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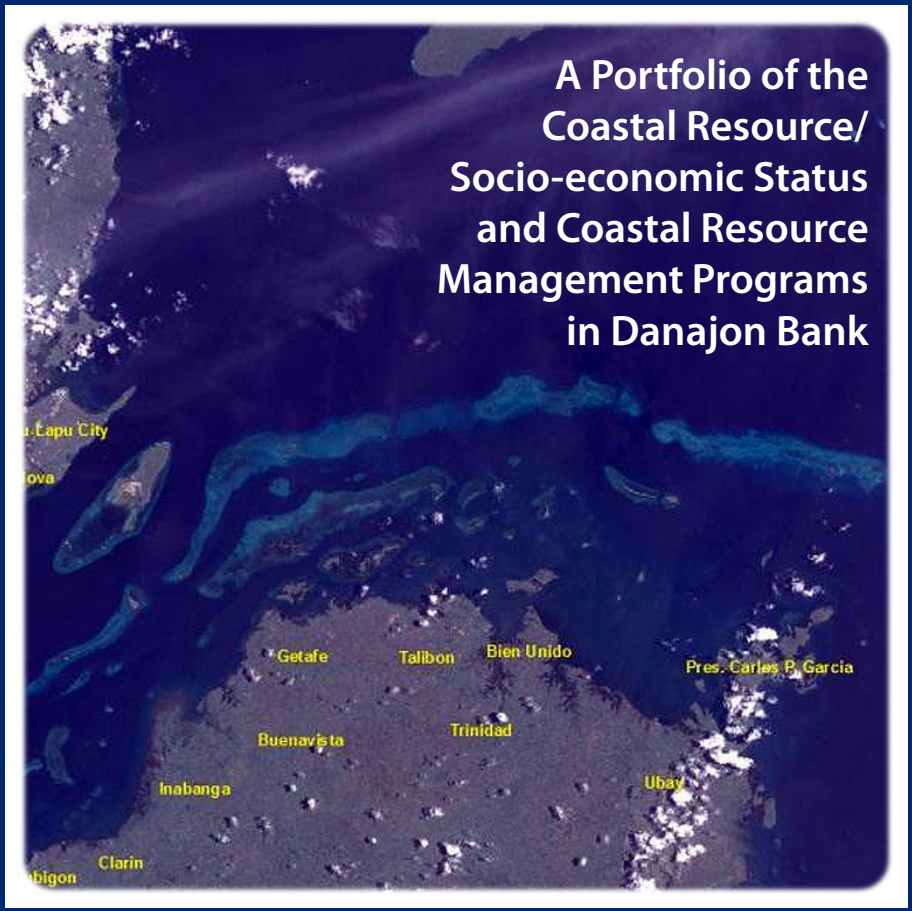
A Profile of
DANAJON BANK
Philippines



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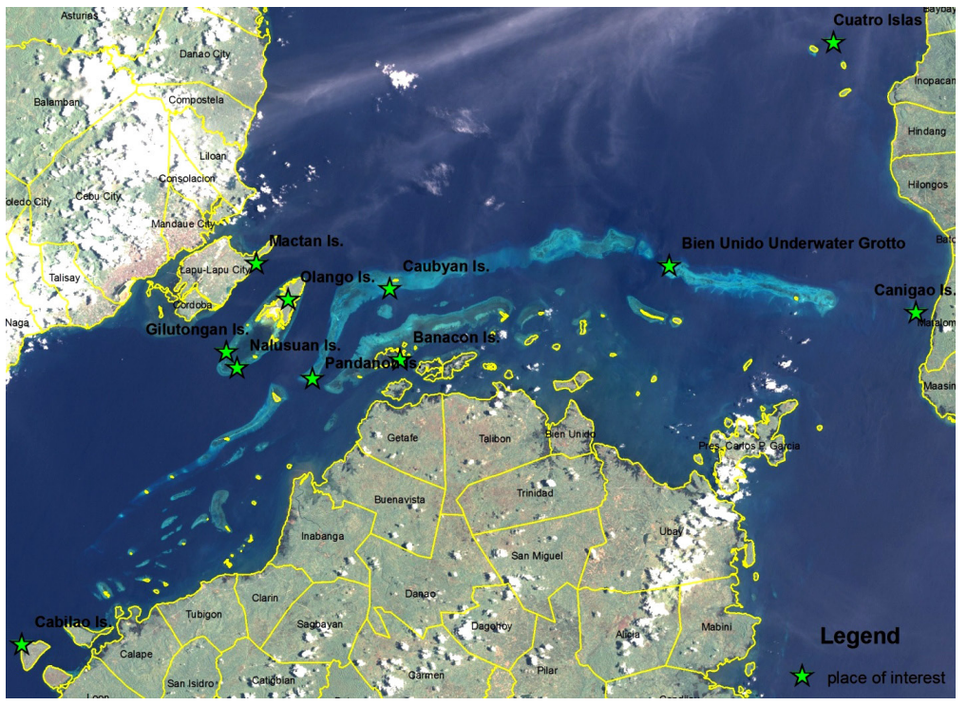
Danajon Bank

Overview

The Danajon Bank is the only double barrier reef in the Philippines formed over the last 6,000 years and one of only three such sites in the Indo-Pacific region. Danajon Bank covers a total area of 272 km^2 (27,200 ha) with a total coastline of 699 km including 40 islands, located off northern Bohol. This unique coastal environment is of global ecological significance is a priority area for the conservation of reef fishes, corals, mangroves and mollusks because of a generally large, poor population which is highly reliant on fishery resources.



Danajon Bank consists of three large reefs and clusters of small reefs. The outer barrier reefs and slopes contain the most prolific coral growth while the inner reefs and lagoons are more turbid and have less coral growth. In 2004, 211 hard coral species have been recorded by local scientists while the presence of a variety of sharks and rays as well as a large population of seahorses were also reported. There are more than 30 marine

protected areas (MPAs) including seven strict nature reserves and three protected seascapes. Danajon Bank hosts significant mangrove forest cover with over 2,000 ha of Rhizophora sp. The area also serves as important feeding and roosting grounds of over 20 bird species during July to November, one of which is the IUCN-listed threatened species Chinese egret (Egretta eulophotes).

The outer reef is largely outside any active management effort. The collaborative management of Danajon Bank serves three important functions: (1) supporting sustainable fisheries in Central Philippines, (2) protecting marine biodiversity for human wellbeing, and (3) creating new economic development opportunities for dive tourism.

Danajon Bank is located off the northern part of Bohol, the mid-eastern part of Cebu and south-western part of Leyte within the Visayan region. It is the only double barrier reef in the Philippines (Pichon, 1977). It covers a total area of 27,200 hectares with a total coastline of 699 km including 40 islands, and accounts for over one percent (1%) of the total area of coral reefs of the Philippines which is estimated at 27,000 km^2 (Christie et al. 2006). This unique coastal environment is of global ecological significance and is at the world's epicenter of marine-shore fish biodiversity (Carpenter and Springer 2005). It has been identified as a priority area for the conservation of reef fishes, corals, mangroves and mollusks (Green et al. 2004).

Danajon Bank is considered a critical resource area especially for fishing, as it sustains the livelihood of around 5,000 fishers in the commercial sector and over 125,000 full-time municipal fishers in its 17 municipalities/cities covering four (4) provinces and two (2) administrative regions. Ten (10) municipalities (Tubigon, Clarin, Inabanga, Buenavista, Getafe, Talibon, Trinidad, Bien Unido, Ubay, and Carlos P. Garcia) are located in northern Bohol, two (2), Lapu-Lapu City and Cordova are geographically located in Cebu province, four (4), Hindang, Hilongos, Bato, and Matalom in Leyte province, and one (Maasin City) in Southern Leyte province. Fishing is not only considered as a subsistence practice for the people living near the Danajon Bank as it has been embedded within their cultural identity as individuals and as communities (Langjahr, 2006).

Over time, the degradation of the Danajon Bank reef system has had serious consequences for food security, conservation and economic growth because of overfishing, population pressure and degradation of habitats. Actual living coral cover is low despite high coral diversity in the area. Fish abundance and diversity in six inner reef sites surveyed were considered low by Philippine standards given that a typical reef, the maximum number of fish count is 800 per 500m^2 (Calumpong, 2005). Fish biomass was also very low suggesting that the general status of the area is degraded.

A number of coastal resource management projects initiated either by local

communities or government agencies such as the Department of Environment and Natural Resources (DENR) and the Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture (DA) have been implemented within the Danajon Bank in partnership with non-government organizations or special programs such as the Fisheries Improved for Sustainable Harvest (FISH), and Project Seahorse Foundation. 10 National Integrated Protected Area System (NIPAS) sites have been established within these boundaries, including 7 strict nature reserves and 3 protected seascapes (Green et al., 2002).

A local mangrove reforestation initiative has also been implemented within this area. In her paper, Amper (2004) argues that mangrove reforestation is an indigenous, locally-driven initiative. The 487-hectare mangrove area has not only protected the island from big waves and strong winds, and provided a spawning area for fish and other marine creatures, but also brought eco-tourists from all over the world to relish the magnificent view. A number of marine protected areas have also been established by various local government units in the area supported by such projects as the Community-based Coastal Resource Management Project (CBCRMP) of the Department of Finance and the Coastal Resource Management Project of the DENR. As of 2004, 60 community and municipal-based MPAs has been established within the area in various stages of implementation (CRMP, 2004).

In 2002, the provinces surrounding the Danajon Bank signed a Memorandum of Agreement to create a technical working group to oversee the management and conservation of Danajon Bank. This was the CeLeBoSoLe Council (or the Cebu-Leyte-Bohol-Southern Leyte Council) which had representatives from the Bureau of Fisheries and Aquatic Resources (BFAR), Philippine National Police (PNP) Maritime Group, Philippine Coast Guard (PCG), Department of Environment and natural Resources (DENR), National Economic and Development Authority (NEDA), and Department of Interior and Local Government (DILG) with the support of several projects and non-government organizations.

In 2011, The Coastal Conservation and Education Foundation, Inc. (CCEF) assisted the 23 municipal local governments and the four concerned provinces to create the Danajon Double Barrier Reef Management Council (or DDBRMC) for improved collaborative management of Danajon Bank.

Legal and Institutional Framework

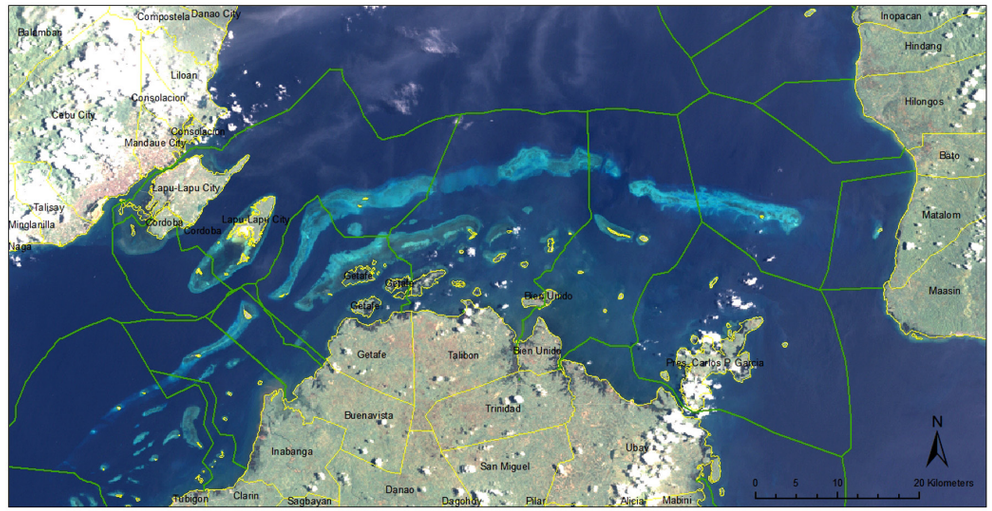


Figure 1. Administrative boundaries in the Danajon Bank area

Introduction

Pursuant to the constitutional policy to protect the right of the people to a balanced and healthful ecology, the local government units (LGUs) are given territorial jurisdiction to manage municipal waters, including the power to formulate ordinances, resolution, policies and programs consistent with the framework of local autonomy. One of the basic services mandated by the Local Government Code (RA 7610) is the duty to protect and manage the coastal and marine environment, to impose local fishery revenues and taxes, to delineate their municipal waters, and to allocate the use of resources within municipal waters. The national government is also required to conduct consultation with the local governments pursuant to their proposed projects to promote coastal protection. The Fisheries Code (RA 8550) also granted powers to the LGU to grant license and fishing privileges to registered fishers as well as to register motorized boats with tonnage of three tons and below. On the other hand, the Fisheries Code of the Philippines (RA 8550) granted the Bureau of Fisheries and Aquatic Resource (BFAR) general supervision over activities in waters outside municipal waters, including the grant of fishing licenses to commercial fishing boats.

The following are some of the legislative frameworks related to coastal management in the Philippines:

- The Local Government Code (RA 7160) – provides certain autonomy to city/municipal governments in the management of their municipal waters.
- The Fisheries Code of the Philippines (RA 8550) – is the primary legislation for fisheries management in the country.
- The National Integrated Protected Area System Act (NIPAS ACT- RA 7586) – has provided protection to biologically significant flora and fauna.
- The Wildlife Conservation Act (RA 9147) – provides for the management and protection of wildlife and important habitats.
- The Clean Water Act (RA 9275) – provides for the management and protection of bodies of water from pollution.
- Other important laws are the Forestry Code, Public Land Act, Philippine Mining Act, Marine Pollution Decree, Solid Waste Management Act, and the Clean Air Act.
- International Treaties: CITES, UNCLOS, AGENDA 21, Bonn Convention, RAMSAR and Convention on Biodiversity.

Coastal Management and Protected Areas in Danajon Double Barrier Reef

An important devolved function of LGUs is the enforcement of fishery laws within its municipal waters. This all encompassing mandate includes the correlative duty to enact ordinances related to fishery management within their city/municipal waters. The 19 LGUs encompassing the Danajon Double Barrier Reef have enacted ordinances that are mostly prototypes of the Fisheries Code of the Philippines but, at the same time, tailored fit to respond to local issues. There are local legislation on marine protected areas (MPAs) that has enabled locally-managed sanctuaries. The Municipality of Inopacan, Leyte passed an ordinance declaring the three islands - Apid, Mahaba and Digyo - as marine sanctuaries and charges a penalty to violators, despite the fact that the three islands were declared as part of a protected seascape under Presidential Proclamation No. 270.

MPAs have been the focus of most city/ municipal coastal resource management programs. All the LGUs within the Danajon Double Reef have their own established MPAs. Some LGUs have also established marine parks. For instance, the Municipality of Bien Unido in Bohol, through an ordinance, declared 7,600 hectares out of their municipal waters as Bien Unido Double Barrier Reef Marine Park. The City of Lapu-Lapu also established the Minantaw Marine Park covering 214.6 hectares of marine waters.

Specific coastal management activities are also effectively implemented through local legislation. The City of Maasin regulated the use of payao (fish aggregating device or FAD) through a city ordinance. It also requires the registration of motorboats and charges a penalty to violators thereof. The municipality of Getafe in Bohol designated a closed season for the catching and gathering of siganids during the fourth, fifth, and sixth days after the new moon of every month.

Several municipalities have also codified their fishery ordinances. All of these fishery codes cover the regulation of all fishery activities in the city/municipal waters, and business relating to use, development, conservation, and management. The codification has facilitated the review of fishery regulations within the city/ municipality and has enabled better enforcement from local enforcers.

The City of Maasin has passed its Environmental Code that incorporated fishery management. The Municipality of Carlos P. Garcia (CPG) in Bohol approved its Fisheries and Coastal Management Code in 2006. To effectively implement its Fisheries and Coastal Management Code, the Code mandates the local government of CPG to create the Fisheries and Coastal Resources Management (FCRM) office headed by an Environmental Management Specialist with two support personnel. The Municipal CRM Code of Clarin also created a CRM section under the Municipal Agriculture's Office. Its functions include the development of plan and strategies for CRM implementation, enforcement of fishery rules and regulations, and recommendations to the Sangguniang Bayan (SB or municipal council) and the Mayor on all other matters related to environment and natural resources, particularly in coastal and fisheries resources. A similar provision can be noted in Inabanga, Bohol. Its municipal coastal code created the CRM technical working group (CRM TWG) which is a coordinating body within the LGU that will recommend, facilitate, and catalyze coastal resource management initiatives. The CRM-TWG is headed by the mayor. The Coastal Code of Inabanga also created a resource accounting and information system. The system aims to develop a data bank for continuous accounting and assessment of the state of fishery and aquatic resources in the town. The modified and strengthened coastal resource management code of the Municipality of Tubigon institutionalized the CRM Office solely for the purpose of attending to the needs of coastal resource management of the town.

In brief, some of the landmark ordinances in Leyte and Southern Leyte are:

- An Ordinance Establishing and Protecting the Esperanza Fish Sanctuary in the Marine Reserve Area of Brgy. Espereanza, Inopacan, Leyte (Barangay Ordinance No. 02, s.2005
- An Ordinance Regulating Fishing and/or Fisheries in the Municipality of Hindang, Leyte and Imposing Penalties Thereof (Municipal Ordinance No. 2004-02)
- The Municipal Fisheries Ordinance of the Municipality of Hilongos, Leyte

(Municipal Ordinance No. 2002-08)
- The Amended Municipal Basic Fisheries Ordinance of Bato, Leyte (Municipal Ordinance No. 2003-04)
- An Ordinance Revising the Municipal Fishery Ordinance No. 95-03 of the Municipality of Matalom, Leyte (Municipal Ordinance No. 2003-04)
- An Ordinance Establishing the City Fish Sanctuary at Sto. Rosario, Maasin City (City Ord. No. 2001-004)
- Environmental Code of Maasin

On the other hand, a few noteworthy ordinances in Bohol include:

- Fisheries and Coastal Management Code of Pres. Carlos P. Garcia, Bohol (Municipal Ordinance C-004)
- An Ordinance Declaring Portions of Municipal Waters of Bien Unido, this Province, as Bien Unido Double barrier Reef Marine Park and Establishing the Rules and Regulations of the Marine Park and Prescribing Penalties for Violation Thereof (Municipal Ordinance No. 2009-04)
- Fishery Code of Trinidad (Ordinance No. 01-2009)
- An Ordinance Providing For the Sustainable Management, Development, and Conservation of the Municipal Waters and Its Coastal Resources, Harmonizing and Integrating All Ordinances Pertinent Thereto and For other Purposes (Municipality of Talibon, Ordinance No. C-004, 2005)
- An Ordinance On Coastal Resource Management Plan of the Municipality of Getafe, Bohol from Calendar yr 2001-2005 (Municipal Ordinance No. 25 series of 2003)
- An Ordinance Designating Closed Season for the Catching and Gathering of Siganids During the 4th, 5th & 6th days after the New Moon of every Month Throughout the year in the Municipality of Getafe, Bohol (Municipal Ordinance No. 08, s. 2008)
- Comprehensive Municipal Code Providing for the sustainable management, development and conservation of the Municipal Waters and its Coastal Resources, Harmonizing and Integrating all Ordinances Pertinent Thereto and for all other Purposes (Municipal Ordinance No. 007, s. 2005)
- Coastal Resource Management Code, Municipality of Inabanga (Municipal Ordinance No. C-006, s. 2006)
- Municipal Coastal Resource Management Code of Clarin, Bohol (Municipal Ordinance No. 04, s. 2011)
- The Modified and Strengthened Coastal Resources Management Code of the Municipality of Tubigon, Bohol (Municipal Ordinance No. 2009-04-297
- The Municipality of Cordova, Cebu and Lapu-Lapu City has passed various ordinances declaring and establishing marine sanctuaries and mandating the registration of fishing vessels three (3) gross tons and below, among others.

Locally-managed Marine Protected Areas

Utilizing locally-managed marine protected area as a tool for coastal resource management has long been adapted by local government units throughout the Philippines. Usually, nearshore waters and coastal resources are largely or wholly managed at the community level by the coastal barangays, fishers' organizations, and/or a collaborative undertaking by different stakeholders. Community tenure is usually enshrined in an ordinance approved by the local government. Such a system ensures that benefits from marine conservation efforts accrue directly to the local community.

To date, there are 120 MPAs that have been established within the Danajon Bank reef which are in various stages of protection and management. In the Province of Leyte, 11 marine protected areas were established under local legislation. The Municipality of Inopacan has five marine protected areas within its territorial waters. Of the five MPAs, the Apid, Digyo, Mahaba Marine Sanctuary has a rating of "excellent" in terms of management status although the MPA is under the process of establishment/ Level 1 in terms of level of performance, when considering the MPA-MEAT rating tool. The Tinago and Esperanza Fish Sanctuaries which, were established under Municipal Ordinance No 62, series of 2005, have a rating of "very good" together with Conalum Fish Sanctuary, when measured under the same tool.

The Municipality of Matalom has one MPA, the Canigao Island Fish Sanctuary. With the MPA-MEAT tool, it has a management rating of "good" with level of performance 1 even if it is still in the process of establishment. The Municipality of Bato also has one MPA, the Dawahon Marine Sanctuary which is under the process of establishment, level 1.

The Municipality of Hindang has two MPAs, the Himokilan Marine Sanctuary and Bontoc Fish Sanctuary, both of which are under the process of establishment-level 1. The City of Baybay has two MPAs, the Pangasugan and Plaridel Marine Sanctuaries. Under the MPA-MEAT, both have a management status of "very good".

The City of Maasin, in Southern Leyte, has two MPAs rated at "excellent" and at level 2- MPA is effectively strengthened when measured using MPA-MEAT. These are the Sto. Rosario and Guadalupe fish sanctuaries.

The Province of Bohol has the most number of MPAs in the Danajon Reef. It has 16 locally managed MPAs which have been declared as no-take zones. Eight of these MPAs are under the rating "sustained" which means that management plans are enforced. These are Batasan MPA (Tubigon), Asinan MPA (Buenavesta), Jandayan Norte MPA (Buenavesta), Libaong MPA (Getafe), Cataban MPA (Talibon), Pinamgo MPA (Bien Unido), Bantigian MPA (CPG), and Sinandigan MPA (Ubay). Three are also under the rating "enforced". These are MPAs that are legally established and have visible

boundaries with functional management bodies. These are the Jandayan Sur MPA (Buenavesta), Pandanon MPA (Getafe) and Tugas MPA (CPG). The remaining MPAs are rated "established". Local legislation was passed establishing their existence. These are the Guindacpan MPA (Buenavista), Busilan MPA (Talibon), Lipata MPA (CPG), Gaus MPA (CPG) and Bilangbilangan MPA in Tubigon.

Protected Areas under the NIPAS Act

The Philippines has sufficient laws governing the protection of wildlife species and their habitats and the most important one is the Republic Act 7586, otherwise known as the National Integrated Protected Areas System (NIPAS) Act which was enacted in June 1992. This law provides for the establishment of protected areas to "protect outstandingly remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals representative of biogeographic zones and related ecosystems." Under the law, the designated key implementing body is the Protected Area Management Board (PAMB).

Ten National Integrated Protected Area System sites occur within the Danajon Bank Reef (see Fig. 1). Seven of which are strict nature reserves and three are protected seascapes. These protected areas are:

- Talibon Group of Islands Protected Landscape/Seascape (Presidential Proclamation No. 131) covering the four islands of Banbanon, Bansahan, Saag, and Tambu including its surrounding waters situated in the Municipality of Talibon
- Cuatro Islas as Protected Landscape/ Seascape (Presidential Proclamation No. 270) situated in coastal areas of the Municipalities of Inopacan, Hindang and neighboring islands comprising Digyo, Apid, Mahaba and Himukilan islands and their surrounding reefs
- Banacon Island (Presidential Proclamation No. 2151) covers 425 hectares of mangrove forest.
- Olango Island Wildlife Sanctuary (Presidential Proclamation No. 903) covers 1,030 hectares of mangroves

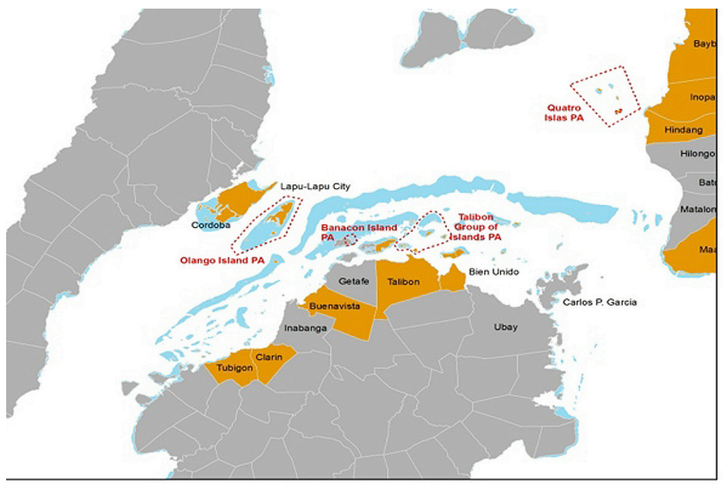


Figure 2. Areas under National Integrated Protected Areas System

The Provincial-level Policies and Initiatives

Provincial Environment Codes

Pursuant to the powers granted to them by the Local Government Code of the Philippines, provincial governments shall adopt adequate measures to safeguard and conserve land, mineral, forest, and other resources. It shall also provide fisheries resource management services and facilities such as assistance to fishermen's cooperatives and other collective organizations as well as the transfer of technology, enforcement of community-based (mangrove) forest management laws and other laws on the protection of the environment, and coastal tourism development and promotions.

To streamline the execution of these governmental powers mandated by law, and cognizant of the need to protect the municipal waters within their province, Provincial Environment Codes in Southern Leyte, Bohol, and Cebu were created. A common feature found in these Codes is the adoption of a guide for coastal municipalities in the formulation and establishment of their own coastal resource management plans and strategies through a resource management framework. In the Province of Southern Leyte, the Code enjoins the establishment of measures to promote the management of coastal and fisheries resources as well as municipal waters by local communites, supported by barangay and municipal governments and other stakeholders. For Bohol, the framework was established as a guide for coastal municipalities in undertaking the delineation, establishment, management, maintenance, and protection of municipal waters. In turn, the recently-approved Cebu Provincial Environment Code is deemed as a guide for coastal municipalities in undertaking, among others, the delineation, establishment, management, and maintenance and protection of their municipal waters within six (6) months upon the effectiveness of the Code.

For the purpose of implementing the provisions of Bohol Environment Code, the Bohol Environment Management office (BEMO) under the Office of the Governor was created. The BEMO have jurisdiction and authority over all environment and natural resources in the province, subject to the provisions of the Local Government Code and all other applicable national laws, rules and regulations. Similar offices are present in other provinces like the Provincial Environment and Natural Resource Office (PENRO) in Cebu, Provincial Environment and Resource Management Office (PENRMO) in Southern Leyte, and the Office of the Provincial Agriculture, with its own CRM Section in Leyte.

Inter-Local Government Unit Clustering

Inter-municipal partnerships among adjoining LGUs sharing a common ecosystem have been initiated in the Provinces around Danajon. In Cebu, nine (9) inter-LGU clusters have been created through related memoranda of agreement. One of the first active collaborations is the Southeast Cebu Coastal Resource Management Council (SCCRMC) between and among the municipalities of Sibonga, Argao, Dalaguete, Alcoy, Boljoon, Oslob, Santander, and Samboan. This group of municipalities agreed to collaborate in 2005 on habitat and fisheries management, coastal law enforcement, gear and harvest regulation and water access regulation. Banking on the experiences learned from the SCCRMC, the municipalities of Southwest Cebu, having experienced the same perennial problems, also forged an agreement to implement resource management under the EBM framework in 2006. The municipalities of Barili, Dumanjug, Ronda, Alcantara, Moalboal, Badian, Alegria, Malabuyoc, and Ginatilan signed a memorandum of agreement creating the Southwest Cebu Resource Management Council (SWCCRMC) and agreed to collaborate and implement common programs on fisheries and habitat management, coastal law enforcement, and ecotourism. In this line, the Province of Cebu created the Cebu Provincial Marine Protection and Conservation Council through an Executive Order No. 2005-07 Series of 2005. One of their foremost programmed activities is the replication of the success SCCRMC has gained to other parts of the province. As a result, 8 other clusters of municipalities were organized.

In the Province of Leyte, the Integrated Municipal Fisheries and Aquatic Resource Management Council (IMFARMC) has been created through an acknowledgement, commitment, and understanding (or a memorandum of understanding – MOU) document signed by the House of Congress 5th District of Leyte, LGUs, national line agencies in Region-8, and the academe. The municipalities that signed the acknowledgement are Inopacan, Hindang, Matalom, Bato, Hilongos, and the City of Baybay. The Marine Science Department of the Visayas State University is a signatory representing the academe. The DENR and BFAR represent the national government line agencies. The memorandum of understanding that binds the signatories has identified key functions of the IMFARMC, such as to assist in the preparation of municipal development plan, recommend the enactment of municipal fishery ordinances to SB/SP, assist in the enforcement of fishery laws in the municipal waters, advise the SB/SP on fishery matters, and perform such other functions assigned by SB/SP. The IMFARMC regularly conducts its meeting and has recently approved the adoption of the Unified Fishery Ordinance for the entire 5th District of Leyte.

In Bohol, a memorandum of understanding (MOU) initiated the Coastal Law Enforcement Councils (CLECs) in each congressional district. Each council serves as the main planning and coordinating body for law enforcement involving all the members in terms of resource sharing and scheduling. The CLEC- 2 member municipalities are Clarin, Buenavesta, Inabanga, Getape, Talibon, Trinidad, Bien Unido, CPG, and Ubay. Regular meetings and trainings, together with IEC campaigns, are regular activities of the council.

Institutions Involved in Coastal Resource Management

Fisheries and Aquatic Resource Management Councils (FARMCs)

The Fisheries Code mandates coastal cities and municipalities to create their own Fisheries and Aquatic Resource Management Council (FARMC). A majority of its members are fishers and they are given the power to recommend policies and programs affecting their municipal waters. In compliance with this mandate, 11 out of 19 municipalities and cities in the Danajon reef have functional FARMCs. While these councils are at varying degrees of functionality, they have put the various management programs in Danajon reef within the framework of the Fisheries Code and the Local Government Code.

The functionality of FARMCs is based on the its composition which must be in accordance with the Fisheries code, have regular meeting, meetings conducted have agenda and documented and have caused the enactment of fishery ordinances in their cities and municipalities. The 11 cities and municipalities which have shown functional FARMC are the Cities of Lapu-lapu, Maasin in So. Leyte and Baybay in Leyte Province, the Municipalities are Inopacan and Hindang in Leyte Province, Cordova in Cebu, Tubigon, Clarin, Buenavesta, Talibon and Bien Unido in Bohol. Most of the ordinances that been enacted focuses on law enforcement, fisheries management, establishment of marine sanctuaries, user's fee and incentive to law enforcers. Based on the total number of municipalities and cities (19) adjoining Danajon, the following summary show the percentage of ordinances enacted and enforced thereat:

- 7 out of 19 LGUs (37%) have codified or have comprehensive fishery ordinance
- 12 out of 19 municipalities (63%) have declared some fisheries management regulation (spawning, open-close seasons, gear-boat regulation)
- 10 out of 19 municipalities (52%) have declared marine sanctuaries
- 4 out of 19 municipalities (21%) have ordinance on User's fee
- 7 out of 19 LGUs (37%) have clear incentive systems for law enforcement

Coastal Law Enforcement

Over the years, the Danajon reef has been protected by a municipal law enforcement team, which is a composite team with local fisheres (bantay-dagat or fish wardens) and

the local PNP. The focus is mainly within the territorial jurisdiction of the respective towns. While many towns in the Danajon reef have effectively protected their own municipal waters, some have been left open to illegal fishing activities due to the absence of their own enforcement teams. In other case, there are logistical problems affecting the operations of these coastal law enforcement teams.

Out of 19 municipalities and cities, 10 have demonstrated to have functional municipal coastal law enforcement (CLE) teams. The Municipality of Inopacan in Leyte and Maasin City have shown capability in enforcing fishery laws within their respective jurisdictions. The Municipalities of Tubigon, Inabanga, Buenavista, Getafe, Talibon, and Bien Unido are performing regular law enforcement in Bohol area. Lapu-lapu City and Cordova of Cebu Province have been capacitating their respective CLE teams. The City of Lapu-lapu has its own team, Task Force Kalikasan. The Municipality of Cordova also established its own Sea Watch team.

A provincial initiative on illegal fishing is under way in Cebu through the creation of the Cebu Province Anti-illegal Fishing Task Force by virtue of Executive Order No. 21, Series of 2010. This was the Province's response to the increase in illegal fishing activities. This also supports the local CLE operations initiated by the different towns in Cebu. Primarily the task force is the lead agency in the province that conducts seaborne operations, market denials, and seizure operations, as well as seized items when confiscating illegally caught marine products. It is a multi-agency which is composed of the BFAR-7, DENR-7, 78 IB-Phil. Army, NAVFORCEN, PCG, PNP-CPPO-SRU, NBI-7, PNP-MARIG, Province of Cebu, CIDG-7 and PNP-PRO-7. Further, it has adopted four operational plans to broaden the scope of its operations and effectively apprehend all aspects of illegal fishing activities in the province. These are Team Pukot that focuses on commercial fishing, and Team Eskina which focuses on market denial operations. Team Anihaw is a province-wide operation and which included CRM cluster patrolling.

At the regional level, the Coastal Law Enforcement Alliance in Region – VII (CLEAR-7) has been created as a multi-agency, multi-sectoral group established to develop, package, pilot, and implement an integrated coastal law enforcement strategy in Region 7. The Alliance is legally bound by a memorandum of understanding (MOU) signed amongst government and non-government entities with mandates, programs, and projects that concern the coastal and marine environment. The MOU was formally signed in July 2000 in Cebu City with the following signatories: Department of Environment and Natural Resources (DENR), the Bureau of Fisheries and Aquatic Resources (BFAR), Department of Interior and Local Government (DILG), PNP Maritime Group (PNPMG), Philippine Coast Guard-Central and Eastern Visayas (PCG-CEV), National Bureau of Investigation (NBI), International Marinelife Alliance (IMA), Environmental Legal Assistance Center (ELAC), Philippine National

Association of Fishwardens (PHILNAF), League of Municipalities of the Philippines –Bohol Chapter (LMP-Bohol) and the Coastal Resource Management Project (CRMP). A decade after its inception, CLEAR-7 has continued to fulfill its mission in implementing an integrated coastal enforcement in Region-7.

Non- Government Organizations

Non-government organizations (NGOs) are private entities that operate to give advice to, offer technical assistance, and sometimes give logistical support to LGUs. In the context of coastal resource management (CRM), NGOs have been effective in placing CRM at the helm of public governance through collaboration and joint project implementation. While the basic services provision in the Local Government Code has included resource management among the LGUs deliveries, a gap in technical capacity has greatly impaired its implementation. However, through the project intervention by NGOs, CRM has now becoming one of the functional basic services provided by LGUs.

Recognizing the importance of the Danajon Bank Double Barrier Reef, it has been the center of many project interventions by many NGOs. While these interventions vary in terms of project deliverables, its overall goals in the program are to preserve, protect, and rehabilitate this critical barrier reef. FISH Project, supported by USAID-Philippines, has provided ecosystem-based coastal management, capacity building, IEC, and research from 2003 to 2010. A follow-on project, EcoFish, continues the implementation of the same programs but in different focal areas/municipalities in Danajon.

Other NGOs and projects involved in Danajon include Project Seahorse Foundation, Environmental Legal Assistance Center (ELAC), PATH Philippines Foundation, Inc., and Coastal Conservation and Education Foundation, Inc.

Stakeholders in Danajon Bank

Resource managers agreed that the involvement of all stakeholders is crucial in any ecosystem-based management approach. While their interest in management varies, the same is anchored on the proposition of protecting and conserving the Danajon Double Barrier Reef. In a stakeholder's analysis conducted, three major groups of stakeholders were indentified to be affiliated in the management of the Danajon Bank under different capacities:

1. those directly engaged in the management of municipal waters. Although not considered to be primary stakeholders, their interest is focused primarily on good governance and their support is critical to the success of all resource mangement initiatives. They are the mayors, the Municipal Planning Officers, the Municipal Agriculture Officers and the Tourism Officers.

2. those seeking to implement CRM at the cluster or provincial level that follow a collective or joint program mostly initiated by a collaborating body. These are the CRM Councils in Southern Cebu, the IMFARMC of Leyte Province, and the Coastal Law Enforcement Council of Districts 1 and 2 of Bohol. Oversight functions for these bodies are usually provided by the BEMO and secretariat or office directly managing day-to-day operations. Their interests in the project and in the Danajon Bank management are joint coastal law enforcement, joint trainings, and unified fishery policies.
3. those considered as primary stakeholders. These are the fishers, the fish vendor associations, pump-boat operators, tropical aquarium fish collectors, and seaweed farmers. Their interest in the area lies mainly on livelihood opportunities, increase in production, and management conducive to the implementation of their activities.

Challenges

Notwithstanding project interventions on institutional development from different agencies, functionality of institutions in order to implement, monitor, and evaluate CRM programs in Danajon remains a problem. This is mainly due to the lack of budget for municipal CRM implementation. This perennial problem often results to inactive MFARMCs and Coastal Law Enforcement Teams. In most municipalities, they have created their own "bantay-dagat" groups but no regular patrolling or sufficient law enforcement activities have been implemented.

Further, the lack of proper livelihood programs for fishermen is another issue. Although previous initiatives in Danajon involve livelihood development programs, further inputs for livelihood through assistance in project proposal-making to existing organizations, funds for livelihood training, and fund sourcing for income generating projects (IGPs) are some of the challenges identified.

Various challenges that were identified range from municipal water delineation, proper adjudication of cases, management of NIPAS areas, varying fisheries programs and policies among municipalities, and lacking in incentives for law enforcers.

Coastal Habitats and Resources

As one of six double barrier reefs in the world, the Danajon Bank is an epicenter of marine biodiversity. One cannot stress enough the importance of protecting such an area in the interest of food security, environmental tourism, and basic community livelihood. This technical document aims to identify major issues and threats to coastal natural resources as well as the condition that they are in.

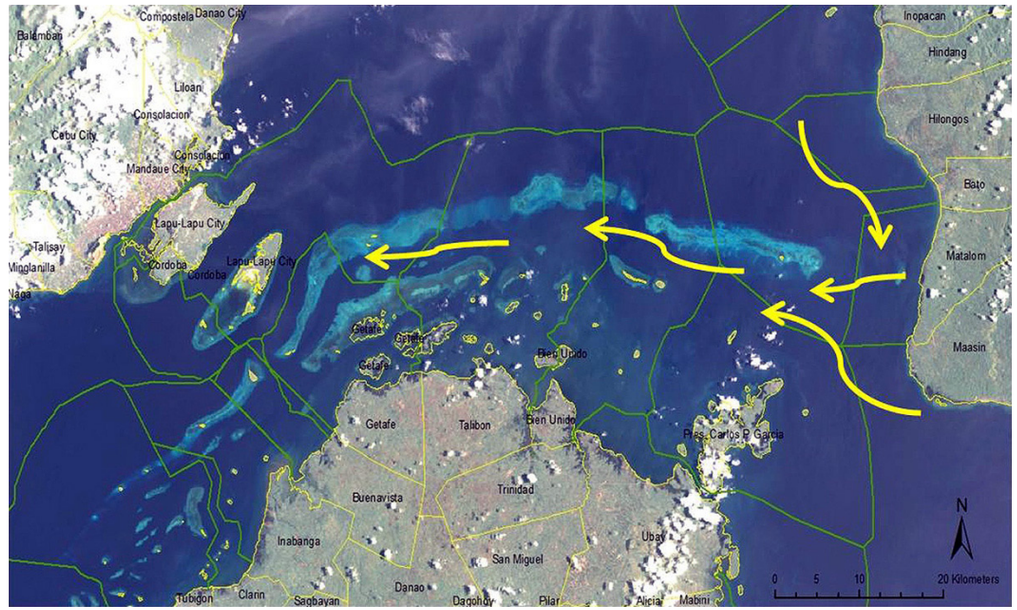


Figure 3. The administrative boundaries in Danajon Bank and where the currents flow.

A relatively protected reef, placed within between three major archipelagic islands (Cebu, Bohol, and Leyte), Danajon bank naturally flourishes with coral life and fish. However, it is also plagued by anthropogenic factors that take the form of dynamite fishing, overfishing, cyanide fishing, and commercial fishing.

In 2002, the provinces surrounding the Danajon Bank signed a Memorandum of Agreement to create a technical working group to oversee the management and conservation of Danajon Bank. This was the CeLeBoSoLe Council (or the Cebu-Leyte-Bohol-Southern Leyte Council) which had representatives from the Bureau of Fisheries and Aquatic Resources (BFAR), Philippine National Police (PNP) Maritime Group, Philippine Coast Guard (PCG), Department of Environment and natural Resources (DENR), National Economic and Development Authority (NEDA), and Department of

Interior and Local Government (DILG) with the support of several projects and non-government organizations.

By 2009, the Bien Unido Double Barrier Reef Marine Park (or BUDBRMP) was established by municipal ordinance in the town of Bien Unido which protects about 3,317 hectares of the bank (including two 50-hectare no-take zones). In addition to this, there are also 75 community-based no-take zones in Danajon Bank's inner reef 2,506 hectares, or 9.3%, of the entire bank.

In 2011, The Coastal Conservation and Education Foundation, Inc. (CCEF) assisted the 23 municipal local governments and the four concerned provinces to create the Danajon Double Barrier Reef Management Council (or DDBRMC) for improved collaborative management of Danajon Bank.

In 2009, Lucas conducted an extensive biophysical survey on the outer bank and reported that both the SCUBA transects and manta tow series revealed similar percentages of live hard coral cover (Lucas 2010). The overall coral condition of the surveyed outer reef sites was classified to be in "Fair" condition (34.3 ± 4.1 %) based on Reef Condition Index at 6-16m depth (range: 25-49.9% LHC) (Lucas 2010). The mean total reef fish density was 957.6 ± 201.7 individuals/500m^2, classified to be at "Moderate" abundance (677-2276 individuals/1000m^2). The most abundant fish species recorded were members of

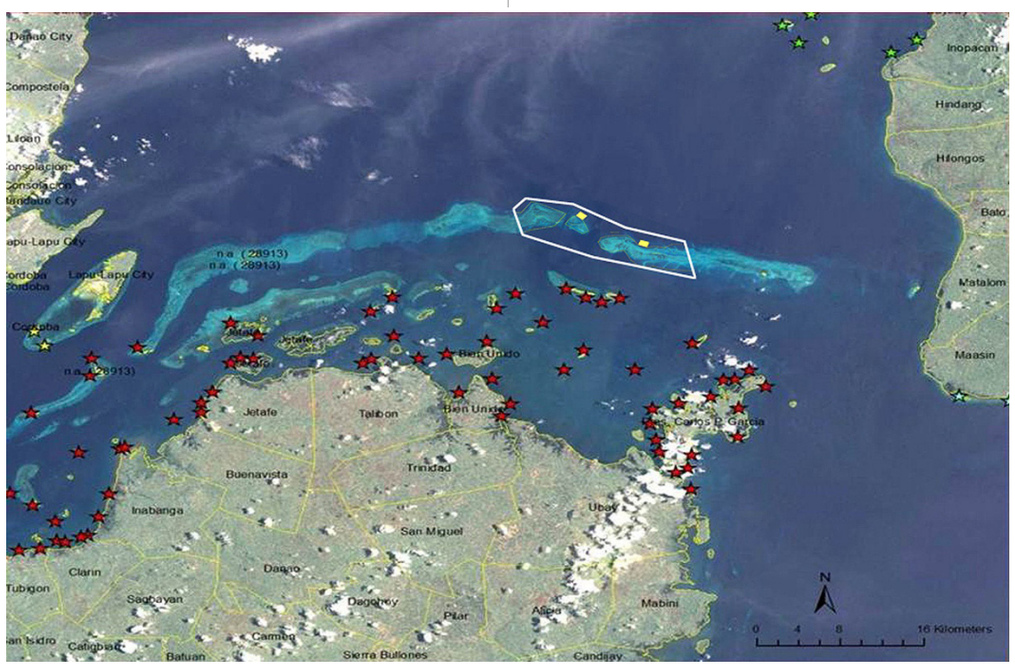


Figure 4. The Bien Unido Double Barrier Reef Marine Park and the 75 marine protected area no-take zones in Danajon Bank.

the Labrids (wrasse; labayan), observed at 234.1 ± 57.8 individuals/500m^2. Caesionids (fusiliers or solid) were the most abundant family (203.9 ± 87.9 individuals/500m^2). Piscivores (ex. Snapper or maya-maya, grouper or lapu-lapu), commercially important species, were recorded at very low levels (0.32 ± 0.28 individuals/500m^2). They also reported that majority of fish were of very small size (0-10cm size class) and that no fish over 30cm were encountered during the surveys (Lucas 2010).

Methodology

Five different scientific surveying methods were used to measure the condition of the coral reefs, fish abundance/species richness, seagrass cover, and mangrove forest cover. The manta tow survey on snorkel (for shallow extensive reefs) and the scuba survey (for deeper reefs) were used to measure/estimate hard coral cover at different depths and rated using the live coral cover index by Gomez et al. (1994). The scuba survey was also used to utilize the point-intercept transect (PIT) to collect coral cover data and the 500m^2 fish visual census to collect information on fish abundance, fish species density, and fish biomass and rated using the rating index of Hilomen et al. (2000). Seagrass surveys used the transect-quadrat method, a 50-m transect was laid perpendicular to the shore at each site and the quadrat contents were determined by the method used by Saito and Atobe (1970). Mangrove surveys utilized the transect line-plots method after English et al. (1994).

Live Hard Coral

Live coral cover was relatively variable between sites and ranged from 11.4% coral cover at site 9 (northeast of Pandanon Island), which is characterized by bare reef substrate due to a wide intertidal flat, to 50.6% coral cover around northeast of Pandanon Island which is dominated by branching corals. The comparatively low coral cover across the bank, 29.46% ± 3.6%, may be a result of extensive coral mortality caused by years and years of rampant, irresponsible fishing practices in the outer reef and the continually poor water quality near the many river mouths along that section of coastline. Percent LHC cover from the SCUBA assessment data is consistent with the manta tow

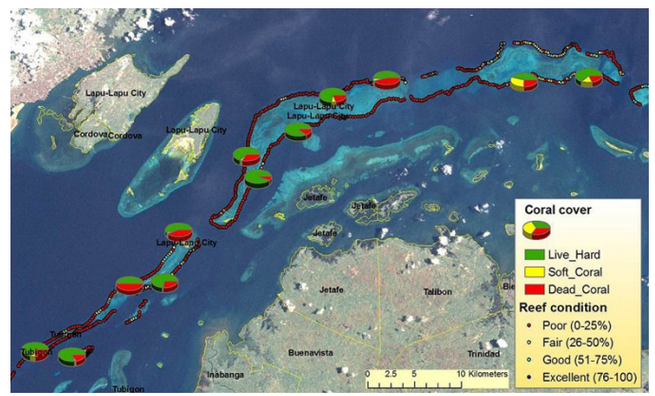


Figure 5. Percent benthic cover using generalized categories: Live Hard Corals, Soft Corals, Non-Living (all abiotic substrate) and Others ponges, anemones, other animals).

observations (N = 638) along with other benthic categories collected a month earlier which revealed an average of 18.33 ± 1.5% bank-wide. This is attributed to large stretches of sandy areas and the natural soft bottom profile in the inner reef.

The most common fish found on all sites were damselfish (pomacentridae) and wrasses (labridae) (see fish species list table). Overall, the survey data suggests that intensive fishing pressure has removed most of the large apex predatory fish. Low numbers of coral health indicator species also suggest a declining reef condition or removal from the reef system for the aquarium trade.

Fish Density

Mean fish abundance (numerical abundance) for all reef species across the bank was estimated to be at 280.5 ± 51 individuals/500m^2 of which 42.5 ± 6.1 individuals/500m^2 are target fishes. The sites with the highest mean fish abundance are site 12 (769.8 individuals/500m^2) and site 13 (510.8 individuals/500m^2).

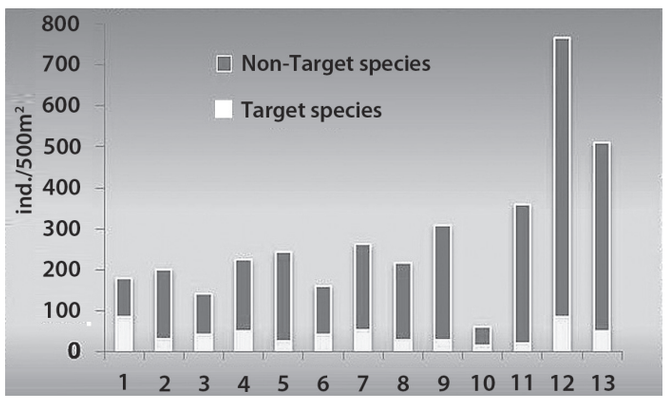


Figure 6. Mean fish abundance (ind./500m2) for all reef species at 13 surveyed sites.

Fish Diversity

Bank-wide, mean species diversity (presented as species richness) was computed at 54.4 ± 2.8 spp/500m^2 from which only 21.5 ± 1.5 spp/500m^2 were considered target species. Mean diversity is consistent with mean abundance with sites 12 and 13 as the two most diverse sites with 74 spp/500m^2 and 66 spp/500m^2, respectively.

Fish Biomass

Mean fish biomass bank-wide was very low, calculated to be at 7.35 ± 1.9 kg/500m^2 with only 2.84 ± 0.6 kg/500m^2 coming from target fishes. As a result from being the top sites in abundance and diversity, sites 12 (20.01 kg/500m^2) and 13 (24.10kg/500m^2) also has the highest biomass among all sites.

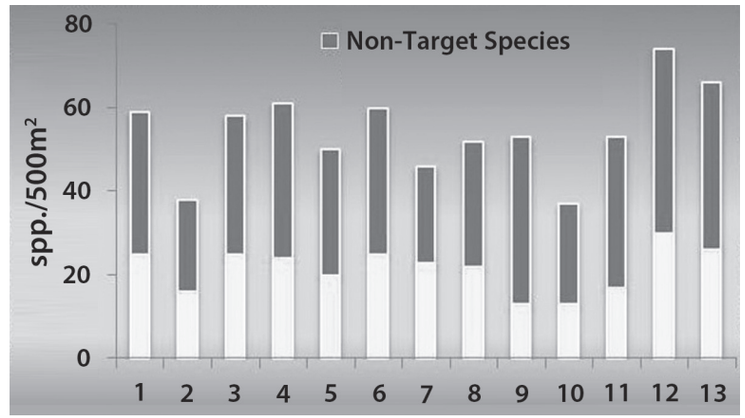


Figure 7. Mean species richness (spp./500m^2) at each site.

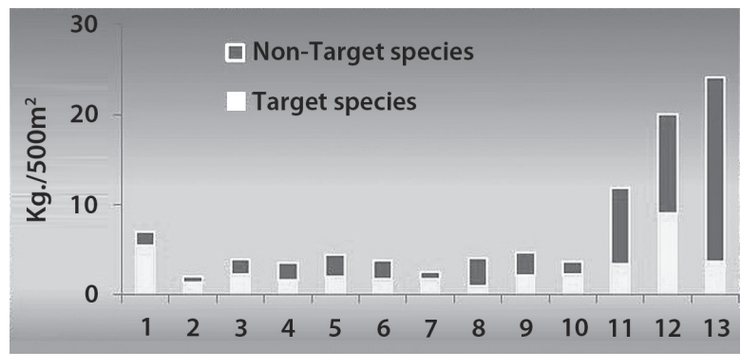


Figure 8. Mean fish biomass (kg./500m^2) for all reef species at each site.

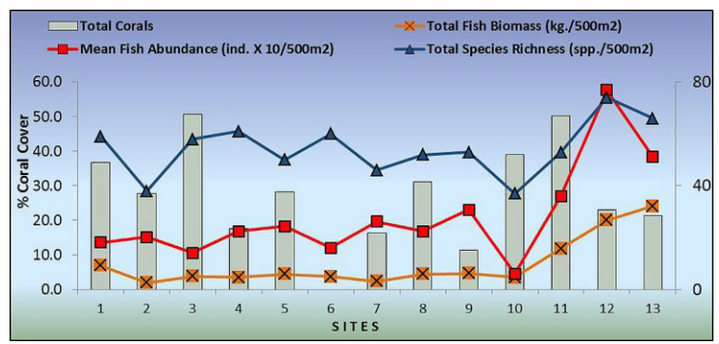


Figure 9. Means of percent coral cover, fish abundance, species richness and biomass at each site.

Seagrass

Seagrass cover for Danajon bank averaged at 39.59% ± 12% (range 10.0-77.21%). Buenavista has the densest seagrass community having 77.21% cover followed by Tubigon with 64.21%. Clarin had the lowest cover at only 10% cover. No seagrass surveys were conducted in Getafe due to accessibility concerns. Banacon Island has the most seagrass diversity with four species including Thalossodendron cilliatum, which was absent from all the other surveyed sites. Enhalus acoroides is the most common seagrass species which was recorded in three out of the six sites.

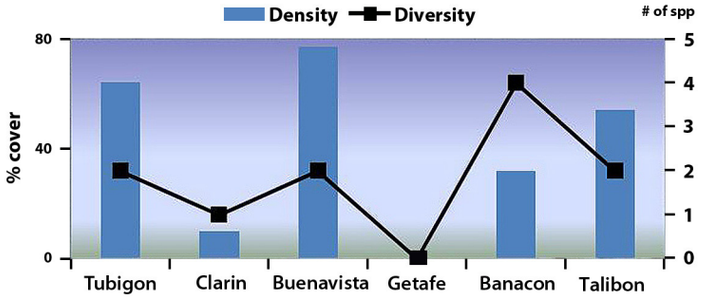


Figure 10. Mean of percent seagrass cover and species richness (# of species) at each site.

Mangroves

Danajon Bank has a relatively abundant mangrove cover averaging at 131.37 ± 58.7 trees/100m^2 (range 53.63 – 412.1 trees/100m^2) of which 111.22 ± 61.6 trees/100m^2 are mature. Banacon Island has the densest mangrove community averaging 412.0 trees/100m^2, but has the least diversity. This is not surprising because the island is a known planting site monospecifically planted with Rhizophora stylosa and a beneficiary of DENR's mangrove reforestation programs the last 20 years. Tubigon had the most recruits (51.3 trees/100m^2) due mainly to recently planted seedlings. The least abundant area was Clarin averaging 28.12 trees/100m^2. Mangrove diversity averaged at 5.5 ± 1.5 spp/100m^2 (range 1–12 spp/100m^2), with Banacon Island and Buenavista as the least and most diverse sites, respectively.

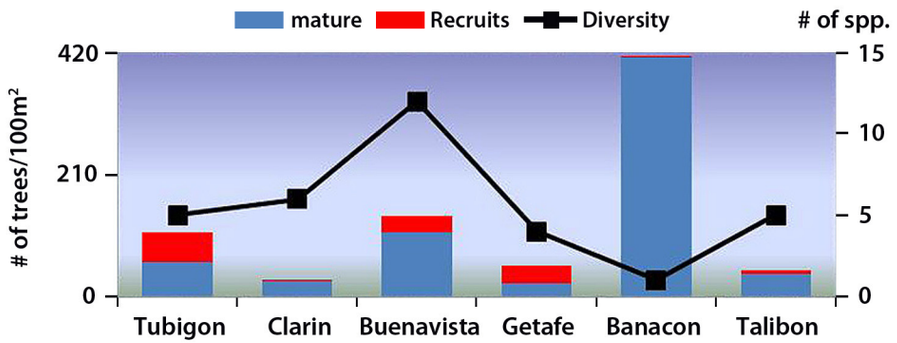


Figure 11. Mean mangrove abundance (# of trees/ 100m^2) and species richness (# of species) at each site.

Management Implications and Recommendations

Overall, the health of Danajon Bank's coral reefs is declining. Many challenges still remain in the joint management of the coastal resources. Financial and human resources are limited and are disproportionate to the value of goods and services generated by coral reefs.

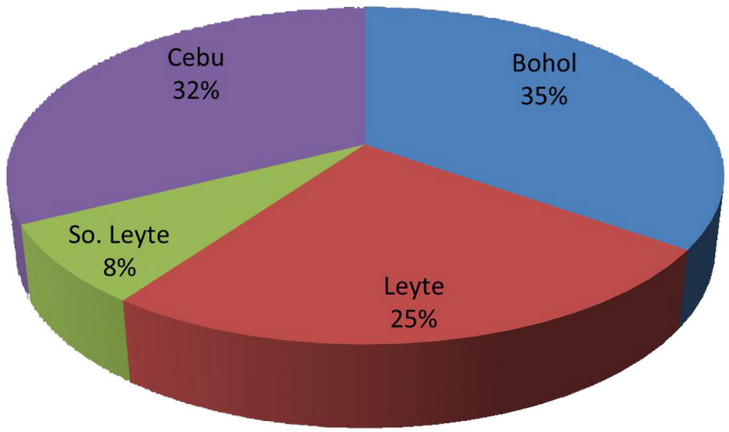
Global climate change is an increasingly pressing threat with increasing incidences of coral bleaching, ocean acidification and the potential for stronger storms challenging even the most resilient reefs. Policy interventions must be prioritized to efficiently allocate limited financial and human resources available to coral reef managers. Site-based approaches that involve strong community participation and a coordinated network of organizations can address threats together. Further, the commitment and capacity of managers to deal with these threats must be enhanced. This means that better education for an improved understanding of reef resilience to climate change should also be shared.

Socio-Economic Profile

Summary

This study is a major component of the Danajon Bank Marine Park Project aimed at establishing a socio-economic and demographic baseline profile of the coastal island communities surrounding the Danajon Bank. Data obtained from the survey was used to inform the management of the Danajon Bank Marine Park with special attention given to the environmental and gender issues involving women in fisheries. The respondents include 4,336 coastal residents from 834 households taken from a sample of 60 barangays in the outlying islands of the municipalities and cities of Danajon Bank. The population is almost evenly distributed among four provinces with a little over a third of the total population comes from Bohol; another third from Cebu; and about a third from Leyte and Southern Leyte combined.

Figure 12. Population Distribution per Province



Primary livelihood of households is fishing, mainly small-scale fishing for subsistence and income generation. Secondary sources of income, whether marine or land-based, are limited. Women participation in livelihood activities is also limited and largely unrecognized. Moreover, skills development and educational attainment of those in the productive ages are low. Fertility, although showing signs of decline in later years, remains high; and population densities and growth rates are also high. Such findings indicate an increasing population pressure on the marine and coastal environment of the Danajon Bank, which needs to be immediately addressed. Awareness of MPAs is rather high and perceptions on their benefits are favorable. Residents generally prefer to be consulted on the establishment of the Danajon Bank marine park and are likely to be in favor of charging user fees for divers.

Background

Danajon Bank is located off the northern part of Bohol, the mid-eastern part of Cebu and south-western part of Leyte within the Visayan region. It is the only double barrier reef in the Philippines (Pichon, 1977). It covers a total area of 27,200 hectares with a total coastline of 699 km including 40 islands, and accounts for over one percent (1%) of the total area of coral reefs of the Philippines which is estimated at 27,000 km^2 (Christie et al. 2006). This unique coastal environment is of global ecological significance and is at the world's epicenter of marine-shore fish biodiversity (Carpenter and Springer 2005). It has been identified as a priority area for the conservation of reef fishes, corals, mangroves and mollusks (Green et al. 2004).

Danajon Bank is considered a critical resource area especially for fishing, as it sustains the livelihood of around 5,000 fishers in the commercial sector and over 125,000 full-time municipal fishers in its 17 municipalities/cities covering four provinces and two administrative regions. 10 municipalities (Tubigon, Clarin, Inabanga, Buenavista, Getafe, Talibon, Trinidad, Bien Unido, Ubay, and Carlos P. Garcia) are located in northern Bohol, two, Lapu-Lapu City and Cordova are geographically located in Cebu province, four, Hindang, Hilongos, Bato, and Matalom in Leyte province, and one (Maasin City) in Southern Leyte province. Fishing is not only considered as a subsistence practice for the people living near the Danajon Bank as it has been embedded within their cultural identity as individuals and as communities (Langjahr, 2006).

Over time, the degradation of the Danajon Bank reef system has had serious consequences for food security, conservation and economic growth because of overfishing, population pressure and degradation of habitats. Actual living coral cover is low despite high coral diversity in the area. Fish abundance and diversity in six inner reef sites surveyed were considered low by Philippine standards given that a typical reef, the maximum number of fish count is 800 per 500m2 (Calumpong, 2005). Fish biomass was also very low suggesting that the general status of the area is degraded.

A number of coastal resource management projects initiated either by local communities or government agencies such as the Department of Environment and Natural Resources (DENR) and the Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture (DA) have been implemented within the Danajon Bank in partnership with non-government organizations or special programs such as the Fisheries Improved for Sustainable Harvest (FISH), and Project Seahorse Foundation. 10 National Integrated Protected Area System (NIPAS) sites have been established within these boundaries, including 7 strict nature reserves and 3 protected seascapes (Green et al., 2002).

A local mangrove reforestation initiative has also been implemented within this area. In her paper, Amper (2004) argues that mangrove reforestation is an indigenous, locally-driven initiative. The 487-hectare mangrove area has not only protected the island from big waves and strong winds, and provided a spawning area for fish and other marine creatures, but also brought eco-tourists from all over the world to relish the magnificent view. A number of marine protected areas have also been established by various local government units in the area supported by such projects as the Community-based Coastal Resource Management Project (CBCRMP) of the Department of Finance and the Coastal Resource Management Project of the DENR. As of 2004, 60 community and municipal-based MPAs has been established within the area in various stages of implementation (CRMP, 2004).

The following are the key survey findings from the Socio-Economic Baseline Study:

Demographic Profile

- Population distribution is roughly equally divided between the Provinces of Bohol (35%), Cebu (32%), and Leyte, and Southern Leyte (25% and 8%).
- Median age is 19; age dependency ratio is 65 with 62 in the young-age and 3 in the old-age population brackets; sex ratio is 111 males to 100 females; CWR is 44; and highest population density is at 814.8 per hectare.

Socio-economic Profile

- 47.7% of the survey sample has had some elementary education; 39.8% high school; 10.6% college; 0.2% vocational; and 1.7% no education.
- Primary livelihood of 77.7% of households is fishing; and 15.6% seaweed farming. 96.6% of the households do not have any secondary livelihood.
- Women participation in livelihood activities is 15.7%, with higher participation rates in land-based livelihood activities than marine-based ones.
- Median years of fishing is 20; usual fishing grounds are municipal waters; catching a variety of marine organisms include crabs, shrimps and various fish species; they use various fishing gear, primarily hook and line and gill nets; fish catch is intended primarily for selling and also for consumption.
- Median income is P2500 per month; average household size is 5; household expenses are primarily for food, electricity, water, education and gasoline; 90% own their house but only 31.7% have ownership of the land.
- 59.3% use electricity and 37.3% use kerosene for lighting; 98.5% use firewood or charcoal for cooking; 47.7% have water-sealed toilets while 45% have no toilets at all; garbage is disposed either through composting (43.8%), garbage collection (19.4%), burning (20.6%) and dumping (16%).

- Water sources include rainwater (35.5%), local piped-in water supply (18.3%), open-dug wells without pump (10.6%) and wells equipped with pumps (8.8%); location of water source is usually at an open space within the community (43.7%), in the household yard (29.6%), and inside the house (14.9%).

Table 1. Primary Livelihood of the Sample Households

Type of Livelihood	% of households
Municipal fishing	77.7
Commercial fishing	2.3
Gleaning	2.4
Seaweed farming	15.6
Aquaculture	0.2
Diving	0.6
None	1.2
TOTAL	100.0

Perceptions of MPAs

90.2% are aware of MPAs; 84.4% see the benefits of MPAs; 82.2% view the need for management of the outer Danajon Bank; and the creation of a marine park (82.3%); 59.4% prefer to be consulted regarding this matter and 67.2% see the benefit of participating in the creation of the marine park; 69.6% say that user fees should be charged to divers.

Table 2. Awareness and Perceptions on the Benefits of MPAs

Aware-ness	Beneficial or Not			Total
	Yes	No	D/K	
Yes	84.2	3.6	2.4	90.2
No	0.2	1.7	7.9	9.8
TOTAL	84.4	5.3	10.3	100.0

Table 3. Perceptions on Management and Creation of Marine Park in the Outer Danajon Bank

Mgt of Outer Danajon Bank	Creation of Marine Park			Total
	Yes	No	D/K	
Yes	75.4	1.5	5.3	82.2
No	1.1	1.4	0.1	2.6
D/K	5.8	0.3	9.1	15.2
TOTAL	82.3	3.2	14.5	100

Table 4. Perceptions on Consultation Process in Establishing Marine Park

Consul-tation	Benefits of Participation				Total
	Yes	No	D/K	De-pends	
Yes	53.8	0.6	2.7	2.3	59.4
No	0.6	3.0	2.6	0	6.2
D/K	12.8	0.9	20.5	0.2	34.4
TOTAL	67.2	4.5	25.8	2.5	100

Table 5. Perceptions on Charging User Fees for Divers in Outer Danajon Bank

Charge User Fees	%
Yes	69.6
No	30.4
TOTAL	100

Table. 6. Purpose of Fish Catch

Purpose	% of households
Household Consumption	0.5
Selling	53.6
Selling & Consumption	45.9
TOTAL	100

Analysis

The socio-demographic and socio-economic profile of Danajon bank speak of a population that is heavily reliant on resource extraction from marine and coastal ecosystems, mostly for subsistence. Fishing as primary livelihood of majority of the enumerated households in the Danajon does not bring in much cash but provides food for the household. Aside from this, fishing consumes much of the time of those in the productive age group. On the other hand, secondary sources of income are very limited as other types of skills are also very scanty. Alternative marine-based livelihoods, such as seaweed farming, although can bring in more cash than fishing, are engaged in only by a small percentage of the residents. Worse, land-based livelihoods are very limited as most of those in the productive age group have generally low educational attainment and lack of sufficient skills other than fishing.

Women's participation in livelihood activities is relatively low, largely due to prevailing notions on the gender division of labor, relegating women to more "reproductive work" than "productive work". Productive work performed by women may sometimes not be considered as a means of livelihood since it usually does not bring in much cash. Women in the early part of their productive ages tend to seek work elsewhere due to lack of opportunities, while most of the men who stay opted for fishing as it is considered in Philippine society as a traditional gender role assigned to men.

Table 7. Gender Participation in Livelihood Activities

Type of Livelihood	% Male Participation	% Female Participation	% to Total
Municipal fisher	95.2	4.8	67.6
Commercial fisher	85.0	15.0	2.0
Gleaning	60.0	40.0	2.5
Seaweed farming	82.3	17.7	15.7
Aquaculture	75.0	25.0	0.4
Farming	80.0	20.0	0.5
Business or self employment	26.8	73.2	7.0
private employment	40.9	59.1	2.2
government employment	6.3	93.8	1.6
Others	66.7	33.3	0.6
TOTAL	84.3	15.7	100

Population growth rates are uneven and vary from one municipality to another. However, growth rate is generally high. The Child-Woman Ratio (CWR) is still relatively high compared to national CWR figures, although there are signs that fertility levels may have declined in recent years as evidenced by the lower population of children aged 0-4 compared to those in the 5-9 and 10-14 age brackets. Out-migration is more evident than in-migration. In-migration was high in the 1940s-1950s when resources were still very abundant, but this has declined in recent years. Despite this trend, population densities are still relatively high especially in the small islands.

Human activity in the Danajon is not only confined to fishing as these areas are also where residences are located. Households have basic needs not only for food but also for housing, water, fuel, energy, sanitation, and garbage disposal. These are major concerns in these areas as many rely on rainwater, do not have toilets, majority still use wood or charcoal as cooking fuel, and most do not have functional solid waste management systems in their barangays. These spell a number of environmental implications – first, water is scarce; second, human and solid waste could contaminate coastal and marine ecosystems as well as ground water sources; third, use of wood as cooking fuel and burning of garbage emit toxic gases to the atmosphere.

Table 8. Garbage Disposal Practices

Method of Garbage Disposal	%
Collected by garbage collector	19.4
Burning	20.6
Composting	43.8
Dumped away from house	6.7
Dumped near house	0.4
Dumped in river/stream/ open sea	8.9
Others	0.1
TOTAL	100

The situation in the Danajon Bank calls for comprehensive solutions especially on environmental protection and livelihood enhancement among others. Given these pressing concerns which put pressure on the Danajon Bank, we turn to government for solutions especially in resource management as well as regulation. However, the Danajon Bank is a unique and complex area to manage as it is under the jurisdiction of a number of political entities from the barangay, municipal, provincial, and regional levels. Each LGU might have different programs for the Danajon Bank, and there seems to be a lack of coordination among them

in this regard. This is the challenge that needs to be faced not only by government officials but more so by the residents of the Danajon area.

Conclusions

1. The Danajon Bank is a complex area involving a number of barangays, municipalities, provinces, and regions.
2. Primary livelihood in the Danajon revolves around small-scale municipal fishing both for subsistence and income generation. Secondary sources, both marine-based and land-based are very limited. Women participation in livelihood activities is also limited.
3. Population pressure on the marine and coastal ecosystems is growing as fertility continues to be high although slowly declining. Population densities and growth rates are also high.

Recommendations

1. Create a regular coordinating body composed of representatives from local government units that are part of the Danajon bank to constantly plan, implement, monitor and evaluate programs in the area.
2. Conduct various skills training to undertake alternative livelihood activities whether marine or land-based involving both men and women in order to generate more household income and thereby lessen extractive fishing activities.
3. Disseminate more information on the need, methods, and benefits of family planning to the households in particular and the community in general, thereby easing population pressure on the environment.

Economic Valuation Study

Summary

This study estimated the economic values marine ecosystems comprising the Danajon Bank area under present conditions and the future values of economic benefits and costs among stakeholders in the fishing and tourism industry. These values will be used as a basis to promote policies and livelihood options that reinforce establishment of the Danajon Double Barrier Reef Management Council. The results will also inform the regional, provincial and local government units and relevant government agencies on guidelines for the development of appropriate user fees that support the economic and environmental sustainability of local fishing and ecotourism industry in the provinces of Cebu, Bohol, Leyte and Southern Leyte.

The objectives of this study are to (1) estimate the economic values of ecosystem services provided by the Danajon reefs; and (2) estimate an appropriate diver visitation fee based on a willingness-to-pay valuation.

The benefits generated from marine resources include: (1) direct benefits from fisheries, seaweed farming, gleaning, and recreation/tourism; and (2) indirect benefits as reflected from the shoreline protection and nursery function of mangroves. The marine resources generate direct and indirect values. Mangroves and coral reef areas yield a value at PhP 273.9 mil (USD 6.4 mil) in annual benefits. This implies that in terms of management efforts, the protection and conservation of mangroves and coral reefs should be prioritized.

The present value of the stream of net benefits derived from the marine resources of the Danajon bank over a 20-year period using a 10% discount rate, amounts to PhP 2.6 bil (USD 59.6 mil). This implies that the current net benefits are dependent on the quality of the coastal and marine resources for these benefits to continue into the future.

If these coastal resources are not protected and destructive economic activities are allowed to continue, then present value economic losses equivalent to PhP 273.9 mil (USD 6.4 mil) on an annualized basis will be incurred.

Key Result Findings

Estimation of Economic Value

The study determined the economic value of coastal and marine resources of Danajon reefs are based on the Total Economic Value framework (Fig.13). Use value measures the consumptive value (direct use values) of tangible natural resources such as fish and shellfish, as well as non-consumptive (indirect use values) ecological and recreational uses. Use value consists of direct, which can be classified as "goods" and indirect use values, which can be classified as "services". Some major economic values of the important resources are considered.

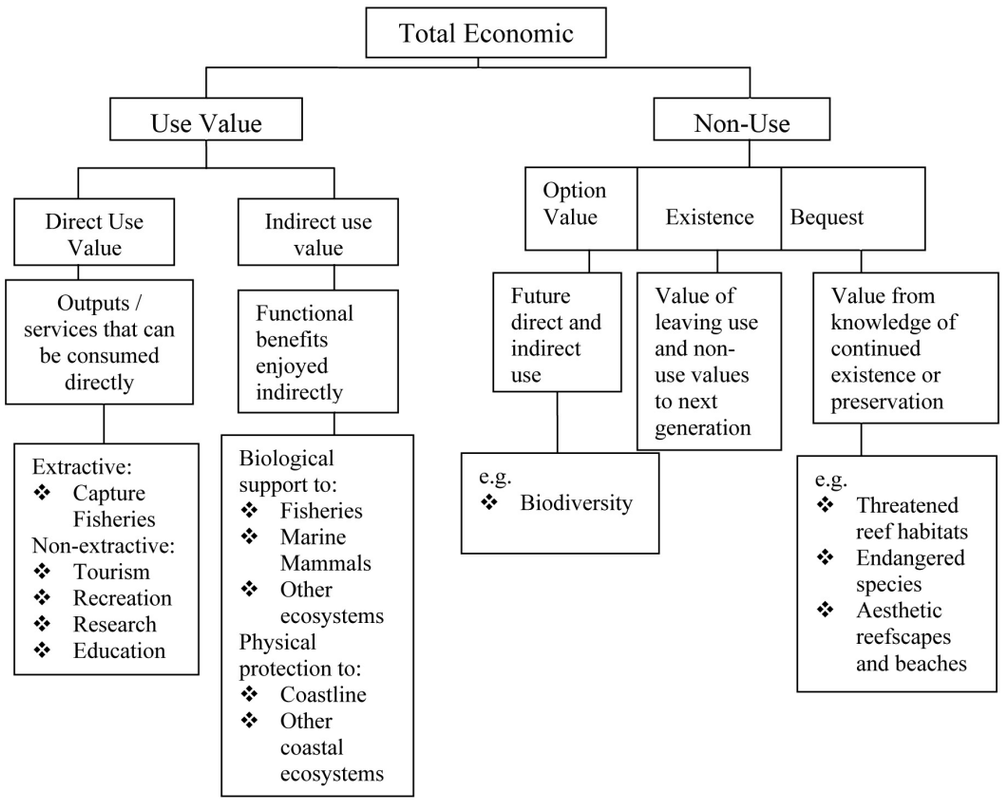


Figure 13. Total Economic Value Framework

Fishing

The local communities use the coastal resources for municipal fishing. Fishers are dependent on reefs, mangrove areas and marine waters for fish food (subsistence and commercial) and viable marine-based ventures. Majority of the fishers use the coral reefs (43%) and other marine areas, pelagic and open ocean (40%). Average fish catch ranged from 1.6 – 4.0 kg during lean months to 4.4-13.7 kg/fisher/day during peak months. 3% of the fish catch are used for family consumption while 97% are for selling (Fig. 14). In general, November through April are considered peak fishing months. Lean months are from May to October.

FISHERIES

No. of Years Fishing	Mean
	22
Location	**% of Fishers**
Mangrove area	17
Coral reefs	43
Other (pelagic, open ocean)	40
Catch from Fishing (kg)	**Mean**
Peak months – minimum	4.38
Peal months – maximum	13.70
Lean months – minimum	1.62
Lean months – maximum	4.09
Revenue from Fishing (PhP)	**Mean**
PEAK – Min	492.54
PEAK – Max	1536.19
LEAN – Min	202.27
LEAN – Max	567.64
Cash and Non-Cash Expenses	**Mean**
Daily Expenses	
Fuel	305.51
Boat Rental	53.42
Supplies	466.49
Hired Labor	1186.00
Family Labor	
Monthly Expenses	155.15
Annual Expenses	507.32

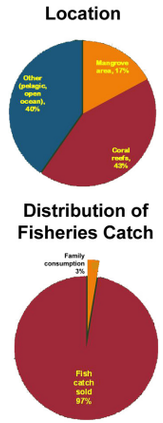


Figure 14. Location and distrbution of municipal fisheries catch

Gleaning

Gastropods and bivalves are major species gleaned from intertidal areas and seagrass beds. Echinoderms are harvested mainly for consumption while molluscs are sold at local market or public market. Figure 3 shows the location and distribution of gleaned harvest.

Seaweed Farming

Bien Unido, Bohol is where majority of the seaweed farms are located. Compared to five years ago, there is an increase in seaweed farmers from 100 to 300, the

GLEANING

No. of Years Gleaning	Mean
	13
Location	**% respondents**
Mangrove area	40
Beach	30
Other	30
Catch from Gleaning (kg)	**Mean**
Primary Gear	
PEAK – Min	1.33
PEAK – Max	3.86
LEAN – Min	0.83
LEAN – Max	1.71
Secondary Gear	
PEAK – Min	0.00
PEAK – Max	9.00
LEAN – Min	50.00
LEAN – Max	2.00
Revenue from Gleaning (PhP)	**Mean**
Primary Gear	
PEAK – Min	56.67
PEAK – Max	732.86
LEAN – Min	32.33
LEAN – Max	161.43
Secondary Gear	
PEAK – Min	0.00
PEAK – Max	315.00
LEAN – Min	50.00
LEAN – Max	75.00
Cash and Non-Cash Expenses	**Mean**
Daily Expenses	
Fuel	30.00
Boat Rental	20.00
Supplies	450.00

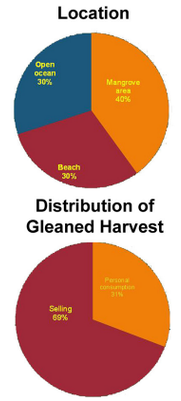


Figure 15. Location and distribution of gleaned harvest

SEAWEED FARMING

General Information	Mean
No. of years farming	9
Size of farm	453.65
Location	**% respondents**
Mangrove area	26
Coral reef area	74
Purpose of Catch	**% respondents**
Personal consumption	0
Selling	100
Quantity Harvested (kg dry)	**Mean**
Aug-Dec (1st crop)	
Min	3000
Max	4000
Jan – Jun (2nd crop)	
Min	1000
Max	2000
Expenses	**Mean**
Boat Rental	
Supplies – Bamboo	5000
Supplies – Rope/Nylon	8000
Seedlings/Fingerlings	40000
Hired Labor	2000
Annual permit	650

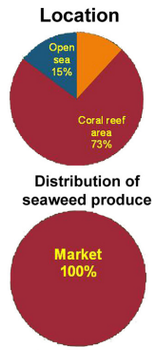


Figure 16. Location and distribution of seaweed products

reason stated is that seaweed farming ensures more income compared to fishing and is considered a viable livelihood and a potential attraction for tourists. Most farms are one hectare and the usual farming method is the off-bottom which consists of approximately 2000 single lines per hectare. Seaweed is mostly for selling after it is dried (7:1 fresh-dry ratio). Peak months for seaweed farming are August – November. Figure 16 shows the location and distribution of seaweed products.

Tourism

Tourism contributes to the local economy of many coastal communities as many tourist activities take place in the coastal areas of Mactan Island and norther Bohol. These activities are mainly SCUBA diving, swimming, snorkeling, beach combing, boating, sun bathing, some recreational fishing and visiting fishing villages. Bien Unido municipality in northern Bohol, as well as the other Cordova municipality and Mactan City in Cebu, are endowed with historical places and scenic attractions such as white beaches and underwater cultural sites. With the variety of recreational activities in the Danajon reef area, there is potential for tourism development. Tourism revenues include direct revenues (e.g., diver fees and park entrance fees) and indirect (private sector) revenues (e.g., lodging and resort accommodation, dive operations and restaurants). Peak months for tourism are January-February and May through December.

Indirect values

1. Shoreline protection
Indirect use values include the control of coastal erosion or damage protection from storms, wave action and wind. For shoreline protection, the cost of constructing protective seawalls or dikes is used. Using the replacement cost approach, the shoreline protection value is estimated using PhP 6.4 mil (USD 149,301). Shoreline protection value accounts for 2% of the total economic value.

2. Nursery function
Another indirect use value is the provision of feeding, nursery and breeding areas for fish. The net value of nursery and habitat role provided by mangroves for fish is estimated at 25% of net landings for annual value of PHP 5.6 mil (USD 130, 593).

Total Economic Value

The economic value of the marine resources of Danajon reefs is estimated based on the total economic value framework. Use values, which measure the consumptive value or direct use values of tangible natural resources as well as non-consumptive or indirect use values of natural resources were estimated. The total economic value of the marine resources is PhP 273.9 mil/yr (USD 6.4 mil/yr). The tourism and fisheries sectors were the major economic sectors generating annual direct use values from the marine resources of PhP 130.8 mil (USD 3 mil/yr) and PhP 88.6 mil (USD 2 mil/yr), respectively (Fig. 6). Shoreline protection and habitat/nursery function were indirect use values

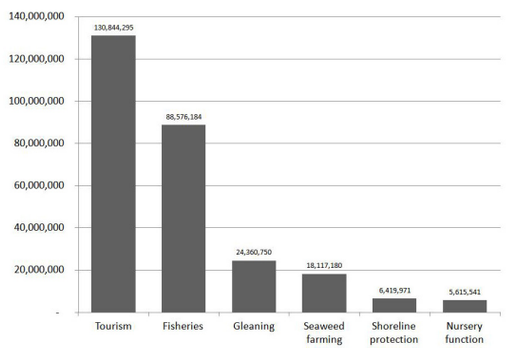


Figure 17. Annual direct use values from various sectors in Danajon.

amounting to PhP 6.4 mil (USD 149,301/yr) and PHP 5.6 mil (USD 130,593/yr). Other values are gleaning and seaweed farming which account for 9% and 7% of the total economic value, respectively (Fig. 18).

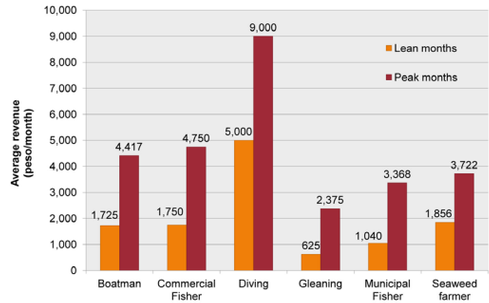


Figure 18. Annual net benefits from Danajon reefs.

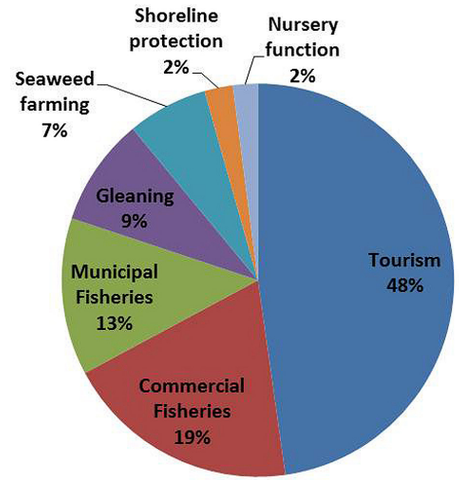


Figure 19. Distribution of benefits by use and non-use values

Willingness to Pay

When asked the question, 'If you were traveling to Danajon Bank, what is the maximum amount that you would be willing to pay as a daily, per person entrance fee to the marine park?', the entrance fee of respondents' interviewed ranged from PHP 20 -1,500 for local tourists and USD 2 – 40 for foreign tourists. The median entrance fee that tourists would be willing to pay is PhP 173 and USD 14 for local tourists and foreign tourists, respectively. This study found that diver tourists were willing to pay a positive amount to enter the Danajon reef park. This suggests that the establishment of an entrance fee to cover park maintenance and management costs is a feasible option.

Policy Implications

Current financing of reef management is insufficient considering the threats of land- and marine-based activities that cause irreversible damages to the reefs. In a recent study, results showed that visitors to marine managed areas were generally willing to pay more to enter the park than they were required to pay, meaning that there are opportunities for increasing management funds (Pendleton, et al., 2009).

Dive tourism is a rapidly growing economic sector and the Philippines has only one substantial international dive destination with Tubbataha Marine Park which is accessible only four months of the year due to rough seas. Danajon Bank

is accessible year round. With proper training, local residents could work as dive boatmen and provide services to park visitors.

Danajon reefs generate revenue from more than one economic activity- fishing, tourism, seaweed farming. Efforts must be exerted to maintain the diversity and productivity of Danajon reefs to sustain the benefits. The challenge is to ensure that benefits derived from Danajon reefs sources are optimized now and in the future.

Conclusion and Recommendations

This study shows that the Danajon reef ecosystem supports several economic activities which are crucial for the economic development of the local community as well as the improvement in the quality of life of the coastal community. The local policy-makers and decision makers should recognize that there are huge economic benefits derived from coastal resources.

Occupational-multiplicity is common for the fishermen located along the coastal areas adjacent to the Danajon reefs. The more marine-based occupations an individual or household is engaged in, the more dependent the individual or household is on the Danajon reefs. This further indicates that the marine resources of the region are very important to the community. Reducing stress on the marine resources will require recognition of other livelihood options. Finally, the local policy-makers and decision makers should recognize that there are huge economic benefits derived from marine resources. More importantly, the local policy-makers and decision-makers should not doubt that any economic activity which will adversely impact on reef habitats, mangroves, seagrass in particular and on the marine water quality in general, will have corresponding severe effects on the environment as well as on the socio-economic well-being of the community.

Unless unsustainable livelihood is mitigated or the Danajon reefs are managed (e.g., National marine park), the economic losses may continue to increase until such time that the coastal and marine resources will be unable to generate benefits to the community.

Climate Change Vulnerability Assessment

Introduction

The Philippines lies at the apex of the Coral Triangle which stresses the importance of protecting this marine key biodiversity area from the impacts of climate change. Human anthropogenic activities are increasing carbon dioxide and other greenhouse gases in the atmosphere. The global concentration of carbon dioxide (CO2) in the atmosphere today far exceeds the natural range over the last 650,000 years of 180 to 300 ppmv. According to the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emission Scenarios (SRES), by the end of the 21st century, carbon dioxide concentration is expected to rise from 490 to 1260 ppm (75-350% above the pre-industrial concentration). The increasing concentration of greenhouse gases is undoubtedly driving change in the physical and chemical characteristics of marine and coastal environments in the Coral Triangle (Hoegh-Guldberg et al. 2009), including the Philippines.

The Philippine coastal zone is considered as one of the most vulnerable areas from the impacts of climate change. Certain direct impacts have been identified such as rising sea level, warming oceans, reduction of seawater pH levels, increase in sea surface temperature leading to extensive coral bleaching, and increase frequency and intensity of storms causing widespread coral breakage. Further, its impacts on marine ecosystems can include elimination of coral dominated reefs, decimation of mangrove systems, and elimination of seagrass beds ((CTI Interim Regional Secretariat 2011).

According to the latest IPCC Reports, hydrographic surveys and modelling studies, among others, some of the climate change impacts globally are:

1. **Global mean sea level has been rising at an average rate of 1.7mm/year (+/- 0.5mm) over the past 100 years**. This is higher than the average rate of sea level rise over the last several thousand years. Depending on which greenhouse gas scenario is used (high or low) sea level rise in the next 100 years is projected to be anywhere from 0.18 (low greenhouse gas increase) to 0.59 meters for the highest greenhouse gas increase scenario. However, this increase is due mainly to thermal expansion and contributions from melting alpine glaciers, but does not take into account any potential contributions from melting ice sheets in Greenland or Antartica where larger increases are expected due to ice sheet dynamics. In the recent estimated of the global sea level rise in the next century (2100), sea level could rise up to 2.15m. For this climate change impact, coral reefs will be drastically affected because of reduction of light availability, especially for species that grow in deeper areas. With other impacts such as coral bleaching and ocean

acidification, this may also further the slow down the coral growth rates.

2. **Global surface temperature have increased about 0.74 ºC (+/- 0.18 ºC) since the late 19th century**. Warming has not been globally uniform though, with some areas getting cooler (e.g., southeastern U.S. and parts of North Atlantic) and some areas getting warmer (North America and Eurasia). But seven of the eight warmest years on record have occurred since 2001 and the 10 warmest years have all occurred since 1995.

3. **The pH of ocean surface waters has already decreased by about 0.1 units from an average of about 8.21 to 8.10 since the beginning of the industrial revolution**. The ocean's uptake of carbon dioxide has resulted to negative impacts on the chemistry and biology of the oceans. Based on IPCC CO2 scenarios and coupled ocean-atmosphere models, atmospheric carbon dioxide levels by the middle of this century could reach more than 500 ppm, and near the end of the century by over 800 ppm. This would decrease additional surface water pH by approximately 0.3 pH units by 2100.

4. **The number of regions reporting mass coral bleaching has increased substantially in recent years.** Using satellite data over the last 20 years, warming in most tropical areas is easily seen. Mass coral bleaching events occurred in 1997-1998 due to increase sea surface temperature associated with El Nino. Mass mortalities of corals occurred in many reef regions. This implies that should tropical seas like the Philippines' continue to warm, coral reef ecosystems are likely to undergo significant changes. These changes include losses to biodiversity and coral cover as well as economic losses to fisheries and tourism sectors. Increase in intensity and frequency of storms resulting to coral reef damage.

Faced with the many threats associated with global climate change, the challenge is to build capacity, not only to directly address these impacts, but to first determine the vulnerability of coastal ecosystems. Coastal managers are now tasked to assess vulnerability of the coastal environment through specific impacts of climate change in their localities.

Vulnerability assessment (VA) tools have been developed through the Resilience Seas Project supported by the Department of Science and Technology. The Integrated Coastal Sensitivity, Exposure, Adaptive Capacity for Climate Change (IC-SEA-CChange) assessment tools by Licuanan, et al. (2011) allow the conduct of vulnerability assessment in a cost-effective, user-friendly, and diagnostic manner. These tools help gather critical information on the sensitivity and level of exposure of an area to climate change impacts and its capacity to minimize these impacts. The tools have become a practical first step in identifying priority area and adopting site-specific climate change adaptation measures.

The Vulnerability Assessment Framework

The assessment of vulnerability focuses on gaining an understanding of how climate variability and change will impact coastal communities, the goods and services provided by coastal resources, and systems in place to cope with the impacts of climate change.

Exposure

Exposure quantifies the intensity or severity of the conditions (or the threat thereof) of the physical environment that drive changes in the state or condition of the bio-physical system. Exposure is quantified based on climate-driven factors in a given marine area. Data on sea surface temperature, incidence of storms, change in sea level, and rainfall trends over the year are used.

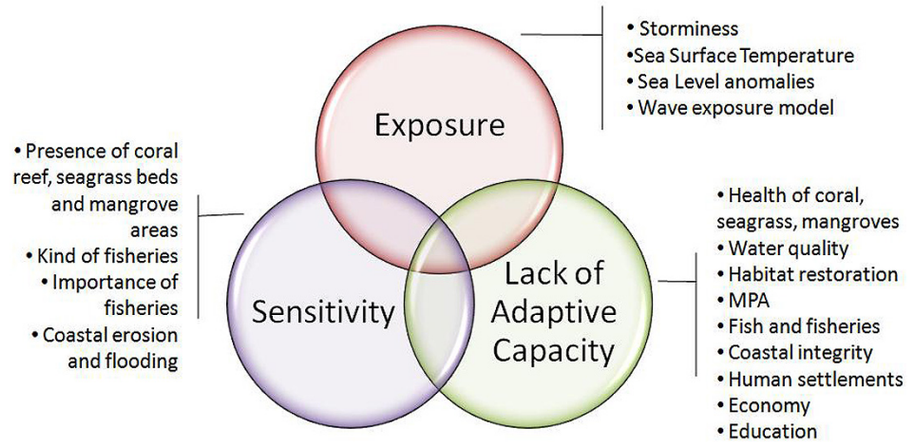


Figure 20. Vulnerability assessment framework for climate change of coastal areas.

Vulnerability assessment for climate change in specific coastal regions considers three factors: (1) the nature and magnitude of climate variability and change (exposure); (2) the human, capital, and natural assets that will be exposed to and impacted by climate change (sensitivity); and (3) the current capacity of coastal communities and ecosystems to adapt to and cope with climate impacts (adaptive capacity). Combined, these three factors define the vulnerability of people in a place to climate change (USAID 2009).

(1) **Storminess. A total of 29 tropical storms have been recorded since 1962 to 2012 that have hit 100 km around Danajon Bank.** Minimum atmospheric pressure range from 915 – 998 hPa with an average of 964 hPa. Although, storm

frequencies have remained steady through these years an indication that the intensity of these storms has increased based on minimum atmospheric pressures. Most tropical storms occur from November – January.

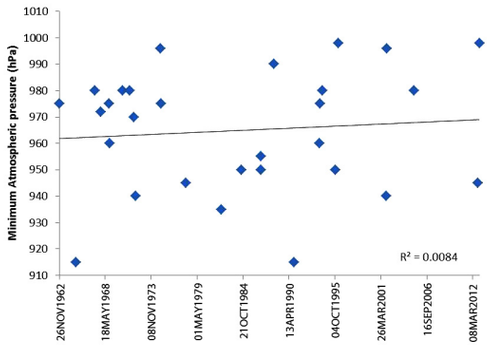


Figure 21. Minimum atmospheric pressure of the tropical storm around Danajon in last 50 years (1962 – 2012)

In the climate projection provided by PAGASA (2011), Regions 7 and 8 will show an increase in extreme events. Central Visayas will have increase of number of days with rainfall of more than 100mm from the current 5–15 days to 6–23 days by 2050. Moreover, Eastern Visayas, already with high rainfall, will have an increase in days of above 200mm from 1–15 days to 22–94 days by 2050. With increasing frequency of storms, shallow reef areas are often affected brought about by strong storm surges.

(2) **Sea surface temperature. SST records around the province have indicated an increasing trend.** An average SST from two points (i.e. western and eastern) are at 28.98˚C and 28.67˚C, respectively. This has been steadily increasing in both areas of the bank.

With increasing sea surface temperature over a longer period, coral bleaching may happen in shallow coral reef areas. In 1998, the coral bleaching event which occurred in the Philippines decreased live hard coral cover to 46%. Coral reefs that are more susceptible are those that are greatly influence by wave energy, tidal fluctuations and reef morphology (Arceo et al 2001). In Danajon Bank, there has been no reported extensive coral bleaching in that same year. However, it has been noted that the 1998 coral bleaching incidence had very minimal reporting especially in the Visayas region.

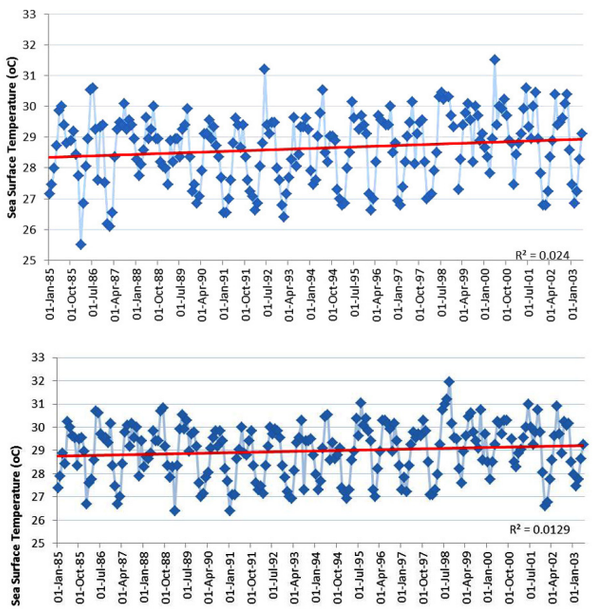


Figure 22. SST records from 1985 – 20003 within Danajon Bank; (above) western portion and (below) eastern portion.

(3) Sea level rise. An increase in sea level is one of the significant impacts of climate change, especially in coastal and island areas. The IPCC report in 2007 estimated an increase of up to 60 cm in sea level based on the current average. NOAA provided its recent estimate (2011) of an increase of up to 2 m by 2100.

An initial estimate is made in Danajon Bank projecting one to two meter increases in sea level. This initial estimate was made based on the Digital Elevation Model (DEM) derived from the Shuttle Radar Topography Mission (SRTM) provided by NASA. It should be noted that this initial estimate has several limitations and other critical information is necessary to get more accurate projections. Projected areas that will be affected were then compared to the demographic data to deduce the affected population in each municipality. The results show that the areas that will be affected are the island barangays and those bordering mangrove forests, estuaries and low-lying areas in the mainland.

For the vulnerability assessment, an exposure rating was provided by Resilient Sea Project for the entire country. The Regions of the country were clustered into 11 clusters based on sea surface temperature (extreme and perennial), precipitation, and sea surface height. Danajon Bank belongs to Cluster VIII, with its corresponding rating for SST (both extreme and perennial), precipitation (for extreme and long-term,) and sea surface height.

Table 9. Projected barangays and % of population that will be affected by the sea level rise in Danajon Bank.

Province/ City/ Municipality	Municipal Population (NSO 2010)	Annual growth rate 1990 - 2010 (NSO 2010)	# of possible affected barangay		% Population of affected brgy (NSO, 2010)
			Coastal	Island	
Bohol		**1.41**	**125**	**31**	
Bien Unido	25,796		7	7	94.9
Buenavista	27,031		16		46.5
Clarin	20,296		7		42.1
Inabanga	43,291		22	1	53.3
Getafe	27,788		11	9	89.1
Pres. C.P. G.	23,287		15	2	78.9
Talibon	61,373		11	8	81.3
Trinidad	28,828		9		50.8
Tubigon	44,902		13	3	63.0
Ubay	68,578		14	1	35.2
Cebu		**2.15**	**28**	**9**	
Cordova	50,353		10	1	77.0
Lapu-Lapu City	350,467		18	8	93.7
Leyte		**1.22**	**31**	**3**	
Bato	35,610		2	1	21.2
Hilongos	56,803		16		41.8
Hindang	20,179		7	1	61.0
Inopacan	19,904		2	1	28.0
Matalom	31,097		4		20.2
Southern Leyte		**1.08**	**7**		
Maasin	81,250		7		10.5
TOTAL	1,016,833		191	43	

Sensitivity

Sensitivity is the degree to which built, natural, or human systems, are directly or indirectly affected by changes in climate conditions or specific climate change impacts. If a system is likely to be affected as a result of projected climate change, it

should be considered sensitive to climate change.

Sensitivity was assessed based on three factors which include: coastal habitat, fish and fisheries, and coastal integrity. Coastal habitats consider the extent and coverage of the coral reef, seagrass beds, and mangrove forest of the province. Fisheries consider the type of fisheries (demersal and/or pelagic based) as well as the dependency of the fishing community to these fisheries. Coastal integrity evaluates the susceptibility of the coastline to coastal erosion. Using the Level 1 vulnerability assessment tools developed by the Reef Resilience Project, a set of key indicators were used to assess sensitivity of a certain localities. This indicator was tested in six island barangays to initially assess the level of vulnerability of the reef and island barangay in Danajon Bank. These barangays include: Hamboangan, Cuaming, Bilang-bilangan East, Hingotanan East, Cataban and Jao Island (Busalian area).

(A) **Coral reefs.** Coral reef area of the Danajon Bank can be categorized into three major regions i.e. outer reef, inner reef, and the fringing reef bordering the mainland provinces. In the recent survey conducted by Diaz et al in 2011, most of the outer reef of Danajon is in poor condition (0-25% Live Hard Coral cover). The broad-scale survey manta tow indicated that 75% of the reef is in poor condition with live coral cover within 0 – 25%. Surveys within these reefs showed a high percentage coral cover with over 60 genera of hard coral mostly dominated by massive, submassive, and encrusting colonies in the deeper areas; and tabulate and branching colonies in the shallow reef.

(B) **Seagrass**. In a survey conducted in Danajon Bank, seagrass cover averaged at 39.59% ± 12% (range 10.0-77.21%) with Buenavista showing the densest seagrass community (77.21% cover) followed by Tubigon (64.21%). Although diversity and extent of the seagrass beds are found in shallow coastal areas, there has been a continued degradation of seagrass due mostly to destructive fishing activities and sedimentation from major rivers. Seagrass community sensitivity, resiliency, and species diversity are greatly affected by the density of the community.

(C) **Mangroves**. Mangroves in Danajon Bank are among the most diverse coastal forests in the region. This is mainly distributed within the municpalities of Getafe, Tubigon, Talibon, Buenvista and Inabanga. Mangrove forests line up the coasts, river mouths, and island areas. Most of the mangroves within Danajon are relatively abundant with over 130 trees covering per 100m2 of mangrove forest. Banacon island is the densest mangrove forest in the whole bank. There is an abundance of monospecific species such as Rhizophora due to the mangrove reforestation efforts by many government, non-government and private sectors. However, a high diversity of mangrove species is exhibited. Mangrove forests are highly sensitive to the impact of sea level rise on the coastline. The type of mangrove (i.e. riverine, fringing, scrub or combination of both) determines

the gravity and how the ecosystem can recuperate (resettlement and recruitment) from impacts caused by coastal flooding.

(D) **Fisheries.** Municipal fishing is the primary source of livelihood by many communities of Danajon. Most fish within the reefs of Danajon Bank as their primary fishing grounds, while the areas surrounding it, such as the waters within Maasin, Camotes, Bohol, and Cordova, are their alternative fishing areas. Their fish catch includes demersal species, such as crabs, shrimps, squid, and fish including parrotfishes, siganids, snappers, and groupers. The most common fishing gears used are hook and line (pasol) used by 24.7% of the municipal fishers. Other common fishing gear are gill net (pukot), 9.6%; spear (pana), 4.4%; and fish trap (bobo)or panggal, 3.6%, and others such as palaran, pamu, basnig, ariba-ariba, sapyaw, kitang, and bungsod. These are predominantly active gears. 74.7% of municipal fishers have their own boats. Fishing is primarily for income generation and not just for subsistence.

(E) **Coastal integrity.** Coastal integrity refers to the susceptibility of the coastline to erosion. In Danajon Bank, the island coastline is highly susceptible to erosion brought about by strong storm surges. Most of the island community lives very close to the shoreline and most of inhabited islands are also densely populated where land area is limited. The width of the reef flat among these island also varies. In some islands the narrow reef flat are highly susceptible to shoreline erosion. Several anecdotal accounts among fishers and elder community members have reflected the significant changes in their coastline.

The Lack of Adaptive Capacity

Adaptive capacity refers to the ability of society (e.g. local government units) to plan for, and respond to, climate change to better equip them to manage their exposure and sensitivity to climate change. Adaptive capacity depends on economic well-being, ecological well-being, the extent of dependency on natural resources, infrastructure (human-built or natural), effectiveness of institutions and governance systems, insurance, secure land tenure and mediation measures, and information and communication systems. A community with the capacity to adapt is likely to be more resistant to impacts and will able to recover from stressful events and conditions. In assessing the adaptive capacity of each municipality, the VA tool used considered the health of the coastal ecosystem (coral reef, seagrass and mangrove forest), coastal integrity, efforts made by local government units (e.g MPA, habitat restoration), type of fisheries, human settlement, land use, and level of education.

Results in the assessment have indicated that most of the island barangays in Danajon Bank are at Medium Level in terms of sensitivity to the impacts of climate change. Although all of the assessed sites are at Medium Level, some of the island are still highly sensitive in terms of fisheries and coastal integrity, particularly in Hambongan and Cuaming Island.

Table 10. Results of Vulnerability Assessment of Danajon Bank

	Hambongan	Cuaming	Bilang Bilangan East	Hingotanan East	Cataban	Busalian (Jao Is.)
Municipality	Inabanga	Tubigon	Bien Unido	Bien Unido	Talibon	Talibon
Sensitivity Score	3.67	4.00	2.80	2.67	3.00	2.80
Sensitivity Level	Medium	Medium	Medium	Medium	Medium	Medium
Coastal Habitat (Ave)	3.17	3.33	3.83	3.83	2.83	3.17
Fisheries (Ave)	3.8	4.6	2.8	2.2	3	2.8
Coastal Integrity (Ave)	4.25	4.25	1.25	1.5	3.5	2.25
Lack of Adaptive Capacity Score	3.29	2.75	2.21	2.42	1.75	2.17
Lack of Adaptive Capacity Level	High	Medium	Medium	Medium	Low	Medium
Coastal Habitat (Ave)	3.14	2.71	2.43	2.79	1.57	1.64
Fisheries (Ave)	3.8	3	1.4	1.4	2	4
Coastal Integrity (Ave)	5	1	3	3	3	3
Human Activity (Ave)	3.25	2.5	2.5	2.5	2.25	2

Summary of Key Findings

The impact of climate change is among one of the most pressing and inevitable issues for coastal and reef ecosystem. Its foreseen impact includes sea level rise, increased storminess, and increased sea surface temperature. This similar effect is seen to affect Danajon Bank. With the two-meter increase in sea level by 2100, this can cause changes in coastal wetlands, flooding, coastal erosion, and saltwater intrusion into estuarine areas, mangroves, and wetlands. These effects will be seen in both coastal and island barangays in the towns making up Danajon Bank. The population from 10%-95% of each municipality will be affected by increasing sea levels. Indicative data has shown that there is increasing sea surface temperature in the Danajon area, which is similar to the country's average. However, there have been very few incidences of coral bleaching within Danajon Bank due to a lack of observation and reports made within the area. There has been no significant increase of the frequency of typhoons around the Danajon Bank area, however, indicative data suggest an increasing frequency of days with higher rain volume and increasing strength among typhoons that do pass through. Several reports on extensive coral reef damage have been recorded in the Bohol Sea, southern Cebu, Siquijor, and the northern portion of Mindanao due to the strong magnitude of recent typhoons, such as Typhoon Sendong and Typhoon Pablo. Damages have been shown to have destroyed up to 80% of the live coral cover in some areas, especially in the shallow (<20m) reef.

Recommendations

This initial vulnerability assessment of Danajon Bank of the possible impacts of climate change are based on available information about the reef and associated habitats, community activities, and current management intervention by local government managers. Generally, this information is scarce and broad. Detailed sites-based surveys should be conducted by each town. Although, this is an extensive effort, it may be best to initiate the effort in specific priority pilot sites. This can be done using the Integrated Coastal Sensitivity, Exposure, Adaptive Capacity for Climate Change (IC-SEA-Cchange) assessment tool by Licuanan, et al. (2011). Level 3 considers coastal integrity, fisheries, and biodiversity in a specific target area if the area is previously identified as having undergone the Level 1 vulnerability assessment. Level 3 assessments can aid in determining current management practices and implementing adaptive planning activities by the province, especially in areas that are identified as highly vulnerable.

Effort to address the impact of climate change has already been initiated within the Danajon Bank local government units. Several towns have already created their own local disaster risk reduction/management teams to respond to impending natural disasters. This group can be capacitated to understand possible climate change-related impacts as well as to set up adaptation measures. Each town should identify hazard areas and initiate adaptation programs.

The Danajon Double Barrier Reef Management Council (DDBRMC), as a coordinating council, has identified Disaster Risk and Climate Change as one of its focal programs. The council will identify specific activities towards addressing issues concerning climate change impacts. This may include: assistance to local disaster councils on capacity-building programs, reef rehabilitation activities, and extensive information drives within the coastal and island barangays about the impacts of climate change and how they can be involved in disaster mitigation and preparedness.

References

Amolo, RC. R.L Eisma-Osorio, and D. Apistar. 2012. Initial vulnerability assessment to impact of climate change of Danajon Double Barrier Reef, Central Visayas. Coastal Conservation and Education Foundation, Inc., Cebu City, Cebu, Philippines. 27pp.

Amper, Z.H.S. 2012. Socioeconomic Baseline Study for Danajon Bank Marine Park. Coastal Conservation and Education Foundation, Inc. , Cebu City, Cebu, Philippines.50pp.

Danajon Governance Framework. 2013. Coastal Conservation and Education Foundation, Inc., Cebu City, Cebu, Philippines. 39pp.

Diaz, R. 2012. Danajon Bank Profile – The Coastal Habitats and Resources. Coastal Conservation and Education Foundation, Inc., Cebu City, Cebu, Philippines. 38pp.

Kirit, R. 2012. Legal and Institutional Framework: Danajon Bank Project. Coastal Conservation and Education, Foundation, Inc. , Cebu city, Cebu, Philippines. 30pp.

Samonte-Tan, G. 2012. Economic Valuation: Danajon Reef, Philippines. Coastal Conservation and Education Foundation, Inc., Cebu City, Cebu, Philippines. 52pp.