 metric tons in 2015 (PSA, 2018). More recent data from the Philippine Statistics Authority show that fisheries production continues to increase from 60,959.51 metric tons in 2016, to 65,494.99 metric tons in 2017, and 63,620.25 metric tons in 2018.

The population dependent on farming and fishing belong to the vulnerable groups. Although they serve as the country's lifeline in ensuring food security, farmers and fishers are the top sectors with an alarming poverty incidence of 38.3% and 39.2%, respectively (PSA 2012). Existing documents attribute this to big family size and low educational level (Reyes et al., 2012). Depletion of fish stocks and the continuing deterioration of the coastal habitats have also been demonstrated to be the cause of dismal economic status of fishing families. To address the alarming poverty incidence in fishing communities, as well as protect and conserve coastal resources, the Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR) launched the Fisheries, Coastal Resources, and Livelihood (FishCORAL) Project. This United Nations International Fund for Agricultural Development (UN-IFAD)-funded project prioritizes 11 target fishing grounds to enable coastal communities to sustainably manage their fishery and coastal resources, as well as generate livelihood benefits for fishing households. At the end of the project, it is expected that poverty incidence in the coastal communities will be reduced by 5% from the baseline of 42%, child malnutrition will be reduced by 4% from the baseline of 24.4%, and employment of women shall increase to 40% from the baseline of 20%. The project also intends to increase the annual income of fishing households by 10% and asset ownership by 20%, based on the baseline to be identified at the local level.

This study intends to describe the livelihood profile of coastal communities in Asid Gulf. Specifically, the paper aims to:

1. describe the participation of male and female household members in economic activities,
2. identify fishing inputs particularly the fishing gears used and cost of inputs per trip,
3. document marketing practices of fishery products, and
4. estimate household income from fishing and other sources.

METHODOLOGY

This research employed the descriptive research method through the conduct of a sample survey in identified project sites of FishCORAL. This section presents the population where the samples were identified, method of data collection, and method of data analysis.

Population and sample. According to the 2019 FishR data of the Bureau of Fisheries and Aquatic Resources Region V, there are 8,062 registered fishers that are involved in capture fisheries in the municipalities of Balud, Milagros, Cawayan, Placer, and Esperanza. They are distributed in 53 coastal barangays. The sample size was 265 households based on a 95% confidence level (Z=1.96), with a margin of error of 0.0602 and a sample proportion of 0.5. For each barangay, there was a target of five households. However, the study only covered 257 study-participants, which is equivalent to 97% of the target sample size, because of (1) outright refusal to be interviewed and (2) no qualified respondent in the household as the fishing household member already abandoned fishing as source of livelihood or no one is really engaged in fishing. The number of respondents per municipality is presented in Table 1.

Table 1. Coastal barangays covered along Asid Gulf: 2019

Municipality	Coastal Barangays	No. of Respondents
Balud	Baybay (Lumocab), Bongcanaway, Calumpang, Casamongan, Jangan, Jintotolo, Panguiranan, Pulanduta, GuinyanganDiotay, Salvacion, and San Antonio de Padua	55
Cawayan	Begia, Divisoria, Mahayahay, Naro, and Poblacion	25
Esperanza	Agoho, Domorog, Iligan, Labangtaytay, Libertad, Masbaranon, Poblacion, Potingbato, Rizal, Santiago, Sorosimbajan, and Villa	56
Milagros	Bangad, Bara, Calumpang (Taisan), Capaculan, Jamorawon, Magsalangi, Narangasan, Pamangpangon, Poblacion East, Poblacion West, Sawmill, and Tigbao	60
Placer	Camayabsan, Daanglungsod, Daraga, Guin-Awayan, Katipunan, Luna, Nagarao, Nainday, Naocondiot, Pasiagon, Quibrada, Taboc, and Villa Inocencio	61
	Total Respondents	**257**

Method of data collection. The research instrument used in this study was patterned after the Participatory Coastal Resource Assessment Training Guide developed by Deguit et al. (2004). The questionnaire was pre-tested in Sto. Domingo, Albay on March 2-3, 2019 before it was refined through the assistance of FishCORAL Technical Committee members. The training of the field interviewers immediately followed. To facilitate the data collection, coordination with the municipal and barangay officials was done prior to the activity. Then, simultaneous data collection was conducted. The questionnaire utilized in the study was divided into eight parts: (1) socio-demographic profile, (2) household members, (3) property ownership, (4) economic characteristics, (5) coastal resources management, and (6) community involvement.

Each field interviewer was assigned to conduct face-to-face interviews with the respondents for approximately 25-30 minutes. In each barangay, the purok with the greatest number of fishers was selected as the sampling unit. With the assistance of the assigned barangay official, households were randomly selected with an interval of one household after each qualified household. Replacements were done in cases of outright refusal or when there was no member engaged in fishing. In cases when the member of the household primarily engaged in fishing activities was not available during the day of the visit, other members "directly or personally and physically engaged in taking and/or culturing and processing fishery and/or aquatic resources" (R.A. 8550) served as the respondent. Data collection was conducted in June-August 2019.

Method of data analysis. The data were analyzed using descriptive statistics. For the socio-demographic characteristics, frequency and percentage distribution were illustrated using figures and tables. Income and expenditure data, on the other hand, were reported using mean and range as numerical measures.

Figure 2. Photo documentation during data collection in Asid Gulf

RESULTS AND DISCUSSION

This section is divided into five parts: participation of males and females in household economic activities, fishing inputs, marketing of products, household income, and trainings attended by household members.

Participation of males and females. Fishing, being the primary livelihood activity in coastal communities, is a male-dominated activity. Almost all (99.10%) of the household members engaged in fishing are male. Among them, 216 or 84.05% have at least 10 years of experience in fishing. They have been engaged in fishing since they were 10 years old. Preparing gears for fishing is also primarily performed by male household members (92.91%). There are only nine respondents who reported that female members of their household also perform these activities. Fish processing, particularly drying, is performed by both sexes with 82.22% of males and 17.78% of females performing the activity. Gleaning, as an activity to provide supplemental food for the household, is primarily performed by males as reported by 15 respondents.

Animal and crop production are also supplemental livelihood activities of the households. There are 23 households that are involved in backyard raising of chickens and pigs. Out of the 23 households, 86.99% have male household members engaged backyard raising while 13.04% have female household members who are engaged in the same activity. Crop production, such as rice and corn farming, vegetable production, and root crop production are minor supplemental livelihood activities of the households as reported by 12 respondents. Similar to fishing, these activities are also male dominated. Lastly, only three respondents reported that they are engaged in small-scale business.

Table 2. Distribution of respondents by nature of activities performed by male and female household members, Asid Gulf: 2019

Nature of Activities	Male		Female	
	Freq.	Percent	Freq.	Percent
Fishing				
Fish capture	220	99.10	2	0.90
Preparing gears for fishing	118	92.91	9	7.09
Processing/drying of fish	37	82.22	8	17.78
Gleaning	15	100.00	0	0.00
Farming (animal production)				
Backyard raising	20	86.96	3	13.04
Feedlot fattening	9	90.00	1	10.00
Ranching/carabao raising	2	100.00	0	0.00
Farming (crop production)				
Rice/corn farming	5	100.00	0	0.00
Vegetable production	3	100.00	0	0.00
Root crop production	2	100.00	0	0.00
Other income-generating activities				
Small-scale business	3	60.00	2	40.00

Fishing inputs. Bottom-set gill net is the most common fishing gear used by the fishers in Asid Gulf as reported by 124 respondents (see Table 3). Only 82.26% of the respondents own their bottom-set gill net, while 19.35% share the fishing gear with other fishers. Simple handline/hook and line is also a common fishing gear as reported by 48 respondents. Among them, 87.20% own the fishing gear while the remaining five respondents use shared or leased fishing gear. Fish/crab/squid pots, scoop net with light, and bottom-set long line are also used by the respondents.

Table 3. Distribution of respondents by type and ownership of fishing gear, Asid Gulf: 2019

Fishing Gear	No. of HH Reporting	Ownership					
		Owned		Shared		Leased	
		Freq	%	Freq	%	Freq	%
Bottom-set gill net	124	102	82.26	24	19.35	2	1.61
Simple handline/hook and line	48	42	87.50	4	8.33	1	2.08
Drift gill net	19	15	78.95	1	5.26	4	21.05
Fish/crab/squid pots	11	9	81.82	2	18.18	0	0.00
Scoop net with light	4	4	100.00	0	0.00	0	0.00
Bottom-set long line	9	9	100.00	0	0.00	0	0.00

Fuel is the most common expenditure incurred by the fishers. This amounts to ₱303.36 per trip for at least six liters of fuel per trip (see Table 4). Fishers also spend for food (₱66.96 per trip) and consumables, such as cigarettes (₱85.92 per trip), every time they go fishing. Repair of fishing gears and boats usually costs ₱5,084.29 per repair. It was also reported that 16 fishers rent boats amounting to ₱426.25 per trip.

Table 4. Distribution of respondents by average expenditure per trip, Asid Gulf: 2019

Expenditure per trip	No. of HH Reporting	Total Expenditure	Average Expenditure
Fuel	203	61,582.60	303.36
Food	123	8,236.00	66.96
Consumables (e.g., cigarettes)	78	6,702.00	85.92
Repair	70	355,900.00	5,084.29
Boat rental	16	6,820.00	426.25

Marketing of products. The fishing industry in Asid Gulf is market driven. Fishers moved away from the traditional subsistence fishing, in which they caught fish to sustain the need for food of their families. Seventy-eight percent of the respondents catch fish that are intended to be sold for cash (see Table 5). The proceeds are then used to buy other food, such as rice, meat, and vegetables; pay for utilities; and repair fishing gears. Only six respondents reported that they catch fish primarily for household consumption, while 16.73% of the households catch fish for sale and household consumption.

Table 5. Distribution of respondents by utilization of fish caught, Asid Gulf: 2019

Marketing of fish catch	Frequency	Percent
Sold	201	78.21
Household consumption	6	2.33
Both	43	16.73
No response	7	2.72
TOTAL	**257**	**100**

Among the respondents, 64.95% of husbands and 20.62% of wives sell fish. Fish catch are sold to neighbors immediately after the boat touches the shore as reported by 44.36% of the respondents. Upon arrival of the boat, the neighbors line up to see the fish caught by the fishers. Assembler-wholesalers or *bagsakan* is also a common market outlet of fishers, which accounts for 22.57% of the reported marketing agent to whom the fishers sell their catch. Aside from neighbors and bagsakan, 14.4% of the fishers sell their catch to middlemen and 13.62% to the local market, in which the household members act as retailers.

Table 6. Distribution of respondents by immediate market of fish caught, Asid Gulf: 2019

To whom the catch is sold	Frequency	Percent
Neighbors	114	44.36
Bagsakan	58	22.57
Middleman	37	14.40
Local market	35	13.62
No response	13	5.06
TOTAL	**257**	**100**

Household income. Considering the differences in the sources of income and household size of the respondents in the study, the mean and median per capita income was estimated and is presented in Table 10. Income from sources aside from fishing constitutes ₱5,550 of the total household income, while only ₱5,450 can be attributed to fishing activities. This result, however, should not be used to characterize the entire coastal barangay because of the limited sample size. The sampling that was performed is intended to provide a picture of the poverty situation in coastal communities in Asid Gulf and not for each municipality surrounding the gulf. ₱2,257 is the per capita poverty threshold per month, according to the Family Income and Expenditure Survey for a household with five members. Using this threshold, it can be seen that 64% of the households in Asid Gulf are poor. This is high compared to the average poverty incidence in Masbate, which slightly reduced from 33% in 2015 to 29.4% in 2018. The baseline poverty threshold is higher compared to the 42% baseline of the FishCORAL project. Nonetheless, this figure can be used for monitoring activities as the project progresses to be able to establish trend and provide estimate of the project's impact. Among the municipalities covered in the research, Cawayan has the highest reported poverty incidence of 76% followed by Balud (72%), Placer (65%), Milagros (61%), and Esperanza (53%).

Table 7. Average annual per capita income and poverty incidence per covered municipality, Asid Gulf: 2019

Municipality	Sample size*	Mean annual per capita income		Median annual per capita income		Poverty incidence
		All sources	Fishing only	All sources	Fishing only	
Balud	53	13,594.81	7,086.11	8,725.00	3,280.00	72%
Cawayan	25	7,104.00	4,759.20	7,100.00	5,000.00	76%
Esperanza	55	14,594.11	9,087.86	10,075.00	5,625.00	53%
Milagros	57	28,413.67	14,115.67	14,200.00	9,660.00	61%
Placer	60	12,924.10	8,356.89	9,800.00	7,200.00	65%
Total	**250**	**16,492.89**	**9,247.11**	**10,000.00**	**5,450.00**	**64%**

*Sample size differ from 257 because of non-disclosure of income of 7 respondents.

Training attended by households. While fishing is the primary source of livelihood in Asid Gulf, there were initiatives to capacitate the people to explore alternative sources of income to lessen the pressure on the ability of the natural resources to sustainably provide for the food and economic needs of the people. The trainings provided to the household members by external organizations were planting of mangroves and corals (11.67%), fish processing (9.34%), seaweed production (8.56%), and mud crab culture (1.17%; see Table 8).

Table 8. Distribution of respondents by trainings attended, Asid Gulf: 2019

Trainings Attended	Frequency	Percent
Planting of mangroves and corals	30	11.67
Fish processing	24	9.34
Seaweed production	22	8.56
Culturing of mud crabs	3	1.17
Others	9	3.50

These trainings provide additional knowledge for the members of the fishing households to potentially engage in alternative livelihood activities, not only to supplement their income but also to reduce dependence on the gulf while it recuperates from damage caused by natural calamities and anthropogenic activities.

CONCLUSIONS AND RECOMMENDATIONS

None of the municipalities surrounding Asid Gulf has a mean per capita income from fishing higher than the poverty threshold of ₱2,257 per capita per month or ₱27,084 per capita per year. Considering all income sources, only the respondents from Milagros have a mean annual per capita income of ₱28,413.67, which is higher than poverty threshold. This implies that even with other sources of income aside from fishing, supplemental income from other sources is insufficient for an average fishing household to move away from the poverty threshold. The trainings related to value addition and very low level of participation of women in livelihood activities can be considered as opportunities to engage them in fish processing, seaweed processing, and mud crab culture. This should be complemented by the provision of equipment and other necessary inputs for people to start their businesses. Agriculture should also be promoted through the provision of farm animals, such as chicken and pigs, to provide additional income for the household.

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COASTAL RESOURCES MANAGEMENT BASELINES IN ASID GULF, MASBATE

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ABSTRACT

This study sought to provide coastal resource management (CRM) baseline information in Asid Gulf, Masbate. There were 257 households randomly selected from the 53 covered barangays facing Asid Gulf that were involved in the study. The results revealed that the majority of the fishing households perceived that the previous years were better in terms of fish size and abundance. Dynamite fishing was reported as the most common illegal fishing practice in the area. Although most of the households perceived that CRM projects were effective and that the enforcement of policies was good, few households are aware of the existing CRM projects and policies being implemented in the coastal communities. Thus, to increase the awareness and participation in CRM of the fishing households, efforts must be intensified through information drive campaigns, intensive monitoring and evaluation of the existing CRM projects, livelihood assistance, crafting of policies through legislation, law enforcement, organizational strengthening of the fisherfolk organizations, tapping the 4Ps beneficiaries to be involved in CRM projects, and giving recognition to local government units with outstanding CRM practices.

Keywords: *Asid Gulf, coastal resource management, PRSA, FishCORAL*

INTRODUCTION

The concept of coastal resource management (CRM) was introduced to coastal communities under the threat of negative effects of habitat and watershed degradation, overfishing, destructive fishing, and pollution. These effects were worsened further because of the lack of access to basic services, institutional support, and alternative income-generating activities. As a result, a number of fishing households in the Philippines are living below the poverty line. Recognizing the great benefit Filipinos are getting out of coastal and marine resources, the government implemented numerous CRM projects. Funded by either grants or loan, these projects targeted the deteriorating quality of water and the coastal habitats, declining fish catch, weak socio-political or policy infrastructure, and the worsening poverty among fisherfolks.

In 2015, the government, though the Bureau of Fisheries and Aquatic Resources (BFAR) forged a five-year agreement with the International Fund for Agricultural Development to address the emerging concerns on poverty incidence in poor coastal communities in the country. The Fisheries, Coastal Resources, and Livelihood Project of the FishCORAL Project was launched. It was expected to attain two outcomes: (1) fishing communities adopted sustainable management of fishery and coastal resources and (2) income of fishing households in target coastal communities increased through sustainable engagement in diversified livelihood activities. It had three components, namely (1) CRM, (2) livelihood development, and (3) project management and coordination.

For the third component, in particular, a rapid participatory resource and social assessment (RPRSA) was carried out. This was meant to provide baseline information on the conditions of the coastal and fishery resources, and will be used as basis for the project's impact evaluation after its implementation. The results of the RPSA will be used for planning by the local government units and BFAR. The RPRSA covers four assessment components, namely (1) socio-economic assessment (SEA), (2) aquatic ecology and coastal habitat assessments, (3) water quality assessment, and (4) capture fisheries resources assessment. The first assessment component covers the following three studies: (1) socio-demographic, economic, institutional, and policy baselines; (2) documentation and evaluation of the livelihood; and (3) CRM baselines.

Among the beneficiary fishing grounds included in the coverage area of the FishCORAL Project in the Philippines is the Asid Gulf in Masbate. Hence, this study covers only the assessment of CRM under the SEA component of RPRSA. It assessed the awareness and perception of the fishing households in the coastal barangays along Asid Gulf on governance, legislation, and law enforcement in terms of the following: (1) existing CRM projects and activities for the protection, conservation, and rehabilitation of the gulf's resources and (2) existing laws and ordinances being implemented in the covered fishing community areas.

OBJECTIVES

The study provides an assessment of the baseline data of households engaged in fishing along Asid Gulf. Specifically, the paper intends to:

1. Provide coastal resource management baseline data along Asid Gulf, and
2. Assess the extent of implementation of existing projects and policies related to coastal resource conservation and protection in the coastal barangays covered.

METHODOLOGY AND MATERIALS

This section describes the population and sample, as well as the method of data collection and analysis used throughout the study.

Population and sample

The study covered 53 coastal barangays in five municipalities along Asid Gulf. Each barangay was represented by five randomly selected respondents who belong to a fishing household. Thus, the expected total number of fisher-respondents was 265. However, the study only covered 257 study-participants, which was equivalent to only 97% of the target sample size, because of (1) the outright refusal to be interviewed and (2) the absence of qualified respondent in the household as the fishing household member already abandoned fishing as source of livelihood or no one is really engaged in fishing.

Table 1. Coastal barangays covered along Asid Gulf, 2019

Municipality	Coastal Barangays	No. of coastal barangays covered	Number of Respondents
Balud	Baybay (Lumocab), Bongcanaway, Calumpang, Casamongan, Jangan, Jintotolo, Panguiranan, Pulanduta, Guinyangan Diotay, Salvacion, and San Antonio de Padua	11	55
Cawayan	Begia, Divisoria, Mahayahay, Naro, and Poblacion	5	25
Esperanza	Agoho, Domorog, Iligan, Labangtaytay, Libertad, Masbaranon, Poblacion, Potingbato, Rizal, Santiago, Sorosimbajan, and Villa	12	56
Milagros	Bangad, Bara, Calumpang (Taisan), Capaculan, Jamorawon, Magsalangi, Narangasan, Pamangpangon, Poblacion East, Poblacion West, Sawmill, and Tigbao	12	60
Placer	Camayabsan, Daanglungsod, Daraga, Guin-Awayan, Katipunan, Luna, Nagarao, Nainday, Naocondiot, Pasiagon, Quibrada, Taboc, and Villa Inocencio	13	61
Total		**53**	**257**

Method of data collection

To facilitate the data collection, coordination with the municipal and barangay officials were done prior to the activity. Then, simultaneous data collection was conducted by the team. The questionnaire utilized in the study was divided into eight parts: (1) socio-demographic profile, (2) household members, (3) property ownership, (4) economic characteristics, (5) coastal resources management, and (6) community involvement. Using the structured questionnaire approved by the FishCORAL Technical Committee of the Bureau of Fisheries and Aquatic Resources Regional Office V, each field interviewer was assigned to conduct face-to-face interviews with the respondents, which lasted for 25-30 minutes. For each barangay, the purok with the greatest number of fishers was selected as the sampling unit. With the assistance of the assigned barangay official, households were randomly selected with an interval of one household after each qualified household. Replacements were identified in cases of outright refusal or when there was no member engaged in fishing. In cases when the member of the household primarily engaged in fishing activities was not available during the day of the visit, other members "directly or personally and physically engaged in taking and/or culturing and processing fishery and/or aquatic resources" (R.A. 8550) served as the respondent.

Method of data analysis

After each interview the field enumerator checked the questionnaire, including the qualitative responses, for logical consistency and readability. The filled-out questionnaires were surrendered to the study leaders for rechecking. The responses were summarized using frequency and percentage distribution, which were presented in tables and figures.

RESULTS AND DISCUSSION

This section provides the descriptive statistics of the socio-demographic profile of the respondents. Details on the characteristics of the study participants include the age structure, sex composition, marital status, and highest educational attainment. Meanwhile the occupational status of the respondents is illustrated in Figure 1. For the purpose of this study, the term "respondents" was used interchangeably with "study participants" and "interviewees."
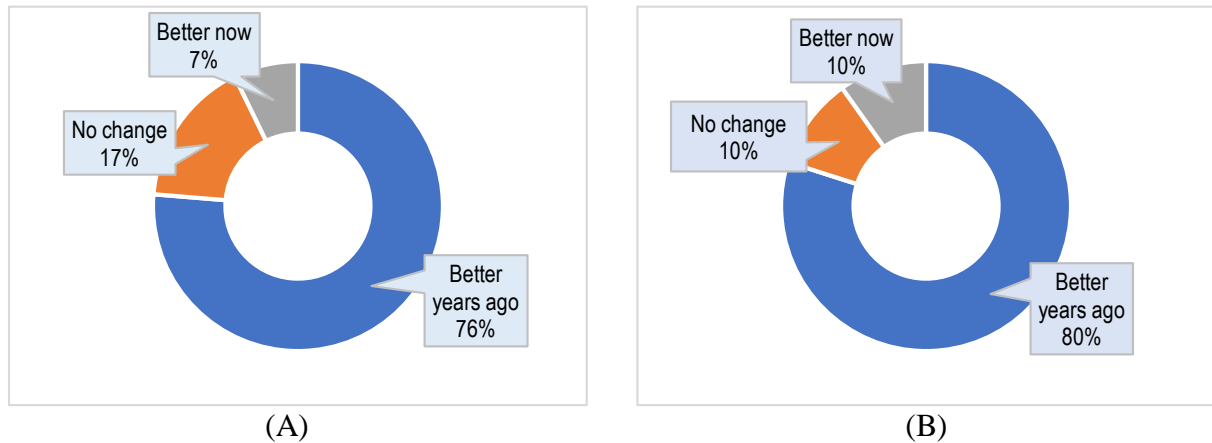
Figure1. Observed differences between the present and the past (five years ago) with regard to fish size (A) and abundance (B) in Asid Gulf, 2019

Observed differences between the present and the past (five years ago) with regard to fish size and abundance

As shown in Figure 1, 76% of the study participants believed that fish were larger in the past five years than the present year, while only 7% said otherwise. However, 17% believed that there was no change in fish size. For fish abundance, the results show that the perception of study participants were very similar with the opinion on fish sizes. Eighty percent observed that fish was more abundant in the past five years than at present, while only 10% believed that fish is more abundant today. Meanwhile, 10% believed that there is no change in fish abundance.

When asked why fishing was better five years ago, most of the study participants answered that there was less competition among fishermen and there was only a limited number of big fishing vessels back then. It can then be presumed that the population of Asid Gulf was smaller five years, so there were fewer fishers. As time passed, the number of fishers gradually increased. Those who said that they have bigger catch at present than in the past years before attributed the situation to the new technologies in fishing. They have adopted these modern technologies, which—according to them—resulted in less incidence illegal fishing Asid Gulf.

Biggest problems in fishing in Asid Gulf

In relation to observed changes in fish sizes and abundance in Asid Gulf, the study participants were asked to name at least three biggest problems in fishing, as well as their possible causes and solutions. Table 2 summarizes the responses of the study participants. It shows that illegal fishing was identified by 35% of the study participants as the biggest problem in Asid Gulf. This was followed by weather disturbances (31%) and intrusion of commercial fishing vessels (10%). These constitute the top three biggest problems observed in Asid Gulf in 2019. The study participants suggested as possible solutions the strict enforcement of laws and ordinances, as well as the provision of livelihood assistance

to fishers. This assistance may come in the form of provision of fishing gears and the conduct of capacity-building programs.

Table 2. Biggest problems in fishing in Asid Gulf, 2019

Biggest problems in fishing	Frequency	Percent
Illegal use of destructive fishing practices	62	35%
Weather disturbances	54	31%
Intrusion of commercial fishing vessels	17	10%
Damaged fishing gears	15	8%
Few catch	12	7%
Lack of fishing gears	10	6%
Improper waste disposal	2	1%
Others	5	3%
Total	**177**	**100%**

Observance of destructive fishing methods

Since destructive fishing practices is identified as the biggest problem with fishing in Asid Gulf, it is meaningful to determine its frequency of observation. As shown in Table 3, destructive fishing methods is really a prevalent problem in the gulf. A majority of the study participants (53%) have observed that there are fisherfolks who are performing illegal fishing methods in Asid Gulf. There were respondents who refused to give feedback (12%). Asked why some people engage in illegal fishing, the respondents said that it is the easiest way to catch more fish and obtain bigger income for the family.

Table 3. Observance of destructive fishing methods in Asid Gulf, 2019

Observance of destructive fishing methods	Frequency	Percent
Yes	135	53%
No	92	36%
No Response	30	12%
TOTAL	**257**	**100%**

These destructive fishing practices observed in Asid Gulf are summarized in Table 4. Dynamite fishing (44%) is the most prevalent destructive fishing method identified in the gulf, followed by trawl fishing or *palupad* (18%), the use of fine mesh net or *baling-baling* (17%), danish seine fishing or *hulbot-hulbot* (6%), compressor fishing (6%), cyanide fishing (2%), and commercial fishing or the intrusion of commercial fishing vessels (2%). These activities are destructive to coral reefs and marine habitats. Commercial fishing vessels are prohibited in most of Asid Gulf because it is comprised of municipal waters. These imply that illegal fishing activities in Asid Gulf are common and prevalent.

Table 4. Observed destructive fishing methods in Asid Gulf, 2019.

Destructive Fishing Methods	Frequency	Percent
Dynamite fishing	78	44%
Trawl fishing or p*alupad*	33	18%
Fine mesh net or *baling-baling*	30	17%
Danish seine fishing or *hulbot-hulbot*	11	6%
Compressor fishing	10	6%
Cyanide fishing	3	2%
Commercial fishing	3	2%
Others	11	6%

Note: Values may not add to totals due to multiple responses

National government agencies have key mandates in the intricate coastal resource management (CRM) process. This is carried out as support infrastructure to local governments since they have an important role in the management of municipal waters by virtue of the Local Government Code (RA 7160). The participation of private sector stakeholders can form part of the management community and is essential in all facets of CRM.

According to the respondents, there are seven identified people's organizations and agencies that are involved in community development in the costal barangays along the Asid Gulf. There are fisherfolk organizations operating in most of the coastal barangays. The agencies involved are the municipal local government units (MLGUs), Bureau of Fisheries and Aquatic Resources (BFAR), Department of Social Welfare and Development, Philippine Coconut Authority, Department of Agrarian Reform, and financial institutions, such as CARD Bank, among others.

Level of effectiveness of existing projects/activities for the protection, conservation, and rehabilitation of resources in the coastal barangays along Asid Gulf

Among the projects commonly implemented in the coastal barangays of Asid Gulf that are meaningful for CRM planning are mangrove tree planting, establishment of fish sanctuaries, mud crab culture, and seaweed farming. These are carried out by the fisherfolk organizations, BFAR, and the MLGUs. Table 5 summarizes the projects and activities for the protection, conservation, and rehabilitation of resources in the coastal barangays along Asid Gulf in 2019 and the level of effectiveness perceived by the study participants for each project and activities. Out of the 257 study participants interviewed, only 28 were aware of the existing alternative livelihood projects being implemented in their area, 20 were aware of the existing resource conservation projects, 21 were aware of law enforcement issues, seven were aware of Marine Sanctuary and Fisheries Reserve (MSFR) establishment, and four were aware community organizing efforts. This implies that there is still a need to intensify the awareness of the fishing households on the projects and activities for the protection, conservation, and rehabilitation of resources being implemented in their communities.

Table 5. Level of effectiveness of existing projects/activities for the protection, conservation, and rehabilitation of resources in the coastal barangays along Asid Gulf, 2019

Projects/Activities	No. of households aware	Level of Effectiveness				
		Very Effective	Effective	Moderately effective	Ineffective	Very Ineffective
Alternative livelihood	28	12	11	1	4	0
Resource conservation	20	11	4	3	1	1
Law enforcement	21	6	10	2	1	2
MSFR establishment	7	2	2	3	0	0
Community organizing	4	0	1	1	1	1
Others	3	2	0	1	0	0
Total	**86**	**35**	**28**	**12**	**7**	**4**

The study participants were also asked to assess the level of effectiveness of the existing CRM projects or activities in their communities. Figure 2 presents the level of effectiveness of the existing CRM projects in Asid Gulf in 2019. Among the identified CRM projects, resource conservation has the highest effectiveness rating with 4.2, followed by alternative livelihood with 4.1, MFRS with 3.9, law enforcement is only at 3.8, and community organizing with only 2.5. These data suggest that there is a need to intensify law enforcement and the awareness drives for fishery laws and regulations. More effort

and attention must also be given to community organizing activities as it has the lowest level of effectiveness among the identified CRM projects and activities in Asid Gulf.
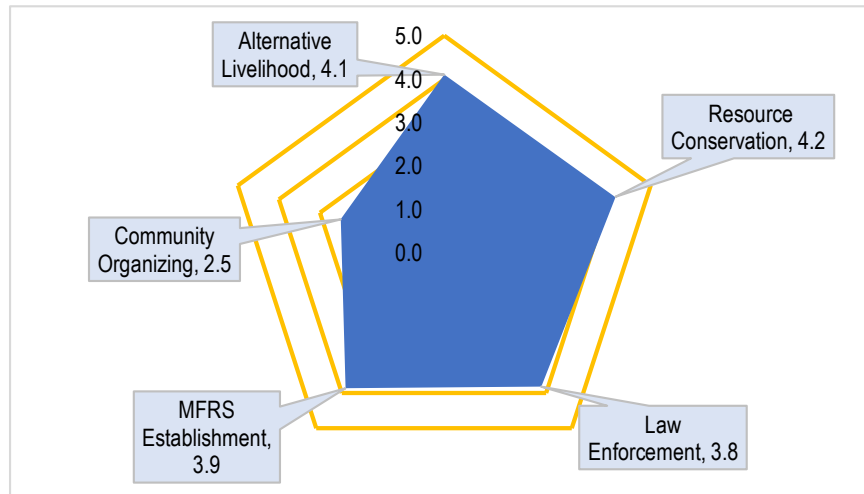
Figure 2. Effectiveness of the existing CRM projects and activities in Asid Gulf, 2019

To help them have alternative livelihoods, the study participants were provided fishing gears, such as *lamba t*and *pangke,* either from the MLGU or BFAR. Table 6 presents the common alternative livelihood projects or activities that were implemented in the fishing communities of Asid Gulf. Among the municipalities covered, only Cawayan has piggery as the most common alternative livelihood of the fishing households. Welding and seaweed farming were observed as the other alternative livelihood projects in Esperanza and Placer, respectively.

Table 6. Common alternative livelihood projects in the coastal barangays along Asid Gulf, 2019

Municipality	Common alternative livelihood projects
Balud	Provision of fishing gears (lambat, pangke)
Cawayan	Piggery
Esperanza	Provision of fishing gears (lambat, pangke) and welding
Milagros	Provision of fishing gears (lambat, pangke)
Placer	Provision of fishing gears (lambat, pangke) and seaweed farming

Level of enforcement of existing laws/ordinances related to coastal resource conservation in the coastal barangays along Asid Gulf

Table 7 shows the existing laws and ordinances related to coastal resource conservation and protection along Asid Gulf. These were assessed by the respondents based on their perceived enforcement. Out of the 257 study participants, 70% were aware of the laws and ordinances being implemented in their respective, barangays particularly those related to proper waste disposal. In a like manner, 69% were aware of the laws and ordinances pertaining to the illegal practice of destructive fishing practices. The respondents were also aware of the legislations protecting rare species (63%), banning the use of active fishing gears (51%), and establishing fishing seasons in municipal waters (21%).

As shown in Figure 3, most of the study participants perceived that the protection of rare or endangered species has a relatively stronger enforcement than the other laws or ordinances being implemented in Asid Gulf with a rating 4.1. On the other hand, there is also a good level of enforcement

for proper waste disposal with a rating of 3.9. This was followed by the legislation on illegal use of destructive fishing practices, with a rating of 3.7. The implementation of ordinances on the closed season for fishing in municipal waters and the illegal use of active fishing gears both had enforcement ratings of 3.6. These data suggest that the level of enforcement of laws and ordinances in Asid Gulf is generally good. However, there is still a need to maintain or even enforce the laws and ordinances in stricter ways so that illegal activities will be reduced.

Table 7. Level of enforcement of existing laws/ordinances related to coastal resource conservation in the coastal barangays along Asid Gulf, 2019

Laws/ Ordinances	No. of households aware	%	Enforcement Level				
			Very strong enforcement	Strong enforcement	Good enforcement	Weak enforcement	No enforcement
Proper waste disposal	180	70%	73	48	37	17	5
Illegal use of destructive fishing practices	178	69%	50	58	39	22	9
Protection of rare species	163	63%	74	45	31	10	3
Illegal use of active fishing gear	132	51%	36	43	29	15	9
Closed season fishing in municipal waters	53	21%	16	15	13	5	4
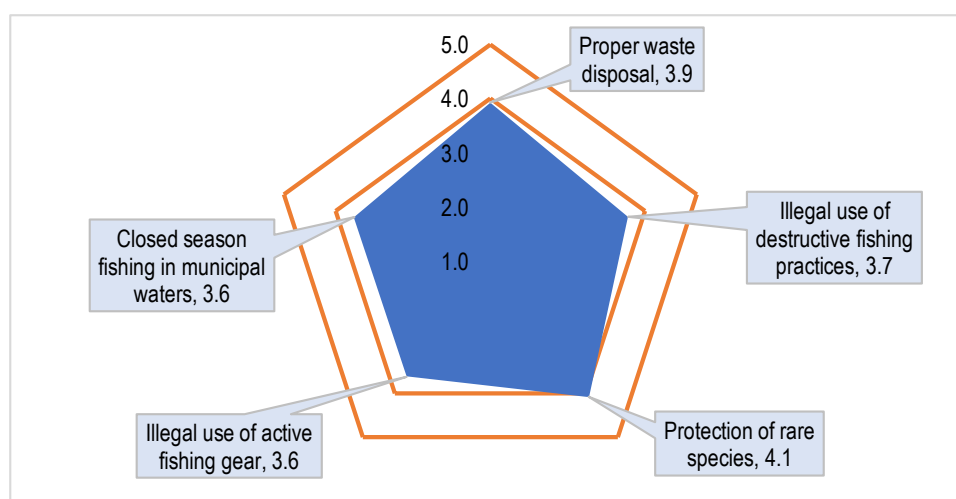
Figure 3. Enforcement of the existing laws/ordinances related to coastal resource conservation in the coastal barangays along Asid Gulf, 2019

CRM-related trainings attended by fishers

Part of the implementation of CRM in Asid Gulf is the conduct of capacity building activities through trainings and alternative livelihood assistance. Table 8 presents the list of CRM-related trainings attended by the study participants. Out of the 257 respondents, only 88 or 34% attested that they had attended CRM-related training. The majority (34%) of the study participants have attended various training programs on mangrove and coral planting. This was followed by fish processing with

27%, seagrass and seaweed planting with 25%, fiberglass making with 6%, mud crab culture with 3%, freshwater species culture with 1%, and aqua silviculture with 1%. The data imply that concerned local authorities must encourage more fishing households to participate in various CRM training projects. Additionally, local authorities must exert more effort and resources to involve more fishers in capacity building and livelihood trainings.

Table 8. Trainings attended by fishers on CRM in the past five years

Trainings Attended	Frequency	Percent
Planting of mangroves and corals	30	34%
Fish processing	24	27%
Seagrass and seaweed planting	22	25%
Fiberglass boat making	5	6%
Culturing of mud crabs	3	3%
Culturing of freshwater species	1	1%
Aqua silviculture	1	1%
Others	2	2%

Note: Values may not add to totals due to multiple responses

Recommendations of the fishers of coastal barangays along Asid Gulf for the protection, conservation, and rehabilitation of the gulf's resources

As shown in Table 9, out of the 203 study participants who gave their recommendations for the protection, conservation, and rehabilitation of Asid Gulf, about 78% recommended having stricter law enforcement because of illegal fishing activities present in the gulf. The study participants wanted to stop the various illegal fishing activities to protect and conserve the resources within Asid Gulf. The study participants (18%) also suggested having sustainable livelihood and rural enterprise development in their communities. Others recommended the provision of social infrastructure and local capability building with 3% and the provision of support facilities with only 1%.

Table 9. Recommendations of the fishers of coastal barangays along Asid Gulf for the protection, conservation, and rehabilitation of the gulf's resources, 2019

Recommendation	Frequency	Percent
Stricter law enforcement	159	78%
Sustainable livelihood and rural enterprise development	36	18%
Provision of social infrastructure and local capability building	6	3%
Provision of support facilities	2	1%
Total	**232**	**100%**

CONCLUSIONS

The study assessed the attributes of coastal resources management as perceived by the fishing households in coastal barangays along Asid Gulf in Masbate. The data on the perception of the difference between the present and the past with regard to fish size and abundance revealed that a majority of the households perceived that the situation in the past was better than today. In terms of the biggest problems in fishing, destructive fishing practices and weather disturbances were the top problems as perceived by the households. Among the destructive fishing methods observed in Asid Gulf were dynamite fishing, trawl fishing or *palupad,* and fine mesh net fishing or *baling-baling.*

On a positive note, resource conservation and law enforcement were perceived to be effective for the protection, conservation, and rehabilitation of resources in the coastal barangays along Asid Gulf. In a like manner, the households also perceived that the enforcement of existing laws and ordinances related to coastal resource conservation was generally good but needs to be intensified further. However, there is still a need to increase public awareness of the existing projects and activities for the protection, conservation, and rehabilitation of resources and the existing CRM laws and ordinances.

On top of public awareness, community participation was also low. Because of this gap, more efforts need to be done to achieve the intended ends of regulating the fisheries sector through CRM.

RECOMMENDATIONS

Given the abovementioned conclusions, the study recommends that the local authorities concerned address the existence of illegal and destructive fishing practices in Asid Gulf. The local government unit (LGU) may implement a verification scheme to validate the presence of illegal fishing practices in the coastal barangays along the gulf, and strictly enforce existing laws and ordinances. In general**,** the political environment plays an important role in the attainment of effective coastal resource management (CRM) initiatives in the gulf through legislations.

Intensive information drives, as well as monitoring and evaluation of existing CRM projects and activities, are also essential to increase the awareness and participation rate of fishing households in protecting and conserving costal resources. To reach more fishing households who will be benefited by CRM projects, the study recommends the intensification of capacity-building and alternative livelihood assistance for the fisherfolk organizations through partnerships with national line agencies and other assisting organizations. In addition, the fisherfolk organizations, being community partners in CRM projects, must be strengthened in terms of their organizational and economic capacity, as well as their community involvement, to enhance community participation. There is also a need to assist other fisherfolks who want to be organized as an accredited people's organization and make them functional and active.

Tapping the 4Ps beneficiaries can also be a viable option to enhance community participation in terms of engaging them in CRM projects and activities. They can be provided with incentives, like livelihood assistance. Giving recognition to LGUs with best practices for coastal and fishery resource management is also recommended to increase awareness and, at the same time, improve the local implementation and sustainability of CRM.

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STATUS OF CORALS AND CORAL REEF FISHES IN ASID GULF

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Milagros, Masbate

ABSTRACT

This study can be considered as the first comprehensive assessment specific for Asid Gulf. Its 2,261-km^2 area is predominantly municipal waters (91%) and this is protected (1.51%) by the 14 marine protected areas (MPAs) spanning an area of 3,113.13 hectares. This is below the 15% prescribed under RA 8550 and the 25-40% under the Masbate Environment Co

de. Coral reefs inside the MPAs are mostly poor to fair, while a reference non-MPA station nearby is fair to near good. Progressive deterioration of the reef can be gleaned from sporadic baselines made in 2001, 2013, and 2015. There was a proliferation of macroalgal beds encroaching the shallow denuded reef systems. This will have some serious implication on the recovery of the reefs. The reef fishes reported in 2017 were more abundant, more diverse, and denser than at present. The biomass estimates in Asid Gulf are comparably lower than estimates in other nearby Bicol locations. Fishes from major groups dominate fish abundance (72%), while target and indicator species are low (17% and 11%, respectively). The small number of fishes from target and indicator species may be an offshoot of intense fishing and damage to habitats. The earlier report that the reef fishes were mostly plankters, algal feeders, and are of low commercial value is still true, but a significant reduction of herbivores has been observed in the present study. There seems to be an imbalance now between the feeding groups as carnivores outnumber those at the lower trophic level. The low count of herbivore fishes will directly connect to the significant elimination of grazers by fishing and this could have partly caused the macro algal growth along reef systems. A review and revalidation of the location, as well as the extent of the MPAs is recommended alongside the improvement in the management of these MPAs.

Keywords: Asid Gulf, coral reef, reef fishes

INTRODUCTION

The establishment of marine protected areas (MPAs) is one of the most popular coastal resources management strategy implemented by many local government units in the Philippines (White et al., 2006). This is primarily intended to protect the remaining coral assemblages and the wealth of reef-associated fishes that were known to contribute 20% to the coastal fisheries production in the country (Alcala & Russ, 2002). However, fisheries and other human activities have inflicted damage to this critical habitat. Studies in from the 1970s to the 1990s estimated that sonly 4-5% of the remaining coral reef of the country were in excellent condition (Gomez & Alcala 1979; Licuanan & Gomez, 2000). Succeeding studies showed further deterioration. In fact, Carpenter et al. (2008) estimated extinction of near to one-third of reef-building coral species due to human impacts and climate change stressors. As an archipelagic state with a huge proportion of its population dependent on the resources of the sea, losing these reefs would mean further economic displacement in the Philippines. The little protection afforded to the reef systems further contribute to the high vulnerability of the country to loss of coral reefs (Burke et al. 2011).

Masbate lies at the center of the Philippine archipelago between latitudes 11°43' and 21°36' N, and longitude 123°09' and 124°15' E. Asid Gulf is bordered by five coastal towns from Jintotolo Island of Balud (in the southwest) through Milagros, Cawayan, Placer, and Esperanza (in the southeast) with a shoreline length of 142 kilometers. Approximately, it covers 2,664.34 km^2 of coastal and marine waters, 91.3% of which are municipal waters. It serves as the northern headwater of the very complex Visayan Sea. Of the 12 islets in Asid Gulf, four (Guinawayan, Chico, Naro, and Pobre) are technically protected areas as they were declared in 1981 as wilderness areas by virtue of Presidential Proclamation No. 2150. Through this proclamation, the islets formed part of the initial National Integrated Protected Areas System (NIPAS) categories designated prior to the passage of the NIPAS Act in 1992 (RA 7586, see Soliman et al., 2002). A decade later, a parcel of Naro Island was set aside and declared the Naro Island Wildlife Sanctuary (Proclamation No. 317) pursuant to the NIPAS Act.

By the late 1990s, nine MPAs were listed in the province of Masbate (Pajaro et al., 1999). Three of them are in the gulf and two are in Ticao Pass. Masbate passed its Provincial Environmental Code of 2001 by virtue of Provincial Ordinance No. 166. This mandates the declaration of "at least 25% to a maximum of 40% of the municipal waters as marine sanctuary and fishery reserves to be co-managed by the local government, Fisheries and Aquatic Resource Management Councils, and non-government and people's organizations." Soliman (2002) reported that around 12 additional MPAs were established in the municipal waters of Masbate as an offshoot of the environment code. Recently, there were at least 14 MPAs in Asid Gulf established for varied objectives like the protection of coral habitats and scallops. Here, Mendoza and Soliman (2018) reported low structure and biomass estimates of reef-associated fishes, which can be attributed to the poor quality of reef habitats. The huge sargassum beds invading reef systems were also noted, which were attributed to the overfishing of herbivorous fishes and invertebrates.

Asid Gulf is fairly well-studied, like Ragay Gulf, Lagonoy Gulf, and San Miguel Bay—all in the Bicol Region. Being located within the Visayan Sea, Asid was a part of the Visayan Sea Project in late the 2000s. It also became the venue of assessments under the ICRMP, implemented by Bicol University in collaboration with Silliman University. Likewise, it was also a monitored fishing ground for vital stocks for the National Stock Assessment Program.

The very recent Fisheries, Coastal Resources, and Livelihood (FishCORAL) Project was a very timely opportunity as it anticipated the need to update the bio-ecological foundation of fisheries for sustainable livelihood engagements. As part of the FishCORAL Project, the conduct of the Participatory Resource and Socioeconomic Assessment offers an opportunity to update the bio-physical and socio-economic information of the gulf. Considering climate change impacts today, the importance of the present assessments cannot be overemphasized.

This paper focuses on the assessment of coral reefs and the reef fishes in the MPAs and the known artificial reef systems in Asid Gulf. The 14 MPAs were established from 2001 to 2017 and do not include the NIPAS protected areas established earlier. The most recent were those in found in the southeastern wing of the island, namely Placer and Esperanza. The oldest were the scallop sanctuary in Cawayan (2004) and Milagros (2005). The reef systems in these MPAs are worth assessing, especially their functionality in enhancing coastal fisheries productivity through spill-over effects and protection of critical habitats. Alcala (1998) stressed that for an MPA to be called functional, it shall have addressed these two measures of functionality in 5-10 years. This paper also intended to know the status of coral reef systems and the resident and associated reef fishes. Specifically, this paper delved into the following:

1. Determination of the area covered by the coral reefs
2. Characterization of the MPAs based on percentage cover of live hard corals, soft corals, dead corals, and other substrates and life forms
3. Estimation of the diversity, abundance, and other measures of community structures of resident and reef-associated fish species
4. Comparison of coral reefs status and reef fish abundance and biomass between inside and outside sanctuaries
5. Provision of notes on associated macro invertebrates and seaweed/algal colonization

METHODOLOGY

Review of existing reports and publications were carried out. Principally, findings and publications from the Integrated Coastal Resources Management Project served as the baseline. Gulf-wide occurrence of coastal habitats, specifically coral reefs, were worked out from Landsat data and rendered in a mapping software. The coral map was then used in validating their occurrence through actual ground truthing and community consultation. Coordination with local government units and community partners were done both in writing and personal interactions. Selection of sampling stations were based on the existence of a marine protected area (MPA) in the municipality and the expanse of the coral reef systems. The preparation of base maps indicating the location and extent coral reefs was generated under Project 5.

Coral reef assessment used the conventional Line Intercept Transect method (English et al., 1987), which employed video documentation to enable off-water life form identification and intercept reading. This was undertaken in all MPAs situated inside the gulf, except those established under a series of proclamations and then established either as sanctuaries or wilderness areas under RA 7586 (National Integrated Protected Areas System Act). In addition, some stations were also surveyed at non-MPA reef system for comparison purposes. Location coordinates were obtained for these sampling stations using Garmin

Table 1. Coral cover condition

% Live Coral	Condition
0-24.99	Poor
25-49.99	Fair
50-74.99	Good
75-100	Excellent

GPS76CSx. All transects used were at 50 meters in length. Coral reef status was evaluated based on the criteria set by Gomez (1982, Table 1). Ecological indices such as Simpson and Shanon-Weiner Index of Diversity, Dominance Index, and Equitability/Evenness were computed using the following formulas:

- Simpson's Diversity measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species)

    $$D = \Sigma \, pi^2$$
    Where P_i is the proportion of each species in the sample

- Evenness (E) is the ratio of the actual H' value to the maximum value (and thus it ranges from 0 to 1). It is expressed as follows:

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

    where H' is the Shannon's Diversity and
    H_{max} is derived by getting the natural logarithm of the total number of species

    Dominance = 1/D (total of the square of the proportion of each species [square of pi] defined as pi above)

Fish Visual Census (FVC) was also employed in the sampling stations. This is to assess the diversity of fish assemblage and estimate their approximate biomass. Stations for

FVC were the same stations used for the coral health assessment. Along the 50-meter transect line, a 2.5-meter observation area on both sides was used, accumulating a 250 m^2 survey area covered per station. Within this observation area, reef fishes encountered were identified, counted, and their lengths estimated. These length estimates were then converted into weights using established length-weight relationships from published and unpublished local works and from FishBase. Macro invertebrates were observed and noted for their occurrence and abundance. A comparison of the reef health and the reef fish diversity and biomass were done per MPA using available baselines.

Observable perturbations, such as the presence of garbage, crown of thorns, ghost nets, and bleaching, were documented together with macro algal colonization and the presence of macro invertebrates. All diving activities used SCUBA equipment and with the knowledge and participation of barangay officials, designated bantay dagat members, or community representatives.

RESULTS AND DISCUSSION

Extent/area covered by the coral reefs

Figure 1 presents the map of Asid Gulf, showing the extent of coastal waters, which cover a total area of 2,261 km^2. There is a small portion (216 km^2 or 8.7% of the gulf area, pointed by the red arrow) south of Balud waters that is beyond 15 kilometers from any land or island reference point. Hence, it is considered as located in offshore waters. The total gulf area was estimated to be at 2,476 km^2, which is comparable to the 2,417 km^2 area reported by Mendoza and Soliman (2017). The neighboring Milagros (598.8 km^2) and Cawayan (693.4 km^2) cover 52.18% of the total gulf area. As noted in Integrated Coastal Resources Management Project results done in 2012, reef areas of the gulf are mostly found in the surrounding dozens of islands within the gulf or from a narrow reef assemblage fringing the coastal zones of most of the

Figure 1. Asid Gulf and the concentration of coastal habitats

Municipality	Mun.water (km^2)	Percent
Balud	453.71	18.32
Milagros	598.79	24.18
Cawayan	693.35	28.00
Placer	377.88	15.26
Esperanza	137.13	5.54
Total	2,260.86	
Offshore	215.09	8.69
total	2,475.95	100.00
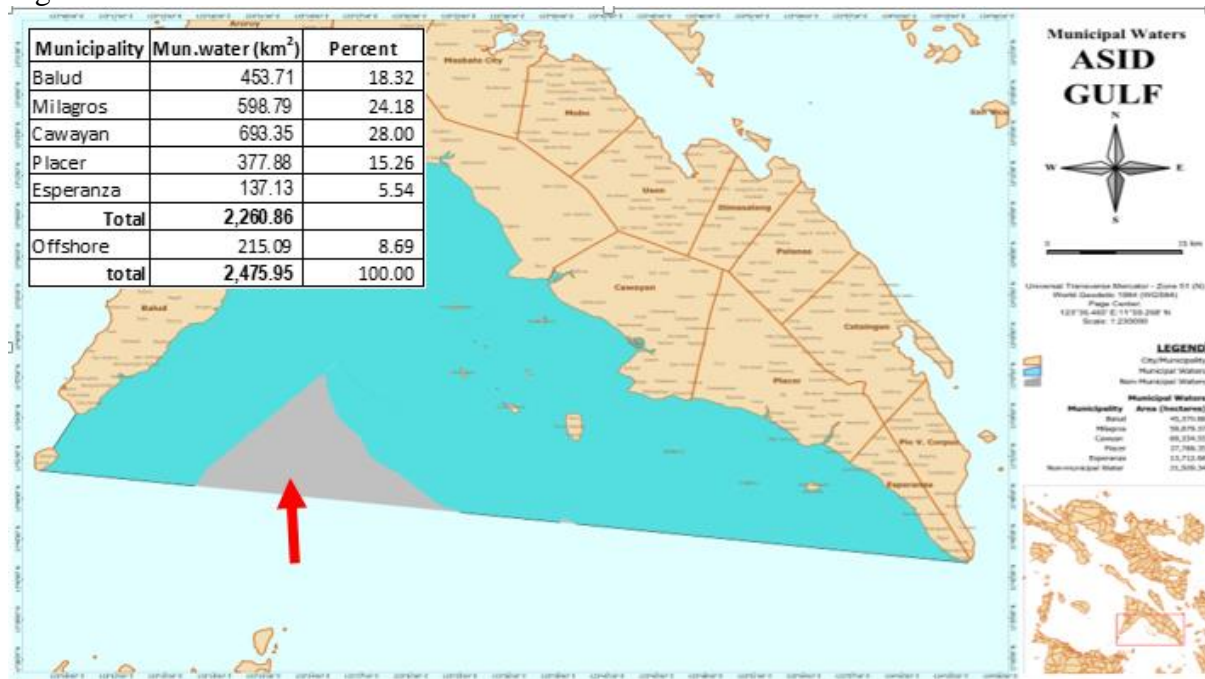
municipalities.

Status of marine protected area (MPA) coral reef systems in Asid Gulf

The 3,113.3-hectare (31.13 km^2) aggregate MPA area contributed by the 14 MPAs in Asid Gulf provides 1.51% protection to its 2,661 km^2 coastal waters. Although this is relatively larger than the 0.88-0.89% MPA protection coverage in Albay and Ragay gulfs (see Dioneda et al., 2019), it is still way below the 15% mandated coastal area protection from the fisheries code (RA 8550 as amended by RA 10654). The Provincial Environment Code of Masbate, in turn, prescribes 25-40% protection to the municipal waters of the province. The oldest MPA in Asid Gulf was the one established in 2002 fronting Barangay Recodo in Cawayan, Masbate. At the outset of the environment code, there were just a few MPAs in Masbate waters, but shortly after its passage, the number of MPAs grew to a dozen in just a short period (see Soliman et al., 2002). In Asid Gulf, Balud and Milagros almost responded at the same time, establishing one MPA each in 2004 and 2005. Placer established four MPAs within the reef systems of its four islets in 2007. Milagros, with already one MPA in Bangad, established two

more in 2010. Cawayan claimed to have added another three MPAs in 2013, mostly at Naro Island and were principally devoted for scallop habitat and stock protection. The youngest (four years old) MPAs were the two established in Esperanza in 2015. Table 2 presents the general profile of these MPAs.

Cawayan afforded the highest coastal water protection at 3.85% of its coastal waters. The remaining municipalities have coastal water protection provision through MPAs ranging from 0.18% to 0.55%. As hinted above, these are far from the coastal protection prescribed by existing policies. This coastal water under protection is not unique to Asid Gulf. In fact, the west coast municipalities of Albay also protects 0.8-1.4% of their coastal waters (Dioneda et al., 2017). At Ragay Gulf and the Pacific seaboard of Albay Gulf, the protection was only 0.88-0.89% (Dioneda et al., 2019) while in Donsol's waters, it was 1.72% (Dioneda & Burce, 2018). Core areas or sanctuaries comprise the 30.6% while the remaining portions are reserves or buffer zones.

The succeeding sections present the recent technical information about the condition of reef systems and the associated reef fishes of the MPAs, and other non-MPA reef systems included in the assessment. This assessment established nine high resolution transects containing benthic life forms and reef fish data within the five major reef systems of Asid Gulf. Near to recent data (i.e., ICRMP data in 2016) were lifted and incorporated here to serve as part of the baseline.

Table 2. Vital information of MPAs in Asid Gulf, Masbate

Name of MPA	Municipal water area	Area in hectares				Year Established	Legal basis
		Sanctuary (has.)	Reserve (has.)	Total (has.)	Mun water protection		
Balud (Jintotolo)	45,370.88	22.80	51.70	74.50	0.16	2004	Ordinance no.10 s. 2004
Milagros (Bangad)	59,879.37	43.50		43.50	0.22	2005	Ordinance no.001-05 s. 2005
Milagros (Pacao)		67.60		67.60		2010	Ordinance no. 19-02 s. 2010
Milagros (Boray)		23.20		23.20		2010	Ordinance no. 19-02 s. 2010
Cawayan (Recodo)	69,334.55	200.00	700.00	900.00	3.85	2002	M.O. 01 series of 2002 & M.O. 99-02 passed in 1999
Cawayan (Looc)		80.00	120.00	200.00		2013	
Cawayan (Naro)		120.00	600.00	720.00		2013	
Cawayan (Naro Scallops)		200.00	650.00	850.00		2013	
Placer (Nagarao)	37,788.35	27.50		27.50	0.55	2007	M.O. 08 series of 2007
Placer (Guin Awayan)		54.00		54.00		2007	M.O. 08 series of 2007
Placer (Pasiagon)		32.00	66.00	98.00		2007	M.O. 08 series of 2007
Placer (Naboctot)		30.00		30.00		2007	M.O. 08 series of 2007
Esperanza (Labangtaytay-libertad)	13,712.68	20.00		20.00	0.18	2002	SB Reso no. 96-1180
Esperanza (Sorosimbahan)		5.00		5.00		2015	Resolution no. 2015-59
Total	**226,085.83**	**925.60**	**2187.70**	**3113.30**	**1.38**		

Status of Asid Gulf coral reefs

Table 3 presents the status of the coral reef systems in Asid Gulf. Except for the reef system in Guinlobngan Island, the rest of the reef systems assessed are inside the MPAs. The coral reef health in the gulf is mostly poor to fair.

Table 3. Status of corals in major reef systems in Asid Gulf

Life Forms/ substrate	Milagros	Cawayan				Placer*		Esperanza*	
	Bangad	Guinlob-ngan T1	Guinlob-ngan T2	Recodo T1	Recodo T2	Nagarao (S)	Guinawayan (S)	Surosimbahan T1	Surosimbahan T2
Hard Corals (HC)	14.86	37.46	36.84	19.66	15.30	40.72	34.00	40.44	24.86
Soft Corals (SC)	0.44		0.64	0.12					
Dead Corals (DC)	2.32	19.82	13.92	0.80		8.00	2.36	1.62	0.16
Other Organisms (O)	0.28	3.96	3.36	3.62	1.28	1.20	4.20	0.54	0.82
Algae (ALG)	46.74	7.72	14.18	59.58	69.32	15.88	44.08	49.02	66.42
Sunstrates (AB)	35.36	31.04	31.06	16.22	14.10	34.20	15.36	8.38	7.74
Total	100	100	100	100	100	100	100	100	100
LCC *(HC+SC)	15.30	37.46	37.48	19.78	15.30	40.72	34.00	40.44	25.00
Reef Health	POOR	FAIR	FAIR	POOR	POOR	Fair	Fair	FAIR	Fair

*from Mendoza et al. 2017

Coral reef status of Bangad MPA, Milagros, Masbate

Of the three MPAs in Milagros, only the one in Bangad yielded valid transects. Algae here was very expansive, occupying nearly half of the transect length (47%). Abiotic substrate was also very high (53.3%). Corals in this MPA were in poor state as there were only 15.3% live cover. Although dead corals may appear to be low (2.32%), it was misleading as previously dead corals were now inhabited by massive a sargassum bed. The water here was also silted, resulting in poor coral growth and recovery.

Coral reef status of Cawayan, Masbate

In Cawayan, two reef systems were assessed. One was within the Recodo MPA, while the other was a reference non-MPA reef located at Guinlobngan Island. Attempts to dive and assess a reef system in the Naro MPAs yielded negative presence of corals. This was expected as these protected areas were designed to protect scallops and sand flat habitat.

The coral reef of Recodo MPA was in poor condition as the live cover ranged from 15.3% to 19.8% only. In a 2013 assessment (Mendoza et al, 2013), live coral cover ranged from 20% to 28%. A Department of Environment and Natural Resources assessment undertaken here in 2001 reported that the live coral cover was in fair condition (25.07%). There was already a note in 2013 about the proliferation of seaweed dominated by sargassum and turbinaria in the MPA and its immediate surroundings. Algae, as of the most recent assessment, was at 46.7%. With the low level of dead corals (2.32%), it is understandable that the bulk of the previously dead corals (20-46% in 2013) is now inhabited by seaweeds at its effective substrate.

Still in Cawayan, but this time in the reef system of Guinlobngan Islet, two transects yielded almost identical results. The corals here were in fair condition (37.4% live coral cover), better than in Recodo MPA despite of lack of protection, being a non-MPA. There was less algae here (7.7-14.2%) as compared to Recodo MPA, which had a very high incidence at 59-79%. In a 2013 assessment, live coral cover in Guinlobngan ranged from 15.8 to 67%. Dead corals were minimal (5.3-29.6%) and algae was almost negligible then at 0-8.2% (Mendoza & Soliman, 2017). In 2003, live oral cover here was 62% (Soliman & Mendoza 2005). As highlighted by Mendoza and Soliman (2017), the reef system here is protected by the family who claimed ownership of the islet.

Key general trends are obvious from these results. One is the general deterioration of the state of the reef system inside and outside MPAs. Dead corals and abiotic substrates are also increasing. The proliferation of macroalgae (e.g., *Sargassum sp., Turbinaria sp., Hormophysa sp., Padina sp.*) would indicate the high nutrients that come with the heavy siltation. On the ecological point of view, the prevalence of large macroalgae may also indicate loss of organisms (fishes and invertebrates) feeding on them. This may have negative effects on coral growth and recovery since macroalgae competes for space with corals (Mumby & Steneck, 2008).

Coral reef status of Placer

Attempts to dive the reef systems of Placer was hampered by storms due to the onset of the southwest monsoon in June 2019. The team was even stranded for a day in Guinawayan Island and was rescued back to Placer mainland the next day. The data, then, that will be presented here was the coral reef status reported by Mendoza and Soliman (2017).

The reef system in Guinawayan and Nagarao of Placer were in a fair state with live coral cover of 34-40.7%. The shallow reef of Guinawayan, however, was beset by the expansion of sargassum and turbinaria-dominated seaweed bed (44%). This macroalgal assemblage was not as extensive as in Nagarao (only 15.9%), but the abiotic substrates here were high (34.2%). Dead corals may appear to be in good condition in the two islets (2.4-8%), but the high abiotic components (14-34%), which were in the form of rubbles and coral rocks are indicators that the area is impacted by both natural phenomena (storms) and human activities (blast fishing, boat anchorage, and others).

Coral reef status of Esperanza

The coral reef of Surosimbahan of Esperanza was in fair condition. The two transects reported a fair live coral cover of 25-40.4%. Again, it is the proliferation of the macroalgae that covers the bulk of the transect, yielding 49-66.2%. Dead corals and abiotic substrates here were low (1.62-153%) as they have been covered by extensive macro algal growth. Accounts of local folks even hinted at the practice of harvesting the sargassum, which are shipped dried to undisclosed locations in the Visayas for unknown industrial use.

Succeeding efforts to conduct dives in the remaining reefs of Placer, Esperanza, and Jintotolo of Balud all failed. In fact, the Jintotolo dive was aborted due again to rough seas. The team just settled on an exploratory dive at a claimed reef along the Paguirangan station. Here, the same expansive seaweed bed was seen. Fishing activity was very intense in these macro algal beds as catches of siganids from these sites are important to the fish drying industry.

Diversity, abundance, and community structure of resident and reef-associated fish species

Table 4 shows the result of the fish visual census in selected reef systems of Asid Gulf. A report by Mendoza and Soliman (2017) showed more abundant and dense coral reef fish assemblage than in the present assessment. Guinlobngan reef fishes are more diverse (30-32 species) at present than in the past (16-25 species). However, the number of fishes encountered in the present assessment is lower (480-497) compared to the 2017 report (233-615). Notable

is the improvement of fish biomass in the present assessment, which registered 25-34 mt/km^2 as compared to just 5-13.5 mt/km^2 in the past. This can be attributed to the significant number of target fish species encountered in the present monitoring, which was fewer than in the previous assessment.

Table 4. Result of fish visual census in major reef systems of Asid Gulf.

Municipality	Coral Reef system	Fish Number	Fish Count	Density fish/m^2	Biomass kg/250m^2	Biomass MT/km^2
Milagros	Bangad MPA	18	91	0.42	2.20	8.80
Cawayan	Recodo PA	24	145	0.58	4.11	16.45
Cawayan	Guinlobngan T1	30	480	1.92	6.35	25.39
Cawayan	Guinlobngan T2	32	497	1.99	8.50	34.00
Cawayan	Guinlobngan T1*	25	615	2.46	1.25	4.98
Cawayan	Guinlobngan T2*	16	233	0.93	3.37	13.49
Placer	Nagarao*	39	542	2.17	11.78	47.12
Placer	Guinawayan*	32	503	2.01	9.67	38.67

from Mendoza and Soliman (2017)

The reef fish assemblage of Bangad MPA in Milagros was the least diverse, with only 18 species. Most of these were Pomacentrids. They were also the least abundant, with a density of 0.42/m^2. This is comparable to the reef fish assemblage of Recodo with just 24 species. However, fishes here were more abundant and slightly denser (0.58 fishes/m^2) than that of Bangad.

Benchmark data reported in 2017 for the reef fishes of the two MPAs of Placer located at its Nagarao and Guinawayan islands showed superior fish diversity (32-39 species), fair density (2.01-2.17 fishes/m^2), and high biomass estimates (38.7-47.1 mt/km^2). This somehow relates to the present state of coral reef habitats in Asid Gulf, which are in a progressive state of deterioration.

The reef fish biomass is considered a potential yield a reef system could offer to fisheries. The estimates in Asid Gulf are comparably smaller than those computed from other locations in Bicol. Dioneda et al. (2019) reported the biomass estimate of the Sarimao reef system in Pasacao, Camarines Sur at 122.9 mt/km^2. This is almost equal to the fish biomass estimate of 125.8 mt/km^2 in the Itiw-itiw reefs of Monreal, Masbate (Dioneda et al., 2014). Very lately, Dioneda et al. (2019) estimated the reef fish biomass in Albay Gulf to just within the range of 9.8-56 mt/km^2. Corollary to this, estimates of reef fishes in the region vary widely, indicative of the quality of habitat and the magnitude of fishing pressure they receive. For instance, Dioneda and Burce (2018) estimated a reef biomass range of 38.8-67.7 mt/km^2 within the twin MPAs of Donsol, Sorsogon. This was comparable to estimates done in previous years in the same MPAs (29.5-80.5 mt/km^2; Dioneda & Burce, 2017). These reef fish biomass estimates in Asid Gulf is inferior when compared with those computed from the east coast of Albay, which ranged from 9.2 to 44.32 mt/km^2 (see Mendoza et al., 2015).

Figure 2 shows that target species in Asid Gulf is fairly better than the 12% in Albay Gulf but is slightly inferior to that of Ragay Gulf (20%). No data about fish groups are available to compare trends. This can be the offshoot of intense fishing and poor state of coral habitat. Target species are essentially the preferred species of fishing operations because of their inherent economic value. Observed valuable target species in the reef systems assessed were several species of nemipterids, snappers, groupers, lizard fish, and their hard bottom demersals.

2a. Fish Groups.
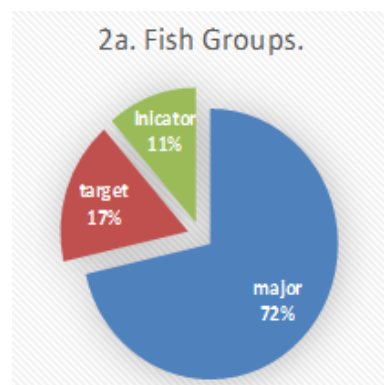
Generally, less proportion of fishes from target species may be an offshoot of intense fishing pressure challenging the regenerative capacity of the fish population.

2b. Feeding habits

■ Herbivore ■ Carnivore ■ Omnivore
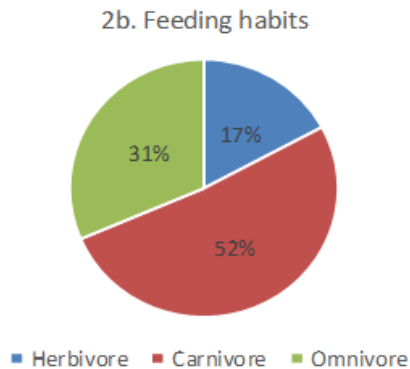
Indicator species were minimal, representing just 11% of the fish count. This is better than the 4% in Ragay Gulf in 2019 (Dioneda et al.) and 7% in 2005 (Ticson et al.). Indicator species are mostly represented by perturbation-sensitive species from Family Chaetodontidae (butterfly fishes) and some from Family Labridae (cleaner wrase). Less fishes from indicator species may mean some degree of deterioration of habitats. Bulk (72%) of the fishes encountered belong to major groups. Fish assemblage dominated by major groups have less to offer to fisheries as these fishes are of less economic importance and are not normally part of any traditional fisheries. It is, however, important to stress that all fishes belonging to major groups, just like the target and indicator species, are ecologically important.

Mendoza (2017) observed that most of the reef fishes are plankters and algal feeders of low commercial value. The recent study showed a reduction of herbivores, which is just at 17% of all observed reef fishes. While omnivores are high (31%) and could substantially help in the herbivorous feeding system, the fact remains that the representation of fishes based on feeding mechanism is strongly tilted toward carnivores (52%). There seems to be an imbalance between the feeding groups as carnivores outnumber those that are at the lower trophic level, such as herbivores and omnivores, which represent 17% and 31% respectively. The very low count of herbivore fishes will directly connect to the significant elimination of grazers, which partly could have caused the macro algal growth along the reef systems of the gulf.

Fishes are getting less abundant now, and if ever there are improvements in fish counts, most of them are due to the population growth of some major fish species. Notable is the abundance of pomacentrids, some wrasses, and cardinal fishes, which generally dominate most of the reef fish assemblage in terms of species count.

The declining fish abundance and the reduced variety of species indicate ecological disturbance. Although the reef habitat had improved from the 2006 condition, other factors, like the condition of the related seagrass/seaweed and mangrove habitats, could have deteriorated, affecting the species supported by the reef habitat. Also, climate change factors (i.e., increasing sea surface temperature) may have favored those fish species that have competitive advantage under warm water conditions. Fishing could also be a factor, as the economically important species are subjected to intense fishing while less economically important species have been favored—which made them flourish. The detected increase in biomass can be due to the dominance of some species (i.e., pomacentrids and some wrasses), which are likely favored by the factors mentioned above.

Table 5 shows the basic ecological indices computed in selected reef assessment stations in Asid Gulf. The reef fish assemblage in Guinlobngan registered the highest diversity index as these areas harbor the greatest number of species and fishes

Table 5. Ecological indices of reef fishes in Asid Gulf.

Municipality	Name of Reef Area	Diversity Simpson	Evenness	Simpson's Dominance
Milagros	Bangad	0.08	0.73	0.93
Cawayan	Recodo	0.11	0.76	0.92
Cawayan	Guinlobngan	0.23	0.89	0.85
Placer	Guinawayan	0.18	0.77	0.86
Placer	Nagarao	0.22	0.82	0.88

encountered. Reef fishes in this location are fairly distributed as well, with an evenness index of 0.89. Notable are the low diversity indices computed for the reefs of Recodo in Cawayan, Bangad in Milagros, and Guinawayan in Placer. These areas have either less species and fish abundance, or a species or several species dominate in terms of fish abundance. This measure is provided by the dominance index, where locations with lower diversity indices generally have high values of dominance.

Associated macro invertebrates and observable perturbation

Crown of thorns were present, but not as prevalent as in the case of Ragay and Albay gulfs. Varied species of sea cucumbers (Holuthuria) were observed, especially at the reef systems of Guinlobngan and Recodo. Some scallops (*Chlamys nobilis*) and spiny oysters (*Spondylus*) were also seen in Guinlobnagn reef. Sea urchins (Diadema) were very extensive in the reefs of Guinawayan and Nagarao, especially in areas with damaged corals.

CONCLUSION AND RECCOMENDATIONS

This assessment can be considered as the first comprehensive bio-ecological and social assessment made in Asid Gulf. Although it has been a part of the Integrated Coastal Resources Management Project (ICRMP) before, it only focused then on selected coastal habitats and fisheries assessments. Likewise, sporadic initiatives prior to the ICRMP, such as the routine Participatory Coastal Resource Assessments of the Department of Environment and Natural Resources and the Bureau of Fisheries and Aquatic Resources Region V, were undertaken, collating these vital benchmarks is in itself a challenge. Despite the limitations resulting from security and bad weather, the Participatory Resource and Socioeconomic Assessment was able to gather important information vital for the long-term utilization and management of Asid Gulf's rich resources.

Only 91% of the 2,261 km^2 statistical area is municipal, as a small portion south of Balud waters can be considered offshore water under RA 8550. Cawayan and Milagros cover more than half of these coastal waters (52%). Reef areas in the gulf are commonly seen fringing coastal zones and the dozens of islands of varied sizes within. Around 14 marine protected areas (MPAs) were completed in this assessment. The MPA coverage in the gulf totaled 3,113.13 hectares (31.13 km^2). This represents protection to 1.51% of the municipal waters, which is slightly better than the 0.88-0.89% protection in Ragay Gulf. This is, however, way below the 15% prescribed under RA 8550 and the 25-40% under the Masbate Environment Code.

The status of the corals in Asid Gulf are mostly poor to fair. This is very pronounced in all MPA reef stations. Ironically, the situation was better in the non-reef station (Guinlobngan) used as reference. The progressive deterioration of the reef condition can be gleaned from sporadic baselines from 2001, 2013, and 2015. Among the assessed reef systems, the one in Guinlobngan stood out as the only location with fair to near to good coral cover. The reef system is not an MPA, but protection was carried out by a family who claim ownership of the scenic islet. The proliferation of macroalgal beds encroaching the shallow denuded reef systems was commonly observed in all sampling stations except for the one in Guinlobngan. Dominated by *Sargasum, Padina,* and *Turbinaria*, these seaweeds were seen to cover 46-66% of the transects made in all stations, except for the ones in Guinawayan and Guinlobngan. These macro algal communities now thriving in coral reef systems are using dead coral hard substrates. This will have some serious implications to the recolonization and recovery of the coral reefs.

The reef fishes in 2017 were more abundant and denser than in the present. They are also more diverse (16-39 species) then than in the present (18-32 species). An exception is Guinlobngan, which is showing improvement in diversity. Fish biomass in this reef area also improved significantly, while it considerably diminished in the Recodo MPA reef. The biomass estimates in Asid Gulf are comparably lower than the estimates in other nearby Bicol locations.

The reef fish groupings are again heavily dominated by those from major groups (72%), while target and indicator species represent 17% and 11%, respectively. The lower proportion of fishes from target species may be an offshoot of intense fishing pressure challenging the regenerative capacity of the fish population.

Indicator species are also minimal in fish count, representing just 11%. This is better than the 4% in Ragay Gulf in 2019 and 7% in 2005. Fewer fishes from indicator species may mean some degree of deterioration of habitats.

The bulk (72%) of the fishes encountered belong to major groups. Fish assemblage dominated by major groups have less to offer to fisheries, but they are still ecologically important.

Earlier reports observed that most of the reef fishes were plankters and algal feeders of low commercial value. This is still true but a significant reduction of herbivores, which were just at 17% of all observed reef fishes, was glaring. While omnivores were high (31%) and could substantially help in the herbivorous feeding system, the fact remains that the representation of fishes based on feeding mechanism is strongly tilted toward carnivores (52%). There seems to be an imbalance between the feeding groups as carnivores outnumber those at the lower trophic levels, such as herbivores and omnivores. The very low count of herbivore fishes will directly connect to the significant elimination of grazers by fishing. This could have partly caused the macro algal growth along reef systems.

With all these findings, the following are recommended:

1. **Revalidation of the location and expanse of the MPAs**. Some of the MPAs are right in front of the mouth of the river (i.e., Kabunturan and Manito MPAs). With the presence of other nearby reef systems that are in better condition, expansion of preexisting MPAs can be considered. This addresses the issue that the municipalities bordering the gulf offers protection to just 0.88% of the entire gulf area. Inasmuch as Asid Gulf is largely municipal waters, this protection coverage is way below the mandated coastal environment protection under RA 8550 and the Environment Code of Masbate.

2. **Networking of the MPAs.** The MPAs in Asid Gulf are isolated from each other and are managed at varied scales. Since all of them are within one ecological setting, their functionality could better serve the intended purpose of habitat and biodiversity protection if their operational and management mechanisms follow the same standards.

3. **Careful rehabilitation efforts**. Coral restoration in areas with poor reef health can be explored to improve and restore their diversity. The local government units should carefully embark on coral restoration projects.

4. **Curbing coral ecosystem disturbances**. Solid and liquid wastes are the main killers of coral reefs. Liquid wastes introduce unnecessary high levels of nutrients to oligotrophic reef ecosystems. This partly enhances macro algal growth. Regular clean-up operations for ghost nets should be undertaken.

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Appendix A. Coral Health of Bangad, Milagros, Masbate			
Reefs			MPA
Depth (meters)			
Direction			
Live Coral	Hard Coral	Acropora — Acropora branching (ACB)	
		Acropora digitate (ACD)	
		Acropora encrusting (ACE)	
		Acropora submassive (ACS)	
		Acropora tabulate (ACT)	1.86
		Acropora Total	1.86
		Non Acropora — Heliopora (CHL)	
		Millepora (CME)	
		Mushroom coral (CMR)	
		Branching corals (CB)	0.02
		Encrusting corals (CE)	3.14
		Foliose corals (CF)	
		Massive corals (CM)	6.82
		Submassive corals (CS)	3.02
		Non Acropora Total	13.00
		Hard Coral Total	14.86
	Soft Corals		0.44
	Live coral Total		15.30
Percent cover category			POOR
Dead corals	Dead Coral (DC)		2.32
	Dead coral with algae (DCA)		
	Dead Coral Total		2.32
Other Organism	Other animals (OT)		
	Sponge (SP)		0.28
	Zoanthids (ZO)		
	Other Organism Total		0.28
Algae	Algal assemblages (AA)		1.10
	Coralline algae (CA)		
	Halimeda (HA)		
	Macroalgae (MA)		45.64
	Turf Algae (TA)		
	Algae Total		46.74
Abiotic	Rock (RO)		
	Rubble (R)		0.32
	Sand (S)		18.94
	Silt (SI)		16.10
	Total		35.36
TWB			
Total			100.00

Appendix B. Details of the life form assessment of the reef systems of Cawaan, Masbate

Coral Health of Cawayan, Masbate					Guiblobngan MPA T1	Guiblobgan MPA T2	Recodo MPA T1	Recodo MPA T2
Reefs					Guiblobngan MPA T1	Guiblobgan MPA T2	Recodo MPA T1	Recodo MPA T2
Live Coral	Hard Coral	Acropora		Acropora branching (ACB)	10.72	11.46	0.64	
				Acropora digitate (ACD)				
				Acropora encrusting (ACE)	1.56	0.36		
				Acropora submassive (ACS)	6.82	6.82		
				Acropora tabulate (ACT)				
				Acropora Total	19.10	18.64	0.64	
		Non Acropora		Heliopora (CHL)		1.54		
				Millepora (CME)	0.38			
				Mushroom coral (CMR)	1.04	0.22		
				Branching corals (CB)	2.06	0.62	2.1	3.30
				Encrusting corals (CE)	2.22	0.42	0.08	0.08
				Foliose corals (CF)	0.70	0.92		
				Massive corals (CM)	11.64	11.76	14.92	8.54
				Submassive corals (CS)	0.32	2.72	1.92	3.38
				Non Acropora Total	18.36	18.20	19.02	15.30
				Hard Coral Total	37.46	36.84	19.66	15.30
				Soft Corals		0.64	0.12	
				Live coral Total	37.46	37.48	19.78	15.30
Percent cover category					FAIR	FAIR	POOR	POOR
Dead corals				Dead Coral (DC)	17.66	8.34	0.8	
				Dead coral with algae (DCA)	2.16	5.58		
				Dead Coral Total	19.82	13.92	0.80	
Other Organism				Other animals (OT)		0.80	0.12	0.12
				Sponge (SP)	3.96	2.56	3.5	1.15
				Zoanthids (ZO)				
				Other Organism Total	3.96	3.36	3.62	1.28
Algae				Algal assemblages (AA)	5.94	10.62	24.4	17.65
				Coralline algae (CA)	0.28		0.34	
				Halimeda (HA)				
				Macroalgae (MA)	1.50	3.20	34.84	51.67
				Turf Algae (TA)		0.36		
				Algae Total	7.72	14.18	59.58	69.32
Abiotic				Rock (RO)				
				Rubble (R)	9.96	10.74	0.52	0.58
				Sand (S)	2.56	7.54	8.38	13.53
				Silt (SI)	18.52	12.76	7.32	
				Total	31.04	31.04	16.22	14.10
TWB						0.02		
Total					100.00	100.00	100	100.00

Appendix C. Status of Coral Reef Sstem of Surosimbahan MPA, Esperanza, Masbate.

Reefs				Sorosimbahan MPA T1	Sorosimbahan MPA T2	Average (optional)
Live Coral	Hard Coral	Acropora	Acropora branching (ACB)	0.82	0.54	0.68
			Acropora digitate (ACD)			
			Acropora encrusting (ACE)		0.26	0.26
			Acropora submassive (ACS)	0.32		0.32
			Acropora tabulate (ACT)	0.6	0.6	0.6
			Acropora Total	1.74	1.40	1.86
		Non Acropora	Heliopora (CHL)	0.32		0.32
			Millepora (CME)			
			Mushroom coral (CMR)			
			Branching corals (CB)	4.94	2.88	3.91
			Encrusting corals (CE)	3.3	3.82	3.56
			Foliose corals (CF)	0.86	0.8	0.83
			Massive corals (CM)	27.8	15.96	21.88
			Submassive corals (CS)	1.48		1.48
			Non Acropora Total	38.70	23.46	31.98
			Hard Coral Total	40.44	24.86	33.84
	Soft Corals					
	Live coral Total			40.44	24.86	33.84
Percent cover category				FAIR	POOR	FAIR
Dead corals			Dead Coral (DC)	1.44	0.12	0.78
			Dead coral with algae (DCA)	0.18	0.04	0.11
			Dead Coral Total	1.62	0.16	0.89
Other Organism			Other animals (OT)	0.52	0.48	0.5
			Sponge (SP)	0.02	0.34	0.18
			Zoanthids (ZO)			
			Other Organism Total	0.54	0.82	0.68
Algae			Algal assemblages (AA)	39.52	28.16	33.84
			Coralline algae (CA)	2.06	1.82	1.94
			Halimeda (HA)			
			Macroalgae (MA)	7.12	35.92	21.52
			Turf Algae (TA)	0.32	0.52	0.42
			Algae Total	49.02	66.42	57.72
Abiotic			Rock (RO)			
			Rubble (R)	1.32	0.58	0.95
			Sand (S)	6.56	7.08	6.82
			Silt (SI)	0.5	0.08	0.29
			Total	8.38	7.74	8.06
TWB						
Total				100	100	100

STATUS OF SEAGRASS, SEAWEEDS AND MANGROVE COMMUNITIES IN ASID GULF, MASBATE, PHILIPPINES

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ABSTRACT

Assessment of seagrass, seaweeds and mangrove communities were conducted in Asid Gulf. The study aimed to characterize these habitats in terms of species composition, percentage cover, community structure and associated macroinvertebrates. Basal area and regenerative capacities are also investigated for mangroves. Seven (7) out of 18 known species of sea grass in the country were identified thriving in Asid Gulf. The best seagrass cover was found in Nagurang Island in Milagros while Cawayan seagrass communities got the highest values in terms of index of diversity. There were also 12 species of seaweeds noted gulfwide and the species composition differed significantly between municipalities. The highest number of species was found at Cawayan. Boat anchorage, wastes, gleaning and fishing activities were seen as the man-induced threats to the seagrass and seaweeds beds.

Mangroves of Asid Gulf covers around 686 hectares. Most of these mangrove areas are in Placer (61%) and in Cawayan (21%). Species composition of mangroves in the assessed locations are fairly diverse as 11 species were encountered. Except Placer station, most of these mangrove areas assessed are reduced to thin stretch of remaining natural stands as a result of fishpond conversion. The thin mangrove assemblage are the ones with very low regenerative capacities. Solid wastes, fishpond conversion and human habitation near the mangrove areas are the common disturbances seen in the five assessed locations.

The protective and developmental activities of the five coastal municipalities shall include these habitats in addition to the usual emphasis given to corals. This shall be captured in an integrated management plans for the gulf. Mangrove rehabilitation shall strongly consider site suitability assessment prior to planting the right species to the right substrates.

Keywords: *Seagrass, Sea weeds, Mangrove, Asid Gulf*

INTRODUCTION

Mangroves and seagrass-seaweeds are very important coastal habitats. With corals, they perform a synergy of ecological functions that contribute to the economic productivity and ecological stability of the coastal zones (Katherisan and Alikunhi, 2011). Coastal resources management (CRM) activities often involves protection and conservation of these habitats. It due to the effective interaction of these habitats that makes possible the provision of wide range of support to aquatic processes and resources. For instance, many economically important fishes and invertebrates depend heavily in the functioning of these habitats (Honda et al, 2013). Many natural processes and anthropogenic activities are impacting these critical and useful habitats. The ever growing coastal communities and industrial uses within the coasts and the conversion of these habitats for aquaculture and ecotourism purposes have significantly put these coastal habitats in peril. Likewise, climate change impacts would surely provide wide range of impacts. Unfortunately, seagrasses, seaweeds and mangroves are less studied ecosystems unlike corals.

Seagrass beds are submerged flowering plants with hard underground roots system which give the intertidal areas a stable substratum. The Indo-Pacific region has the richest diversity of seagrass species in the world, and is home for megafauna such as dugongs and sea turtles. Seagrass as well as seaweeds provide a complex habitat for many marine organisms, which directly supports human livelihoods and economies. In the Philippines, little is known about seagrasses and seaweeds communities and few protections exists. Seagrass communities contribute to about 50-64% of the organic carbon sequestered annually by coastal vegetated ecosystems (Duarte et al. 2013) and sink 20% of the carbon buried in the global ocean (Duarte et al. 2005; Kennedy et al. 2010). Seagrass meadows ranks the highest in terms of global loss rates among coastal vegetated habitats, declining annually at 7% (Waycott et al. 2009). The overwhelming degradation and loss of seagrass beds are due to physical impacts such as ocean warming, thermal/desalination sewage disposal, anchoring of boats, fish trawling, coastal erosion, sea water turbidity and siltation.

Mangroves are considered critical habitats in coastal areas with great ecological and socio-economic importance. Mangroves span the interphase between marine and terrestrial environments, growing in the mouths of rivers, in tidal swamps, and along coastlines, where they are regularly inundated by saline or brackish water (Sterling et. al. 2006). Mangroves play an important role within these areas as they guard the low-lying coastal land by forming a protective barrier. This biological barrier reduces damage caused by storms by limiting wave energy and preventing the land from being flooded. Their intricate root systems provide protection and food source for estuarine and coastal fishery food chains. Many fish, shellfish, birds and other wildlife species adopt the mangrove areas as breeding, feeding and nursery areas. However, treats are imminent both from resource use and climate change. Over exploitation, population explosion, land classification conflicts and interest, wrong choice of species, deliberate disregard of their importance and poverty posed great risks in the very existence of this coastal habitat.

Mangrove forests are recognized as the world's richest ecosystems for they serve as barriers against strong winds, waves, storm surges, and erosions. Moreover, they prevent silt, sediments and pollutants from reaching fragile habitats such as seagrass meadows and coral reefs. Mangroves are salt tolerant trees that have adapted to living in salt and brackish water

conditions. It also serves as shelter, spawning and breeding grounds for birds, fish, crustaceans, molluscs and other organisms. It is a unique community which forms a link between the land and the sea. Mangroves is a rich habitat which serve as life support systems to about 75 percent of fish species and as well as to indeterminate numbers of crustaceans and wildlife (Baldevarona, 2001). Typical mangrove zonation are observed as species with pneumatophores are found at the low-intertidal; prop and knee roots species are in the mid-intertidal; and buttress or plank root species are at high intertidal area (Samson and Rollon, 2011).

These habitats are often excluded in the coverage of MPAs established. In fact, the designs of LGU-established MPAs in Asid gulf are mainly focused on coral reef ecosystem and do not capture protective emphasis for seagrass, seaweeds while mangroves are protected by non-MPA schemes. Considering the immense ecological and economic benefits these habitats are providing assessment and periodic monitoring should be of paramount concern. Scientific studies needs to be conducted in order to generate information concerning the status and functionality of the seagrasses and seaweeds ecosystems for effective management. This study was made to determine the status of seagrass, seaweeds and mangroves in Asid gulf. Specifically, it dealt with the following:

1. Identification of seagrass, seaweeds and mangrove species observed in the sampling stations;
2. Characterize the community structures in terms of:
   a) Percentage cover, frequency density, diversity and community structure indices (diversity, dominance, and evenness indices) of seagrass and seaweeds
   b) Diversity. Density and relative density, frequency and relative frequency, dominance, basal area and importance value.
3. Determine the status and condition of seagrass, seaweeds and mangroves communities in Asid Gulf.
4. Estimate the regenerative capacity of the mangrove communities
5. Document rehabilitation efforts, disturbances and observable perturbations in the seagrass/seaweeds and mangrove beds.

MATERIALS AND METHODS

Study Area

Masbate Island (Figure 1) is located at the center of the Philippine archipelago. The island lies 30 miles (48 km) southwest of the southern tip of Luzon and is V-shaped with the open end of the V forming the Asid Gulf. The gulf is bordered by five coastal towns namely, Balud in the southwest, Milagros, Cawayan, Placer and Esperanza in the southeast. One third (57 km) of the gulf's 174 km coastline is within Milagros while Balud and Cawayan covers 24% (42 km) and 18% (32 km) respectively. The municipalities with the shortest coastline coverage (21 km) are Placer and Esperanza. Near these coastlines are seagrass-seaweed beds and mangrove communities at varied level of conditions. The assessments were carried out in Milagros and Cawayan for sea grass and seaweeds while for mangroves, stations in Balud, Milagros, and Placer were successfully assessed. Actions in other target locations were hampered by security concerns attributed to election and inclement weather condition due to the onset of the South West monsoon.

Seagrass and seaweeds assessment

There were 10 stations initially identified for seagrass and seaweeds assessment. The identified stations in Milagros were in Barangays Bangad and Nagurang Island while, in Cawayan they were at Barangays Poblacion and Recodo and at Guilotungan and Naro Islands. In Placer, Masbate there were two stations targeted, Barangays Daraga and Pasiagon. These were selected after conducting the reconnaissance surveys with the locals and fishermen, identifying the seagrass and seaweeds beds locations. But due to the inclement weather condition during the actual conduct of the assessment only stations in Milagros and Cawayan were actually assessed. Figure 1 shows Asid gulf and the long v-shaped stretch of internal water, sizeable portion of which (91.3%) is municipal water.

Figure 1. Map of Asid Gulf showing the targeted seagrass and seaweeds beds stations

Sampling Techniques

Line Transect-Quadrat Method (LQM as described by English et al. 1994) was used. A 100 meter transect line was laid along the subtidal zone perpendicular to the shoreline while quadrats with a dimension of 50 cm x 50 cm and composed of 25, 10 cm x 10 cm sub-quadrants were laid at 10m interval. Locations of each sampling site were recorded using global positioning system (GPS).

Seagrasses and associated seaweeds that occurred inside the quadrat were taxonomically identified. The frequency of seagrass and seaweeds were also estimated by counting the occurrence of each species inside the quadrat. The cover of each species was also estimated using the standard technique developed by Saito and Atobe (1970). Table 1 shows the Saito and Atobe standard technique on estimating the cover of each species.

Table 1. The Seagrass Meadows Coverage Percentage Category

The Seagrass Meadows Coverage Percentage Category		
Class Coverage Area	% Cover Area	Midpoint
5	1/2 to full (50-100)	75
4	1/4 to ½ (25-50)	37.5
3	1/8 to ¼ (12.5-25)	18.75
2	1/16 to 1/8 (6.25-12.5)	9.38
1	< 1/16 (<6.25)	3.13
0	None 0	0

Percentage cover was estimated using the formula: $C= \sum (M_i \times f_i)/ \sum f$. where: M_i = mid point percentage of class i and f = frequency (number of sectors with the same class of dominance). The community structure of seagrass and seaweeds was determined using the conventional functional ecological indices such as diversity (Shannon H') and dominance (Simpsons D) index.

$$D= \sum (n_i/N)^2 \qquad H=- \sum (n_i/N) \log(n_i/N)$$

The condition of overall seagrass coverage was determined using the criteria set forth by Fortes (1989) (Table 2).

Table 2. Criteria used to determine the condition of seagrass beds (Fortes, 1989)

Condition	Criteria
Excellent	76 – 100% coverage
Good	51 – 75% coverage
Fair	26 - 50% coverage
Poor	0 – 25% coverage

Source : PCRA manual

The taxonomic identification of seagrasses was based on a field guide to the common mangroves, seagrasses and algae of the Philippines, (Calumpong and Meñez, 1997). Moreover, colour and morphological differences between different genera/species and taxonomic characteristics were considered in identifying seaweeds. The taxonomic description of the specimen and anatomical characteristics of the specimen to be identified were referred from

the field guide and atlas of the seaweed resources of the Philippines developed by Dr. Gavino Trono (1997), monograph and reference herbaria.

Mangrove assessment.

The mangrove habitat condition was evaluated using the Habitat Criteria Rating Chart for Mangroves by Participatory Coastal Resource Assessment (PCRA. Table 3).

Table 3. Habitat Criteria Rating Chart for Mangroves

Condition	Criteria
Excellent	Undisturbed, no cutting, clean, etc.
Good	Some cuttings for firewood, etc.
Fair	Heavy cuttings, fishpond conversions, etc.
Poor	Nearly destroyed, reclaimed or filled, pollution, etc.

Information on rehabilitation efforts were obtained from actual site visits and interview of local officials and residents in the area. Disturbances were observed while conducting the ocular inspections, reconnaissance trips and during the actual assessments. Table 4 shows the coordinates of the mangrove sampling stations visited and assessed.

Line Plot Method (English et al (1997) was employed in order to assess the mangrove communities and to determine its frequency, density and species diversity. A 100-meter transect line was laid perpendicular to the shoreline segmented every 5 meters distance with established sample plots (5 m x 5 m). Sampling stations in every municipality were assessed using this method of line plots per station covered from the seaward margin, middle and land ward of the forest laid perpendicular to the shoreline. A 1m x 1m sub-plot was established inside each plot for the identification and counting of sapling and seedling required for the regenerative capacity characterization.

Table 4. Coordinates of mangrove sampling stations

Mangroves Location Barangay	LATITUDE			LONGITUDE			Average Thickness (m)	Direction (Azimuth Degrees)
	Deg	Min	Sec	Deg	Min	Sec		
PLACER								
Daraga	11	54	7.96	123	51	50.10	103	105
BALUD								
Quinayangang Tonga	11	57	43.01	123	12	1.01	315	50
Quinayangang Diotay	11	57	52.17	123	14	0.72	18	No transect
Boncanaway	11	55	41.05	123	11	10.37	20	
MILAGROS								
Calasuche	12	13	33.13	123	31	55.56	50	271
Calasuche (Near Bacolod)	12	14	26.73	123	32	21.90	50	331
Bara-Sawmill boundary	12	5	50.37	123	36	51.29	353	334

Each mangrove tree encountered along the transect was identified, counted and the diameter measured. This method provides quantitative descriptions of the species composition and community structure of mangrove forest. Tree girth measurements were taken at breast height, approximately 1.3m above the ground over the highest prop root or 30 centimeters above the ground for those species without prop roots. The girth measurements can be converted into diameter at breast height (DBH) by dividing the computed girth by *3.1416.* Basal area can in turn be computed by the formula below. It describes the average amount of an area occupied by tree stems. More specifically, basal area is defined as the total cross-sectional area of all

stems in a stand measured at breast height, and expressed as per unit of land area. The higher the basal area means bigger diameter trees present which will eventually dominate with high percentage compared to those with smaller diameter trees regardless of the number of individual species present.

$$\text{Basal Area} \quad = \quad 0.005454 \text{ x } (\text{DBH})^2$$

Ecological Diversity Indices

Ecological diversity relates to the different species of a particular genus which are present in an ecological community. The measures or indices of ecological diversity are statistical summaries of the abundance vector, that is, the frequencies or proportions of each species in the community. These indices includes the following:

- Shannon-Weiner Diversity Index (H) is a measure of the amount of information needed to describe every member of the community. It is calculated using the following equation:

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

Where P_i is the proportion of each species in the sample

- Simpson's Index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The formula for calculating D is presented as:

$$D = \frac{\sum n_i (n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species
N = the total number of organisms of all species

- Evenness (E) is the ratio of the actual H' value to the maximum value (and thus it ranges from 0 to 1). It is expressed as follows:

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

Statistical Analysis

From the collected data, the following parameters were computed using the following equations:

$$\text{Frequency} \quad = \quad \frac{\text{Total number of segments in which a species occur}}{\text{Total number of segments sampled}}$$

$$\text{Relative Frequency} \quad = \quad \frac{\text{Frequency of a species}}{\text{Total frequency of all Species}} \text{ X } 100$$

$$\text{Density} \quad = \quad \frac{\text{Number of individual of a species}}{\text{Total area sampled}}$$

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$$

$$\text{Relative Basal Area} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all species}} \times 100$$

$$\text{Importance Value} = \frac{RF + RD + \text{Rel. BA}}{\text{Area Sampled}}$$

$$\text{Relative Dominance} = \frac{\text{Basal of a species in a quadrat}}{\text{Total basal area of all species in a quadrat}} \times 100$$

Density is the number of individuals of a species found within the line plots per hectare while the relative density is the density of individual species over the total number of species multiplied by 100, expressed in percent.

Frequency is the number of times individual species appeared in every quadrat versus the total number of quadrats laid while the relative frequency refers to the frequency of individual species versus the total frequency of all species multiplied by one hundred. The result would be the percentage of every species occurrence. This has something to with the distribution of all species surveyed.

Importance value is the sum of the computed relative density, relative frequency and relative dominance combined per species that appeared or included in the survey. This means that distribution, number of species appeared and the sizes of mangrove species are included for them to be classified as species of importance. All species surveyed with any of the three relative frequency, relative density and relative dominance appeared with the highest value become species of high great importance to the mangrove stands

RESULTS AND DISCUSSION

Status of Seagrass and Seaweeds of Asid Gulf

Species Composition for Seagrasses

There were seven (7) seagrass species noted thriving in selected municipalities of Asid gulf, Masbate (Table 5). This represents 39% of the eighteen (18) species occurring in the Philippines (Fortes, 2012). Four (4) species belonged to family *Cymodoceaceae* namely, *Cymodocea serrulata, Halodule pinifolia, Halodule uninervis, Syringodium isoetifolium,* and three (3) species from family *Hydrocharitaceae* namely, *Enhalus accoroides, Halophila ovalis,* and *Thalassia hemprichii* were identified *(Figure 2).* This species assemblage was reinforced by available benchmark (The PCRA in 2010).

Table 5. List of Seagrass species found in Asid Gulf.

Seagrass	English/local name	*Milagros	*Cawayan	**Placer	**Esperanza
Thalassia hemprichii	Sickle seagrass	√	√	√	√
Syringodium isoetifolium	Noodle seagrass	√	√	√	√
Halodule pinifolia	Needle seagrass		√		
Halodule uninervis	Trident seagrass	√			√
Enhalus acoroides	Eel/tape seagrass/ "lusay"		√	√	√
Cymodocea serrulata	Serrated ribbon seagrass	√	√		
Halophila ovalis	Spoon seagrass				√
No. of species present		4	5	3	5

Sources of data: *Milagros and Cawayan, PRSA, 2019
**Placer and Esperanza, PCRA 2010

Species composition of sea grass beds in the municipalities manifest striking differences. For instance, *Thalassia hemprichii* and *Syringodium isoetifolium* were all present in all municipalities. While, *Cymodocea serrulata* was found abundant in Cawayan but was observed to be limited in occurrence in Milagros and none were seen in Placer and Esperanza. Moreover, *Halodule uninervis,* a pioneer species was abundant in Cawayan but it was not found in Milagros and *Halophila ovalis* was only found in Esperanza. Asid gulf coastal vegetation was observed to be characterized by mixed community of seagrasses.

Seagrass density is directly associated with water temperature conditions (Fortes, 1987). Moreover, according to Green and Short (2001), the differences in the species composition could be attributed to the physical characteristics of the study site such as light depth, current, salinity, nutrient and substratum. Substratum is a very important regulator of seagrass distribution (Greve and Binzer 2004). *Halophila ovalis* thrived in Esperanza because the area had a sand-coralline substrate that most of the observed species could not tolerate. The other study sites had sandy to muddy substrates that suited for the rest of the seagrass species.

Figure 2. Seagrass found in the waters of Cawayan and Milagros, Masbate

The present study recorded the same number of seagrass species (7) conducted by BFAR V in 2010 in Asid gulf and in Bontoc, Leyte by Meode et al. in 2014. Whereas, different results were seen from other studies along Masbate. For instance, Reteurma et al., (2006, unpublished report) noted six species for Deagan Island, Dimasalang Masbate while Licuanan et al., (2011) also got six species in Ticao and Palaguigue Islands. Lastly, Guiriba et al., (2016, unpublished report) observed eight species of seagrass in Biton Bay, Batuan, Masbate.

Seaweed Species Composition

There were 10 species encountered in Cawayan (see Table 6). The identified seaweeds were from the three main groups namely, Chlorophyta (8) (green), Phaeophyta (2) (brown) and Rhodophyta (2) (red). The green type seaweeds dominated the seaweeds of both municipalities. Of the 12 species noted it the area namely; *Halimeda macroloba*, *Bornetella spherica Chlorodesmis fastigiata, Codium sp., Ulva expansa, Caulerpa racemosa, Ulva lactuca,* and *Ulva reticulata.* Both two from red and brown algae namely, *Euchema sp. Gracillaria sp*. and *Sagassum sp. and Padina sp.,* respectively. Majority of the seaweeds species were observed in Cawayan (9) and only three were noted in Milagros. The great occurrence of seaweeds in Cawayan was influenced by the sandy-coralline substratum which is favorable to its growth. This observation was corroborated by the study of Dioneda et al., 2019 (this volume) which found that *Sargassum* bed is so extensive with in seagrass and seaweeds beds and even at the coral reefs areas.
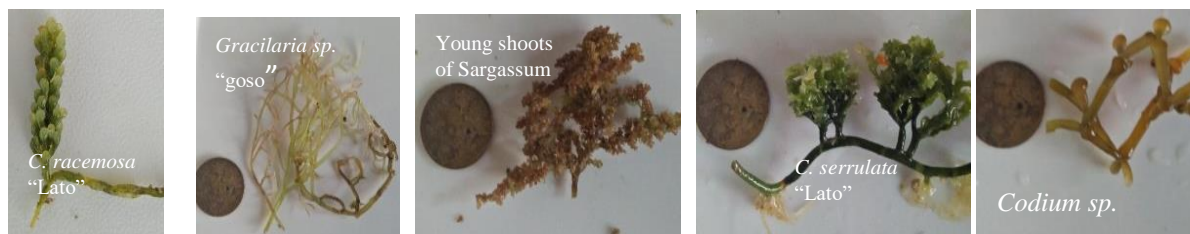

Figure 3. Some seaweeds species observed in the municipalities of Milagros and Cawayan,

Seagrass and Seaweeds Percent Cover and Diversity

Table 6. Seagrass and Seaweeds Cover in Naro Island, Cawayan, Masbate

Seagrass	Transect 1	Transect 2	Average	Seaweeds	Transect 1	Transect 2	Average
Thalassia hemprichii	58.8	9.40	34.6	*Halimeda macroloba*		3.13	3.13
Syringodium isoetifolium		75.00	75.00	*Bornetella spherical*		3.13	3.13
Haludole pinifolia		75.00	75.00	*Chlorodesmis fastigiata*		3.13	3.13
Enhalus acoroides		20.30	20.3	*Ulva expansa*		3.13	6.26
Cymodocea serrulata	38.3	46.90	42.6	*Caulerpa racemosa*		3.13	3.13
				Sargassum sp.		3.13	3.13
				Ulva lactuca	3.13	9.4	6.26
				Ulva reticulata		3.13	3.13
				Euchema sp.		3.13	3.13
				Gracilaria sp.		3.13	3.13

Table 6 shows the estimated percent cover of seagrass and seaweeds per species observed in Naro island, Cawayan, Masbate. Transects 2 was dominated by Syringodium *isoetifolium and Halodule pinifolia,* each with computed percentage cover of *75%.* This is followed by *Cymodocea serrulata (46.90%), Enhalus acoroides* (20.30%) and *Thalassia hemprichii* with the least estimated percent cover of 9.40. Meanwhile, only *Thalassia hemprichii* and *Cymodocea serrulata* were seen in transect 1 with estimated percent cover of 58.80 and 38.30, respectively. It was observed that variety of seagrass and seaweeds species favour clear water and sandy-muddy bottom (transect 2) over a silty and muddy substrate (transect 1). Anthropogenic activities were evident in transect one area such as boat anchorage, dumped solid and liquid wastes, rendering the area with murky and muddy bottom.

Table 7 shows the seagrass and seaweeds profile of Nagurang Island in Milagros, Masbate. Two transects were made here. The seagrass-seaweed bed here is relatively deeper so SCUBA equipment was used. Substrate is sandy-coralline and the water is relatively clearer.

Table 7. Seagrass and Seaweeds Cover in Nagurang Island, Milagros Masbate.

Seagrass	Transect 1	Transect 2	Average	Seaweeds	Transect 1
Thalassia hemprichii	37.5		37.5	*Codium sp.*	3.13
Syringodium isoetifolium	46.9	40.6	43.75	*Sargassum sp.*	3.13
Haludole uninervis	77.5	37.5	57.5	*Padina sp.*	3.13
Cymodocea serrulata	6.3	18.8	12.5		

There were four species of seagrasses observed and these were *Thalassia hemprichii, Syringodium isoetifolium, Halodule uninervis, and Cymodocea serrulata.* The most dominant species of seagrass was found in transect one (*Halodule uninervis*) with the 77.50% cover followed by *Syringodium isoetifolium* with 46.9% cover. Seagrass along this area have wider

leaf blades which can be indicator of luxuriant growth rather than compensation to reduced irradiance. It was noted that Nagurang Island seagrass beds were located in the deeper indention of Asid Gulf, hence more protected from waves, with hard sandy-coralline substrate. *Halophila ovalis* was not observed here maybe it was shaded by the other taller and broad-leaved species so that the species could be hidden and not sampled. According to McKinzie et al. (2003), Halophila is known as a pioneer species that can tolerate a wide range of substrates. Three seaweeds species were also encountered and with identical estimates of percent cover.

Generally, the habitat condition of seagrass communities in the four municipalities were in good condition (Table 8). This was due to the observed clear and less silt water along the sampling areas.

Table 8. Habitat condition in different Municipalities in Asid Gulf, Masbate, Philippines.

Municipality	Numerical rating %	Adjectival rating
Milagros*	52.75%	good
Cawayan*	67.21%	good
Placer**	52.00%	good
Ezperanza**	54.63%	good

Sources of data: *Milagros and Cawayan, PRSA, 2019
**Placer and Esperanza, PCRA 2010

The assessment also revealed low percent cover of seaweeds across stations (see Table 6). *Ulva lactuca* got 6.26 mean percent cover while, all the rest registered only 3.13 % cover. This might be due to the intensive collection of economically important species of seaweeds by the residents along the gulf, for instance, *Eucheuma sp.* and *Gracillaria sp* were harvested as wild stock and used in farming while, *Caulerpa racemosa* and *Codium sp.* used as food source. There were also accounts of massive harvesting of *Sargassum* in Placer and adjoining areas for undisclosed industrial use.

Table 9. Ecological indices per seagrass/seaweeds community in Cawayan and Milagros, Masbate

Municipality	Diversity (Shannon's H')		Dominance (Simpsons D)		Evenness	
	SG	SW	SG	SW	SG	SW
Cawayan	1.57	2.1	0.21	0.13	0.97	0.95
Milagros	1.35	0.94	0.26	0.42	0.97	0.85

Table 9 shows the community structure of the seagrass/seaweeds community per municipality along Asid Gulf, specifically of Cawayan and Milagros. The Shannon's diversity values for seagrass was moderately high for both municipalities. This result is maybe due to the substrate characteristic, nutrient availability and water quality which is favorable for the multi-species growth. Also, diversity values for each municipality confirmed by higher values for evenness which provides measure of occurrence equitability of encountered species. In contrast, seaweeds in Asid Gulf appear to be high in Cawayan but it is less in Milagros in terms of diversity. Seaweeds species per municipalities were different and is relatively minimal except for the occurrence of S*argassum sp.* which is abundant in Milagros, Cawayan and Placer specifically along coral reef system boundaries. This was already noted by earlier works (Mendoza et al., 2017 and BFAR-ROV PCRA, 2010).

Moreover, less macroinvertebrates were observed in both sites (Milagros and Cawayan). This can be due to the traditional gleaning and fishing activities in the seagrass and seaweeds beds. The occurrence of four food species of seaweeds species namely, *Caulerpa racemosa, Caulerpa serrulata, Codium sp., Eucheuma sp., Gracilaria sp is* an indication that Asid gulf is natural habitat for the economically important type of seaweeds. In fact, according to SEAFDEC (2008), Masbate was the 4[th seaweeds] *(guso)* producers in the Philippines and these are specifically grown along Asid Gulf (Cawayan, Placer and Esperanza). Aside from food species, industrial seaweed species were also noted such as *Halimeda macroloba*, *Ulva sp*. and *Sargassum sp.* which are used as components of liquid fertilizers and soil conditioners (Montaño & Tupaz, 1990; Trono, 1999).

Status of Mangroves in Asid Gulf.

Asid gulf's mangrove area is estimated to be covering 686 hectares. Bulk (61%) of which are within the municipal jurisdiction of Placer, despite of having just 12% contribution to the total coastline of the gulf. This is followed by Cawayan which harbors 21% (146 has). The rest of the three municipalities shared the remaining (Figure 4). Of the 47 known mangrove species in the country, only 12 are seen and observed in the sampling stations of Asid Gulf. The mangrove communities surveyed are all riverine type. Natural stands are still observed and rehabilitation efforts have shifted some sectors of the existing mangrove areas into a Rhizophora-dominated mangrove community.
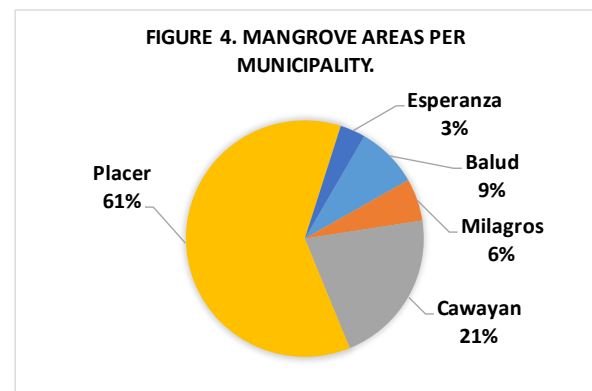

FIGURE 4. MANGROVE AREAS PER MUNICIPALITY.

Esperanza 3%
Balud 9%
Milagros 6%
Cawayan 21%
Placer 61%

Table 10 shows the very poor diversity in mangrove assemblage at Guinayangan Tonga in Balud Masbate. There were only three species with *Avecinnea marina* and *Rhizophora apiculata* dominating the number of stands (27 ad 21 respectively) and in terms of density (1080 and 840/ha respectively). Basal area however is dominated by the bigger although fewer trees of *Soneratia alba*. The mangrove trees are all natural stands. Some parts are however visibly part of the mangrove replantation efforts with *Rhizopora* as the planting material provided by the LGU of Balud. There were very few seedlings and saplings in the site hence this mangrove area has low regenerative capacity.

Table 10. Mangroves of Guinayangan Diotay, Balud, Masbate.								
Species	No. stand	Density	RD	Freq'cy	RF	Basal Area	RDom	IV
Avicennea marina	27	1080	42.86	0.5	38.46	61.28	28.77	110.09
Soneratia alba	15	600	23.81	0.3	23.08	121.73	57.15	104.03
Rhizophora apiculata	21	840	33.33	0.5	38.46	30.00	14.08	85.88
Total	63					213.01		

Table 11 shows the recent information about the mangrove assemblage of another site in Balud (Guinayangan dyotay). This mangrove area harbours six true mangrove species dominated by *C. philippinensis* in terms of number of stands (24) and density (960/hectare). Despite its relatively thicker area (approximately 315 meter from shoreline it registered a very small basal area (42 ft^2), which is again dominated by *C. philippinensis.* Same with the one in Guinayangan dyotay, regenerative capacity of this area is very low. Disturbances seen are some fresh and old tree cuttings and the fish nets that straddle in the mangroves.

Table 11. Mangroves of Guinayangan tonga, Balud, Masbate.

Species	No. stand	Density	RD	Freq'cy	RF	Basal Area	RDom	IV
Rhizophora mucronata	7	280	16.22	0.30	15.79	4.58	10.73	42.74
Rhizophora apiculata	6	240	13.90	0.20	10.53	3.55	8.31	32.75
Soneratia alba	3	120	6.95	0.20	10.53	7.21	16.89	34.36
Bruguiera sexangola	3	120	6.95	0.20	10.53	0.16	0.37	17.85
C. philippinensis	24	960	55.62	0.40	21.05	27.15	63.58	140.26
l. lumnitzera	6	6	0.35	0.60	31.58	0.05	0.12	32.04
Total	49					42.7		

Table 12 shows the mangrove assemblage of Calasuche in Milagros, Masbate. Four species were identified dominated by *Avecinnea* species. Mangroves here are very thin which fringe the river channels. They are obviously the ones left after massive conversion of mangrove areas into fish ponds. In addition of cuttings were also observed. Low basal area computed reflects how thin this mangrove area is (only 50 meters in width). Regenerative capacity is also very low.

Table 12. Mangroves of Calasuche, Milagros, Masbate.

Species	No. stand	Density	RD	Freq'cy	RF	Basal Area	RDom	IV
Avicennea marina	1	80	7.69	0.20	16.67	4.28	12.28	36.64
Avicennea rumphiana	7	560	53.85	0.60	50.00	27.65	79.34	183.19
Soneratia alba	1	80	7.69	0.20	16.67	2.64	7.58	31.93
Rhizophora mucronata	4	320	30.77	0.20	16.67	0.28	0.80	48.24
Total	13					34.85	100	

There were five true mangrove species encountered in the mangrove area assessed in in Calasuche, near Bacolod area (Table 13). Again, the thin mangrove community harbours limited number of stands of matured mangrove trees. Consequently, basal area is very low also. Here, high count of seedlings and saplings were encountered resulting to very high regenerative capacity of the area.

Table 13. Mangroves of Calasuche (near Bacolod), Milagros, Masbate.

Species	No. stand	Density	RD	frequenc	RF	Basal Area	RDom	IV
Avicennea rumphiana	5	400	35.71	0.40	28.57	7.84	64.52	128.81
Acicennea officinalis	2	160	14.29	0.20	14.29	3.98	32.75	61.33
Ceriops tagal	2	160	14.29	0.20	14.29	0.03	0.21	28.78
Xylocarpus granatum	4	320	28.57	0.40	28.57	0.04	0.30	57.44
Bruguiera sexangola	1	80	7.14	0.20	14.29	0.27	2.22	23.65
Total	14					12.151		

Table 14 shows the recent bioecological condition of the mangrove area in Placer. The mangroves in Daraga is one of the very expansive mangrove forest of the municipality. Five species of true mangroves were encountered here, dominated by *Soneratia Alba* in terms of tree stands, density and basal area. The mangroves are natural stands and with very high regenerative capacity evidenced by numerous saplings and seedlings. Solid wastes were however seen along the waterways. This can be traced from human habitation which was right at the back of the mangrove area. A matured *pototan* tree was seen to have been used as tree house in this area. Likewise, significant portion of this mangrove was converted to a fishpond.

Table 14. Mangroves of Daraga, Placer, Masbate.

Species	No. stand	Density	RD	Frequen	RF	Basal Area	RDom	IV
Avicennea marina	13	520	22.03	0.50	31.25	49.13	33.78	87.06
Soneratia alba	26	1040	44.07	0.60	37.5	76.28	52.45	134.02
Rhizophora mucronata	3	120	5.08	0.10	6.25	4.37	3.00	14.34
Aegiceras corniculatum	13	520	22.03	0.30	18.75	2.72	1.87	42.65
Bruguiera sexangola	4	160	6.78	0.10	6.25	12.94	8.90	21.93
Total	59					145.44		

CONCLUSION

Seven species of seagrasses were observed in the selected municipalities of Asid gulf, and these were *Cymodocea serrulata, Halodule pinifolia, Halodule uninvervis, Syringodium isoetifolium* of family Cymodoceaceae and *Enhalus accoroides, Halophila ovalis,* and *Thalassia hemprichi* of family Hydrocharitaceae. While 12 species were noted for seaweeds namely, *Halimeda macroloba*, *Bornetella spherica Chlorodesmis fastigiata, Codium sp., Ulva expansa, Caulerpa racemosa, Ulva lactuca,* and *Ulva reticulata* of Chlorophyta group. *Euchema sp. Gracillaria sp*. of Rhodophyta group and *Sagassum sp. and Padina sp.,* of Phaeophyta.

The highest number of species of seagrass was recorded both in Cawayan and Esperanza where five species were observed. The lowest number of seagrass species was found in Placer wherein only *Thalassia hemprichii, Syringodium isoetifolium* and *Enhalus acoroides* were seen. Also, it was in Cawayan where the highest number of species (11) for seaweeds was observed. The lowest number of seaweeds encountered in the transects was in Milagros, wherein only *Ulva lactuca* was present. The most extensive seagrass and seaweeds beds in Asid gulf was found in Cawayan while the narrowest was identified in Placer. Moreover, the seagrass and seaweeds beds of Asid gulf were fairly diverse compared to nearby locations and they were in good condition.

The observed human disturbance along seagrass and seaweeds beds in the gulf are boat anchorage, gleaning, operation of fishing gears with fine mesh nets (beach seine), near shore human settlements and unsanitary disposal of solid waste. These are frequently encountered in the sampling stations in Cawayan and Milagros. These disturbances may hamper the growth and recovery of this ecologically-important coastal habitat.

Mangroves of Asid Gulf covers around 686 hectares. Most of these mangrove areas are in Placer (61%) and in Cawayan (21%). Only five sites were successfully assessed as the sampling actions in the gulf were hampered by security reason (election time) and by the onset

of the South West monsoon. Species composition of mangroves in the assessed locations are fairly diverse as 11 species (including *Nyppa fruticans*) were encountered. Most of these mangrove areas are reduced to thin stretch of remaining trees as a result of fishpond conversion. Most of these mangroves are natural stands. The thin mangrove assemblage are the ones with very low regenerative capacities. Solid wastes, fishpond conversion and human habitation near the mangrove areas are the common disturbances seen in the five assessed locations.

RECOMMENDATIONS

Seagrass/seaweeds cover and diversity can be improved through strict implementation of management measures such as coastal use zoning to conserve marine ecosystem. A permanent monitoring site could be established to determine whether the seagrass /seaweeds beds resource is stable, improving or declining. However, with the steady population increase along coastal areas, strong political is needed to effectively implement management schemes.

Moreover, the seagrass areas should be included in the management plans in every municipality. Integrated management plans should be prepared gulf wide including seagrass beds inside the managed areas. Periodic monitoring of their status is needed. Also, local awareness on the economic and ecological benefits of the seagrass beds must be conducted.

In case of mangroves, there is a need to put in check the cases of cuttings that are still happening. Rehabilitation has obviously been started but there is a need to intensify the efforts by direct targeting of candidate locations for rehabilitation of the appropriate species. Solid waste disposal of nearby communities shall be looked into.

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WATER QUALITY ASSESSMENT IN ASID GULF

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ABSTRACT

In-situ and laboratory scale water quality assessment were conducted among the identified water quality stations in Asid Gulf. Specifically, there were 20 established stations for in-situ measurements while six were identified as water quality sampling stations. Selection of number and locations of these stations were based on prevailing situations and issues in the gulfs. Philippine water quality is assessed based on the set of beneficial use as defined in a set of standards. Accordingly, a water body must meet the corresponding criteria of each applicable parameter 100% of the time to maintain its designated classification. This project, as part of the Participatory Resource and Socioeconomic Assessment Program, aims to establish baseline measurements for primary water quality parameters for marine waters and to assess the conditions of the water in the identified gulf.

Two approaches were employed in the assessment of primary water quality parameters in Asid Gulf. These are in-situ measurements and laboratory analysis. All measured primary parameters were compared to the standards and minimum and range limits set under the Department of Environment and Natural Resources Administrative Order (DAO) 2016-08 for SB classifications and usage. Primarily, the identified stations were covered by the municipalities of Balud, Milagros, Cawayan, Placer, and Esperanza. Results showed that the condition of Asid Gulf conforms to the standards set by DAO 2016-08 considering the SB water classification and usage of marine waters. pH is almost similar in all stations, ranging from 8.11 to 8.47 while dissolved oxygen (DO) have normal readings with a narrow range of 6.48-8.51 ppm. Temperature along the water quality station ranged from 29.60 to 32.20 ^{0}C. The mean values recorded for the in-situ parameters were identified and the predominant activities encountered in the area further implies good water condition prevailing within the gulf. This is based on its comparison against the existing DAO 2016-08 water quality guidelines. However, some of the identified stations exceeded the limits set by the standards for nitrate (7.73-14.35 mg/L), phosphate (0.14-5.04 mg/L), and fecal coliform levels (<1.1 and 300 MPN/100ml). This implies that some of the parameters for the water quality stations are perturbed. The high nitrate and phosphate concentration can be ascribed to agricultural runoff and the prevailing nutrient load of the seawater. On the other hand, the high fecal coliform values from the identified stations can be attributed to sources like runoffs, waste discharge, domestication of animals, and poor sanitation compliance along coastal areas.

Keywords: Water quality, standards, laboratory tests

INTRODUCTION

Water quality is commonly defined as a measure of the physical, chemical, biological, and microbiological characteristics of water—assessment of which would provide empirical evidence to support decision making on health and environmental issues. This assessment is used to alert the community to current, on-going, and emerging problems; to determine compliance with existing standards; and to protect the known beneficial uses of water. In this study, water quality assessment was carried out in selected stations scattered along the Asid Gulf. The selection of these stations was based on prevailing situations and issues in the gulfs. The criteria included the presence marine protected areas (MPAs), aquaculture sites, recreational zones, and industries with the potential of perturbing the coastal environment.

Marine environments like Asid Gulf are important for fisheries as they provide habitats for many marine living species. Basically, the water quality of gulfs is influenced by natural environmental processes and human activities. Philippine water quality is assessed based on the set of beneficial use as defined in a set of standards. The Department of Environment and Natural Resources (DENR) – Environmental Management Bureau (EMB) has issued DENR Administrative Order (DAO) No. 2016-08: Water Quality Guidelines (WQG) and General Effluent Standards (GES) of 2016 on May 24, 2016. The release of the guidelines repealed DAO 1990-34 (Revised Water Usage and Classification/Water Quality Criteria) and DAO 1997-23 (Updating DAO 1990-34), as modified DAO 1990-35 (Revised Effluent Regulations of 1990). Under this DAO, there are 10 primary parameters that define the desired water quality per water body classification. Accordingly, a water body must meet the corresponding criteria of each applicable parameter 100% of the time to maintain its designated classification. Water body classification and usage of marine waters was also specified in the standard, such as Class SA (protected waters, fishery water class I), SB (fishery water class II and tourist zones), SC (fishery water class III, marshy and mangrove areas), and SD (navigational waters). As outlined in DAO 2016-08, primary parameters are set as minimum water quality parameters to be monitored in a water body. The quality guidelines (WQG) enumerates dissolved oxygen (mg/L), fecal coliform (MPN/10ml), nitrate as NO_3-N (mg/L), pH (range), phosphate (mg/L), temperature, (0C), and total suspended solids (TSS, mg/L).

This study determined the status of the basic water quality of Asid Gulf by establishing baselines of the primary water quality parameters for marine waters. Specifically, the study aimed:

a. To establish baseline measurements for primary water quality parameters for marine waters in Asid Gulf, such as:

1. pH
2. Dissolved oxygen (DO)
3. Temperature
4. Total Suspended Solids
5. Nitrates
6. Phosphates and
7. Fecal coliform

b. Assess the conditions of waters in Asid Gulf based on the established stations

METHODOLOGY

Fig. 1 Water quality stations at Asid Gulf

Twenty stations were established for in-situ measurements while six were identified as water quality sampling stations. These stations were prioritized based on the locations of marine protected areas, aquaculture projects, ecotourism facilities, and proximity of potential discharging industries. The sampling stations were covered by the municipalities of Balud, Milagros, Cawayan, Placer, and Esperanza.

Two approaches were employed in the assessment of primary water quality parameters in Asid Gulf. These were in-situ measurements and laboratory analysis. Laboratory analyses for nutrients (phosphate ad nitrate), fecal coliform, and Total Soluble Solids (TSS) were undertaken at the Regional Center for Food Safety and Quality Assurance laboratory of the Office of the Vice President for Research Development and Extension of Bicol University.

Sample Collection

Water samples were collected at specified stations at three- and five-meters depth using a Kemmerer water sampler. At least 20 sampling stations were established in Asid Gulf and the sanctuaries were prioritized for their identification and assignment. Samples were collected following the recommended sampling protocols and were immediately conditioned in sterile polyethylene bottles as part of the proper sample handling prior to laboratory analyses.

In-situ Measurements

Physical parameters such as temperature, dissolved oxygen, and pH were obtained using Hanna multi-parameter water quality meter (HI 91894) with the capacity to read simultaneous recordings of at least seven parameters with an instrument probe deployable to up five meters maximum depth. This instrument can also measure temperature, salinity, conductivity, oxidation-reduction potential (ORP), and others.

Laboratory Analyses

Fecal Coliform (MPN/100mL). For this analysis, the Multiple Tube Fermentation Technique (MTFT) was employed. Fecal coliform may be distinguished from another coliform by means of EC medium. All presumptive fermentation tubes or bottles showing formation of gas, growth, and acidity were subjected to fecal coliform test.

Nitrate as NO₃-N (mg/L). Brucine colorimetric method using UV-Vis Spectrophotometer is applicable for the analysis of surface, drinking, saline, domestic and industrial wastes. However, certain modifications can be made to remove and correct the turbidity, color, salinity, or dissolved organic compounds in the collected samples. This method is based on the reaction of nitrate ion with brucine sulfate in a 13N H_2SO_4 solution at a temperature of 100^0C. The color of the resulting complex is measured at 410 nm. Temperature control of the color reaction is extremely critical.

Phosphate (mg/L). The Vanadomolybdophosphoric Acid Colorimetric Method was used. Phosphate content of water samples were determined using the Vanadomolybdophosphoric Acid Colorimetric Method with Spectrophotometer as Colometric equipment to measure the yellow intensity of the solution when vanadomolybdophosphoric acid is formed. In a dilute orthophosphate solution, ammonium molybdate reacts under conditions to form a heteropoly acid and molybdophosphoric acid. In the presence of vanadium, yellow vanadomolybdophosphoric acid is formed. The intensity of the yellow color is proportional to phosphate concentration.

Total suspended solids (mg/L). The conventional filtration and drying method were employed. Mixed sample was filtered through a weighed standard filter and the residue retained on the filter is dried to a constant weight at $103\text{-}105^0$C. The increase in weight of the filter represents the total suspended solids.

All measured primary parameters were compared to standards and minimum and range limits set under the DAO 2016-08 for SB classification and usage. GIS maps to depict selected water quality conditions within each gulf shall be made.

RESULTS AND DISCUSSION

In-situ measurements of water quality assessment

Table 1 summarizes the results for the in-situ measurements on different parameters for Asid Gulf water quality stations.

Table 1. Physico-Chemical Characteristics of Asid Gulf Water Quality Stations

Station	Site Description	pH	Temp (^{0}C)	DO (mg/L)	Cond (µS/m)	TDS (ppt)	Salinity (PSU)
DAO 2016-08		*6.5-8.5*	*25-31*	*5-6*			
WQAS1	Milagros Aqua	8.47	31.63	7.22	46.44	23.53	33.26
WQAS2	Asid River Exit	8.31	32.20	7.51	46.43	23.66	33.43
WQAS3	Milagros MPA	8.14	31.92	7.31	46.50	23.41	32.50
WQAS4	Pangui Open, Balud	8.16	31.45	7.33	46.54	23.40	33.07
WQAS5	Seaweed Farm, Balud	8.15	30.57	7.45	46.41	23.27	32.96
WQAS6	Esperanza, MPA	8.15	30.57	7.45	46.41	23.27	32.96
AS1	Talisay, open	8.11	31.35	7.30	46.50	23.42	33.13
AS2	Bangad, open	8.12	31.50	7.33	46.53	23.41	33.08
AS3	T. Pag Island, Open	8.15	30.56	7.61	46.39	23.27	32.95
AS4	T.Pag Island	8.14	30.68	8.51	46.43	23.97	32.91
AS5	Mayong-payong	8.13	30.20	6.56	46.43	23.22	32.90
AS6	Guinyangan Diotay, open	8.13	30.65	7.27	46.55	23.25	32.00
AS7	Palanduta	8.23	30.85	7.25	46.61	23.31	32.98
AS8	Jintotolo Is, open	8.20	30.65	8.32	46.55	23.27	32.91
AS9	Gilotongan Is, open	8.17	30.26	6.76	46.33	23.16	32.82
AS10	Naro Is, open	8.18	29.60	6.55	46.29	23.15	32.85
AS11	Near Naro Island	8.16	30.30	6.53	46.48	23.23	32.89
AS12	Binagsac	8.18	30.73	7.20	46.54	23.32	32.91
AS13	Guinawayan Is	8.18	31.48	6.74	46.81	23.39	33.07
AS14	Nagarao	8.18	30.63	6.48	46.51	23.25	32.92
AS15	Cobre Island	8.26	30.47	6.69	46.26	23.16	32.70
AS16	Kampato, open	8.23	31.47	6.70	46.61	23.27	32.90
AS17	Namatyan Is	8.20	30.63	6.66	44.80	22.41	31.59
AS18	Guiniurangan	8.18	31.52	6.65	46.81	23.48	33.09
AS19	Bara	8.23	30.64	6.63	44.85	22.42	31.61
AS20	Tigbao, open	8.22	31.54	6.62	46.83	23.44	33.10

Note: Results are reflected as means of three determinations

Temperature and Salinity

The reading profile of Asid Gulf shows that the temperature along the water quality station ranged from 29.60 to 32.20 ^{0}C (see Figure 2). These values are slightly higher than the recommended temperature values as stated in DAO 2016-08. The highest value was recorded at Milagros Aquaculture while the lowest value was obtained from Talisay open waters.
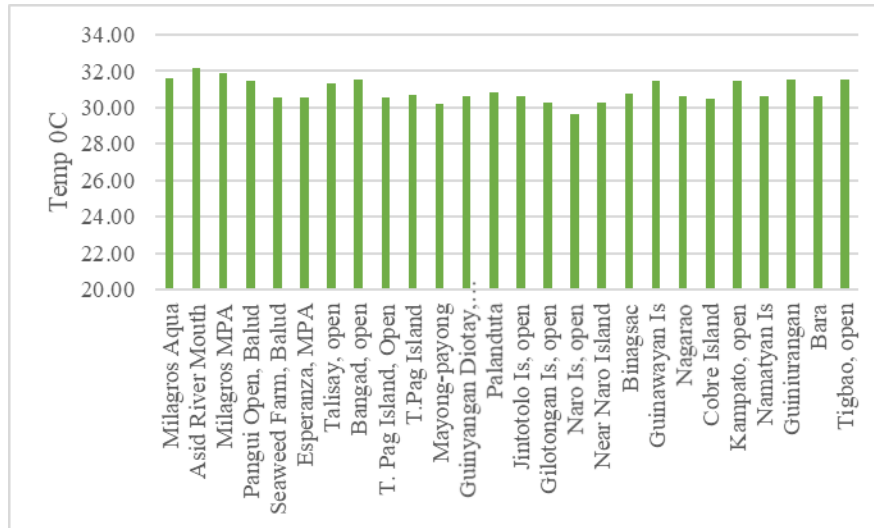
*Fig. 2 Temperature readings at Asid Gulf*

The predominant temperature of the water is an important variable in aquaculture areas, and—in most cases—it cannot be controlled. This variable depends on the amount of solar radiation, air temperature, and even the temperature of water that passes through the aquaculture area. Temperature strongly affects aquatic animals, and this is critical for efficient operations. Phytoplankton and zooplankton also respond to temperature and warm water favors greater rates of chemical reactions. Therefore, temperature is an important factor affecting the growth and survival of all organisms. In Asid Gulf, readings varied in different stations, but with only minimal differences that did not exceed 1°C. These differences may be due to the time the samples were taken. However, this observed range in difference in the recorded temperatures of the water is still within the allowable temperature range as stipulated in DAO 2016-08 which is 25-31^{0}C for SB classification of water.

Salinity, on the other hand, is the measure of dissolved salts in a concentration of water. Salts in marine water not just include sodium chloride but also other elements such as calcium, magnesium, and potassium. These substances can easily get into the ocean through several complex and less complex processes. Salinity measurements along the identified stations were observed to be ranging from 31.59 to 33.43 psu, the highest of which was recorded in Asid River Exit while the lowest was obtained near Namatyan Island. There were no standards set for the allowable limits of salinity measurements required in DAO 2016-08. However, salinity values normally range from 34 to 36 psu. It can be observed that the salinity values near the exit of rivers are higher compared to other sampling stations. This variation may be due to the varying influences of river inputs and the submarine ground discharge (SDG) of fresh water. Generally, salinity is controlled by a balance between water removed by evaporation, freshwater added by rivers and SDG, and amount of precipitation received by the water body. It can also be noted that the sampling station with the highest recorded temperature is also the station that has the highest salinity values. This can be attributed to the fact that temperature is also an important factor that affects the salinity of water. The rate of evaporation from the surface water that is due to an increase in temperature removes water molecules, which eventually affects the salinity concentrations in water.

Total Suspended Solids (TSS) and Total Dissolved Solids (TDS)

Total suspended solids (TSS) on the other hand, measures the concentration of undissolved solid particles in water and is a significant factor in observing water clarity. These solids include anything drifting or floating on the water from sediments and silts. Even chemical precipitates are considered a form of suspended solids.

Total suspended solid (TSS) values recorded among the water quality sampling stations in Asid Gulf ranged from 18.33 to 60.00 ppm, the highest of which was obtained from a seaweed farm while the lowest was recorded at the water quality station in Pangui, Balud (see Figure 3). Comparing these obtained values with the existing DAO 2016-08, it can be noted the seaweed farm in Balud exceeded the TSS limit for SB classification of marine water. These suspended particles can come from soil erosion, runoffs, and even discharges. High concentrations of TSS in water have several negative effects, such as decreasing the amount of light that can penetrate the water, which would slow down photosynthetic process that in turn can lower the production of dissolved oxygen. It can also elevate absorption of heat from sunlight, thus increasing the temperature, which results to lower oxygen levels. The clarity of water is also affected, thereby lowering the visibility of organisms to hunt for food. In some cases, higher TSS levels is an indicator of higher concentration of bacteria, nutrients, and pollutants in water.
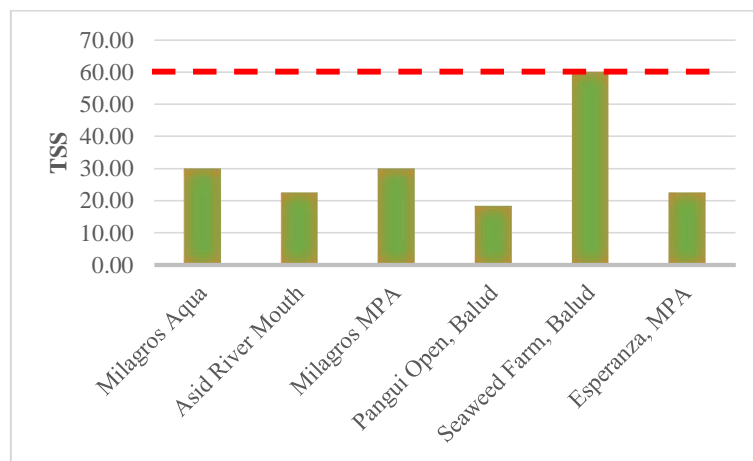

Fig. 3 Total Suspended Solids

Total dissolved solids (TDS) is another parameter that has been considered in this assessment. This comprises all the disassociated electrolytes that make up salinity concentrations, as well as other compounds, such as dissolved organic matter, and may even include organic solutes, such as hydrocarbons and urea in addition to salt ions. The measured values along the stations in Asid Gulf showed variety in terms of TDS. Recorded values exhibited slight variations ranging from 23.97 ppt as the minimum value to 22.41 ppt as the highest recorded value for TDS. There is no standard value for TDS in DAO 2016-08. These recorded values, however, are still acceptable for seawater since a constant level of minerals in water is necessary for aquatic life. This further supports the density of TDS that determines the flow of water in and out of an organism's cells. This can also be attributed to the contribution

on the TDS levels brought about by urban run-offs while some dissolved solids come from organic sources such as leaves, silt, and other waste and sewage.

Electrical Conductivity (EC)

Conductivity is a well-known measure of water's capacity to pass electrical flow and this ability is directly related to the concentration of ions in the water. These ions come from dissolved salts and inorganic materials, such as chloride, sulfides, and the like. Seawater is expected to have a very high conductivity due to the presence of salt ions, which conducts electricity as an effect of positive and negative charges. The conductivity values recorded for the sampling stations in Asid Gulf ranged from 44.80 to 46.83 mS/cm. Conductivity is not a pollutant itself, rather it serves as an indicator of the presence of pollutants. The conductivity is affected by the presence of dissolved substances in the water, including salts and even heavy metals. Some of these substances are known to be harmful to aquatic life and to humans, especially at high concentrations. DAO 2016-08 has no standard for the EC values of marine waters.

pH and Dissolved Oxygen (DO)
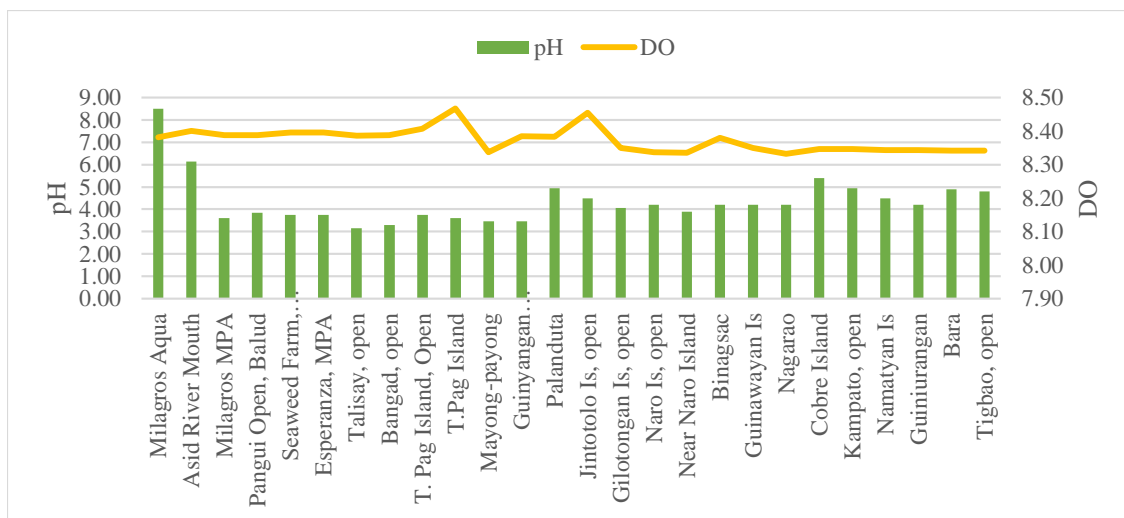
Fig. 4 pH and DO levels

pH is almost similar in all stations, ranging from 8.11 to 8.47. This range is normal, in which ocean water is nearly alkaline because of numerous dissolved ions that most are alkaline in nature. pH is interdependent with other quality parameters, such as carbon dioxide, alkalinity, and hardness. It can be toxic in itself at a certain level and greatly affects the toxicity of hydrogen sulfides, cyanides, heavy metals, and even ammonia. All recorded values fell within the standard allowable pH value for Class SB marine waters. This further indicates that the water is in good condition in terms of pH buffering system. As pH moves away from the standard range, either up or down, it can stress the system and reduce hatching and survival rate. In addition to these biological effects, extreme pH levels usually increase the solubility of

elements and compounds, which further makes toxic chemicals more mobile and increasing the risk of absorption by aquatic life.

With regard to DO, all stations had normal readings with narrow a range of 6.48-8.51 ppm. Highest DO was encountered at T. Pag Island. DO is also one of the parameters of paramount importance in aquatic systems. In marine waters, oxygen is available in a dissolved state and can be found in microscopic bubbles mixed between water molecules. These dissolved oxygens can enter the system through direct diffusion and as a by-product of photosynthesis. DO is considered as one of the most important aspects of aquaculture since it is needed by fish to respire and perform metabolic activities.

Nutrient Levels

Nutrients, such as nitrates and phosphates, are essential for plant and animal growth and nourishment. However, the overabundance of certain nutrients in water can eventually cause several adverse and ecological effects. Summarized in Table 2 are the nutrient levels in Asid water quality stations, particularly nitrates and phosphates expressed in mg/L.
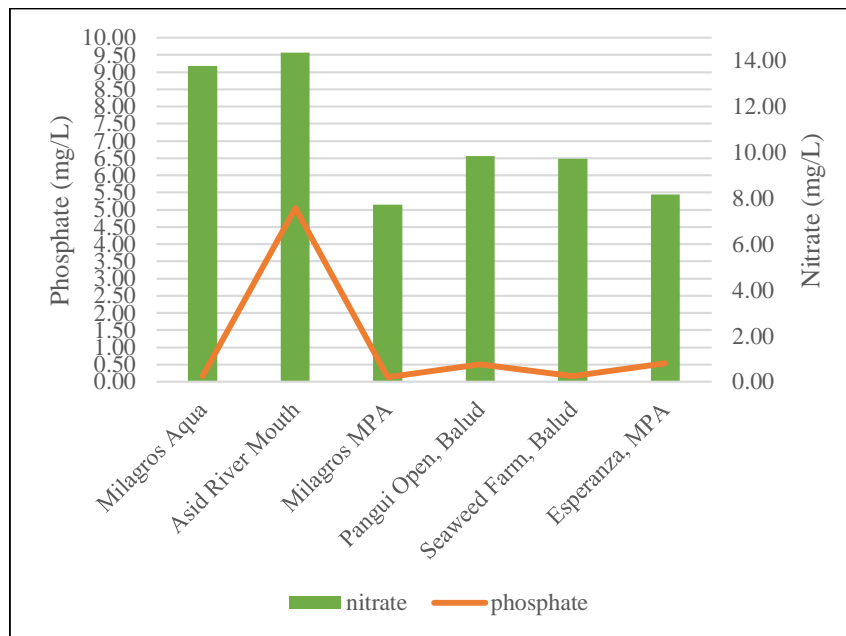

Fig. 5 Nitrate and Phosphate levels

Nitrates (NO_3-) as nitrogen and phosphates as phosphorous were measured along water quality sampling stations in Asid Gulf. Nitrate levels in Asid gulf ranged from 7.73 to 14.35 mg/L (ppm). Comparing these obtained values with the standard limits set by DAO 2016-08, it can be deduced that two stations (Milagros Aquaculture and Asid River Exit) exceeded values for SB classification. Nitrates also come from the earth. Soil contains organic matter, which contains nitrogen compounds. Although nitrates occur naturally in soil and water, an excess level of nitrogen can be considered as contaminants. Nitrogen is one of the limiting nutrients used during the photosynthetic process. Nitrogen is largely controlled by redox reactions mediated by phytoplankton and bacteria. Nitrate is formed through the nitrification process through oxidation of NO_2 into NO_3 by the action of aerobic bacteria. Same with DO, temperature, and pH, the levels of nitrates in water is determined both by natural processes and human intervention. Marine water may have naturally high levels of nitrates or elevated nitrate levels

as a result of human activities. Nitrogen fertilizers that have been applied to agricultural areas to promote the growth of plants may be washed off by rainwater into streams and rivers, eventually leading to marine waters. In addition, this can also occur in animal wastes sand manure. Fish and aquatic organisms can be affected indirectly by increased nitrate concentration in water. Basically, any excess nitrate in water is a source of fertilizer for aquatic plants and algae. Excess plants in a body of water creates an unstable amount of dissolved oxygen. During the day, high levels of DO is expected and, at night, levels of oxygen can decrease dramatically, thereby creating a stressful environment for aquatic organisms.

On the other hand, the phosphate levels measured along the Asid Gulf water quality stations range from 0.14 to 5.04 mg/L (ppm). These values suggest strong variation among the stations. The majority of the stations showed higher phosphate levels compared to the limit set by the standard for SB classification. Phosphates in water come from a variety of sources and runoff from fertilizer is one contributor. Other factors may be due to sewages, runoff from areas lacking sufficient vegetation to hold soil in place, and even use of detergents that contain phosphates from surrounding communities. Phosphates are chemicals containing the element phosphorous and they affect water quality by causing excessive growth of algae that eventually lead to algal blooms that can produce neurotoxins and hepatoxins.

Fecal Coliform (FC) Levels in Asid Gulf

Table 2 presents the fecal coliform levels within the water quality stations in Asid Gulf. As observed, Milagros Aquaculture and Asid River Exit had the highest fecal coliform. FC has been widely used as a standard indicator of the presence of sewage pollution and potential health hazards associated with fecal pollution.

Table 2. Fecal coliform levels

Station	Site Description	Fecal Coliform (MPN/100ml)
DAO 2016-08		100
WQAS1	Milagros Aqua	300
WQAS2	Asid River Exit	300
WQAS3	Milagros MPA	200
WQAS4	Pangui Open, Balud	100
WQAS5	Seaweed Farm, Balud	100
WQAS6	Esperanza, MPA	<1.1

Although FC is generally not harmful by itself, it indicates the possible presence of pathogenic (disease causing) bacteria, viruses, and even protozoans that also live in human and animal digestive systems. Therefore, the presence of fecal coliform in water suggests that pathogenic microorganisms might also be present and that swimming and eating shellfish might be a health risk.

A majority of the alarming values obtained from the water quality sampling stations in Asid Gulf exceeded the limits set by DAO for SB classification. FC may be linked to human population and anthropogenic activities as observed from the highest recorded values of FC from opening of rivers. The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man, or even animals. FC bacteria can enter these rivers through the discharge of waste from agricultural and storm runoff, as well as from untreated human sewage. Agricultural practices, such as allowing animal wastes to wash into nearby streams during the rainy season, spreading manure and fertilizer on fields during rainy periods, and allowing livestock watering in streams can all contribute fecal coliform contamination.

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

There were 25 established stations for in-situ measurements, while six stations were identified as water quality sampling stations, in Asid Gulf. These stations were prioritized based on the locations of marine protected areas, aquaculture projects, ecotourism facilities, and proximity of potential discharging industries. Primarily, sampling stations in Asid Gulf covered the municipalities of Balud, Milagros, Cawayan, Placer, and Esperanza.

The physico-chemical characteristics of the waters in the identified gulf was measured using multiparameter water quality meter. Water temperature can affect the metabolic rates and biological activity of aquatic organisms. The temperature in the water quality stations ranged from 29.60 to 32.20 ^{0}C, a slightly higher value compared to the limit set by the standard, 25-31.00 ^{0}C. This means that as far as water temperature is concerned, Asid Gulf is in good condition. pH was similar in all stations. ranging from 8.11 to 8.47. All recorded values fell within the standard allowable pH value for Class SB marine waters, which indicates good condition and buffering capacity of Asid Gulf water. If the pH is too high or low, the aquatic organism living within the area would eventually die. Apart from this effect, pH can also affect the solubility and toxicity of chemicals and heavy metals present, if any, in water.

With regard to DO, all stations had normal readings with a narrow range of 6.48-8.51 ppm. The highest DO was encountered at T. Pag Island. These values even surpassed the 6 ppm DO level set as the standard—an indication of good water condition to support the survival of all aquatic organisms. Adequate DO is necessary for good water quality and oxygen is a necessary element to most forms of life. When dissolved oxygen concentration drops, major changes in the aquatic environment can occur. For TDS, recorded values exhibited slight variations ranging from 23.97 ppt as the minimum value to 22.41 ppt as the highest recorded value. There is no standard value for TDS in DAO 2016-08. These recorded values, however, are still acceptable for seawater since a constant level of minerals in water is necessary for aquatic life.

Total suspended solid (TSS) values recorded among the water quality sampling stations in Asid Gulf ranged from 18.33 to 60.00 ppm, the highest of which was obtained from a seaweed farm while the lowest was recorded at the water quality station in Pangui, Balud. Comparing these obtained values with DAO 2016-08, it can be noted that the seaweed farm in Balud exceeded the TSS limit for SB classification of marine water. These suspended particles can come from soil erosion, runoffs, and even discharges.

Nitrate levels in Asid Gulf ranged from 7.73 to 14.35 mg/L (ppm). Comparing these obtained values with the standard limits set by DAO 2016-08, it can be deduced that two stations (Milagros Aquaculture and Asid River Exit) exceeded values for SB classification. Nitrates also come from the earth. Soil contains organic matter, which contains nitrogen compounds. Although nitrates occur naturally in soil and water, an excess level of nitrogen can be considered contaminants. Like DO, temperature, and pH, the amount of nitrate concentrations in water is determined by both natural processes and human interventions. A body of water may be naturally high in nitrates or have elevated nitrate levels as a result of human activities. Although nitrates can occur naturally, excess levels can be considered contamination. Most sources of excess nitrates come from human activities and can be traces to agricultural activities, human wastes, or industrial pollution. The nitrates in nitrogen fertilizers can be washed by rainwater into streams or rivers. This run-off problem is serious,

especially when the fertilizer is animal waste or manure. In addition to animal waste, untreated human sewage can also contribute to high nitrate levels.

On the other hand, the phosphate levels measured along the Asid Gulf water quality stations ranged from 0.14 to 5.04 mg/L (ppm). These values suggest a strong variation among the stations. The majority of the stations showed higher phosphate levels compared to the limit set by the standard for SB classification. Some stations exceeded the phosphate concentration limits for class SB of marine water, which is 0.5 mg/L. Phosphorous generally gets into the water through urban and agricultural settings. It tends to attach to soil particles and move into surface water bodies from run-off. This excess phosphates in water, as can be observed from the values obtained for the water quality stations near the opening of rivers, can affect water quality by excessive algal growth. Fertilizers containing phosphates can also be a factor in elevated levels of phosphates in water systems. Applying chemical fertilizers to soil that has been already saturated with phosphates and spreading excessive amounts of manure on land causes phosphates to run off during heavy rainfall through rivers and streams.

While fecal coliform levels within the water quality stations in Asid Gulf, Milagros Aquaculture and Asid River Exit had the highest fecal coliform and exceeded the 100 MPN/100 ml limits for SB classification of marine water. This could possibly mean that the presence of fecal coliform bacteria in aquatic environment indicated that the water has been contaminated with the fecal material of humans or other animals. At the same time, the water may have been contaminated by pathogens or disease-producing bacteria or viruses that can also exist in fecal matter.

In general, water quality in Asid Gulf is compliant to the standards set by DAO 2016-08, based on physico-chemical characteristics, such as pH, dissolved oxygen, temperature, and salinity. However, the nutrient levels (nitrates and phosphates) and the fecal coliforms recorded within the identified water quality stations obviously surpassed the limits for class SB for these parameters. The high nitrate and phosphate concentration can be ascribed to agricultural runoff, in addition to the nutrient load of the seawater. On the other hand, the high levels of fecal coliform values from the identified stations compared to the limits can be attributed to sources like runoffs, waste discharge, domestication of animals, and poor sanitation.

Given the same water quality conditions prevailing in Asid Gulf in comparison with DAO 2016-08, more stringent water quality monitoring is recommended especially for the stations that exhibited irregular values for important water quality parameters. This can be done through regular monitoring as directed by regulatory guidelines. In addition, the high levels of nutrients, such as nitrates and phosphates in some of the water quality stations within the gulf, which can be attributed mainly to agricultural contributions, calls for a need for the local government to revisit its conditions and management for sustainable agriculture. The solid waste management and proper household and industry sanitation initiatives of the municipalities along Asid Gulf should also be enhanced, taking into consideration the seemingly alarming fecal coliform levels in areas near rivers and aquaculture sites.

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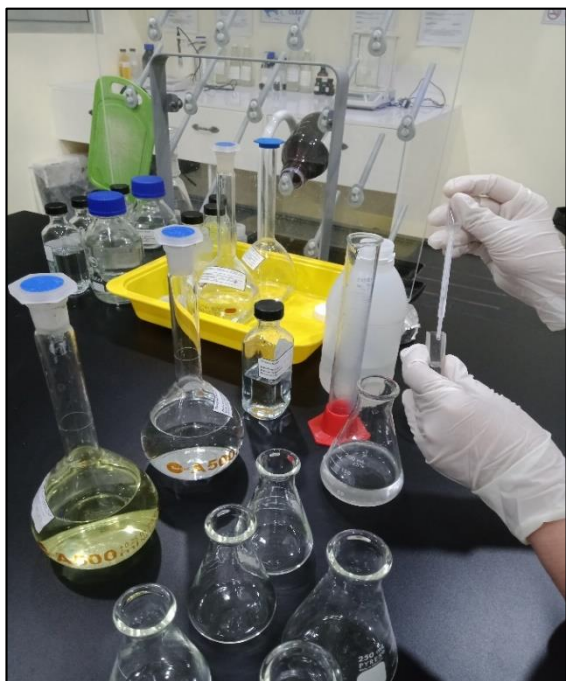
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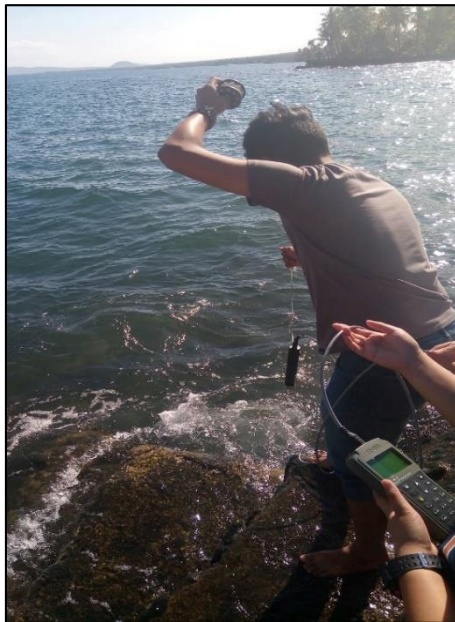
Method standardization on the use of multiparameter water quality meter and kemmerrer bottle

In-situ measurements and sample collection at Asid Gulf

Sample preparation and laboratory analyses

CATCH AND EFFORT ASSESSMENT OF FISHERIES IN ASID GULF, PHILIPPINES

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Abstract

Fishing is not just an industry but a way of living for the communities located within Asid Gulf. The study utilized different methodologies, such as structured interview and reports, in collecting primary and secondary data from the key officers. Key informant interview technique was also used to gather necessary data from the fishermen and officers of the local fishing organizations in the municipalities of Balud, Cawayan, Esperanza, Milagros, and Placer. The study revealed that the gulf is rich in crabs and squids. Entangling nets have the largest production (30.90%) compared to other fishing gear categories, with a 7,284.28 metric-ton annual catch. Other gear categories with large production are handlines and impounding nets that produce 5,473.89 (23.22%) and 5,305.09 (22.50%) metric tons a year, respectively. Other gears were also observed and some of these were identified as illegal. It was observed that fishing is a family activity where the spouse and children helped in the preparation stage, like mending the fishing gears during lean season. The study concluded that weather conditions and their impact to seasonality of gear types are evident and are dependent on the target species of specific fishing gears. Catch rates of operations and fishing efforts manifest a high exploitation level in the gulf area. Likewise, fishing operations and fish catch within the gulf area will continue to decline if the community and stakeholders will not respond proactively to the issues of overfishing and illegal fishing.

Keywords: Asid Gulf Capture Fisheries

1. INTRODUCTION

Fishing is a dynamic industry in the country that contributes to income, employment, foreign exchange earnings, and nutrition (Daw, Paca, & Navarro, 2010). In Asid Gulf, Masbate, it is more than an industry, but a way of life deemed as the major source of livelihood in coastal communities that has been passed down from generation to generation (Daskalov, 2002).

In 2006, the Philippines ranked eighth among the top fish-producing countries in the world with a total production of 4.41 million metric tons (BFAR, 2006). In 2016, the country ranked 10th in the list of top-producing nations of marine products with an annual catch of 1,865,123 metric tons (FAO, 2018).

The Marine Resource Assessment of Asid Gulf (MRAG) identified the existence of fishes and invertebrates in the gulf with high value in the local and national markets. These included scallops, sardines, seahorses, sea cucumbers, sea snakes and abalone (DOST PCAARRD, n.d.). The coastal habitats of the gulf, such as coral reefs, mangroves, and seaweed beds showed high levels of perturbation.

Studies undertaken by the Bureau of Fisheries and Aquatic Resources (BFAR), showed a steady decline in seafood supply in the Visayan Sea since the 1980s. The decline was caused by blast fishing, trawls, danish seines, and other destructive gears in municipal waters (PNA, 2018). MRAG also revealed that illegal fishing methods were still used in the gulf (DOST PCAARRD, n.d.). Oceana Philippines observed that in the Visayan Sea, overfishing, illegal fishing, and the destruction of key marine habitats caused the fish population to decline by 70% (Ramos, G. (2018) . The decline was a result of massive overfishing and fishers' retreat from fishery due to low economic returns (Bobiles & Soliman, 2017). Scallop production in the gulf also declined by from 86% in 2003 to 79% in 2007 due to overfishing (Bobiles & Soliman, 2018). The marine protected areas play a crucial role in reviving the coastal ecosystem in protecting fish stocks, scallops, and other invertebrate fisheries (Mendoza & Soliman, 2017).

Considering the uncertainty of the volume, number of catches, type of marine resources, and the danger that might occur due to environmental conditions, the fisherfolk of Asid Gulf constantly explore the marine area using popular fishing techniques and approaches available in the local communities.

The fishery dynamics of a given fishing ground provides vital information for the rational management of its marine resources. However, this requires timely, adequate, and reliable information about the resource and its uses. The study intends to assess the catch and effort of fishery in Asid Gulf, specifically to determine the number of gear units and gear types that exploit fishery resources in the gulf, seasonality of different gear units and types, catch rates, and fishery production estimates.

2. MATERIALS AND METHODS

2.1 Study Site

Asid Gulf is located at the northern region of the Visayan Sea, a major fisheries area for sardines, blue swimming crabs, and squid (PNA, 2018). The gulf is surrounded by the coastal towns of Balud, Milagros, Cawayan, Placer, and Esperanza, extending to a coastal length of 142 km. It is located at 12°11'9.78 north latitude and 123°27'21.99 east longitude. The fishing ground area covers about 2,475.95 km^2. A small portion (215.09 km^2 or 8.69%) is considered as offshore.

2.2 Gear Inventory

Key informant interview was used to identify the different fishing gears, number of units, and number of fishing operations. Interviews were conducted in 64 coastal communities located in five municipalities within Asid Gulf. The communities were represented by 11 fisherfolks from Balud, 13 from Milagros, 12 from Esperanza, 14 from Placer, and 14 from Cawayan.

2.3 Catch and Effort Analysis

Recall interview was used to identify the fish catch, fishing operations, and seasonality of various fishing gear types per category. Key informant interviews were utilized to identify the historical data on catch rate (e.g., kg/trip), fishing trips (e.g., trips per week, per month, and per year), and gear seasonality (peak and lean months). This was validated through the same methodology conducted with different groups of respondents, such as organization officers and local traders.

Fishing efforts were assessed by multiplying the average annual fishing trips and count of gear unit. The collected data were analyzed to determine the total fishing gears and the volume of catch per fishing operation. Recall interview was also utilized to identify the data on catch composition. Only the members of the fishing communities with a minimum of five

years' exposure in the gulf were the subject of the study. Persons involved in the fish landing were also part of the key informant interview. Secondary data from government agencies and offices were also utilized.

2.4 Fishery Production Estimation

The result of data validation was used to estimate the overall production of fishing gear types in the gulf and the municipalities located in the area. The production per type of gear was determined by identifying the product of catch rate per specific gear unit multiplied by the product of fishing frequency and number of specific gear unit. The summation of the total fishery production per municipality shows the total fishery production in the gulf.

3. RESULTS AND DISCUSSION

3.1 Units and types of fishing gears operating in Asid Gulf

Fishing is the main source of income of the communities living in the coastal areas. A number of fishing gears were used by different groups of fisherfolks in Asid Gulf. These were classified into different categories, namely: entangling nets, impounding nets, handlines, longlines, spears, gleaning, barriers and traps, miscellaneous hand instruments and others. This classification was based on Umali (1950).

The specific gears used have corresponding local terminologies.

Entangling nets:
    a. Bottom set gill net: "Tabudlak", "Panggisaw" and "Latab";
    b. Drift gill net: "Palutang", "Pamo", "Pangtabagak" and "Pangkanuos";
    c. Drift gill net haftbreaks: "Bugkat";
    d. Gill net for crabs: "Pangkasag";
    e. Trammel net: "3-ply";
    f. Encircling gill net: "Likos"; and
    g. Shrimp net: "Pamasayan".

Impounding nets:
    a. Push net "Hudhod";
    b. Crab lift net: "Bintol" for crabs and mud crabs;
    c. Bagnet: "Layalaya";
    d. Beach seine: "Baling";
    e. Trawls such as midwater trawl "Palupad"
    f. Danish trawl: "Hulbot hulbot",
    g. Pen seine: "Lapak", finternet "Tangab"; and
    h. Ring net "Kalansisi".

Handlines:
    a. simple handline "Kawil";
    b. troll line "Kalansisi";
    c. multiple trawl line "Rambo";
    d. artificial bait "Buyod-buyod";
    e. Pole and line "Bigawnan";
    f. Multiple handline "Og og";
    g. Squid jigger "Tina-tina"; and
    h. Bottom set long line: "Kitang"

Table 1. Total number of fishing gear variants and number of gear units per gear category

Gear Categories	Total Number of Gear Units	Number of Variants
Entangling net	2,397	12
Handlines	2,365	7
Longlines	692	1
Impounding net	1,924	4
Barriers and traps	666	11
Spears	405	3
Miscellaneous hand instruments	613	1
Others	317	3
Total	9,379	42

Different approaches using spears were practiced, such as the use spear gun or "pana," of "flashlight" at night, and of compressor or "pana-compressor." Gleaning or "panginhas," sodium cyanide or "tubli," and blast fishing or "putok" were also noted. Gleaning was the only type observed under the category of miscellaneous hand instrument. Other illegal fishing practices were also noted, such as the use of sodium cyanide and compressors, as well as blast fishing (see Appendix A).

A total of 9,379 fishing gear units and 42 variants are active in the areas of Asid Gulf. Most of the gear units were entangling nets (2,397), handlines (2,365), and impounding nets (1,924). The combination of these categories covers 71.27% of the total units that operate in the gulf. Entangling nets (12) and barriers and traps (11) have the most variants (see Table 1). The most numerous entangling nets were gill net for crabs or "pangasag" with 1,474 units and 340 units of bottom set net or "tabudlak".

The study likewise revealed that across the municipalities located in Asid Gulf, specific types of entangling nets that capture marine resources, specifically fish, crabs, and squids are popularly used. The bottom set gill net or "panggisaw," gill net for crabs or "pangasag," and squid jigger or "tina tina" are also utilized by fishermen year-round. On the other hand, bottom set gill net or "tabudlak" is used in all the municipalities of the gulf except for Cawayan where they close the fishing season for "tabudlak" during the onset of the southwest monsoon. This weather condition is considered by many as a threat to the fishing industry. On the other hand, the same weather condition serves as an opportunity for them to modify and adjust their strategies since other marine resources are abundant during this period. Most fishermen in Cawayan practice alternative modes of fishing, like gill net for crabs or "pangasag" to take advantage of the crab season. This explains how flexible, innovative, adaptable, and goal-oriented the fishing communities are in taking advantage of catch opportunities.

It was also noted that there were specific impounding nets that operate every month in all the municipalities except Esperanza. These nets were crab lift net or "bintol sa kasag," bag net or "layalaya," and trawl. Other impounding nets, such as beach seine or "baling," midwater trawl or "palupad," danish trawl or "hulbot hulbot," pen seine or "lapak," filter net or "tangab," and crab pot or "bobo pangasag," were also being used in the gulf.

The nets made in the form of a conical bag with the mouth kept open by various devices or trawls like the danish trawl or "hulbot hulbot" and midwater trawl or "palupad" are used more often than other modes of fishing. The danish trawl has long wings with extremely long

ropes that keep the mount of the net open to catch a higher volume of marine resources in comparison to other alternative tools. The same findings were noted in the fishing households as trawl nets are used as the major fishing gear by the community (Daskalov, 2002).

Table 2. Proportion of fishing gear units used in Asid Gulf per municipality

Municipality	Number of Gears	Relative Proportion of Gear Unit per Municipality (%)
Cawayan	3,355	35.77
Balud	2,640	28.15
Milagros	2,023	21.57
Esperanza	686	7.31
Placer	675	7.20
Total	9,379	100

In terms of the proportion of fishing gear units in the different municipalities, 35.77% of the total fishing gears in the gulf were present in the town of Cawayan. Other municipalities with big contributions were Balud and Milagros with 28.15% and 21.57%, respectively. The two municipalities (Esperanza and Placer) on the southern region of the gulf only shared 7.31% and 7.20%, respectively (Table 2).

3.2 Seasonality of Fishing Gear Types and Units in Asid Gulf

Based from the recall interview, it was noted that the lean periods in the gulf were the months of September and October. The months of April, May, and June were the season for the longlines gear category while the months of November, December, January, and February were seasons for impounding net operations. The greatest number of catch using handline gears were during the months of June, July, and August.
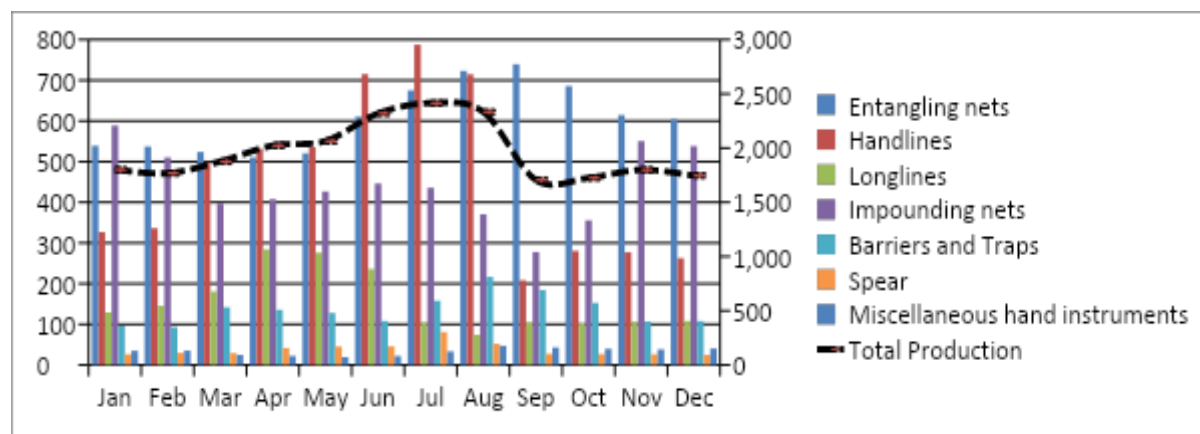

Figure 1. Seasonality of Fishing Gear Types and Units in Asid Gulf

Monsoon weather creates different conditions on the habitation environment. Sea waves and its frequency and density affect the marine environment and the natural activities of the different marine resources. The northeast monsoon, which lasts from late October to February, is beneficial to the fishing industry due to the low water pressure under the marine environment. This results in the fish and other sea creatures, except for crabs, to perform instinctive and survival routines in their natural habitat. This builds good avenues and opportunities for fishing-related activities. With this condition of the marine environment, it is not surprising to see that the calendar for fishing activities fall on the "amihan" season. The same factor is associated with the size and quantity of the daily catch. However, different findings during the same months were experienced in other fishing villages even outside the

gulf during the same season. It was perceived that the volume of marine products in the different fish landings drop during the northeast monsoon from November to March due to heavy rainfall (Jafar-Sidik, Aung, & Singh, 2010).

Fish, crabs, shrimps, and other marine resources can sense weather conditions. These creatures are very sensitive to the changes and conditions in their environment. For this reason, any given weather condition is not always favorable for all types of fishing activities. This opens the window for groups of fishermen to innovate their approaches to match with the weather condition.

Fishermen consider various factors in preparing for their daily fishing trip. They can foresee the possible situations in the fishing area through the current weather conditions in the gulf, specifically in their particular communities. Their day-to-day exposure to the trade developed their technical know-how in predicting the chances for success by considering the implications of weather in their fishing trip and activities.

3.3 Trips and Catch Rate in the Asid Gulf

The most common fishing gears in the area, as presented in Table 3, were handlines, entangling nets, and impounding nets. The entangling net has the greatest number of utilizations in the gulf, with 27,056 trips a year. Other fishing gears most frequently used were spears (19,043), handlines (15,346), and impounding nets (15,305). The number of trips operated by entangling nets was associated with the volume of fish catch. The 10 fishing gears with the greatest number of operations were simple handline or "kawil" (7,282), gill net for crabs or "pangasag" (7,165), bottom set gill net or "tabudlak" (6,651), drift gill net or "Palutang" (4,023), bottom set long line or "kitang" (3,915), squid jigger or "tina tina" (3,790), gleaning or "panginhas" (3,672), crab pot or "bobo pangasag" (3,076), trap for squid or "bobo pangkanuos" (2,724), and trawl (2,408). A total of 78,802 fishing trips in Asid Gulf were conducted this year. A low frequency on the activities of the crab lift net for "alimango" was also noted. This result was expected given that "alimango" production in the areas of Asid Gulf and the province of Masbate is a product of cultured technology in various fishponds, specifically in the municipality of Placer (see Appendix A).

Table 3. Fishing gear category, number of units, and fishing trips

Fishing Gear Category	Number of Units	Fishing Trips
Entangling net	2,397	27,056
Handlines	2,365	15,346
Longlines	692	3,915
Impounding net	1,924	15,305
Barriers and traps	666	7,471
Spears	405	19,043
Miscellaneous hand instrument	613	3,672
Others	317	2,436
Total	9,379	78,802

The declining fish catch during the southwest monsoon season encourages fishermen to venture in activities using gill net for crabs. This is the reason a large number of fishermen catch crabs from June to September. On the other hand, fishing for squids using the trap system is not profitable with this weather condition. Thus, fishing activities for marine fish and squids are rarely observed. Success per trip is not only dependent on the equipment but also on proper

timing, preparation, scheduling, and planning as dictated by the environment. This is also affected by meteorological factors (Jafar-Sidik, Aung, & Singh, 2010).

3.4 Key Species Caught, Catch Rate, and Production Estimates

Asid Gulf is generally characterized as multi-species fisheries. Highlighting some the fishing gears commonly caught, "kasag" (*Portunus armatus)* was noted to be the usual catch of fishers using gill net for crabs and "tanguigui" (*Acanthocybium solandri*) for catch utilizing simple handline (kawil). Tabudlak (bottom set gill net), on the other hand, usually catches species like "gisaw" (*Mugilidae*), "alumahan" (*Scomber scombrus*), and "buraw" (*Rastrelliger kanagurta*). Moreover, palutang (drift gil net) usually catches major species of "bukhawon" (*Lethrinus sp.),* "sapsap" (*Eubleekeria splendens*), and "malasugi" (*Istiophorus sp.).* Kitang (bottom set long line) catches species of "bisugo" (*Nemipterus isacanthus*) and "talkitok" (*Carangoides armatus*), while "tina tina" (squid jigger) commonly catches "pusit" (*Decapodiformes*).

Table 4. Production contribution (in MT) of fishing gears by municipality in Asid Gulf

Fishing Gears	Production by Municipality					Total
	Balud	Milagros	Cawayan	Placer	Esperanza	
Entangling nets	1830.28	1116.37	2530.72	315.48	1491.43	7,284.28
Handlines	2110.98	369.19	2086.74	340.71	566.28	5,473.89
Longlines	985.42	490.46	143.21		231.39	1,850.47
Impounding nets	510.04	1347.05	3051.18	396.82		5,305.09
Barriers and Traps	1003.72	68.35	56.68	27.77	472.78	1,629.30
Spear	77.88	2.23	376.26	0.96		457.33
Miscellaneous hand instr	85.92	206.38	105.98	2.88		401.16
Others	51.39	22.28	1069.56	1.68	28.00	1,172.91
Total	**6,655.62**	**3,622.31**	**9,420.33**	**1,086.30**	**2,789.88**	**23,574.44**

The lean periods in the gulf were the months of October and September, contributing only 1,724.12 and 1,704.53 metric tons, respectively, to the estimated annual catch. Fishing seasons for entangling nets were the months of August and September. The annual production was estimated to be at 23,574.44 metric tons, with the months of July, August, June, and May as the peak fishing months producing 2,414.66, 2,333.87, 2,318.99, and 2,064.34 metric tons, respectively. Fishing seasons for entangling nets were the months of August and September.

The total annual production in Asid Gulf was estimated to be 23,574.44 metric tons. The largest fish catch production was contributed by entangling nets, with a total of 7,284.28 metric tons. Other fishing gears that had large volumes of production were handlines and impounding nets, with 5,473.89 and 5,305.09 metric tons, respectively (see Table 4). The top six producing fishing gears in the area were gill net for crabs or "pangasag" (3,276.984 MT), squid jigger or "tina-tina" (2,900.068 MT), bottom set long line or "kitang" (1,850.470 MT), trawl (1,736.248 MT), simple handline or "kawil" (1,548.777 MT), and bottom set gill net or "tabudlak" (1,448.214 MT). It was noted that most of the fishing communities in the area utilized bottom set gill net or "tabudlak," gill net for crabs or "pangasag," and drift gill net or "palutang" across Asid Gulf. The "pangasag" produces almost twice than the "palutang," producing 3,276.98 metric tons annually.

The volume and quality of catch justifies the number of operation and activities of fisherfolks operating in the gulf. The danish trawl or "hulbot-hulbot" operates almost every

day in the area, thereby producing 252.58 metric tons a year. Only unfavorable weather conditions, such as storms and typhoons, limit and regulate their fishing activities.

Typhoons and storm surges were the common reasons for the devastation of different fishing vessels in the gulf and the province in general. They are, however, unavoidable due to the geographical location of the gulf and the surrounding area being in the eastern side of the Philippine archipelago. During this time, fish are less likely to come up normally for food during times of high atmospheric pressure. Other studies also show the effects of climate on fish catch. Brander (2007) revealed that climate change causes the reduction in the age, size, and geographic diversity of the fish population.

4. CONCLUSION

The fishery in Asid Gulf is characterized by the use of multiple gears. An abundance of crabs and squids were observed, as justified by the volume of production and number of fishing activities associated to it. Weather conditions and seasonality of gear types were evident and were species dependent. Trawls, compressor, sodium cyanide, and blast fishing observed in some parts of the gulf. The catch rates and fishing efforts manifested a high exploitation level in the gulf area, which needs to be addressed. Fishing operations and fish catch in the gulf will continue to decline if the community and other stakeholders will not respond proactively to the issues of overfishing and illegal fishing.

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Appendix A. Specific Gears, Local Names, Trips, and Production in Asid Gulf

Gear Category		Units	Trips	Production (MT)
Entangling Nets	**Local Name**			
Bottom set gill net	Tabudlak	340	6651	1448.214
Bottom set gill net	Panggisaw	66	1700	210.204
Bottom set gill net	Latab	14	468	63.960
Trammel net	3-ply	51	2376	335.727
Gill net for crabs	Pangasag	1474	7165	3276.984
Drift gill net	Palutang	157	4023	657.511
Drift gill net	Pamo	142	2225	877.157
Drift gill net	Pangtabagak	113	1561	354.416
Drift gill net for halfbeaks	Bugkat	11	319	18.580
Drift gill net	Pangkanoos	4	204	11.152
Encircling gill net	Likos	5	288	28.200
Shrimp net	Pamasayan	20	76	2.180
Total		2397	27056	7284.284
Handlines	**Local Name**			
Simple handline	Kawil	753	7282	1548.777
Troll line	Kasikas	60	931	83.317
Multiple troll line	Rambo	58	717	87.510
Artificial bait	Buyod-buyod	280	666	717.920
Pole and line	Bigawnan	118	1212	46.680
Multiple handline	Og-og	55	748	89.620
Squid jigger	Tina-tina	1041	3790	2900.068
Total		2365	15346	5473.892
Bottom set long line	Kitang	692	3915	1850.474
Impounding Nets	**Local Name**			
Push net	Hudhod	49	1340	112.542
Crab lift net	Bintol (Kasag)	102	2028	89.720
Crab lift net	Bintol (alimango)	12	81	3.441
Bagnet	Laya-laya	270	2140	1153.458
Beach seine	Baling	100	1904	413.746
Midwater Trawl	Palupad	581	1812	1307.800
Trawl	Trawl	618	2408	1736.248
Danish trawl	Hulbot-hulbot	36	1560	252.582
Pen seine	Lapak	41	476	25.225
Filternet (Tangab)	Tangab	112	1524	188.008
Ring net	Kalansisi	3	32	22.320
Total		1924	15305	5305.090

Barriers and Traps	Local Name			
Fish corral	Bunoan	18	888	49.372
Fish pot	Bobo pansira	96	1283	238.031
Crab pot	Bobo pangasag	249	3076	762.269
Squid/cutlefish pot	Bobo panglokus	303	2724	579.632
Total		666	7971	1629.303
Spears	**Local Name**			
Spear gun	Pana	139	1121	145.730
SPGN at night	Flashlight	151	1008	153.073
SPGN using Compressor	Pana-compressor	115	972	158.523
Total		405	3101	457.326
Miscellaneous hand instrument	**Local Name**			
Gleaning	Panginhas	613	3672	401.162
Others	**Local Name**			
Sodium cyanide	Tubli	40	336	5.830
Compressor	Compressor	230	1028	918.360
Blast fishing	Putok	47	1072	248.720
Total		317	2436	1172.910
Grand Total		**9,379**	**78,802**	**23,574.440**

Appendix B. Number of Gear Units per Fishing Gear Types Identified Per Municipality in Asid Gulf

Fishing Gears			Municipality					
English Name	Local Name	Balud	Milagros	Cawayan	Placer	Esperanza	Total
Entangling nets							
Bottom set gill net	Tabudlak	159	87	2	52	40	340
Bottom set gill net	Panggisaw	2	12	40	12		66
Bottom set gill net	Latab		4		10		14
Trammel net	3-ply	13	1		6	31	51
Gill net for crabs	Pangasag	117	378	811	151	17	1474
Drift gill net	Palutang	67	31	20	3	36	157
Drift gill net	Pamo	32	2	17		91	142
Drift gill net	Pangtabagak	18	65	5		25	113
Drift gill net for halfbeaks	Bugkat	10	1				11
Drift gill net	Pangpusit/kanoos	4					4
Encircling gill net	Likos			5			5
Shrimp net	Pamasayan			20			20
Handlines							
Simple handline	Kawil	245	166	114	98	130	753
Troll line	Kasikas		37		8	15	60
Multiple troll line	Rambo	10	1		45	2	58
Artificial bait	Buyod-buyod	255	25				280
Pole and line	Bigawnan	80	20	8	10		118
Multiple handline	Og-og	25			30		55
Squid jigger	Tina-tina	421	21	560	34	5	1041
Longlines							
Bottom set long line	Kitang	326	320	11		35	692
Impounding nets							
Push net	Hudhod	5	44				49
Crab lift net	Bintol (Kasag)	1	34	37	30		102
Crab lift net	Bintol (alimango)	10	2				12
Bagnet	Laya-laya	1	138	112	19		270
Beach seine	Baling		56	15	29		100
Midwater Trawl	Palupad		60	515	6		581
Trawl	Trawl	197	40	350	31		618
Danish trawl	Hulbot-hulbot		10	10	16		36
Pen seine	Lapak		35	3	3		41
Filternet (Tangab)	Tangab		56	51	5		112
Ring net	Kalansisi	3					3
Barriers and Traps							
Fish corral	Bunoan		8	3		7	18
Fish pot	Bobo pansira	32	2	2		60	96
Crab pot	Bobo pangasag	127	7	20	30	65	249
Squid/cutlefish pot	Bobo panglokus	162	17	1	10	113	303
Spear							
Spear gun	Pana	25	9	105			139
SPGN at night	Flashlight	51		100			151
SPGN using Compressor	Pana-compressor	13		100	2		115
Miscellaneous hand instruments							
Gleaning	Panginhas	212	323	58	20		613
Others							
Sodium cyanide	Tubli	5		20	15		40
Compressor	Compressor	2	1	220		7	230
Blast fishing	Putok	10	10	20		7	47
	Total	2,640	2,023	3,355	675	686	**9,379**

Appendix C. Total Fishing Trips (Efforts) Per Municipality in Asid Gulf

Fishing Gears		Municipality					
English Name	Local Name	Balud	Milagros	Cawayan	Placer	Esperanza	Total
Entangling nets							
Bottom set gill net	Tabudlak	446,313	142,854	392	40,872	48,800	679,231
Bottom set gill net	Panggisaw	576	11,184	13,440	1,728		26,928
Bottom set gill net	Latab		1,152		1,800		2,952
Trammel net	3-ply	6,188	132		2,016	44,392	52,728
Gill net for crabs	Pangasag	94,419	709,884	1,761,492	171,536	19,924	2,757,255
Drift gill net	Palutang	61,908	24,800	8,620	756	58,176	154,260
Drift gill net	Pamo	11,040	416	10,608		95,368	117,432
Drift gill net	Pangtabagak	12,384	21,060	725		10,100	44,269
Drift gill net for halfbeaks	Bugkat	9,065	60				9,125
Drift gill net	Pangkanoos	816					816
Encircling gill net	Likos			1,440			1,440
Shrimp net	Pamasayan			1,520			1,520
Handlines							
Simple handline	Kawil	550,025	195,050	159,144	135,436	140,920	1,180,575
Troll line	Kasikas		22,459		288	4,320	27,067
Multiple troll line	Rambo	450	144		15,120	384	16,098
Artificial bait	Buyod-buyod	75,990	9,200				85,190
Pole and line	Bigawnan	10,240	37,632	2,528	960		51,360
Multiple handline	Og-og	11,600			8,520		20,120
Squid jigger	Tina-tina	688,756	11,298	436,800	19,856	1,260	1,157,970
Longlines							
Bottom set long line	Kitang	538,226	328,960	5,280		26,460	898,926
Impounding nets							
Push net	Hudhod	480	54,736				55,216
Crab lift net	Bintol (Kasag)	336	24,616	23,384	10,080		58,416
Crab lift net	Bintol (alimango)	450	72				522
Bagnet	Laya-laya	224	101,706	82,432	8,417		192,779
Beach seine	Baling		54,208	6,240	15,080		75,528
Midwater Trawl	Palupad		32,640	350,200	3,528		386,368
Trawl	Trawl	209,608	13,440	117,600	20,832		361,480
Danish trawl	Hulbot-hulbot		3,360	5,680	10,496		19,536
Pen seine	Lapak		4,200	288	780		5,268
Filternet	Tangab		54,208	10,506	1,750		66,464
Ring net	Kalansisi	96					96
Barriers and Traps							
Fish corral	Bunoan		1,280	1,488		1,624	4,392
Fish pot	Bobo pansira	21,120	450	292		15,120	36,982
Crab pot	Bobo pangasag	181,610	1,120	5,640	25,200	23,660	237,230
Squid/cutlefish pot	Bobo panglokus	253,368	10,880	112	1,080	33,900	299,340
Spear							
Spear gun	Pana	11,325	2,412	42,000			55,737
SPGN at night	Flashlight	36,720		28,800			65,520
SPGN using Compressor	Pana-compressor	7,644		28,800	192		36,636
Miscellaneous hand instruments							
Gleaning	Panginhas	243,588	671,517	17,400	2,880		935,385
Others							
Sodium cyanide	Tubli	840		2,880	360		4,080
Compressor	Compressor	192	196	27,648		1,120	29,156
Blast fishing	Putok	3,360	2,880	5,760		1,120	13,120
	Total	3,488,957	2,550,206	3,159,139	499,563	526,648	**10,224,513**

Appendix D. Fishery Production of Various Fishing Gear Types per Municipality in Asid Gulf (MT)

Fishing Gears		Municipalities					
English Name	Local Name	Balud	Milagros	Cawayan	Placer	Esperanza	Total
Entangling nets							
Bottom set gill net	Tabudlak	892.85	188.75	2.27	165.07	199.28	1,448.21
Bottom set gill net	Panggisaw	6.48	27.16	165.76	10.80		210.20
Bottom set gill net	Latab		48.96		15.00		63.96
Trammel net	3-ply	120.87	0.95		13.70	200.21	335.73
Gill net for crabs	Pangasag	400.21	581.55	2165.55	105.70	23.97	3,276.98
Drift gill net	Palutang	225.23	64.52	58.44	5.21	276.75	630.15
Drift gill net	Pamo	126.60	27.36	83.37		667.18	904.52
Drift gill net	Pangtabagak	29.29	176.15	24.95		124.04	354.42
Drift gill net for halfbeaks	Bugkat	17.61	0.97				18.58
Drift gill net	Pangkanoos	11.15					11.15
Encircling gill net	Likos			28.20			28.20
Shrimp net	Pamasayan			2.18			2.18
Handlines							
Simple handline	Kawil	567.75	144.40	122.87	181.23	532.52	1,548.78
Troll line	Kasikas		56.25		1.15	25.92	83.32
Multiple troll line	Rambo	7.95	2.42		75.60	1.54	87.51
Artificial bait	Buyod-buyod	636.13	81.80				717.92
Pole and line	Bigawnan	10.85	15.96	15.55	4.32		46.68
Multiple handline	Og-og	52.96			36.66		89.62
Squid jigger	Tina-tina	835.35	68.37	1948.31	41.74	6.30	2,900.07
Longlines							
Bottom set long line	Kitang	985.42	490.46	143.21		231.39	1,850.47
Impounding nets							
Push net	Hudhod	1.80	110.74				112.54
Crab lift net	Bintol (Kasag)	0.78	20.59	35.59	32.76		89.72
Crab lift net	Bintol (alimango)	3.23	0.22				3.44
Bagnet	Laya-laya	4.99	457.16	610.38	80.93		1,153.46
Beach seine	Baling		278.06	62.43	73.26		413.75
Midwater Trawl	Palupad		144.20	1155.90	7.70		1,307.80
Trawl	Trawl	476.92	91.84	1097.60	69.89		1,736.25
Danish trawl	Hulbot-hulbot		60.76	63.97	127.85		252.58
Pen seine	Lapak		23.28	0.67	1.28		25.23
Filternet (Tangab)	Tangab		160.22	24.64	3.16		188.01
Ring net	Kalansisi	22.32					22.32
Barriers and Traps							
Fish corral	Bunoan		18.50	11.30		19.58	49.37
Fish pot	Bobo pansira	23.40	1.14	1.81		211.68	238.03
Crab pot	Bobo pangasag	612.14	3.55	41.34	24.05	81.20	762.27
Squid/cutlefish pot	Bobo panglokus	368.18	45.17	2.24	3.72	160.32	579.63
Spear							
Spear gun	Pana	16.84	2.23	126.66			145.73
SPGN at night	Flashlight	28.27		124.80			153.07
SPGN using Compressor	Pana-compressor	32.76		124.80	0.96		158.52
Miscellaneous hand instruments							
Gleaning	Panginhas	85.92	206.38	105.98	2.88		401.16
Others							
Sodium cyanide	Tubli	0.91		3.24	1.68		5.83
Compressor	Compressor	2.88	1.40	902.88		11.20	918.36
Blast fishing	Putok	47.60	20.88	163.44		16.80	248.72
Total		6,655.62	3,622.31	9,420.33	1,086.30	2,789.88	**23,574.44**

FISHCORAL-PRSA INFORMATION SYSTEM FOR ASID GULF

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ABSTRACT

The development of an information system (IS) provides a significant role in project management. In this paper, an agile framework was used to develop a system designed to database the information gathered from the participatory resource and socio-economic assessment of Asid Gulf. Geographical information system, application programming interface, and open libraries were used to develop the baseline map for corals, seaweed/seagrass, water quality, and mangrove areas target sample sites. Black-white box testing was used to evaluate the internal and external characteristics of the developed system. As a result, based on the evaluation the system, building blocks and parameters satisfied the standard functional system requirements. Thus, the system offers the features of the IS and may serve as a model of future similar projects.

Keywords: information system, GIS, software testing, Asid Gulf

I. INTRODUCTION

The purpose of this study was to develop and implement an information system (IS) that would serve as a repository for resources and socio-economic assessments. The term "information system" refers to software and hardware systems that operate as a whole and support data-intensive applications. It is concerned with the design, modelling, algorithms, and hosting of hardware for a system to run smoothly (Information System, 2019). It provides users with updated information, as well as leads to better business productivity and efficiency, better decision making, better communication, better data, and better knowledge of customer needs. It also provides the building blocks for government information system projects, as well as covers the information and communication technology (ICT) developments of the Philippines. The Public Services Information System (PSIS) and the Electronic Procurement System (EPS), to name a few, provide users with a range of government services and information useful to the public in a fast and convenient way (Strategies and Solutions, n.d). In general, IS can perform multiple tasks all at the same time, which increases efficiency and productivity (Babaei & Beikzad, 2013).

Past research has integrated the features of geographical information system (GIS) to capture and display spatial patterns. Maliene et al. (2011) integrated GIS technologies into a single analytical model in which diverse data were "geo-referenced" to cartographic projections. This integration made it easy for users to mark certain geographical locations with corresponding data for processing needed information. GIS has the ability to handle much larger databases and to integrate and synthesize data from a much wider range of relevant criteria than might be achieved by manual method (Wright & Bartlett, 2001).

Although there had been utilizations of various GIS technologies, their implementations were limited only on system features, not on the raw data of the project/program activities. Thus, this study aims to design and implement an IS model for a project designed to capture the raw information of the components, aside from the important features like component information profiling and registration. The system may serve as a prototype concept for future project-based activities. It offers a user-friendly graphical user interface, easy access to system features not limited to Create, Read, Update, Delete (CRUD) management, updated data entry, GIS mapping to target sampling areas, and printing solutions for prompt report requests. The government, in its efforts and pursuit to establish an electronic government in the country using development and innovations in ICT, adopted a digital transformation strategy that will greatly improve the Philippines's governance capability, socio-economic development, and services to the people (Philippine Digital Transformation Strategy 2022).

The study aimed to design, develop, and implement an IS for Asid Gulf that would help project stakeholders adopt an effective and efficient database management system. This paper used case diagrams, identified key components, and proposed an IS to improve data management and access to system features.

II. METHODOLOGY

The study used the Rational Unified Process (RUP) an Agile methodology that relates on building the essential output requirements of the system. This methodology is based on a set of building blocks and content elements describing what is to be produced (artifacts) and deals with a life cycle that ends with a milestone. The key benefit of RUP is that it provides a specific plan for each step of the development process, helps prevent resources from being wasted, and reduces unexpected development costs.
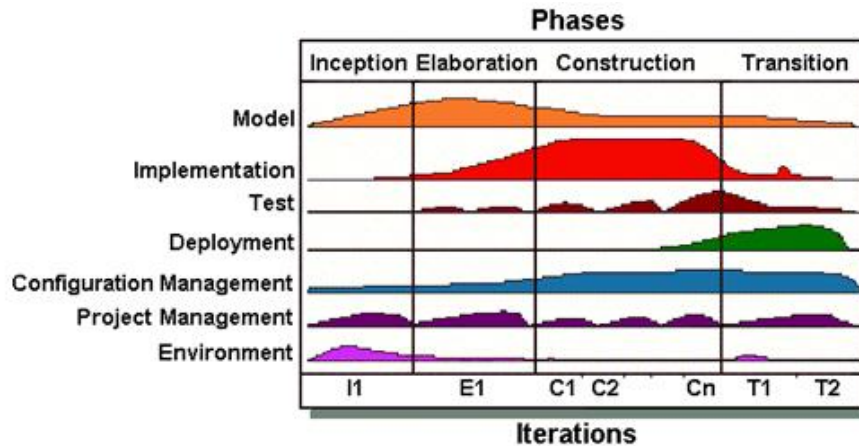
Fig. 1. Rational Unified Process Methodology
source: http://www.ambysoft.com

The researchers undertook the following phases of the methodology:

Inception phase

For this phase, the researchers analyzed the existing literature, as well as identified the opportunities and project objectives. It was observed that existing systems have limited features in capturing important details (like raw data) and systems that would keep present and future projects. Thus, these resulted in an unsynchronized repository of data, which means that new projects tend develop other new systems.

It is the intention of this project to address the identified problems and transform the same into opportunities to attain stakeholder's objectives. The opportunities are the situations observed in the existing literature. Guided by the objectives and deliverables stipulated in the project proposal, researchers have a clear understanding of the scope and objectives of the project.

The researchers analyzed the survey instrument used and designed the database schema. Some application programming language for script and map rendering were analyzed and considered in the development process. Storyboarding was considered to pre-visualize the location of various objects, such as text, pictures, and other interactive media.

Elaboration phase

The goal of this phase was to define and specify the baseline architecture of the system in order to provide a basis for the design and implementation in the construction phase. The

architectural framework was dissected to give a clear understanding of each requirement in the subsequent development stage. The researchers used context flow diagram, data flow diagram, and use case diagram to analyze the system needs and their architectural components. The web architecture was considered, including its features and sub-modules. The software/hardware specification was considered to make sure that the system accommodates the required system operation.

These components were linked and shared with sub-modules for data management. Table 1 defines the relationship of each component. The context flow diagram defines the boundaries of the system. The data flow diagram defines the data relationship, while the use case diagram was used to analyze the system needs and the architectural components of the system. The software/hardware specification was considered to make sure that the system accommodates the required system operation.

Table 1. Software/Hardware Requirements

Software Requirement		Hardware Requirement	
Front End development	HTML, CSS, Bootstrap 3.0, Javascript, JQuery, Leaflet	Core Processor	Core i7 x64-based PC 8565U CPU@1.80GHz
Back End development	XAMPP/PHP 5.6.20 10.1.13-MariaDB Apache/2.4.17	Memory	8GB
		HDD space	1TB
GIS application	Manifold, ENVI 5.3	Others	Ethernet LAN: Yes
			HDMI: Yes
			Audio: Yes

Construction phase

This phase is the production process where emphasis is placed on developing and constructing the details of the system. This is where the finalized features and sub-modules worked functionally. The milestones of this phase include the web interface modules, user management module, report generation, and maintenance module.
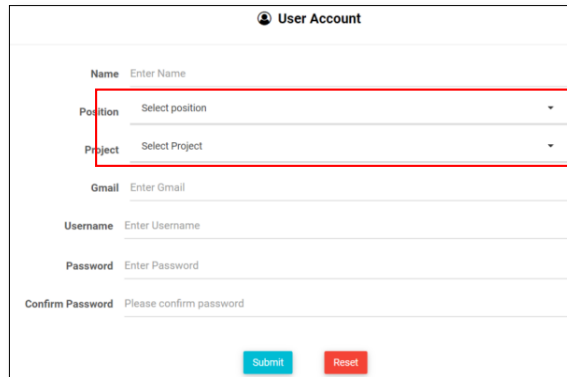
Transition phase

This phase is focused on delivering the system into stakeholder implementation and the shift to link the system to the stakeholders' web portal, so that it would be available to the community. The presentation of the system at a stakeholders' meeting would help the researchers fine-tune the system and make it ready for alpha/beta testing.

III. RESULTS AND DISCUSSION

User management and login module

This module allows the administrator of the system to control and manage user access and define the roles in the security domain. The system was broken down into sub-modules. These sub-modules were the user management, project assessment management, and map module. The user management consists of users and administrators, who are controlled by security privileges (see Fig. 2).
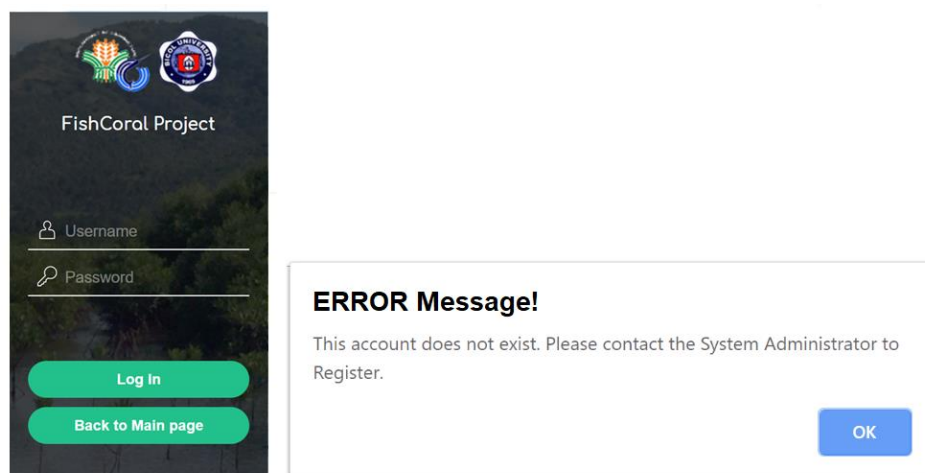
Fig. 2. User account interface

The user needs to fill-in information, such as full name, position, name of the project, email address, username, and password, before access privilege will be given. The level of security privilege depends on the position that shall be approved by the system administrator upon registration. The user accounts will be managed by the system administrator, who oversees, controls, and monitors the activities of the system.

Figure 3 shows the user login screen, which shall prompt the user to enter the valid username and password. An invalid error message will be displayed for incorrect input. A user who is granted access shall have exclusive privilege over the information and could perform data management. This serves as a control mechanism to prevent other users from manipulating the information, which may corrupt the data from improper usage (see Fig. 4).

Fig. 3. User login interface and error message for invalid login attempt

Fig. 4. Interface showing user account for valid and invalid user entries

It is important to record and monitor system status and operation. Figure 5 shows the history log interface, which contains the log information of the users who accessed the system. This captures the username, date and time logged in, and the position.

Fig. 5. History log interface

Project assessment management module

This module presents the assessment results and field activities of the project components. The features include socio-economic, aquatic ecology and habitat assessment, water quality, and capture fisheries assessment, which has a distinct interface and functionalities. Figure 6 shows the main interface of the system. To manipulate the system, the user can use the option about, components, photo gallery, and other information by simply selecting the menu or scrolling from the page.
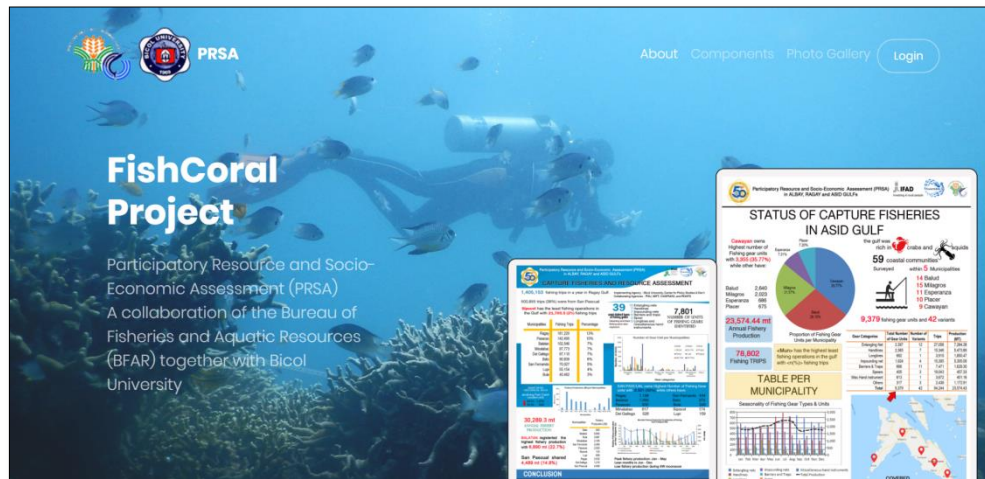
Fig. 6. Main interface of the system

Each component has its individual webpage that features the sample target sites, results and discussion, infographics, and field activities. Figure 7 shows a sample interface for water quality assessment.
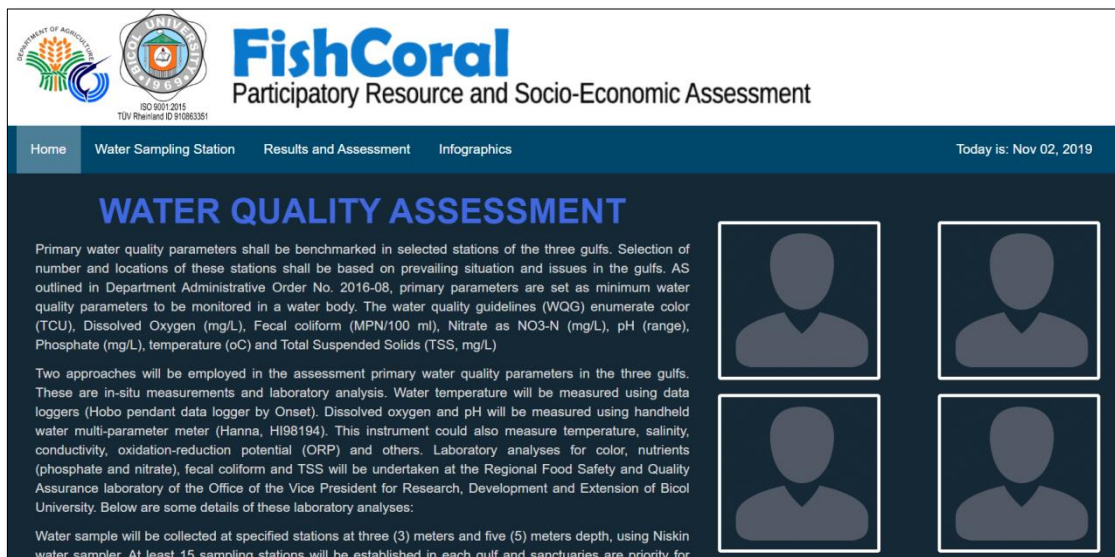
Fig. 7. Water quality assessment interface

Additionally, the project management module has its feature showing pictures of the project team members. Using a light gallery plugin for jQuery, the images are fully responsive to dynamic transitions. The project management module is the user assessment sub-module, which provides support to users in managing the assessment results. The user shall be allowed to perform CRUD management, view other component information, and generate reports. The overall function of the module is to assist project leaders and administrators effectively manage the assessment results.

A customized feature for socio-cultural, economic and institutional policy, aquatic ecology and habitat, water quality, and capture fisheries were designed to attain the objectives. Each component has its distinct features catering to the activities of the project. The management and control of assessment results are exclusive to registered users. However, information about other components shall be available for viewing only. Information shall be

inputted and recorded per project component. The information displayed in the component results reflects the actual information stored in the database. The details are stored according to the summary results per province, municipality, and barangay. Information shall be temporarily saved every after entry and shall be automatically saved to the master database after actual form submission. Thus, in the event of any unwarranted system occurrences, users could limit the effort in repeating their input and directly modify the saved record. This feature shall be true to all components to maximize the efforts in reducing the time for checking user entries.

Fig. 8. Interface to store and manage fish species assessment results

In Figure 9, the interface for seagrass and seaweed species allows the user to perform updates on existing information. Sometimes, the users lose track of what they are doing, and—in many situations—they tend to go back where they started the process. The purpose of the update module is to keep track of the information and store the accurate details.

Fig. 9. Seagrass and Seaweeds species entries ready for editing and printing

It can be observed that records on display represent those species collected or found within Asid Gulf only. Similarly, records for water quality are arranged based on the date the records were submitted. Still, the records can be displayed in ascending or descending order (Fig. 10). The parameters recorded for water quality assessment results include pH, dissolved oxygen, temperature, conductivity, salinity, color, nitrate, phosphate, total suspended solids, and fecal coliform.

Fig. 10. Interface showing the water quality existing records

For capture fisheries and resource assessment, the system managed to record the details for catch and effort, which includes gear inventory, catch rate, and production. To enhance the process of recording, the researchers devised an approach that simplified the process. In the selection option, the gulf name shall be selected first, which triggers the province, municipality, and barangay option to be in the automatic state. That is, this shall display the appropriate options managed by the program. The results from capture fisheries resource assessment include the fishing gear used per month and calculated catch rate. Thus, the user could navigate and provide options for the type of fishing gears used. The selections for fishing gears are in their local names (i.e., baklad, ispat, kati, tina-tina, etc.; see Fig. 11). Entries should be in number values and negative values are also accepted. The system also recognizes null and zero entries for each parameter.

Fig. 11. An interface showing the capture fisheries resource assessment with adding feature

Report Generation

Report generation is an integral component of an information system. This improves the quality of providing accurate records, reduce errors, and minimize costs. The system uses the available tool to generate the reports in a format with the extensions .xls, .pdf, and .csv, as well as direct printing. In Figure 12, a generated sample report for water quality was produced in Excel format.

Gulf	Location	pH	Temperature	Dissolved Oxygen	Total Suspended Solid (TSS)
Asid gulf	Bangad, Open	8.31	32.2	7.51	23.66
Asid gulf	Tacot, Nagurang Island, Open	8.14	31.92	7.31	23.41
Asid gulf	Tacut, Paguiranan Island	8.16	31.45	7.33	23.4
Asid gulf	Mayong-Payong	8.23	30.85	7.4	23.3
Asid gulf	Guinyangan Diotay, Open	8.15	30.57	7.45	23.27
Asid gulf	Palanduta	8.17	30.66	8.09	23.51
Asid gulf	Jintotolo Island	8.17	30.63	7.31	23.25
Asid gulf	Gilotongan Island, Open	8.21	30.65	8.27	23.26
Asid gulf	Naro Island, open	8.21	30.65	8.27	23.26
Asid gulf	Near Naro Island	8.2	30.25	6.89	23.16
Asid gulf	Milagros, AquaCulture	8.47	31.63	7.22	30

Fig. 12. Sample report generated in Excel format (.xls)

The values therein are the actual summary reports taken from the water quality report. Fig. 13 shows the ready-to-print water quality report. The report was arranged based on the date the entries were inputted in the system and user preference. However, printing by preference shall be made before printing.

Fig. 13. Ready-to-print water quality report

An on-screen display report is another option that the system has provided. This feature is very common, yet it gives prompt and direct output to the user. Fig. 14 shows the sample on-screen report generated for coral (live form). The major category percentage cover for Asid Gulf is presented. The total percentage comes from the actual values of hard coral, dead coral, soft coral, other organisms, algae, substrate, and turbid-water bioconstructions (TWB).

Fig. 14. Sample report generated for coral (live form)

Along with other project components, this interface represents the main description, which takes the overall appearance of the process. Selecting the accordion button would display the details of the target sampling site. Fig. 15 shows an example where details of mangrove assessment accomplished in Buyo, Legazpi City is presented. This gives the user a clear description of the mangrove species found, number of stands, density, relative density, and others. Also, the general comment is provided, which gives the user updated information and the opportunity to update. A similar report interface is presented in Fig. 15 for capture fisheries resource assessment.

Masbate , Balud

Balud Quinayangang Tonga

| Copy | CSV | Excel | PDF | Print | | | | | | Search: |

Mangrove Species	No. Stand	Density	Relative Density	Frequency	Relative Frequency	Basal Area	Relative Dominace	Important Values
Avicennia marina	27	1080	42.86	0.5	38.46	61.28	28.77	110.09
Rhizophora apiculata	21	840	33.33	0.5	38.46	30	14.08	85.88

No. OF PLOTS : 5
PLOT AREA : 25
TOTAL AREA SAMPLED: 250
HA. : 0.025

GENERAL COMMENTS : -

☑ Update Informtaion

Fig. 15. Interface showing the summary report of mangrove along name of species, count, relative density, relative frequency, basal area, relative density, and important values

TRIPS PER MONTH - CAPTURE FISHERIES RESOURCE ASSESSMENT

📍 ALBAY GULF   ◎ RAGAY GULF   ▲ ASID GULF

Masbate , Balud

Mabuhay (Boncanaway III)

Fishing Gear	Category	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.
Bobo pangasag	Barriers and Traps	-	-	-	15	15	-	-	-	-	-
Kawil	Lines	28	28	28	28	28	28	28	28	28	28
Panke (palubog) / Tabudlak	Nets	28	28	28	28	28	28	28	28	28	28

Fig. 16. Interface showing the trips per month report of fishing gear used in Asid Gulf

Other information includes catch and fish landing statistics, catch per unit effort of fishing gears, and fisheries production disaggregated to dominant species by municipality and by fishing gears. Likewise, boat inventory is included as part of the gear inventory, which displays the type of fishing vessels used, gross tonnage, and horsepower per municipality. The scientific name of species, percentage covered, and average biomass are presented in tables (see Fig. 17).

AVERAGE COVER AND BIOMAS		
Scientific Name	Cover (%)	Biomas
Cymodocea rotundata	19.32	54.18
Cymodocea serrulata	5.97	13.64
Enhalus acoroides	12.89	274.55
Halodule pinifolia	16.19	160.00
Halodule uninervis	5.68	33.27
Halophila decipiens	0.28	3.64
Halophila minor	3.70	4.36
Halophila ovalis	4.12	14.73
Syringodium isoetifolium	24.29	75.82
Thalassia hemaprichii	8.67	122.91

Fig. 17. Sample results for average cover and estimated biomass (sw/sg)

Fig. 18 shows the graph generated for water quality assessment. The parameters displayed include color (TCU), dissolved oxygen (mg/L), fecal coliform (MPN/100 ml), nitrate as NO_3-N (mg/L), pH (range), phosphate (mg/L), temperature (°C) and total suspended solids (TSS, mg/L). The data were collected in 15 sampling stations of along Asid Gulf with the use of a geographic information system (GIS) map tool.

WATER SAMPLING ANALYSIS

TARGET SAMPLING SITES

Gulf	Target Site	pH	Temperature	Dissolved Oxygen
Asid	Bangad, Open	8.31	32.2	7.51
Asid	Tacot, Nagurang Island, Open	8.14	31.92	7.31
Asid	Tacut, Paguiranan Island	8.16	31.45	7.33
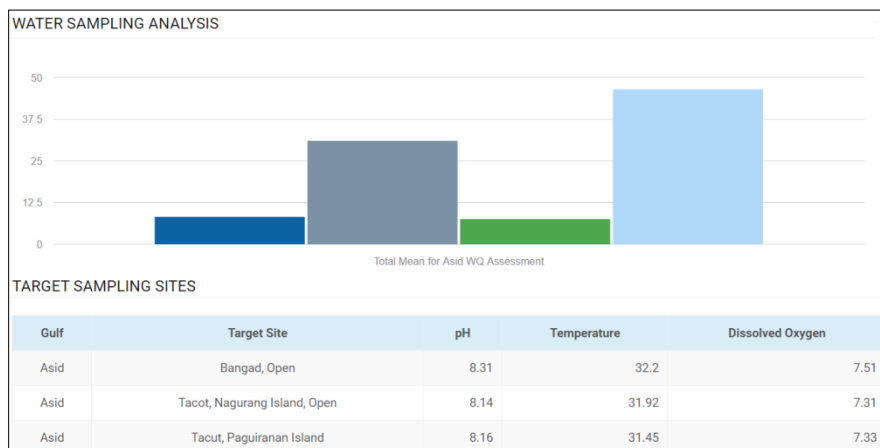
Fig. 18. Graph showing water quality assessment in Asid Gulf

Geographical Information System (GIS)

The geographical information system (GIS) is not only a technological tool to gather, analyze, and visualize spatial information, but is also used to make intelligent decisions (Wright, 2011). It is a fully integrated environment for the management and analysis of spatial information (Caloz & Collet, 1998). It has been used as a standard tool for environmental assessment and analysis (Gonzalez, 2012) in government, industry, business, and educational

settings (Learning to Think Spatially, 2006). In the system, the GIS application facilitates map rendering and generating coordinates of target sampling sites for corals, SW/sg, mangrove, and water quality. Fig. 19 shows the location of some sample target sites in Asid Gulf using the Openstreetview map generated by leaflet API. The balloon marker indicates the covered areas in the gulf.
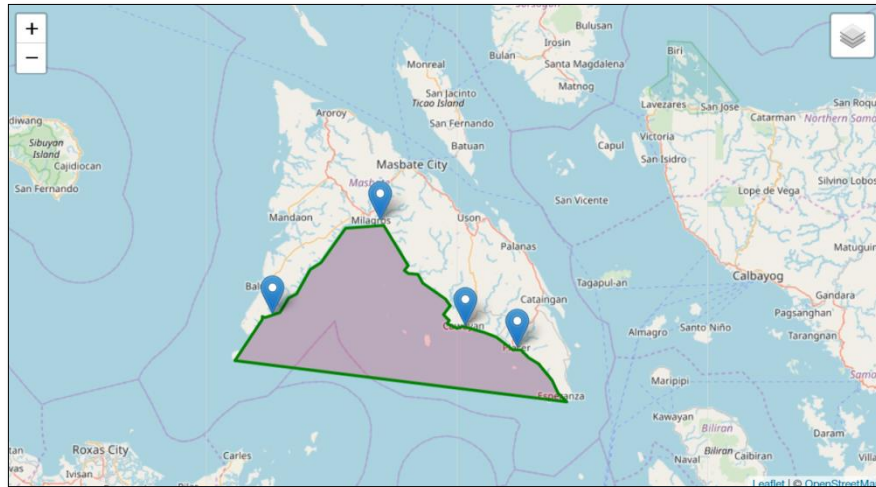
Figure 19. Generated GIS map with some sample target sites

To facilitate the generation of coordinates for corals, SW/sg, water quality, and mangrove, the researchers used some GIS applications, such as manifold and NV, to produce the map (see Fig. 20).
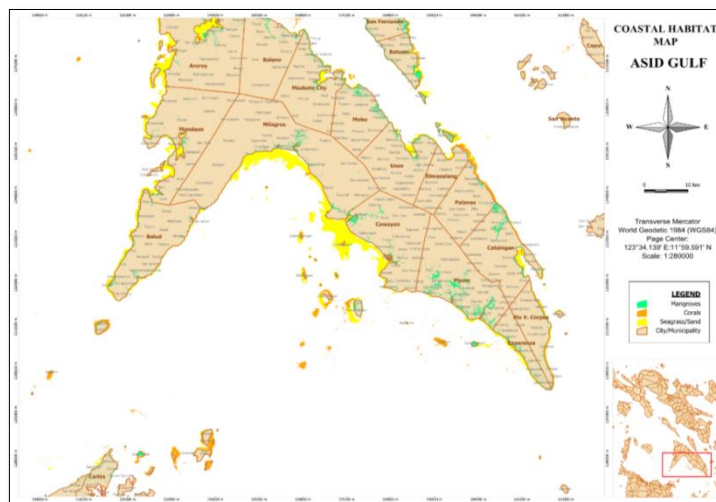
Fig. 20. Sample map generated by GIS applications for Asid Gulf

The generated image map produced by satellite reveals the coordinates and the existence of mangrove (green color), corals (orange), and SW/SG (yellow) in Asid Gulf. These served as a baseline to identify the approximate location of the sample target sites. Project teams shall be guided and be able to come up with the best strategy to accomplish the objectives. This shall improve the planning strategy and predict possible precautionary measures before field actions (see Fig. 21).
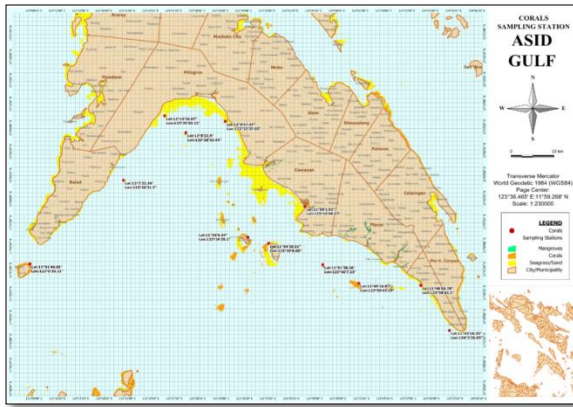
(a) corals target sites

(b) SW/SG sites

(c) mangrove sites

Fig. 21. Generated GIS map showing the sample target coordinates for Asid Gulf: (a) corals, (b) SW/SG sites, and (c) mangrove sites

System Evaluation

The study used a software testing (white/black box testing) method to analyze and validate the internal structures and functionalities of the system components including the full visibility of the logic and code structures. The study used branching and statement testing for white box testing to validate the specific requirement of the system. Table 2 shows the results of branch testing after evaluating the test cases for every procedure in the system.

Table 2. Results of Branch Testing with Test Cases

Test ID	Description	Actual Results
1	if not isset(var) display alert else register the variable as session	PASSED
2	read gulf if no Municipality or Barangay is active assign given area, if area is active then call a mysql query of said area then display the result	PASSED

3	execute sql query
	count the number of records per area
	do the loop
	    assign the field variables to different parameters
	    do the computation then divide the results by records count
	prepare the chart tables
	display the chart with values
		PASSED

The system used applicable local and global variables necessary to determine the scope of the variables. These variables, together with other parameters, were used as references to execute the procedure. The identified test cases represent the majority of the processes involved in storing data entries, error message alert, SQL queries, collecting data values, and transforming these values into graphical representation (see Table 3).

Table 3. Results of Statement Testing with Test Cases

Test ID	Description	Actual Results
1	Assignment of labels as variables are related to project (*i.e., gulf, temperature, transect, etc.*)	PASSED
2	Statement syntax and delimiters were appropriately applied	PASSED
3	Top-down coding approach was properly used	PASSED

A trial was conducted to determine the functionality of the system, specifically on the ability to determine authorized login request, assessment results, and generate map coordinates. In Black Box testing, results showed that the features of the developed system successfully attained the expected outputs (see Table 4). This can be seen from the fact that upon testing, the user was able to manipulate the system and view the results of each component.

Furthermore, the results have accomplished the provision of user acceptability, interactivity, error messages, and attained the expected output.

Table 4. Sample Results of Functional Testing

Test Case	Description	Expected Output	Next State	Results
Display username and password	S1	passed user level validation	S2, S3	accomplished
Invalid login attempt and display error message	S2	display error message	S1	accomplished
Display sub-module features	S3	access to features	S4, S5	accomplished
Access to use map features	S4	display target sites	S5	accomplished
User admin allowed to perform CRUD	S5	perform create, read, update and delete	S7	accomplished
Exit sub-module and return to main page	S7	confirmation window	S8	accomplished
Logout to system	S8	destroy sessions and close database	S1	accomplished

Infographics

The project aims to design infographics and fact sheets based on the summary reports submitted by different project components. Four infographics and six fact sheets were designed and presented before the stakeholders' meeting. It was observed that stakeholders were interested both in the system for dissemination to the community and infographics as IEC campaign materials. Some have suggested to allow them to access the system and download the materials. As feedback, the BFAR counterpart agreed to look into the possibility of linking the developed system into their existing system. Details of the infographics are presented in the appendices.

IV. CONCLUSIONS AND RECOMMENDATIONS

The development of the system provided an opportunity to have a reliable and systematic information storage, archiving, and management system for socio-economic, fisheries, and coastal resource management. The socio-economic, aquatic ecology, water quality, and capture fishery components have successfully developed the interface and tested test cases based on program structures. Also, system access and privileges were successfully validated and provided security procedures for user requests. The results and findings are encouraging. Thus, there should be a more comprehensive data gathering tool that should be introduced to capture a wider range of parameters that affect coastal habitats and fisheries in different seasons, use data mining to analyze the reports of socio-economic trends and other components depending on given or acquired datasets, and develop a real-time collection of data through system integrated hardware devices.

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APPENDIX A

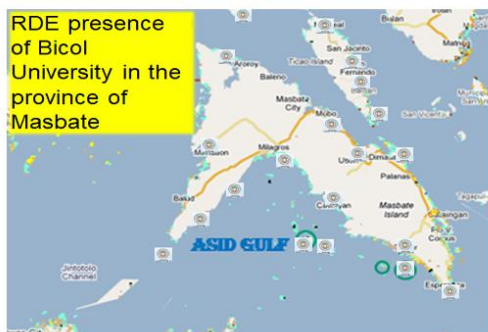Participatory Resource and Socio-Economic Assessment (PRSA) in ALBAY, RAGAY and ASID GULFs

JL IFAD — Investing in rural people

FishCORAL

STATUS OF CORALS AND ASSOCIATED REEF FISHES IN ASID GULF

RDE presence of Bicol University in the province of Masbate

ASID GULF

Live coral cover of Asid Gulf.

Municipality	MPA % Coral Cover	Benchmark % Coral Cover
Balud (Jintotolo)	Failed dive attempt	
Milagros	15.30	
Cawayan		
Guinlobngan T1	37.46	15.8-67%*
Guinlobngan T2	37.48	
Recodo T1	19.78	
Recodo T2	15.30	
Placer		
Guinawayan (S)*	34.00	
Guinawayan (D)*	31.16	
Nagarao (S)*	40.72	
Nagarao (D)*	24.24	
Esperanza		
SurosimbahanT1	40.44	
SurosimbahanT2	24.86	
Mean	**29.16**	

*from Mendoza et al. 2017

- ❑ Most of the reefs in Asid Gulf are in poor to fair conditions
- ❑ This reef condition is generally inferior than those in neighboring reef systems of Masbate, in Ragay gulf and Albay Gulf
- ❑ A 67% live coral cover benchmark in 2014 at Guinlobngan in has deteriorated to just 37%

Vital information of MPAs in Asid Gulf, Masbate

Name of MPA	Municipal water area	Sanctuary (has.)	Reserve (has.)	Total (has.)	Mun water protection	Year Established	Legal basis
Balud (Jintotolo)	45,370.88	22.80	51.70	74.50		2004	Ordinance no.10 s. 2004
Milagros (Bangad)		43.50		43.50		2005	Ordinance no.001-05 s. 2005
Milagros (Pacao)	59,879.37	67.60		67.60	0.22	2010	Ordinance no. 19-02 s. 2010
Milagros (Boray)		23.20		23.20		2010	Ordinance no. 19-02 s. 2010
Cawayan (Recodo)		200.00	700.00	900.00		2001	M.O. 01 series of 2002 & Resolution no. 38 series of 2002
Cawayan (Looc)	63,354.84	80.00	120.00	200.00	4.21	2013	
Cawayan (Naro)		120.00	600.00	720.00		2013	
Cawayan (Naro Scallops)		200.00	650.00	850.00		2013	
Placer (Nagarao)		27.50		27.50		2007	M.O. 08 series of 2007
Placer (Guin Awayan)	37,788.35	54.00		54.00	0.55	2007	M.O. 08 series of 2007
Placer (Pasiagon)		32.00	66.00	98.00		2007	M.O. 08 series of 2007
Placer (Naboctot)		30.00		30.00		2007	M.O. 08 series of 2007
Esperanza (Labangtaytay-libertad)		20.00		20.00	0.18	2015	Resolution no. 2015-58
Esperanza (Sorosimbahan)	13,712.68	5.00		5.00		2015	Resolution no. 2015-59
Total	**220,106.12**	**925.60**	**2187.70**	**3113.30**			

- ❑ Some sanctuaries are in existence for more than a decade now
- ❑ Aggregate total area of protection is way far from mandated by law

Coral Health of Asid Gulf, Masbate

Life Forms/ substrate	Milagros	Cawayan				Placer*		Esperanza	
	Bangad Milagros	Guinlobn gan T1	Guinlobn gan T2	Recodo T1	Recodo T2	Nagarao (S)	Guinawa yan (S)	Surosimb ahan T1	Surosimb ahan T2
CORAL (HC)	14.86	37.46	36.84	19.66	15.30	40.72	34.00	40.44	24.86
SOFT CORAL (SC)	0.44		0.64	0.12					
DEAD CORAL (DC)	2.32	19.82	13.92	0.80		8.00	2.36	1.62	0.16
OTHER ORGANISMS (OT	0.28	3.96	3.36	3.62	1.28	1.20	4.20	0.54	0.82
ALGAE (ALG)	46.74	7.72	14.18	59.58	69.32	15.88	44.08	49.02	66.42
SUBSTRATE (AB)	35.36	31.04	31.06	16.22	14.10	34.20	15.36	8.38	7.74
Total	100	100	100	100	100	100	100	100	100
LCC *(HC+SC)	15.30	37.46	37.48	19.78	15.30	40.72	34.00	40.44	24.86
Reef Health	POOR	FAIR	FAIR	POOR	POOR	Fair	Fair	FAIR	POOR

*from Mendoza et al. 2017

Prevalence of algae signals disruption of coral recovery as they are outgrown primarily by seaweeds.

A benchmark in 2014 from Guinlobngan shows high dead corals (26-29%)

Indicators of coral deterioration: Guinlobngan's case.

Sharp dive of live coral cover in span of five years

Evidences: Increases in Dead corals, colonization of algae and increase in abiotic components. Periodic monitoring enables trend analysis. We need more data sets!

Feeding habits of reef fishes

❑ Herbivore ❑ Carnivore ❑ Omnivore

- ❑ Grazers (herbivores) are becoming less abundant
- ❑ Intense fishing my have reduced population of grazers significantly
- ❑ The overgrowth of macroalgae could ba an offshoot of elimination of grazers in the ref ecosystem
- ❑ This is bad news to coral reef growth and recovery.

REEF FISH GROUPS

Inicator 11%
target 17%
major 72%

- ❑ Notable is the presence of economically-important fishes
- ❑ Indicator species are minimal in occurrence

ASID GULF VS. RAGAY GULF

Biomass (kg/250m²)	
2.2-8.5	6.56-31

Diversity	
15-32	21-33

Fish Density (pcs/m²)	
0.36-1.65	0.7-3.2

- ❑ Reef fishes are less dense and less abundant in Asid Gulf
- ❑ This directly connect with the disturbed reef ecosystems

Implementing Agency: Bicol University, Center for Policy Studies and Dev't
Collaborating Agencies: PSU, MIFT, CASIFMAS, and RNAFS

APPENDIX B

Participatory Resource and Socio-Economic Assessment (PRSA) in ALBAY, RAGAY and ASID GULFs

IFAD — Investing in rural people

FishCORAL

SEAGRASS AND SEAWEEDS OF ASID GULF

Seagrass % cover per Municipality

Seagrass species — % cover
■ Cawayan ■ Milagros ■ Placer ■ Esperanza

Most Abundant Seagrass (%cover)

75% Syringodium isoetifolium- Cawayan

75% Haludole pinifolia - Cawayan

57.50% Haludole uninervis - Milagros

37.66 Thalassia hemprichii - Placer

32.88% Enhalus acoroides - Esperanza

Other recorded seagrass are Cymodocea serrulata and Halophila ovalis.

Threats to seagrass/seaweeds beds

Siltation
Boat anchorage
Pollution

Seagrass diversity in Asid Gulf

Seagrass	English/local name	Milagros	Cawayan	Placer	Esperanza
Thalassia hemprichii	Sickle seagrass/ Turtle grass	√	√	√	√
Syringodium isoetifolium	Noodle seagrass	√	√	√	√
Haludole pinifolia	Needle seagrass	√			
Haludole uninervis	Trident seagrass		√		√
Enhalus acoroides	Eel/tape seagrass/ "lusay"	√		√	√
Cymodocea serrulata	Serrated ribbon seagrass	√	√		
Halophila ovalis	Spoon seagrass/ Dugong grass				√
No. of species present		5	4	3	5

Species present 5
Numerical rating 52.75 %
Adgective ratting Good

Species present 4
Numerical rating 67.21 %
Adgective ratting Good

Species present 3
Numerical rating 23.33%
Adgective ratting Poor

Species present 5
Numerical rating 54.63 %
Adgective ratting Good

- Seagrass species serve as important sources of food for various marine organisms such as:
  Dugong(Sea cow)-Halophila sp., Cymodocea sp. and Halodule sp.
  Green Sea Turtle (pawikan)- Thalassia sp., Halophila sp. and Halodule sp.
- Of the 10 species of seagrass previously found in the waters of Masbate 7 were thriving in the gulf.
- Presence of these seagrass beds harbor different types of macro algae and invertebrates.
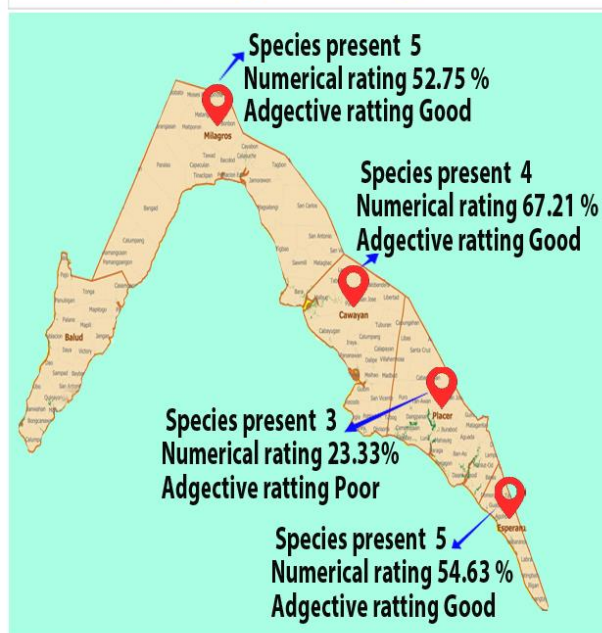
Total number of taxa in each Municipality

■ Rhodophyta ■ Phaeophyta ■ Chlorophyta ■ Seagrass
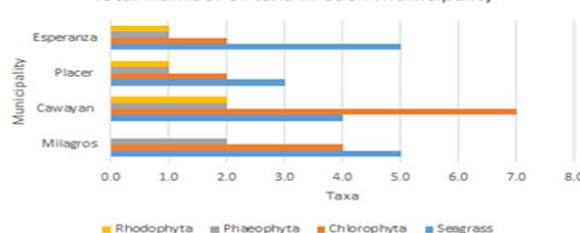
Habitat condition per Municipality

Municipality	Numerical rating %	Adjectival rating
Milagros	52.75%	Good
Cawayan	67.21%	Good
Placer	23.33%	Poor
Esperanza	54.63%	Good

Conclusion:

➢ Seagrass meadows in Asid gulf is in fair diversity condition.
➢ Valuable green and red algae dominate the seaweedsbeds in Asid gulf such as Caulerpa, Gracilaria, E ucheuma and Kappaphycus species making Masbate among the top producers of seaweeds in the country.
➢ Anthropogenic ac tivities such as siltation, boat anchorage and coastal pollution are threats seagrass/seaweeds beds along the gulf.

➢ Masbate was 4th seaweeds producers in the Philippines.
➢ Seaweeds are most abundant in Cawayan Masbate and Chlorophyta has the highest number of species.
➢ Sargassum sp. occurred in vast number in Cawayan, Milagros and Placer.

Implementing Agency: Bicol University, Center for Policy Studies and Dev't
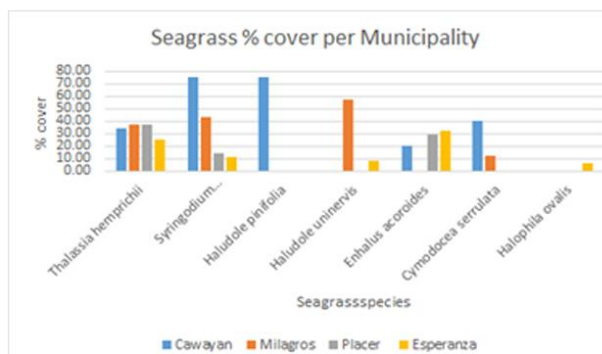*Collaborating Agencies:* PSU, MIFT, CASIFMAS, and RNAFS

Source: DENR-PCRA report 2010 for Placer and Esperanza, Masbate.

APPENDIX C

Participatory Resource and Socio-Economic Assessment (PRSA) in ALBAY, RAGAY and ASID GULFs

IFAD — Investing in rural people

FishCORAL

STATUS of MANGROVES IN ASID GULF

Mangrove species found in the areas of Asid Gulf

- *Avicennia marina* (Bungalon)
- *Sonneratia alba* (Pagatpat)
- *Rhizophora mucronata* (Bakawan Babae)
- *Avicennia Corniculatum*
- *B. Sexangola*
- *A. Rhumphiana*
- *Avicennia Officinalis*
- *C. Tagal*
- *X. Granatum*
- *Rhizophora apiculata* (Bakawan Ialaki)
- *C. Philippinensis*
- *L. Lumnitzera*

Diversity of Mangrove in Asid Gulf

Municipality	Mangrove Station	No. of Species
Placer	Daraga (Placer)	5
Milagros	Cayabon (Milagros)	5
	Calasuche (Milagros)	4
	Borongan (Milagros)	6
Balud	Quinayangang Tonga (Balud)	3

Municipality	Mangrove Station	Mangrove Type	status	Regenerative capacity	remarks
Milagros	Cayabon (Milagros)	riverine	fair	very high	cuttings and fishing nets present
	Calasuche (Milagros)	riverine	fair	low	cuttings present, thin mangroves
	Borongan (Milagros)	riverine	fair	low	cuttings/fishing nets
Balud	Quinayangang Tonga (Balud)	riverine	fair	low	natural stand

Total Stand and Basal Area

Mangrove Station	Trees	Total Basal Area (sq. ft.)
Daraga (Placer)	59	145.44
Cayabon (Milagros)	14	12.15
Calasuche (Milagros)	13	34.85
Borongan (Milagros)	49	42.7
Quinayangang Tonga (Balud)	63	213.01

Placer (Daraga) has the highest Relative Dominance and Importance Values with 100 and 300 respectively while Milagros (Cayabon) has the lowest.

* Presence of fishponds and wastes particularly in Placer Daraga
* low species diversity, only 1 or 2 mangrove species used in reforestation
* Mostly secondary growth and low regenerative capacity except Cayabon mangrove area
* low species diversity, only 1 or 2 mangrove species used in reforestation

CONCLUSION:
* Some mangrove areas have lownershoip claim disputes with the barangay and owners of adjacent land areas
* Mangrove used as lumber for housing and cuttings in some mangrove areas atre still observed

Implementing Agency: Bicol University, Center for Policy Studies and Dev't
Collaborating Agencies: PSU, MIFT, CASIFMAS, and RNAFS

APPENDIX D

Participatory Resource and Socio-Economic Assessment (PRSA) in ALBAY, RAGAY and ASID GULFs

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STATUS OF WATER QUALITY IN ASID GULF

8.15 to 8.47 were recorded for pH level exhibiting good buffering capacity

Dissolved Oxygen range: 7.22-7.51 In good state. Exceeded 6 mg/L limit in DAO 2016-08 for Class SB

TSS in all stations does conform to the standard limit of **50mg/L** defined in **DAO 2016-08 for Class SB water**

Fecal coliform
Some stations have exceeded tolerable limit (100 MPN, SB water, DAO 2016-08).

High coliform: 200-300 MPN
MIlagros waters, Asid River mouth
Milagros MPA

Low and tolerable coliform level in Balud
Excellently low in Esperanza
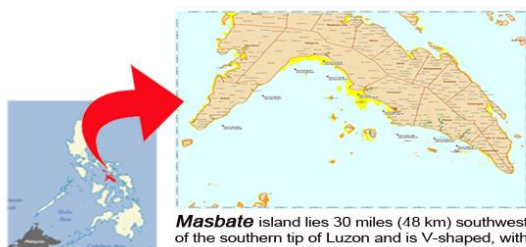
Masbate island lies 30 miles (48 km) southwest of the southern tip of Luzon and is V-shaped, with the open end of the V forming the Asid Gulf on the south. Asid Gulf is the northern head of the Visayan Sea. This 2,475.95 sqkm area is home to crab, squid, sartdines and small pelagic fisheries.

Highest temperature 32.20 $^{\circ}$C
Lowest is 29.60 $^{\circ}$C
Tolerable limit: 26-31 $^{\circ}$C

High temperature measurements make Asid gulf vulnerable for impacts of changes of sea surface temperature and other climate change-related disturbances
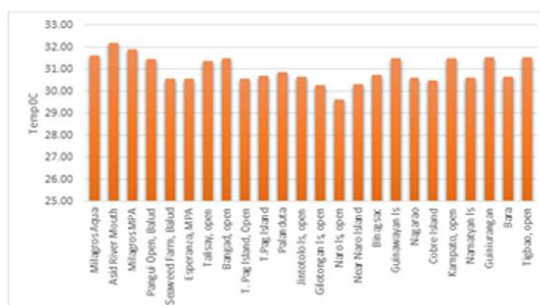
Nitrate concentration: 7.73-14.35 mg/L
Tolerable limit: 10 mgh/L
Milagros water and Asid River mouth exceeded the (10 mg/L)

Phosphate concentration:
Tolerable limit: 0.5mg/L
Esperanza, Pagui in Balud Asid River Mouth exceeded the limit (0.5 mg/L)
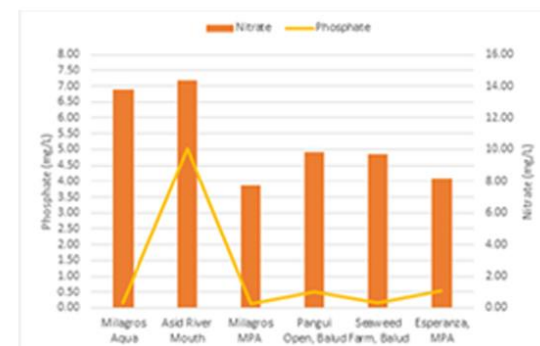
Site Description	pH	DO	Conductivity (µS/cm)	TDS	Salinity (PSU)	Total Suspended Solids (ppm)
Milagros Aqua	8.47	7.22	46.44	23.53	33.26	30
Asid River Mouth	8.31	7.51	46.43	23.66	33.43	22.5
Milagros MPA	8.14	7.31	46.5	23.41	32.5	30
Pangui Open, Balud	8.16	7.33	46.54	23.4	33.07	18.33
Seaweed Plan, Balud	8.15	7.45	46.41	23.27	32.96	60
Esperanza, MPA	8.15	7.45	46.41	23.27	32.96	22.5

Implementing Agency: Bicol University, Center for Policy Studies and Dev't
Collaborating Agencies: PSU, MIFT, CASIFMAS, and RNAFS

APPENDIX E

Participatory Resource and Socio-Economic Assessment (PRSA)
in ALBAY, RAGAY and ASID GULFs

IFAD
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FishCORAL

STATUS OF CAPTURE FISHERIES IN ASID GULF

Cawayan owns the highest number of fishing gear units with **3,355 (35.7%)** while other have:

Balud   2,640
Milagros   2,023
Esperanza   686
Placer   675

10,224,513mt
Fishing TRIPS per Year

Fishing Gear Units per Municipality

- Placer 7.20%
- Esperanza 7.31%
- Cawayan 35.77%
- Balud 28.15%
- Milagros 21.57%
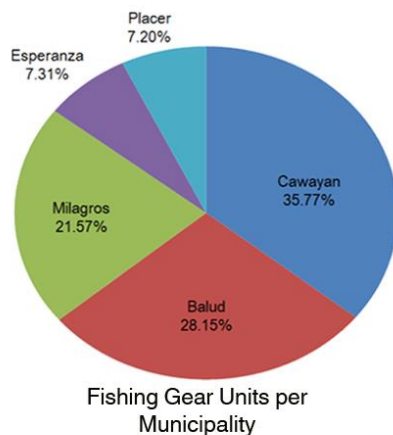
the gulf is rich in crabs and squids

64 coastal communities
Surveyed   within **5** Municipalities

11 Balud
13 Milagros
12 Esperanza
14 Placer
14 Cawayan

9,379 fishing gear units and **42** variants

Balud registered the highest fishing number of fishing trips 3,488,957 (34%) fishing trips while **Placer** has the least with 499,563.

Municipality	Number of Gears	Trips	Produc MT
Balud	2,640.00	3,488,957.00	6,655.62
Milagros	2,023.00	2,550,206.00	3,622.31
Cawayan	3,355.00	3,159,139.00	9,420.33
Placer	675.00	499,563.00	1,086.30
Esperanza	686.00	526,648.00	2,789.88
Total	9,379.00	10,224,513.00	23,574.44

Gear Categories	Total Number of Gear Units	Number of Variants	Trips	Production (MT)
Entangling Net	2,397	12	3,847,956	7,284.28
Handlines	2,365	7	2,533,380	5,473.89
Longlines	692	1	898,926	1,850.47
Impounding net	1,924	4	1,221,673	5,305.09
Barriers & Traps	666	11	577,944	1,629.30
Spears	405	3	157,893	457.33
Misc Hand instrument	613	1	935,385	401.16
Others	317	3	46,356	1,172.91
Total	9,379	42	10,224,513	23,574.44

23,574.44 mt Annual Fishery Production

Seasonality of Fishing Gear Types & Units

- Entangling nets
- Handlines
- Longlines
- Impounding nets
- Barriers and Traps
- Spear
- Miscellaneous hand instruments
- Total Production
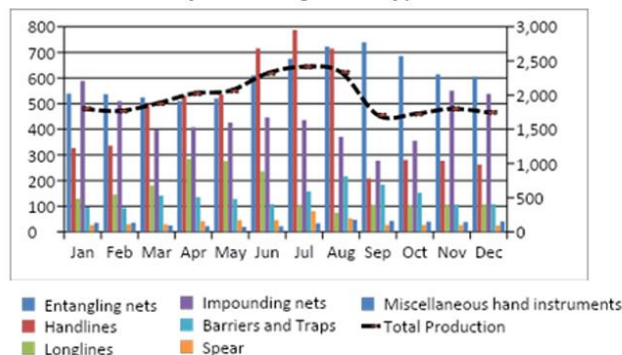
Peak Fishery Period: July, August, June and May
Lean Months: September and October

Fishing Gear 2,640
Trips 3,488,957
Production 6,655.62

Fishing Gear 2,023
Trips 2,550,206
Production 3,622.31

Fishing Gear 675
Trips 499.563
Production 1,086.30

Fishing Gear 3,355
Trips 3,159,139
Production 9,420.33

Fishing Gear 686
Trips 536,648
Production 2,789.88

2,475.95 sqKm

Implementing Agency: Bicol University, Center for Policy Studies and Dev't
Collaborating Agencies: PSU, MIFT, CASIFMAS, and RNAFS

APPENDIX F

SOCIO-ECONOMIC ASSESSMENT OF ASID GULF

Age
- 61 and above
- 51-60
- 41-50
- 31-40
- 21-30
(0, 10, 20, 30, 40)

13% / 87%

94% MARRIED

Highest Educational Attainment
- College Grad.
- College Level
- Highschool Grad.
- Highschool Level
- Elem. Grad.
- Elem. Level
- No formal schooling
- No Response
(0, 20, 40)

- 51% Owner of house and lot
- 33% Own house, rent-free lot w/ consent
- 10% Rent-free house and lot w/ consent
- 39% Nipa/Cogon Hut
- 31% Concrete
- 29% Wood/ Bamboo w/ GI roof

6 to 10 No. of HH Members

- 44% Electricity own connection
- 19% Electricity shared connection
- 5% Generator and Battery
- 45% Deep Well
- 21% Bottled Water
- 11% Own Water Faucet
- 67% Water-sealed

Economic Activities Performed by Household Members

Nature of Activities	Male Freq.	Male Percent	Female Freq.	Female Percent
Fishing				
Fish Capture	220	99%	2	1%
Processing/Drying of Fish	37	82%	8	18%
Mending of nets and other gears	108	98%	2	2%
Preparing gears for fishing	118	93%	9	7%
Farming (Animal production)				
Backyard raising	20	87%	3	13%
Feedlot Fattening	9	90%	1	10%
Farming (Crop production)				
Rice / corn farming	5	100%		
Vegetable production	3	100%		
Other Income-generating activities				
Small scale business	3	60%	2	40%

Fishing Gears Used by Household Members

Fishing gear used	No. of household reporting	Percent (n=257)
Bottom-set gill net	124	48%
Drift gill net	19	7%
Simple handline/ Hook&Line	48	19%
Speargun	14	5%

Observed Changes in Fish Catch

Changes in	Better now	Better years ago	No change	No response	Total
Fish Size	7%	74%	16%	3%	257
Fish Abundance	9%	76%	10%	5%	257

Marketing of Fish Catch

To whom the catch are sold	Frequency	Percent (n=257)
Neighbors	114	44%
Bagsakan	58	23%
Middleman	37	14%
Local Market	35	14%

Biggest Problems in Fishing

Biggest Problems in Fishing	Frequency	Percent
Illegal use of destructive fishing practices	62	35%
Natural Disaster	38	21%
Intrusion of Commercial Fishing Vessels	17	10%

Poverty Rate of Fishing Households Along Asid Gulf

Municipality	No. of households covered	No. of households with income below poverty threshold	Poverty incidence
Balud	53	38	72%
Milagros	57	35	61%
Cawayan	25	19	76%
Placer	60	39	65%
Esperanza	55	29	53%
Total	**250**	**160**	**64%**

BICOL UNIVERSITY
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APPENDIX G