FISH-BE MODEL

Fisheries Information for Sustainable Harvests Bio-Economic Model

LIBRARY OF MODELS

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FISH-BE Library of Models

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EcoGov2 is a collaborative effort resulting from the bilateral agreement between the United States government through USAID and the government of the Philippines through the Department of Environment and Natural Resources and the Department of the Interior and Local Government. EcoGov2 focuses on strengthening local government units or LGUs, so that they can carry out localized but strategic actions that aim to:

- Reduce overfishing and the use of destructive fishing practices;
- Reduce illegal logging and promote the conversion of natural forests; and
- Improve the management of solid wastes and wastewater.

EcoGov 2 provides technical assistance to some 130 strategically located LGUs to enable them to plan and implement locally financed environmental programs, while observing the principles of transparency, accountability and people's participation in all their decisions, transactions and actions.

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Acronyms and Abbreviations

ADB	Asian Development Bank
ASCOT	Aurora State College of Technology
FISH BE	Fisheries Information for Sustaining Harvest – Bioeconomic
CIDA	Canadian International Development Agency
CRM	Coastal Resource Management
ECOGOV2	Philippine Environmental Governance
FAD	fish aggregating devices
FEBM	Fisheries Ecosystem-Based Management
FGD	focus group discussion
FLET	Fisheries Law Enforcement Team
IBRA 9	Illana Bay Regional Alliance
ILCRMC	Inter-LGU Coastal Resource Management Committee
LCE	Local Chief Executive
MAO	Municipal Agricultures Office
MPA	Marine protected area
MTO	Municipal Treasurer's Office
UPMSI	University of the Philippines Marine Science Institute
USAID	United States Agency for International Development

Foreword

Getting a handle on the state of our environment and natural resources can be daunting. Finding the solutions to such dynamic systems seems complicated and motivating people to act can be an arduous task. The Philippine Environmental Governance (EcoGov2) project continues to look at innovative, strategic and sustainable approaches to assist local governments incorporate resource management within their overall agenda.

The Fisheries Information for Sustaining Harvest—Bioeconomic (FISH-BE) model is one of the tools that EcoGov2 has supported and developed to assist local government units. FISH-BE can help local governments understand the state of their fisheries and help people realize the importance of stewardship and the need for a shared responsibility in coastal resources management (CRM).

As a model, FISH-BE can be a powerful communication tool. It can be used to reiterate urgent call to action for more MPA and better fisheries management. FISH-BE can also present opportunities and benefits from sustained catch and incomes.

Aside from presenting options, the participatory coastal resources assessment tools that are incorporated in the data collection inputs of FISH-BE allows for the various stakeholders to engage with local governments and to demand for good CRM services in a timelier manner. FISH-BE can also foster accountability among decision makers and stakeholders and gives a good visual graphic information of underwater resources.

Some of the priority coastal resource management options for LGUs vis-à-vis fisheries management are fishing effort regulation and establishing marine protected areas (MPA) and sanctuaries. LGUs also need to consider the possible tradeoffs such as the implications to forgone revenues from fees and fishing income as these can be the consequences of decisions to allocate no-take areas.

Equity considerations as to who would benefit from such environmental governance decisions are clarified in the FISH-BE simulation scenarios model before actual fisheries collapse happens. FISH-BE gives users a glimpse of the synergy of actions in managing sustainable fisheries harvest.

The case studies in this FISH-BE Library of Models will show the varied roads that local communities can undertake. FISH-BE is a tool that can help develop and expand our understanding or our coastal and marine resources. If we put into practice the lessons learned in the management of coastal and marine resources, there will be considerable improvement in our fisheries.

Ernesto S. Guiang, PhD
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Introduction

Fisheries is a major source of income and livelihood among Filipinos. It contributes around 2.2% to the Philippine Gross Domestic Product. In 2003, municipal fisheries yield is estimated to be $741 million (World Bank, 2005). Fishing provides around 3% employment to the country's labor force with municipal fishing contributing 68% of the total employment, aquaculture 26% and commercial fishing 5% (Asian Development Bank, 2003).

Since most areas in the country are overfished, management of these critical resources is imperative. To deal with this issue, policies and mandates concerning coastal and marine resources management were included in the Local Government Code (RA 7160) and the Philippine Fisheries Code (RA 8850). Setting up of marine sanctuaries and marine protected areas (MPA) has also been one of the popular strategies in fisheries management.

FISH-BE was also introduced (Licuanan et al., 2006) to help decision makers understand the choices and decisions that will sustain fisheries utilization. FISH-BE can be used by fishery technicians and researchers to provide an approach to gather data (see Basic Fisheries Profile Information: Inputs for FISH-BE) and make a fisheries profile to systematically present and evaluate fisheries information and make an estimate of the fishing capacity of an area.

This FISH-BE Library of Models contains a synthesis paper entitled "Going Beyond FISH BE: Towards Understanding Ecosystem Scale and Simple Rules for Local Fisheries Management" and 14 case studies of municipalities. The synthesis provides the context of the various fisher density scenarios, their implications to MPA size, and the need for regulating fishing effort. The case studies on the other hand, provide the profile inputs of four bays or sea where EcoGov has provided technical assistance (i.e., Baler Bay, Illana Bay, Subugay Bay and Camotes Sea). The case studies also contain several scenarios to show the context of the range of options of fishers' populations, area access management regimes and their relation to overall fishing effort regulation. Instead of emphasizing the critical condition of the fishery of various municipalities, the synthesis and the case studies focused on the comparative lessons to be learned and the need for a shared responsibility in fisheries management.

The call for improving fisheries management is resounded in FISH-BE. It calls us to go beyond the setting up of marine protected areas (MPA) and move towards other innovative ways to achieve combined effects as a result of synergy of inputs and outcomes.

We hope that people will learn from FISH-BE so that there will be more improved versions, more situational lessons learned and more innovative and effective communications tools that will be developed. May FISH-BE/FISHDA be the start of our journey together to understand and use our fisheries resources wisely. We look forward for your participation in producing the next library of models and be part of the development of fisheries knowledge-based communities.

Going Beyond FISH-BE:

Towards Understanding Ecosystem Scale and Simple Rules for Local Fisheries Management

Wilfredo Roehl Y. Licuanan, Rollan C. Geronimo and Porfirio M. Aliño

Management of fisheries in the Philippines is as challenging as appreciating and understanding the diversity and complexity of the ecosystems that support it. Simplified approaches have highlighted the overfished state of its coastal habitats. Previous work has taught us that local waters are mostly, and often grossly, overfished (Tandog-Edralin, 1987) and that distinction needs to be made between demersal and pelagic stocks (Dalzell et al., 1987; Dalzell, 1996) when fishing assessments are made. Other work also highlighted the importance of considering the various coastal ecosystem interactions when managing fisheries (Camacho and Bagarinao, 1986; Pauly et al., 2000; Christensen and Pauly, 2004) and for the use of more holistic approaches to decision making (Bernascek,1996).

The FISH-BE approach (Licuanan et al., 2006 and Castillo et al.) is our initial attempt to provide decisionmakers with simple but powerful tools for decision-making. The choices available for decision makers can become an overly difficult process, hence, an ecosystem management approach (Browman and Stergiou, 2004) with its multifaceted information needs is imperative.

To improve the transparency process of coastal resources management (CRM), decision makers within their municipal waters have to have the tools to understand the choices available to them and those that can affect larger fisheries ecosystem such as bays. Other previous work has tried to compare the range of choices within municipality vis-à-vis adjacent municipalities and using mean field conditions among provinces with bays (e.g. Lingayen Gulf, SuPFA).

To better understand the fisheries ecosystem conditions, we studied the experiences of various LGUs in over a dozen municipalities in four EcoGov 2 bay area clusters, clarified decision options for improvement and found opportunities where LGUs can work together.

This synthesis of the "library of models" helps to provide the context of the range of parameter estimations vis-à-vis various governance and ecosystems. We continue to seek refinements to FISH-BE by applying this approach to a variety of conditions from individual towns, networks of towns and in embayments, and even the country as a whole. The application of the FISH-BE approach is continued here in over a dozen municipalities in four EcoGov 2 bay area clusters where many of the data protocols are compatible to FISH-BE have been piloted.

This paper is a first attempt to integrate the learnings from the FISH-BE models developed to (1) identify areas in which the FISH-BE program itself may be improved and even expanded, (2) provide a framework by which other FISH-BE models may be evaluated against and refined, and 3) outline "rules of thumb" for managers interpreting the model outputs and applying them to management. These "rules of thumb" for determining the sustainable levels of fishing effort and the capacity of ecosystem to support fishing can even be useful for those situations where data is insufficient for the FISH-BE model to be applied.

Materials and Methods

Simulation modeling often involves the use of abstract entities (e.g., a "typical" demersal fish, a "typical fisher") that most users of FISH-BE may be uncomfortable with. This level of abstraction of reality is necessary, but in order to make the modeling exercise useful, the numbers generated by models must be put back in the context of the real world (i.e., back to evaluating options for fisheries management).

The FISH-BE models of 15 towns were compiled in this Library. These include the 14 EcoGov assisted towns and the Tabina town from Zamboanga del Sur. Two versions of FISH-BE were used: one with fixed catch compositions provided as inputs by the user and the other with a variable catch composition represented by a function in the model based on the biomass of each stock at a given time. In the variable catch composition, fishers exploit both stocks at a rate determined by the biomass of each stock. If there are more demersal fishes compared to pelagics, it gets fished more and vice-versa. This creates a range of minimum MPA sizes for a given town instead of having knife-edge estimates.

Table 1 summarizes the data inputs used for each town. Since most towns have no or have minimal commercial fishing activities within its municipal waters, commercial fishers were excluded from model runs.

Table 1. FISH-BE inputs used for the 15 towns*

PARAMETERS	Busan Bay				Illana Bay			
	Tungawan	Naga	RT Lim	Payao	Dimataling	Pagadian	Dumalinao	Labangan
Total area of coastal waters (km^2)	380	125	57	666	40	50	76	26
Initial municipal stock (mt/km^2)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Initial commercial stock (mt/km^2)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Total municipal fishers	825	1,039	940	2,673	1,611	2,611	598	463
Municipal catch per fisher per day (kg/fisher/day)	4.4	3.4	5.0	3.5	2.7	3.9	3.0	2.5
Municipal fishing days/year	180	240	202	230	179	271	166	201
Municipal catch area (km^2)	177	90	70	180	40	50	76	26
Percent demersal in municipal catch	60%	60%	60%	60%	variable	variable	variable	variable

PARAMETERS	Baler		Camotes				ZDS
	San Luis	Dipaculao	Danao	Poro	San Francisco	Tudela	Tabina
Total area of coastal waters (km^2)	353	445	126	167	906	260	400
Initial municipal stock (mt/km^2)	1.0	1.0	1.0	1.0	1.0	1.0	1.3
Initial commercial stock (mt/km^2)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Total municipal fishers	560	690	2,576	951	1,883	2,193	1,350
Municipal catch per fisher per day (kg/fisher/day)	5.0	5.0	2.3	2.1	3.3	2.4	5.8
Municipal fishing days/year	180	180	345	288	363	287	200
Municipal catch area (km^2)	129	113	69	135	256	77	240
Percent demersal in municipal catch	variable	variable	40%	40%	10%	30%	0.27

FISH-BE models for each town were ran to determine:

- The maximum number of fishers which can be accommodated by the system without causing both demersal and pelagic stocks to collapse
- The minimum total MPA size to avert the collapse of both demersal and pelagic stocks
- Minimum MPA sizes to avert collapse of both demersal and pelagic fish stocks at current fishing pressures were plotted against standardized indicators of fishing effort to generate "rules of thumb" for minimum MPA size requirements.

Results and Discussion

The relationship between fisher density (i.e., number of fishers per square kilometer) and the minimum MPA size needed to support fisheries, both over the short term (fixed catch composition) and long term (variable catch composition) is shown below.

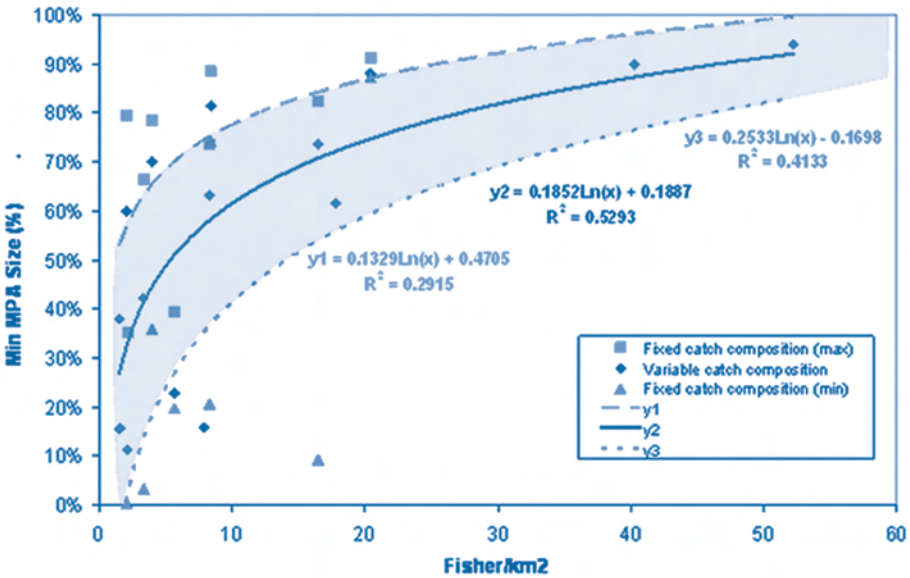

Figure 1 . Relationship between fisher density and MPA size*

* Range of MPA sizes (shaded area) in percentage of total municipal waters versus fisher density for the 15 towns using variable and fixed catch composition versions of FISH-BE (n=15 for Variable catch composition and n=9 for Fixed catch composition).

Figure 1 shows that MPA requirements increase logarithmically with increase in fisher density. It also shows that variability in MPA requirement is high (+/- 25% from the variable catch composition results) when fisher density is low. This may be related to greater variety of gears and associated efficiencies when fish stocks are still abundant, the nature of the stocks (pelagic vs. demersal), and characteristics of the fisheries habitats available to particular communities. This suggests that towns with comparable status of stocks may differ greatly in management needs depending on the gears used and the nature of their stocks and fishing grounds.

Figure 1 suggests that the 15% prescribed in the Fisheries Code (Republic Act 8550) is a good first approximation of the minimum MPA size a community will need, but this requirement increases rapidly beyond one fisher per square kilometer of waters. Most communities are having a hard time achieving this minimum requirement. This indicates the need for alternative fishery management options (i.e., reduction of fishing effort (e.g., diverting some fishers from fishing to value-added processing of fishery products), seasonal restrictions and area closures (i.e., when fish migrate and reproduce and mariculture). The degree of area closures for maricultures has to be considered carefully given its impact on social equity, since in most cases mariculture benefits only a few individuals and corporations. Perhaps an index of equity should be built into the economic portion of FISH-BE.

Other improvements to the model could include map based geographic information system (GIS) complement inputs but this will require more sophisticated hardware and software additions. The different models summarized in this volume demonstrate the flexibility of FISH-BE and its variants (FISHDA being the first) in that they not only integrate information into a logical sets of choices, but that they suggest the possible consequent costs and benefits of resulting decisions, and the urgency of certain choices.

Intuitive logic and the use of proxy information to target strategic action is useful (10-15% to be allocated for MPA in the fisheries code) as an initial decision option. Due to limited capacities of LGUs to undertake protection measures, fisheries management require a diverse, complementary intervention that is sustainable.

In many municipalities, area-based seasonal restrictions that are legislated through unified fisheries ordinances and color-coding of boats are tacit directions that may lead to access controls and territorial use rights fisheries at the municipal level. This the effect of mariculture concession areas with its social equity concerns, where large areas of municipal waters are allocated to a few individuals or corporations.

These is also a need to provide better bases for estimating other default values in FISH-BE runs such as carrying capacities, turnover rates, and migration between communities. These are often dependent on scale (i.e., whether the model is applied at the level of a barangay or a network of towns), the mix of habitats (coral reef or soft bottom habitats), the species that are involved in the fisheries, and the degree of connectedness among the component areas that make up a composite model.

The FISH-BE model is just like any model and decision support tool—each new lesson learned presents new challenges. Adaptive management gives us a new perspective of FISH-BE. We can look at the context of Fisheries Ecosystem-Based Management (FEBM) and monitor their effectiveness: (1) either in improved biomass as reflected in the change in initial standing stock of the population with a change in fishing effort regime in the area of operation; or, (2) in their total effort at each management ecosystem scale, e.g., coral reef or soft bottom habitats, village or barangays or aggregated into municipalities and provinces within bays. While the scale is primarily of quantitative concern, the qualitative attributes of the habitats and the species within their areas affect the turnover, resilience and degree of connectedness among its component parts. These will help motivate further informed decisions and move people into more purposeful actions in a concerted way.

Summary and Recommendations

- This compilation makes us learn and understand that informed decisions starts with the participation of stakeholders utilizing simple, good data acquisition tools. An analytical framework such as FISH BE/FISHDA is useful so that information is comparable and integrated into a holistic perspective;

- The extensions of the MSY rules of thumb of fisher population and fishing area regimes have been extended and refined using more recent ground validated information. The tools can be used to improve monitoring and adapt management options with new management scenarios;

- Improving the adaptive nature, choices and action scenarios would require improving the quantitative and qualitative understanding of the inputs and output procedures of decision support parameters: behavior of fishers and their fishing effort and fishing area of operation;

- The links to their management implications and the effects of these interventions on the biophysical and management regimes could enhance parameterization and data acquisition taken at the appropriate the context of its scale, its dynamics and boundaries of the components of the fisheries ecosystem; and

- FISH-BE variants will need to be more network oriented (i.e., explicitly account for multiple management jurisdictions working together), showing the benefits of synergistic effects of coordinated management actions and their ecological significance to the resiliency and vulnerabilities of coastal fisheries ecosystems.

FISH-BE Simulation Scenarios

Aurora Province

Paul Watts, Teddy Torio, Eusebio Angara, Jagger Enaje, Raymar Tercero, Pedcris Orencio

A. Data Generation and Processing

A series of fish profiling activities were conducted in the municipalities of Baler, Dipaculao and San Luis in Aurora Province using focus group discussions (FGD) to update the information on the state of their fishery. Through the efforts of the local government and assistance from Aurora State College of Technology (ASCOT), Inter-LGU Coastal Resource Management Committee (ILCRMC) and the Philippine Environmental Governance 2 (EcoGov2) project, a fish profile that consists of information on catch and effort, graphical representation of the areas for gear operations as well as establishing seasonal usages were produced.

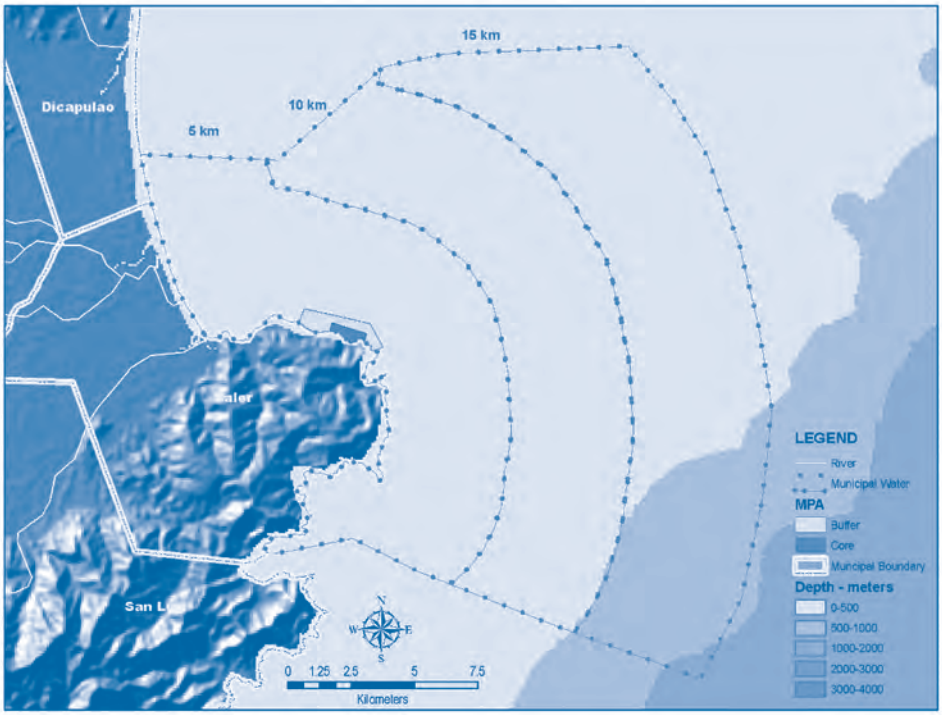

Figure 2. Municipal waters of Baler

In order to generate such information, the group conducted FGDs with fisherfolk groups, barangay captains, and resource managers. Further information was collected from the local government especially with the Municipal Agricultures Office (MAO), Municipal Treasurer's Office (MTO) and Licensing Offices on the registry of the fishers and boats and other pertinent information related to fishery. This information was processed to come up with a municipal catch matrix. Tables 2 and 3 are the catch matrices of San Luis and Dipaculao, based on the collected information.

Table 2. San Luis catch matrix

Gear	Total No. of Units	Total No. of Fishers	Estimated Catch/ Day	Estimated Fishing Days	Estimated Annual Catch	% Contribution	Kg/Gear/Day
Kaskas	117.0	117.0	2.3	124.5	287.9	2.0	0.9
Pataw	574.0	56.0	6.0	112.5	675	4.8	0.8
Kitang	1875.0	9.0	5.0	51.3	256.7	1.8	0.4
De-pain	12.0	12.0	6.0	105.0	630	4.4	0.7
Hilada	246.0	157.0	7.8	62.2	482.4	3.4	0.4
Lambat	25.0	25.0	5.0	239.5	1197.5	8.4	1.7
Pana	61.0	61.0	2.9	77.0	221.4	1.5	0.5
Dala	6.0	6.0	3.2	85.5	277.9	1.9	0.6
Biwas	289.0	73.0	3.1	177.0	547.6	3.8	1.2
Pamburaw	8.0	8.0	15.0	60.0	900.0	6.3	0.4
Palutang	167.0	17.0	3.0	186.0	558.0	4.0	1.3
Pansaray	750.0	82.0	2.0	108.0	216.0	1.5	0.8
Pamusit	176.0	50.0	2.2	98.0	220.5	1.5	0.7
Og-og	73.0	73.0	2.0	70.0	140.0	1.0	0.5
Longline	16.0	16.0	270.0	28.0	7,560.0	53.2	0.2
Tungkab	73.0	77.0	1.0	28.0	28.0	0.2	0.2
Total			336.5		14,148.9		11.3
Fishing Day/ Year= 100.8 Actual Number of Fishers= 232							

Table 3. Dipaculao catch matrix

Gear	Total No. of Units	Total No. of Fishers	Estimated Catch/ Day	Estimated Fishing Days	Estimated Annual Catch	% Contribution	Kg/Gear/Day
Kawil	240.0	240.0	7.7	160.0	1,240.0	27.3	3.5
Hilada	200.0	170.0	6.7	70.0	472.5	10.4	1.5
Kitang	245.0	200.0	4.3	132.0	572.0	12.7	2.9
Lambat	100.0	210.0	2.2	146.7	326.1	7.2	3.2
Pamusit	50.0	50.0	2.0	90.0	180.0	4.0	2.0
Pangbalaw	20.0	60.0	2.3	30.0	69.9	1.5	0.7
Salap	60.0	145.0	437.5	135.0			
Pamburaw	80.0	140.0	5.0	90.0	450.0	9.9	2.0
Pukot	40.0	80.0	1.5	180.0	276.9	6.1	4.0
Bubo	60.0	60.0	2.5	120.0	300.0	6.6	2.6
Largarete	210.0	200.0	5.8	111.0	647.5	14.3	2.4
Total			477.8		4,534.9		24.8
Fishing Day/ Year= 100.8 Actual Number of Fishers= 232							

Table 4. Outputs

Expected outputs	Description	Dipaculao	San Luis
1. Maximum number of municipal fishers supported without MPA	(in fishers/km^2 of coastal waters)	810; with allowance for 98 fishers more or 1.69 fishers/ km^2	113 (roughly 50% of fishers) or 0.186 fisher/km^2
2. Total annual catch for #1 above	(in metric tons/km^2 of coastal waters)	1.24 mt/ km^2	0.201 mt/ km^2
3. Minimum MPA size to avert collapse of fishery	(in percent)	no collapse even without MPA	no collapse even without MPA
4. Minimum price of fish (at #3 above) so all municipal fishers earn P100/day	(in pesos; use same price for demersal and pelagics)	All can be supported with an allowance for other 82 fishers	P68.50/ kilo for both municipal and commercial
5. Which fish stocks collapse first if there is no MPA?	Pelagic or demersal?	Pelagic, only after year 3; Demersal after year 7; and fishers increased to 850	Demersal; only after 9 years and fishers increased to 3,300

B. Management Consideration

The FISH-BE model requires a series of inputs to provide local validation. Many of these parameters can be estimated from other sources. However, the use of default data parameters from other locations limits the application of the model. The use of these default parameters needs to be examined one by one to ensure confidence in any conclusion that will result from model iterations. There is also the validation of the applicability of the model to specific sites, given accurate site-specific data.

After careful examination of the significance of using non-local data parameters, the following questions are considered:

San Luis

- Should we work/experiment further with the model to consider the priority level for the development of further MPAs, in terms of improving either the biophysical or economic environment?

Dipaculao

- Should we work/experiment further with the model to consider the priority level of preventing further growth in the number of fishers in the community?

C. Considerations for further Modeling and Development

The FISH-BE model has a high level of application, especially if it is viewed as a platform for discussion of coastal resurce management (CRM) and fisheries decisions. The model provides an opportunity to run

scenarios based on management decisions and create science-based predictions of the results. It can also give the user an opportunity to examine priority areas for research and maximize the decision-making value of research through prioritizing topic selection. The model is perhaps best used when the user understands the dynamics of the program, assumptions, and configuration of specific subroutines. Someone who does not have these skills, at least in part as a developmental tool for considering decision-making approaches, can also use it.

Applying the model to management needs is in itself an iterative process. The model is not infallible and results are expected to lead to further model development. The monitoring and evaluation associated with the development of the model through the application to specific sites were emphasized by the authors as a goal and a potential for FISH-BE. This level of application can be best supported by further development of the interactive abilities and information provided through FISH-BE.

To improve the model, an individual page that can be accessed through a right or left click function, for every line of input/output can be created. Currently, since there are no units associated with the input variables, this could be at the top of each support page to link specific inputs and outputs with the specific sections of the flow diagrams on page 2 of FISH-BE. This change can assist users to consider and develop subprograms for specific application sites. Additional information can include default parameters, background on the data sets and sites (i.e., Tabina) that are the basis for the default parameters and even references to specific topics to allow the user the opportunity to focus on the development of their fisheries understanding and management skills. It might be of value, for example to have all users understand the possible variance associated with the values that have been provided for them (Tabina) to move forward in the analysis of their specific area topography and fisheries management. The program use current stocks as a baseline and does not allow for input on the possibilities for ecosystem repair, if for example, a stock is already depleted. Further, the necessary assumption of zero emigration and immigration will only allow a limited focus for significant broader ecosystem issues.

The continuity of fish stocks and the relationship between the specific municipal/provincial, even international fishery is not intended as a current application function of the FISH-BE model. The final product could be linked to other models such as (generalized or site specific) energetics-based Ecopath and Ecosim (Pauly, et al.) to provide decisions makers with a connection to the larger marine ecosystems; a level of approach that may be significant in the long-term management of both the marine environment and related livelihoods. These developments may appear difficult, but the approach can be used to build a focused learning. It can also be a development tool that is linked up to the level of large marine ecosystems, focusing on tools that deal with specific decisions at the municipal level. Such an enhanced tool or virtual classroom applied on a national level could form as the basis for the development of larger ecosystem forums that include multiple jurisdictions.

The benefit of FISH-BE is that it allows simple input iterations of management scenarios. The significant added value of the approach is that it is also applicable to a broader (larger marine ecosystem) manager-based development platform for science application, while still maintaining a clear connection to municipal management decisions.

Camotes Sea

Wilfredo Campos

Camotes Sea is bordered by Cebu on the west, Leyte on the east, Bohol in the south and the Visayan Sea to the north. Its entire coastline extends to about 476 kilometers (km). It is considered a moderately fished fishing ground, with close to 32,000 fishers, corresponding to a fisher density of about 66 fishers per km coastline. The estimated annual catch amounts to 27,882 metric tons, with commercial ring net operations contributing about 11.6% of this total catch. Gill nets and hook and line are the dominant gear types, jointly contributing about 65% of the total catch. In terms of fishing trips, gillnets, hook and line, and gleaning contributed about 85% of total fishing effort. On average, municipal fishers showed a daily mean catch rate of 2.6 kg/fisher (204 days fishing) while commercial catch rates were about 7.9 kgs/fisher (304 days fishing).

Total Cebu coastline for Camotes Sea (incl islands)	250.5
Raised Leyte coastline on Camotes	225.6
Total coastline of Camotes Sea (all sides)	476.1
Descriptors of the Fisheries	
Est TOT ann C (mt)	27,881.9
Est mun ann C	24,643.0
Est fishing trips/yr	6,781,483.0
Est mun fishing trips	6,777,403.0
Est no fishers from med of CRMP category	31,837.0
Est no mun fishers	31,637.0
Proj gear units for proj # fishers	22,341.0
Mun gear units	22,321.0
Est mun kg/trip	3.6
Est comm kg/trip	793.9
Est mun days fishing	303.6
Est comm days/fishing	204
Est mun kg/fisher	2.6
Est comm kg/fisher	7.9

A. Management Issues

The commercial fleets of mostly ring netters operating in Camotes Sea are based not only in Cebu, Bohol and Leyte, but also in other regions. Because of the narrow shelf area within most of Camotes Sea, encroachment has been rampant. The large capacity and high technology employed by the commercial fleet has "displaced" small-scale fishers even in municipal waters. This has led to an increased used of fine meshed nets (fry nets, push nets and beach seines) which inadvertently catch a disproportionate amount of juveniles, leading to recruitment and ecosystem overfishing.

The major management needs in Camotes Sea include the following:

- Defining limits for commercial operations that are based within municipalities/provinces bordering Camotes Sea and those from other provinces/regions. This will encourage self-regulation/ management of local commercial operations.

- Curbing the use of fine-meshed nets to reduce pressure on juveniles of local stocks. Use of gear types targeting small fish (anchovies) or fry can be restricted to specific seasons.

- Inventorying, licensing and standardizing of gear types (and dimensions) to keep "technology creep" (steady improvement in design and efficiency of gear) in place. This is one way of regulating effort.

- Rehabilitating coastlines with abandoned fishponds (mangrove reforesting).
- Improving implementation of protective measures in established MPAs (capitalize on extensive eco-tourism in the area).
- Design of large MPAs to include key habitats that will allow completion of life cycles of pelagic resources in the area.

A major management challenge of Camotes Sea, as in many other basins or fishing grounds in the country, is to harmonize and coordinate management efforts of municipalities, provinces and different administrative regions bordering it.

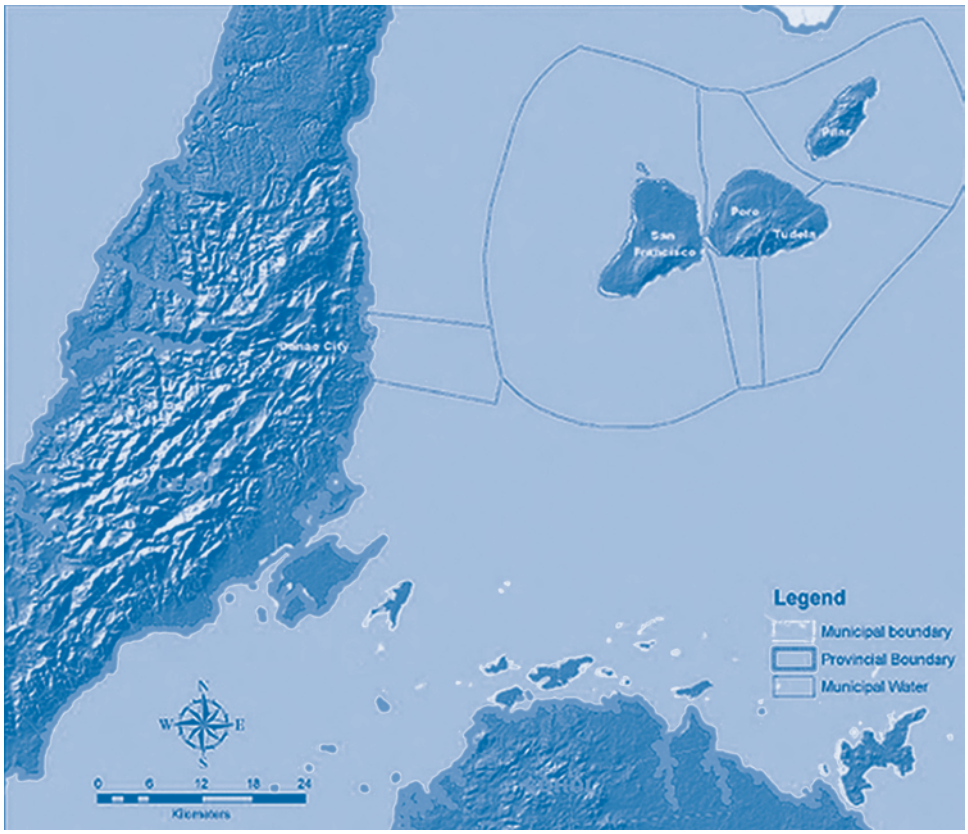

Figure 3. Camotes Sea

Danao City, Cebu

Hazel Arceo and Antonio Balang

Danao City is situated within the geographic frame of 100 28' 33" to 100 35' 42" north latitude and 1230 50' 24" to 1240 02' 14" east longitude. It is located at the northeastern tip of Cebu province and approximately 33 road km from Cebu City, the provincial capital. It is roughly 8.2 km from Carmen, 97 road km from Asturias via Lugo route, 7.8 road km from Campostela and 27 nautical miles from Camotes Island. The total land area is approximately 14,253 hectares or roughly 142.53 km^2 distributed throughout its 42 urban and rural barangays. It was established as a city on June 7, 1961 by Republic Act (RA) No. 3028 that was passed largely through the efforts of the late congressman Ramon Durano Sr. who was then representing Cebu's First Congressional District.

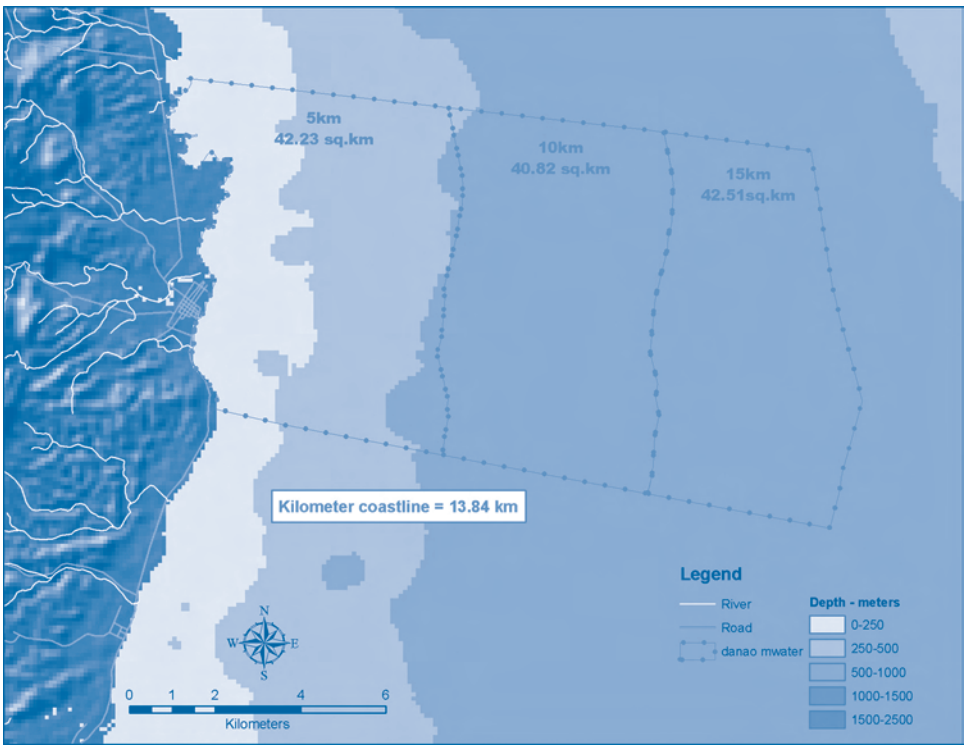

Figure 4. Municipal waters of Danao City

Fisheries Profile

The city of Danao is comprised of 42 barangays, where 8 are coastal barangays, namely: Dungoan, Guinsay, Taytay, Suba, Poblacion, Looc, Sabang and Maslog. Its coastline stretches approximately 13.8 km and its municipal waters cover an estimated area of 12,567 hectares (125.67 km^2). There is an estimated 1,600 small-scale fishers in Danao City and 1,104 have registered as of January 2006. There are about 80 motorized and undetermined numbers of nonmotorized boats. There are also 11 dominant fishing gears and activities in Danao City. Almost half of the fishers are using the most common fishing practice—gleaning. The miracle hole, locally known as *gango*, is the least common gear being used. Fifteen commercials fishing boats are also presently based in Danao City and most of them are using purse seine.

At present, the marine sanctuary of Danao City is being legitimized by the Sangguniang Panglungsod. The proposed marine sanctuary covering about 39.7 hectares is located at the boundary of Barangay Taytay and Guinsay. The LGU and the community want to protect the area because the coral reefs have been damaged because of dynamite fishing in the late 1990s.

A. Method

Table 5. Catch matrix of Danao City

Fishing Gear	Total No. Gear Units	No. of Fishers	Fishing days/ year	Fishing months/ year	Fishing Days/ month	Catch Rate (kg/ trip)	Est. trips/ year	Est. Annual catch (mt)
Baling	37.0	194.3	88.8	5.0	17.8	8.3	4,925.6	40.6
Bubo	13.0	19.5	360.0	12.0	30.0	3.0	46,800.0	140.4
Bungsod	13.0	32.5	144.0	12.0	12.0	2.5	262.1	0.7
Gango	4.0	16.0	180.0	12.0	15.0	5.0	720.0	3.6
Gleaning	599.0	599.0	294.0	12.0	24.5	1.4	17,610.6	237.7
Pasol	530.0	609.5	318.0	12.0	26.5	4.7	202,248.0	950.6
Pokot	312.0	780.0	289.1	12.0	24.1	5.4	106,595.7	571.7
Sapang/ pana	79.0	102.7	300.0	12.0	25.0	2.2	23,700.0	52.1
Sarap	7.0	10.5	120.0	6.0	20.0	1.0	840.0	0.8
Sikpaw	28.0	28.0	330.0	12.0	27.5	1.5	9,240.0	13.9
Sudsod	92.0	184.0	222.8	11.1	20	1.7	20,497.6	35.1
AVERAGE			240.6	10.7	22.0	3.3		
TOTAL	1,714.0	2,576.0					433,439.6	2,047.2

Summary of Table 4

	Total
Total catch (mt)	2,047.3
Total fishers	2,576.0
Total trips	591,935
Total gear units	1,714.0
Estimated # of days/fishing/year*	345.3
Estimated kg/trip**	3.5
Estimated kg/fisher/trip***	2.3

NOTE:

* Estimated number of days/fishing/year is computed by dividing the total trips by total gear units.
** Estimated kg/trip is computed by multiplying total catch (mt) with 1000 and dividing the product by the total trips.
*** Estimated kg/fisher/trip is computed using the product of the total catch (mt) multiplied by 1000 divided by total fishers and divided by the estimated no of days/fishing/year.

Table 6. Data inputs to the FISH BE model

A. FGD Results	Value
1. Estimated annual catch, mt (a)	2,047.3
2. Total fisher (b)	2,576.0
3. Total estimated trip/year (c)	591,935.0
4. Total fishing units (d)	1,714.0
5. Municipal fishing days/year (e)	345.4
6. Average fishing month/year (f)	10.7
7. Average fishing days/month (g)	22.0
8. Estimated kg/day = [a*1000/c]	3.5
9. Municipal catch per day (est. kg/fisher/day) (h)	2.3
10. Market price, in pesos (municipal)	62.8
11. Market price, in pesos (commercial)	60
B. Physical Parameters	
1. Municipal catch area (km^2)	125.7
2. Total area of coastal waters (km^2)	125.7
3. Commercial catch area (km^2)	1.0
4. Commercial catch per day (kg/fisher/day)	1.0
5. Commercial fishing days per year	1.0
C. Other Constant Parameters	
1. Municipal fish turnover rate	1.5
2. Commercial fish turnover rate	2.0
3. Initial municipal stock	1.0
4. Initial commercial stock	2.0
5. Commercial fish carrying capacity	3.0
6. Municipal fish carrying capacity	10.0
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp req/mun fisher)	100.0
9. Fisher's income.... (min sales req/comm. fisher)	20,000.0
10. Fees and charges	0
11. MPA cost and revenue (cost reduction)	0
12. MPA cost and revenue (reg., rentals, charges)	0, 0, 0
13. Cost centers (4 parameters)	All values 1 except multiple fishery
14. Annual operating cost	All values 1 except multiple fishery
15. Benefits and cost variables	Equation On

The FISH-BE model requirements were the total number of gear units, the number of fishers, the average fishing days per year, average fishing days per month, average catch per kilogram per trip, estimated trips per year and estimated annual catch. Table 6 shows the data entered in the FISH-BE model. After running the model, results showed that the fishery in Danao City will eventually collapse at the current number of fishers and without any marine protected area (MPA).

B. FISH-BE Exercise Result

Table 7. Data outputs from the model for different scenarios

Parameters	Scenario 1	2	3	4
1. % increase size of MPA	0.0	1.0	1.0	43.0
2. Nearest distance of commercial fisher (km)	15.0	15.0	15.0	15.0
3. % decrease of commercial fisher	0.0	0.0	0.0	0.0
4. % decrease of municipal fisher	81.0	0.0	0.0	0.0
5. Number of fisher's supported	679.0	3.0	2,593.0	1,115
6. Municipal catch (mt)	388.8	1.4	1.4	418.0
7. Municipal catch per day (kg/fisher/day)	2.3	2.3	2.3	2.3
8. Municipal catch area (km^2)	125.7	125.7	125.7	125.7
9. Municipal fishing days per year	345.3	345.4	345.3	345.3
10. Number of municipal fisher/km^2	3.9	20.5	20.5	8.8
11. Total catch (mt/km^2)	3.1	0.0	0.0	3.3
12. Price of fish per kilo municipal catch	P62.80	P62.80	P65,000.00	P96.00
13. Price of fish per kilo commercial catch	P60.00	P60.00	P65,000.00	P96.00

NOTE:

- Municipal catch is taken from the table in the FISH-BE model
- The number of municipal fishers/km^2 is computed by dividing the number of active municipal fishers by the municipal catch area (km^2)
- Total catch (mt/km^2) is computed by dividing the municipal catch (mt) by the Municipal catch area (km^2)

C. Discussion

Scenario 1

In scenario 1, there has to be a reduction of 81% from the total number of fishers to avert the collapse of the fishery in Danao City. However, this reduction can only support 679 fishers, or 5.4 fishers per km^2.

If the number of active fishers is used, this scenario can only support 3.89 fishers per km^2. This scenario shows that the reduction of the fishers can sustain the fishery resource but not all of the remaining fishers can be supported.

Scenario 2

In scenario 2, the minimum MPA size to avert collapse in the fishery is 1%. However, although this option prevents the fishery from collapse, only 3 fishers can be sustainably supported. Hence, establishing 1% of the municipal waters as MPA is not enough to rehabilitate or respond to the possible collapse of the fishery.

Scenario 3

Scenario 3 combines the establishment of a 1% MPA with an increase in the price of fish. The model shows that the price needs to be increased to P65,000/kg for the fishery to be able to support 2,593 municipal fisherfolks or all of the existing fishers. This scenario shows that the fishery of Danao City can be sustained but to increase the price of fish to that amount is not realistic.

Scenario 4

Another management option is to increase the size of the MPA to 50% of the municipal waters so that the price of fish can be decreased. The scenario showed that 2,622 fishers, or all fishers, can be supported if the price of fish will be pegged at P225/kg.

Between scenario 3 and scenario 4, the latter appears to be a better option. It considers the economic capability of the people to buy fish and a large portion of the marine ecosystem will be placed under protection. However, it will be very difficult to convince the LGU to place 50% of municipal waters under protection or closed to fishing.

D. Lessons Learned and Management Insights

The FISH-BE model can help LGU legislators make informed decisions for the welfare of the general public, particularly the fisherfolks. The model can be used to simulate various types of scenario that will put the fishery resource into a symmetrical condition, thereby lessening the trial and error response which usually puts the resource in a critical situation. The model can also provide realistic forecasts and options to maximize the finite fishery resources while considering economic and environmental benefits.

The four scenarios tested for Danao City used the data gathered from the results of the fishery registration and focus group discussions with selected fisherfolk. The scenarios are just some of the many possible options to sustain the fishery resources given the current rate of exploitation.

As shown in Scenario 1, the fishery resource will be sustained but could only support 679 fisherfolks if fishers are reduced by 81%. Scenario 1 considers only resource conservation but not the economic well-being of fisherfolk. Scenarios 2 and 3, on the other hand, showed that the establishment of a 1% MPA is not enough to sustain the economic needs of the fishing community and the need for conservation of the fishery resources of the city. Scenario 4 is not the best option either, but in this case, we can see the importance of the presence of a marine protected area in conserving the limited fishery resources to respond to the economic problems of fisherfolk.

The FISH-BE model will not give the best possible option to the user if the data entered are not properly reviewed or are inaccurate. Hence, the LGUs first step is to adopt a system for data collection and re-examine and validate the fishery profile data to ensure the accuracy to come up with conservative estimates. LGUs should review, field test and undergo training on the operation of the model to understand its limitations and to avoid big margins of error on the results of the simulation. It is also important to remember that the model only provides scenarios that can be used to effectively communicate with the LGU so they can make pro-active decisions on coastal resources management.

Poro, Cebu

Hazel Arceo

The municipality of Poro is located in Poro Island of the Camotes Group of islands. It is bounded by the Camotes Sea on the north and south, by the municipality of Tudela on the east, and by the municipality of San Francisco on the west. It has a total land area of 6,388 hectares.

The coastline is approximately 27 km long and the municipal waters cover an area of about 167 km^2. The island is situated approximately 565 km. southeast of Manila, 62 km northeast of Cebu City, and 54 km west of Leyte.

Poro is a fourth class municipality with 10 coastal and 7 upland barangays. It has a total population of 21,397 (as of 2000).

Poro is currently implementing its 10-year Coastal Resource Management (CRM) plan. The LGU is conducting fisheries registration and catch monitoring of selected fishing gears. There are about 565 registered fishers as of August 2006. The major issues in fisheries and coastal resource management include the continued use of destructive fishing practices such as poison and blast fishing, compressor fishing, encroachment of commercial fishers into the municipal waters, and encroachment into the marine sanctuaries.

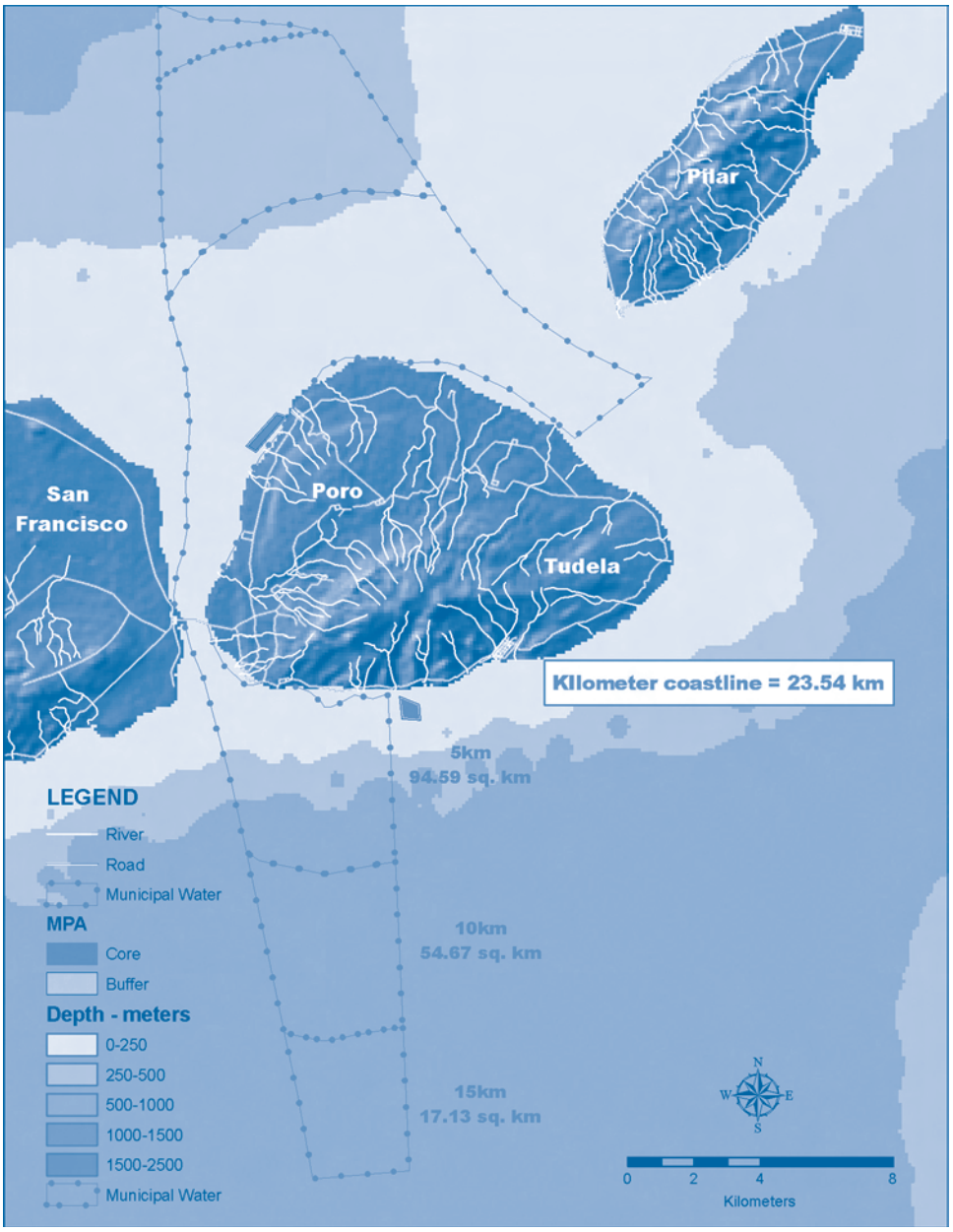

Figure 5. Municipal waters of Poro

There are two existing marine sanctuaries in the municipality—Esperanza Marine Sanctuary and Libertad Marine Sanctuary—which were established through municipal ordinances in 2004 and 2005, respectively, and with corresponding legitimized 5-year management plans. The marine sanctuaries cover a total area of about 75 hectares and are being managed by local management bodies with support from the municipal LGU. Trainings were conducted on participatory reef monitoring methods to enhance enforcement mechanisms.

A. METHODS

Table 8. Catch matrix of Poro

Fishing Gear	Total No. Gear Units	No. of Fishers	Fishing Days/ Year	Fishing Months/ Year	Fishing Days/ Month	Catch Rate (kg/trip)	Est. Trips/ Year	Est. Annual Catch (mt)
Bubo	56.0	75.0	180.0	12.0	15.0	2.0	10,080.0	20.2
Gleaning	263.0	263.0	237.3	12.0	19.8	1.5	62,419.0	93.6
Pasol	154.0	154.0	350.0	12.0	29.2	4.8	53,900.0	224.5
Pokot	204.0	459.0	334.5	12.0	27.9	3.5	68,238.0	243.1
AVERAGE			275.5	12.0	23.0	3.0		
TOTAL	677.0	951.0					194,637.0	581.4

Summary of Table 8

	Total
Total Catch (mt)	581.4
Total Fishers	951.0
Total Trips	194,637.0
Total Gear Units	677.0
Estimated no. of days/fishing/year*	275.5
Estimated kg/trip**	3.0
Estimated kg/fisher/trip***	2.1

NOTE:

* Estimated no. of days/fishing/year is computed by dividing the total trips by total gear units.
** Estimated kg/trip is computed by multiplying total catch (mt) with 1000 and dividing the product by the total trips.
*** Estimated kg/fisher/trip is computed using the product of the total catch (mt) multiplied by 1000 divided by total fishers and divided by the estimated no. of days/fishing/year.

Table 9. Data inputs to the FISH BE model

A. FGD results	Value
1. Estimated annual catch, mt (a)	581.4
2. Total fisher (b)	951.0
3. Total estimated trip/year (c)	194,637.0
4. Total fishing units (d)	677.0
5. Municipal fishing days/year (e) =[(c)/(d)]	287.5
6. Average fishing month/year (f)	12.0
7. Average fishing days/month (g)	22.9
8. Estimated kg/trip	2.9
9. Municipal catch per day (kg/fisher/trip) (h)	2.1
10. Market price, in pesos (municipal)	64.4
11. Market price, in pesos (commercial)	58.4
B. Physical Parameters	
1. Municipal catch area (km^2)	166.7
2. Total area of coastal waters (km^2)	166.7
3. Commercial catch area (km^2)	1.0
4. Commercial catch per day (kg/fisher/day)	1.0
5. Commercial fishing days per year	1.0
C. Other constant parameters	
1. Municipal fish turnover rate	1.5
2. Commercial fish turnover rate	2.0
3. Initial municipal stock	1.0
4. Initial commercial stock	2.0
5. Commercial fish carrying capacity	3.0
6. Municipal fish carrying capacity	10
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp req/mun fisher)	100
9. Fisher's income.... (min sales req/comm. Fisher)	20,000
10. Fees and charges	0
11. MPA cost and revenue (cost reduction)	0
12. MPA cost and revenue (reg., rentals, charges)	0, 0, 0
13. Cost centers (4 parameters)	All values 0 except for multiple fishery, trade and navigation and recreation and tourism
14. Annual operating cost	All values 0 except for multiple fishery, trade and navigation and recreation and tourism
15. Benefits and cost variables	Equation On

B. FISH-BE Exercise Result

Table 9 shows the data entered to the FISH-BE model. The data showed that the fishery in Poro will eventually collapse at the current number of fishers and without any marine protected area (MPA).

Table 10. Data outputs from the model for different scenarios

	Scenario			
Parameters	1	2	3	4
1. % increase size of MPA	0.0	1.0	9.0	5.0
2. Nearest distance of commercial fisher (km)	15.0	15.0	15.0	15.0
3. % decrease of commercial fisher	0.0	0.0	0.0	0.0
4. % decrease of municipal fisher	10.0	0.0	0.0	4.0
5. Number of fishers supported	938.0	10.0	957.0	959.0
6. Municipal catch (mt)	524.1	5.4	530.0	531.1
7. Municipal catch per day (kg/fisher/day)	2.1	2.1	2.1	2.1
8. Municipal catch area (km^2)	166.7	166.7	166.7	166.7
9. Municipal fishing days per year	287.5	287.5	287.5	287.5
10. Number of municipal fisher/km^2	5.1	5.7	5.7	5.5
11. Total catch (mt/km^2)	3.1	0.0	3.9	3.2

NOTE:

- Parameters in italics are given values.
- Number of fishers supported was obtained from the outputs of the FISH-BE model in the cost and benefits to municipal fishers.
- Municipal catch is taken from the table in the FISH-BE model.
- Number of municipal fishers/km^2 is computed by dividing the number of active municipal fishers by the municipal catch area (km^2).
- Total catch (mt/km^2) is computed by dividing the municipal catch (mt) by the municipal catch area (km^2).

Table 11. Other results from the FISH-BE model

Expected Output	Units	Result
Q1. Max. no. of municipal fishers supported w/o MPA	(in fishers/km^2 of coastal waters)	5.63 at 10% reduction
Q2. Total annual catch for #1 above	(in metric tons/km^2 of coastal waters)	3.14
Q3. Minimum MPA size at present number of fishers to avert fishery collapse	(in percent)	1
Q4. Minimum fishers price of fish at Minimum MPA size to avert fish collapse	(in pesos)	P6,300.00
Q5. Which fish stocks (demersal or pelagic) collapse first?	Pelagic or demersal?	Both collapsed at the same time but pelagics showed a decline first

C. Results and Discussion

Baseline Scenario: Using the data gathered from focus group discussions, if there is no MPA and the number of municipal fishers is not decreased, both the pelagic and demersal fish stocks collapsed. However, pelagic stocks declined earlier than the demersal stocks.

Scenario 1

If the number of municipal fishers is reduced, a 10% reduction is needed so that the municipal and commercial stock will not collapse. The number of municipal fishers that will be supported from this scenario is 5.6 fishers/km^{2,} using the value of the municipal fishers supported by the total fishery income which is 938. If the value used is the active municipal fishers which is 856, the municipal fishers that will be supported in this scenario is 5.14 fishers/km^2. The total catch is 3.14 metric tons per km^2.

Scenario 2

The minimum MPA size to avert fishery collapse is 1%. However, the number of fishers that can be supported is only 10. To support all of the municipal fishers, the price of fish needs to be increased to P6,300/kg.

Scenario 3

To avert fishery collapse, increase the size of the MPA by 9% while pegging the price of fish at P65 for both municipal and commercial fish. The number of fishers that can be supported in this scenario is 957 which mean that all of the existing fishers in Poro can be supported. The municipal catch is 529.96 metric tons.

Scenario 4

Another option to avert fishers collapse is to increase the MPA size by 5% and reduce the number of fishers by 4%. The price of fish is pegged at P65/kg. This option can support about 959 fishers, or all of the existing fishers of Poro. The total catch is 3.94 metric tons per km^2.

D. Lessons Learned and Management Insights

Initially, the FISH-BE model seems difficult to use because of the technical terms and data requirements. However, FISH-BE become easier to use as the user gets more practice and becomes more familiar with the functions. It was also hard to prepare/summarize existing fisheries data to obtain the data inputs for the model. It is critical for the user's manual to be exhaustive in its explanations of the operations, data inputs and data outputs of the model while at the same time remain simple and understandable to any user who may have different technical backgrounds.

The scenarios that can be generated from the FISH-BE model can help communicate the possible outcomes of current fishery activities or practices in an area, municipality or bay, to decisionmakers and the community in general. The scenarios can influence people to establish fishery management programs or to sustainably implement and strengthen current Fishery Resources Management (FRM) programs.

The FISH-BE model provides some suggestions to common dilemmas that many LGUs are facing. These include several basic questions in fishery management such as allowing commercial fishers into the municipal waters up to the allowed distance or not, establishing a marine protected area or not, and determining the optimum MPA size to achieve the greatest common good. The model is very useful for visualizing these questions and for exploring possible mixes of fishery management strategies.

San Francisco, Cebu

Vincent Lumbab and Hazel Arceo

The municipality of San Francisco is the whole of Pacijan Island of the Camotes Group of islands situated on the northeastern portion of mainland Cebu. It is located at geographical coordinates between 124° 14' 4" to 124° 30' 37" longitude and 10° 26' 15" to 10° 32' 48" latitude. The municipality is bounded on the north, south and west by the shark-infested Camotes Sea and in the east by the Island of Poro. San Francisco is a fourth-class municipality and is composed of 12 coastal barangays.

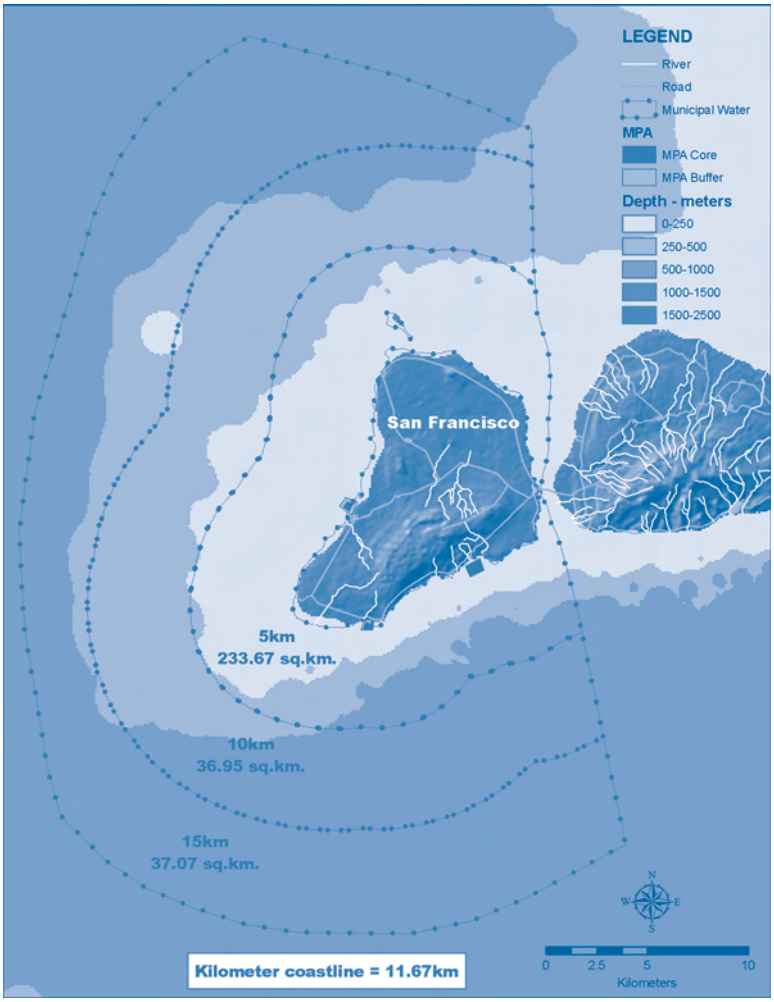

Figure 6. Municipal waters of San Francisco

San Francisco has a total land area of 10,596 hectares and a total coastline of 51 km. Its municipal waters cover an area of about 906 km^2. The results from biophysical assessment of reef attributes show that reef fish biomass is estimated to be about 3.4 mt/km^2.

San Francisco is currently implementing its 10-year fisheries management plan. There are ongoing coastal law enforcement activities being conducted by the San Francisco Camotes coastal law enforcement team. The LGU is also conducting fisheries registration, have recently enacted an ordinance for the registration of fishing vessels 3 gross tons or less, and is in the process of legitimizing their ordinance for the management of specific gears and marine organisms. As of June 2006, there are 944 registered fishers. The major issues in fishery and coastal resource management include the continued use of destructive fishing practices such as poison and blast fishing, compressor fishing, encroachment of commercial fishers into the municipal waters, and sand extraction.

There is one existing marine sanctuary in the municipality which is situated in Barangay Consuelo. It was established by the barangay in 2000 but was only legitimized through a municipal ordinance in 2004. The marine sanctuary has a 5-year management plan and covers an area of about 32.8 hectares. The LGU has expanded its coastal conservation and rehabilitation by adding three new marine sanctuaries in Barangays San Isidro, Santiago and Esperanza.

A. Method

Table 12. Catch matrix of San Francisco, Cebu

Fishing Gear	Total No. Gear Units	No. of Fishers	Fishing Days/ Year	Fishing Months/ Year	Fishing Days/ month	Catch Rate (kg/trip)	Est. Trips/ Year	Est. Annual Catch (mt)
Baling	3.0	13.5	90.0	6.0	15.0	8.0	270.0	2.2
Bubo	109.0	272.5	200.0	12.0	16.7	7.3	21,800.0	159.9
Gleaning	213.0	213.0	360.0	12.0	30.0	1.4	76,680.0	107.4
Pasol	465.0	465.0	360.0	12.0	30.0	5.4	184,140.0	985.2
Pukot	275.0	715.0	354.0	12.0	29.5	6.4	107,085.0	685.3
Sapang/ Pana	188.0	188.0	346.7	12.0	28.9	4.7	65,173.3	307.8
Sudsod	8.0	16.0	300.0	12.0	25.0	1.2	2400.0	3.0
AVERAGE			287.2	11.1	25.0	4.9		
TOTAL	1,261	1,883.0					457,548.3	2,250.8

Summary of Table 12

	Total
Total Catch (mt)	2,250.8
Total Fishers	1,883.0
Total Trips	457,548.3
Total Gear Units	1,261.0
Estimated no. of days/fishing/year*	287.2
Estimated kg/trip**	4.9
Estimated kg/fisher/trip***	3.3

NOTE:

* Estimated no. of days/fishing/year is computed by dividing the total trips by total gear units.
** Estimated kg/trip is computed by multiplying total catch (mt) with 1,000 and dividing the product by the total trips.
*** Estimated kg/fisher/trip is computed using the product of the total catch (mt) multiplied by 1,000 divided by total fishers and divided by the estimated no. of days/fishing/year.

Table 13. Data inputs to the FISH BE model

A. FGD results	Value
1. Estimated annual catch, mt (a)	2,250.8
2. Total fisher (b)	1,883.0
3. Total estimated trip/year (c)	457,548.3
4. Total fishing units (d)	1,261.0
5. Municipal fishing days/year (e) =[(c)/(d)]	362.8
6. Average fishing month/year (f)	11.1
7. Average fishing days/month (g)	25.8
8. Estimated kg/trip	4.9
9. Municipal catch per day (kg/fisher/trip) (h)	3.3
10. Market price, in pesos (municipal)	64.4
11. Market price, in pesos (commercial)	58.4
B. Physical Parameters	
1. Municipal catch area (km^2)	906.3
2. Total area of coastal waters (km^2)	906.3
3. Commercial catch area (km^2)	1.0
4. Commercial catch per day (kg/fisher/day)	1.0
5. Commercial fishing days per year	1.0
C. Other constant parameters	
1. Municipal fish turnover rate	1.5
2. Commercial fish turnover rate	2.0
3. Initial municipal stock	1.3
4. Initial commercial stock	2.0
5. Commercial fish carrying capacity	3.0
6. Municipal fish carrying capacity	10.0
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp req/mun fisher)	100.0
9. Fisher's income.... (min sales req/comm. Fisher)	20,000.0
10. Fees and charges	0.0
11. MPA cost and revenue (cost reduction)	0.1
12. MPA cost and revenue (reg., rentals, charges)	0, 0, 0
13. Cost centers (4 parameters)	All values 1
14. Annual operating cost	All values 0
15. Benefits and cost variables	Equation On

B. FISH-BE Exercise Result

Table 14. Data outputs from the Model for different scenarios

Parameters	Scenario 1	2	3	4
1. % increase size of MPA	0.0	1.0	21.0	10.0
2. Nearest distance of commercial fisher (km)	15.0	15.0	15.0	15.0
3. % decrease of commercial fisher	0.0	0.0	0.0	0.0
4. % decrease of municipal fisher	25.0	0.0	0.0	15.0
5. Number of fishers supported	5,082.0	19.0	1,961.0	5,232.0
6. Municipal catch (mt)	2,840.6	10.9	613.8	2,897.4
7. Municipal catch per day (kg/fisher/day)	3.3	3.3	3.3	3.29
8. Municipal catch area (km^2)	906.3	906.3	906.3	906.3
9. Municipal fishing days per year	362.3	362.3	362.3	362.3
10. Number of municipal fisher/km^2	1.6	2.1	2.1	1.8
11. Total catch (mt/km^2)	3.1	0.01	0.7	3.2

NOTE:

- The given values include the municipal catch per day (kg/fisher/day), municipal catch area (km^2), and municipal fishing days per year.
- Number of fishers supported was obtained from the outputs of the FISH-BE model in the cost and benefits to municipal fishers.
- Municipal catch is taken from the table in the FISH-BE model.
- The number of municipal fishers/km^2 is computed by dividing the number of active municipal fishers by the municipal catch area (km^2).
- Total catch (mt/km^2) is computed by dividing the municipal catch (mt) by the municipal catch area (km^2).

Table 15. Other results from the FISH BE model

Expected Output	Units	Result
Q1. Max. no. of municipal fishers supported w/o MPA	(in fishers/km^2 of coastal waters)	5.6 at 25% reduction
Q2. Total annual catch for #1 above	(in metric tons/km^2 of coastal waters)	3.13
Q3. Minimum MPA size at present number of fishers to avert fishery collapse	(in percent)	1
Q4. Minimum fishers price of fish at Minimum MPA size to avert fish collapse	(in pesos)	6,600
Q5. Which fish stocks (demersal or pelagic) collapse first?	Pelagic or demersal?	Both collapsed at the same time but pelagics showed a decline first

C. Discussions

Baseline Scenario: All of the relevant data from the FGD were entered into the FISH-BE model. If there is no MPA and the number of municipal fishers is not decreased, both the pelagic and demersal fish stocks collapsed. It was also observed that the pelagic stocks declined ahead of the demersal stocks. Below are the results of the FISH-BE model using the baseline scenario.

Figure 7. FISH-BE model results using the baseline scenario

Scenario 1

If the number of municipal fishers is reduced, a 25% reduction is needed so that the municipal and commercial stocks will not collapse. The number of municipal fishers that will be supported from this scenario is 5.61 fishers/km^2, using the value of the municipal fishers supported by the total fishery income which is 5,082. But when the value used is the active municipal fishers, which is 1,412, the municipal fishers that will be supported in this scenario is 1.56 fishers/km^2. The total catch is 3.13 metric tons per km^2.

Scenario 2

The minimum MPA size to avert collapse in the fishery is 1%. However, the number of fishers that can be supported is only 19. To support all of the municipal fishers, the price of fish needs to be increased to P6,600 per kilo.

Scenario 3

One option to avert fishery collapse is to increase the size of the MPA by 21% while pegging the price of fish at P115 for both municipal and commercial fish. By doing this, the number of fishers that can be supported is 1,961 which means that all of the existing fishers in San Francisco can be supported. The municipal catch is 613.8 metric tons.

Scenario 4

Another option to avert the collapse of fishers is to increase MPA size but only by 10% while also reducing the number of fishers by 15%. The price of fish may be maintained at P65.00 per kilo. This option can support a larger number of fishers at 5,232.

D. Lessons Learned and Management Insights

One of the difficulties in operating the FISH-BE model is finding out the correct data to be entered into the model. Initially, the data and the formula to be used to come up with the right value to input were not clear. In one of the FGDs conducted at the community during the FISH-BE Partner's Consultation, participants emphasized and clarified the data to be collected and what type of gears should be used and what particular fish data are needed.

The scenarios are relevant in determining the following: the size of the MPA, number of fishers that will be supported by the fishery given its current status, e.g., municipal catch and the price of fish. Another important thing that the model can display is whether the fishery stock would collapse or not. The scenarios are helpful in providing some insights on the size of the MPAs that the LGUs may need to establish in order to avert the continuing decline of fishery stocks or the need to explore other fishery management options if having MPAs is not sufficient.

Tudela, Cebu

Hazel Arceo

The municipality of Tudela is located in Poro Island of the Camotes Group of Islands. It is bounded by Cawit Strait on the north, by the Camotes Sea on the south and east, and by the municipality of Poro on the west. Tudela is a fifth class municipality, with a total land area of 3,241 hectares. The coastline is 15.378 km long, and the municipal waters cover an area of about 260.03 square kilometers.

The municipality of Tudela has 7 coastal barangays and 4 mountain barangays. It has a total population of 10,401 (as of 2000) and 2,346 households.

Tudela is currently implementing its 10-year coastal resource management (CRM) plan. The LGU is conducting fishery registration and catch monitoring of selected fishing gears. There are about 900 registered fishers as of August 2006. The major issues in fishery and coastal resource management include the continued use of destructive fishing practices such as poison and blast fishing, compressor fishing, encroachment of commercial fishers into the municipal waters, and encroachment into marine sanctuaries.

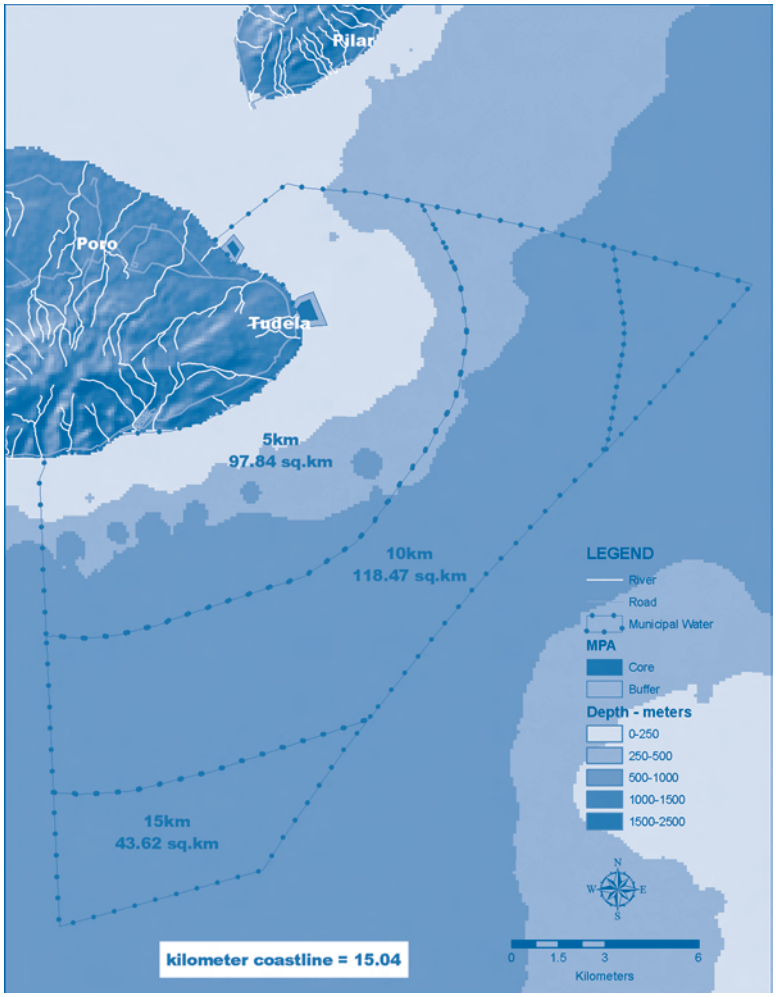

Figure 8. Municipal waters of Tudela

There are two existing marine sanctuaries in the municipality— Villahermosa Marine Sanctuary and Puertobello Marine Sanctuary. These sanctuaries were established through municipal ordinances in 2004, with corresponding legitimized 5-year management plans. The marine sanctuaries cover a total area of about 108.4 hectares and are being managed by local management bodies with support from the municipal LGU. They are currently conducting 24-hour guarding and have been trained on participatory reef monitoring methods.

A. Methods

Table 16. Catch matrix of Tudela, Cebu

Fishing Gear	Total No. Gear Units	No. of Fishers	Fishing Days/ Year	Fishing Months/ Year	Fishing Days/ month	Catch Rate (kg/trip)	Est. Trips/ Year	Est. Annual Catch (mt)
Baling	4.0	16.0	180.0	12.0	15.0	3.0	720.0	2.7
Bubo	62.0	62.0	180.0	12.0	15.0	4.5	11,160.0	50.2
Gleaning	532.0	532.0	256.4	12.0	21.4	1.7	136,385.0	229.4
Pasol	497.0	564.8	294.5	12.0	24.5	4.4	159,697.0	711.4
Pokot	441.0	926.1	294.0	12.0	24.5	3.4	129,654.0	447.3
Sapang/ Pana	92.0	92.0	317.1	12.0	26.4	2.1	29,177.0	62.5
AVERAGE			253.7	12.0	21.1	3.2		
TOTAL	1,628.0	2,192.9					466,793.0	1,503.5

Summary of Table 16

	Total
Total Catch (mt)	2,250.8
Total Fishers	1,883.0
Total Trips	457,548.3
Total Gear Units	1,261.0
Estimated no. of days/fishing/year*	287.2
Estimated kg/trip**	4.9
Estimated kg/fisher/trip***	3.3

NOTE:

* Estimated no. of days/fishing/year is computed by dividing the total trips by total gear units.
** Estimated kg/trip is computed by multiplying total catch (mt) with 1,000 and dividing the product by the total trips.
*** Estimated kg/fisher/trip is computed using the product of the total catch (mt) multiplied by 1,000 divided by total fishers and divided by the estimated no. of days/fishing/year.

Table 17. Data inputs to the FISH BE model

A. FGD results	Value
1. Estimated annual catch, mt (a)	1,503.5
2. Total fisher (b)	2,192.9
3. Total estimated trip/year (c)	466,793.0
4. Total fishing units (d)	1,628.0
5. Municipal fishing days/year (e) =[(c)/(d)]	286.7
6. Average fishing month/year (f)	12.0
7. Average fishing days/month (g)	21.1
8. Estimated kg/trip	3.2
9. Municipal catch per day (kg/fisher/trip) (h)	2.4
10. Market price, in pesos (municipal)	64.4
11. Market price, in pesos (commercial)	58.4

B. Physical Parameters	
1. Municipal catch area (km^2)	260.0
2. Total area of coastal waters (km^2)	260.0
3. Commercial catch area (km^2)	1.0
4. Commercial catch per day (kg/fisher/day)	1.0
5. Commercial fishing days per year	1.0
C. Other constant parameters	
1. Municipal fish turnover rate	1.5
2. Commercial fish turnover rate	2.0
3. Initial municipal stock	1.0
4. Initial commercial stock	2.0
5. Commercial fish carrying capacity	3.0
6. Municipal fish carrying capacity	10.0
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp req/mun fisher)	100.0
9. Fisher's income.... (min sales req/comm. Fisher)	20,000.0
10. Fees and charges	0.0
11. MPA cost and revenue (cost reduction)	0.0
12. MPA cost and revenue (reg., rentals, charges)	0, 0, 0
13. Cost centers (4 parameters)	All values 0 except for multiple fishery and trade and navigation
14. Annual operating cost	All values 0 except for multiple fishery and trade and navigation
15. Benefits and cost variables	Equation On

B. FISH BE Exercise Result

After running the model using the data on table 17, the results showed that the fishery in Tudela will eventually collapse at the current number of fishers and without any marine protected area.

Table 18. Data outputs from the model for different scenarios

	Scenario			
Parameters	1	2	3	4
1. % increase size of MPA	0.0	1.0	50.0	25.0
2. Nearest distance of commercial fisher (km)	15.0	15.0	15.0	15.0
3. % decrease of commercial fisher	0.0	0.0	0.0	0.0
4. % decrease of municipal fisher	46.0	0.0	0.0	25.0
5. Number of fishers supported	1,452.0	15.0	2,212.0	2,231.0
6. Municipal catch (mt)	811.5	8.5	7,51.4	845.3
7. Municipal catch per day (kg/fisher/day)	2.4	2.4	2.4	2.4
8. Municipal catch area (km^2)	260.0	260.0	260.0	260.0
9. Municipal fishing days per year	286.7	286.7	286.7	286.7
10. Number of municipal fisher/km^2	4.5	8.4	8.4	6.3
11. Total catch (mt/km^2)	3.1	0.0	2.9	3.2

NOTE:

- Parameters in italics are given values.
- Number of fishers supported was obtained from the outputs of the FISH-BE model in the cost and benefits to municipal fishers.
- Municipal catch is taken from the table in the FISH-BE model
- Number of municipal fishers/km^2 is computed by dividing the number of active municipal fishers by the municipal catch area (km^2).
- Total catch (mt/km^2) is computed by dividing the municipal catch (mt) by the municipal catch area (km^2).

Table 19. Other results from the FISH-BE model

Expected Output	Units	Result
Q1. Max. no. of municipal fishers supported w/o MPA	(in fishers/km^2 of coastal waters)	5.6 at 46% reduction
Q2. Total annual catch for #1 above	(in metric tons/km^2 of coastal waters)	3.12
Q3. Minimum MPA size at present number of fishers to avert fishery collapse	(in percent)	1.0
Q4. Minimum fishers price of fish at Minimum MPA size to avert fish collapse	(in pesos)	P9,300
Q5. Which fish stocks (demersal or pelagic) collapse first?	Pelagic or demersal?	Both collapsed at the same time but pelagics first showed a decline

C. Results and Discussions

Baseline Scenario: Using the data gathered from FGDs, without any MPA and no decrease in the number of municipal fishers, both the pelagic and demersal fish stocks collapsed. The pelagic stocks declined before the demersal stocks.

Scenario 1

If the number of municipal fishers were reduced, a 46% reduction is needed so that the municipal and commercial stock will not collapse. The number of municipal fishers that will be supported from this scenario is 5.6 fishers/km^2, using the value of the municipal fishers supported by the total fishery income which is 1,452. If the value used is the active municipal fishers which is 1,184, the municipal fishers that will be supported in this scenario is 4.55 fishers/km^2. The total catch is 3.12 metric tons per km^2.

Scenario 2

The minimum MPA size to avert fishery collapse is 1%. However, the number of fishers that can be supported is only 15. To support all of the municipal fishers, the price of fish needs to be increased to P9,300/kg.

Scenario 3

One option to avert fishery collapse is to increase the size of the MPA by 50% while pegging the price of fish at P106 for both municipal and commercial fish. With this option, the number of fishers that can be supported is 2,212 which mean that all of the existing fishers in Tudela can be supported. The municipal catch is 751.4 metric tons. However, this scenario is unrealistic because it would be very difficult to close 50% of the municipal waters for protection.

Scenario 4

Another option to avert the collapse of fishers is to increase the size of the MPA by 25% and reducing the number of fishers by 25%. The price of fish is pegged at P95/kg. This option can support about 2,231 fishers (i.e., all of the existing fishers of Tudela).

Subugay Bay

Wilfredo Campos

Subugay Bay's coastline extends to about 168 km. It is bordered by the Zamboanga Peninsula on the west and Illana Bay on the east. With about 6,800 fishers, the bay may be considered a moderately fished fishing ground, with a fisher density of about 40.2 fishers per km coastline. While this is only about 80% the fisher density in adjacent Illana Bay, the latter is much wider, yielding a larger area (km^2). Subugay Bay, on the other hand, is a rather narrow embayment, with nearly overlapping water boundaries of municipalities on opposite sides of the bay. Hence, actual fishing pressure (fishers/km^2) is likely high within the bay.

Coastline data	
Est. total coastline (km)	168.0
Fisher density (fishers/km coastline)	40.2
CATCH & EFFORT summary	
Est. annual C (mt/y)	7,066.5
Pelagic	3,526.0
Demersal	3,540.5
Est. no. gear units	4,263.0
Est. no. of fishers (mostly mun)	6,755.0
Est. no. fishing trips/y	924,030.0
Ave. no. fishing days/y	216.8
Mean Daily Catch rate (kg/trip)	7.6
Mean Daily Catch rate (kg/f/d)	4.8

The estimated annual catch amounts to about 7,066 metric tons with limited commercial operations contributing only about 3% of this total catch. The use of various types of hook and line gear (excluding longlines) make up over 42% of total fishing trips but only contribute around 19% of the total catch. The major contributors to total catch include stationary lift nets, purse seines, gill nets, and bottom set long lines, which jointly contribute 51% of the total catch. On average, municipal fishers showed a daily mean catch rate of 4.8 kg/fisher with an average of 217 days of fishing in a year.

A. Management Issues

The commercial fisheries operating within the bay include trawls and large Danish seines. Although they contribute only a small portion to the total catch, they operate regularly and are very likely of small mesh sizes. Other gear types that are usually of small mesh sizes include gill nets, seines, push nets, and lift nets. These gear types comprise only a fifth of total fishing trips but contribute 45% of the total catch. Hence, a large portion of the catch is likely to consist of small and young individuals. In addition, the catch estimates from dynamite fishing were available for at least one area. The extrapolated catch from blast fishing amounts to over 300 mt annually, or about 4.4% of the total catch. In the FISH-BE simulations, sustainability was attained only with effort reductions ranging from 21-78%.

While catch rates remain relatively high, changes in fishing effort are needed to maintain current conditions. The major management needs include the following:

1. Enforce ordinances/laws prohibiting the use of small mesh sizes (this will reduce pressure on juveniles and allow fish to grow to maturity and larger sizes). Push nets targeting shrimp or milkfish fry and similar gear should be limited to specific areas and times of the year, depending on distribution and seasonality of the stocks.

2. Enforce the ban on the use of destructive fishing methods (blast fishing) and active fishing activities that may cause extensive damage to shallow water habitats such as seagrass beds and coral reefs. These include blast fishing, the use of compressors, and the use of seines and trawls in sensitive habitats.
3. Regulate the deployment of fish corrals, stationary lift nets and similar gear types to prevent hindrances to water circulation and disruption in the life cycles of local stocks.
4. Exclude all commercial fishing operations within the bay (i.e., in Naga);
5. Proper zoning to allow more fishers to engage in seaweed farming in place of fishing.
6. Plan for programmed reduction in the number of fishers over a 3-5 year period.

A key issue is the need to coordinate and collaborate with other municipalities bordering the bay to allow sharing of resources as well as responsibilities in jointly managing them.

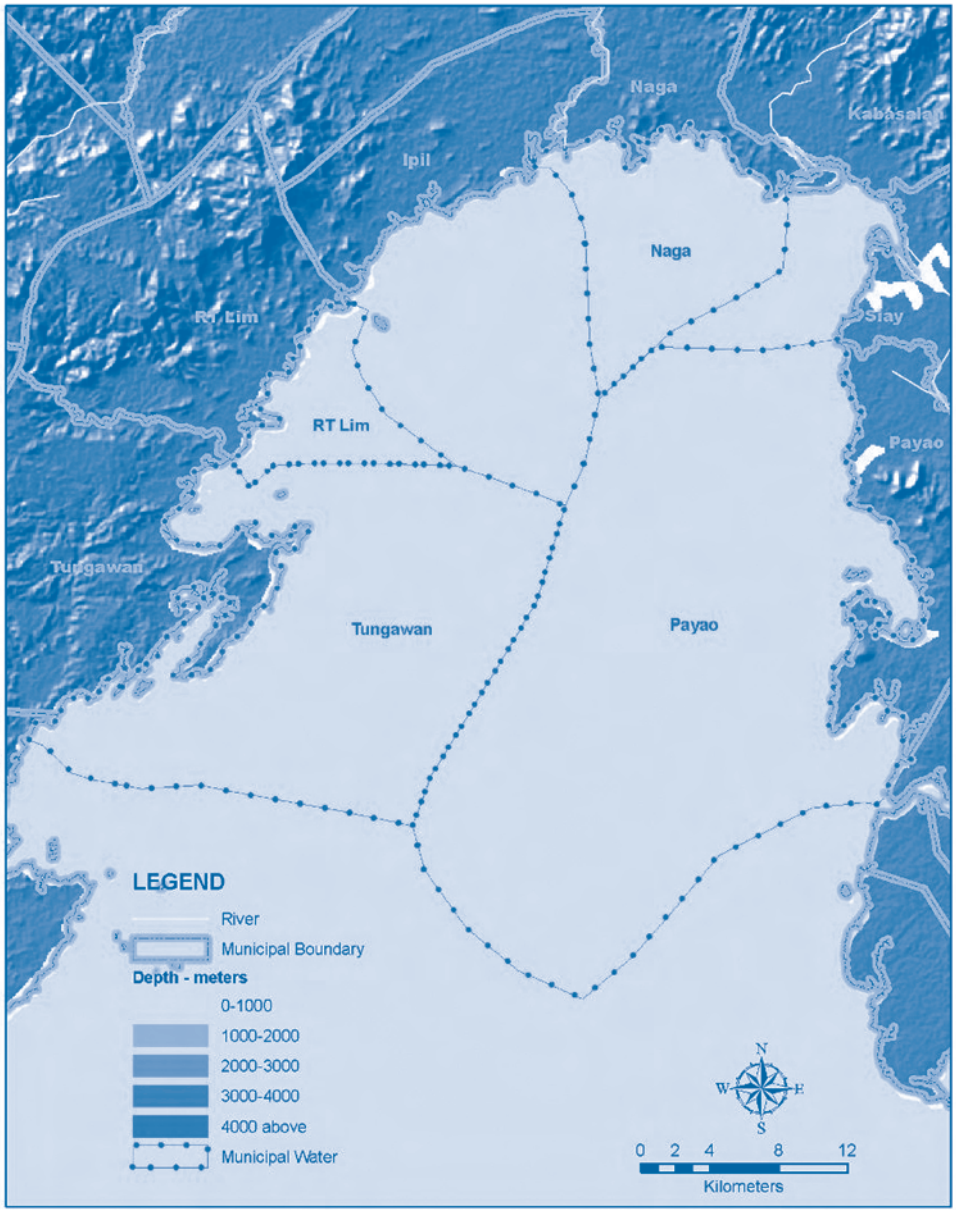

Figure 9. Subugay Bay

Naga, Zamboanga Sibugay

Cleto Nañola and Michelle Baird

The municipality of Naga is situated approximately 155 km from Zamboanga City or between 7°46.444-7°45.455'N and 122°37.032-122°45.375'E. Naga has a total land area of 246 km^2 and is composed of 23 barangays, 8 of which are coastal (Naga MPA plan). These 8 coastal barangays cover a coastline of about 30 km. The estimated population of Naga in 2004 was about 38,031 with 7,060 households.

In 2004, Naga looked into the management of its coastal resources during the formulation of its marine protected area (MPA) management plan with the assistance from the Philippine Environmental Governance 2 (EcoGov2) project and Zamboanga State College of Marine Science and Technology. In the same year, Naga adopted its 5-year MPA management plan. Today, EcoGov2 still assists the municipality of Naga in the implementation of its MPA management plan.

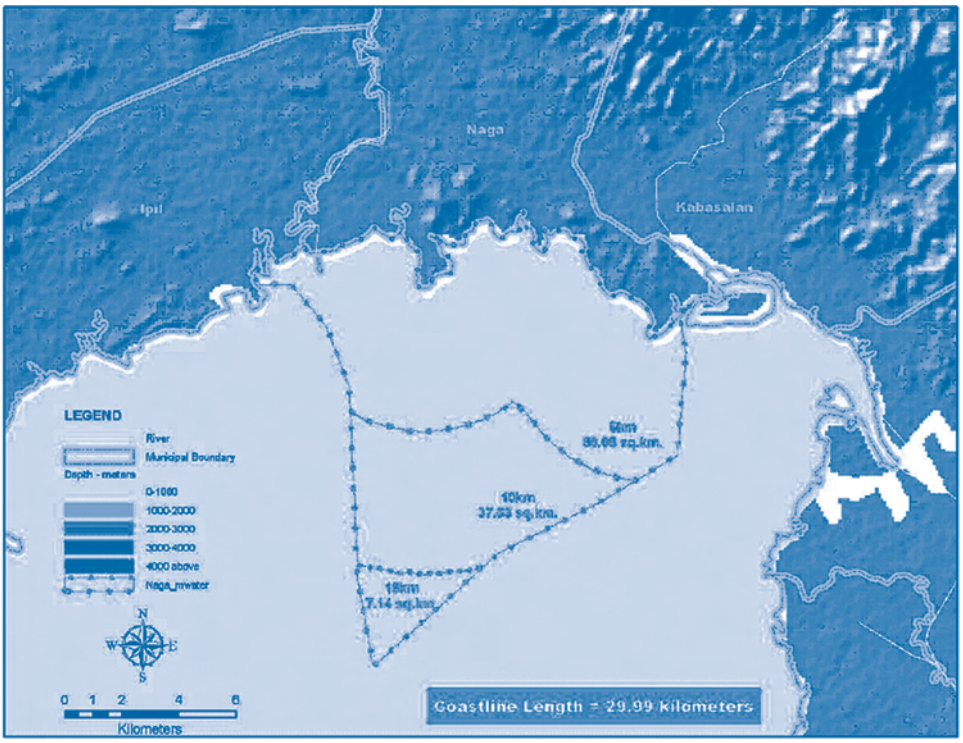

Figure 10: Municipal waters of Naga

At present, several activities have been conducted to support the coastal resource management plan of Naga. Some of these activities include biophysical training and establishment of benchmark information, fisheries profiling, enforcement training and the introduction of the fisheries information for sustainable harvest bioeconomic (FISH-BE) model. The FISH-BE model helps fishery managers choose which options will sustain the fishery.

The basic information needed by the model are the fishery (i.e., catch per unit effort, total fishers, total catch) and socio-economic profiles (i.e., daily expenses and earnings, price of catch), and estimated area of fishing ground. This information can be obtained using focus group discussions and secondary literatures.

The fishery and socioeconomic information obtained from the FGDs were used as inputs to the model. Various combinations were tested to determine the maximum number of fishers that can be sustained by the fishery. The scenarios presented in this report are as follow: (a) maximum number of fishers allowed to avert fishery collapse in the absence of an MPA; (b) maximum size of MPA to avert fishery collapse; (c) optimum conditions where fishery can be sustained (avert the collapsed) by manipulating the combination of the following parameters: size of MPA, number of fishing effort and fishing days, price per kg of fish; and (d) entry of commercial fishing at 10.1-15 km^2.

A. Methodology

All information on fishery and socioeconomic profiles were obtained using focus group discussions. The physical parameter such as the area of municipal waters for municipal and commercial fishing was provided by EcoGov2.

During the FGD, these information were gathered to get fishery information from the fishers: (a) types of fishing gears (both for municipal and commercial fishing) and the activity calendar; (b) the number units per fishing gear including the number of fisher involved per unit; (c) the estimated catch per gear per trip; (d) estimated fishing hours per gear; (e) number of fishing days and month per gear; and (f) cost of fishing and gross income per trip per gear.

The FGD was conducted in all coastal barangays of Naga in separate occasions. Table 20 presents the date and list of coastal barangays where the FGDs were conducted.

Table 20. List of coastal barangays of Naga and the date when the FGD was conducted

Barangay	Date
Taytay, Baluno, Poblacion	August 10, 2005
Gubawang, Lapaz	August 11, 2005
Bangkaw-bangkaw Mamagon	August 25, 2005
Kaliantana	February 15, 2006

B. Construction of Catch Matrix

The computation of total catch, total number of fishers, total trips per year and estimated catch per fisher per trip follows the method described by Campos (2006). The catch matrix obtained is presented in table 21. The formulae used in the computation of certain parameters is found below:

Total catch (mt) = ∑ [no. of units]*[fishing months]*[fishing days/mo]*[average catch(kg/fisher/day]/1000
Total number of fishers = ∑ [total units]*[no. of fisher/unit]
Total trips per year = ∑ [number of units]*[fishing months]*[number of days fishing/mo]
Number of fishing days = ∑ [est. trips per year] / ∑ [total units]
Estimated catch per year = total annual catch (kg)/total fisher/est. trips per year

Table 21. Fishery catch matrix derived from FGD

Fishing gears	Computed Annual Catch (mt)	Total Units	Total Fisher	Ave. Fishing Mo/Year	Est. No. of Fishing Days/ Mo	Catch Rate kg/trip	Est. Trip/Year
Municipal gears							
1. *Bira-bira* (multiple hook)	21.6	10.0	10.0	12.0	18.0	10.0	2,160.0
2. *Bobo-fish* (fish pot)	4.1	3.0	7.0	12.0	15.0	7.5	540.0
3. *Bungsod* (fish corral)	1.1	5.0	5.0	6.0	18.0	2.0	540.0
4. *Laya* (cast net)	8.4	28.0	28.0	12.0	25.0	1.0	8,400.0
5. *Newlook* (modified lift net)	154.0	36.0	152.0	11.0	20.0	20.6	7,466.0
6. *Pahubas* (gill net)	5.0	3.0	12.0	12.0	14.0	10.0	504.0
7. *Palangre* (long line)	37.3	26.0	76.0	12.0	19.0	6.4	5,850.0
8. *Panggisaw* (gill net)	54.6	14.0	42.0	12.0	26.0	12.5	4,368.0
9. *Pasol* (hook and line)	71.1	118.0	118.0	10.0	21.0	2.9	24,387.0
10. *Patuloy* (gill net)	52.3	50.0	148.0	12.0	25.0	3.4	15,257.0
11. *Sud-sud* (push net)	5.8	11.0	11.0	12.0	16.0	2.8	2,112.0
12. *Kubkuban* (small purse seine)	336.0	7.0	175.0	12.0	20.0	200.0	1,680.0
13. *Baling* (beach seine)	5.0	4.0	24.0	12.0	15.0	7.0	720.0
14. *Bobo (lambay)* (crab pot)	32.3	59.0	104.0	12.0	27.0	1.7	18,974.0
15. *Bobo-squid* (squid pot)	0.4	1.0	1.0	12.0	24.0	1.5	288.0
16. *Lenti* (scoop net w/ light)	10.6	30.0	30.0	12.0	24.0	1.3	8,460.0
17. *Ilang-ullang* (squid jig)	8.4	20.0	20.0	12.0	7.0	5.0	1,680.0
18. *Hulbot-Hulbot* (small Danish seine)	23.0	8.0	24.0	12.0	24.0	10.0	2,304.0
19. *Compressor* (hookah)	6.8	13.0	52.0	7.0	15.0	5.0	1,365.0
Commercial gears							
1. Palupad (trawl)	115.2	100.0	170.0	12.0	12.0	80.0	1,440.0
2. Giant (Danish seine)	92.2	8.0	136.0	12.0	12.0	80.0	1,152.0
Total (average)							
Municipal	837.8	446.0	1,039.0			(3.4)+	(240)++
Commercial	207.4	18.0	306.0			(4.7)+	(144)++
Grand Total	1,045.0	464.0	1,345.0				

+avg catch=annual catch*1000/total fisher/estimated trips per year
++avg trip per year

C. Input Parameters for the FISH-BE Model

Table 22 presents the types of information entered in the FISH-BE model. All other parameters used have been described by Licuanan et al. (2006).

Table 22. Input parameters for the FISH-BE for the municipality of Naga

Parameters	Value
A. FGD results	
1. Total number of municipal fishers	1,039.0
2. Total number of commercial fishers	306.0
3. Average catch of municipal fishers (kg/trip)	3.4
4. Average catch of commercial fishers (kg/trip)	4.7
5. Total annual catch (municipal) (mt)	838.0
6. Total annual catch (commercial) (mt)	207.0
7. Municipal fishing days per year	240.0
8. Commercial fishing days per year	144.0
9. Market price both municipal and commercial catch	55.0
B. Physical Parameters	
1. Area of coastal waters (15km from the coast) (km^2)	125.0
2. Municipal catch area (0.1-5km from the coast) (km^2)	90.0
3. Commercial catch area (10.1-15km from the coast) (km^2)	7.0
4. Size of the MPA (km^2)	1.24
5. Percentage of pelagic fish in catch of commercial/municipal gear	1/0.6
C. Other constant parameters	
1. Municipal fishery turnover rate	1.5
2. Commercial fishery turnover rate	2.0
3. Initial municipal stock	1.0
4. Initial commercial stock	2.0
5. Municipal fish carrying capacity	10.0
6. Commercial fish carrying capacity	3.0
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp. Req/mun fisher)	100.0
9. Fisher's income..(min sales req/comm. fisher)	20,000.0
10. Fees and charges	0.0
11. MPA cost and revenue (cost reduction)	0.1
12. MPA cost and revenue (registration, rentals, charges)	0,0,0
13. Cost centers (4 parameters)	0.0
14. Annual operating cost	0.0
15. Benefits and cost variables	Equation on

D. Scenarios Tested Using the FISH-BE Model

Several scenarios were tested in using the program. These are as follows:

a) Maximum number of fishers allowed to avert the collapse of the fishery in the absence of an MPA;
b) Maximum size of MPA to avert the collapse of the fishery;
c) Optimum condition wherein fishery is sustained (avert the collapsed) by manipulating the combination of following parameters:
    1) size of MPA;
    2) number of fishing effort and fishing days;
    3) fishing ground;
d) Entry of commercial fishing at 10.1-15 km^2 .

E. Results

Twenty-one types of fishing gears are being used in Naga. Two are commercial fishing gears—the palupad (trawl) and giant (Danish seine). The estimated annual catch is computed at 1,045 mt of which 207.4 mt (20%) is contributed by commercial fishing gears. The total fishers are computed at 1,345 with 306 (23%) fishers involved in commercial fishing. Catch rates (kg/trip) per gear were highly variable ranging from 1.0-200 kg/trip. For municipal fishing gears, the computed average catch per fisher is 7.8 kg/trip. On the other hand, the average catch for commercial fishing gears is 4.7kg/fisher/trip (see **appendix 1**). Table 23 presents the results of the different scenarios output of the FISH-BE.

Scenario 1

The fishery in Naga will collapse with the current number of fishers (1,039). The effort must be reduced to 245 to avert the collapse of the demersal and pelagic stocks. Under this condition, fisher's income is P62,333 and can support as much as 424 fishers.

Scenario 2

With an MPA of 1.24 km^2 and 1,039 fishers, the fishery still collapsed. The number has to be reduced to 260 with an MPA size of 4% (5 km^2) to avert fishery collapse. Under this condition, fisher's income is P59,840 and can support as much as 432 fishers.

Scenario 3

The possible realistic scenario for the fishery of Naga to avert fishery collapse is to reduce the number of fishing effort to 380, catch rate to 2.5kg/fisher/day and fishing ground to at least 100km^2 with an MPA size of 2% (2.5km^2) of the municipal waters. Under this condition, the fisher's income is P40,425 and can support as much as 427 fishers. Fishers income will be higher if the price per kg of fish will increase.

Scenario 4

Based on the optimum scenario 3, if commercial fishing is allowed, it will result in the collapse of the fishery, especially the pelagic stock. Furthermore, the average income of active municipal fisher will decline to P24,255 and about 124 fishers will have no fishery income. The minimum commercial fishing the fishery can allow is one boat with a crew of 17 fishers.

Table 23. Outputs derived from the FISH-BE model of Naga fishery

		Scenario			
Parameters	Baseline	1	2	3	4
1. % increase size of MPA	1.2	0.0	5.0 (4%)	2.5 (2%)	2.5 (2%)
2. Number of municipal fisher	1,039.0	245.0	260.0	380.0	380.0
3. Number of commercial fisher	306.0	0.0	0.0	0.0	306.0
4. Number of municipal fisher supported by the fishery income		424.0	432.0	427.0	256.0
5. Number of displace fisher		0.0	0.0	0.0	124.0
6. Municipal catch (mt/yr)		277.0	282.0	279.0	167.0
7. Municipal catch per day (kg/fisher/day)	3.4	3.4	3.4	2.5	2.5
8. Average income per year of active municipal fisher (P)		62,333.0	59,840.0	40,425.0	24,255.0
9. Fishery status sustained?		Yes	Yes	Yes	No
10. Stock to collapse (demersal, pelagic)		None	None	None	Pelagic

E. Lessons Learned and Management Insights

It was found that a municipality with very small fishing ground (<100 km^2) can only support as much as 380 fishers without collapsing its fishery and at the same time fishers earn a considerable income.

Under the same scenario, the present size of the MPA can be increased up to 2% of the total municipal catch area without affecting the income of the fishers. However, before any increase in the size of the MPA can be done, it must take into account the available suitable sites. At present, potential sites in Naga is very limited.

The coastal barangays of Naga, particularly Barangay Kaliantana, is just like other coastal barangays around Subugay Bay—they are heavily dependent in the fishery as their source of livelihood. The reduction in the number of fishers from 1,039 to 380 will be very hard to implement. The LGU might not support this initiative but they can do something to sustain their fishery such as suggesting a catch quota limit to make the fishery sustainable. Running the model using a catch limit of 2.5kg/fisher/trip showed that it can support 380 fishers each with an annual income of P40,425.

To avert the collapse of the fishery in Naga, fishing efforts must be reduced, catch quota must be implemented, and the current MPA size should be doubled. These calls for the LGU to implement other programs for displaced fishers. One form of alternative livelihood that is currently being practiced by the municipality is seaweed farming.

Tungawan, Zamboanga Sibugay

Cleto Nañola and Michelle Baird

Tungawan is situated 110 km from Zamboanga City or between 7°28.120'-7°37.411'NN and 122°21.293'-122°28.371'E. It has a total land area of 273.3 km^2. It has a coastline of 77.9km and a municipal water of 381 km^2. It is a third class municipality with a population of 33,319 comprising of 6,000 household (NSO 2000). It is composed of 25 barangays, 12 of which are coastal. The coastal population is about 17,088, or 51% of the total population (NSO 2000).

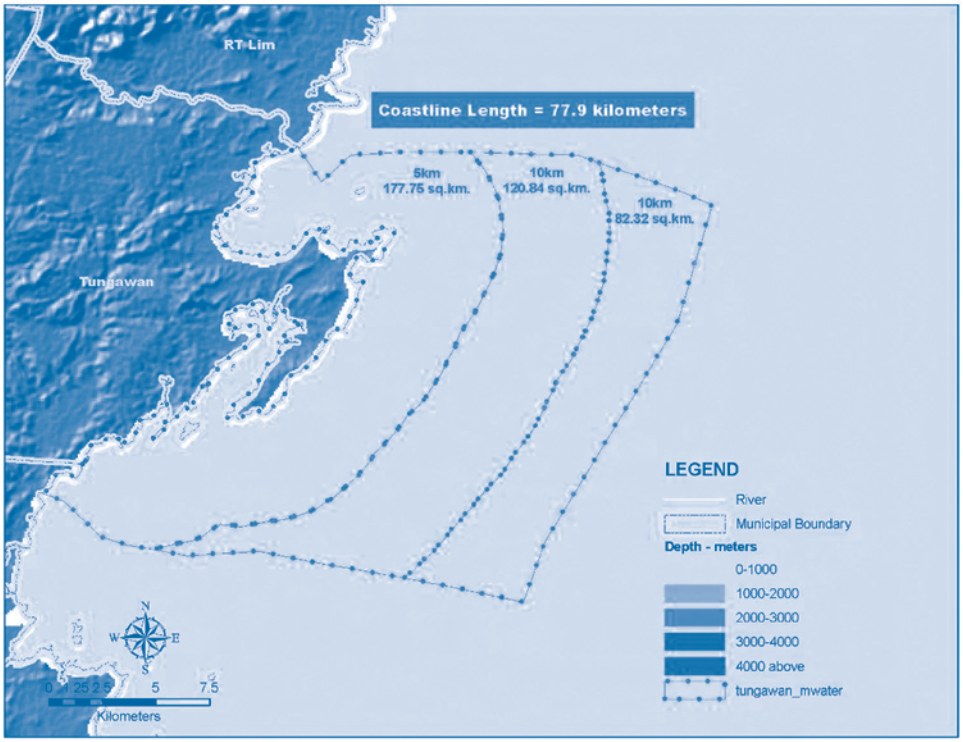

Figure 11: Municipal waters of Tungawan

The coastal resources management (CRM) program of Tungawan started during the enactment of Municipal General Ordinance No. 13-95 in 1995 that prescribes the policies, principles, and strategies for the sustainable development, conservation, protection, and management of the municipal coastal fishery and aquatic resources. However, the LGU's CRM program did not materialize due to weak implementation. In 2002, with the help of former Vice-Governor Eugenio Famor, a CRM program called the 4Ks (Kalayaan, Kapayapaan, Kasaganahan sa Karagatan) was launched. However, because of the lack of support from the provincial government, the program didn't push through but the LGU was able to conduct information, education and communication (IEC) activities in the coastal barangays. The CRM program of Tungawan finally started in 2003 with the signing of a memorandum of agreement (MOA) with EcoGov2 and with assistance from Zamboanga State College of Marine Science and Technology. The MOA resulted in the adoption of three management plans in September 2004. These were the 10-year CRM mananagement plan, the 5-year fishery resource management plan, and marine protected area (MPA) management plan. The latter resulted in the creation of 880 hectares. MPA at Bangaan Island, Tibugcay. In April 2004, the LGU proclaimed another MPA at Pulo Piña with an area of 100 hectares. Presently, both MPAs are fully enforced.

The LGU of Tungawan has obtained several kinds of resource information such as benchmarking of the MPA and fishery profiling, with the continuous assistance from EcoGov2. The information served as inputs for the management of the coastal resources of Tungawan.

A. Methodology

All information on fishery and socioeconomic profiles were obtained using focus group discussions (FGD). The area of fishing ground was provided by Trina Isorena of EcoGov2.

In the FGD, the following questions were asked: (a) types of fishing gears (both for municipal and commercial fishing) and the activity calendar; (b) the number units per fishing gear including the number of fisher involved per unit; (c) the estimated catch per gear per trip; (d) estimated fishing hours per gear; (e) number of fishing days and month per gear; and (f) cost of fishing and gross income per trip per gear.

The FGD was conducted in 11 of the 12 coastal barangays of Tungawan. The barangay which was not surveyed was Tigbanuang. Based on the records of the LGU, the number of fishers and the catch from this barangay cannot significantly affect the results obtained. Table 24 presents the date and list of coastal barangays where the FGD were conducted.

Table 24. List of coastal barangays of Tungawan and the date when the FGD was conducted

Barangay	Date
Baluran, Masao, Poblacion	June 30, 2005
Linguisan, Looc Labuan	July 2, 2005
San Pedro, San Vicente	
Sto Niño, Taglibas	
Tigbucay, Tigpalay	

B. Construction of catch matrices

The computation of total catch, total number of fishers, total trips per year and estimated catch per fisher per trip follows the method described by Campos (2006). Table 24 presents the catch matrix obtained. The formulae used in the computation of certain parameters is found below:

Total catch (mt) = ∑ [no. of units]*[fishing months]*[fishing days/mo]*[average catch(kg/fisher/day]/1000
Total number of fishers = ∑ [total units]*[no. of fisher/unit]
Total trips per year = ∑ [number of units]*[fishing months]*[number of days fishing/mo]
Number of fishing days = ∑ [est. trips per year] / ∑ [total units]
Estimated catch per year = total annual catch (kg)/total fisher/est. trips per year

Table 25. Fishery catch matrix of Tungawan, Zamboanga Sibugay

Fishing gears	Est. Annual Catch (mt)	Total Units	Total Fisher	Ave. Fishing Mo/Year	No. of day/ Fishing Mo	Catch Rate kg/trip	Est. Trips/Year
Municipal gears							
1. *Bobo-fish* (fish pot)	41.5	22.0	26.0	10.0	18.0	10.7	3887.0
2. *Bungsod* (fish corral)	31.6	15.0	15.0	12.0	26.0	6.9	4603.0
3. *Bira-bira* (triple hook & line)	160.0	175.0	175.0	10.8	18.0	4.6	34776.0
4. *Bira-bira2 (double hook & line)*	4.6	10.0	10.0	6.0	22.0	3.5	1320.0
5. *Pasol* (single hook & line)	48.5	75.0	75.0	12.0	17.0	3.1	15525.0
6. *Laya* (cast net)	9.4	31.0	31.0	12.0	15.0	1.8	5394.0
7. *New Look* (stationary lift net)	36.0	4.0	24.0	12.0	15.0	50.0	720.0
8. *Palangre* (bottom set long line)	11.1	9.0	27.0	11.5	21.0	5.3	2122.0
9. *Pana* (spear fishing)	2.0	12.0	12.0	7.5	5.0	4.5	450.0
10. *Pataw/Hantok* (hook & line)	46.6	75.0	75.0	12.0	12.0	4.5	10350.0
11. *Patuloy* (gill net)	58.8	34.0	68.0	12.0	18.0	8.1	7262.0
12. *Pokot* (gill net2)	29.6	16.0	16.0	12.0	22.0	7.0	4224.0
13. *Tapsay* (gill net3)	0.8	1.0	1.0	12.0	22.0	3.0	264.0
14. *Banagan* (pokot) (gill net lobster)	0.3	1.0	2.0	12.0	22.0	1.0	264.0
15. *Bobo-lambay* (crab pot)	53.7	93.0	93.0	7.7	23.0	3.2	16706.0
16. *Lappas*(abalone) (gleaning)	5.3	10.0	10.0	12.0	22.0	2.0	2640.0
17. *Lenti* (scoop net with light)	0.8	4.0	4.0	12.0	16.0	1.0	768.0
18. *Nasa* (crab pot)	10.8	10.0	10.0	12.0	30.0	3.0	3600.0
19. *Pahala* (gill net lobster)	1.1	4.0	4.0	6.0	30.0	1.5	720.0
20. *Panggal* (crab pot)	4.6	55.0	55.0	12.0	7.0	1.0	4620.0
21. *Bobo-pusit* (squid pot)	5.5	29.0	29.0	5.3	16.0	2.3	2436.0
22. *Sud-sud* (push net)	29.0	46.0	46.0	12.0	18.0	2.9	10074.0
23. *Ulang-Ulang* (squid jig)	7.6	17.0	17.0	8.0	19.0	3.0	2516.0
Total (average)	599.0	748.0	825.0			(4.4)+	

+avg catch=annual catch*1000/total fisher/estimated trips per year

C. Input parameters for the FISH-BE model

Table 26 presents the information entered to the FISH-BE model.

Table 26. Input parameters for the FISH-BE model for Tungawan. (* data not from Tungawan)

Parameters	Value
A. Summary of FGD results	
1. Total number of municipal fishers	825.0
2. Total number of commercial fishers	150*
3. Average catch of municipal fishers (kg/trip)	4.4
4. Average catch of commercial fishers (kg/trip)	4.7*
5. Total annual catch (municipal) (mt)	599.0
6. Total annual catch (commercial) (mt)	0.0
7. Municipal fishing days per year	180.0
8. Commercial fishing days per year	144*
9. Market price both municipal and commercial catch	55.0
B. Physical parameters and others	
1. Area of coastal waters (15km from the coast) (km^2)	380.0
2. Municipal catch area (0.1-5km from the coast) (km^2)	177.0
3. Commercial catch area (10.1-15km from the coast) (km^2)	82.0
4. Size of the MPA (km^2)	9.8
5. Percentage of pelagic fish in catch of commercial/municipal gear	1/0.6
C. Other constant parameters	
1. Municipal fishery turnover rate	1.5
2. Commercial fishery turnover rate	2.0
3. Initial municipal stock	1.0
4. Initial commercial stock	2.0
5. Municipal fish carrying capacity	10.0
6. Commercial fish carrying capacity	3.0
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp. Req/mun fisher)	100.0
9. Fisher's income(min sales req/comm. fisher)	20,000.0
10. Fees and charges	0.0
11. MPA cost and revenue (cost reduction)	0.1
12. MPA cost and revenue (registration, rentals, charges)	0,0,0
13. Cost centers (4 parameters)	1.0
14. Annual operating cost	0.0
15. Benefits and cost variables	Equation on

* data not from Tungawan

D. Scenarios Tested Using the FISH-BE model

There were the scenarios tested using the program:

a) Maximum number of fishers allowed to avert the collapse of the fishery in the absence of an MPA;
b) Maximum size of MPA to avert the collapse of the fishery;
c) Optimum condition wherein fishery is sustained (avert the collapsed) by manipulating the combination of following parameters:
    1) size of MPA
    2) number of fishing effort and fishing days
    3) fishing ground
d) Entry of commercial fishing at 10.1-15 km^2

E. Results

From the 23 types of municipal fishing gears, the estimated annual catch computed was 599 mt and the total number of fishers was 825. The average catch per fisher computed was 4.4 kg/trip. There is no known commercial fishing operator in Tungawan. The completed catch matrix is presented in **appendix 2**. Table 27 shows the summary results of the FISH-BE run.

Scenario 1

In the absence of an MPA and with the current fishing pressure of 825 fishers, the municipal (demersal) stocks collapsed although there were no fishers displaced and the fishers income is high (P37,407.00). In order for both stocks not to decline, the fishing effort must be reduced to 500. In this scenario, fisher's income is P93,519 and can support as much as 1,299 fishers.

Scenario 2

With an MPA of 9% (34.2km^2) of the municipal water, the fishing effort can only increase up to 550 fishers without collapsing the demersal and commercial stocks. The fisher's income is P85,102 and can support up to 1,300 fishers. In the initial runs, of the 380 km^2 municipal waters only 177km^2 was used as a reasonable fishing ground. But if the fishing ground is 200km^2 and the MPA size is 9% of the municipal waters, the fishery can support as much as 625 fishers.

Scenario 3

For Tungawan to avert fishery collapse, the effort must be maintained at 750 with a catch rate of only 3.5 kg/fisher/day and the fishing ground must be at least 200 km^2. In this scenario, fisher's income is P62,543 and can support as much as 1,303 fishers. Also, the minimum MPA size is 5% (19km^2) of the municipal waters.

Scenario 4

Based on scenario 3, even with the presence of a commercial fishing vessel with a fishing effort of 150, the fishery (both demersal and commercial stocks) did not collapse. However, if the effort is increased to 200, the commercial stock would collapse.

Table 27. Outputs derived from the FISH-BE model of Tungawan fishery.

	Scenario				
Parameters	Baseline	1	2	3	4
1. Size of MPA (km^2) (% of the municipal waters)	9.8	0.0	34.2 (9%)	19.0 (5%)	19.0 (5%)
2. Number of municipal fisher	825.0	500.0	550.0	750.0	750.0
3. Number of commercial fisher					150.0
4. Number of municipal fisher supported by the fishery income		1,299.0	1,300.0	1,301.0	1,303.0
5. Number of displace fisher	0.0	0.0	0.0	0.0	0.0
6. Municipal catch (mt/yr)	599.0	850.0	851.0	852.0	852.0
7. Municipal catch per day (kg/fisher/day)	4.4	4.4	4.4	3.5	3.5
8. Average income per year of active municipal fisher (PhP)		P93,519.00	P85,102.00	P62,543.00	P62,543.00
9. Fishery status sustained?		Yes	Yes	Yes	Yes
10. Stock to collapse (demersal, pelagic)		None	None	None	None

* present fishery status

F. Lessons Learned and Management Insights

The FISH-BE model is a good decision support tool for resource managers. It helps fishery managers manipulate or try various combination of management to attain sustainability of their fishery. There is no trial and error in the field and possible irreversible disasters are prevented.

Through the runs made using the model, it was found that a municipality with a large fishing ground provides leeway in manipulating fishing effort and MPA size without collapsing the fishery. This could be true under the assumption that the area is not yet overfished.

The most important thing to be remembered is that the numbers being manipulated are close to reality. The fishing effort numbers, for example, cannot simply be reduced by half because it cannot be applied. It will involve a large amount of money from the LGU to provide other sources of income and conduct enforcement activities. Or if it is really the best choice, then the fishery managers can employ flow rated reduction of effort on an annual basis until the desired number is met.

Further, the actual situation in the area must be taken into account if the size of the MPA will be increased. If there is no viable MPA site that can be established, the fishery managers must focus on other parameters that are attainable, such as the reduction of fishing effort and/or number of fishing days per year.

The best option for Tungawan is a reduction in the number of fishers by a few hundreds of about 275 or a much lesser reduction of about 75 if the catch is reduced to 3.5 kg/fisher/day from 4.4 kg/fisher/day and fishing ground must be larger. Further, the MPA size must be between 5-9% of the fishing area (table 27).

The decrease in the effort and increase in MPA size are both realistic for Tungawan. It has a coastline of 77 km, total reef area of 6.57 km^2 and municipal coastal waters of 380 km^2. Providing livelihood for the displaced fishers (75-275) is achievable from the side of the LGU. Many fishers are no longer fishing and are already engaged in seaweed farming. Seaweed farming provides higher income compared to fishing. It is also less laborious except during the planting season which is being done only 4 times a year. Each planting season will last for 1-2 weeks depending on the size of the seaweed farm.

The model also showed that commercial fishing at 10.1 km from the coast is viable for the municipal waters of Tungawan. But since there is no known commercial fishing operator in the area, then it is best to consider that commercial fishing will not be entertained within the municipal waters.

RT Lim, Zamboanga Sibugay

Cleto Nañola and Michelle Baird

The municipality of RT Lim is situated approximately 120 km from Zamboanga City, or between 7°37.411-7°42.278'N and 122°28.371-122°31.211'E. It has a total land area of 488 km^2 with a municipal water of 57 km^2. It has 26 barangays where 7 are coastal. The total population is 34,152 and 24.5% (8,384) is concentrated in the coastal barangays (NSO 2000).

RT Lim started to manage its coastal resources upon the enactment of its fishery ordinance in 1996 which was rectified in December 2006. From then on, the LGU regularly conducts (at least 2-3 times a month) seaborne patrol. In 2004, EcoGov2 together with the Zamboanga State College of Marine Science and Technology assisted RT Lim in the formulation of its 5-year marine protected area (MPA) management plan. Upon its adoption in the same year, EcoGov2 continues its assistance through the implementation of the MPA management plan.

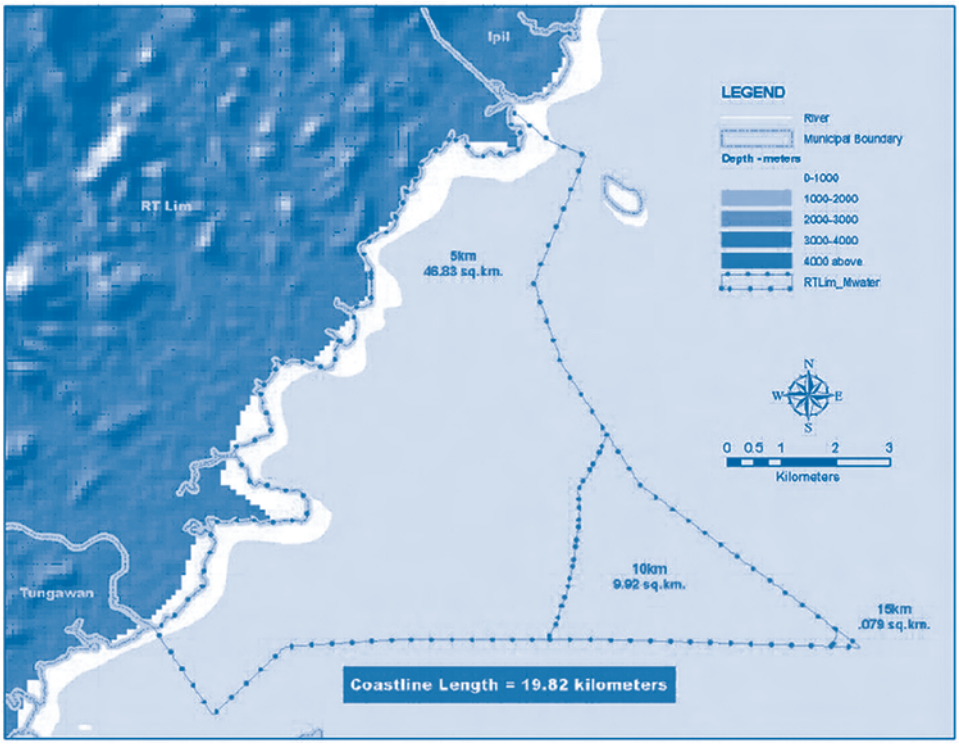

Figure 12: Municipal waters of RT Lim

A. Methodology

All information on fishery and socioeconomic profiles were obtained using focus group discussions. The fishery information gathered from the fishers are: (a) types of fishing gears (both for municipal and commercial fishing) and the activity calendar; (b) the number of units per fishing gear including the number of fisher involved per unit; (c) the estimated catch per gear per trip; (d) estimated fishing hours per gear; (e) number of fishing days and month per gear; and (f) cost of fishing and gross income per trip per gear.

The FGD was conducted in all 7 coastal barangays of RT Lim. Table 27 presents the list of coastal barangays and when the FGD were conducted.

Table 28. List of coastal barangays of RT Lim and the date when the FGD was conducted

Barangay	Date
Ali-alsree, Kulambugan, Magsaysay, Tupilak	May 11, 2006
Gango, Pres. Roxas Silingan	May 12, 2006

B. Construction of catch matrices

The computation of total catch, total number of fishers, total trips per year and estimated catch per fisher per trip follows the method described by Campos (2006). Table 29 presents the catch matrix obtained. The formulae used in the computation of certain parameters is found below:

Total catch (mt) = ∑ [no. of units]*[fishing months]*[fishing days/mo]*[average catch(kg/fisher/day]/1000
Total number of fishers = ∑ [total units]*[no. of fisher/unit]
Total trips per year = ∑ [number of units]*[fishing months]*[number of days fishing/mo]
Number of fishing days = ∑ [est. trips per year] / ∑ [total units]
Estimated catch per year = total annual catch (kg)/total fisher/est. trips per year

Table 29. Fishery catch matrix of RT Lim, Zamboanga Sibugay

Fishing Gears	Estimated Annual Catch (mt)	Total Units	Total Fisher	Ave fishing mo/yr	No. of Fishing days/ mo	Catch Rate kg/trip	Est trip/ year
1. *Bobo-lagao* (fish trap)	3.6	1.0	1.0	12.0	20.0	15.0	240.0
2. *Bobo-lambay* (crab pot)	13.5	45.0	45.0	12.0	20.0	1.2	216.0
3. *Lapu-lapu* (fish pot)	3.2	7.0	7.0	12.0	15.0	2.5	720.0
4. *Bobo-nocos* (crab pot)	29.4	35.0	35.0	12.0	20.0	3.5	1,260.0
5. *Bungsod* (fish corral)	28.2	20.0	41.0	9.7	17.5	8.3	995.6
6. *Kabiawan* (lift net)	228.0	2.0	30.0	12.0	25.0	380.0	240.0
7. *Kubkuban* (small purse seine)	43.2	1.0	13.0	12.0	20.0	180.0	840.0
8. *Lampurnas* (gill net)	8.4	8.0	24.0	12.0	25.0	3.5	3,440.0
9. *Laya* (cast net)	2.0	20.0	20.0	12.0	14.3	0.6	2,400.0
10. *Newlook* (modified lift net)	246.0	24.0	48.0	10.0	20.0	51.2	4,950.0
11. *Pahubas* (gill net)	1.6	2.0	5.0	12.0	9.0	7.5	600.0
12. *Palangre* (long line)	176.3	72.0	113.0	12.0	13.8	14.8	6,840.0
13. *Pana* (spear)	1.6	8.0	8.0	9.3	13.3	1.7	4,080.0
14. *Pasol* (hook and line)	51.8	240.0	340.0	12.0	18.0	1.0	4,896.0
15. *Pasol (undak)* (multiple hook and line)	47.0	25.0	25.0	12.0	16.5	9.5	8,400.0
16. *Patuloy* (gill net)	55.3	20.0	35.0	12.0	20.4	11.3	3,383.0
17. *Pokot* (gill net)	0.5	7.0	14.0	12.0	10.0	0.6	10,800.0
18. *Salapang* (spear)	6.1	17.0	34.0	12.0	20.0	1.5	4800.0
19. *Sud-sud* (push net)	22.9	66.0	66.0	9.7	14.3	2.5	9145.0
20. *Tapsay* (enclosing net)	7.2	3.0	6.0	12.0	20.0	10.0	11952.0
21. *Ulang-ulang* (squid jig)	10.3	30.0	30.0	12.0	19.0	1.5	51840.0
Total	986.1	653.0	940.0			(5.0)+	

+avg catch=annual catch*1000/total fisher/estimated trips per year

C. Input parameters for the FISH-BE model

Table 30 presents the types of information entered to the FISH-BE model. The area of municipal catch (70 km^2) used for the model was beyond the area of municipal waters (57 km^2) since fishers in RT Lim fish beyond their municipal waters., The area used covers portion of the coastal waters of the adjacent LGUs particularly Tungawan. All other parameters used have been described by Licuanan et al. (2006).

Table 30. Input parameters for the FISH-BE for the municipality of RT Lim

Parameters	Value
A. Summary of FGD results	
1. Total number of municipal fishers	940.0
2. Total number of commercial fishers	150*
3. Average catch of municipal fishers (kg/trip)	5.0
4. Average catch of commercial fishers (kg/trip)	4.7*
5. Total annual catch (municipal) (mt)	986.0
6. Total annual catch (commercial) (mt)	207*
7. Municipal fishing days per year	202.0
8. Commercial fishing days per year	144*
9. Market price both municipal and commercial catch	55.0
B. Physical parameters and others	
1. Area of coastal waters (15km from the coast) (km^2)	57.0
2. Municipal catch area (0.1-5km from the coast) (km^2)	70+
3. Commercial catch area (10.1-15km from the coast) (km^2)	0.9
4. Size of the MPA (km^2)	1.1
5. Percentage of pelagic fish catch of commercial	1.0
6. Percentage of demersal fish catch municipal gear	0.6
C. Other constant parameters	
1. Municipal fishery turnover rate	1.5
2. Commercial fishery turnover rate	2.0
3. Initial municipal stock	1.0
4. Initial commercial stock	2.0
5. Commercial fish carrying capacity	10.0
6. Municipal fish carrying capacity	3.0
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp. Req/mun fisher)	100.0
9. Fisher's income..(min sales req/comm. fisher)	20,000.0
10. Fees and charges	0.0
11. MPA cost and revenue (cost reduction)	0.1
12. MPA cost and revenue (registration, rentals, charges)	0,0,0
13. Cost centers (4 parameters)	1.0
14. Annual operating cost	0.0
15. Benefits and cost variables	Equation on

*data from other sources + an estimate of actual fishing ground

D. Scenarios tested using the FISH-BE model

The scenarios that were tested in the program are the following:

Scenario 1

Maximum number of fishers allowed to avert the collapse of both fishery stocks in the absence of an MPA; total annual catch projected.

Scenario 2

Minimum size of MPA to avert the collapse of both fishery stocks and minimum price of fish to support the displaced fisher.

Scenario 3

Other options for sustainable fishery to avert the collapse of both stocks by manipulating the combination of following parameters:

1) size of MPA
2) number of fishing effort
3) number of fishing days
4) catch regulation (kg/fisher/day)

E. Results

Of the 21 kinds of municipal fishing gears used in RT Lim, two involve large number of fishers. The *kabiawan* (modified liftnet) and *kubkuban* (small purse seine) employ 15 and 13 fishers per unit. The total number of municipal fisher computed was 940 with an annual catch of 986 mt. The average catch per fishers in RT Lim was computed at 5.1 kg/trip. There is no known commercial fishing operator in RT Lim (**appendix 3**). Tables 31 and 32 present the summary data output of the FISH-BE model.

Scenario 1

Both fishery stocks collapsed in the absence of an MPA and with the current fishing pressure of 940 fishers. The fishing effort has to be lowered to 150 fishers for both stocks not to collapse. At this rate, the projected annual catch is 127.5 mt with an annual income of P41,121 that can support up to 171 fishers.

Scenario 2

At the current fishing effort of 940 fishers, the minimum MPA size must be 85% (48.4 km^2) of the municipal waters to avert fishery collapse. At this stage, the average annual income is P6,785 and can support only 177 fishers. To support the displaced 763 fishers, the price per kilogram of demersal fish must be P325/kg.

Scenario 3

RT Lim has a very small fishing ground (70 km^2). By varying variables such as MPA size, fishing effort, fishing days, catch rates, and fishing ground, the best scenario for RT Lim is to double its MPA size (4%), reduce the catch to 3.5 kg/fisher/day, reduce the fishing days to 180, and double the area of fishing ground from 70 to 140 km^2. In this scenario, the number of fishers who can be supported without collapsing fishery stocks is 465 displacing about 475. The annual income is P15,198 and can support about 196 fishers.

Table 31. Different scenarios tested during the workshop

Scenario	Output	Results
1. a) Without MPA	Current number of fishers	940 fisher
	Projected annual catch	0 mt
	First stock to collapse	both
1. b) without MPA	Maximum fishers to avert collapse of both stocks	150 fisher
	Projected annual catch	127.48 mt
2. Minimum MPA size in percent of municipal waters		85%
	Price/kg of demersal fish catch that can support all fishers	P325.00

Table 32. Other options tested

	Scenario				
Parameters	Baseline	1	2	3	4*
1. Size of MPA (km^2) (% of the municipal waters)	1.1 (1.9%)	48.4 (85%)	8.5 (15%)	2.3 (4%)	2.3 (4%)
2. Number of municipal fisher	940.0	940.0	185.0	200.0	465.0
3. Number of displaced fisher			755.0	740.0	475.0
4. Number of fishing days	202.0	202.0	202.0	202.0	180.0
5. Number of municipal fisher supported by the fishery income		177.0	198.0	193.0	196.0
6. Municipal catch (mt/yr)	986.0	116.0	129.3	126.3	128.5
7. Municipal catch per day (kg/fisher/day)	5.0	5.0	5.0	4.0	3.5
8. Average income per year of active municipal fisher (PhP)		P6,785.00	P38,499.00	P34,739.00	P15,198.00

* Municipal fishing ground was doubled

F. Lessons Learned in Using the FISH-BE Model

The FISH-BE model provided valuable assistance to fishery managers on how to maximize the present use of the resource and how to make it sustainable. The results of the simulations showed that municipalities with very small fishing ground (70km^2), can only support as much as 200 fishers for the fishery not to collapse and for fisher's to earn a considerable income. Furthermore, the simulations also suggested that there is a need to increase the price per kg of fish to support the displaced fishers.

When the fishery is at this level, the size of the MPA must be at least 4% of the municipal fishing area. Since there are areas that are not yet MPAs, the LGU of RT Lim can declare some areas as MPAs to increase its size.

G. Management Content in the Application of the Model

The applicability of the changes should be considered in manipulating the input values. In the case of RT Lim, there must be a huge cut of the present number of fishers from 940 to 200 (78.7% reduction). This drastic reduction is hard to achieve and implement, but is necessary if it is the only way to sustain the fishery.

Another management option is for fishers of RT Lim to fish in other areas. There must be an arrangement with neighboring LGUs for fishers to be legally allowed to fish outside RT Lims municipal waters. This can be attained through various means such as the creation of inter-LGU fishery ordinance wherein both parties could benefit.

Payao, Zamboanga Sibugay

Cleto Nañola and Michelle Baird

The municipality of Payao is located at the southeastern part of Zamboanga Sibugay bounded on the north by the municipality of Siay and Talusan on the south. Payao has a coastline of 61.82km with an estimated municipal water of 666 km^2. It has a total of 26 barangays of which 16 are coastal. Based on the census conducted by the NSO in 2000, the municipality has a total population of 27,036. In 2003, based on the provincial growth rate, it was estimated that the population has increased to about 30,229 (11%) (MPA management plan 2004) wherein 67% of the population resides in the coastal area (Bernadez pers. comm.).

Conservation and protection of the coastal resources and habitat started during the time of late Mayor Moises Araham. During his administration, the LGU was actively enforcing local ordinances and national laws. They also established the Takot Patumbok Marine Protected Area through the assistance of Zamboanga State College of Marine Science and Technology and EcoGov in 2004. On the same year, the 5-year MPA management plan was adopted by the municipality.

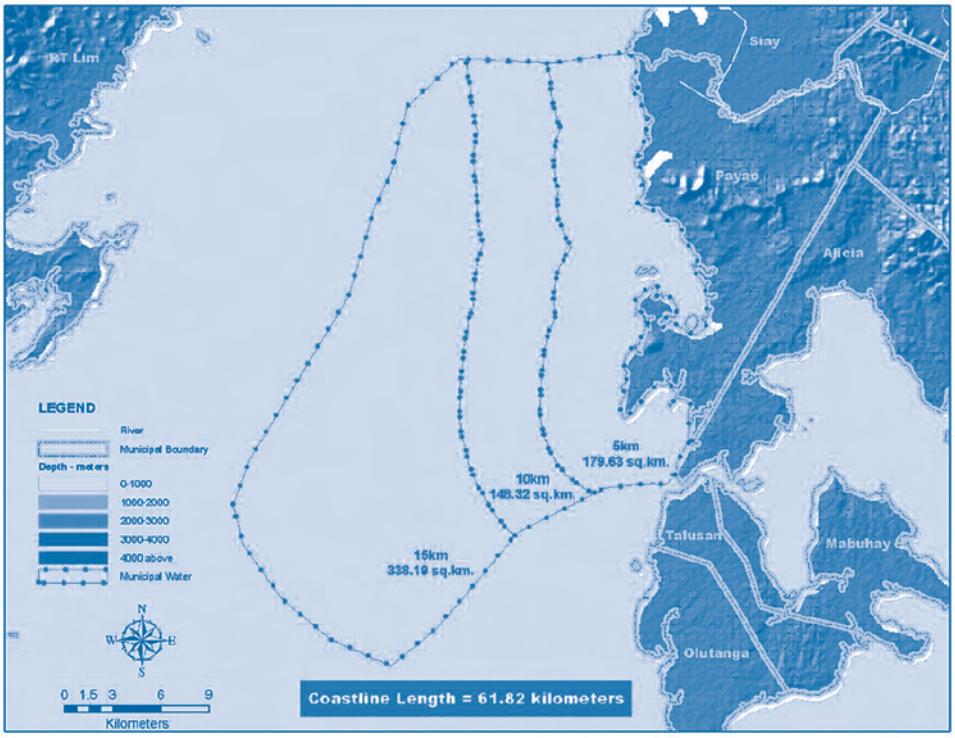

Figure 13: Municipal waters of Payao

A. Methodology

All information on fishery and socioeconomic profiles was obtained using focus group discussions (FGD). The FGD was conducted in 13 coastal barangays of Payao in three separate occasions. The FGD in Poblacion and Katipunan were conducted on June 5, 2006 while the FGD in other coastal barangays were completed in August 2006. Table 33 presents the date and list of coastal barangays where the FGDs were conducted.

Table 33. List of coastal barangays of Payao and the date when the FGD was conducted

Barangay	Date
Katipunan, Poblacion	June 5, 2006
Labatan, Mayabo, Dalama, San Roque, Minundas, Balogo, Balian	August 23, 2006
Bulawan, Kima, Kulasian, Silal	August 24, 2005

B. Construction of Batch Matrices

The computation of total catch, total number of fishers, total trips per year, and estimated catch per fisher per trip follow the methods described by Campos (2006). Table 34 presents the catch matrix data.

Total catch (mt) = ∑ [no. of units]*[fishing months]*[fishing days/mo]*[average catch(kg/fisher/day]/1000
Total number of fishers = ∑ [total units]*[no. of fisher/unit]
Total trips per year = ∑ [number of units]*[fishing months]*[number of days fishing/mo]
Number of fishing days = ∑ [est. trips per year] / ∑ [total units]
Estimated catch per year = total annual catch (kg)/total fisher/est. trips per year

Table 34. Fishery catch matrix derived in Payao, Zamboanga Sibugay

Fishing Gears	Annual Catch (mt)	Total Units	Total Fisher	Ave fishing mo/yr	Est Fishing days/mo	Catch Rate kg/trip	Est Trip/Yr
1. Bungsod-big (fish corral)	597.0	67.0	184.3	12.0	30.0	24.8	24,120.0
2. Bungsod-small (fish corral)	32.4	30.0	55.0	12.0	30.0	3.0	10,800.0
3. Compressor (hookah)	130.0	38.0	171.0	12.0	15.0	19.0	6,840.0
4. Dinamita (blasting)	416.5	116.0	212.7	12.0	26.0	11.6	35,960.0
5. Habong (gill net)	54.0	30.0	90.0	12.0	15.0	10.0	5,400.0
6. Laya (cast net)	4.9	21.0	28.0	12.0	17.0	1.2	4,200.0
7. Newlook (modified lift net)	19.2	1.0	5.0	12.0	20.0	80.0	240.0
8. Pahubas (gill net)	9.9	6.0	18.0	12.0	9.0	15.0	612.0
9. Palangre (long line)	157.8	126.0	252.0	12.0	12.0	9.0	175,39.2
10. Pamana o panulo (spear)	115.6	107.0	107.0	12.0	15.0	6.0	19,260.0
11. Pasol (hook & line)	438.6	548.0	1,056.9	12.0	23.0	3.0	147,960.0
12. Patuloy (gill net)	102.7	112.0	224.0	12.0	13.0	5.9	17,360.0
13. Sanggab	7.0	10.0	13.3	12.0	8.0	7.3	960.0
14. Tapsay (gill net)	-	7.0	42.0	12.0	15.0	3.0	-
15. Baling (beach seine)	0.2	1.0	10.0	12.0	2.0	10.0	24.0
16. Bintol (crab pot brackish)	2.4	4.0	4.0	12.0	25.0	2.0	1,200.0
17. Bobo-alimango (crab pot brackish)	48.6	115.0	115.0	12.0	12.0	2.9	16,905.0
18. Bobo-lambay (crab pot marine)	4.5	5.0	5.0	12.0	15.0	5.0	900.0
19. Lenti (scoop net with light)	16.8	53.0	53.0	12.0	20.0	1.3	12,720.0
20. Sud-sud (push net)	7.8	26.0	26.0	12.0	13.0	2.0	3,900.0
21. Ulang-ulang (squid jig)	0.1	1.0	1.0	12.0	6.0	1.0	72.0
Total	2,200.8	1,429.0	2,690.7			(3.5)+	

+avg catch=annual catch*1000/total fisher/estimated trips per year

B. Input Parameters for the FISH-BE Model

Table 35 presents the types of information entered in the FISH-BE model. All other parameters used have been described by Licuanan et al. (2006).

Table 35. Input parameters of the FISH-BE for the municipality of Payao

Parameters	Value
A. Summary of FGD results	
1. Total number of municipal fishers	2,673.0
2. Total number of commercial fishers	18.0
3. Average catch of municipal fishers (kg/trip)	3.5
4. Average catch of commercial fishers (kg/trip)	8.3
5. Total annual catch (municipal) (mt)	2,165.0
6. Total annual catch (commercial) (mt)	35.0
7. Municipal fishing days per year	230.0
8. Commercial fishing days per year	240.0
9. Market price both municipal and commercial catch	55.0
B. Physical Parameters	
1. Area of coastal waters (15km from the coast) (km^2)	666.0
2. Municipal catch area (0.1-5km from the coast) (km^2)	180.0
3. Commercial catch area (10.1-15km from the coast) (km^2)	338.0
4. Size of the MPA (km^2)	2.2
5. Percentage of pelagic fish in catch of commercial	1.0
6. Percentage of demersal fish catch municipal gear	0.6
C. Other constant parameters	
1. Municipal fishery turnover rate	1.5
2. Commercial fishery turnover rate	2.0
3. Initial municipal stock	1.0
4. Initial commercial stock	2.0
5. Municipal fish carrying capacity	10.0
6. Commercial fish carrying capacity	3.0
7. MPA spill over rates	0.1
8. Fisher's income expenditure (daily exp. Req/mun fisher)	100.0
9. Fisher's income..(min sales req/comm. fisher)	20,000.0
10. Fees and charges	0.0
11. MPA cost and revenue (cost reduction)	0.1
12. MPA cost and revenue (registration, rentals, charges)	0,0,0
13. Cost centers (4 parameters)	1.0
14. Annual operating cost	0
15. Benefits and cost variables	Equation on

C. Scenarios tested using the FISH-BE model

These are the scenarios tested using the program:

Scenario 1

Maximum number of fishers allowed to avert the collapse of fishery stocks in the absence of an MPA; total annual catch projected.

Scenario 2

Minimum size of MPA to avert the collapse of fishery stocks and minimum price of fish to support the displaced fishers.

Scenario 3

Other options for sustainable fishery to avert the collapse of both stocks by manipulating the combination of the following parameters:

a. size of MPA
b. number of fishing effort
c. number of fishing days
d. catch regulation (kg/fisher/day)

D. Results

Based on the fisheries profile data, there are about 22 types of fishing gears used in Payao. Among the different methods, 2 are destructive (dynamite and compressor), and 1 is active fishing gear (small Danish seine or *hulbot de mano*). The estimated annual catch was computed at 2,200 mt of which 34.8 mt (17.4%) is contributed by *hulbot de mano* and 547mt (25%) by dynamite and compressor. Total fishers was computed at 2,691 and only 18 were involved in *hulbot de mano*. There is no known commercial fishing gear owned by the residents of Payao, but there are many commercial fisherfolk who operate in their municipal waters. The estimated municipal catch is 3.5kg/fisher/day. The estimate used for the commercial catch was that of the *hulbot de mano* which is 8.3/fisher/day (tables 36 and 37, **appendix 4**).

Scenario 1

The fishery cannot be sustained at the present rate of the number of municipal fishers (2,673). The number of fishers must be reduced to 500 to avert the collapse of both fishery stocks. In this scenario, the projected annual catch is 1,489mt with fishers income of P163,818 and can support as much as 1,064 fishers.

Scenario 2

At the current fishing pressure of 2,673, the minimum MPA size must be 80% (532.8km^2) of the municipal waters to prevent the collapse of both fishery stocks. Furthermore, the price of the fish must be raised at a rate of P65/kg to support all the displaced fishers.

Scenario 3

The possible best scenario for Payao is to have an MPA size of 4% (26.6km^2) of the total municipal waters, reduce the fishing effort to 600 fishers and reduce the fishing days to 200 per year. Under this scenario, the projected annual catch is 1,491mt with an income of P136,752 which can support as much as 2,279 fishers.

Table 36. Different scenarios tested

Scenario	Output	Results
1. a) Without MPA	Current number of fishers	2,673 fisher
	Projected annual catch	0 mt
	First stock to collapse	Both
1. b) Without MPA	Maximum fishers to avert collapse of both stocks	500 fisher
	Projected annual catch	1,489.25 mt
2. Minimum MPA size in percent of municipal waters		80%
	Price/kg of demersal fish catch that can support all fishers	P65.00

Table 37. Other options tested

	Scenario				
Parameters	Baseline	1	2	3	4
1. Size of MPA (km^2; % of the municipal waters)	2.2 (0.33%)	532.8 (80%)	99.9 (15%)	26.6 (4%)	26.6 (4%)
2. Number of municipal fisher s	2,673.0	2,673.0	600.0	520.0	600.0
3. Number of displaced fishers			1,073.0	2,153.0	2,073.0
4. Number of fishing days per year	230.0	230.0	230.0	230.0	200.0
5. Number of municipal fishers supported by the fishery income		2,433.0	2,321.0	2,272.0	2,279.0
6. Municipal catch (mt/yr)	2,165.0	1,592.3	1,519.0	1,486.9	1,491.8
7. Municipal catch per day (kg/fisher/day)	3.5	3.5	3.5	3.5	3.5
8. Average income per year of active municipal fisher (PhP)		P32,763.00	P139,245.00	P157,265.00	P136,752.00

E. Lessons Learned in Using the FISH-BE Model

The FISH-BE model provides different management tools on how managers and LGUs manage and sustain their coastal resources. The results of the runs using the model indicated that in a large coastal area like Payao, a complex management intervention (i.e., reduction of fishing effort, regulation of fishing days, increase in MPA size, and etc.) is needed in order to sustain the fishery. The simulation of the different parameters in the model provides guidance to determine accurate and more realistic measures.

Furthermore, in manipulating the input values, managers have to ensure that the numbers used are reasonable, realistic and applicable to the present situation. The LGU's resources and capability must also be considered to implement the programs.

F. Management Content in the Application of the Model

The model suggests that Payao can only support as much as 520 municipal fishers with an annual income of P157,625 without collapsing both fishery stocks. The model also showed that municipalities with large municipal waters can provide high income for fishers and can support about a thousand fishers at a rate of only 200 fishing days per year. The results on the entry of commercial fishing showed that it can only accommodate one commercial fishing vessel (1 boat=17 to 18 fishers). This means that it would be better not to entertain the entry of such vessels for easy management. The reduction of fishing effort from 2,673 to 1,000 may be attainable but it has to be planned well through consultation and participation of all stakeholders. Nevertheless, the model provides many choices on how the fishery can be sustained.

Among the coastal municipalities of Zamboanga Sibugay, Payao has the largest coastline (62 km) and coral reef area (2,021hectares). Its coastal communities are also largely dependent on fishery resources. With the FISH-BE model, LGUs are able to determine appropriate management measures that will lead to the sustainability of the fishery.

Illana Bay

Wilfredo Campos

Illana Bay is located in western Mindanao and forms the inner portion of the Moro Gulf. It covers a total area of about 4680 km^2, about 23% of which are shelf (depth = not more than 200 m) waters. It is bordered by the provinces of Zambonga del Sur, Lanao del Norte, Lanao del Sur and Maguindanao. The total number of fishers is conservatively estimated at about 14,200, of which 89% are municipal fishers. Illana Bay's coastline extends to about 266 km, this translates to a fisher density of about 53.3 fishers/km coastline (based on adjusted estimates of MSU Foundation, Incorporated [unpublished report]). This falls within the range of moderate fishing intensity. The latter can also be expressed in a parallel manner as number of fishing gear units per km coastline (= 31.8 units/km coastline). The estimated total annual catch about 20,000 mt, 60% of which is landed by municipal fishers, which in turn account for 99% of all fishing trips. On the average, municipal fishers fish about 228 days in a year with mean daily catches of 4.2 kg/fisher. In contrast, commercial fishing (purse seine, bagnet and handline, and payao) operates about 151 days in a year, with mean daily catch rates of 33 kgs/fisher. The combined catch rate is about 6.3 kg/fisher/day. Pelagic fish comprise about 80% of total landings, while the remaining 20% (demersals) is landed exclusively by municipal fishers.

Spatial Characteristics					
Length of coastline (km)	265.9				
Width of shelf (km)	4.0				
Area of shelf (km^2)	1,066.2				
Bay area w/in 15km	3,988.5				
Bay area outside 15km	691.7				
Total area of Bay (km^2)	4680.2				
Catch & Effort Summary					
Est. Annual C (mt/y)	Mun		Comm		Total
Pelagic	7,868.3	65.3%	8,012.8	100%	15,881.0
Demersal	4,186.1	34.7%	0	0%	4,186.1
Total	12,054.3		8,012.8		20,067.1
Gear units	8,309.0		141.0		8,450.0
Est. no. of fishers	12,558.0	0.886	1,609.0		14,167.0
Fishing trips	1,892,235.0	0.989	21,278.0		1,913,513.0
Fishing days	228.0		151.0		226.0
Fishing trips/km^2	8.0		0.030		
Fishers/km coastline					53.3
Daily Catch rate (kg/trip)	6.4		376.6		10.5
Daily Catch rate (kg/f/d)	4.2		33.0		6.3

In terms of total fishing trips, the dominant gear types are handlines and multiple hook and line, while in terms of fish landings the dominant gear types include the various forms of hook and lines, purse seines and bagnets.

A. Potential Management Issues

Encroachment of commercial operations seems to be a major issue as manifested by the large discrepancy in contributions to overall fishing effort and to total landed catches. This is further encouraged by the narrow shelf (~ 4km) of the bay and the deployment of payaos well within municipal boundaries. Designing MPAs that extend well into deep water would allow resource conservation and might discourage payao deployment within municipal waters.

There is a predominance of juveniles in the catches in Illana Bay which might be related to the use of *payaos*. The use and deployment of Fish Aggregating Devices (FADs) should be regulated based on what is known about spawning, feeding, and movement of local stocks. While overall mean catch rates (6.3 kg/fisher/day) seems high compared to many other areas in the country, this may be an artifact of the relatively large contribution of gear types typically used with FADs, and hence related to aggregation. When aggregation is a major factor, catch rates become a poor indicator of exploitation status because the aggregation allows catches to continue to remain "high" even when abundance has been considerably reduced, and it is only when depletion sets in that catches start decreasing.

Dimataling, Zamboanga del Sur

Maria Fe Portigo and Freddie Puerto

Dimataling is a municipality on the eastern part of the Baganian Peninsula in Zamboanga del Sur. Its boundary on the north are the municipalities of Dinas and San Miguel; on the east is the Illana Bay; on the south are the municipalities of Tabina and Pitogo and on the west are portions of the municipalities of Margosatubig, Vicenso Sagun and Maligay Bay.

Dimataling has 25 barangays and covers a land area of 170.18 km^2 or 17,018.17 hectares. Eleven barangays are coastal, 6 are found along Illana Bay while the other 5 are located along the Maligay Bay.

The income of the coastal residents of Dimataling is drawn primarily from fishing and other water-based activities like seaweed farming and fishpond operation. Fishery annual production of 973.63 tons provides an estimated annual net income of P 41,838.

Of the 635 boats owned by fishers, there is a prevalence of non-motor boats (539) over the motorized (96). Twenty kinds of gears were identified in the area, where 9 were most frequently used.

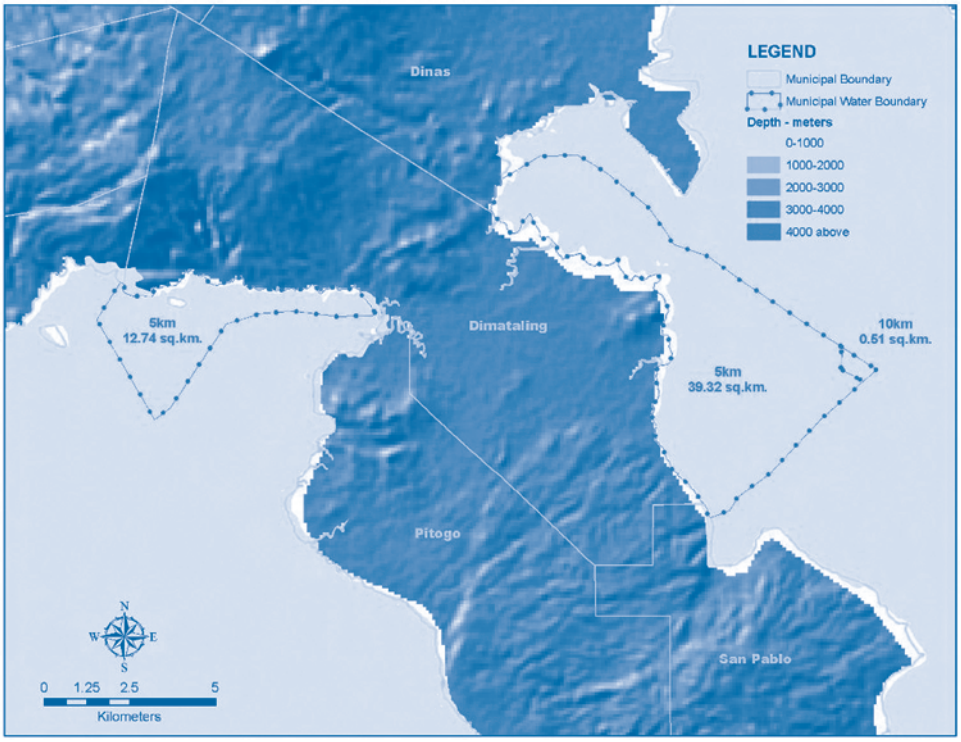

Figure 14: Municipal waters of Dimataling

The economic life of fishers in Dimataling is unstable. Income from fishing is meager and fishers tend to spend more than they earn from a day's fishing activity. Like in most coastal areas of the country, fishers in Dimataling perceive a decline in fish catch due to overharvesting and habitat destruction. Many of them resort to efficient but destructive fishing methods like blast and poison fishing. Cyanide and blast fishing are dealth with by the Coastal Law Enforcement Plan.

The two marine sanctuaries of Dimataling are in Barangay Buburay and Barangay Bacayawan. The former has an area of approximately 50 hectares while the latter has approximately 20 hectares. Both marine sanctuaries have technical descriptions and have been delineated into zones. These are also legitimized by local ordinances and local chief executive orders. Information, education and communication programs for the protection of the two marine sanctuaries are part of the Dimataling's Marine Protected Area (MPA) Management Plan.

The heavy siltation of waterways that eventually reach the sea poses serious threat to corals. Since the cutting of mangroves exacerbates this condition, the municipal government has instituted the reforestation of 3 hectares of mangrove area in Barangay Buburay.

The municipality of Dimataling is a member of the Illana Bay Regional Alliance (IBRA 9), a network of local government units located along Illana Bay. The network aims to sustain the bay's resources through integrated and participatory management efforts. Threats like sea robbery and extortion require a force beyond the municipality and this is where the Fisheries Law Enforcement Team (FLET) created by IBRA 9 provides the necessary assistance to municipal level law enforcers.

A. Data Inputs

The EcoGov2 project commissioned a participatory coastal fisheries assessment of four LGUs of Zamboanga del Sur, including the municipality of Dimataling. The results of the rapid assessment provide a synoptic scenario of the fishing industry of the LGU.

As shown in table 38, among the different kinds of fishing gears in Dimataling, spear fishing obtains on the average about 7.5 kg, the highest catch for each fisher in a day while the fish corral obtains the lowest at 1.3 kg. per fisher per day. Average daily fish catch per fisher is placed at an average of 2.7 kg. There are 1,611 fishers in Dimataling. Fishers usually go fishing 179 days in a year. Hook and line (single and multiple) appears to be their most preferred gear. All in all in a year, the fishers in Dimataling catch about 948,885 kg. Sold at an average price of P58, this total fish catch will fetch an annual gross income of P59,862,244.

Table 38. Dimataling consolidated municipal fisheries catch matrix of major gears (based on MSU Naawan Foundation Inc. Fisheries Profile)

Gear Type	Type of Catch	Ave. Catch/ Fisher/ day	No. of Fisher	No. of Fishing days/ month	Ave. No. of kg/ fisher/ annum	Price	Annual Gross income
Bottom set gill net	Putian, timbungan, molmol, lapu, boagaong, Banak, kitong, katambak, laya	1.8	173.0	21.0	78,472.8	P65.00	P5,100,732.00
Drift Gill net	Burot, kubal-kbal, guisaw anduhaw pirit						
Multiple hook an line	Kutob, laya, trakitk, lapis, barla, pugapo, diwit, and others	2.5	50.0	21.0	31,500.0	P35.00	1,102,500.00
Multiple H/L (p)	Burot kutob, tulingan						

Single H/L	Liplipan, tanggigue	2.5	620.0	24.0	446,400.0	P60.00	P26,784,000.00
Fish corral	Putian, timbungan, molmol, lapu, boagaong, banak, kitong, katambak, laya						
Fish trap	Dangit, molmol, timbumgan,	2.5	17.0	24.0	12,240.0	P45.00	P550,800.00
Spear fishing	Liplipan, tanggigue						
Spear fishing	Lapu, pugapo, molmol, kitong, dangit, timbungan	2.5	620.0	18.0	334,800.0	P70.00	P23,436,000.00
AVERAGE		2.9				P58.90	
TOTAL			1,611.0	176.0	948,885.6		P59,862,244.00

B. Simulation Exercises

The problems on overfishing and illegal fishing call for management interventions. The FISH-BE model was used to guide local chief excutives in identifying and evaluating management options and possible trade-offs.

In all of the scenarios below, commercial fishers were kept at a distance of 15 kilometers from the shore since they cannot be accommodated in the small area of Dimataling's municipal waters. The sustainability of a given scenario is judged on the basis of unchanged catch levels within the first 20 year- model run.

Base Scenario 1: No intervention Scenario

This scenario shows that the fishing industry in Dimataling will collapse in 2 years if no management intervention is instituted. As shown on table 39, the municipal fishers will lose an income of P57,996,000. This amount will be the cost of the government's social amelioration program to support the fishers' survival. Government obtains revenues in the amount of P878,055. However, the community's loss in terms of the economic benefits of the MPA is calculated at P992,234, while environmental losses like aesthetic values, biodiversity and tourism potentials are estimated at P39,621.

Scenario 2: With the Existing MPA of 0.70 km^2, Number of MF Maintained and Fish Price Pegged at P58/kg

Scenario 2 shows that with the existing marine sanctuaries and an aggregate area of 70 hectares, or 0.70 km^2, the fishing industry will be sustained over a period of 20 years. Municipal fishers will be earning an average income of P29/day and the total fishery income can support only 1 fisher. There will be 1,610 fishers without income, constituting an income deficit of P57,949,615 for municipal fishers and a cost on

the LGU in terms of social amelioration program. Government net revenues are estimated at P845,730 while its expenditure for the MPA management is P66,203. The positive gain of this scenario is that society will be able to enjoy the MPA benefits valued at P694,564.30 and environmental benefits of P13,177.

Scenario 3: MPA Size is Increased to the Maximum Size of 15% of the Municipal Waters, Number of Municipal Fishers is Maintained and Fish Price Pegged at P58/kg

With an MPA of 5.5 km^2, the fishing industry will be sustained over a period of 20 years. The total fishery income can support 10 fishers and the average income of municipal fishers will increase to P225/day. About 1,601 fishers will not earn minimum requirements resulting in an income deficit of P57,633,797, which also represents the cost of government's amelioration programs. MPA management cost increases to P 83,817 and economic benefit drawn from the MPA increases to P5,457,290.

Scenario 4: MPA at 0.7 km^2, Fish Price Increased to P402 per kg

Scenario 4 shows that increasing the fish price from P70.00 to P402 per/kg will yield an average daily income of P200 for the municipal fishers. The total fishery income will support 9 fishers and about 1,602 fishers will not be able to obtain the minimum requirements. The fishers total income deficit will be P57,674,504. The net revenue for the government will be P815,730 with MPA and CRM expenditure reduced to P66,203. Economic benefits from the MPA will be P694,564 and environmental benefits will be about P22,949.

Scenario 5: MPA at 0.7 km^2, Number of Fishers Reduced to 636

Scenario 5 reveals that the reduction in the number of fishers from 1,611 to 636 will make the average income of municipal fishers to P208 per day. However, only 4 fishers will be supported by the fishery income and about 633 fishers (39.42%) cannot avail the minimum requirements which will increase the deficit to P57,863,513. The fishers will need support from the government's social amelioration program in the same amount. The LGU will be able to earn revenues of about P818,057, even while spending P66,203 for MPA and CRM management. The community will be able to enjoy MPA economic benefits valued at P694,564 and environmental benefits of P43,571.

Table 39. Summary results from simulation of government intervention options

Outcome Variables	Scenario 1: (Baseline: No Management)	Scenario 2: (Existing MPA 70 ha.)	Scenario 3: (MPA 5.5 km^2)	Scenario 4: (MPA 0.70 km^2, Increase Fish Price to P402/kg)	Scenario 5: (MPA 0.70 Reduce number of fishers to 636)
Size of MPA	0	0.7 km^2	5.5 km^2	0.7 km^2	0.7 km^2
Nearest Distance to shore for CF	15.0	15.0	15.0	15.0	15.0
Number of MF	1,611.0	1,611.0	1,611.0	1,611.0	636.0
Market Price	P58	P58	P58	P402	P58
Average Catch/day/fisher	2.7 kg	2.7 kg	2.7 kg	3.5 kg	2.7 kg

Municipal catch Area	39.83 km^2	39.83 km^2	39.83 km^2	39.83 km^2	39.83 km^2
Average fishing days/ year	179	179	179	179	179
Municipal Fishers					
Number of fishers supported by total fishery income	0	1	10	9	4
Equivalent number of municipal fishers without fishery income	1,611	1,610	1,601	1,602	633
Average income of municipal fishers	0	P29/day	P225/day	P200	P208
Active municipal fishers	1,611	1,611	1,611	1,611	636
Inactive Municipal fishers	0	0	0	0	975
Income requirement of inactive municipal fishers	0	0	0	0	P35,087,580.00
Government					
Municipal fishers' total income deficit	P57,996,000.00	P57,949,615.00	P57,633,797.00	P57,674,504.00	P57,863,513.00
Local government net revenue	P878,055.0	P845,730.00	P824,525.00	P815,730.00	P818,057.00
Annual cost of MPA management	0.00	66,203.00	P83,817.00	P66,203.00	P66,203.00
Government expenditures for CRM	0.00	66,203.00	P83,817.00	P66,203.00	P66,203.00
Society					
MPA benefits to society or forgone benefits if without MPA	(992,234.7)	P694,564.30	P5,457,290.7	P694,564.30	P694,564.30
Net Losses to society with less than or without minimum MPA	(39,621.9)	P13,177.20	0.00	P22,949.30	P43,571.30

As shown on table 39, the scenario most favorable to fishers is scenario 3, which expands the MPA area to 5.5 km^2. This option will still be difficult for a municipality like Dimataling whose municipal water is small. It can, however, explore mutually beneficial arrangements with its neighboring municipalities (e.g., Tabina) which may in a way expand its fishing area. MPA economic benefits are also the highest among the options. Reduction of fishers is a much more difficult option as it may have political consequences.

C. Recommendations

1. Data collections on the key data parameters should be refined through the CRM management council of the municipality to contribute to their municipal fisheries database.

2. These scenarios should be presented to the local chief executives (LCE) and members of the CRM management team to guide them in their fishery management decisions. We can also obtain some scenarios from them that can be tested and evaluated using FISH-BE.

3. CRM provincial partners especially the Fisheries Division of the province and IBRA 9 PMO should have some sessions on the use of the FISH-BE model to improve their capacity as technical service providers.

4. Dimataling inputs should be part of the Illana Bay-wide FISH-BE model.

Dumalinao, Zamboanga del Sur

Maria Fe Portigo and Freddie Puerto

The municipality of Dumalinao is one of the 8 LGUs along Illana Bay in the province of Zamboanga Del Sur. The municipality is fast moving in terms of local economic development and coastal resources management. It is strategically located at the intersection of the highway going to Zamboanga Sibugay province, Zamboanga City and the road going to Zamboanga peninsula, and Dumanquillas Bay areas. It lies between 123°17' to 123°23' E longitude and 7°45' to 7°52' N latitude. It is bounded on the northeast by Pagadian City, on the northwest by the municipality of Tigbao, on the southeast by the municipality of Guipos and on the south by the municipality of San Pablo.

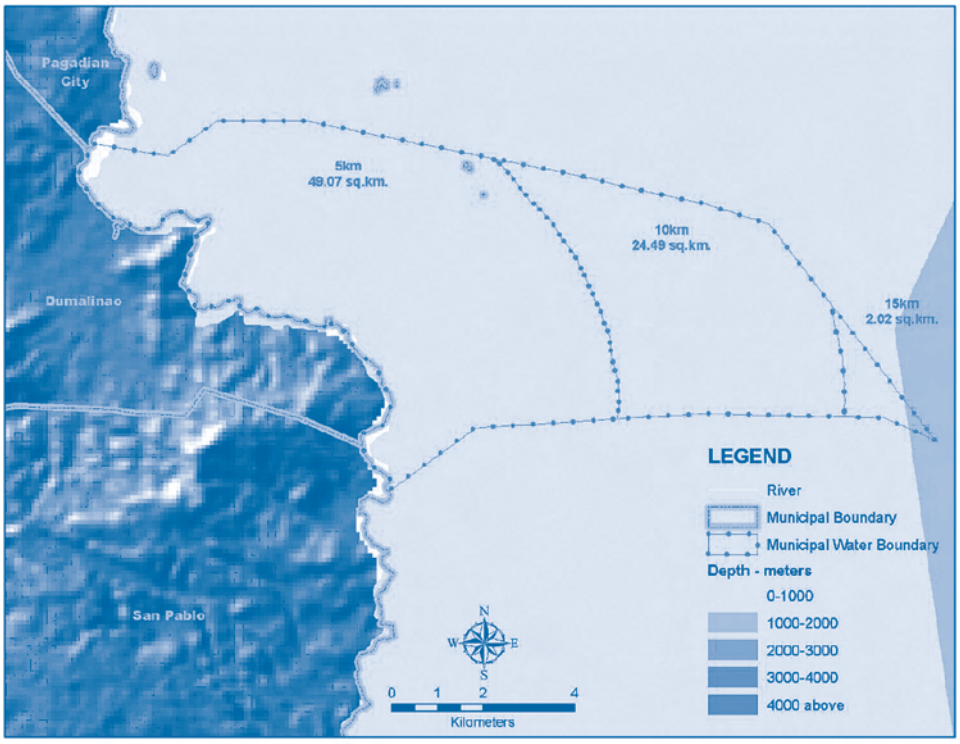

Figure 15: Municipal waters of Dumalinao

The municipality of Dumalinao was created by RA No. 1539 on June 16, 1956. The municipality is composed of 30 barangays, 7 of which are coastal barangays— Rebokon, Mama, Bibilik, Bag-ong Silao, Pantad, San Agustin and Metokong. The municipality of Dumalinao is an active member of Illana Bay Regional Alliance (IBRA 9) Council which is composed of the seven municipalities and one city, represented by the local chief executives and government organization from the province.

A. Geographical and Topographical Condition

Dumalinao has a total land area of 11,756.7 hectares, politically subdivided into 30 barangays, 7 of which are coastal. It is a fourth class municipality with a total population of 30,821 (MCLUP, 2002). The major sources of income in Dumalinao are farming, fishing and small-scales businesses.

The 7 coastal barangays of Dumalinao have 1,724 households and have a population of 9,323 (see table 40). Based on the survey conducted, there are 466 fishing households and 598 fishers in the municipality who are engaged in different fishing activities for living, while others are engaged in farming, small-scale businesses like fish vending, sari-sari store and others.

Table 40. List of coastal barangays with corresponding land area, number of households total number fishing house-holds and total population as of January 2006

Barangay	Land Area Hectares	Household	Fishing Households	Population
Bag-ong Silao	235.8	196.0	52.0	1,176.0
Bibilik	354.4	243.0	126.0	1,254.0
Mama	293.1	157.0	47.0	800.0
Metokong	353.5	111.0	48.0	665.0
Rebokon	1,718.2	655.0	65.0	3,421.0
San Agustin	303.9	170.0	21.0	1,003.0
Pantad	155.8	192.0	107.0	1,004.0
TOTAL	3,414.7	1,724.0	466.0	9,323.0

B. Climatic Conditions

The municipality of Dumalinao has two distinct climatic conditions, the wet and dry seasons and wind pattern known as northeast and southeast monsoon winds or Amihan. This season usually occurs in November to the later part of April. Coastal communities particularly fisherfolk who are solely dependent on the sea hardly meet both ends with their meager income during this season.

C. Dumalinao Major Coastal Habitat

Dumalinao has a total coastal area of 75.58 km^2 producing more or less 340.4 mt per annum of various fishery products produced by its natural resources such as mangroves, seagrass beds, corals reefs, tidal flat and marine ecosystems. However, due to excessive and uncontrolled fishing activities in the municipality, there is rapid resource degradation and decline in fish catch. To date, the average fish catch per fisher per day is only about 3 kg per trip which could hardly sustain the minimum basic needs of fisherfolk.

In order to address environmental degradation issues, the local government units of Dumalinao tried to allocate regular budget for CRM program to protect and enhance coastal resources and prevent further destruction of the coastal ecosystem. These initiatives will bring back the bounty of the coastal and marine resources for ecological and economic benefits of the populace.

D. LGU Initiatives

As part of the LGU initiatives in protecting and enhancing their degraded resources, the local government of Dumalinao implemented the following coastal projects:

- Establishment of 2 has of mangrove rehabilitation and reforestation project at Sitio Baroy Rebukon through funding from the Canadian International Development Agency (CIDA);
- Coral transplanting at Bibilik;
- Formulation of MPA management plan and establishment of 2 MPAs at Bagong Sialao and Bibilik (total of 42 hectares) through the assistance of EcoGov2;
- Establishment of enforcement mechanisms (i.e., Bantay Dagat) in coastal communities to safeguard the area from illegal fishers.

E. Municipal Fisheries and Socioeconomic Profile (based on MSU Naawan Foundation Inc. Fisheries Profile)

1. Fisheries Products and Coastal Livelihood

   Dumalinao is endowed with abundant fishery resources from capture fisheries and fishpond development. Because it faces the rich waters of Illana Bay and has wide areas of developed fishponds, it has a great advantage in terms of fisheries production.

   Barangays Rebukon and San Agustin have a total land area of 104 hectares of underdeveloped and abandoned land that is suitable for mangrove rehabilitation and silve-culture activities that can provide additional income for marginalized fisherfolk.

2. Socioeconomic Profile of Fishers

   Fishing is a common livelihood among the residents of Dumalinao. Most fishers employ traditional gears such as single hook and line, multiple hook and line, fish corrals (*bungsod*), gill nets, spear, and fish traps. Some fishermen are engaged in fishpen culture and *agar-agar* farming. A few are also into fishcage and oyster culture. A number of these fishers are likewise engaged in farming for their daily sustenance and augmentation of their fishing income.

   Focus group discussions were conducted in seven coastal barangays by the Dumalinao Fisheries Technicians and EcoGov2 staff to obtain important data on fishing activities, yield and effort, and estimate of gross daily income from fishing. Although the majority, about 80%, of Dumaliano fishefolk are full-time fishers, all of them are engaged in a variety of alternative livelihood activities such as domestic animal raising, farming, fishpond work, seaweed farming and small business (sari-sari store).

3. Type of Dwellings in the Coastal Communities

   Based on the survey conducted, majority of the houses are constructed along the shoreline. Very few (3.3%) fishers have concrete houses and only 7.5% have semi-concrete houses usually owned by entrepreneurs, barangay officials, and landowners (see table 41). Some fishers (14.6%) have houses made of wood with galvanized roofing while 34.3% have walls made of either nipa or Coconut leaves. The most common type of house of fishers are those made of wood/bamboo with nipa (40.3%).

Based on the survey conducted, 85-90% of the coastal residents are landless. Most landowners do not allow fisherfolk to construct a decent house.

Table 41. Type of dwellings per coastal barangays and ownership

Barangay	Type of Dwelling					Ownership			
	Total no. of Concrete	Total no. of Semi-Concrete	Total no. Wooden/ Galvanized Roof	Total no. Wooden with Nipa Roof	Total no. shanties	Own land		Rent	Free
						Title	Tax dec		
Mama	5.0	12.0	86.0	50.0	8.0	11.0			2.0
Bibilik	7.0	17.0	97.0	104.0	18.0	31.0			
Bagong Silao	3.0	7.0	76.0	92.0	18.0	6.0		62.0	
San Agustin	8.0	18.0	49.0	72.0	23.0	34.0			
Metokong		1.0	21.0	65.0	24.0				
Pantad	9.0	13.0	70.0	60.0	40.0	15.0			
Rebokon	25.0	62.0	193.0	265.0	120.0	84.0			
Total	57.0	130.0	592.0	708.0	251.0	181.0	0.0	62.0	2.0

4. Major Gears

A total of 7 different kinds of fishing gear were identified (figure 16). Multiple hand-line, single hand-line and fish corral are the most commonly operated gears. The average catch rates (or CPUE) and daily income for each gear type are presented in table 42. The generic hook-and-line gear is comprised of two modifications (single and multiple).

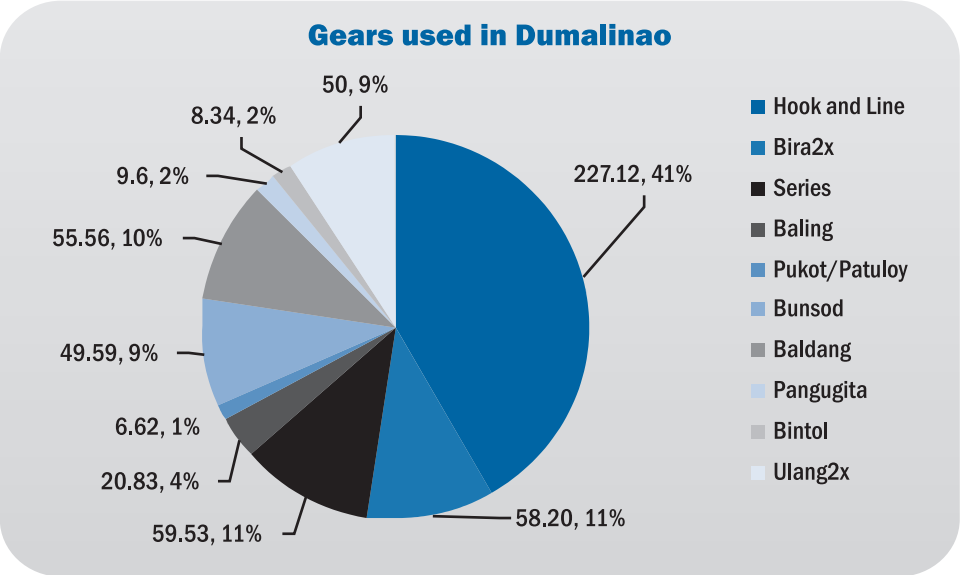

Figure 16. Type of gear commonly used in the municipality of Dumalinao

F. Municipal Fishery Production

Majority of municipal fisherfolk are using traditional fishing gears with motorized boats for off-shore fishing and nonmotorized boats for near–shore fishing. Gears that are commonly used in Dumalinao are: multiple hook and line locally known as *bira-bira*, *bundak* which is also known as barangay in other neighboring municipalities to capture *galunggong* and *kutob* or *matambaka*. The hook and line type of gear with one big hook, locally known as *pahawin*, is used for sail fish, blue marlin, tuna and other pelagic fishes. Table 42 show the average fish catch and average income per fisher per day per trip. So far, only *bundak* or bira-bira and bunsod got an average of 5 kg of fish per day with an average income of P375. *Baling–baling* or *pamasayan* got the smallest average catch per day with only 500 grams per day.

Table 42. Estimates of average catch rates (CPUE) and gross income of Dumalinao fisher folks from various gears

Gear Type	Type of Catch	Ave. Catch/ Fisher/ day	No. of Fisher	No. of Fishing days/ month	Ave. No. of kg/ fisher/ Yr	Price	Annual Gross income
Multiple Handline	Bira-bira; Bundak/pasol	212.0	22.0		5.0	P375.00	P1,749,000.00
Fish Corral	Bungsod	36.0	30.0		5.0	P350.00	P378,000.00
Spear	Pana	1.0	22.0		3.0	P90.00	P1,980.00
Simple Gillnet	Putuoy,pahubas, Handok	15.0	12.0		3.7	P277.50	P49,950.00
Squid Jig	Subidaranias/series light	75.0			2.75	P192.50	P5,390.00
	Pangugita	11.0	22.0		3.0	P240.00	P58,080.00
	Ulang-ulang	60.0	12.0		5.0	P200.00	P302,400.00
	Baling	184.0	22.0		.8	P45.00	P182,160.00
	Baling-baling /Pamasayan	4.0	22.0		.5	P50.00	P4,400.00

The multiple handline or bundak also got a large CPUE value of 5 kg/fisher/day, bunsod 5 kg/unit while catch rates of many gears (spear and squid jig, *pahubas, patuloy, baling*, and *baling-baling* for shimp) are low (0.50-3.5 kg/fisher/day). A number of fishers use a combination of two or more gears, but CPUE values remain small. Overall average CPUE of various gears is 3 kg/fisher/day, which translates into a monetary value of between P65 and P195/day, depending on the quality of fish caught. A comparison of average gross daily income from fishing is shown in figure 17.

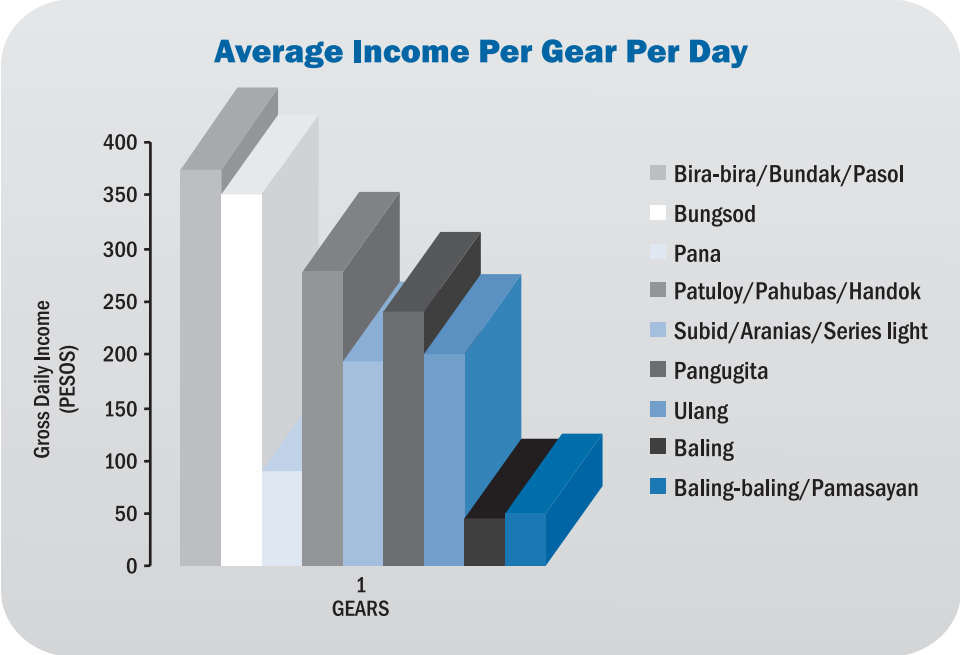

Figure 17. Gross daily income of some fishers in the municipality of Dumalinao

G. Management Options Using the FISH-BE Model

The economic life of fishers is unstable. The income from fishing is relatively below poverty level. Fishers tend to spend more than they earn from a day's fishing activity. Similar to most coastal areas in the Philippines, Dumalinao fisherfolk perceive a decline in fish catch due to overfishing, habitat distraction and intrusions of commercial fishers in the municipal waters.

Problems of overfishing and illegal fishing call for management interventions. To guide LCEs on the trade-offs of some management options, the fisheries bio-economic model was used to identify and evaluate these management options. The sustainability of a given scenario is judged on the basis of unchanged catch levels within the first 20-year model run.

In all of the scenarios below, commercial fishers are kept at a distance of 15 kilometers from the shore because they cannot be accommodated in the municipal water as mandated by law.

Base Scenario 1: No Intervention Scenario

This scenario shows that the fishing industry in Dumalinao is bound to collapse in 5 years if no management intervention is instituted. As table 43 shows, the municipal fishers will lose an income of P21,528,000. The same amount will be the cost of the government's social amelioration program to support the fishers' survival. The government obtains revenues of P872,990. Society loss in terms of economic benefits of the MPA is P992,234 while environmental losses like aesthetic values, biodiversity and tourism potentials are P13,319.

Scenario 2: With the Existing MPA of 0.42 km^2, Number of MF Maintained and Fish Price Pegged at P65/kilogram

Scenario 2 shows that with the existing marine sanctuaries with an aggregate area of 42 hectares, or 0.42 km^2, the fishing industry will be sustained over a period of 20 years. Municipal fishers will be earning an average income of P149/day and the total fishery income can support only 2 fishers. There will be 596 fishers without fishery income, constituting an income deficit for municipal fishers of P21,438,866 and a cost on the government in terms of its social amelioration program. Government net revenues are estimated at P817,802 while its expenditure for MPA management is P61,839. The positive gain of this scenario is that the community will be able to enjoy the MPA benefits valued at P416,738 and environmental benefits in the amount of P29,951.

Scenario 3: MPA size is Increased to the Maximum Size of 15% of the Municipal Waters Based on RA 8550, Number of MP Maintained and Fish Price Pegged at P65/ kilogram

With an MPA of 11.33 km^2, the fishing industry will be sustained for 20 years. The total fishery income can support 269 fishers and the average income of municipal fishers will increase to P16,176/day. About 329 fishers will not earn minimum requirements resulting in an income deficit of P11,390,870 which also represents the cost of government's amelioration programs. The local government net revenue is P1,504,813. MPA management cost increases to P89,970 and economic benefit from the MPA increases to P11,212,251.

Scenario 4: MPA at 0.42 km^2, Fish Price Increased to P100/kilogram

Scenario 4 shows that increasing the price of fish from P65 to P100/kilogram will yield an average daily income of P229 for municipal fishers. The total fishery income can support 4 fishers and about 594 fishers will not be able to earn the minimum requirements. The total income deficit will be P21,390,870. The net revenue of the government will be P817,802, with expenditure for MPA and CRM reduced to P61,839. Economic benefits from the MPA will be P416,739 while environmental benefits will be about P21,702.

Scenario 5: MPA at 0.42 km^2, Number of Fishers Reduced to 10%

Scenario 5 shows that the reduction in the number of fishers from 598 to 537 will cause municipal fishers to have an average income of P58 per day. However, only 1 will be supported by the fishery income and 536 fishers will not be able to avail of the minimum requirements. The total income deficit will be P21,152,800. Fishers will need support from the government's social amelioration program in the same amount. The government will be able to earn revenues of P813,176, even with annual MPA cost of management and LGU expenditures of P61,839. The community will be able to enjoy MPA economic benefits valued at P416,738 and environmental benefits at P20,993.

Table 43. Summary results of simulation of government intervention options

Outcome Variables	Scenario 1: (Baseline: No Management)	Scenario 2: (Existing MPA .42 km^2)	Scenario 3: Increase MPA size to 15%	Scenario 4: Increase fish price, remain MPA size	Scenario 5: Reduce 10% in municipal fishers.
Size of MPA	0.0	.42 km^2	11.3 km^2	.42 km^2	.42 km^2
Nearest Distance to shore for CF	15.0	15.0	15.0	15.0	15.0
Number of MF	598.0	598.0	598.0	598.0	598.0
Market Price	65.0	65.0	65.0	100.0	65.0
Average Catch/day/fisher	3.0	3.0	3.0	3.0	3.0
Municipal Catch Area	75.58 km^2	75.58 km^2	75.58 km^2	75.58 km^2	75.58 km^2
Average Fishing Days/ year	166.0	166.0	166.0	166.0	166.0
Municipal Fishers					
Number of fishers supported by total fishery income	0.0	2.0	269.0	4.0	1.0
Equivalent number of municipal fishers without fishery income	598.0	596.0	329.0	594.0	537.0
Average income of municipal fishers	0.00	P149.00	P16,176.00	P229.00	P58.00
Active municipal fishers	598.0	598	598	598	538.0
Inactive Municipal fishers	0.0	0	0	0	60.0
Income requirement of inactive municipal fishers	0.0	0	0	0	2,152,800.0
Government					
Municipal fishers' total income deficit	P21,528,000.00	P21,438,866.00	P11,854,492.00	P21,390,870.00	P21,496,862.00
Local government net revenue	P872,990.00	P817,802.00	P1,504,813.00	P817,802.00	P813,176.00
Annual cost of MPA management	0.0	P61,839.00	P89,970.00	P61,839.00	P61,839.00
Government expenditures for CRM		P61,839.00		P61,839.00	P61,839.00
Society					
MPA benefits to society or forgone benefits if without MPA	P992,234.70	P416,738.60	P11,212,251.70	P416,738.60	P416,738.6.00
Net Losses to society with less than or without minimum MPA	P13,319.40	P29,951.70	0.0	P21,701.20	P20,993.50

As shown on table 43, the scenario most favorable to fishers is Scenario 3. This scenario expands the MPA area to 11.3 km^2. However, this option will be difficult for a municipality like Dumalinao since its municipal water is small. The LGU can explore other management options by regulating certain fishing gears like beach seine (baling), having a close season, or banning the catching of danggit fry especially during spawning season to allow the fish population to increase. MPA economic benefits in this scenario are also highest among the options. Reduction of fishers is a difficult option since it has political consequences.

Table 44. Dumalinao municipal fisheries production

Gear type	Type of Catch	Average Catch/ Fisher/ Day	No. of Fishers	No. of Fishing Days/ Month	Ave. No of Kg/ Fisher/ Year	Ave. Fish Price	Annual Gross Income
Drift Gill net	*Putian, timbungan, molmol, lapu, boagaong, banak, kitong, katambak, laya*	3.7	15.0	22.0	14,652.0	65.0	P952,380.00
Multiple hook an line (B)	*Kutod, languso, sigarilyo, tikab*	5.0	212.0	23.0	292,560.0	45.0	P13,165,200.00
Fish coral	*Putian, timbungan, molmol,lapu, boagaong, banak, kitong, katambak, laya*	5.0	36.0	30.0	64,800.0	65.0	P4,212,000.00
Beach seine	Assorted fish	0.8	184.0	22.0	36,432.0	60.0	P2,185,920.00
Spear fishing	*Mulmol, katambak, lapu,* etc.	3.0	1.0	20.0	720.0	70.0	P50,400.00
Octopus fishing	Octopus	3.0	11.0	22.0	8,712.0	85.0	P740,520.00
Ulang-ulang	Giant squid	5.0	60.0	12.0	43,200.0	80.0	P3,456,000.00
Squid Jig	Squid	2.8	75.0	10.0	24,750.0	75.0	P1,856,250.00
Pamasayan (baling-baling)	Shrimps (*pasayan*)	0.5	4.0	22.0	528.0	60.0	P31,680.00
		3.0	598.0	166.0	486,354.0	65.0	P31,613,010.00

Labangan, Zamboanga del Sur

Maria Fe Portigo and Freddie Puerto

Labangan, the major rice supplier of Zamboanga del Sur, sits on a total land area of 177.21 km^2 or 17,721 hectares, located along the northern shores of Illana Bay. On its northeastern boundary is the municipality of Tukuran, on its northern edge is the municipality of Midsalip and on its western and northwestern borders is the city of Pagadian.

The municipality has 25 barangays, 5 barangays are located along its short coastline of about 4.3 kilometers. Its population mix of Christians and Muslims depends on Illana Bay's resources for food and livelihood. Labangan's municipal water covers an area of 25.66 km^2, with annual fishery production estimated at 336,066.36 tons yielding an annual net income of about P16,546,244. There are a total of 210 fishing boats in Labangan; about 53% (111) are motorized while 47% (95) are paddle boats or non-motorized boats. About 20 gears were identified in the area of which about 10 are common. Fishers in Labangan prefer to use the hook and line specifically designed for catching tuna (*pangbariles*).

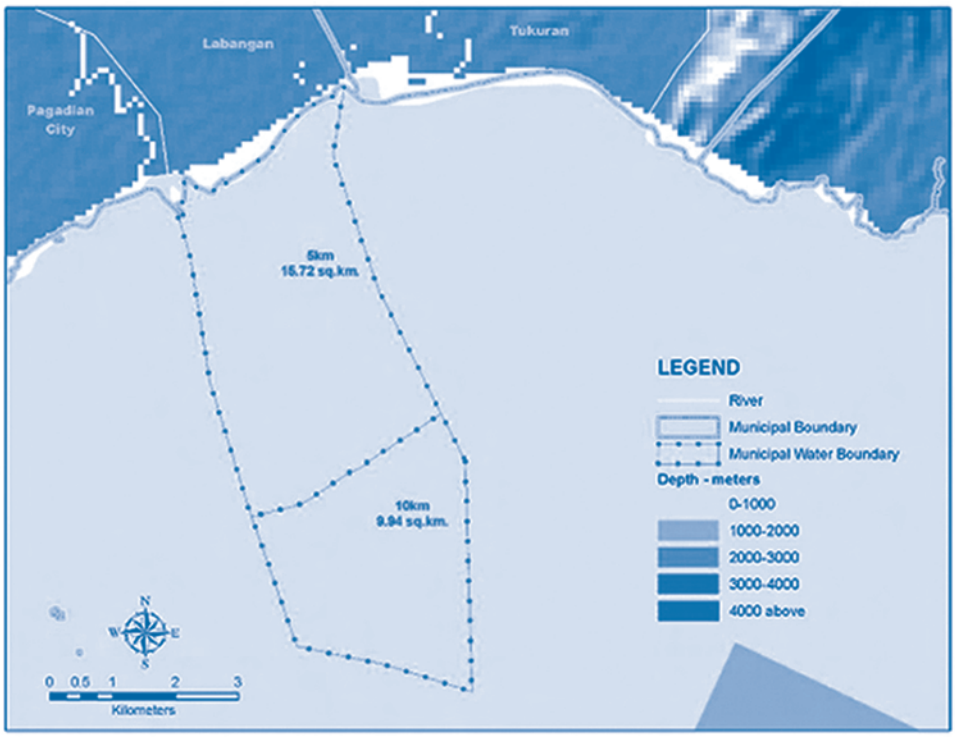

Figure 18. Municipal waters of Labangan

The fishing industry in Labangan can best be described as municipal in nature. However, a considerable number of fishers employing municipal gears (e.g., hook-and-line) operate in a magnitude that may be already classified as commercial. These are usually fishers chasing after tuna resources outside Illana Bay and sometimes even beyond the Moro Gulf.

As in most areas of the country, fishers in Labangan perceive the progressive decline in their daily catch and consequently, in their incomes. The situation is made worse by weak law enforcement against activities such as habitat destruction, pollution and illegal fishing. There is also piracy and extortion in the area.

As early as 1994, the LGU of Labangan has initiated some fishery management interventions. In that year, a 48-hectare marine sanctuary was established in Bulanit, in consonance with 11 Unified Ordinances proposed by Illana Bay Regional Alliance (IBRA 9). Another marine sanctuary of about 20 hectares was established in Barangay Combo on June 2, 2006. The LGU has approved an MPA Plan crafted with the assistance of EcoGov2. There is a mangrove reforestation area of 4 hectares established through DENR assistance.

The municipality of Labangan is a member of IBRA 9, a network of local government units located along Illana Bay that aims to sustain the bay's resources through integrated and participatory management efforts. Threats like sea robbery and extortion are raised to the Fisheries Law Enforcement Team (FLET) created by IBRA 9 for appropriate action.

Most LGU executives in coastal municipalities contend with the dilemma of curbing overfishing and illegal fishing and generating revenues and improving the livelihood of their constituents whenever they make decisions on fishery management interventions. Recognizing this difficulty, EcoGov2 experts designed the Fisheries Information for Sustainable Harvest Bio-Economic (FISH-BE model) to aid in decision-making. With the FISH-BE model, LCEs can assess the positive and negative trade-offs of possible fisheries management interventions. FISH-BE links fishery resources (bio-physical elements), resource users (fishers) market, and government interventions.

A. Data Inputs

Table 45 provides important information on the common gear types, type of catch, daily catch, fish price and annual gross income from captured fisheries. It shows that the average daily fish catch of each fisher (kgs/day/fisher) is 2.48. The 463 fishers in the area accumulate about 201 fishing days in a year. Total annual municipal fish catch is estimated at 336,066.4 kilograms. At an average price of P60 per kilo, municipal fish production would most likely fetch an annual gross income of P10,378,857.

Table 45. Fish production in the municipality of Labangan

Gear Type	Type of Catch	Ave. Catch/ Fisher/ Day	No. of Fisher	No. of Fishing Days/ Month	Ave. No. of kg/Fisher/ Annum	Price	Annual Gross Income
Bottom set gill net	*Putian, timbungan, molmol,lapu, boagaong, banak, kitong, katambak, laya*	1.3	80.0	24.0	30,643.2	P65.00	P1,991,808.00
Drift gill net	*Burot, kubal-kubal, guisaw, anduhaw pirit*						
Multiple hook an line	*Kutob, laya, trakitk,lapis, barla,pugapo, diwit, etc.*	2.0	25.0	24.0	14,400.0	P35.00	P504,000.00
Multiple H/L (p)	*Burot kutob, tulingan,*						

Single H/L	*liplipan, tanggigue*	1.9	90.0	20.0	40,608.0	P60.00	P2,436,484.00
Fish corral	*Putian, timbungan, molmol, lapu, boagaong, banak, kitong, katambak, laya*						
Fish trap	*Dangit,molmol, timbumgan*	0.8	20.0	24.0	4,320.0	P45.00	P194,400.00
Spear fishing	*Liplipan, tanggigue*	4.9	159.0	21.0	197,134.6	P70.00	P197,134.00
Spear fishing	*Lapu-lapu, pugapo, molmol, kitong ,dangit, timbungan*	3.2	59.0	26.0	58,905.6	P65.00	P706,867.20
AVERAGE		2.48				P58.90	
TOTAL		22.4	463.0	201.0	336,066.4		10,378,857.20

B. Simulation Exercises

The FISH-BE model was used to identify and evaluate the options for fishery management interventions. Sustainability of a given scenario was judged on the basis of unchanged catch levels within the first 20-year model as well as on the benefits to the environment, resource users, government, and society as a whole.

In all of the scenarios below, commercial fishers are kept at a distance of 15 km from the shore since they cannot be accommodated in the small area of Labangan's municipal waters.

Base Scenario 1: No Intervention Scenario

This scenario shows that the fishing industry in Labangan is bound to collapse in 2 years if no management intervention is instituted. As shown on table 46, the municipal fishers will loss an income of approximately P21,668,400. This amount will also be the cost of government's social amelioration program to help fishers obtain their minimum daily requirements. In addition, government loses P878,055 from revenues from fishing activities. The community's loss in economic benefits from existing MPAs is estimated to be P992,234 while environmental losses such as aesthetic values, biodiversity and tourism potentials may be valued at P127,424.

Scenario 2: With the Existing MPA of 0.68 km^2, Number of Municipal Fishers Maintained and Fish Price Pegged at P60/kg

Scenario 2 shows that with the existing marine sanctuaries with an aggregate area of 68 hectares or 0.68 km^2, the fishing industry will be sustained over a period of 20 years. Municipal fishers will be earning an average income of P107/day. The total fishery income can support only 1 fisher. Since there will be 462 fishers without income, the government has to provide social amelioration program of P21,618,754 to fill the income deficit of the municipal fishers. The government is predicted to suffer a net revenue loss of P746,032 with the added cost for MPA management at P59,360. The positive trade-off of this scenario is that the community will be able to reap economic benefits valued at P674,719 from MPA management and environmental benefits of P333,409.

Scenario 3: MPA Size is Increased to the Maximum Size of 15% of the Municipal Waters, Number of MF Maintained and Fish Price Pegged at P60/kg

Scenario 3 illustrates that with the expansion of the MPA size to 4 km^2 will sustain the fishing industry over a period of 20 years. The total fishery income from a larger MPA can support 6 fishers. The average income of municipal fishers will soar to Php631 per day. The government will have to spend in terms of its social amelioration program about P21,376,367 to support the nearly 457 fishers who will be unable to obtain their minimum daily requirements resulting from an income deficit of approximately similar amount. Annual cost of MPA management will rise to P72,987 and CRM expenditures to P1,635,987. Government deficit slightly drops to P724, 726. Government loss is compensated by an enormous amount of economic benefits from MPA management is P3,968,938 and ecological benefits valued at P227,195.

Scenario 4: MPA at 0.68 km^2, Price of Fish Increased to P402/kg

Increasing fish price from P60 to P112 per kilogram will yield an average daily income of P200 for the municipal fishers. The total fishery income will only be able to support 2 fishers. To support the rest of the 461fishers who are unable to obtain their daily minimum requirements, the government will have to provide social amelioration program of about P21,575,728, which is equivalent to the total income deficit of the municipal fishers. The government incurs a net revenue loss of P746,032 and its annual expenditure for MPA management is estimated at P815,730 and P1,622,360 for CRM management. Economic benefits from MPA management will probably be at P674,719 while environmental benefits will be about P533,753.

Scenario 5: MPA at 0.68 km^2, Number of Fishers Reduced to 417

In scenario 5, the drop in the number of fishers from 463 to 417 will cause municipal fishers to have an average income of P119 per day. However, the total fishery income can support only 1 fisher. About 416 fishers will need support from the government's social amelioration program in the amount of P1,618,754. In addition, the 46 displaced fishers will pose an income requirement of P2,166,840. The government will suffer net revenue loss of about P746,264 and MPA management and CRM will cost the government P59,360 and P1,622,360, respectively. The community will be able to enjoy MPA economic benefits valued at P674,719 and environmental benefits at P442,416.

Summary

Table 45 presents a summary of these scenarios. Except for Scenario 1, all the scenarios are sustainable within the 20-year cycle of the model. All the scenarios also provide economic and environmental benefits from the establishment of MPAs. In these four scenarios, the government incurred net revenue losses. It may be because at the moment, the fisheries management interventions are in their initial phase. Scenario 3 offers the lowest amount of net revenue loss of the government. In this same scenario revenue loss is compensated by an enormous average daily income of the fishers at P631 as well as economic benefits of MPA management. Scenario 4 offers the second highest average daily income for municipal but the price subsidy from government may add to its net revenue loss and disrupt the interplay of market forces. Scenario 5 erodes the municipal fishers' total income deficit. However, the reduction in the number of fishers may have political consequences.

Table 46. Summary of scenarios simulated using the FISH BE model in the municipality of Labangan, Zamboanga del Sur

Outcome Variables	Scenario 1: (Baseline: No Management)	Scenario 2: (Existing MPA .68 km^2)	Scenario 3: Increase MPA size to 15%	Scenario 4: Increase fish price, remain MPA size	Scenario 5: Reduce 10% in municipal fishers.
Size of MPA	0.0	.68 km^2	4 km^2	.68 km^2	.68 km^2
Nearest Distance to shore for CF	15.0	15.0	15.0	15.0	15.0
Number of MF	463.0	463.0	463.0	463.0	463.0
Market Price	P60.00	P60.00	P60.00	P112.00	P 60.00
Average Catch/day/fisher	2.5	2.5	2.5	2.5	2.5
Municipal Catch Area	25.66 km^2	25.66 km^2	25.66 km^2	25.66 km^2	25.66 km^2
Average Fishing Days/ year [see table comments]	201	201	201	201	201
Municipal Fishers					
Number of fishers supported by total fishery income	0	1	6	2	1
Equivalent number of municipal fishers without fishery income	463.0	462.0	457.0	461.0	416.0
Average income of municipal fishers	0.0	P107.00	P631.00	P200.00	P119.00
Active municipal fishers	463.0	463.0	463.0	463.0	417.0
Inactive Municipal fishers	0.0	0.0	0.0	0.0	46.0
Income requirement of inactive municipal fishers	0.0	0.0	0.0	0.0	P2,166,840.00
Government					
Municipal fishers' total income deficit	P21,668,400.00	P21,618,754.00	P21,376,367.00	P21,575,728.00	P1,618,754.00
Local government net revenue	- 690,685.00	- 746,032.00	- 724,726.00	- 746,032.00	- 746,264.00
Annual cost of MPA management	0.0	P59,360.00	P72,987.00	P59,360.00	P59,360.00
Government expenditures for CRM	P1,563,000.00	P1,622,360.00	P1,635,987.00	P1,622,360.00	P1,622,360.00
Society					
MPA benefits to society or forgone benefits if without MPA	P992,234.70	P674,719.60	P3,968,938.70	P674,719.60	P674,719.60
Net Losses to society with less than or without minimum MPA	P127,424.10	P333,409.50	P227,195.50	P533,753.30	P442,416.10

C. Management Considerations

The municipal waters of Labangan is the smallest among the eight municipalities of IBRA 9. Usually, municipal fishers fish outside Labangan since catch from traditional gears is not enough to sustain the daily needs of an average fishing household. However, Labangan's scenario should be further reviewed since the summary of simulated scenarios (table 46) shows that the average income of municipal fishers ranges from P107 to P631, which is relatively a good income in an area like Labangan.

The government should also invest a substantial amount for habitat enhancement and protection. Other options should also be explored with other municipalities for the utilization and comanagement to protect Illana Bay's resources.

D. Recommendations

1. Data collections on the key data parameters should be refined through the CRM management council of the municipality to contribute to the municipal fisheries database.

2. The scenarios should be presented to the local chief executive (LCE) and members of the CRM management body to guide them in their fisheries management decisions. Some scenarios can also be obtained from them to test and evaluate using FISH-BE.

3. CRM provincial partners especially the Fisheries Division of the province and IBRA 9 Project Management Office (PMO) should have some sessions on the use of the FISH-BE model to improve their capacity as the technical service providers.

4. Labangan inputs should be part of the Illana Bay-wide FISH-BE model.

Pagadian, Zamboanga del Sur

Maria Fe Portigo and Freddie Puerto

The city of Pagadian is the capital and commercial hub of Zamboanga del Sur, the regional center of Region 9. On its southwestern boundary is the municipality of Dumalinao while on its eastern edge is the municipality of Labangan, from which Pagadian was carved out and made a municipality in 1937.

Pagadian is a first class city with a population of 142,515. It has a total land area of 331.6 km^2 or 33,160 hectares. Its hilly landscape encompassing commercial and residential areas has caused it to be dubbed as the "Little Hongkong of the South."

The city lies on the northwestern shore of Illana Bay. It has 54 barangays, 12 of which are located along the coastline stretching to about 19.86 km. The waters under its jurisdiction encompass an area of 49.82 km^2 with annual municipal fishery production estimated at 439 metric tons yielding an annual net income of about P288,308,456.

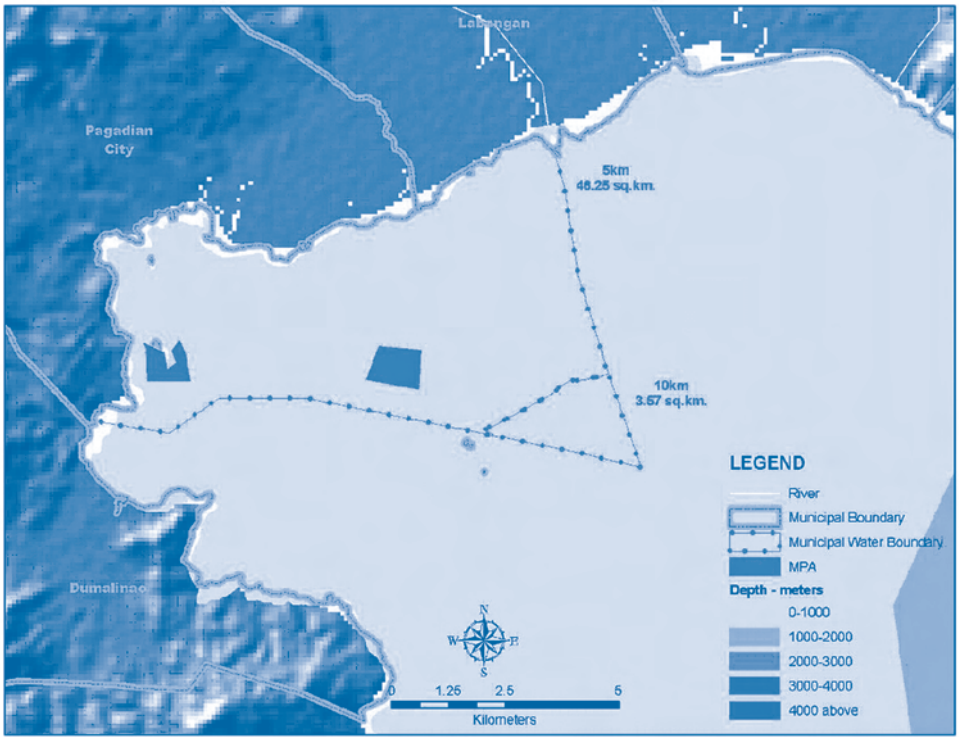

Figure 19: Municipal waters of Pagadian City

The fishing industry in Pagadian City embraces both municipal and commercial fishing. There are about 2,611 municipal fishers and 3,631 fishing boats in Pagadian City; about 76% (2,760) are nonmotorized boats or paddle boats while 24% (871) are motorized boats. There are also 59 units of commercial fishing vessels.

During the FGDs, 3 types of commercial fishing gears were identified—the bag net (*tapay-tapay or basing*), encircling gillnets (*likom*), and the tuna hook-and-line fishing (ice-bakan). The latter is the most abundant, in terms of boat units. About 646 fishers are employed in these commercial fishing fleets that yield an annual catch of 10,636 tons.

The near shore areas of Pagadian City sustain high levels of fishing effort. In some places, the gear density is so high that they are already overcrowded. About 24 gears were identified in the area; 8 of which are considered major fishing gear. The most abundant fishing gear is the simple hand line. These are usually operated along reef crests and around fish aggregating devices (FADs). *Agar-agar* lines also proliferate during peak seasons blocking a sizable portion of the shallow areas making it almost impassable.

Fishers in Pagadian observe a progressive decline in their daily catch and consequently, in their incomes. Fishers attribute this to the number of fishers in the area which may be due to the expansion of population in the coastal areas. Some fishers also use illegal and destructive gears. Even seaweed farms are not spared from blast fishing. Commercial fishers also encroach to the 15 km zone reserved for artisanal fishing. Some fishers also arm themselves for protection because of piracy and extortion in the area.

Because of these issues, the city government undertook some fishery management interventions. It established 2 MPAs with an aggregate area of 150 hectares, or 1.5 km^2. A guardhouse was also built in the MPA of Daodao Daku. The city's Bantay Dagat members are provided with allowances and a motorboat. Pagadian City also registered fishers and boats.

The city of Pagadian is the sole member city of the Illana Bay Regional Alliance (IBRA 9), a network of local government units located along Illana Bay that aims to sustain the bay's resources through integrated and participatory management efforts.

A. Data Inputs

Summary tables (table 47, 48 and 49) provides important information on the common gear types, type of catch, daily catch, fish price and annual gross income from artisanal and commercial fisheries. Table 47 shows that the average daily fish catch of each artisanal fisher is 3.87 kilograms. The 2,611 fishers in the area accumulate about 271 fishing days in a year. Total annual artisanal fish catch is estimated at 4,392,599 kilograms or at an average price of P55/kg, municipal fish production would fetch an annual gross income of P16,546,244. On table 48, there are 646 fishers employed in nearly 59 commercial vessels. Estimated annual catch is placed at 1,0636.80 tons. Table 49 further shows that annual fisher income from employment or partnership arrangements in the commercial fishing using tuna hook and line, icebox, bag net and encircling gill net.

Table 47. Pagadian City fishery production of (Artisanal)

Gear Type	No. of Units	Crew Size	No. of Fishers	Mean Catch Per Trip (kg/f/trip)	No. months Fishing/ Year	Est. Monthly Catch (tons)	Est. Annual Catch (tons)
Tuna H/L	40.0	10.0	400.0	350.0	4.0	294.0	1,176.0
Bag Net	12.0	10.0	120.0	1,250.0	12.0	360.0	4,320.0
Encircling gillnet	7.0	18.0	126.0	2,550.0	12.0	428.4	5,140.8
	59.0	38.0	646.0			1,082.4	10,636.8
TOTAL	40.0	10.0	400.0	350.0	4.0	294.0	1,176.0

Table 48. Income of Pagadian City commercial fishing boats

Gear Type	Mean Catch/f/day	No. of Fishers	No. of Fishing Days/Month	Ave. No. of kg/ Fisher/Day	Price	Annual Gross Income
Drift gillnet	3.3	191.0	24.0	181,526.4	P35.00	P6,353,424.00
Bottom-set gillnet	3.7	10.0	28.0	12,432	P65.00	P808,080.00
Multiple H/L (B)	2.5	361.0	15.0	13,537.5	P37.50	P507,656.25
Bottom-set Long line	2.7	30.0	13.0	12,636	P68.00	P859,248.00
Single H/L	7.5	1,466.0	23.0	3,034,620	P70.00	P212,423,400.00
Fish corral	1.7	51.0	28.0	29,131.2	P65.00	P1,893,528.00
Push net	7.4	15.0	28.0	37,296	P45.00	P1,678,320.00
Fish trap	9.0	370.0	24.0	959,040	P60.00	P57,542,400.00
Barrier net	2.6	15.0	15.0	7,020	P60.00	P421,200.00
Spear (Tangigue)	3.0	20.0	18.0	12,960	P70.00	P907,200.00
Modified line	3.5	52.0	25.0	54,600	P45.00	P2,457,000.00
Modified H/L	3.5	30.0	30.0	37,800	P65.00	P2,457,000.00
AVERAGE TOTAL	50.4	2,611.0	271.0	4,392,599.1	57.0	288,308,456.25

Table 49. Income of Pagadian City fishers employed in commercial fishing vessels

Gear type	Gross Sales/ Trip (pesos)	Cost/Trip (pesos)	Net Income/Trip (pesos)	Share per Fisher/ Trip* (pesos)	Monthly Fisher Income (pesos)	Annual Fisher Income (pesos)
Tuna H/L	35,000**	41790	-6,790	n/a	n/a	n/a
('ice box")	11,200***	5000	6,200	388	9,300	37,200
Bag net	42,263	4075	38,188	1,909	46,202	554,423
Encircling gillnet	65,475	1600	63,875	1,774	42,583	511,001

NOTE:

* Fisher' share of income from bag net and encircling gillnet operations comprise 50% of net income.
** Fishing outside Illana bay for 8 months/ year.
*** Fishing inside Illana bay for 4 months/year.

B. Simulation Exercises

The FISH-BE model was used to identify and evaluate some options for fishery management interventions. Sustainability of a given scenario was judged on the basis of unchanged catch levels within the first 20-year model as well as on the benefits to the environment, resource users, government and society as a whole.

Base Scenario 1: No intervention scenario

This scenario shows that the fishing industry in Pagadian City will collapse in 2 years, if no management intervention is instituted. As shown on table 47, all the municipal fishers will not earn fishery income and this loss in income will approximately be P1,22195 e+008 adjust this to proper form This amount will also be the cost of the government's social amelioration program to help fishers obtain their minimum daily requirements. In addition, government loses P679,945 from fishing revenues. The community's loss in economic benefits from the absence of an MPA is estimated to be P992,234, while environmental losses like aesthetic values, biodiversity and tourism potentials is valued at P586,470.

Scenario 2: With the existing MPA of 0.68 km^2, number of Municipal Fishers maintained and fish price pegged at Php 55 per kilogram

Scenario 2 shows that with existing marine sanctuaries with an aggregate area of 1.5 km^2, the fishing industry will be sustained over a period of 20 years. Municipal fishers will be earning an average income of P38 per day and the total fishery income can support only 2 fishers. There will be 2,609 fishers without income for basic needs, so the government has to provide social amelioration program of P1,22094 e+008 to fill the income deficit of the municipal fishers. The government is predicted to suffer a net revenue loss of P736.53 with the added cost for MPA management at P65,444. The positive trade-off in this scenario is that the community will be able to reap economic benefits from MPA management valued at P1,488,352 and environmental benefits of P235,215.

Scenario 3: MPA size is Increased to the Maximum Size of 15% of the Municipal Waters, Number of MF Maintained and Fish Price Pegged at P55/kg

Scenario 3 shows that with the expansion of the size of the MPA to 7.5 km^2 the fishing industry will be sustained over a period of 20 years. The total fishery income from a larger MPA can support 11 fishers. The average income of municipal fishers will jump to P192/day. The government will only have to spend P1,21693 in social amelioration program to support the nearly 2,600 fishers who will be unable to obtain their minimum daily requirements. The annual cost of MPA management will rise to P77,821 and CRM expenditures to P1,640,821. The government deficit slightly drops to P698,164 but its loss is compensated by an enormous amount of economic benefits from MPA management placed at P7,441,760 and ecological benefits valued at P171,892.

Scenario 4: MPA at 1.5 km^2, price of fish increased to Php 300 per kilogram

Increasing fish price from P55 to P300/kg will yield an average daily income of P210 for the municipal fishers. The total fishery income will support 12 fishers. Government support for the rest of the 2,599 fishers who are unable to obtain their daily minimum requirements will cost about P1.21647 e+008, which is equivalent to the total income deficit of the municipal fishers. The government incurs a net revenue loss of P736,537. Its annual expenditure for MPA management is P65,444 and P1,628,444 for CRM. The economic benefits from MPA management are estimated at P1,488,352 while environmental benefits will be about P487,401.

Scenario 5: MPA at 0.68 km^2, number of fishers reduced to 417

Scenario 5 reveals that the reduction in the number of fishers from 2,611 to 1,306 will cause municipal fishers to have an average income of Php77 per day. However, the total fishery income can support only 2 fishers. About 1,303 fishers will need support from the government's social amelioration program in the amount of P1.22094 e+008. In addition, the 1,306 displaced fishers will call for support in the amount of P 61,097,200, adding to the government's burden of a net revenue loss valued at P743,064. MPA management and CRM will cost the government P65,444 and P1,628,444, respectively. The community will be able to enjoy MPA economic benefits valued at P1,488,352 and environmental benefits at P449,464.

C. Summary

Table 50 presents a summary of the scenarios tested. All the scenarios, except scenario 1 are sustainable within the 20-year cycle of the model. They also provide the community with economic and environmental benefits from the establishment of MPAs. The government incurred net revenue losses in the four scenarios. This may be because the fishery management interventions in Pagadian are in their initial phase and the fishery demands huge financial expenditure from the government to avert its collapse.

Scenario 3 offers the lowest amount of net revenue loss of the government. In this same scenario revenue loss is compensated by a marked increase of P192 in the average daily income of the fishers. Scenario 4 offers the highest average daily income for municipal fishers but requires a price subsidy that may compound the government's net revenue loss and disrupt the usual interplay of market forces.

Scenario 5 doubles the average income of the municipal fishers. The political consequence of the reduction in the number of fishers is not worth the income increase compared with those offered in scenarios 3 and 4. The most plausible choice is scenario 3.

Table 50. Summary of scenarios simulated using the FISH BE model in the city of Pagadian, Zamboanga del Sur

Outcome Variables	Scenario 1: (Baseline: No Management)	Scenario 2: (Existing MPA 150 ha.)	Scenario 3: (MPA increase 15%)	Scenario 4: (MPA 1.5km2, Increase Fish Price to P300/kg)	Scenario 5: (MPA 1.5 km^2 Reduce number of fishers to 50%, no commercial)
Size of MPA	0	1.5 km^2	7.5 km^2	1.5km^2	1.5 km^2
Nearest Distance to shore for CF	15.0	15.0	15.0	15.0	15.0
Number of MF	2,611.0	2,611.0	2,611.0	2,611.0	2,611.0
Number of CF	646.0	646.0	646.0	646.0	0
Market Price	P55.00	P55.00	P55.00	P300.00	P55.00
Average	3.9	3.9	3.9	3.9	3.9
Catch/day/fisher					
Municipal Catch Area	49.82 km^2	49.82 km^2	49.82 km^2	49.82 km^2	49.82 km^2
Average Fishing Days/ year	271	271	271	271	271

Municipal Fishers					
Number of fishers supported by total fishery income	0.0	2.0	11.0	12.0	2.0
Equivalent number of municipal fishers without fishery income	0.0	2,609.0	2,600.0	2,599.0	1,303.0
Average income of municipal fishers	0.0	P38.00/day	P192.00/day	P210.00/day	P77.00
Active municipal fishers	2,611.0	2,611	2,611.0	2,611.0	1,306.0
Inactive Municipal fishers	0.0	0	0.0	0.0	1,306.0
Income requirement of inactive municipal fishers	0.0	0.0	0.0	0.0	P61,097,200.00
Government					
Municipal fishers' total income deficit	1.22195 e+ 008	1.22094 e+ 008	1.21693e+ 008	1.21647 e+ 008	1.22094 e+ 008
Local government net revenue	- 679,945.00	- 736,537.00	- 698,164.00	- 736,537.00	- 743,064.00
Annual cost of MPA management	0.0	P65,444.00	77,821.00	P65,444.00	P65,444.00
Government expenditures for CRM	P1,563,000.00	P1,628,444.00	P1,640,821.00	P1,628,444.00	P1,628,444.00
Society					
MPA benefits to society or forgone benefits if without MPA	(992,234.7)	P1,488,352.00	P7,441,760.0	P1,488,352.00	P1,488,352.00
Net Losses to society with less than or without minimum MPA	(586,470.1)	235,215.30	171,892.5	P487,401.40	P449,464.70

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Appendices

Appendix 1

Catch matrix obtained for the municipality of Naga. For *kubkuban, hulbot-hulbot, baling,* new look, *palupad* and giant, the reflected estimated catch per fisher might not be true because the usual practice for these gears is that the owner gets half of the catch and the other half is equally shared by the fishers involved.

Fishing Gears	English Names	Computed Annual Catch (mt)	Ave. Fisher/ Gear	Total Units	Total Fisher	Ave. Fishing mo/yr	Est. no of Fishing days/mo	Fishing hrs/ day	Catch Rate kg/trip	Computed est. trip/ year	Est. kg/ fisher/ day
Municipal gears											
1. Bira-bira	Multiple hook	21.6	1.0	10.0	10.0	12.0	18.0	10.0	10.0	2,160.0	10.0
2. Bobo (fish)	Fish pot	4.1	2.5	3.0	7.0	12.0	15.0	24.0	7.5	540.0	0.6
3. Bungsod	Fish corral	1.1	1.0	5.0	5.0	6.0	18.0	24.0	2.0	540.0	2.0
4. Laya	Cast net	8.4	1.0	28.0	28.0	12.0	25.0	4.0	1.0	8,400.0	1.0
5. Newlook	Modified lift net	154.0	4.8	36.0	152.0	11.0	20.0	39,440.0	20.6	7,466.0	4.7
6. Pahubas	Gill net	5.0	4.0	3.0	12.0	12.0	14.0	6.0	10.0	504.0	2.5
7. Palangre	Long line	37.3	2.8	26.0	76.0	12.0	19.0	39,153.0	6.4	5,850.0	2.8
8. Panggisaw	Gill net	54.6	3.0	14.0	42.0	12.0	26.0	12.0	12.5	4,368.0	4.2
9. Pasol	Hook and line	71.1	1.0	118.0	118.0	10.0	21.0	39,210.0	2.9	24,387.0	3.5
10. Patuloy	Gill net	52.3	2.7	50.0	148.0	12.0	25.0	39,184.0	3.4	15,257.0	1.1
11. Sud-sud	Push net	5.8	1.0	11.0	11.0	12.0	16.0	16.0	2.8	2,112.0	2.0
12. Kubkuban	Small purse seine	336.0	25.0	7.0	175.0	12.0	20.0	12.0	200.0	1,680.0	8.0
13. Baling	Beach seine	5.0	6.0	4.0	24.0	12.0	15.0	10.0	7.0	720.0	1.2
14. Bobo (lambay)	Crab pot	32.3	1.6	59.0	104.0	12.0	27.0	39,318.0	1.7	18,974.0	0.9
15. Bobo (squid)	Squid pot	0.4	1.0	1.0	1.0	12.0	24.0	3.0	1.5	288.0	1.5
16. Lenti	Scoop net w/ light	10.6	1.0	30.0	30.0	12.0	24.0	4.0	1.3	8,460.0	1.6
17. Ullang-ullang	Squid jig	8.4	1.0	20.0	20.0	12.0	7.0	2.0	5.0	1,680.0	5.0
18. Hulbot-Hulbot	Small Danish seine	23.0	3.0	8.0	24.0	12.0	24.0	39,177.0	10.0	2,304.0	3.3
19. compressor	Hookah	6.8	4.0	13.0	52.0	7.0	15.0	4.0	5.0	1,365.0	1.3
Commercial gears											
20. Palupad	Trawl	115.2	17.0	10.0	170.0	12.0	12.0	8.0	80.0	1,440.0	4.7
21. Giant	Danish seine	92.2	17.0	8.0	136.0	12.0	12.0	8.0	80.0	1,152.0	4.7
Total		1,045.2			1,345.0						

Appendix 2

Catch matrix obtained for the municipality of Tungawan. For new look, the reflected estimated catch per fisher might not be true because the usual practice for these gears is that the owner gets half of the catch and the other half is equally shared by the fishers involved.

Fishing Gears	English Name	Derived Est Annual Catch (mt)	Ave. fisher/ gear	Total units	Total fisher	Ave. fishing mo/yr	Ave. no. of day/ fishing mo.	Ave. fishing hours/ day	Catch Rate kg/trip	Computed est. trips/ yr	Est. kg/ fisher/ day
1. Bobo (fish)	Fish pot	41.5	1.3	22.0	26.0	10.0	18.0	13.0	10.7	3,887.0	7.8
2. Bungsod	Fish corral	31.6	1.0	15.0	15.0	12.0	26.0	24.0	6.9	4,603.0	6.9
3. bira-bira	Triple HL	160.0	1.0	175.0	175.0	10.8	18.0	7.0	4.6	34,776.0	4.6
4. bira-bira2	Double HL	4.6	1.0	10.0	10.0	6.0	22.0	5.0	3.5	1,320.0	3.5
5. pasol	Single HL	48.5	1.0	75.0	75.0	12.0	17.0	6.0	3.1	15,525.0	3.1
6. Laya	Cast net	9.4	1.0	31.0	31.0	12.0	15.0	3.0	1.8	5,394.0	1.8
7. New Look	Stationary lift net	36.0	6.0	4.0	24.0	12.0	15.0	8.0	50.0	720.0	8.3
8. Palangre	Bottom set long line	11.1	3.0	9.0	27.0	11.5	21.0	8.0	5.3	2,122.0	1.8
9. Pana	Spear fishing	2.0	1.0	12.0	12.0	7.5	5.0	8.0	4.5	450.0	4.5
10. Pataw/Hantok	Hook and line	46.6	1.0	75.0	75.0	12.0	12.0	9.0	4.5	10,350.0	4.5
11. Patuloy	Gill net	58.8	2.0	34.0	68.0	12.0	18.0	7.0	8.1	7,262.0	4.1
12. Pokot	Gill net2	29.6	1.0	16.0	16.0	12.0	22.0	6.0	7.0	4,224.0	7.0
13. Tapsay	Gill net3	0.8	1.0	1.0	1.0	12.0	22.0	2.0	3.0	264.0	3.0
14. Banagan (pokot)	Gill net (lobster)	0.3	2.0	1.0	2.0	12.0	22.0	8.0	1.0	264.0	0.5
15. Bobo-lambay	Crab pot	53.7	1.0	93.0	93.0	7.7	23.0	8.0	3.2	16,706.0	3.2
16. Lappas(abalone)	Gleaning (abalone)	5.3	1.0	10.0	10.0	12.0	22.0	4.0	2.0	2,640.0	2.0
17. Lenti	Scoop net with light	0.8	1.0	4.0	4.0	12.0	16.0	6.0	1.0	768.0	1.0
18. Nasa (crab)	Crab pot	10.8	1.0	10.0	10.0	12.0	30.0	4.0	3.0	3,600.0	3.0
19. Pahala (Lobster)	Gill net (lobster)	1.1	1.0	4.0	4.0	6.0	30.0	8.0	1.5	720.0	1.5
20. Panggal	Crab pot	4.6	1.0	55.0	55.0	12.0	7.0	8.0	1.0	4,620.0	1.0
21. Bobo-pusit	Squid pot	5.5	1.0	29.0	29.0	5.3	16.0	7.0	2.3	2,436.0	2.3
22. Sud-sud	Push net	29.0	1.0	46.0	46.0	12.0	18.0	3.0	2.9	10,074.0	2.9
23. Ulang-Ulang	Squid jig	7.6	1.0	17.0	17.0	8.0	19.0	5.0	3.0	2,516.0	3.0
TOTAL		599.0			825						
Total invertebrates		480.5			555						
Total fin fish		118.5			270						

Appendix 3

Catch matrix obtained for the municipality of RT Lim. For new look, *kabiawan* and *kubkuban*, the reflected estimated catch per fisher might not be true because the usual practice for these gears is that the owner gets half of the catch and the other half is equally shared by the fishers involved.

Fishing Gears	English Name	Computed Annual Catch (mt)	Ave. Fisher/ Gear	Total Units	Total Fisher	Ave. Fishing Mo/ Year	Est. no of Fishing Days/ Mo	Fishing Hrs/ Day	Catch Rate kg/ trip	Computed Est. Trip/ Year	Est. kg/ Fisher/ Day
1. Bobo-lagao	Fish trap	3.6	1.0	1.0	1.0	12.0	20.0	8.0	15.0	240.0	15.0
2. Bobo-lambay	Crab pot	13.5	1.0	45.0	45.0	12.0	20.0	15.0	1.3	216.0	3.8
3. Bobo-lapu2	Fish pot	3.2	1.0	7.0	7.0	12.0	15.0	48.0	2.5	720.0	5.0
4. Bobo-nocos	Squid pot	29.4	1.0	35.0	35.0	12.0	20.0	24.0	3.5	1,260.0	2.5
5. Bungsod	Fish corral	28.2	1.7	20.0	41.0	9.7	17.5	22.0	8.3	995.6	1.7
6. Kabiawan	Lift net	228.0	15.0	2.0	30.0	12.0	25.0	7.0	380.0	240.0	13.9
7. Kubkuban	Small purse seine	43.2	13.0	1.0	13.0	12.0	20.0	12.0	180.0	840.0	0.3
8. Lampurnas	Gill net	8.4	3.0	8.0	24.0	12.0	25.0	8.0	3.5	3,440.0	0.6
9. Laya	Cast net	2.0	1.0	20.0	20.0	12.0	14.3	3.3	0.6	2,400.0	1.2
10. Newlook	Modified lift net	246.0	2.0	24.0	48.0	10.0	20.0	18.3	51.3	4,950.0	9.5
11. Pahubas	Gill net	1.6	2.5	2.0	5.0	12.0	9.0	10.0	7.5	600.0	25.3
12. Palangre	Long line	176.3	1.5	72.0	113.0	12.0	13.8	21.3	14.8	6,840.0	1.5
13. Pana	Spear	1.7	1.0	8.0	8.0	9.3	13.3	3.3	1.7	4,080.0	0.8
14. Pasol	Hook and Line	51.8	1.2	240.0	340.0	12.0	18.0	5.0	1.0	4,896.0	6.4
15. Pasol (undak)	Hook and Line	47.0	1.0	25.0	25.0	12.0	16.5	10.3	9.5	8,400.0	3.5
16. Patuloy	Gill net	55.3	2.2	20.0	35.0	12.0	20.4	9.0	11.3	3,383.0	4.5
17. Pokot	Gill net	0.5	2.0	7.0	14.0	12.0	10.0	3.0	0.6	10,800.0	1.3
18. Salapang	Spear	6.1	2.0	17.0	34.0	12.0	20.0	8.0	1.5	4,800.0	25.6
19. Sud-sud	Push net	22.9	1.0	66.0	66.0	9.7	14.3	3.0	2.5	9,145.0	2.5
20. Tapsay	Gill net	7.2	2.0	3.0	6.0	12.0	20.0	5.0	10.0	11,952.0	11.3
21. Ulang-ulang	Squid jig	10.3	1.0	30.0	30.0	12.0	19.0	4.0	1.5	51,840.0	1.0
Total		986.1			940.0						
Total fin fish		866.9			751						
Total invert		76.0			176						

Appendix 4

Catch matrix obtained for the municipality of Payao. For compressor, dynamite, new-look and *hulbot-hulbo de mano*, the reflected estimated catch per fisher might not be true because the usual practice for these gears is that the owner gets half of the catch and the other half is equally shared by the fishers involved.

Fishing Gears	English Names	Computed Annual Catch (mt)	Ave. fisher/ gear	Total units	Total fisher	Ave. fishing mo/yr	Est. no of fishing days/ mo	Fishing hrs/ day	Catch Rate kg/ trip	Computed est. trip/year	Est. kg/ fisher/ day
Municipal gears											
1.Bungsod (big)	Fish corral	597.0	3.0	67.0	184.3	12.0	30.0	18.0	24.8	24,120.0	9.0
2. Bungsod	Fish corral	32.4	2.0	30.0	55.0	12.0	30.0	24.0	3.0	10,800.0	1.6
3. Compressor	Compressor	130.0	5.0	38.0	171.0	12.0	15.0	4.0	19.0	6,840.0	4.2
4. Dinamita	Dynamite	416.5	2.0	116.0	212.7	12.0	26.0	2.0	11.6	35,960.0	6.3
5. Habong	Gill net	54.0	3.0	30.0	90.0	12.0	15.0	24.0	10.0	5,400.0	3.3
6. Laya	Cast net	4.9	1.0	21.0	28.0	12.0	17.0	3.0	1.2	4,200.0	0.9
7. Newlook	Modified lift net	19.2	5.0	1.0	5.0	12.0	20.0	8.0	80.0	240.0	16.0
8. Pahubas	Gill net	9.2	3.0	6.0	18.0	12.0	9.0	10.0	15.0	612.0	5.0
9. Palangre	Long line	157.9	2.0	126.0	252.0	12.0	12.0	6.8	9.0	17,539.2	4.5
10. Pamana (panulo)	Spear	115.6	1.0	107.0	107.0	12.0	15.0	4.0	6.0	19,260.0	6.0
11. Pasol	Hook & line	438.6	2.0	548.0	1,056.9	12.0	23.0	9.3	3.0	147,960.0	1.5
12. Patuloy	Gill Net	102.7	2.0	112.0	224.0	12.0	13.0	5.8	5.9	17,360.0	3.0
13. Sanggab		7.0	1.0	10.0	13.3	12.0	8.0	9.0	7.3	960.0	5.5
14. Tapsay	Gill net	-	6.0	7.0	42.0	12.0	15.0	4.0	3.0	-	-
15. Baling	Beach seine	0.2	10.0	1.0	10.0	12.0	2.0	3.0	10.0	24.0	1.0
16. Bintol	Crab traps	2.4	1.0	4.0	4.0	12.0	25.0	24.0	2.0	1,200.0	2.0
17. Bobo-alimango	Crab pot	48.6	1.0	115.0	115.0	12.0	12.0	12.0	2.9	16,905.0	2.9
18. Bobo-lambay	Crab pot	4.5	1.0	5.0	5.0	12.0	15.0	12.0	5.0	900.0	5.0
19. Lenti	Scoop net w/ light	16.8	1.0	53.0	53.0	12.0	20.0	8.0	1.3	12,720.0	1.3
20. Sud-sud	Push net	7.8	1.0	26.0	26.0	12.0	13.0	5.3	2.0	3,900.0	2.0
21. Ullang	Squid jig	0.1	1.0	1.0	1.0	12.0	6.0	12.0	1.0	72.0	1.0
22. Hulbot de Mano	Small Danish seine	34.8	4.0	5.0	17.5	12.0	20.0	8.5	29.0	1,200.0	8.3
Total		2,200			2,691						