Bataan Coastal Resource Management Programs: Environmental, Socio-Economic, and Implementation Issues from Stakeholders' Views

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Abstract *–A study on the status of Bataan's coastal zones, and the issues on the province's coastal resource management (CRM) programs under an integrated framework was commissioned by the Department of Science and Technology-Region III in the Philippines. Twenty-eight representative coastal villages and 11 water testing sites served as study areas. The research participants totalled to 1,300. Focused group discussions, survey and interviews, laboratory testing, documentary analysis, and literature review were used in the data gathering. It was concluded that the province's coastal zones are in a disturbed state, which has negative implications to its already subsistent coastal population and important coastal economic activities. The province's CRM projects have been arbitrary and intermittent. There are too few conservation initiatives due to scarcity of baseline data necessary for more methodical CRM programs. There is poor grassroots level involvement in CRM decision-making processes as well which clearly defeats the essence of integrated coastal management. A coordinated effort to strengthen stakeholder participation in critical CRM stages, and to conduct more comprehensive profilings and assessments of the province's coastal environment involving the government, academics, and scientists are recommended to substantiate stakeholder involvement and increase the quality of data for CRM projects.*

Keywords *–Coastal resource management, Coastal management, Coastal zone management, Integrated coastal management, Bataan*

INTRODUCTION

The Philippines' coastal environment is under tremendous stress. The combined effect of overpopulation and industrialization have led to habitat loss, poor water quality, and harm to marine life [1]. Destructive fishing methods and siltation have destroyed the country's coral reefs [2]–[3], and coastal development have devastated its mangrove forests [4]. The "open access" nature of the country's fishing grounds have resulted to dwindling resources. Marine capture fishery is starting to become economically non-viable in many localities [4].

The said devastations are detrimental to Bataan, a peninsular province in the Philippines' Central Luzon region. Due to its geographical setting (in between the West Philippine Sea and the Manila Bay), the province depends highly on coastal zones and resources. It is home to many small- and large-scale fishery industries, primarily fish processing, brackish water aquaculture, and marine capture fisheries. Some ports, power plants, and oil refineries thrive near its shores. It is fast becoming a hotspot for coastal-tourism too due to the upsurge of beach resorts along its western coastline.

In order to preserve the coastal resource bases in the province, hence, support livelihood in its coastal areas, the Bataan Integrated Coastal Management Program (BICMP) was formulated in early 2000 as a joint effort by the Bataan Provincial Government, the Bataan Business Community, and the Global Environment Facility-United Nations Development Programme-International Maritime Organization-Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), making Bataan the first parallel site of the last. The BICMP was implemented through a public-private

partnership using provincial and private sector resources. From its inception, the program engaged in various CRM activities based on the Integrated Coastal Management (ICM) framework as promoted by the PEMSEA.

Under the ICM framework, BICMP's success lies on high quality field information derived from partnerships between all stakeholder groups [5] namely: the local government units (LGU), the private sector, non-government organizations (NGO), community-based organizations, people's organizations, the media and other civil society groups, international organizations, the academe and the scientific community, donor organizations, and of course the coastal population. The main premise in the ICM framework is that "no single sector can resolve CRM issues by itself."

From the environmental management perspective, it is imperative to assess how Bataan's coastal zones are benefitting from CRM programs under the BICMP. Essentially, it is important to describe the impacts of CRM activities on the coastal environment, resources, and population so that appropriate course of actions can be instituted to address any implementation concerns. It is vital to investigate and document all these in order to safeguard Bataan's most productive areas—its coastal zones. On this background, a study seeking to ascertain data on the status of Bataan's coastal environment and resources, and the implementation issues on the province's CRM programs was commissioned by the Department of Science and Technology-Region III in the Philippines.

Specifically, the study addressed the following: Rapid profiling of Bataan's coastal zones, environmentally and socio-economically, to describe the impacts of past and present CRM programs under the BICMP; and identification of implementation issues by stakeholders on CRM activities under the BICMP.

METHODS

Description of Study Area

The province of Bataan is composed of 11 municipalities and a component city. It covers a land area of 1,373 km^2 with a population of 687,482 as of May 2010 [6].

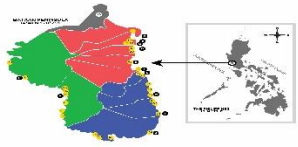

Fig. 1. Map of the study area

Except for the town of Dinalupihan (entry point from the north), all localities are coastal areas. The towns / city of Hermosa, Orani, Samal, Abucay, Balanga, Pilar, Orion, and Limay are located along the Manila Bay coastline in the east, while the municipality of Mariveles is in the southern end facing the point where the Manila Bay meets the West Philippine Sea. The towns of Bagac and Morong lies along the South China Sea coastline. Approximately 33% of the province's population resides in coastal areas [6] in 79 coastal villages. It has a total municipal waters of 133,962 ha with 188.66 km of coastline from Hermosa to Morong (Fig. 1).

Clustering and Designation of Water Quality Testing Sites

Due to geographical, ecological, and coastal resource utilization similarities among coastal localities, the researchers clustered them into three. Cluster 1 included Hermosa, Orani, Samal, Abucay, and Balanga. These areas lie along the Manila Bay coastline in Bataan's north-eastern side. They are known to be the province's fish-processing and brackish water aquaculture centers. They are also recognized to be the area's main bivalve producers using farms made from man-made sea enclosures. The said places are low-lying as well, hence prone to flooding. The cluster is host to two multi-purpose river networks—the Almacen and Talisay River Systems.

Cluster 2 comprised of the southern towns along Bataan's industrial zones—Pilar, Orion, Limay, and Mariveles. These localities face the deeper Manila Bay portions. This, combined with their sandy to rocky coasts, makes them home to many of the province's industrial ports, jetties, docking facilities, and other shipping activities. Lastly, Cluster 3 included the towns of Bagac and Morong in the province's west coast. The cluster is characterized by pristine and rocky beaches with relatively plenty coral reefs, seaweeds, and seagrass beds. The areas serve as breeding grounds for several of the world's species of marine turtles as well. The cluster is sandwiched between the industrial areas of Mariveles in the south and Subic Bay Freeport Zone (SBFZ) in the north.

Twenty-eight coastal villages were selected as cluster representatives (Table 1). Eight villages represented Cluster 1 (Almacen in Hermosa; Pantalan Luma, Kabalutan, and Palihan I in Orani; Tabing-Ilog and East Daang-Bago in Samal; Wawa in Abucay; and Puerto Rivas Ibaba in Balanga), 12 represented Cluster 2 (Landing and Wawa in Pilar; Capunitan, Santa Elena,

Table 1. Clustering and Designation of Water Sampling Sites

Cluster	Locality	Representative Village			Water Sampling Site	
		Name	Map Code	Coordinates	Map Code	Coordinates
1	Hermosa	Almacen	2.1	14°50'08.5"N 120°31'13.1"E	A	14°48'35.21"N 120°34'03.24"E
	Orani	Pantalan Luma	3.1	14°48'13.0"N 120°32'34.0"E	B	14°47'37.04"N 120°33'28.29"E
		Kabalutan	3.2	14°48'01.0"N 120°32'00.0"E	C	14°47'37.04"N 120°33'28.29"E
		Palihan	3.2	14°48'15.1"N 120°32'23.3"E		
	Samal	Tabing-Ilog	4.1	14°46'13.7"N 120°32'37.4"E	D	14°46'16.1"N 120°34'23.7"E
		Daang-Bago	4.2	14°46'03.0"N 120°32'36.9"E		
	Abucay	Wawa	5.1	14°43'19.0"N 120°32'52.2"E	E	14°43'29.20"N 120°33'00.06"E
	Balanga	Puerto Rivas Ibaba	6.1	14°41'59.5"N 120°33'37.0"E	F	14°41'52.31"N 120°34'06.84"E
2	Pilar	Landing	7.1	14°40'12.4"N 120°34'12.0"E	G	14°39'49.87"N 120°34'42.27"E
		Wawa	7.2	14°40'21.8"N 120°33'50.2"E		
	Orion	Capunitan	8.1	14°36'58.0"N 120°34'58.9"E	H	14°35'00.69"N 120°35'34.04"E
		Santa Elena	8.2	14°35'32.7"N 120°35'10.2"E		
		Puting Buhangin	8.3	14°35'07.3"N 120°35'27.1"E		
	Limay	Lamao	9.1	14°30'48.4"N 120°36'35.0"E	I	14°31'04.25"N 120°36'46.21"E
		Saint Francis I	9.2	14°34'07.9"N 120°35'44.8"E		
		Saint Francis II	9.3	14°33'44.8"N 120°35'52.7"E		
	Mariveles	Ipag	10.1	14°25'21.5"N 120°29'13.7"E	J	14°27'17.53"N 120°35'49.50"E
		Biaan	10.2	14°26'33.2"N 120°27'04.2"E		
		Balon-Anito	10.3	14°26'24.0"N 120°27'27.1"E		
		Cabcaben	10.4	14°27'14.2"N 120°35'35.2"E		
3	Bagac	Pagasa	11.1	14°34'57.7"N 120°23'36.1"E	K	14°35'28.3"N 120°23'14.2"E
		Bagumbayan	11.2	14°35'51.5"N 120°23'27.0"E		
		Tabing-Ilog	11.3	14°35'31.8"N 120°23'33.2"E		
		Saysain	11.4	14°33'45.9"N 120°23'26.1"E		
		Paysawan Proper	11.5	14°30'49.7"N 120°22'53.1"E		
		Sitio-Caibobo-Paysawan	11.6	14°29'28.3"N 120°23'16.1"E		
	Morong	Sabang	12.1	14°41'48.6"N 120°14'59.3"E	L	14°41'48.19"N 120°14'55.11"E
		Nagbalayong	12.2	14°39'36.3"N 120°17'17.9"E		

and Puting Buhangin in Orion; Lamao, Saint Francis I, and Saint Francis II in Limay; and Ipag, Biaan, Balon-Anito, and Cabcaben in Mariveles), and 8 represented Cluster 3 (Pagasa, Bagumbayan, Tabing-Ilog, Saysain,Paysawan Proper, and Sitio Caibobo-Paysawan in Bagac; and Sabang and Nagbalayong in Morong).

The selection was based from similarities in terms of physical features, proximity to the coast, demographic characteristics, and interactions with coastal resources within a cluster.Apart from the representative coastal villages, 11 areas representing each coastal locality were chosen as water quality testing sites (Table 1). Recommendations laid down in Attachment 3.2 of the Department of Environment and Natural Resources-Environmental Management Bureau's (DENR-EMB) Manual for Ambient Water Quality Monitoring Manual served as guide for the site selection [7].

Sampling

The participants in this study totalled to 1,300 (550, 503, and 247 respondents in Clusters 1, 2, and 3 respectively [Table 2]). Since the aim was to ascertain data on coastal zone status and CRM impacts and issues, the respondents needed to be purposively chosen. The criteria for the purposive selection were the following: at least 5 years of residence in the coastal area; at least 3 years of involvement in fishery-related activities as livelihood means; and willingness to narrate their own stories.

All 1300 participants were included in the survey and interviews (SAI). SAI participants who were active members of village councils, people's organizations, civil society sector, fisher organizations, and private groups were included in the focus group discussions (FGD) too. The "multi-sectoral" nature of the participants in this investigation highlights its "participatory" feature.

Table 2. Distribution of SAI and FGD Participants

Cluster	Locality	Representative Village	Participants	
			SAI	FGD
1	Hermosa	Almacen	100	12
	Orani	Pantalan Luma	50	5
		Kabalutan	50	5
		Palihan	50	8
	Samal	Tabing-Ilog	50	10
		Daang-Bago	50	12
	Abucay	Wawa	100	14
	Balanga	Puerto Rivas Ibaba	100	12
2	Pilar	Landing	60	14
		Wawa	30	12
	Orion	Capunitan	55	9
		Santa Elena	44	7
		Puting Buhangin	44	7
	Limay	Lamao	60	10
		Saint Francis I	30	6
		Saint Francis II	30	8
	Mariveles	Ipag	40	8
		Biaan	55	10
		Cabcaben	30	3
		Balon-Anito	25	3
3	Bagac	Pagasa	50	8
		Tabing-Ilog	10	2
		Bagumbayan	10	2
		Saysain	30	6
		Paysawan Proper	30	3
		Sitio-Caibobo-Paysawan	8	2
	Morong	Sabang	59	15
		Nagbalayong	50	7

Data Gathering

Prior to data gathering, permissions were secured from municipal administrators of concerned localities. Likewise, collaborations were sought from leaders of participating stakeholders' groups to explain the project objectives to target communities.

Primary and secondary data (both in qualitative and quantitative forms) were collected through a mixed-method approach covering socio-economic, coastal environment health, and environmental management spheres. Primary data were obtained through SAI, FGD, and Water Quality Assessment (WQA). The following were ascertained—socio-economic characteristics of study areas, current condition of coastal and marine resources, current state of coastal habitat systems, and past and present CRM issues. Meanwhile, secondary data were obtained from reports from government departments and literature review. Secondary data were limited to demographics, types of economic activities, and topographic maps.

Survey and Interview

A survey-questionnaire developed by the researchers was used in the SAI. The tool comprised of items covering the participants' socio-economic information, perceived state of the coastal environment, and issues on Bataan CRM. The tool underwent scrutiny of experts from the DOST-III Regional Technical Evaluation Committee and Bataan Provincial Science and Technology Center prior to field use.

Focus Group Discussion

An FGD was done in each of the 11 localities. Each session included 12 to 24 participants (Table 2) and was led by a facilitator, note-taker, and technician. The facilitator served as guide and moderator keeping the participants focused on main topics for discussion (Bataan's socio-economic and coastal environment conditions, and the province's CRM issues). The note-taker served as observer identifying how comments were said and recording the transitions from one topic to the next. The technician was responsible for recording the FGD using an electronic device and creating a transcript for each session. Although there were main topics for consideration, the discussions were unstructured. Extensive probing was used to get the discussants speak freely and express in-detail their opinions and feelings on the topics. Examples of the questions asked are the following:

1) How has the coastal environment changed in relation to CRM implementation under the BICMP?
2) How has the changing state of the coastal environment and resources affected your day-to-day living?
3) What are the challenges to the successful implementation of CRM in your locality?
4) How can the implementation of CRM in your locality be improved?

Water Quality Assessment

The WQA procedures used in this study were anchored on the DENR-EMB's Manual on Ambient Water Quality Monitoring. The manual serves as the Philippines' national guide for the monitoring of water quality in ambient water bodies including marine waters (coastal or offshore) [7]. Per the manual, whatever the objective may be, WQA must proceed with the following steps: preparation of monitoring plan; collection of water samples; field tests and measurements; recording of field observations, on-site test results, and field activities; pre-treatment, preservation, storage, and transport of samples

to the laboratory; analyses of samples in the laboratory; data processing, interpretation, analysis, and storage; and preparation of report.

This study faithfully followed the aforesaid procedures. The following physico-chemical parameters were tested: Power of Hydrogen (pH), 5-Day Biological Oxygen Demand (BOD_5), Dissolved Oxygen (DO), Oil and Grease (OAG), and Heavy Metals: Mercury (Hg) and Lead (Pb). It should be noted that the heavy metal analysis was limited to 3 localities only because of budgetary constraints. The researchers took water samples at about 100m from the shores using an improvised collector they designed specifically for the task.The results were compared against the standards set forth in the latest DENR Water Quality Guidelines andGeneral Effluent Standards or the DENR Administrative Order No. 2016-08 for Class SB and Class SC water bodies (water body classes that are suitable for marine fishery and coastal tourism) [8].

All data gathered formed the basis for the rapid profiling of Bataan's coastal zones, discussion of the province's CRM issues, and recommendations for future interventions for sustainable BICMP.

RESULTS AND DISCUSSION

Bataan Coastal Zone Status

Coastal Waste Build-Up. The province is suffering from coastal waste build-up especially in Clusters 1 and 2 due to lack of any sewage treatment system and efficient solid waste management schemes. Domestic wastewater is only discharged to drains leading to rivers that release to the seas. Such situation is posing threats to public health as well as to the riverine and coastal environment. The increasing number of informal settlers (living in shanties that lack toilet facilities) alongside riverbanks and shores predominantly in Abucay, Pilar, Orion, and Mariveles is aggravating the problem. Residents from these areas admitted to have poor waste management practices, arguing that they rather "look for extra-income" than spend valuable time and resources to segregate household wastes. Waste management is a tough task according to them given that most LGUs lack efficient services (village cleaners and garbage collection) to address the matter. Interestingly though, some informal settlers are defensive on the apparent waste build-up along the coasts, claiming that the wastes are carried to their areas only by sea currents and north-east wind from the capital region. One discussant from Cluster 2 quipped: "We may have been practicing improper waste disposal but we are not solely responsible for the problem. Trash from Metro Manila always reach our area (Limay FGD)."

Table 3. Water Quality Assessment Results

Sampling Site	pH	BOD_5	DO	OAG	Hg	Pb
Hermosa	7.25	329 mg/L	0.09 mg/L	0.55 mg/L	-----	-----
Orani I (Kabalutan)	7.63	657 mg/L	10.20 mg/L	3.76 mg/L	-----	-----
Orani II (Palihan)	7.64	193 mg/L	0.90 mg/L	5.76 mg/L	-----	-----
Samal	7.69	493 mg/L	1.50 mg/L	0.41 mg/L	-----	-----
Abucay	7.78	3,380 mg/L	0.30 mg/L	3.59 mg/L	-----	-----
Balanga	7.36	203 mg/L	1.40 mg/L	5.58 mg/L	-----	-----
Pilar	7.81	444 mg/L	1.00 mg/L	6.36 mg/L	-----	-----
Orion	7.95	328 mg/L	1.30 mg/L	2.38 mg/L	-----	-----
Limay	7.81	2,320 mg/L	1.60 mg/L	4.22 mg/L	-----	-----
Mariveles	8.04	1,840 mg/L	1.40 mg/L	0.15 mg/L	0.0227 5 mg/L	-----
Bagac	7.86	232 mg/L	1.10 mg/L	4.94 mg/L	0.0400 4 mg/L	-----
Morong	7.42	970 mg/L	6.70 mg/L	2.60 mg/L	0.0440 4 mg/L	0.0000 9 mg/L

Deteriorating Coastal Water Quality. Results from the WQA are alarming (Table 3). In terms of BOD_5, none of the sampling sites passed the national standards—all were very high considerably exceeding the DENR-EMB thresholds (5 mg/L and 7 mg/L for Classes SB and SC respectively). The highest was found in Abucay, 3380 mg/L, and the lowest was in Orani, 193 mg/L.

For DO, all sites fell below the criterion level (5 mg/L to 7 mg/L for both Classes SB and SC) except for Orani and Morong which had 10.2 mg/L and 6.7 mg/L respectively. The elevated BOD_5 and low DO levels are indicative of polluted coastal waters and may be due to excessive biodegradable waste discharges from domestic areas and aquaculture farms. Elevated BOD_5 coupled with low DO is dangerous to aquatic life [9]–[12]. Attention must be given especially to the localities of Orani, Samal, Abucay, Pilar, Limay, and Mariveles where informal coastal settlements and bivalve pens abound.

For pH, all sites fell within the accepted range (pH 6 to 8.5 for Classes SB and SC) with Mariveles and Hermosa being the highest and lowest at 8.04 and 7.25 respectively. The recorded levels are still suited for algal and fish larvae growth though based from literature [8]. Meanwhile, in the OAG analysis, 8 out of 11 testing sites

exceeded the thresholds (2 and 3 mg/L for Classes SB and SC respectively) and such may be due to seeps from oil barges and vessels from oil refineries in Limay, wastewater discharges from industrial facilities operating in Mariveles and SBFZ [13]–[14], and domestic greywater from densely populated coastal areas [15]. The elevated OAG levels, which may contain certain kinds of aromatic hydrocarbons, can be irreversibly lethal to aquatic organisms and the consequences of effects may be transferred to humans via the food-chain [16]. As oils in water can hinder oxygen exchange with the atmosphere, the elevated OAG may have contributed to the low DO levels reported earlier [16].

For heavy metals, elevated Hg concentrations were found in Mariveles, Bagac, and Morong at 0.023, 0.04, and 0.04 mg/L respectively (the thresholds are 0.001 and 0.002 mg/L for Classes SB and SC respectively). Meanwhile, Pb concentration was found normal at 0.000001mg/L at the lone sampling site in Morong (limit is 1.5 mg/L for both SB and SC Classes). Elevated elemental Hg levels in coastal waters is alarming because the methylated form of the heavy metal (methylmercury) is a well-known bioaccumulative toxicant that carries a health threat to humans and aquatic fauna through the food chain [17], and which may be enhanced by high levels of dissolved organic materials [18] given by the elevated BOD_5. Its increased amount in the coastal waters could be attributed largely to industrial waste inputs from harbor activities in the Freeport Area of Bataan (FAB) in Mariveles and in the SBFZ north of Morong [19], [20]–[21].

Table 4. Status of Economically-Important Marine Species in Bataan According to Stakeholders' Views

Cluster	Most Commonly Caught Species	Status
1	Green Mussel (*Perna viridis*)	Over-exploited
	Oyster (*Crassostrea iredalei*)	Over-exploited
	Acetes (*Acetes japonicus*)	Over-exploited
	Mullet (*Liza sp.*)	Depleted
	Flower Crab (*Portunus pelagicus*)	Over-exploited
	Philippine Mantis Shrimp (*Gonodactylus aloha*)	Depleted
	Whiting (*Sillago sp.*)	Moderately Exploited
	Threadfin Bream (*Nemipterus japonicas*)	Depleted
	Four-finger Threadfin (*Eleutheronema tetradactylum*)	Depleted
	Yellowstripe Scad (*Selaroides leptolepis*)	Over-exploited
	Pony Fish (*Leiognathus sp.*)	Moderately Exploited
	Spotted Silver Grunt (*Pomadasys hasta*)	Moderately Exploited
	Goby (*Family Gobidae*)	Depleted
	White Sardinella (*Sardinella albella*)	Moderately Exploited
2	Snapper (*Lutjanus malabaricus*)	Depleted
	Gizzard Shad (*Anodontostoma chacunda*)	Depleted
	Pomfret (*Parastromateus niger*)	Depleted
	Trevally (*Caranx sp.*)	Depleted
	Bigfin Reef Squid (*Sepioteuthis lessoniana*)	Depleted
	Anchovy (*Stolephorus commersonnii*)	Moderately Exploited
	Hardtail Mackerel (*Decapterus macarellus*)	Depleted
	Round Scad (*Decapterus russelli*)	Depleted
	Leather Jacket (*Scombiroides lysan*)	Depleted
	Short-bodied Mackerel (*Rastrelliger brachysoma*)	Depleted
	Grouper (*Epinephelus coioides*)	Depleted
	Big-eye Snapper (*Lutjanus lutjanus*)	Moderately Exploited
3	Long-jawed Mackerel (*Rastrelliger kanagurta*)	Moderately Exploited
	Bullet Tuna (*Auxis rochei*)	Moderately Exploited
	Flying Fish (*Cypselurus opisthopus*)	Moderately Exploited
	Cuttlefish (*S. pharaonis*)	Moderately Exploited
	Spanner Crab (*Ranina ranina*)	Moderately Exploited
	Butterflyfish (*Chaetodontidae sp.*)	Moderately Exploited
	Surgeonfish (*Acanthuridae sp.*)	Moderately Exploited
	Damselfish (*Pomacentridae sp.*)	Moderately Exploited
	Goatfish (*Mullidae sp.*)	Moderately Exploited
	Triggerfish (*Balistidae sp.*)	Moderately Exploited
	Wrasse (*Labridae sp.*)	Moderately Exploited
	Lizardfish (*Synodontidae sp.*)	Moderately Exploited
	Parrotfish (*Scaridae sp.*)	Moderately Exploited

Depleting Economically-Important Species. A variety of marine species can be found in Bataan area, many of which are economically-important (Table 4). However, due to water pollution (previous section), aquaculture, and rampant use of destructive fishing techniques, many of these valuable species are rapidly depleting since the last two decades.

Dynamite and cyanide fishing still exist in Cluster 3 and some parts of Cluster 2 despite of laws to address the malpractices, and locals are pointing to intruding fishers from Zambales, Cavite, Batangas, and Malabon as culprits. Reportedly, intruders encroach the Mariveles, Bagac, and Morong municipal waters every between August and September in what local fishers refer to as the Munting Tagaraw season. As one FGD participant (who heads a local fisher organization) disclosed: "We know that destructive fishing methods are illegal and we abide with the regulations. The real problem are those intruders from other provinces who encroach our vicinities illegally. Sadly, our community-based fisheries patrol group cannot keep up with them due to resources disparity (Morong FGD)."

The discussants decried that fish wardens lack high-powered boats to catch the intruders. Apart from encroachers, the discussants alleged that there are "big-time commercial fishers" operating nightly in their vicinities "under the protection of authorities," robbing

them of regular catch by utilizing more sophisticated fishing tools and equipment like huge mechanized fine nets and big flashlights.

Marine and freshwater aquaculture was the supposed solution to Bataan's problem on dwindling fishcatch, but with its intense production in recent years [22], it brought considerable environmental and economic concerns instead. Reportedly, proliferation of bivalve farms harmed a number of commercially-important species in Cluster 1 and some portions of Cluster 2. Among these are gizzard shad, four-fingered thread-fin, trevally, pomfret, goby, round scad, and some less economically-valuable ones like spotted pomadasid or agoot (*Pomadasys hasta*) and four-lined theraponid or babansi (*Pelates guadrilineatus*). Also, per the FGD participants, the bivalve pens have been driving away local Acetes species significantly affecting the income generated from shrimp paste industry in Cluster 1. Purportedly, there have been frequent small-scale fish kills in Cluster 2 during the last decade and local fishermen claimed wastes from bivalve aquaculture caused them as well. While these still need verifications through separate investigations, the deterioration of coastal water quality in eastern Bataan due to bivalve pens is very apparent per this study's BOD_5 results and the farms' "foul smell" which is presumably due to impeded water circulation brought by crowded bamboo poles and continuous organic decay loadings from the bivalve cultures. The foul smell reaches up to 1 or 2 km, disturbing communities especially during Red Tide occurrences (bloom of toxic dinoflagellates) when huge amount of bivalve produce are unharvested and left to die in the pens.

Coastal Habitat Destruction. Apart from water pollution and destructive fishing methods, the decreasing fish stocks in Bataan can be traced to the worsening condition of its coastal habitat systems (coral, mangrove, and seagrass systems) (Table 5) due to the enhancing shore silt loadings and informal near-shore settlements.

Siltation and narrowing of near-shore areas are evident in all clusters, particularly in the villages of Pantalan Luma, Wawa in Abucay, Puerto Rivas Ibaba, Capunitan, Lamao, Cabcaben, Pagasa, and Saysain. The large amount of silt deposits is threatening not only to the physical well-being of the shores but to their biochemical integrity too [23]. It might affect the growth rate and disturb the reproduction of many fish species because of silt smothering. Habitat alteration due to excessive silt loads might also alter the natural movements and migration patterns of many local marine organisms [24]. Both scenarios are seeming and unfavorable to fisherfolks.

Table 5. Status of Coastal Habitat Systems in Bataan According to Stakeholders' Views

Habitat System	Species	Status
Mangroves	Bacauan-babae and Bacauan-lalake (English Names Unknown) (*Rhizophora sp.*)	Disturbed; Can Be Found in All Clusters
	Mangrove Palm (*Nypa fruticans*)	Disturbed; Can Be Found in Cluster 3 Only
	Bungalon, Apiapi, and Miapi (English Names Unknown) (*Avicennia* sp.)	Disturbed; Can Be Found in All Clusters
	Saging-saging and Tinduk-tindukan (English Names Unknown) (*Aegicera sp.*)	Disturbed; Can Be Found in All Clusters
	Pedada (English Name Unknown) (*Sonneratia sp.*)	Disturbed; Can Be Found in All Clusters
Corals	Hump Coral and Finger Coral (*Porites sp.*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Disc Coral, Scroll Coral, Cup Coral, Vase Coral, Pagoda Coral, and Ruffled Ridge Coral (*Turbinaria sp.*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Table Coral, Elkhorn Coral, and Staghorn Coral *(Acropora sp.*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Fire Coral (*Millepora sp.*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Small Knob Coral *(Plesiastrea versipora*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Cauliflower Coral and Brush Coral (*Pocillopora sp.*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
Seagrasses	Red Seaweed (*Eucheuma sp.*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Turtle Grass (*Thalassia hemprichii*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Smooth Ribbon Seagrass (*Cymodocea rotundata*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Narrowleaf Seagrass (*Halodule uninervis*)	Disturbed; Can Be Found in Clusters 2 and 3 Only
	Tape Seagrass (*Enhalus acoroides*)	Disturbed; Can Be Found in Clusters 2 and 3 Only

The problems can be associated with earth-moving activities in or near the province's waterways that empty into the coasts [25]. Candidate culprits are rock mining, quarrying, and construction in Clusters 1 and 2, and logging activities in Cluster 3 [26].

Rock quarrying and crushing facilities in Pilar uplands, and residential and commercial estates development in Balanga and Abucay downtowns have been contributing so much silt into Cluster 1's major waterways, specifically into Abucay and Talisay Rivers. From these major waterways, the silt loadings have been dispersing into the coastal areas, narrowing an extensive portion of the near-shore zones of Cluster 1.

Soil erosion in the uplands due to rampant slash-and-burn and lumber production have been enhancing the silt deposits in the beaches of Saysain and Pagasa in Cluster 3 on the other hand. The clayish solid particles floating on and settling under the coastal waters have virtually killed much of the coral reef and seagrass systems in the two villages, thereby diminishing fish productivity [27].Only a few reefs in Paysawan,Quinawan, Sabang, and Mabayo remains to be in good physical shape per the FGD participants from Bagac and Morong.

The increasing silt loadings in many localities may also explain the high BOD_5 and low DO levels reported previously as suspended solid materials can increase bacterial activity by amplifying the total available suspended solid area upon which bacteria can propagate [10], and can warm the surrounding water (through conduction) upon which oxygen cannot easily dissolve [28].

Informal settling near-shore is augmenting the aforesaid problems. Informal settlements sprawling the coast of Pantalan Luma, Wawa in Abucay, Wawa in Pilar, Capunitan,Santa Elena, Ipag, and Pagasa have been contributing immensely to coastal waste accumulation. Typical domestic activities in these areas have been damaging some critical mangrove systems in the areas too, especially in Santa Elena. From actual observations and interviews, many informal settlers (about 50 families) live in bamboo stilts and cogon-made houses just above the mangrove trees. Their homes do not have toilet facilities so their fecal wastes go straight to the mangrove areas. Also, since most of them do not own gas stoves, they cut mangrove trees to fuel their improvised coal stoves. With these findings, solving the province's coastal pollution problems necessitates adopting strategies to address hygiene and sanitation issues brought upon by rampant informal coastal settlements indeed [29].

General Coastal Environment Status. The general impression among stakeholders is that Bataan's coastal environment and resources are disturbed, and the condition is worsening even with CRM programs in place. From the SAI (Table 6), most of the participants (60.69%) believe that coastal environment condition is not improving, pointing to destructive fishing methods (53.69%), domestic wastes (28.92%), soil erosion and siltation (15.85%), and aquaculture wastes (9.15%) mostly as primary reasons. All these despite of the on-going interventions under the BICMP.

Table 6. General Coastal Environment Condition in Bataan Based from Stakeholders' Views

Areas	Cluster 1	Cluster 2	Cluster 3
Coastal Environment Status			
I Don't Know (1.31%)	8	5	4
Unchanged 2 Years Ago (5.31%)	24	26	19
Unchanged 5 Years Ago (5.85%)	28	33	15
Unchanged 10 Years Ago (4.08%)	22	19	12
Better 2 Years Ago (6.23%)	38	27	16
Better 5 Years Ago (11.92%)	65	52	38
Better 10 Years Ago (42.54%)	253	224	76
Ruined 2 Years Ago (4.38%)	17	25	15
Ruined 5 Years Ago (6.54%)	44	23	18
Ruined 10 Years Ago (11.85%)	51	69	34
Most Probable Reason for Coastal Environment Destruction			
Soil Erosion and Siltation (15.85%)	47	75	84
Domestic Wastes (28.92%)	164	146	66
Aquaculture Wastes (9.15%)	90	29	0
Industrial Wastes (0.85%)	1	5	5
Commercial Fishing (6.38%)	34	32	17
Destructive Fishing Methods (22.92%)	113	134	51
Land Conversion (7.85%)	84	17	1
Climate Change (6.54%)	16	55	14
Others (1.54%)	1	10	9

Stakeholders' Socio-Economic Condition

Coastal Resources Over-Dependent. The participants in this study are mostly males (76.70%) and are between 41 to 60 years of age. Majority of them have been residing in the coastal area by more than 15 years (74.77%) (Table 7). Their families are living in the coastal area even before they were born. Being mostly adult men (thus, household heads and family providers) and long-time coastal residents, the participants belong

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to the "major coastal resource users" of the Bataan population.

Table 7. Socio-Economic Profile of Stakeholders

Variable	Cluster 1	Cluster 2	Cluster 3
Age			
Less Than 20 Years Old (4.85%)	29	24	10
21 to 40 Years Old (18.62%)	107	68	67
41 to 60 Years Old (67.11%)	360	354	158
61 and Above (9.42%)	54	57	12
Sex			
Male (76.70%)	409	399	189
Female (23.30%)	141	104	58
Length of Residence in the Coastal Area			
5 Years of Residence (0.90%)	2	5	5
6 to 10 Years of Residence (6.61%)	42	37	7
11 to 15 Years of Residence (17.23%)	114	74	43
5 Years of Residence (0.90%)	2	5	5
Distance of Residence from the Coastline			
Less than 50m (57.76%)	314	284	153
50m to 100m (20.89%)	114	106	52
101m to 200m (9.46%)	51	52	20
More than 200m (11.89%)	72	61	22
Primary Livelihood Source			
Fishing (60.65%)	333	319	136
Fish Trading (20.68%)	111	97	61
Fish Processing (13.92%)	81	71	29
Hospitality / Tourism (0.08%)	0	1	0
Retail (0.23%)	1	1	1
Education and Training (0.15%)	1	1	0
Government Services (2.37%)	14	7	10
Healthcare Services (0.15%)	1	0	1
Transportation (Tricycle, Pedicab, or Jeepney Operation) (0.31%)	3	1	0
Agriculture (0.38%)	1	1	3
Construction, Carpentry, and other Related Services (0.38%)	4	0	1
Small-Scale Business (0.68)	0	4	5
Educational Attainment			
Elementary Undergraduate (14.00%)	64	73	45
Elementary Graduate (38.38%)	248	167	84
High School Graduate (38.26%)	166	233	98
Vocational School Graduate (4.39%)	44	10	4
College Graduate (5.11%)	28	21	18
Number of Children in the Family			
0 to 4 (68.55%)	354	364	174
5 to 8 (22.69%)	136	107	52
9 to12 (8.77%)	60	33	21
Monthly Household Income			
9,999 Pesos and Below (77.24%)	424	386	194
10,000 to 19,999 Pesos (20.68%)	113	106	50
20,000 to 29,999 Pesos (1.62%)	13	6	2
30,000 Pesos and Above (0.46%)	0	5	1

Most of the respondents are into fishery-related livelihood means. They depend so much on the sea for livelihood. Most of them are either fishermen (60.65%), fish vendors (20.68%), or fish processing operators (13.92%) (Table 7). With so much reliance on coastal and marine resources for living, continuous fish stocks depletion will be very problematic. As they opened out in the FGD, there are days when the catch is meager or when there is no catch at all. The uncertainty of income from the sea becomes worse when there is inclement weather.

Scarce Alternative Livelihood Opportunities. When fishcatch is inadequate, fisherfolks in Clusters 1 and 2 resort to farming, tricycle driving, or construction work for alternative livelihood. Meanwhile, some coastal dwellers in Cluster 3 particularly in Paysawan and Sitio-Caibobo-Paysawan resort to timber-poaching and logging when off-peak of fishing season. While they admitted to wanting to stop from environmentally exploitive forms of alternative income generation, the Paysawan coastal residents lamented the lack of opportunities and insufficient LGU support for alternative livelihood. As one participant decried: "The (local) government has no support. They have long been telling us that they will provide alternative livelihood opportunities, but there are none. If there is any, only those who they know are benefitting from it surely." Another one quipped: "We have no other choice. It is difficult to find other jobs especially when we did not finish school (Bagac FGD)."

As it turns out, only 9.5% of all participants were able to acquire post-secondary education, which could be due to lack of means to support formal schooling expenses and / or lack of culture on formal schooling itself (Table 7). The lack of exposure to tertiary education can also explain the participants' apparent poor vocabulary and command of many environmental terminologies and processes, and unfamiliarity with specific CRM legal bases (the Fisheries Code and Local Government Code of the Philippines for examples) and related environmental laws during the SAI and FGD.

Bataan CRM Issues

Public understanding of issues in any natural management effort is important to success [32]. In this study, it appears that the coastal residents in Bataan, while lacking when it comes to technicalities, have rational and long-term grasps of many major CRM problems. The following issues were drawn from the FGD and SAI.

Unsubstantial Involvement of Coastal Residents. Majority (34.62%) of the discussants are supportive to CRM initiatives (Table 8).

Table 8. Bataan CRM Issues from Stakeholders' Views

Areas	Cluster 1	Cluster 2	Cluster 3
Stakeholder Participation			
Always (34.62%)	185	167	98
Often (29.62%)	154	150	81
Sometimes (23.69%)	132	122	54
Not Interested (19.62%)	132	104	19
Level of Stakeholder Participation			
Barangay Level (59.87%)	104	96	69
Municipal Level (28.70%)	56	52	21
Provincial Level (7.06%)	16	14	2
National Level (5.37%)	9	5	6
CRM Activities			
Coastal Clean-Up (64.22%)	139	126	24
Artificial Reef Planting (12.67%)	0	4	53
Information Campaign (18.89%)	43	28	14
Cleaning/Dredging of Waterways (1.33%)	2	3	1
Others (2.89%)	1	6	6
Local Level Issues			
Lack of Alternative Livelihood Opportunities (17.46%)	98	78	51
Increasing Coastal Population (10.54%)	38	65	34
Lack of Facilities for Proper Waste Management (5.23%)	0	23	45
Land Conversion (1.31%)	0	11	6
Improper Waste Disposal Practices (10.54%)	41	70	26
Overfishing (5.08%)	36	26	4
Destructive Fishing (16.15%)	93	79	38
Intrusion of Fishers from Far-off Locations (5.08%)	36	17	13
Indiscriminate Fishing (5.38%)	61	8	1
Water Pollution (13.38%)	95	77	2
Habitat Destruction (9.85%)	52	49	27
Critical Areas for Improvement in General			
More Involvement from the Fishing Community (14.85%)	85	57	51
Strict Implementation of Coastal Laws (7.31%)	32	43	20
More Support from the LGU (40.77%)	250	202	78
Incorporate Livelihood Programs in CRM Plans (14.85%)	49	78	66
Widen the Coverage of CRM Implementation (22.23%)	134	123	32
Preventive Action			
Livelihood Provision (50.31%)	239	228	187
Capacity-Building of Fish Wardens (26.38%)	154	166	23
Strict Enforcement of Environmental Laws (17.85%)	119	92	21
Inclusion of Coastal Issues in the School Curriculum (1.46%)	7	3	9
Others (4.00%)	31	14	7

Many noted to have been a part of CRM projects because they think it would be helpful for their livelihood. Such substantiates claims [33] that stakeholder participation to resource management initiatives is largely "economic-driven," that is, their attitudes depend on whether they see the projects to be "economically-benefitting." Despite of this, the discussants noted that their CRM participation is limited mostly at the implementation phase. Reportedly, they are often not consulted during CRM cycle stages. They feel that their opinions are being devalued by higher-ups in these stages. There seemed to be a lack of confidence on their first-hand knowledge and experience by the inner management circle when it comes to the other critical CRM processes.

Clean-Up Drive is the Face of CRM. Coastal clean-up activities dominate the CRM activities in the province (64.22%), and are mostly conducted in Clusters 1 and 2 (Table 8). They are usually paced by LGUs, in collaboration with government agencies, NGOs, schools, police, and military. The localities of Pilar, Orion, and Limay hold coastal clean-ups most frequently (mostly during summer), and village officials, coastal residents, students, and municipal officers and employees are the usual participants. Itshould be noted though that these clean-up activities have no continuity. For this reason, some participants perceive them as mere tools for political agenda only.

Intermittent Information Campaigns. Information drives are evident but intermittent, and mostly seen in Balanga, Bagac, and Morong. As observed, basic informational materials about environmental management in general are lacking in most public places. Information, education, and communication materials relating to CRM are limited to posters and steamers, commonly displayed near village halls. Massive awareness campaigns are only held regularly in Cluster 3. Morong holds the "Fishermen's Day" in Sabang every May to give tribute to its local fishermen and marine resources. The town also conducts the "Pawikan Festival" in Nagbalayong every November to promote the protection of sea turtles nesting in the area.

Too Few Protected Areas and Conservation Projects. While waning fishcatch is widespread, most localities have yet to initiate their respective fish sanctuaries. There are too few protected areas and conservation projects in general despite of their potential environmental and socio-economic contributions to the province [34]. Only the towns of Limay, Bagac, and Morong were able to establish Marine Protected Areas (MPA) formally. Also, only Bagac and Morong have

their own marine turtle conservation projects, and regular coral reef restoration and mangrove reforestation activities. Mangrove planting activities exist in some Clusters 1 and 2 localities but irregular.

Comprehensive Profilings Are Mostly Lacking. Creation of intricate Costal Environment Profiles (CEP) which may jumpstart conservation projects [33] have been seriously addressed only in the localities of Bagac, Morong, Pilar, and Balanga. Even simple demographic information on the coastal population cannot be accessed easily in many localities. An efficient coastal database management system is clearly non-existent in the province as many localities either have no substantial data to be managed or have no uniform formats for available coastal information [6].

Comprehensive and organized coastal profilings were only completed in Bagac and Morong. The assessments were conducted from 2004 to 2008 through the lead of their municipal planning and development units and village Fisheries and Aquatic Resources Management Councils (FARMC). Their assessments were aided by technical persons from international organizations, private groups, and public universities.

Unclear Delineation of Municipal Water Boundaries. In almost all coastal localities, delineation of municipal waters is a contentious issue, and there are ongoing boundary disputes over several local fishing grounds predominantly in Cluster 2. The unclear delineation of municipal waters plays critical inthe enforcement of ban on encroachers and commercial fishers [5], [35]. The intrusion of illegal fishers in Clusters 2 and 3 is continuing largely due to these unsettled boundary issues.

Bias against Far-off Communities on Government Support. Donation of fishing gears and equipment to needy areas (Bagac, Morong, and Limay) was evident but insufficient. While a few towns have been receiving aids well from the Department of Labor and Employment and some private institutions, most of the localities received aids meagerly and rarely, especially the far-off coastal communities in Mariveles and Bagac, according to the FGD discussants.

Over-all CRM Situation. Over-all, the participants believe that Bataan CRM must be improved. Most cited the need for more LGU support (40.77%) and widening of CRM implementation coverage (22.23%) by establishing more volunteer organizations and strengthening of recruitment by existing ones. Most also suggested to incorporate more livelihood programs in CRM plans (14.85%). Most participants considered provision of livelihood programs a critical preventive action under the realm of CRM (50.31%). Over-dependence on marine resources can be salvaged through alternative livelihoods they argued. They want CRM activities that will boost their incomes. Other cited preventive measures are augmentation of fish warden equipment and facilities (26.38%), and strict implementation of environmental laws (17.85%) to counteract illegal fishing activities; and enhanced information dissemination on planned and on-going CRM works (4.00%), and integration of environmental protection (specifically coastal and marine resources conservation) into the basic education curriculum (1.46%) to raise community awareness regarding CRM efforts (Table 8).

CONCLUSION AND RECOMMENDATION

The results of this study articulate the actual state of Bataan CRM. The problems on coastal waste build-up, coastal water pollution, declining fishcatch, enhanced shore siltation loadings, destruction of mangrove areas and other habitat systems, continuing practice of destructive and illegal fishing methods, and laxity in enforcement of fishery and environmental laws are all indications that the province's CRM works have been struggling similar to many other resource conservation and management efforts in the Philippines [3], [36]–[37]. All issues cited have negative implications to the province's already subsistent coastal population and important coastal economic activities. Hence, efforts are needed to improve waste management practices, establish waste control facilities, strictly implement fishery and environmental laws, financially and infrastructurally support fishery organizations and volunteers, and create clear-cut policies on municipal waters delineation [30], [38].

There is poor grassroots level involvement in the province's CRM decision-making processes, clearly defeating the essence of "integrated management." While an integrated approach to CRM necessitates a strong foundation of good information and collaboration of all sectors involved [3], [30], the coastal residents clamor the apparent disregard of their views. Their first-hand knowledge and experience on issues are often ignored in critical CRM cycle stages. They may be involved in CRM projects but not in a substantial manner. Bataan's CRM practitioners need to push for their enhanced involvement for they are the direct coastal resource users. It is them who have the most to lose if CRM efforts failed to work so they must be well-represented in the planning, implementation,

monitoring, and evaluation stages [30], [39]. In here the LGUs will play a pivotal role. A coordinated effort by them to involve the coastal residents in critical stages will not only increase the chances of support and engagement of everyone, but will also increase the quality of data on which the CRM field activities will be based.

The CRM projects under the BICMP have been arbitrary and intermittent. Also, there were too few methodical conservation initiatives like fish sanctuaries, coral nurseries, and artificial reef plantings, which may increase economic prospects for the coastal residents [34]. All these can be traced to the dearth of baseline data from which more methodical CRM programs can offshoot. Such can be addressed by generating comprehensive CEP for each locality on top of strategic management planning [40], and by commissioning academics and environmental scientists to conduct more assessments of Bataan's coastal areas. Studies on population dynamics and coastal resource use utilization in coastal localities must be prioritized. Elaborate water quality assessments of Bataan's major river networks and coastal areas, along with chemical analysis of the province's primary marine resources commodities are also highly recommended. Biodiversity assessments of habitat systems, accompanied by studies on viability of coral and mangrove nurseries in certain places are also needed.

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