DEVELOPMENT OF A MULTI-CRITERIA EVALUATION TECHNIQUE TO ASSESS THE IMPACTS OF FISHERIES MANAGEMENT IN A PHILIPPINE BAY

By

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DEDICATION

My dissertation is dedicated to my father, Vicente, who has always been there for us especially during moments when our family was in crisis- he stood firmly as our fortress and anchor of strength. His love and commitment continue to inspire us to value knowledge and wisdom—we were never deprived of the opportunity to get an education. His dream of receiving a college degree to become an engineer was fulfilled when all of us, his six daughters, finished university and pursued our own profession. What we become now is the fruit of his labor. May God bless his life for the work he has done in us.

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ABSTRACT

Efforts to assess the impacts of fisheries management are usually directed towards determining the effects of a single management intervention. However, the current state and future directions of many coastal fisheries make this approach inadequate because no single management intervention is able to satisfy the multi-level and conflicting goals of coastal fisheries in many tropical developing countries. The achievement of these goals is determined by the interaction of various management interventions collectively referred to as a *management strategy,* and its assessment should be based on a general framework of a multi-criteria evaluation consisting of multiple evaluation criteria and indicators, preference system of decision-makers, and an aggregation procedure. Yet, the literature presents limited frameworks in dealing with the multi-dimensional impacts of fisheries management.

This research investigated the implications of applying multi-criteria evaluation methods to determine the integrated impacts of management in the coastal fisheries using San Miguel Bay, Philippines as a case study. The elements of a multi-criteria evaluation were categorized into three dimensions: *temporal*, *spatial* and *systemic*. The temporal dimension deals with the time line of impacts while spatial dimension characterizes the geographic location (local, national or global) where management strategies are implemented. The systemic dimension is nested within the temporal and spatial dimensions, and it consists of the interactions between humans and natural systems. It is also in the systemic dimension where scientific/technical knowledge and perceptual experience interface with each other. A number of multi-criteria evaluation methods applied in operational research and decision-making analyses were examined to ascertain their applicability in fisheries. The strengths, challenges and typology of uncertainties in the application of these methods to fisheries impact evaluation led to the development of a proposed impact evaluation technique for fisheries management. The technique which is a hybrid of Concordance Analysis, Mixed Evaluation and the Analytic Hierarchy Process is able to handle quantitative and qualitative information, and incorporate judgments of multiple stakeholders. The results of the preference analysis revealed that among the coastal resource users, the fisherfolks exhibited consistency in judgment with respect to the importance of criteria and indicators. Although this technique is labor intensive, it has the advantage of direct involvement of fishers and local managers in the evaluation. Its application may be limited in post-hoc evaluation because of incomplete data sets, however, reliability of the results may be improved if this is integrated at the start of a management program.

ABBREVIATIONS AND SYMBOLS USED

ADB- Asian Development Bank

AHP- Analytic Hierarchy Process

ANOVA- Analysis of Variance

B/LFARMC- Barangay/Lakewide Fisheries and Aquatic Resource Management Council

BFAR- Bureau of Fisheries and Aquatic Resources

BFARMC- Barangay Fisheries and Aquatic Resource Management Council

CI- Consistency Index

CR- Consistency Ratio

CY- Calendar Year

DA- Department of Agriculture

DATFME- Diverse-data Aggregation Technique for Fisheries Management Evaluation

DENR- Department of Environment and Natural Resources

ELECTRE- Eliminating et Choice Translating Reality

EVAMIX- Mixed-Data Evaluation

FARM- Fisheries and Aquatic Resource Management Council

FRMP- Fisheries Resource Management Project

FSP- Fisheries Sector Program

H- Shannon Diversity Index

Ha- hectare

HSD- Tukeys Honestly Significant Difference

ICLARM- International Center for Living Aquatic Resources Management

IFARMC- Integrated Fisheries and Aquatic Resource Management Council

IFDR-CF UPV- Institute of Fisheries Development and Research of the College of Fisheries, University of the Philippines in the Visayas

Kg- kilogram

Km^2- square kilometer

LEAD- Livelihood Enhancement for Agricultural Development

LGU- Local government unit

M/CFARMC- Municipal/City Fisheries and Aquatic Resource Management Council

MCA- Multi-criteria Analysis

MCDM- Multiple Criteria Decision-making

MDS- Multidimensional Scaling

MFARMC- Municipal Fisheries and Aquatic Resource Management Council

MPAEM- Marine Protected Area Evaluation Model

NFARMC- National Fisheries and Aquatic Resource Management Council

NGO- Non-government organization

OECF- Overseas Economic Cooperation Fund of Japan (OECF)

PhP- Philippine Peso

PIU- Project Information Unit

RAPFISH- Rapid Appraisal technique for Fisheries

REA- Resource and Ecological Assessment

RI- Random Index

RSA- Resource and Social Assessment

SEAMEO-SEARCA- Southeast Asian Ministers of Education Organization Regional Center for Graduate Study and Research in Agriculture

SEIOS- Socio-economic and Institutional Opportunities Study

SMB- San Miguel Bay

SPSS- Statistical Package for Social Sciences

WSM- Weighted Sum Model

Σ – summation

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I have always wanted to do a research on impact evaluation for coastal fisheries—keeping in mind the multi-dimensional and intricate interface between humans and the environment. This was accomplished in my dissertation, in which I spent years to conceptualize the research problems, conduct fieldwork, analyze data, and explore other fields of disciplines that are new to me. I realized the complexity, uncertainty and difficulty of the subject matter. However, if not for the countless individuals and institutions that contributed to the successful completion of my thesis, I would not have seen the light at the end of my journey. Without them, my labor could have been in vain, thus, they all deserve a space in my thesis.

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"For I know the plans I have for you",
declares the LORD, "plans to
prosper you and not to harm you,
plans to give you hope and a future."
(Jeremiah 29:11)

CHAPTER I
INTRODUCTION AND BACKGROUND OF THE STUDY

A. Statement of the Problem

The management of complex and heterogeneous tropical coastal fisheries is difficult. For decades, interrelated problems including habitat degradation, natural resource depletion, conflict among resource users, widespread poverty in coastal communities and many others have received extensive attention. Specific problems identified in the Philippine coastal fisheries are habitat degradation, overcrowded coastal areas, overfishing, encroachment of commercial fishing vessels in municipal waters, illegal and destructive fishing methods such as blast and cyanide fishing, resource use conflicts, siltation and pollution from uplands, persistent poverty among municipal fisherfolk, and weak institutional arrangement. All of these problems are documented in the reports of ADB (1999) and studies of White et al. (2000), Courtney and White (2000), Baticados (2004), and many others. In response to these growing problems and in the hope of reversing their negative effects, several fisheries management approaches (oftentimes referred to as *interventions*) have emerged for coastal waters.

The universal goal of sustainable fisheries management is to improve the state of the fisheries for the benefit and enjoyment of the present generation and generations to come. These goals are specified in Charles (1989) to include: (i) resource conservation, (ii) food production, (iii) generation of economic wealth, (iv) generation of reasonable incomes for fishers, (v) maintenance of employment for fishers, and (vi) maintenance of the well-being and viability of fishing communities. These can be broadly categorized as ecological/biological, social, and economic objectives. Because of the diversity of the coastal fishery resources and interest groups, compromises in goals and objectives are often necessary (Mardle et al. 1997). This is the case in tropical developing countries where national goals and objectives of fisheries sometimes do not complement the needs at the local community. For example, conflicts often occur among attempts to conserve fish stocks, maximize efficiency and export earnings, and the desire to satisfy the needs of the fishing communities with respect to jobs and income (Khorsid and Morgan 1990, Mardle et al. 1997, Whitmarsh 1998). Conservation or preservation of biological diversity is often contrary to the aim of many fisheries organizations in maximizing production or economic efficiency (Agardy 2000). In addition, increasing one objective such as regional benefits tends to decrease other goals such as national efficiency (Sylvia and Cai 1995).

In the Philippines, the worsening state of the fisheries resources caused the government to identify and implement fisheries management interventions such as, but not limited to: habitat conservation, restoration and rehabilitation (e.g., mangrove reforestation, artificial reef deployment, establishment of marine protected areas/marine reserves); fishing effort restrictions by regulating the type of fishing gear or methods, minimum mesh size, seasons and area of fishing; limit entry to overfished areas; ban on dynamite and cyanide fishing as well as commercial fishing in municipal waters; and introduction of alternatives to capture fishing (e.g., mariculture, animal husbandry) (Baticados 2004, Baticados et al. 1998, Juinio-Meñez 2002). Each management intervention has an essential yet individually insufficient function in optimizing the goals and objectives of the fisheries. The application of just a single management intervention may prove to be ecologically inadequate, socially and politically unacceptable, and economically impractical as some interventions are short-lived and therefore, have to be continually strengthened with other interventions. To illustrate, if only the number of fishing boats is restricted, there is a possibility to increase fishing efforts either by fishing longer or with the use of more efficient gears and methods. Reduction in fishing efforts is almost impossible to attain when new technologies are adopted. Also, limiting the number of fishing boats may pose social and political obstacles, as it would be difficult to determine which should be included or excluded from the fisheries.

Another example is the establishment of marine reserves, a type of management intervention that has gained popularity and recognition in the Philippines. Extensive studies were conducted by Alcala (1981, 1988); Alcala and Russ (1990); Alcala and Luchavez (1981); Russ and Alcala (1994); Russ and Alcala (Russ and Alcala 1996a, 1996b) on the biological effects of marine reserves in two small Philippine islands (Apo and Sumilon islands). These authors and many others (e.g., Agardy 2000) recognized that marine reserves are unlikely to perform well in the absence of conventional types of management (e.g., size limits, gear restrictions, limited entry). As a result, it may be difficult to attribute a perceived change in the coastal fisheries to just a single management intervention (whether abundance of fish catch or improved standard of living of fishers), because no single management intervention is able to satisfy all ecological, social and economic goals of fisheries simultaneously. This condition justifies the implementation of more than one management interventions if the intention is to optimize attainment of overall goals and objectives. A collection of management interventions is herein referred to as a *management strategy.*

In fisheries, it is crucial to determine the outcomes of a management strategy especially when public money spent on projects and programs has to be accounted for. The success or failure of a management strategy has to be dealt with in an integrated manner that accounts for the multiple objectives of the fisheries. If the need is to regenerate, rehabilitate, conserve, protect and sustainably manage the fisheries resources then, the management of the coastal areas should be based on the understanding of the interrelationships of the various parts of the ecosystem (Griffis and Kimball 1996, Legendre and Legendre 1983) including human interactions. Many program evaluation reports or documents have failed to do away with mere descriptive summary of the findings or present an analytical framework to assess the performance of the fisheries management strategy.

The purpose of the impact evaluation, kinds of available data and the role of resource users, inform the direction as to the type of evaluation method to apply. Since coastal fisheries resources are complex and human's interests concerning them are varied, an evaluation method that is holistic in its approach is worthwhile to examine. In the Philippines, although fisheries data may be insufficient and dispersed, its database of information that is valuable for impact evaluation and decision-making purposes remains under-utilized. For tropical developing countries with fisheries as a very important resource, yet having very limited financial and technical resources, what is needed is an impact evaluation tool that is cost-effective, readily understandable, and applicable. One useful approach may come from the domain of *multi-criteria analysis* or *multi-criteria evaluation methods*.

Multi-criteria evaluation methods or analyses belong to the fields of Operational Research and the Science of Decision-making. This thesis explores these areas in order to understand the functions and importance of multi-criteria impact assessment as a tool to determine progress in fisheries and subsequently, aid decision-making. The framework of a multi-criteria analysis provides a flexible way of handling varied and complex information that are perceived essential in evaluating the performance of fisheries management. Its ability to incorporate and recognize the knowledge and judgment of concerned individuals is also an important factor in the evaluation process. Although scientific knowledge is valuable, the extensive experience of coastal resource users, especially the fishers, is crucial in determining the success or failure of any management strategy. Their day-to-day interaction with the coastal ecosystem makes them a reliable source of information. The information that these coastal resource users are able to provide is especially important given that information obtained through scientific methods may not be readily available to resource managers and decision-makers.

B. Significance of the Research

In this research, the terms impact evaluation and impact assessment are treated as synonymous—both are *analytical process in determining the progress or growth of a set of management actions towards attainment of a specific objective or composite goals of sustainable development*. So far, it is easier to measure the impacts of unsustainable development, what is difficult is to determine whether sustainability is being achieved (Hanson 2003). Few studies have attempted to evaluate the performance of fisheries management strategies by examining the interactions of biological, social, economic and institutional impacts of management. In view of this limitation, this research aims to examine the development and application of a multi-criteria evaluation technique for fisheries that is able to integrate the biological/ecological, social, economic and institutional impacts of management strategies.

C. Objectives of the Research

The following are the specific objectives of this thesis:

1. To develop an impact evaluation technique with a set of criteria for fisheries management strategies;
2. To analyze the criteria using measurable indicators; and
3. To examine the implications of using a multi-criteria evaluation method

Although multi-criteria analysis has potential in fisheries management impact evaluation, it has not been extensively explored. Should the multi-criteria evaluation technique (e.g., incorporation of criteria and indicators, weighting, aggregation, etc.) proposed here be found useful in a Philippine bay, then it may likewise be applicable to other tropical fisheries which require more focused, less costly and locally-specific types of evaluation.

D. Assumptions and Limitations

This research primarily analyzed available secondary information. Although limited, my main argument is that this incompleteness of information is unavoidable and must be treated as a reality and not an obstacle for impact evaluation because no data set will ever be complete. The world remains partially-specified. Completeness of data is desirable, but often a problematic condition in impact evaluation.

Another challenge in this research is the process of information decomposition since most data about the bay are consolidated. Thus, data, specifically for the indicators, have to be taken apart per municipality.

E. Structure of the Thesis

This thesis is composed of five parts. Chapter I lays the rationale as to the importance of a multi-criteria analysis in evaluating the impacts of fisheries management. The specific objectives of the thesis as well as the limitations in conducting this research are also presented. The literature on impact evaluation in fisheries and examples of multi-criteria evaluation methods, and the application of these multi-criteria evaluation methods to fisheries management are reviewed in Chapter II. The methodology of the research is discussed in Chapter III which includes site identification; collection of primary and secondary data; and the participation of coastal resource users in weighing the importance of criteria and indicators, and in determining the scores of some indicators. In Chapter IV, both primary and secondary data are organized into a multi-criteria evaluation framework in order to develop a multi-criteria impact evaluation technique for fisheries management. Also, the pretest results are discussed. The last chapter is a discussion on the potentials and limitations of the existing multi-criteria evaluation methods in fisheries management and the proposed Diverse-data Aggregation Technique for Fisheries Management Evaluation which is a hybrid of existing methods.

CHAPTER II
REVIEW OF RELATED LITERATURE

A. Rationale for Impact Evaluation in Fisheries

Becker (2001) defined impact assessment or evaluation as *"the process of identifying the future consequences of a current or proposed action"*. Fundamental to any evaluation is the method or tool to be used. In fisheries management, the importance of developing analytical and operational evaluation tools is critical for sound decision-making. Evaluation of the impacts of fisheries management is often atomistic in nature which means that impact evaluation is frequently undertaken through a single-disciplinary approach (either a biological or an economic approach). Biological impacts are determined by abundance, biomass and sizes of fish, whereas, economic impacts are evaluated through monetary measures such as benefit-cost analysis, travel cost, hedonic pricing, input-output analysis, contingent valuation, etc. (Dalton 0000, Hoehn 1987, Hushak 1987, Propst and Gavrilis 1987) as well as non-monetary techniques like social well-being, psychophysical measures, attitude measures (Dixon et al. 1994, Gregory 1987). One limitation of each approach is that the impacts are usually considered uni-dimensional as demonstrated in the studies of Heen (1989) and Karydis & Coccosis (1990).

Because of the limited ability of current scientific methods to measure and understand with certainty the ecological processes and the high temporal and spatial variability in the biological components of the marine environment (Parr et al. 2003), it may be insufficient to consider only the biological impacts of management. What if scientific methods fail to detect the impacts on their underlying causality, does it mean that management has no effect at all? For example, McManus (1986) reported that in the Philippines, although a ban on commercial trawling had gradually been imposed on the fishery over several years, the degree of impact of the ban on the local species composition was not known. Many of the costs and benefits of management are difficult to quantify, and even if quantifiable, may be hard to measure in monetary terms (Bingham et al. 1995). In addition, the social and institutional impacts of management (especially the distributional aspects) are not explicitly included in either biological or economic impact assessments. The social aspect is concerned with the survival of coastal communities dependent on the fisheries and can be evaluated as community participation and cooperation, employment, change in the degree of user conflicts, improved standard of living, etc. The institutional one deals with governance or the administrative and political aspects of management.

When the intention of the evaluation is to examine the multiple effects of management strategy, a single approach may no longer provide sufficient estimates of impacts because it precludes a meaningful evaluation of the complexities of fisheries and factor interaction. The current direction then is to consider the multidimensionality of fisheries (i.e., biological/ecological, economic, social and institutional). In which case, a *multiple criteria* (or *multi-criteria*) type of evaluation is a potentially useful analytical tool that can complement (Nijkamp et al. 1990) [not compete nor replace] and strengthen the existing approaches. Unlike any of the single approaches referred to earlier, multi-criteria methods deal with mixed information measured at varying scales—either quantitative (also known as *cardinal*-- i.e. interval and ratio scales) or qualitative (i.e., ordinal or nominal/categorical scales) or both.

B. Fundamentals of Multi-criteria Evaluation Methods

Multi-criteria evaluation approaches may appear in the literature as multi-criteria analysis (MCA) or multiple criteria decision-making (MCDM). Regardless of nomenclature, the intention is to examine a number of choice possibilities (e.g., alternative plans or strategies, administrative zones or regions, etc.) taking into account multiple criteria that measure the attainment of conflicting goals or objectives with the explicit inclusion of subjective weights. This allows different points of view to be identified and explored (Chesson et al. 1999, Mahmoud and Garcia 2000, Van Delft and Nijkamp 1977). Multiple criteria analyses have demonstrated their utility in many environmental issues that link economic, environmental, cultural and technical issues of management (e.g., Abu-Taleb 2000, Makowski et al. 1996). They are especially useful in assessing the progress of a particular objective by reducing the level of complexity of information (Chesson et al. 1999).

The general structure of a multi-criteria evaluation method consists of at least a two-dimensional matrix, where one dimension expresses the various choice possibilities while the other dimension is composed of criteria that will evaluate these choice possibilities (Voogd 1983). Munda et al. (1994) and Nijkamp et al. (1990) summarized the procedure as follows:

a) Structuring of the problem (defines what is to be evaluated);

b) Generation and definition of choice possibilities (e.g., alternatives);

c) Choice of a set of evaluation criteria;

d) *Determination of scores for each criterion and indicator per choice possibility (the value assigned to the choice possibility with respect to a criterion);*

e) *Identification of a preference system of decision-makers (criterion priorities have to be defined so that information can be amalgamated); and*

f) *Selection of an aggregation procedure (choice of methods to come up with an analysis of the evaluation problem).*

The outcome of the above procedure from (a) to (d) is an evaluation matrix composed of a list of criteria and the scores of the criteria for the choice possibilities. A number of existing multi-criteria evaluation methods has similar structure of evaluation matrix. Their only difference would be on how steps (d), (e) and (f) in the procedure will be handled. Prior to the discussion on the aggregation procedure the primary components of the evaluation matrix are herein presented in relation to fisheries management.

1. Choice of Evaluation Criteria and Indicators

The importance of developing evaluation criteria and performance indicators (structural and functional elements used to judge the success of management) for project appraisal (Van Pelt 1993), habitat restoration (Pastorok et al. 1997), management programs (Anderson 1989), and sustainability assessment (Garcia et al. 2000, Hardi et al. 1997) in fisheries is well-recognized. The criteria and related indicators are often derived from goals and objectives of fisheries management and according to Bonzon (2000), the government and local authorities are likely to select them based on their own specific objectives.

The terms criteria and indicators are often used interchangeably in the literature. A ***criterion*** may be defined as a concept designed to specify the expected or desired outcomes of implementing a management strategy. It may not be an actual measure since there is no single exact measure for any of the criteria. Instead, one or more indicators or performance indicators measure a criterion. The kinds and number of criteria selected largely depend on the stated goals and objectives. When goals and objectives of fisheries are vaguely defined, more effort is needed to obtain specificity of the criteria. Although sometimes vagueness of goals and objectives is inevitable to allow flexibility for changing program activities as future circumstances necessitate (Rutman 1984).

Most criteria associated with fisheries sustainability and management that appear in the literature include feasibility (Yahaya 1988, Yap 2000), economic efficiency and benefit (Anderson 1989, Bonzon 2000, Tam et al. 1996, Whitmarsh 1998), equity (Bonzon 2000, Nickerson 1999, Van Pelt 1993, Yahaya 1988), acceptability (Yahaya 1988), social welfare (Tam et al. 1996), effectiveness (Sumaila et al. 2000), enforceability of the management program (Anderson 1989, Yahaya 1988), ecological accountability (Reynolds 1993), institutional performance (Imperial 1999) and biological diversity. Each criterion may also be categorized under a broader classification. For example, Sutinen (1999) referred to biological, social, economic or administrative categories.

Concerns have been raised as to the number of criteria. If too many are used the process becomes unmanageable, or if too few, the evaluation process may become oversimplified. But how many are too many or too few, in fact, depends upon the availability of administrative resources or logistics to acquire the information. Even if an enormous number of criteria that incorporate the biological, social, economic and administrative dimensions of managing a tropical fishery are identified, the choice still depends on whether they are *"policy relevant, scientifically reliable and valid, simple, sensitive, possible to aggregate, affordable and feasible in terms of data collection"* (Hanson 2003). When baseline information with which to compare the current data is incomplete, existing documents that indicate standards, thresholds or reference points may be used. In a developing country, the validity of an evaluation is often challenged because baseline information is frequently insufficient and methods of data collection are inadequate to allow comparability of results (Pomeroy et al. 1997). The problem may not actually be incompleteness of data, but whether available data are reliable or not; and how to delineate those which are perceived useful to ensure a meaningful evaluation.

The sources of information may not only be those which were acquired through scientific means. If the knowledge base that we have is all that is available (Lane and Stephenson 1995) then, Johannes' (1998) strong argument of a data-less management—*"that is, management carried out in the absence of the data required for the parameterization and verification of models that predict effects of various management actions with useful confidence limits"*, justifies the inclusion of local knowledge (e.g., fishers knowledge of the coastal waters and resources) in the evaluation process. He emphasized that management is not to be judged by its roots but by its fruits. Studies such as those of White and Savina (1987) and Ticheler et al. (1998) support the successful participation of fishers in scientific fisheries data collection. Thus, there should be no reason to question the participation of fishers in the evaluation process. An ***indicator*** is a specific and straightforward measure. Bonzon (2000) characterized indicators as tools for measurements as value variables (either quantitative or qualitative), indices or pointers related to criteria of a given system. They are single measures of a resource element in an un-aggregated form (Knuth and Nielsen 1989) used to describe the state of the system and assess trends (Garcia et al. 2000). An indicator is not only a measurement tool it is also a way of defining what is measured (Harte and Lonergan 1995). Cairns et al. (1993) and Pastorok et al. (1997) presented important considerations in the development of indicators of ecosystem health and restoration that are also useful in developing indicators for fisheries evaluation. Indicators should be able to reduce the number of individual variables and data points while maintaining a sufficient level of understanding about coastal systems (Bowen 2003). Sustainability indicators are commonly categorized into discipline (e.g., indicators on biological, economic, social or cultural aspects), or according to whether they measure the factors that exert pressure, show the present system state or indicate responses of concerned groups to system changes (Willmann 2000). Hundloe (2000) cautioned the use of an indicator that is only based on economic measure because economy is only part of the environment and human system. Frequently employed ecological, social and economic indicators in fisheries are discussed in Charles (1995), Garcia et al. (2000), Pastorok et al. (1997), Gislason et al. (2000), Staples (1997), Vandermeulen (1998), among others.

Vandermeulen (1998) provided a list of guidelines for the choice of indicators to include: responsive to change, supported by reliable and readily available data, relevant to the issue, scientifically valid, national perspective, cost effective, and if possible, predictive. Another guideline mentioned in Vandermuelen (1998), also emphasized in Chong (2000) and Cury & Christensen (2001), was easily understandable, simple and acceptable to intended users. Vreeker and Nijkamp (2001) explained that indicators are always context and site-specific and therefore, need not be generalized. This strengthened Staples' (1997) earlier point about the importance of considering the main users of the indicators in impact evaluation. Various resource users or decision-makers may make different choices of indicators. For example, scientists or people from academia would prefer indicators that are basic such as water quality parameters while fishers or local government officials would opt for applied indicators such as income, number of boats, etc. The research of Boyd (2002) evaluated the suitability and practicality of marine fisheries indicators at the local level (i.e., fishing communities of Glace Bay, Nova Scotia, Canada). Her study revealed a weak indicator monitoring system with regards to the community, institutional and socio-economic characteristics of fisheries sustainability. According to Bonzon (2000), indicators can reflect the needs of various entities and stakeholders (e.g., management authorities, producer associations, or the general public). He further stated that in selecting indicators, information needed mainly for academic research must be distinguished from information directly related to strategic management planning. The choice of the number of indicators may also depend on the group of decision-makers; politicians may prefer a few simple indicators while technical experts would more likely include large numbers of indicators (Dahl 2000). Moreover, Dahl (2000) acknowledged the technical and methodological complexities that come with aggregation and weighting of mixed indicators.

While Staples' (1997) and Vandermuelen's (1998) basic premise that indicators should be able to compare information with a standard, target, threshold or limit value, has merit, this is often difficult to satisfy since standards and thresholds are not always established for all indicators. If this is the case, then the indicators can be classified as *benefit* or *cost* indicators. This means that the higher the values of the benefit indicators, the more they are preferred. Similarly, the lower values of cost indicators are more preferred. For example, the abundance of commercial fish catch is considered as benefit indicator while unemployment rate is regarded as a cost indicator.

The amount of information generated for the criteria may also limit the number of indicators that can be measured to only a fraction of those possible (Cairns et al. 1993, Propst and Gavrilis 1987). Often, a criterion contains two or more indicators. Since many fisheries criteria and indicators are interrelated or interdependent, the choice of evaluation methods has to consider interdependence. Some evaluation methods have very limited assumptions; for instance, there are those which would only allow analysis if the criteria or indicators are independent from each other. However, it is less likely to find fisheries indicators that are unrelated especially those belonging to the same criterion. For example, the indicators *number of trainings and seminars conducted* and *level of awareness of resource users* intended to measure the criterion acceptability of management may somehow be directly related. Our knowledge of which indicator would best measure a criterion is quite limited. Our assumption is that an infinite number of indicators contribute to the measure of a criterion and the probability of an overlap, redundancy or double counting of the indicators is bound to exist because of the inherent interrelationships among them.

While the development of performance criteria and indicators for fisheries management requires technical information, Chong (2000) emphasized that the interest, willingness and commitment of the people or the community are also imperative in the sustainable management and conservation of fisheries and other coastal resources. Therefore, these same people have to be part of the development of the performance criteria and indicators for sustainable management.

2. Measurement of Criteria and Indicators

Deriving the values of the indicators, and subsequently, the criteria is critical in the final evaluation process. Usually both qualitative and quantitative information associated with several criteria need to be systematically considered when evaluating several decision alternatives (Wenger and Rong 1987). Indicators as measures of criteria are categorized according to the four types of measurement scales, namely, *nominal, ordinal, interval* and *ratio scales*. Van Delft and Nijkamp (1977) and (Vogt 1999) characterized these scales as follows: in *nominal scale* the numerical operations are pointless because the numbers only represent names having no order or value while in the *ordinal scale*, the subjects are ranked in an order such that differences between rank orders have meaning. *Interval scale* does not have a fixed origin but it allows some numerical operations such as averaging, addition, or subtraction. The *ratio scale* has a true zero point therefore, all standard operations can be carried out on this scale. Interval and ratio data can also be collectively called 'cardinal data'. Data measured on interval or ratio scale are either continuous or discrete (discontinuous); continuous data are placed in a scale with infinite range of points while discrete data are made up of distinct and separate units or categories (Vogt 1999, Wheater and Cook 2000).

In fisheries, a criterion is measured quantitatively or qualitatively using two or more indicators. But even if all indicators are measured using only one type of scale (e.g., quantitative), the units of measures may not be homogenous (e.g, hectares, \$, tons, percentage, etc.). This is a type of scaling problem that was resolved through transformation of values to a common order of 0 to 1 (Yakowitz 1998) or normalization to obtain comparable scales because each function may have different number of variables or mathematical relationships and corresponding maximum scores (Hruby 1999). Although there are different kinds of normalization formula, the most commonly used are found in Voogd (1983), Pomerol and Barba-Romero (2000) and Hwang and Yoon (1981) and these are presented below:

(a) $e_{ij} = x_{ij} / \Sigma\, x_{ij}$

where e_{ij} = normalized indicator score

x_{ij} = score of the indicator

$\Sigma\, x_{ij}$ = sum of all indicator scores

(b) $e_{ij} = x_{ij} / x_{ij}^{max}$

where x_{ij}^{max} = maximum indicator score

(c) Vector normalization:

$$e_{ij} = \frac{x_{ij}}{\sqrt{\sum_i x_{ij}^2}}$$

(d) Linear scale transformation:

$$e_{ij}= (x_{ij}- x_{ij}^{min})/(x_{ij}^{max} – x_{ij}^{min}) \text{ , for } \textit{benefit} \text{ criterion or,}$$
$$e_{ij}= (x_{ij}^{max}- x_{ij})/(x_{ij}^{max} - x_{ij}^{min}) \text{ , for } \textit{cost} \text{ criterion}$$

where, x_j^{min} = minimum indicator score

The advantage of using vector normalization is that all indicators are measured in dimensionless units, thus facilitating inter-indicator comparisons. However, the drawback is that, it is difficult to make a straightforward comparison because the minimum and maximum values of the measurement scale are not equal for each indicator. Linear transformation can be more advantageous as results are transformed in a linear (proportional) way making the relative magnitude of the outcomes equal. (Hwang and Yoon 1981)

Also, if the nature of the indicators is different, the indicators are grouped as benefit indicators (larger x_j or value of the indicator is more preferred) or cost indicators (smaller x_j or value of the indicator is more preferred). Some authors (e.g., Nijkamp et al. 1990) recommended that if normalization is made, it is best to test the sensitivity of the outcome for the particular type of normalization.

3. Weights of Importance of Criteria and Indicators

The importance placed on the criteria and indicators is another consideration—importance may be modeled statistically by means of rank orders (Yakowitz 1998), rating scales, paired comparisons or magnitude estimates. Some studies used multiple regression analyses to predict judgmental values as a function of various physical features of the environment while others applied multivariate techniques such as factor and cluster analyses to learn more about interrelationships among the indicators (Gregory 1987, Petry 1990). Prato (1999) noted that while there is no theoretical limit to the number of criteria (which he referred to as attributes), an individual's ability to assign weights to these criteria decreases with their number. One method found useful to address this issue is the Analytic Hierarchy Process (AHP) developed by Thomas Saaty in the early 1970s (DiNardo et al. 1989, Leung et al. 1998). Leung et al. (1998) and Varis (1989) found AHP to be effective and robust in solving large, complex and evasive decision problems.

AHP structures a problem into hierarchy, then the weights of the criteria (and also indicators) are determined through pairwise comparisons (Saaty 1980) according to preference, importance or likelihood (Peterson et al. 1994). Through pairwise comparisons, evaluators (e.g., coastal resource users) will not be overwhelmed with the amount of information that has to be processed mentally per unit time. AHP has gained wide acceptance in the fields of water resource planning (Willet and Sharda 1991), natural resource management and planning (Fernandes et al. 1999, Peterson et al. 1994, Schmoldt et al. 1994), restoration (Ridgley and Rijsberman 1994), etc. A more detailed application and discussion of AHP appears in the works of Saaty (2001), Saaty (1980), Khorramshahgol and Moustakis (1988); DiNardo et al. (1989), Ridgley and Rijsberman (1992); and Triantaphyllou and Lin (1996). AHP uses a computer program EXPERT CHOICE to assist the evaluators in processing large amount of information properly and performing sensitivity analysis.

Successful application of AHP is demonstrated in Ridgley and Rijsberman's (1992) policy analysis for a Rhine estuary and Peterson et al.'s (1994) resource management plans. However, it is only the study of Peterson et al. (1994) which took note of the actual length of time (i.e., two days discussion) to implement and accomplish the process. Although the authors did not encounter any problem in reaching a consensus, they suggested that if this happens, separate judgment be aggregated using a geometric average.

There are only a few studies documented which applied AHP in fisheries. DiNardo et al. (1989) applied AHP in the management of Maryland's river herring fishery. Leung et al. (1998) and Fernandes et al. (1999) evaluated four alternatives for limiting the entry of longliners into the Hawaii pelagic fishery and coral reef management options, respectively using AHP. Contrary to the works of Ridgley and Rijsberman (1992) and Peterson et al. (1994) [who used consensus building among the evaluators in order to arrive at a final solution using AHP], Leung et al. (1998) [after realizing that the group of decision-makers is large and diverse] employed a mail survey type of instrument. Result of their study showed that mail survey is not an efficient technique to administer AHP because of the low response rate. That is, only 52% of the 66 members of the Western Pacific Fishery Management Council returned usable surveys. Although the authors attributed such low response rate primarily to the geographical distance and non-fisheries background of some Council members, the problem also may have been on the lack of venue for interaction. Respondents who are unfamiliar with AHP may have had a hard time understanding its application without interacting with people who are more knowledgeable about the approach. The most recent study on the application of AHP in fisheries is that of Soma (2003) for the shrimp fishery sector in Trinidad and

Tobago; she found the method as "empowering, educating, focusing, facilitating and quantifying tool" in fisheries management.

AHP approach is highly dependent on the experience, knowledge and intuitive judgment of the evaluators. Ridgley and Rijsberman (1992) vouched the use of this method as: (i) it does not demand independence of alternatives; (ii) it creates and is based on ratio scales rather than interval scales; (iii) it does not require that the range of criterion scores be known before comparison of choice possibilities relative to that criterion can be done; and (iv) it uses subjective assessments of preference intensity. These advantages may be apparent if the intention is to apply AHP beyond weighting of the criteria and indicators to prioritizing of choice possibilities. This was demonstrated in the studies of Schmoldt et al. (1994), Peterson et al. (1994), Ridgley and Rijsberman (1992), and Leung et al. (1998). The final result is a numerical priority value for each choice possibility. The choice possibility with the highest score is considered the best one as determined by the decision process made explicit in the hierarchy and by the comparisons (Peterson et al. 1994). Since AHP ignores the scores of each criterion during the evaluation process, it is possible to just use AHP in weighting the importance of the criteria and indicators, and not proceed directly with the comparison of fisheries management strategies. Although weighting of the criteria is open to criticisms (Munda et al. 1994) because it involves human judgment, it is indispensable in impact evaluation work. Petry (1990) emphasized that as all the simplifications and approximations necessary for scientific analysis have some human value content, technical analysis and political decisions cannot be completely separated.

4. Stakeholders/Resource Users as Decision-makers

The determination of the importance of criteria and indicators would have been simple and easy had preference among individuals been known to be similar. This objectifies value judgment and thus, a single evaluator would then be sufficient to represent preference of a population. But utility functions vary between individuals and preferences vary over time. The problem with a subjective judgment is how to validate whether the derived weighting is representative of the judgment of the population. Bodini and Giavelli (1992) resolved this problem through a survey technique that isolated viewpoints from the subjectivity of the planner and facilitated the involvement of local communities in the decision phases. However, their work failed to account for conflicts that may ensue in the final analysis—if stakeholders are categorized into groups, will each group's perception vary from each other? When Leung et al. (1998) applied the AHP approach, geometric means of the judgment from respondents were used to derive the overall and the respective group's priority, then, variation among individual judgments within and between groups was determined using analysis of variance. Grouping the individuals according to their respective stake in the fisheries would be more rational than combining all individuals with varied interests because of the problems of divergence in preference and domineering behavior of some individuals. The process that Stewart and Scott (1995) identified to re-homogenize individual groups is too tedious because every time a consensus is not achieved within a homogenous group, either multiple points of view or sub-criteria are created, or the group is subdivided into two or more groups representing the different interests.

In a top-down approach type of management, there are only few individuals whose views are likely to influence the final decisions of the management process. However, when larger and varied groups of individuals are involved, identification of preference system has to be approached differently. With increased number of participants (or evaluators), computational burden increases (Prato 1999), however, the problem of computational overburden need not concern the evaluators—this is the responsibility of the analysts (who most likely will use computer software in the analysis of data).

The institutional framework in which the entire decision-making process occurs determines the categories and number of evaluators. An institutional structure that is systematic and flexible is able to facilitate the integration of a wide range of viewpoints through interaction between and among diverse groups of individuals with varying stakes in the fisheries (Petry 1990, Ridgley and Rijsberman 1994). Although technical information is important, resource managers and coastal users' personal knowledge, experience and judgments are needed to develop the evaluation tool. Chong (2000) recognized the invaluable contribution fisherfolk may have in providing feedback of the condition of the resources and habitats. However, despite the wide recognition of the crucial participation of fishers in the management of fisheries resources (Castilla and Fernandez 1998, Ferrer et al. 1996, Gilman 1997), the mechanism through which to include them in the formal evaluation process is not actually established.

5. Multi-criteria Aggregation Approaches

Following the structure of an evaluation matrix, we are now able to construct an *"impact evaluation matrix"*, characterized as an *ex post* evaluation (Nijkamp et al. 1990, Voogd 1983) which deals with the analysis of the effects of management strategies that were already implemented. The multi-criteria evaluation method is usually named after the kind of aggregation procedure applied in the analysis. The principles of these aggregation methods are presented in this section together with examples and interpretations on their applicability to fisheries management evaluation.

The multi-criteria evaluation method often uses two kinds of input data: criterion scores and a set of political weights attached to these criterion scores. When input data are completed, the final step concerns the aggregation procedure to determine the progress of a choice possibility whether based on an already established standard or in comparison with other choice possibilities. There are multi-criteria evaluation methods (for an *ex post* evaluation) in the fields of urban planning, transport, health, water resource management, etc., which have not been fully utilized in the field of fisheries management that may be worth exploring. These are the *Weighted Sum Model (WSM)*, *Concordance Analysis*, *Regime Method*, *Ordination Technique* and *Mixed-Data Evaluation Method* (or EVAMIX). By examining how each one has been applied, it may be possible to determine which methods in what situations are relevant in addressing the issue of performance evaluation of management strategy in a developing country's tropical fisheries.

The level of measurement imposes special conditions on the techniques to be used in further data manipulation. Smith and Theberge (1987) presented three aspects of measurement theory that will be useful in understanding the measurement of the indicators: (i) four basic scales of measurements (nominal, ordinal, interval and ratio) define the types of mathematical operation to be applied to the values; (ii) measuring environmental variables or subjective values; (iii) uncertainty in measurements which affect both how measurement is done and the confidence that is placed in the values obtained. Works on multi-criteria methods rarely discuss how the measures for the indicators were arrived at—e.g., uncertainties attached to the measurement. Because of the temporal and spatial differences associated with the collection of information for each indicator [data for the indicators and criteria may not be collected at the same time], it would be useful to standardize the collection process.

a. Weighted Sum Model (WSM)

The Weighted Sum Model (also known as Simple Additive Weightings) is the simplest and most commonly used method when all criteria are measured on cardinal scales, expressed in comparable units, and weights are assigned per criterion. This method is discussed in detail in Hwang and Yoon (1981), Nijkamp et al. (1990) and Triantaphyllou and Lin (1996). The criterion scores are standardized or normalized to be comparable and these normalized criterion scores are multiplied by their respective weights. The products are called the weighted scores and they are summed up over all criteria yielding a total weighted score or *priority score* for each choice possibility (Smith and Theberge 1987). The choice possibility with the highest priority score is the one that performed well and is said to be the best choice possibility (P*). The best choice possibility (P*) is determined through the mathematical expression $P^* = \max_{M \geq i \geq 1} \sum_{i=1}^{N} x_{ij} w_j$, where, P* is the priority score of the best management strategy, x_{ij} is the measure of performance of the i^{th} choice possibility in terms of the j^{th} criterion, and w_j is the weight of importance (Triantaphyllou and Lin 1996) . Usually the weights are normalized so that

$\sum_{j=1}^{n} w_j = 1$.

The method requires that criteria scores are both numerical (i.e., interval or ratio scales) and comparable because the regular arithmetical multiplication and addition measures are employed (Hwang and Yoon 1981). The scores of the criteria have to be comparable because of the process of combining attributes such that a 'high' score for one criterion must receive about the same numerical values as 'high' scores of other criteria. There is a drawback in this kind of approach—it is difficult to interpret the multiplication of criteria values by weights. Consider for example, criteria *X* and *Y*; the score of criterion *X* (0.800) multiplied by its weight (0.1) would yield the same product as that of criterion *Y* with score and weight of 0.267 and 0.3, respectively. The problem lies with the tendency for the criteria to offset each other. Being based on additive utility assumptions, WSM assumes transitivity of preferences and comparability of any pair of actions. Thus, it is more applicable to single dimension (all units of measurements are similar) than multidimensional (units of measurements are different) problems. Also, this method considers independence of criteria, when in fact, they are complementary (excellence with regard to one criterion enhances the utility excellence with regard to the other attributes). It is a powerful tool as long as no important complementarities exist among the criteria. (Hwang and Yoon 1981). In the evaluation of fisheries management, the data available [especially ecological data] are likely to violate this assumption;

therefore, WSM has little use. Further, since all criteria are aggregated to obtain a single final result, the technique jeopardizes intermediate analysis. (Petry 1990, Triantaphyllou and Lin 1996). According to Voogd (1982) one limitation of the WSM is that the outcomes will strongly depend on the (usually arbitrary) choice of the origins of the various measurement scales used. Chesson et al. (1999) applied the WSM technique to calculate the scores of a fishery over time (i.e., 1993, 1994 and 1995) relative to the best performance achieved by a particular fishery. One important aspect of their evaluation is the aggregation of scores of the indicators across all components of the framework that were introduced. Such aggregation only indicates that it is possible to combine scores of all indicators in each criterion. Chesson et al. (1999) however, reminded that the level of aggregation be used to reduce the information to manageable amounts without being misleading.

b. Concordance Analysis

Concordance analysis, also known as ELECTRE (Eliminating et Choice Translating Reality), is based on pairwise comparisons of several choice possibilities. It was originally introduced by Benayoun et al. in 1966 (Hwang and Yoon 1981), and since then, the method was modified in the works of Van Delft and Nijkamp (1977), Roy (1991), Pomerol and Barba-Romero (2000), etc. The method makes use of successive assessments of outranking relationships such that choice possibilities defined by the outranking relationship can be eliminated. Its important input is a set of weights, and the output is a set of outranking relationships (or partial orders). Compared to WSM, concordance analysis is not based on utility theory. Utility functions are not used because of the substitutability property of the method, that is, a bad outcome for a certain criterion can be compensated by a good outcome for the other criteria. (Hwang and Yoon 1981). It is an evaluation method that can be used for cardinal data in the impact matrix and the weights vector. The basic feature of concordance analysis is a pairwise comparison of choice possibilities through the use of scores that form the impact matrix (Bodini and Giavelli 1992). It examines both the degree to which the preference weights are in agreement with pairwise dominance relationships and the degree to which weighted evaluations differ from each other. Salient features and detailed calculations of the method are found in Hwang and Yoon (1981) and Nijkamp et al. (1990). The central point of the method is the determination of the concordance and discordance indices (Moriki and Karydis 1994).

One disadvantage of the Concordance Analysis method is the use of threshold values that can be selected arbitrarily. Because of this limitation, Van Delft and Nijkamp (1977) in Hwang and Yoon (1981) introduced the concept of net dominance relationships to complement the analysis of the ELECTRE method. Two components of net dominance were presented—*net concordance dominance value* and *net discordance dominance value*. Elements in the concordance and discordance matrices are used to calculate the net concordance and net discordance values, respectively.

Moriki and Karydis (1994) applied Concordance Analysis to biological and chemical indicators, all measured in cardinal scale. They found it useful in identifying distinct areas of pollution according to nutrient characteristics of the coastal waters. Keeney and Wood (1977) remarked that with ELECTRE it is difficult to do sensitivity analyses to see just how much better one system is than another but the latest version (i.e. ELECTRE IV) is able to incorporate sensitivity analysis.

c. Regime Method

The application of Regime Method is reviewed and discussed in Nijkamp et al. (1990), Finco & Nijkamp (1997), De Montis & Nijkamp (1999), Nijkamp & Torrieri (2000), Vreeker & Nijkamp (2001) and Nijkamp & Vindigni (1999). Their discussions are summarized here. Regime method is composed of an evaluation matrix and a set of political weights (Nijkamp and Torrieri 2000, Vreeker and Nijkamp 2001). De Montis and Nijkamp (1999) described it as 1) being able to make use of both cardinal and ordinal indicator scores; 2) based on regime vector that is composed of + or – signs, the ordinal priorities of the criteria/indicators, and the scores the choice possibilities; and 3) the regime vector is constructed based on the sign of the arithmetic difference between scores of two choice possibilities according to each criterion. In the concordance analysis, the concordance sets can still be determined even if the scores of the indicators are ordinal as long as the weight vector is cardinal. However, when both scores and weights are ordinal, it is not possible to compute the concordance index. Such difficulty is resolved by the application of the Regime Method.

Regime method is a generalized form of Concordance Analysis based on pairwise comparison method whose point of departure is an ordinal evaluation matrix and an ordinal weight vector (Nijkamp et al. 1990, Vreeker and Nijkamp 2001). Due to the ordinal nature of the information contained in the evaluation matrix, the magnitude of the difference between the impacts of management strategies is disregarded. A *concordance index* ($c_{ii'}$), which is the sum of the weights of the criteria or indicators for which one choice possibility i is better than i', is also computed. A concordance index is also computed for which i' is better than i and this is written as $c_{i'i}$. Pairwise comparisons can be recorded in a table called regime matrix composed of Z (Z-1) comparisons where Z is the number of choice possibilities. Then, a *net concordance dominance index* ($\mu_{ii'}$) is computed through the formula $\mu_{ii'} = c_{ii'} - c_{i'i}$. According to Nijkamp et al. (1990), the analysis aims to avoid the difficulty of having ambiguous result by partitioning the set of feasible weights, so that for each subset of weights a definite conclusion can be drawn about the sign of the index $\mu_{ii'}$. Because of the ordinal nature of $\mu_{ii'}$, it's size is not the focus of the analysis but the sign. A positive (+) value of $\mu_{ii'}$ means that choice possibility i is preferred over i' and a negative (-) when the reverse is true (Moriki et al. 1996, Moriki and Karydis 1994).

d. Ordination Technique

Identified as a multivariate method, ordination techniques in ecological research are used to quantify the interrelationships among a large number of interdependent variables and to explain those variables in terms of a smaller set of underlying dimensions (e.g., components) (McGarigal et al. 2000). The type of ordination technique that is commonly used in a multiple criteria analysis is the geometric or multidimensional scaling (MDS) ordination technique. It is a qualitative evaluation approach based on ideal point concept (Voogd 1980). Through MDS, quantitative inferences can be drawn without violating the ordinal character of the input data (Voogd 1982).

MDS is very useful when dealing with too many criteria, which in some cases are vague and unknown. It uses proximities of pairs of management strategies in constructing a multidimensional spatial representation. When the information are in a ratio scale, they are converted to rank order dis(similarities). Hwang and Yoon (1981) and Stalans (1995) described the detailed operation of the non-metric MDS as an approach that looks for a configuration, and this configuration gives the spatial representation of the patterns of proximities among objects. Choice possibilities are represented as points in space, so that the interpoint distances correspond to rank order of dissimilarity judgments among management strategies. Those points that are close together are assumed to be close together in terms of preference. The evaluator locates his ideal point in the space and then the distance from the ideal point is measured (using Euclidean distance or other measure) in order to rank the choice possibilities in terms of preference. Interpretation of the relative positions of management strategies in the space is associated with the characteristics of the criteria that were scaled. One way to determine which among the criteria contribute to the positioning in the configuration is by the use of a multiple linear regression—criterion as dependent variable and the coordinates of the configuration as the independent variables. This would mean that the criteria are regressed over the coordinates of the configuration.

The distance measure used to form the configuration assumes that the criteria are independent or non-complementary. The scores of the criteria may take any form since the scaling procedure produces numerical and comparable values of each resultant dimension. None of the dimensions correspond with single criterion of the original matrix. This attribute is particularly useful when the number of criteria is large (around seven) and most criteria are expressed qualitatively. (Hwang and Yoon 1981).

A multidimensional scaling (MDS) technique was used in the eutrophication study of Moriki and Karydis (1994) with physical and chemical factors as the criteria. Through a repeated process of inclusion and exclusion of parameters (or criteria), the technique was able to determine which parameters are most sensitive in assessing different eutrophication levels in the coastal ecosystem. MDS was also used to validate or confirm results of other multi-criteria evaluation methods (i.e., concordance analysis, numerical interpretation method and regime method) which yielded similar results in ranking the alternative sampling locations. This approach however, requires that the evaluation problem should have enough degrees of freedom (Voogd 1982).

Preikshot et al. (1998), Pitcher & Preikshot (2001) and Pitcher (1999) examined the applicability of MDS in comparing the status of the fisheries with respect to biological, economic, sociological and technical attributes. Pitcher (1999) made use of the ordination technique in developing the RAPFISH (Rapid Appraisal Technique for Fisheries) for comparing the status of the fisheries. The technique constructs the best and worst possible fisheries from sets of scored attributes that were derived from fixed reference points (ideal points). MDS was able to generate ordination scores that provided a rating for fishery from 0% (bad) to 100% (good).

e. Mixed Data Evaluation (or EVAMIX)

A clear disadvantage of the qualitative methods (e.g., Regime Analysis) is that the available quantitative information are partially used (only the ordinal rank characteristics). Although ordination technique can also be used to analyze mixed data, a better set of methods has been developed to deal with mixed qualitative-quantitative evaluation scores. Just like the Concordance analysis and Regime method, the Mixed-Data Evaluation or commonly called EVAMIX is classified as a *relative multi-criteria evaluation* because there is no ideal value and the final appraisal score does not provide the absolute quality of a choice possibility; it only shows how different a certain choice possibility with respect to the others (Voogd 1992).

In the application of EVAMIX, the ordinal and cardinal information of the evaluation matrix are separated. Thus two measures are constructed and each one is standardized so that in the end, they can be aggregated to determine the appraisal score for each choice possibility. The procedural framework of EVAMIX uses three approaches in order to come up with an appraisal score: *subtractive summation technique*, *subtracted shifted interval technique*, and *additive interval technique*. Detailed computation and application of the EVAMIX procedure are found among others in Voogd (1983); Voogd (1982); and Nijkamp et al. (1990).

C. Application of Multi-criteria Evaluation Methods to Fisheries Management

If possible, the evaluation of the impacts of fisheries management should relate to the goals or objectives of fisheries. These objectives are most likely stated in a management plan, inferred from general policy statements or sometimes proposed by the authors (Chesson et al. 1999). The evaluation process however, becomes very difficult if management objectives are not clearly specified (McAllister et al. 1999). The gaps, difficulties and challenges in developing and implementing fisheries management system recognized in an ICES Symposium held on November 16-19, 1998 laid important challenges in the development of a multi-criteria evaluation method for fisheries. The salient points raised during the Symposium found in Stokes et al. (1999) are summarized as follows:

a. Evaluation and management of fisheries systems require sound decision-making despite uncertainty. Fisheries management systems must develop techniques to account for these uncertainties;

b. Slow pace of fisheries management to recognize the need to implement formal and rigorous decision-making. The existing case studies and techniques and approaches from the fields of Operation Research and Management Science may be useful;

c. The need for collaborative efforts among stakeholders (e.g., management agencies, scientists, industry, etc.) to articulate objectives for fisheries management to be consistent with international fishery conventions and standards;

d. There is a change in the governance for fisheries, from a single discipline to a meta-discipline involving the socio-economic context of the fishery; and

e. The relevance of formal evaluation and management procedures and system performance in providing information upon which credible management decisions can be based.

The outcome of the conference articulated the need for and lack of an evaluation instrument for fisheries management system. The direction is no longer towards single disciplinary approach but multi-disciplinary with respect to what is to be evaluated and who will participate in the evaluation. The best-known examples of multi-criteria decision-making (MCDM) techniques in fisheries appeared in the review of Romero and Rehman (1987), Van Pelt (1993) and Mardle and Pascoe (1999). Mardle and Pascoe (1999) cited 30 articles found in the literature but most of the methods they referred to were utilized in determining how best to allocate the resources given a set of objectives and constraints. Others were used to analyze which management policy or alternative is preferred. While the methods are useful in dealing with expected and predictable effects of alternatives, projects, and plans which are not yet implemented (for an *ex ante* type of evaluation), they may be of little utility in the review of past activities.

Chesson et al. (1999) applied the framework of a multi-criteria evaluation in structuring the multidimensional effects of management. When they used the Weighted Sum Model, they identified the components of the hierarchical structure of the fishery, specified the objectives for each component, assessed progress with respect to the objectives through the indicators, and evaluated the options to improve future performance concerning the objectives. There are also other studies that explored the multidisciplinary approach of evaluating a single management intervention such as the Marine Protected Area Evaluation Model (MPAEM) (Alder et al. 2002) which is based on the principle of the Rapid Appraisal Technique by Pitcher & Preikshot (2001) and Pitcher (1999).

D. Conclusion

The main problem with existing impact analyses and assessment methods is that they fail to approach the solutions to fisheries evaluation in a holistic or integrated manner. The multi-criteria methods discussed here may, at some point, be able to resolve this evaluation problem if limitations and assumptions for each method are taken into account. The choice of a multi-criteria evaluation method is highly dependent on the nature of information to be included in the evaluation matrix. When criteria scores and weights are both determined on a cardinal scale then, the simple Weighted Sum Model is applied. This method, however, assumes that criteria are independent of each other, a condition unlikely to be satisfied in fisheries assessment as many criteria and indicators are interrelated. In contrast, the Concordance Analysis method though it does not assume independence of criteria and indicators also requires both criteria scores and weights to be measured on a cardinal scale. Concordance Analysis also provides that even if the evaluation matrix is ordinal, the concordance set can still be determined as long as the weight vector is cardinal. When both criteria scores and weights are ordinal, then the Regime Method is appropriate. The appraisal scores in Concordance Analysis and Regime Method are derived through pairwise comparisons of alternatives.

The non-metric Multidimensional Scaling (MDS) is usually employed when standards or reference points for criteria or indicators are available. These reference points are considered 'ideal points' such that choice possibilities which highly deviate from the ideal points are located in space farther from these ideal points. In ecological studies, MDS is commonly applied to data all measured quantitatively (e.g., dissolved oxygen, pH, nitrates, etc.). Because the method was not explicit as to the homogeneity of measurement scale of the indicators, Moriki et al. (1996) found that MDS is applicable to a set of heterogenous data [measured in both ordinal and cardinal scales]. Even in the development of a fisheries rapid appraisal technique (RAPFISH), Pitcher (1999) applied non-metric MDS to compare the status of the different fisheries using a number of fixed reference points for the attributes (or criteria). Their work incorporated attribute scores measured on binary, ordinal and ratio scales.

Important issues have to be considered in choosing the multi-criteria technique to evaluate the impacts of fisheries management in tropical areas. Most fisheries criteria (e.g., equity, economic efficiency, ecological sustainability) are broadly defined and thus, would require indicators to measure them. Measurement of a criterion is rarely possible with only a single indicator because other indicators may also contribute to the measure of a criterion. There will be instances when the number of indicators is not equal for all criteria (e.g., three indicators for biological diversity versus five indicators for economic efficiency). If this is the case, Voogd (1983) suggested to aggregate indicators per criterion. The simplest form of aggregation is to take the mean of the normalized indicators. Thus, the mean is now considered as the normalized criterion score.

One tool that is useful in deriving a cardinal weight vector is the Analytic Hierarchy Process (AHP). Only few studies have explored the use of AHP in fisheries management, maybe because in many impact evaluation studies, coastal resource users' assessment is seldom considered in a formal evaluation process. Many researchers are quite apprehensive about integrating subjective judgments in the process of impact assessment because judgment varies among individuals and with time. This may be one major limitation in terms of integrating resource users in the evaluation process, however, due to the uncertainty and incompleteness of technical information, coastal resource users' experience and indigenous knowledge are critical in providing balance to the entire evaluation process. Although AHP may proceed up to the selection of choice possibilities, the method can also be used in deriving weights for the criteria and indicators and these weights are utilized in a multi-criteria method so that the technical information attributed to the criteria are not ignored.

Another important consideration in applying these multi-criteria methods to fisheries is the possibility of finding heterogenous (measured at varying scales) indicators in each criterion. For example, scores of some indicators under an economic efficiency criterion may be ordinal while others are ratio or interval. A multi-criteria method known in the field of urban and regional planning to address this problem of diverse data is the Mixed-Data Evaluation (or EVAMIX) method. EVAMIX separates the criteria measured quantitatively from those derived qualitatively. Thus, concern as to the validity in combining mixed information is worked on in this method. Its most important feature is that a separate calculation of standard dominance scores for ordinal criteria and cardinal criteria is presented. In the case of fisheries management evaluation, the situation is more complicated and such complication is illustrated in the following example.

Consider the evaluation matrix in Table 1 where four fisheries criteria were measured by several indicators with different measurement scales (i.e., ordinal and cardinal). With the use of the EVAMIX approach, I would suggest that this problem be dealt in two ways: First, is to disregard the original criteria, regard the original indicators as criteria and then apply the EVAMIX to the 16 new criteria (previously the indicators). Therefore, there will be 7 ordinal and 9 cardinal criteria from where to derive the appraisal scores. Since EVAMIX did not specify the minimum number of criteria to use, then it is possible to use these 16 criteria. Voogd (1983) suggested however, that in any impact evaluation the number of criteria should be delimited to approximately seven or eight. The second way is to determine the appraisal score in every criterion using EVAMIX. For example, in the ecological criterion of Table 1, there are four indicators (two are cardinal while the other two are ordinal). There will be separate standardized dominance scores for cardinal and ordinal indicators, which when combined will contribute to the computation of the appraisal score. The summation of appraisal scores in all criteria will be the final appraisal score for that particular management strategy.

Table 1. Sample evaluation matrix for fisheries.

Criteria	Indicators	Type of measurement
Ecological	1. Change in tropic level	Ordinal
	2. Reef fish abundance	Cardinal
	3. Reef areas	Cardinal
	4. Discarded by-catch	Ordinal
Economic	1. GDP/person	Cardinal
	2. Income/fisher	Cardinal
	3. Subsidy	Ordinal
Social	1. Environmental knowledge	Cardinal
	2. Kin participation	Ordinal
	3. Education level	Ordinal
	4. Conflict status	Ordinal
Institutional	1. Fishers' organizations	Cardinal
	2. Alternatives	Cardinal
	3. Municipal ordinance	Ordinal
	4. Enforcement funds	Cardinal
	5. Infringement	Cardinal

Also, when only one criterion in Table 1 has mixed information, it would be possible to consider applying EVAMIX only to the criterion with mixed information. As for the rest of the criteria, either Concordance Analysis or Regime Method may be applied depending on whether they are measured and weighted on cardinal or ordinal scale. Thus, an appraisal score for each criterion is computed; summation of all appraisal scores is equal to the final appraisal score for each management strategy. The preceding suggestion however, is just a theoretical and preliminary assessment of multi-criteria methods for application in fisheries and has not been explored in actual data. Table 2 summarizes the assumptions and limitations in the use of these methods.

Table 2. Assumptions and limitation in using each evaluation method.

Evaluation Method	Assumptions/Limitations
Weighted Sum Model	o All criteria are measured on cardinal scales and expressed in comparable units; weights are assigned per criterion; o Considers independence of criteria; o Assumes transitivity of preferences (additive utility); o Applicable to single dimension problem (all units are similar)
Concordance Analysis	o Not based on utility theory; o Method can be used in cardinal data (impact matrix and weight vector); o Can be applied even if evaluation matrix is ordinal for as long as the weight vector is cardinal
Regime Method	o Useful when evaluation matrix and weight vector are both ordinals
Ordination Technique (e.g., Multidimensional Scaling)	o Useful when dealing with large amount of variables; o The goal is to quantify the relationships among interdependent variables
Mixed Data Evaluation (EVAMIX)	o Deals with mixed qualitative-quantitative evaluation scores

Several studies have compared the performance of either two or three of these methods using a given set of information. In the study of Moriki and Karydis (1994) to assess eutrophication levels in the coastal ecosystem, both Concordance Analysis and Regime Method produced similar results in terms of ranking the alternative sampling locations. Ridgley and Rijsberman (1994) used the Weighted Sum Model (WSM), Concordance Analysis and even the Analytic Hierarchy Process (AHP) to elucidate the implications of using a set of impact assessments and preference evaluations. In order to analyze a set of criteria with varied units of measurements, Bodini and Giavelli (1992) applied the weighted Concordance Analysis and EVAMIX. Scores for the Concordance

Analysis were derived quantitatively then, converted to qualitative data for the EVAMIX analysis. Moriki et al. (1996) realized that the Regime Method and Multidimensional Scaling [together with Cluster Analysis and Principal Component Analysis] are applicable to a set of heterogenous data [measured in both ordinal and cardinal scales]. All these studies applied multi-criteria methods one at a time; but with the type of information available to fisheries evaluation, the possibility of combining multi-criteria models in one evaluation is worth examining.

Multi-criteria evaluation should not be considered a panacea in tropical fisheries assessment but an aid to the decision-making process. Once the method for fisheries assessment is established, research data collection can be streamlined to only those relevant to the evaluation. This is highly significant in developing countries wherein the cost of data collection is a major constraint. By focusing on established indicators and criteria, decision-makers are supplied with relevant, timely and inexpensively-derived information.

CHAPTER III

RESEARCH METHODOLOGY

A. Research Strategy and Data Sources

This research utilizes both primary and secondary data in developing the multi-criteria evaluation method for fisheries management. The secondary information was gathered from various sources including records collected from government offices and outputs of major fisheries research programs and projects in the Philippines. Most of it came from the databank of the Philippine Fisheries Sector Program (FSP), a program funded by the Asian Development Bank (ADB) and Overseas Economic Cooperation Fund of Japan (OECF) and implemented in early 1990s to assist the Philippine fishery sector. Twelve priority bays were selected under the FSP based on the bays' resource regeneration requirements, environmental degradation, and poverty problems as well as initiatives of local governments and communities (ADB 1993, Dames & Moore International et al. 1989). From the databank of FSP, the goals and objectives of the country's fisheries as well as fisheries management interventions were drawn.

The review of existing information led to the selection of five criteria that are deemed relevant in evaluating the impacts of fisheries management strategy in a coastal area. The choice of the criteria considered the multi-dimensional issues in fisheries including the interaction between natural resources and human resources. Five criteria were identified namely, *Acceptability, Biotic Diversity, Economic Performance, Enforceability,* and *Equity,* representing the ecological, social, economics and institutional dimensions of a coastal fishery. Because no single measure is established for each criterion, potential indicators were identified and chosen. The selection of the indicators was done by reviewing current and past literature on sustainability and fisheries indicators such as the works of Garcia et al. (2000), Bonzon (2000), Vandermeulen (1998); Staples (1997), Charles (1995) and many others. The choice of indicators was based on their *suitability to the Philippine fisheries situation, measurability* and *availability of information.* The indicators found in the literature were short listed using the baseline and post evaluation information on FSP's resource and ecological assessment (REA) and socio-economic and institutional opportunities (SEIOS). The indicators were either clearly defined or inferred from the outputs of the FSP.

Twenty-four (24) indicators assumed to collectively contribute to the measure of the five criteria were selected. Other indicators that may also contribute to the criteria were not included for lack of available baseline information or perceived difficulty in measuring them. The five criteria and 24 indicators are presented in Table 3 and discussed in detail in the next section (B). The indicators were measured using existing data and direct assessment from resource users. The measures of the indicators are called *indicator scores*. The indicator scores were determined at two time periods—*before* and *after* implementation of fisheries management strategies.

The degree of importance of the criteria in assessing the impacts of fisheries management strategies and indicators in measuring the criteria is based on the perception of representative groups of resource users. The weights of importance were determined using the Analytic Hierarchy Process (AHP) method developed by Saaty (1980). The final output of this research, based on the indicator scores *before* and *after* implementation of fisheries management strategies and the weights of importance of criteria and indicators, is an impact evaluation matrix showing the degree or level of change.

Table 3. List of criteria and indicators.

ACCEPTABILITY
1. Resource users' participation in the management process
2. Level of awareness of resource users in resource management
3. Number of fishers who belong to an organization
4. Change in the level of intra-sectoral conflicts
5. Change in the level of inter-sectoral conflicts
BIOTIC DIVERSITY
6. Abundance of reef fish
7. Abundance of commercial fish catch
8. Species richness of reef fish
9. Extent of mangrove areas
10. Status of coral reef resources
ECONOMIC PERFORMANCE
11. Number of commercial fishing boats and banned fishing gears
12. Fisherfolk gross revenue from fishing
13. Assessment of fisherfolk gross revenue from fishing
14. Employment structure of small-scale fishers
ENFORCEABILITY
15. Presence of comprehensible laws and regulations
16. Frequency of information dissemination about the management
17. Perception on the suitability of enforcement techniques
18. Performance assessment of law enforcers
19. Financial support for enforcement
20. Assessment of the allocated financial support for enforcement
EQUITY
21. Profit distribution among different fishing gears
22. Financial support for additional livelihood implemented
23. Assessment of the success of additional livelihood implemented
24. Inclusion of women in the management process

B. Definition and Description of Criteria and Indicators

The five criteria and their corresponding indicators are discussed as follows:

ACCEPTABILITY- refers to the degree whereby coastal resource users received, recognized, supported, and acknowledged the presence of management strategies. Clarke et al. (2002) presented a step-wise consultation approach integrating fishers in the decision-making process with respect to artificial reef deployment. They found that increased community participation in monitoring, management and enforcement is possible as long as the fishers realize the benefits of a management activity. Many studies that assessed the state of the Philippines' fishery resources attributed the reduction in the effective functioning of the fishery system to the activities of the coastal population. A management strategy that is said to be acceptable or not depends upon the perceived impacts of the affected groups. Coastal resource users (being the direct recipients of change) may be better assessors of whether a fisheries management strategy is beneficial or not. Historically, the management of Philippine fisheries has been the sole responsibility (or most of the responsibility) of the government. But experience proves that government alone is unable to provide the kind of management its fisheries require without user participation. In the early '80s, when problems in the fisheries arose, the government implemented management practices despite antagonism from the coastal fishers. It was only in recent years that the role of fishers in the management of the fishery resources has been recognized as important. This recognition is embodied in a number of newer laws such as the Local Government Code of 1991 (Republic Act 7160 1992) and The Philippine Fisheries Code of 1998 (Repubic Act 8550 1998).

Indicators for Acceptability

1. *Resource users' participation in the management process.* It has always been debated that one major reason for failure of management is the lack of participation of groups of resource users in the management process. Lack of participation in the decision-making process predisposes fishers and others with an interest in fishing to ignore rules designed to maintain a sustainable fishery (FAO 1999). For instance, Gilman (1997) found that when user groups are not involved or do not understand nor support the rules in the management of protected areas, they will not comply with restrictions on their traditional resource harvesting practices. And in the absence of strong community support, the integrity for example, of protected areas relies more heavily on costly enforcement (Sumaila et al. 2000). Studies of marine reserves in small islands in the Philippines (e.g., Apo Island, Sumilon Island, Pamilacan Island, Malalison Island) and elsewhere around the world (e.g., St. Lucia in the Carribean, Maldives) have demonstrated that in order for management of marine reserves to be successful, local community support is important (Russ and Alcala 1999). The same is true with mangrove reforestation project in Cogtong Bay, Philippines which relied heavily on community participation to prevent further efforts to degrade the resources (Janiola Jr. 1996). Although participation does not guarantee sustainability, a fisheries resource would unlikely achieve sustainability without participation (FAO 1999). Implementation of a management intervention would be very difficult when resource users are never part of the decision-making process, even if scientific knowledge supports such intervention. Fishers may

aspire for a stake in the management (at least 50% of the responsibility) because they believe that their close association with and knowledge of the fisheries resource make them legitimate stewards. It is likely that participation in the management process (which includes conceptualization/planning, implementation, monitoring and evaluation) is positively correlated with the acceptability of the management strategy. Therefore, coastal resource users' perception as to their degree of involvement in the management process measures acceptability of management strategy. Local empowerment through resource participation is seen as a critical factor in the progress of a coral reef management strategy (Bunce et al. 1999).

2. *Level of awareness of resource users*. One indicator of the acceptability of management is the level of awareness of resource users. Bohnsac (1993) justified the use of reserves as a tool to improve public awareness of natural systems and human impacts on those systems. He further argued that in order for these reserves to be successful, public education and awareness about their functions and importance are needed. The same is also true for other management interventions (e.g., mangrove reforestation, coral transplantation, vessel and gear restriction, etc.). The direct and indirect benefits of management are likely to be underestimated with uninformed resource users. According to Spash and Hanley (1995), relatively uninformed consumers (in this case the resource users) are likely to place a lower value on the environment in general and biodiversity in particular. But more informed resource users are better able to assess the overall benefits or costs of present and future development activities. An example is the

development of fishponds in Cogtong Bay, Philippines (most were illegal) which started many years back but had never met resistance from affected coastal residents. It was not until a project (Rainfed Resource Development Project) was implemented that the residents realized the perils of fishpond development (Janiola Jr. 1996). In this regard, determining the extent of awareness amongst resource users concerning management of fisheries resources becomes extremely important.

3. *Number of fishers who belong to an organization.* The presence of active organizations reflects the acceptability of management strategy to the resource users. The formation of fishers' organization is favorable when fishers understand the organization's objectives and thrusts. In the Philippines, people usually show enthusiasm at the start of a project or program but interest dwindles for lack of information and incompetent leadership. Many government projects targeted organized groups. For example, from 1960s to 1980s the Philippine government has initiated the formation of small-scale fishers organizations throughout the country with the primary purpose of extending credit for the modernization of the fisheries. These organizations, however, disappeared as fast as the discontinuation of projects and credit facilities. (Sunderlin and Gorospe 1997). Although fishers' organizations are critical in providing an avenue for more participation by the fishers, the number of organizations in a coastal area may not indicate nor ensure acceptability of management. It may be possible that only 10% of the total fishers population in a coastal community with 15 fishers' organizations belong to an organization. Even if only a single fisheries

organization is present in a coastal community yet supported by the majority of resource users it may be regarded as a good indication of the acceptability of management.

4\. – 5. *Change in the level of intra- and inter-sectoral conflicts.* Intra-sectoral conflict refers to the conflict occurring among members of a particular sector while inter-sectoral conflict occurs between members belonging to different sectors (e.g., small-scale fishers vs. trawlers; fishpond operators vs. small-scale fishers). Conflicts occur because of the use of a common resource by different groups of individuals. While the categorization of fishery conflicts in this research is mainly based on the general classification of Philippine fisheries which is sectoral (e.g., commercial, municipal, and aquaculture sectors), the papers of Charles (1992) and Charles (2001) provided a more comprehensive typology of fishery conflicts. In the Philippines, the most common type of fisheries resource conflicts emanates between small-scale fishers (e.g., bottom-set gillnetters, hook and liners) and commercial trawlers. Cruz (1986) concluded that in San Miguel Bay, traditional fishery (i.e., within the small-scale sector) is not characterized as conflict-oriented despite declining fish catch. He however, noted that conflict becomes a pattern of interaction between traditional and trawl fishers. Bottom trawling destroys habitats that are important for some species (Bohnsack 1993) which are considered the main catch of other fishers (especially small-scale fishers). These trawlers may come from within or outside the municipalities and provinces. Why is conflict an important indicator of the acceptability of the management? When a management intervention (e.g., marine reserves) reduces reserves) reduces user conflicts by separating incompatible activities including those involving fishing (Bohnsack 1993), the acceptability of such management then is said to be high.

BIOTIC DIVERSITY- refers to the change in the diversity of species and habitat resources in an ecosystem as a result of management strategy. Diversity is a combination of the number of species present (richness) and the similarity of their abundances (evenness) (Rice 2000). Kuusiplo & Kangas (1994) defined biological diversity "as the entire continuum of gene diversity and genetic variances from intra-specific to inter-specific level". In the literature, the conventional method of measuring diversity is through the use of diversity indices. Odum (1975) presented two components making up total diversity, i.e., *variety component* (e.g., number of species in the community) and *evenness component* (distribution of relative abundances). These components indicate that the greater the variety and/or the more even are the distribution, the higher is the total diversity index. The most common diversity index for fish species is the Shannon Index *(H)*; the higher the value of *H*, the greater the diversity indicating that the community is less dominated by a few species (Odum 1975). By using fish species and the conditions of critical habitats as indicators of diversity, the ecological and biological impacts of management strategy can be assessed. The increase in fish abundance and diversity are the indicators that were used to convince policy and decision-makers of the effectiveness of management interventions such as marine reserves in Apo Island, Pamilacan Island, Balicasag Island, Balayan Bay and Tubbataha Reef in the Philippines (White et al. 2000). According to Alcala (1988), there are at least two studies that showed positive correlation between live coral cover and abundance of reef fish; one of which also showed a positive correlation between biomass and reef complexity. In several studies on tropical marine reserves (Russ and Alcala 1996), some reef fishes were considered good indicators of impacts. Most of these reef fishes belong to the families Pomacentridae, Anthiinae, Caesionidae, Serranidae, Chaetodontidae, Mullidae, Labridae, etc.

Indicators of Biotic Diversity

6. *Abundance of reef fishes.* This indicator focuses on the relative abundance of reef fishes measured either as frequency (total number of individuals) or biomass (weight in kilograms or tons). The sampling for the abundance of reef fish however, is limited only to the sites where coral reefs are present and reef rehabilitation has been implemented. The change in the abundance of reef fishes indicates the effect of management on the state of fisheries resources.

7. *Abundance of commercial fish catch.* The measurement of this indicator is similar to the abundance of reef fish except that the fish catch from major fishing gears in a particular coastal area becomes the source of information.

8. *Species richness of reef fish.* This refers to the number of reef fish species in a community and is measured using the Shannon Index (*H*) computed as the $H = -\Sigma (n_i/N) \log_e (n_i/N)$ where n_i is the importance value for each species and N is the total importance value (Odum 1975).

9. *Extent of mangrove areas*. This indicator measures the total mangrove areas as a result of reforestation projects. Although there may be other better indicators of mangrove reforestation projects such as characteristic of vegetation structure,

levels of primary production, composition of animals, etc. (Ellison 2000). Reduction in the total mangrove areas in the Philippines is very apparent leading to many reforestation projects. The most common and dominant species of mangroves used in reforestation projects in the Philippines are *Rhizophora apiculata* and *R. macunata* (Ellison 2000). The sources of information came from the reports and database of previous research undertakings.

10. *Status of coral reef resources.* The conditions of a coral reef resource may be determined by measuring live coral cover. In the Philippines, these conditions are classified according to Gomez et al. (1998) as: a) *Excellent,* >75% living coral cover; b) *Good,* 50- 74% living coral cover; c) *Fair,* 25- 49% living coral cover; and d) *Poor,* < 25% living coral cover.

ECONOMIC PERFORMANCE- refers to the accrued economic benefits resulting from the management strategy. Here, economic benefits may not necessarily be equated to financial gain but more of the community's economic welfare. Hundloe (2000) argued that economic information is not merely financial but it also refers to the society's economic welfare; that the indicator of economic performance is sustainable profit (defined as a "*fish caught/harvested multiplied by the selling price minus the costs of obtaining the fish*"). But given the limitations of data on profitability in many coastal fisheries, Hundloe (2000) further espoused the proxy indicators of economic sustainability namely, price entitlements (e.g., cost of licenses), quantity of fish caught/harvested or stability, price per unit of the fish to the fisher, and various costs of fishing.

Indicators of Economic Performance

11. *Number of commercial fishing boats and banned fishing gears.* The economic conditions of small-scale fishers continue to deteriorate because of several factors and one of these is intensive commercial fishing in municipal waters. With the implementation of management strategies, it is assumed that the number of commercial fishers and fishing boats such as trawls, purse seines, etc. have decreased in municipal waters. There may be four explanations why trawlers would decrease in number in municipal waters: 1) improved law enforcement (which includes monitoring, control and surveillance), 2) shift to more productive fishing technology (gears and methods) allowing them to fish offshore; 3) subsidies were provided to increase their fishing fleet capacity to be able to fish offshore; and/or 4) economically unprofitable fishing grounds. This indicator measures the change in the number of commercial fishing boats and banned fishing gears.

12. *Fisherfolk gross revenue from fishing.* Improvement of fishers' incomes is one of the primary objectives of fisheries management. This indicator determines whether the fishery is still profitable or not by examining the total gross revenues from fish caught by major municipal fishing gears in each municipality.

13. *Assessment of fisherfolk gross revenue from fishing.* While gross revenue from fishing may not be considered a robust indicator of economic performance, the assessment from the fishers would somehow reduce the uncertainty attached to it. Who may better assess the change in the revenue derived from fishing than the fishers themselves?

14. Employment structure of small-scale fisheries. Many fishers are owner-operators of their vessels therefore, they find it difficult to leave the fishery (Cunningham 1994). In small-scale fishing, it is unlikely that small-scale fishers would totally quit fishing. It is possible that there may be change in employment structure such that fishers who were previously considered as full-timers will later be categorized as part time fishers. This is more likely to happen when management offers employment opportunities other than fishing. In many coastal areas in the Philippines, in order to re-structure employment in fisheries, the income from fishing should be lower than the income from other sources. Prior to the implementation of management strategy, there are more full-time fishers than part time fishers. A change in the employment structure in fisheries, preferring more part time than full-time fishers, is considered as an economic advantage provided that previous number (before management) of small-scale fishers is unchanged. This means that there is no additional labor force to the fisheries.

ENFORCEABILITY- considers compatibility, ease of implementation, complexity and cost of regulations. Enforcement is a function of the political will and financial means of the government (Pomeroy et al. 1995). In the management of Philippine fisheries, enforcement encompasses a variety of governmental levels and agencies including the provincial, municipal and village governments, Bureau of Fisheries and Aquatic Resources (BFAR), the Coast Guard, the Philippine National Police and qualified individuals designated as deputized wardens. One gauge of a successful enforcement of a management strategy is the priority given by the mayor or government officials to fishing regulations. According to Imperial (1999), enforcement can be formal (e.g., cease and desist order, civil penalties, criminal penalties, etc.) or informal (e.g., verbal comments or facial expressions demonstrating displeasure) sanctions. The most common approach to gain user compliance is through enforcement programs that include surveillance and monitoring activities (Alder 1996). How does one measure the effectiveness of an enforcement program? Studies to investigate the costs and effectiveness of enforcement programs are limited (Alder 1996). User compliance with rules and regulations for effective management of fisheries is as essential as public acceptance and support. In Australia, it was found that for 2% of the cost of recreational fisheries enforcement, an effective education program can be implemented (Bergin 1993). Most Pacific islands do not have the resources for stringent enforcement, but even if they did, it would be more desirable and economical for the community to support the protected area than for the government to conduct surveillance (Gilman 1997).

Indicators of Enforceability

15. *Presence of comprehensible laws and regulations related to management.* One major difficulty in managing the fisheries resource lies in inadequate, unreasonable and incomprehensible laws and regulations. For example, in the Philippines the law concerning the conservation of corals (Presidential Decree 1698) fails to specify how illegally gathered marine materials confiscated by the government agents should be disposed of (Alcala 1988). Many of the laws were written in a foreign language (i.e. English) and it was not common to have local language translation. The comprehensibility of written laws affects compliance of resource users.

16. *Frequency of information dissemination about the management* – it would be difficult for individuals to conform with regulations, even if they desire to cooperate, when they cannot understand what the regulations are all about and what is expected of them (Anderson 1989). Thus, regular dissemination of information (either through printed materials, radio programs, etc.) concerning management strategy is critical in effecting compliance among resource users.

17. *Perception on the suitability of enforcement techniques* – the most common approach to gain user compliance is through enforcement programs that include monitoring and surveillance activities. Enforcement techniques are approaches or methods used to deter violation and effect compliance of fisheries laws and regulations. The most common enforcement techniques are sea and air vessel patrol, placement of markers to identify boundaries, use of media to expose illegal activities and conduct trainings and seminars. In many cases, vessel patrols were designed to cover specific areas at a certain frequency. However, weather and staffing constraints may limit the basis for the patrols (Alder 1996). While the presence of enforcement techniques is essential for management to effect positive change, their suitability is another critical aspect. It may be possible that they may be present yet do not function as expected.

18. *Performance assessment of fisheries law enforcers.* The ability of the enforcers to implement the law is crucial in fisheries enforcement. This indicator goes beyond physical presence of fisheries enforcers but would also include how they handle critical situations. The coastal resource users determine whether fisheries law enforcers are doing the work they are expected to do or not.

19. *Financial support for fisheries law enforcement.* The ease with which a regulation can be implemented has a direct bearing on enforcement and monitoring costs and hence, on net benefit of management (Anderson 1989). It is assumed that in order for the management to be effectively enforced, the municipality has to allocate a certain amount of money for enforcing the municipal fisheries ordinance.

20. *Assessment of the allocated financial support for enforcement.* Financial support is an important component of monitoring fisheries activities in the municipality. While financial support for enforcement is in place, it does not necessarily mean that such support is sufficient. Many fisheries law enforcers would usually complain about the amount of enforcement support. This indicator allows representatives of coastal resource users to assess sufficiency of enforcement support.

EQUITY- refers to the equitable distribution of benefits among groups; this will also tell us how incomes from fisheries are distributed among interest groups. Hundloe (2000) defined equity criterion as a fair and just distribution of goods and services and remarked that there is no single indicator to measure it. In this research, equity also covers improved access to fisheries resources of especially low-income groups (i.e. small-scale fishers). Imperial (1999) presented two important aspects of the equity concept. The first is that those who benefit from the service should bear the burden of financing it while the second concept talks about re-distributional equity which concerns structuring of program activities around differential abilities to pay. He emphasized that an efficient program is not necessarily a fair program. While efficiency would dictate that resources be utilized where they produced the greatest benefit, equity concerns can lead to different resource allocations. The case studies presented by Gilman (1997) demonstrated that interest groups will support a protected area that permits multiple uses, although it is necessary to prohibit certain uses that contradict the goal of the protected area even if this alienates certain interest groups. According to Cunningham (1994), the issue of who is to receive the wealth associated with the fishery and the impact that this wealth will have on the economy is intimately linked with the kind of management system adopted and the way it is implemented.

Indicators of Equity

21. *Profit distribution among different fishing gears.* One way to measure the distribution of access to resources is to assess how profits derived from the fisheries are distributed among different fishing gear types. In the past, profits of trawlers were higher than the other gear types. However, with the implementation of the management strategy, profits incurred by trawlers are assumed to significantly decrease. The differential profit then would consequently go to a greater number of municipal gear types.

22. *Amount of financial support for additional livelihood.* The reliance of many coastal communities on the fisheries resources has caused the destruction of many critical habitats (e.g., dynamite fishing in coral reefs). Given these problems and the situation that many fisheries are located in depressed areas, policy measures are required to increase opportunity incomes (Cunningham 1994). The provision of alternative livelihood may reduce the pressure by making fishing less profitable. This is so because, according to Souter and Linden (2000) , in order to

go fishing fishers forgo whatever income they would have gained from their alternative source, hence increasing the amount of fish needed to be caught before a profit is returned. Small-scale fishers are poor because of lack of investment to provide alternative employment opportunities. The actual amount of money provided to create additional livelihood for those perceived to be displaced as a result of management was used to measure equity.

23. *Assessment of the success of additional livelihood implemented.* This indicator assesses the success of implemented additional livelihood. Financially supporting an additional livelihood does not guarantee that it would work unless it can be sustained. When the market of goods for this alternative fails, then the response would be for fishers to go back to fishing. The coastal resource users will assess whether the alternative livelihoods implemented are successful or not.

24. *Inclusion of women in the management process.* This indicator works on the premise that in the past, women in fisheries had been excluded in the management process. They were considered only as helpers in fisheries production who played a minor role compared to the male fishers. The study of Yater (1982), however, revealed that women in San Miguel Bay assume greater power and responsibility since they control the family's finances and play a key role in all economic decisions. It is assumed that women's knowledge, experience and active involvement in fisheries issues are well-recognized and acknowledged when management was in place.

C. Measurement of Indicators: *Indicator Scores*

The 24 indicators are categorized as cardinal or ordinal indicators based on how they were measured. The indicator scores can be derived in two ways: *a) direct assessment by coastal resource users (ordinal indicators),* or *b) use of data from previous or current research programs and/or available documents in the form of reports (cardinal indicators).*

1. Ordinal Indicators

The measurement scale for the 12 indicators that were assessed by the coastal resource users are as follows:

<u>*Acceptability Indicators*</u>

1. Resource users' participation in the fisheries management process

0	1	2	3	4	5	6	7	8	9	10
None			Sometimes		Moderate (50% of the time)		Often		Always	

2. Level of awareness of resource users in fisheries resource management

0	1	2	3	4	5	6	7	8	9	10
	None/very low		low		moderate		high			very high

4. Change in the level of intra-sectoral conflicts

-10	-8	-6	-4	-2	0	2	4	6	8	+10
worst than before	increased very much		increased/ present most of the time		no change/ same level		decreased		decreased highly	no more conflicts

5. Change in the level of inter-sectoral conflicts

-10	-8	-6	-4	-2	0	2	4	6	8	+10
worst than before	increased very much		increased/ present most of the time		no change/ same level		decreased		decreased highly	no more conflicts

Economic Performance Indicators

13. Assessment of fisherfolk gross revenue from fishing

-10	-8	-6	-4	-2	0	2	4	6	8	+10
decreased very much	decreased		decreased slightly		no change	increased slightly		increased		increased very much

Enforceability Indicators

15. Presence of comprehensible laws and regulations related to management

0	1	2	3	4	5	6	7	8	9	10
	Incomprehensible		slightly		moderately		strongly			very strongly comprehensible

16. Frequency of information dissemination about the management

0	1	2	3	4	5	6	7	8	9	10
Never			irregular		sometimes		regularly			Always

17. Perception on the suitability of enforcement techniques

0	1	2	3	4	5	6	7	8	9	10
not applicable			slightly applicable		moderately applicable		strongly applicable			very strongly applicable

18. Performance assessment of fisheries law enforcers

0	1	2	3	4	5	6	7	8	9	10
poor		slightly effective			moderately effective		strongly effective			very strongly effective

20. Assessment of the allocated financial support for enforcement

0 1 2 3 4 5 6 7 8 9 10

not sufficient — slightly sufficient — moderately sufficient — strongly sufficient — very strongly sufficient

Equity Indicators

23. Assessment of the success of additional livelihood implemented

0 1 2 3 4 5 6 7 8 9 10

failure — slightly successful — moderately successful — strongly successful — Very strongly successful

24. Inclusion of women in the management process

0 1 2 3 4 5 6 7 8 9 10

None — very limited — 50% of management process — high — very high

2. Cardinal Indicators

The 12 other indicators were culled from available reports and presented below. These indicators were not chosen by the coastal resource users but were evaluated during the pre-test with respect to their utility in measuring the criteria.

Acceptability Indicators

3. Number of fishers who belong to an organization- total number of fishers in each municipality who are members in at least one fisheries organization.

Biotic Diversity

6. Abundance of reef fishes- total frequency of reef fish

7. Abundance of commercial fish catch- total weights (tons) of commercial fish caught in each municipality

8. Species richness of reef fish- this is the number of species in a community measured using the Shannon Diversity Index (H)

9. Extent of mangrove areas- total areas of mangroves in hectares from the time when the first documented mangrove reforestation projects were implemented to the most recent information

10. Status of coral reef resources- the percentage of living coral cover, including the soft and hard corals

Economic Performance Indicators

11. Number of commercial fishing boats and banned fishing gears- change in the number of commercial fishing boats and fishing methods and gears banned from operating in the bay

12. Fisherfolk gross revenue from fishing- total amount of money (PhP) generated from major municipal fishing operations prior to the deduction of expenses

13. Employment structure of small-scale fishers- a ratio between full-time to part-time fishers. A ratio of less than 1.0 is more favourable.

Enforceability Indicators

19. Financial support for fisheries law enforcement –amount of financial support (PhP) for enforcement in each municipality

Equity Indicators

21. Profit distribution among different fishing gears- measures the proportion of two dominant gears (i.e., trawls and gillnets), with respect to the gross profits (PhP) derived from fishing

22. Amount of financial support for additional livelihood implemented- measures the available monetary support (PhP) for additional livelihood in each municipality

D. Characterization of the Study Site

1. Site Selection

The development of the multi-criteria evaluation technique for fisheries management commences with the identification of suitable coastal areas. Initially, three to four bays from the 12 priority bays under the Fisheries Sector Program were considered but this was not possible given financial, logistic and time constraints. San Miguel Bay was chosen as the only site because of its long history of extensive studies and research. The most valuable information about the bay appeared in the following research programs and projects:

- *"Small-Scale Fisheries of San Miguel Bay: A Multidisciplinary Analysis"*— a multidisciplinary research project conducted from 1979 to 1981 jointly by the Institute of Fisheries Development and Research of the College of Fisheries, University of the Philippines in the Visayas (IFDR-CF UPV) and the International Center for Living Aquatic Resources Management (ICLARM). This is the first multidisciplinary research that obtained baseline information for the management of the bay's fisheries resources.
- *Philippine Fisheries Sector Program (FSP)* – this Program started in 1992 contracted ICLARM to conduct a Resource and Ecological Assessment (REA) and a Socio-economic and Investment Opportunities Study (SEIOS) for the bay. Results were stored in a CD entitled, *The San Miguel Bay Story*, launched in 1995 by the Fisheries Sector Program of the

Philippine Department of Agriculture (FSP-DA), Philippine Bureau of Fisheries and Aquatic Resources (BFAR), and ICLARM.

- *Post Resource and Ecological Assessment Monitoring and Training in San Miguel Bay*- this project was conducted by the Bicol University in 1995-96 primarily to validate and update the results of the 1992-93 REA.
- *Fisheries Resource Management Project*- this project commissioned the Southeast Asian Ministers of Education Organization Regional Center for Graduate Study and Research in Agriculture (SEAMEO-SEARCA) in consortium with ICLARM in 2001 to conduct the Post Resource and Social Assessment (RSA) for the bay.

2. *Location of San Miguel Bay*

San Miguel Bay is considered as one of the most productive fishing grounds in the Philippines (Mines 1982). However, similar to any rich fishing area, it has been subjected to increased in-migration of people, intensive fishing, use of destructive fishing methods such as dynamite and cyanide, habitat destruction, and intense conflicts among various users, pollution, etc. The bay is situated at the southeastern part of Luzon between longitudes 122°59'E and 123°20'E and latitudes 13°40'N and 14°09'N (Cinco et al. 1995, Sia III and Luna 1992). It is bordered by the provinces of Camarines Norte on the northwest and Camarines Sur on the south and east border with a total area of about 1,115 km^2 and a coastline of 188 km. (Garces et al. 1995b). There are seven coastal municipalities surrounding the bay: *Cabusao, Calabanga, Sipocot, Siruma* and *Tinambac* are in the province of Camarines Sur while *Basud* and *Mercedes* are in Camarines Norte. Basud and Mercedes, situated along the northwestern part of the bay, are characterized with hilly land areas. Also found in the western side of the bay, is the municipality of Sipocot. At the southern end, the municipalities of Cabusao and Calabanga are separated from each other by the Bicol River. Whereas, the municipalities of Tinambac and Siruma are at the eastern portion (Figure 1). These seven coastal municipalities are crucial in the development of the multi-criteria evaluation technique, and they are discussed in detail in the preceding chapters. Each coastal municipality is considered to represent a particular management strategy.

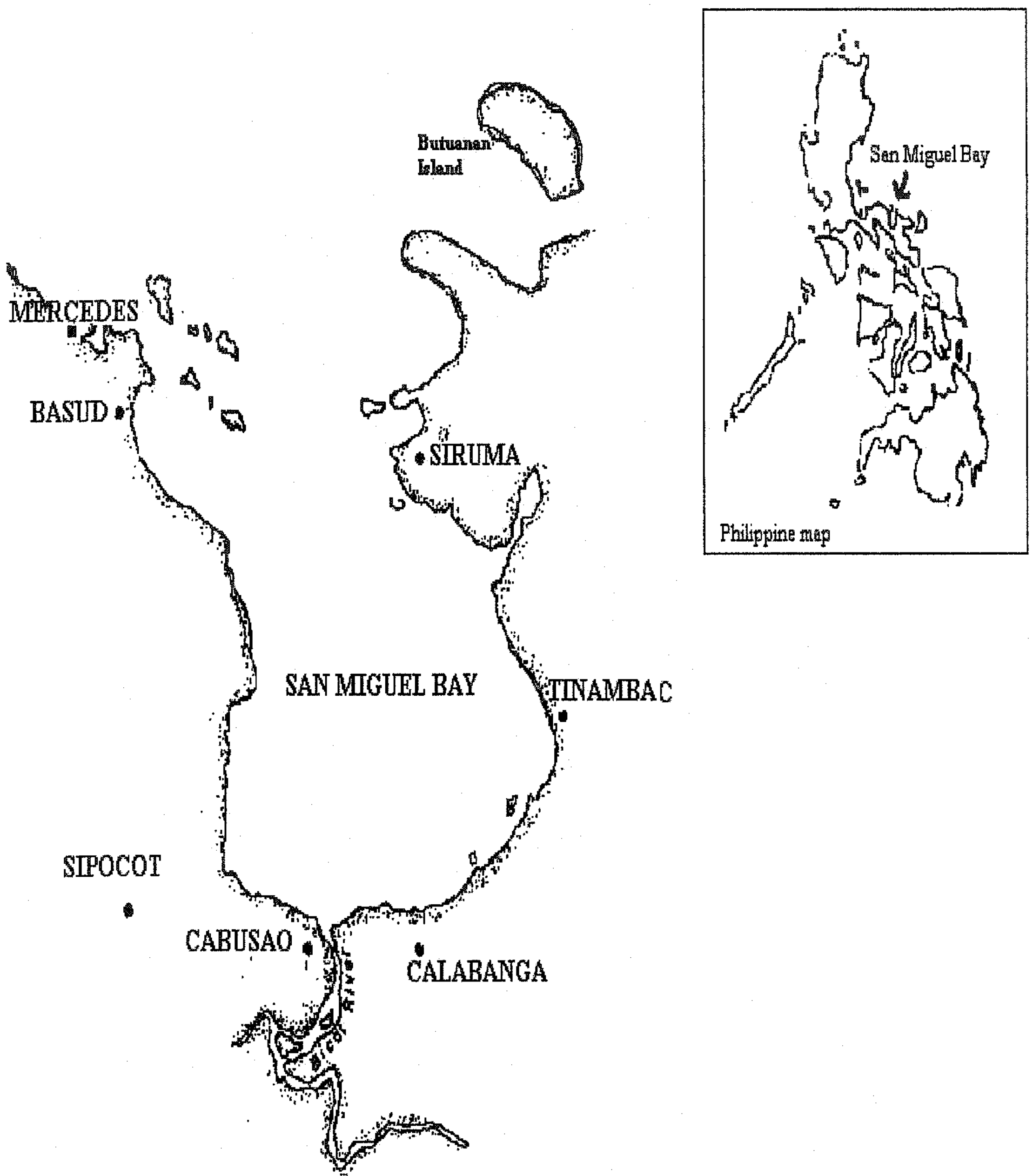


Figure 1. Map showing the 7 coastal municipalities around San Miguel Bay, Philippines. *(figure taken from FSP reports).*

There are 14 islands in San Miguel Bay clustered into three groups. These are the areas where major coastal habitats are situated. The first cluster is composed of seven islands located northwestern at the coralline area near the bay opening and is within the municipal waters of Mercedes; the second cluster composed of three islands is associated with northeastern reefs and part of the municipality of Siruma; and the third cluster with four islands is found at the southern portion off Calabanga. (Luna et al. 1992). Figure 2 illustrates the islands belonging to these clusters.

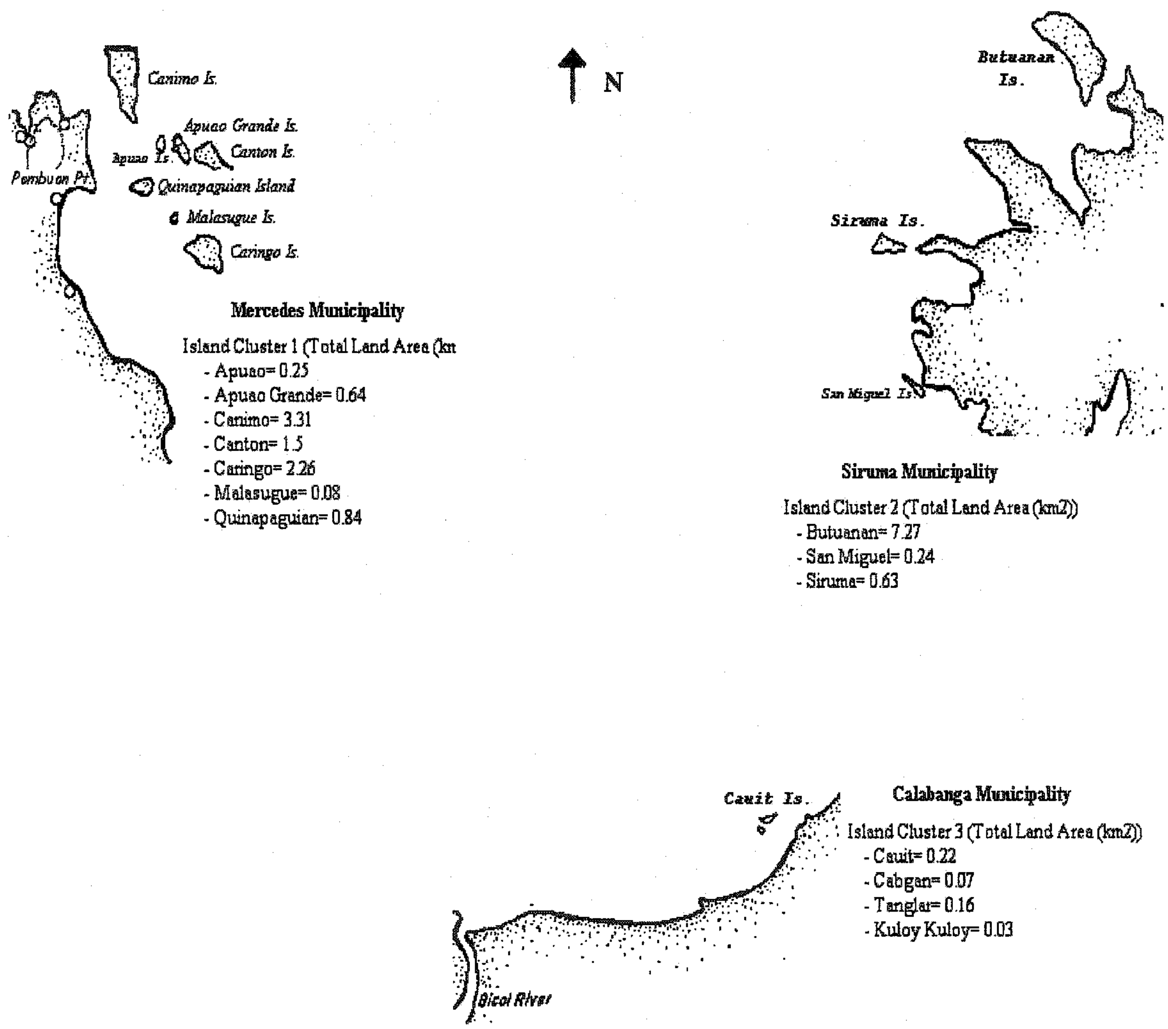


Figure 2. Three island clusters in San Miguel Bay (*Source: Luna et al. 1992)*

3. Physical Characteristics

The bay is generally shallow, with an average depth between 6.9- 7.15 m (estimated from the works of Mines et al. (1982) and Luna et al. (1992)). From the findings of Mines et al. (1982), a 2.05 cm per year silt deposition, assuming a constant rate, can be computed yielding a total silt deposit of about 45.1 cm from 1980 to 2002 (22-year period). Based on this, the average depth of the Bay in 2002 is estimated to be about 6.9 m. Almost 80% of the bay is less than 12.8 meters; the deepest portions (>18.3 meters) are found towards the northern part of the bay off the municipalities of Siruma and Mercedes (Sia III and Luna 1992). The shallowness of the bay may be attributed to the 12 major river systems draining a 3,351 km^2 watershed (Cinco et al. 1995) which carry sediments and domestic wastes from upland into the bay. The waters from one of the major rivers, the Bicol River, traverse deforested land areas and cities carrying silt deposits and domestic wastes Mines et al. (1982). Three major types of bottom features characterized the bay namely muddy, sandy-muddy and hard/coralline-rock bottom (Cinco et al. 1995).

The bay is classified as Type II climate under the Coronas classification, having "no dry season but with very pronounced maximum rainfall from November to January" (Garces et al. 1995a, Garces et al. 1995b, Sia III and Luna 1992). It is affected by monsoonal periods--- southwest monsoon which prevailed from July to October; northeast monsoon is from November to April while easterly winds are experienced in May and June (Cinco et al. 1995). The southwest monsoon has no impact on the bay fisheries Mines et al. (1982), however, the extremely strong winds of the northeast monsoon hinder fishing for small-scale fishers but an opportunity for large trawlers to fish inside the bay (Sia III and Luna 1992).

4. Coastal Habitats

Various types of resources are found in the bay such as coral reefs, mangroves, seagrasses and seaweeds. Coral reefs are present in the northwestern and northeastern portions of the bay. The islands of Apuao, Apuao Grande and Canton share a common reef flat. Narrow reef flat areas surround Canimo while the eastern and northern parts of Malasugue are fringed with shallow reefs. Fish corals are found at the eastern side of Quinapaguian Island. A sheltered reef flat emerges at the southern edge of Butauanan island (Garces et al. 1995b). The 1987 SPOT imagery result shows that the reefs in the bay covered an area of 47.7 km^2 consisting 6.5 km^2 corals, 38.9 km^2 sand and rubbles, and 2.4 km^2 rocks (Luna et al. 1992). A report from the DA-BFAR Region 5 claims that the decreased in the kinds of corals in the municipalities of Mercedes and Siruma was due to illegal fishing practices and siltation.

The mangroves *Rhizophora sp., Avicenia sp.* and *Soneratia sp.* thrive in the western and northeastern beaches of the island Canton and the eastern and northeastern parts of Apuao Grande (Garces et al. 1995b). Results of the 1992 habitat mapping and assessment showed that the bay covered about 17.7 km^2 of mangrove/nipa areas (Garces et al. 1995b) while the Department of Environment and Natural Resources (DENR) recorded a 32.46 km^2 of mangroves. Thus, it can be computed that the remaining mangrove cover is between 5.2- 9.6% of the 1950 coverage of 337.01 km^2 (Luna et al. 1992). The study of (Vega et al. 1995) however, reported that the mangrove cover in the bay has increased to 41.5% of that in the 1950s because of new growths. The massive losses of mangroves in Siruma (northeast), Tinambac (southeast), and Mercedes and Basud (northwest) sectors of the bay were mainly attributed to fishpond conversion (Vega et al. 1995).

Species of seaweeds (e.g. *Eucheuma, Gracilaria, Gelidium* and *Caulerpa*) as well as patches of eelgrasses were reported along the coasts of Mercedes, Siruma and Basud.

5. Fisheries Profile and Status

The bay harbours a variety of finfishes and invertebrates. According to Pauly (1982), because of the bay's estuarine environment 91 euryhaline marine species which tolerate freshwater and/or brackishwater were found. He recorded that from 1868 to 1981, 188 species of fish belonging to 71 families are found in the bay. Such diverse fauna became the target of overexploitation as early as 1970s as noted by Simpson (1978) cited in Mines (1982). These findings were confirmed almost a decade later from the results of the research project, "Small-Scale Fisheries of San Miguel Bay: A Multidisciplinary Analysis" (Pauly and Mines 1982).

The fishers of the bay use a wide range of traditional fishing gears and methods and these are documented in (Pauly et al. 1982) with three additional methods (i.e., the use of explosives in fishing, use of cyanide and other poisons in fishing and, the use of Danish seines (buli-buli) reported by (Silvestre and Cinco 1992). Traditional gears include spear gun, fish trap, fish weir, pole and line, fish corral, longline, scissor net, crab liftnet, filter net, beach seine, and gillnet. The bay is considered as a traditional ground for trawlers because of its wide area of soft bottoms (Silvestre and Cinco 1992). Vakily (1982) classified trawlers into mini, small, medium and large depending on the size or mode of operation. During the 1970s, conflicts transpired between gillnetters and commercial trawlers leading to the banning of commercial trawling within the bay's municipal waters (Mines 1982).

6. Fisheries management interventions in the seven coastal municipalities

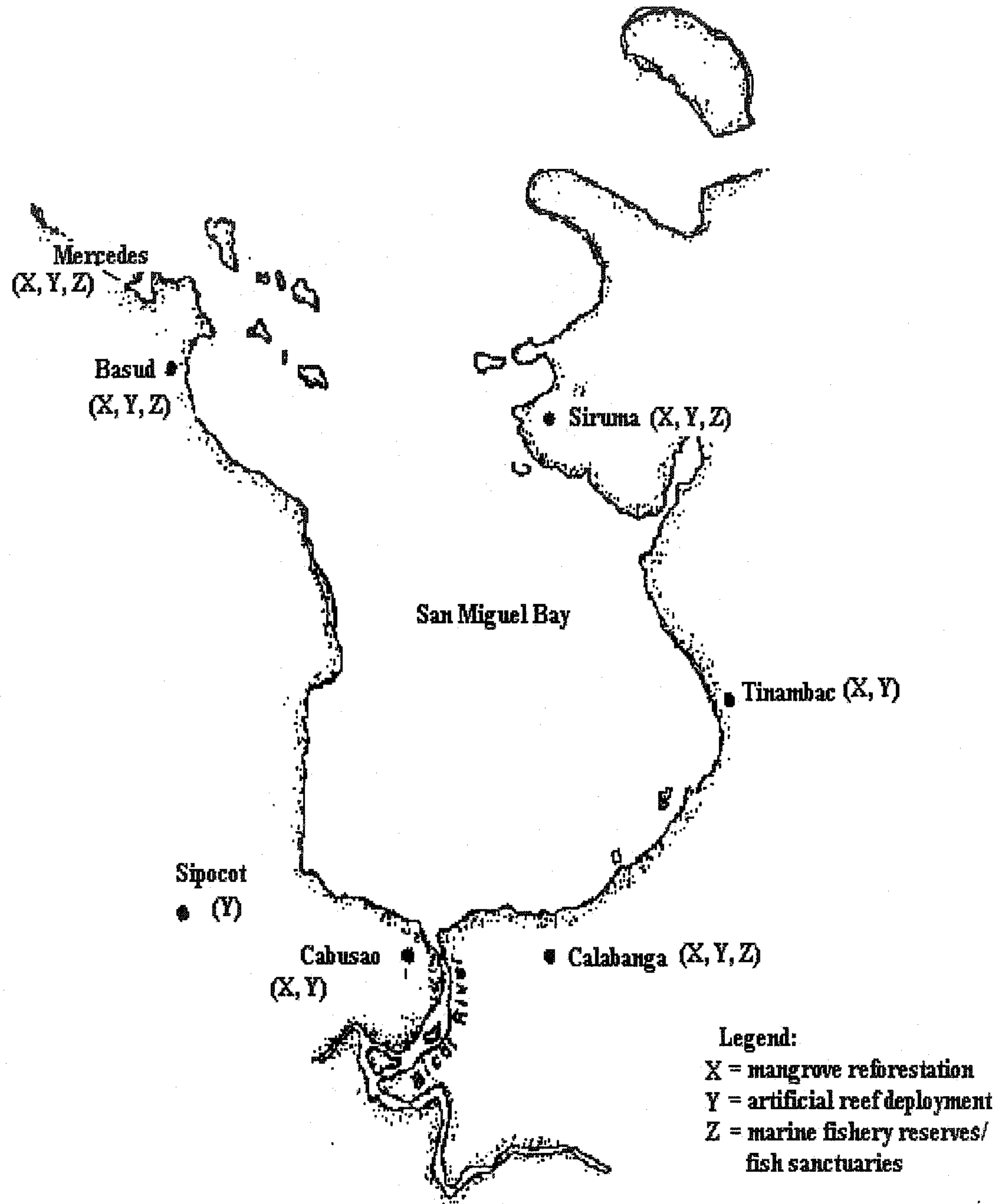
In the multi-disciplinary research in the '80s, management interventions were already recommended however, nothing was realized because during that decade the government's thrust was to modernize the fishing industry in the country. In the early part of 1990s, the bay was revisited through the implementation of the Fisheries Sector Program (FSP) of the Department of Agriculture. The Program not only gathered technical information on the status of the bay's resources and users but also implemented resource management interventions that would lead to the bay's recovery. Aside from the programs and projects of the national government, there were also management interventions initiated and implemented by the local government. The following management strategies were identified to be present in San Miguel Bay:

a) Habitat enhancement- mangrove reforestation; artificial reef deployment; and establishment of marine fishery reserves/fish sanctuaries

b) Limited entry- ban in commercial fishing; gear and vessel restrictions; and modification of licensing system

c) *Poverty alleviation*- implementation of additional livelihood

The fisheries management interventions common to all seven coastal municipalities of San Miguel Bay are *ban in commercial fishing*, *gear and vessel restrictions*, *modification of licensing system*, and *implementation of additional livelihood*. The other interventions are only found in some of these seven municipalities as shown in Figure 3, of which detailed information are summarized in Table 4. The detailed documentation in Table 4 was culled from the records of the municipalities and reports submitted to DA-BFAR Region 5 Office. However, detailed information regarding mangrove reforestation and artificial reef deployment is unavailable for the municipalities of Cabusao and Tinambac



Note: marine fishery reserves/fish sanctuaries were proposed in Basud and Calabanga.

Figure 3. Coastal municipalities where mangrove reforestation, artificial reef deployment and marine fishery reserves/fish sanctuaries were implemented.

Table 4. Implementors of some fisheries management interventions.

Municipality	*Management intervention*	*Location/Site*	*Specifications*	*Implementing agency/ies*
Basud	Artificial Reefs	Mangcamagong	19 tire modules	Local government unit initiative
Calabanga	Artificial Reefs	Sibobo	20 tire modules	Livelihood Enhancement for Agricultural Development (LEAD)/Buklod Yaman Program
	Marine Reserve and Fish Sanctuary	Calabanga waters	Area about 2,587.50 km^2 of Marine Reserve and 1.0 km^2 of Fish Sanctuary	Municipal Ordinance No. 97-09 entitled "The Marine Reserve and Fish Sanctuary in Calabanga Municipal Waters in the Province of Camarines Sur" approved on September 24, 1997
Mercedes	Artificial Reefs	Quinapaguian	11 tire modules	Livelihood Enhancement for Agricultural Development (LEAD)/Buklod Yaman Program; Installed on June 1991
	Artificial Reefs	Quinapaguian	10 tire modules	Artificial Reef Development Project (ARDP); Installed on March 15, 1987
	Artificial Reefs	Quinapaguian	50 tire modules	FSP-DA/BFAR; Installed on August 1992
	Artificial Reefs	Caringo Island	22 tire modules	Installed January 1987
	Marine Reserve and Fish Sanctuary	Malasugue Island, Quinapaguian	3,444 ha marine reserve; 125.19 ha fish sanctuary	The Fish Sanctuary in Malasugue Island, covers the entire area 500 meters from the shoreline. No Marine Reserve area was delineated; instead the entire Malasugue Island was declared a Wildlife Reserve Area. - passed by Sangguniang Bayan in 1990
Siruma	Artificial Reefs	Sapenitan bay, Penitan	55 modules tires	FSP-DA/BFAR
	Marine Reserve and Fish Sanctuary	Sapenitan bay, Penitan	1,932 ha marine reserve; 43.10 ha fish sanctuary-- being a barrier reef is generally shallow with a depth ranging from 5-40 feet.	Established on May 25, 1994 by virtue of Municipal Ordinance No. 4, Series of 1994. As of August 1994-- ordinance for approval; on-going monitoring activities

E. Collection of Primary Data

In the development of a multi-criteria evaluation technique for fisheries management, the seven coastal municipalities of San Miguel Bay were treated as individual coastal site each having a management strategy. Although each coastal site has its distinct characteristics, interdependence among sites was not ignored because each one contributes to the entirety of San Miguel Bay and fish do not recognize jurisdictional boundaries.

The sampling method for this research was purposive rather than random since the groups of participants were already identified. The judgment of resource users on the importance of the criteria and indicators as well as assessment of 12 indicators were solicited from an institutionalized group in the country representing the different sectors of coastal resource users. These groups are known as Fisheries and Aquatic Resource Management Councils (FARMCs) created in pursuant to the provisions of Republic Act No. 8550, also known as the Philippine Fisheries Code of 1998. FARMCs were "*established at the national level and in all municipalities/cities abutting municipal waters to institutionalize the major role of the fisherfolk and other resource users in the planning and formulation of policies and programs for the management, conservation, protection and sustainable development of fisheries and aquatic resources*" (Sec. 3, Fisheries Administrative Order No. 196, Series of 2000- Guidelines on the Creation and Implementation of Fisheries and Aquatic Resource Management Councils). The framework in the creation of FARMCs takes a ladder-type form as shown in Figure 4. The law clearly directed for the creation of the National Fisheries and Aquatic Resource Management Council (NFARMC) (an advisory body to the Department of Agriculture) and Municipal/City Fisheries and Aquatic Resource Management Councils (M/CFARMCs) (in all coastal municipalities and cities) whereas, Barangay/Lakewide Fisheries and Aquatic Resource Management Council (B/LFARMC) may be created when the local government unit deems it necessary (Sec. 14, Fisheries Administrative Order No. 196, Series of 2000). When there are two or more coastal municipalities sharing contiguous resources such as bays and gulfs, the Integrated Fisheries and Aquatic Resource Management Councils (IFARMCs) may be formed.

The Fisheries Aquatic and Resource Management Council fairly represents the interests of coastal resource users.

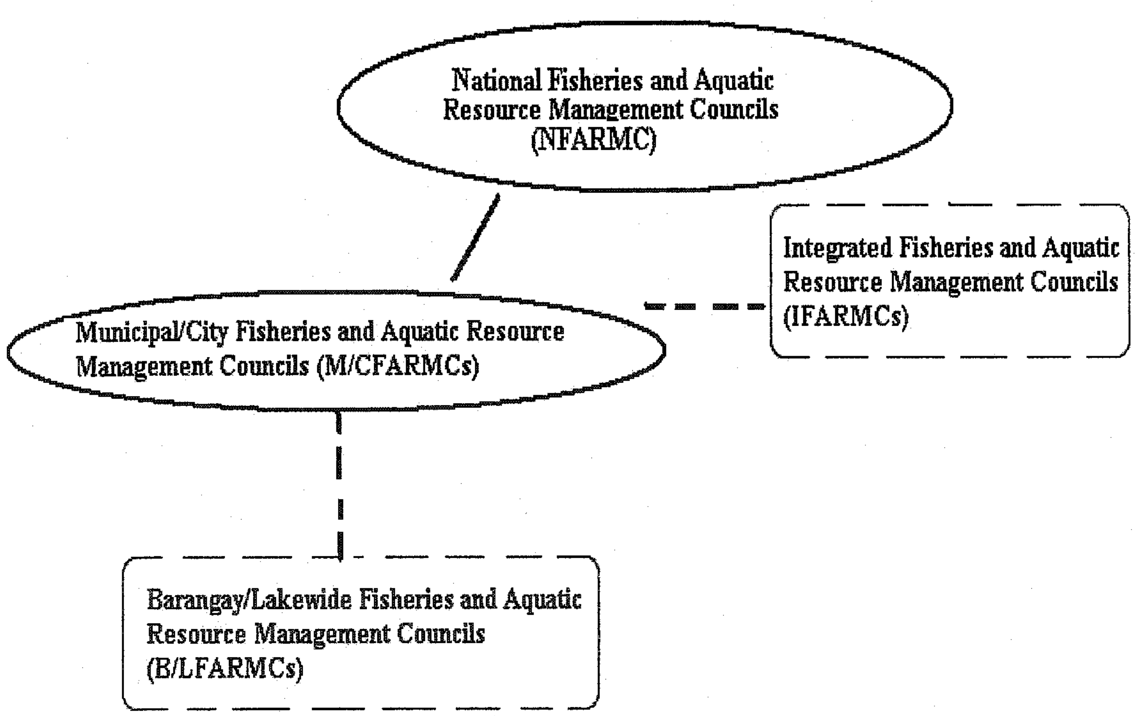


Figure 4. The structure of the Fisheries and Aquatic Resource Management Councils.

1. Weighting the Importance of Criteria and Indicators

a. The Evaluators: Municipal Fisheries and Aquatic Resource Management Councils (MFARMCs)

The importance of the criteria and indicators in assessing the impacts of fisheries management strategies is based on the knowledge and perception of the different groups of resource users. Through direct participation, it may be possible to achieve a greater degree of quantification or weighting of impact significance. It is important, however, to recognize that the importance placed on the criteria and indicators may vary among resource users and across coastal areas.

The Municipal Fisheries Aquatic Resource Management Councils (MFARMCs) from the seven coastal municipalities were selected to weigh the importance of criteria and indicators based on: 1) overall knowledge of the important considerations in the bay; and 2) members represent their group's interest. According to Chapter 3, Article 2, Section 75 of the Philippine Fisheries Code, the regular members of the MFARMC are as follows:

- Municipal Planning Development Officer;
- Chairperson, Agriculture/Fishery Committee of the *Sangguniang Bayan/Panlungsod*;
- Representative of the Municipal Development Council;
- Representative from the accredited non-government organization;
- Representative from the private sector;
- Representative from the Department of Agriculture; and
- At least seven (7) fisherfolk representatives (upto seven (7) municipal fisherfolk, one (1) fishworker and three (3) commercial fishers) in

each municipality/city which include representatives from youth and women sector.

A workshop was conducted to determine the weighting of the criteria and indicators. The result is a weighting of importance from different representative groups in each of the seven coastal municipalities of San Miguel Bay.

b. Weighting Method: The Analytic Hierarchy Process (AHP)

The weights of importance of the criteria in evaluating the impacts of fisheries management strategy and indicators in measuring each criterion were determined using the Analytic Hierarchy Process (AHP) developed by Thomas L. Saaty. The AHP is a method of scaling ratios using the principal eigenvector of a positive pairwise comparison matrix (Saaty 1980, Saaty 2001). In AHP, a problem is structured as a hierarchy, and in Figure 5, the hierarchical arrangement of the goal, criteria and indicators for this research is illustrated. Subsequently, the importance of the indicators to the criteria, and criteria to the overall goal are determined. To assess the scale ratio, Saaty (1980) gives an intensity scale of importance for activities and has broken down the importance ranks in Table 5.

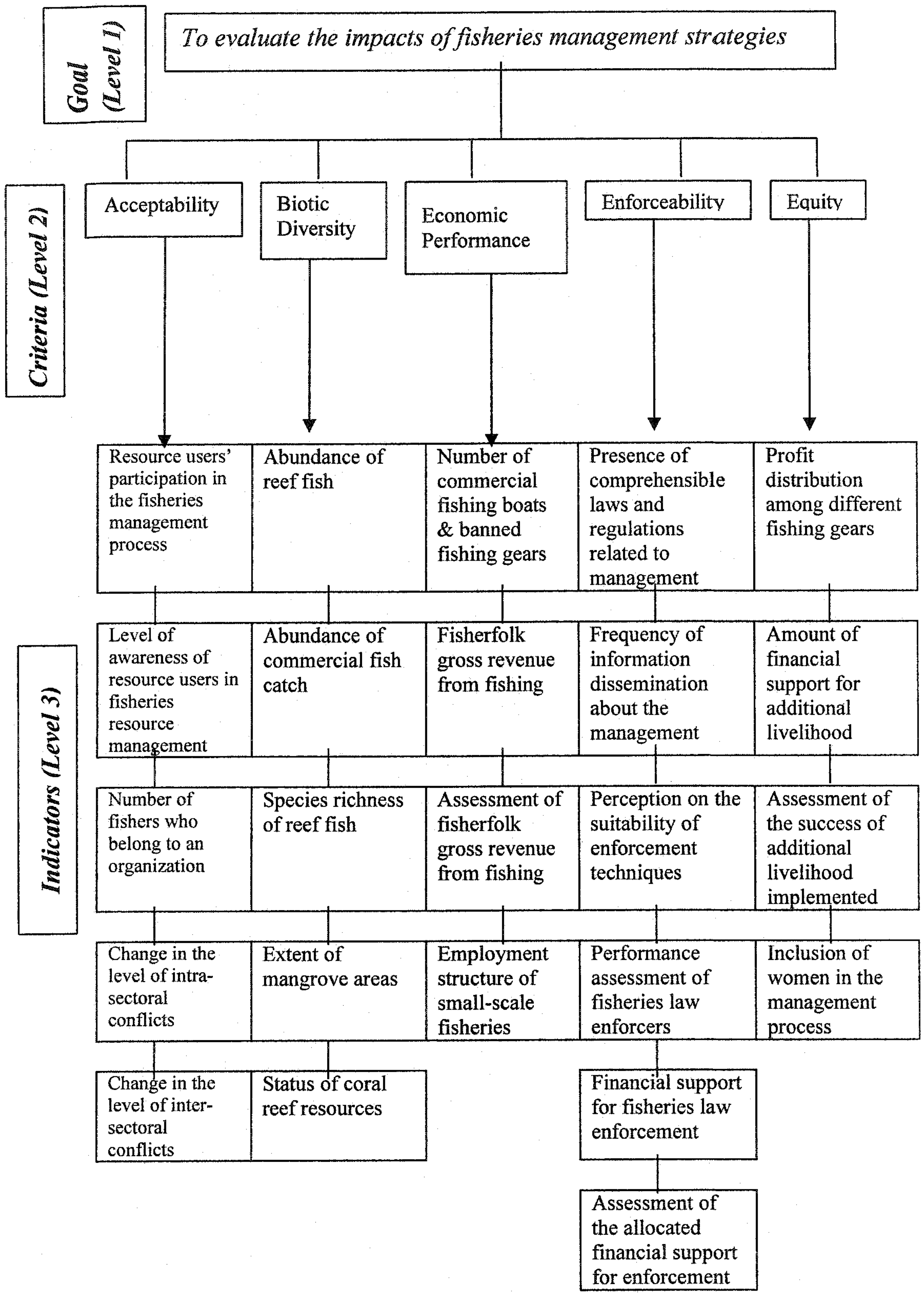


Figure 5. Hierarchic presentation of the goal, criteria and indicators in evaluating the impacts of fisheries management strategies in San Miguel Bay, Philippines.

Table 5. Intensity scale of importance used to compare the indicators (Saaty 1980, Saaty 2001).

Intensity of Importance	Definition	Explanation
1	Equal importance	Two criteria contribute equally to the evaluation of the impacts of management strategies
3	Weak importance of one over another	Experience and judgment slightly favor one criterion over another
5	Essential or strong importance	Experience and judgment strongly favor one criterion over another.
7	Demonstrated importance	A criterion is strongly favored and its dominance is demonstrated in practice.
9	Absolute importance	The evidence favoring one criterion over another is of the highest possible order of affirmation.
2, 4, 6, 8	Intermediate values between the two adjacent judgments	When compromise is needed.

With the use of the intensity scale of importance, pairwise comparison of the criteria was done and the value is entered in a table as in Table 6.

Table 6. Pairwise comparison of the indicators.

GOAL	Acceptability	Biotic Diversity	Economic Performance	Enforceability	Equity
Acceptability	1.0				
Biotic Diversity		1.0			
Economic Performance			1.0		
Enforceability				1.0	
Equity					1.0

By convention, the comparison of strength is always of a criterion appearing in the column on the left against a criterion appearing on the row on top (e.g., How important is acceptability compared with biotic diversity in order to attain the goal of evaluating the impacts of fisheries management strategies?). Thus, in this research the pairwise comparison matrix for the criteria will have five rows and five columns (5 x 5 matrix). A criterion is equally important when compared with itself, thus, the main diagonal of a matrix consists of 1's. The reciprocal value is then used when comparing the second element with the first. For example, when a score of 3 is given in comparing *acceptability* with *biotic diversity* (row 2 and column 3), then the reciprocal 1/3 is automatically assigned when *biotic diversity* is compared to *acceptability* (row 3 and column 2).

After values were assigned to all cells, the next step was to compute the vector of priorities. In mathematical terms the principal eigenvector is computed, and when normalized, becomes the vector of priorities. The vector of priorities is computed by dividing the scores of each column by the sum of that column (i.e., normalize the column) and then adding the scores in each resulting row and dividing this sum by the number (n) of scores in the row. The normalized weights of the criteria sum to 1. According to Saaty (1980), when the matrix is consistent, the normalized sum of each row shows how much each element dominates the others in relative terms.

The AHP also measures the consistency of judgments by computing a *consistency ratio* (CR). It is computed as the ratio of the consistency index (CI) to the average random index (RI). RI is the consistency index of a randomly generated reciprocal matrix from the scale 1 to 9, with reciprocals forced. Thus, CR= CI/RI where, CI = $(\lambda_{max} - n)/n-1$ and RI is referred from a table of average random index found in Saaty (1980). The λ_{max} is Σ(Total normalized value of criterion z $\div$ column vector of priorities of criterion z). The consistency ratio measures the coherence of the pairwise comparisons and estimates the level of consistency with respect to the entire comparison process. A CR of 0.10 or 10% or less is considered acceptable. The consistency ratio measure allows AHP users to be aware of the seriousness of any inconsistent judgments (Leung et al. 1998).

c. *Pre-testing the Analytic Hierarchy Processs (AHP) method: Comments, revision and correction*

The application of AHP in weighting the importance of the criteria and indicators was pre-tested to a group of coastal resource users in the municipality of Sariaya, Quezon province. The coastal municipality of Sariaya has also been actively involved in fisheries resource management and is currently part of a major government-initiated undertaking to protect, conserve and manage its coastal resources. A workshop was held on December 11, 2001 at Dalampasigan Resort, Sariaya, Quezon. Members of Municipal Fisheries and Aquatic Resource Management Council (MFARMC) from the municipality of Sariaya were invited as participants.

Prior to the workshop, a lecture was conducted to explain the mechanics of the decision-making process (i.e. AHP), and introduce/define the criteria, indicators and intensity scale of importance to be used. The participants were provided with a copy of the definitions translated into Tagalog/Filipino. It was made clear that the criteria and indicators are in the process of development and validation thus, participants were encouraged to critically assess the translated version. Following the lecture, the participants were asked to group themselves according to the sector they represent. Each group was given a matrix for recording their agreed response; the only input provided in the matrix is the diagonal 1s (Table 7). Also, each group selected a rapporteur who acted as the moderator. The groups were instructed to do the following:

1) Compare how important is one criterion over another in evaluating the impacts of fisheries management strategies using the intensity scale of importance;

2) Compare how important is one indicator over another in measuring a particular criterion using the intensity scale of importance; and

3) Record the total length of time spent to complete the process of decision-making;

4) Critique the translated version of the criteria, indicators and intensity scale of importance.

Table 7. Matrix used to weigh the importance of criteria and indicators.

GOAL	Acceptability	Biotic Diversity	Economic Performance	Enforceability	Equity
Acceptability	1.0				
Biotic Diversity		1.0			
Economic Performance			1.0		
Enforceability				1.0	
Equity					1.0

Acceptability Indicators

	Resource users' participation in the fisheries management process	Level of awareness of resource users	Number of fishers who belong to an organization	Change in the level of intra-sectoral conflicts	Change in the level of inter-sectoral conflicts
Resource users' participation in the fisheries management process	1.0				
Level of awareness of resource users		1.0			
Number of fishers who belong to an organization			1.0		
Change in the level of intra-sectoral conflicts				1.0	
Change in the level of inter-sectoral conflicts					1.0

Biotic Diversity Indicators

	Abundance of reef fishes	Abundance of commercial fish catch	Species richness of reef fish	Extent of mangrove areas	Status of coral reef resources
Abundance of reef fishes	1.0				
Abundance of commercial fish catch		1.0			
Species richness of reef fish			1.0		
Extent of mangrove areas				1.0	
Status of coral reef resources					1.0

Economic Performance Indicators

	Number of commercial fishing boats & banned fishing gears	Fisherfolk gross revenue from fishing	Assessment of fisherfolk gross revenue from fishing	Employment structure of small-scale fisheries
Number of commercial fishing boats & banned fishing gears	1.0			
Fisherfolk gross revenue from fishing		1.0		
Assessment of fisherfolk gross revenue from fishing			1.0	
Employment structure of small-scale fisheries				1.0

Enforceability Indicators

	Presence of comprehensible laws and regulations related to management	Frequency of information dissemination about the management	Perception on the suitability of enforcement techniques	Performance assessment of fisheries law enforcers	Financial support for fisheries law enforcement	Assessment of the allocated financial support for enforcement
Presence of comprehensible laws and regulations related to management	1.0					
Frequency of information dissemination about the management		1.0				
Perception on the suitability of enforcement techniques			1.0			
Performance assessment of fisheries law enforcers				1.0		
Financial support for fisheries law enforcement					1.0	
Assessment of the allocated financial support for enforcement						1.0

Equity Indicators

	Profit distribution among different fishing gears	Amount of financial support for additional livelihood	Assessment of the success of additional livelihood implemented	Inclusion of women in the management process
Profit distribution among different fishing gears	1.0			
Amount of financial support for additional livelihood		1.0		
Assessment of the success of additional livelihood implemented			1.0	
Inclusion of women in the management process				1.0

In addition, a training- workshop was held on 4-5 February 2002 for the staff of the Project Information Units (PIUs) of the DA-BFAR Regional Office 5 who assisted in the implementation of this research. The staff is responsible in coordinating sectoral efforts in the management of four priority bays in the Bicol Region namely, *San Miguel Bay*, *Lagonoy Gulf*, *Ragay Gulf* and *Sorsogon Bay*. They acted as the facilitators in this research. The training-workshop was intended to: *a) familiarize the facilitators in the application of AHP; b) determine the length of time to complete the decision-making process; and c) identify issues/concerns and recommend changes/modifications in the application of the method.* After the lecture on the first day, the participants were grouped according to the bay areas of responsibility. On day 2, they were asked to do the weighting of the criteria and indicators similar to the instructions given to the MFARMC of Sariaya in Session 1. One modification however, was to record the length of time spent per criterion instead of measuring the total length of time to complete the overall process.

2. *Determination of the Scores for the Ordinal Indicators*

a. The Participants: Barangay Fisheries and Aquatic Resource Management Councils (BFARMCs)

The members of Barangay Fisheries and Aquatic Resource Management Councils (BFARMCs) from the seven coastal municipalities of San Miguel Bay assessed the 12 ordinal indicators to derive their respective scores. Similar to MFARMC, BFARMC was chosen because it represents the major groups of resource users (i.e., local government unit, non-government organizations (NGOs), private sectors, and fisherfolks) in the coastal areas. It is composed of four representative groups:

- Chairperson of the Agriculture/Fishery Committee;
- Representative from accredited NGO;
- Representative from private sectors; and
- Fisherfolk representatives including youth and women

A coastal municipality is composed of villages locally called *"coastal barangay"*. A coastal *barangay* may be organized to create a Barangay Fisheries and Aquatic Resource Management Council (BFARMC) whose functions are to assist in the preparation of municipal development plan, recommend enactment of fishery ordinances, assist in the enforcement of fishery laws in municipal waters, and serve as advisory group on fishery matters to the legislative body of the local government (Sec. 15, Fisheries Administrative Order No. 196, Series of 2000). Based on these functions and the assumed responsibilities attached to these, the members of BFARMCs may then be expected to have a broad knowledge of the coastal fisheries not only within their political jurisdiction (i.e., *barangay*) but throughout the municipality as well.

There are more than one barangay in each coastal municipality of San Miguel Bay, therefore, all BFARMCs were invited to participate in the workshop that was held in the municipal hall. Invitation was coordinated through the Department of Agriculture-Bureau of Fisheries and Aquatic Resources, Regional Office 5; and the Office of the Municipal Agriculturist in each municipality. The respondents were given a *Questionnaire* which is a straightforward inquiry of the indicators, although there may be side questions to clarify the respondent's answers. In the final result, each municipality has an indicator score per criterion obtained as the average scores of the participants.

b. Pre-testing the Questionnaire

A Questionnaire was prepared to derive the scores of the 12 ordinal indicators. Representatives of the BFARMC were invited to a workshop. It was explained to them that the activity aims primarily to determine the clarity of the translated version (from English to Filipino/Tagalog) of the Questionnaire and the ease of implementing the procedure. At the start, terminologies were defined and the procedure on how to go about the workshop was explained. Each individual was provided with an indicator sheet, which was given one at a time. The facilitator read the question aloud and explained what it meant. The participants were encouraged to ask questions and clarification. No one proceeded to answer the next indicator unless everyone is finished or the facilitator said so. Also, a short discussion was initiated immediately after answering each indicator. Modification of the indicators (e.g., scaling definition) was also done and corrections were incorporated in the revised Questionnaire.

CHAPTER IV

ANALYSIS AND FINDINGS

A. Pretest Results for the Weights of Importance and Indicator Scores

The methodology to collect the primary data was pre-tested prior to application in this research. First, the procedure to derive the weights of importance of criteria and indicators in evaluating the impacts of fisheries management was examined through the participation of representatives of the coastal resource users at the municipal level. Subsequently, another workshop was conducted to derive the scores for the 12 ordinal indicators that require the judgment of the resource users. Both the survey Questionnaire and the process of soliciting the response were examined through the representatives of coastal resource users at the *barangay* level.

1. Weighting the Criteria and Indicators through the Analytic Hierarchy Process (AHP) Method

The representatives from the Municipal Fisheries and Aquatic Resource Management Council (MFARMC) of the municipality of Sariaya participated in weighting the criteria and indicators. There were 1, 3 and 5 representatives from non-government organization (NGO), fisherfolk group and local government unit, respectively. The fisherfolk group was subdivided into two because one fisher (Fisherfolk 2) arrived after the session had started, thus, there are two weighting results from the fisherfolk group (Fisherfolk 1 and Fisherfolk 2). The local government unit had the most number of participants. It took them two hours to complete the whole decision-making process while the fisherfolk and NGO groups utilized 1-1.5 hours each. Each group had a rapporteur assigned to record their answers. The deliberation was extensive since each criterion and indicator was also assessed in great detail with respect to translation to the local language (i.e. Filipino). The weighting of a criterion or indicator ranges between 0-1; 0 is the lowest while 1 is the highest.

The following pre-test results were considered in modifying the procedure for the Analytic Hierarchy Process (AHP) method:

1. The MFARMC participants found it difficult to compare the criteria (even when the definitions were given) without referring to the indicators. It was suggested that instead of starting with the comparison of the criteria, the indicators per criterion were compared first since these indicators would provide more explanation and information as to what a particular criterion is all about.

2. Inputting the scores in the matrix was found to be too confusing for the MFARMC representatives. Therefore, much time was spent on the mechanics of recording the answers rather than focusing on an in-depth discussion of the weights of the criteria and indicators. This difficulty has been the basis for changing the usual type of data recording for AHP (Appendix 1) to a more simplified one as shown in Appendix 2. In Appendix 2, first the indicators were compared against each other with respect to the degree of importance in measuring a criterion. When both indicators are found to be of equal importance, each indicator was assigned a score of 1. Otherwise, only the indicator considered more important than the other was assigned a score from a scale of 2 to 9 (Appendix 3). The participants were no longer asked to

assign the reciprocal for the less important indicator; the researcher did this during the data analysis.

3. The MFARMC also clarified the definition, explanation and translation of the five criteria and 24 indicators. Their revisions on the translated version were also incorporated in the Questionnaire.

The second group of fisherfolk (Fisherfolk 2) and local government unit gave the criteria and indicators similar weighting (Table 8). Table 8 shows that all groups considered the criterion *acceptability* as the most important criterion in evaluating the impacts of fisheries management; *biotic diversity* criterion follows. They also regarded *resource users' participation in the fisheries management process* as a critical indicator that measures *acceptability* (Table 9). Among the groups, the non-government organization (NGO) found the indicator *abundance of reef fish* as the most important measure of *biotic diversity* (Table 10). The indicator that accounted the change in the *number of commercial fishing boats and banned fishing gears* weighted more than the other indicators in terms of measuring *economic performance* criterion (Table 11). The amount of *financial support for fisheries law enforcement* and *assessment of the performance of fisheries law enforcers* were regarded the most important indicators in weighting *enforceability* criterion for the Fisherfolk 2 and local government unit groups (Table 12).

Table 8. Weights of importance attributed to the criteria by the representatives of MFARMC of Sariaya, Quezon.

CRITERIA	Fisherfolk 1	Fisherfolk 2	Local government unit (LGU)	Non-government organization (NGO)
ACCEPTABILITY	0.30	0.37	0.37	0.34
BIOTIC DIVERSITY	0.21	0.28	0.28	0.23
ECONOMIC PERFORMANCE	0.22	0.14	0.14	0.14
ENFORCEABILITY	0.21	0.11	0.11	0.19
EQUITY	0.06	0.10	0.10	0.09

Table 9. Weights of importance attributed to the indicators of *Acceptability* criterion by the representatives of MFARMC of Sariaya, Quezon.

ACCEPTABILITY INDICATORS	Fisherfolk 1	Fisherfolk 2	Local government unit (LGU)	Non-government organization (NGO)
Resource users' participation in the fisheries management process	0.37	0.41	0.41	0.42
Level of awareness of resource users in fisheries resource management	0.27	0.20	0.20	0.13
Number of fishers who belong to an organization	0.19	0.25	0.25	0.14
Change in the level of intra-sectoral conflicts	0.09	0.07	0.07	0.19
Change in the level of inter-sectoral conflicts	0.09	0.07	0.07	0.13

Table 10. Weights of importance attributed to the indicators of *Biotic Diversity* criterion by the representatives of MFARMC of Sariaya, Quezon.

BIOTIC DIVERSITY INDICATORS	Fisherfolk 1	Fisherfolk 2	Local government unit (LGU)	Non-government organization (NGO)
Abundance of reef fishes	0.18	0.22	0.22	0.44
Abundance of commercial fish catch	0.13	0.07	0.07	0.19
Species richness of reef fish	0.22	0.32	0.32	0.11
Extent of mangrove areas	0.13	0.19	0.19	0.09
Status of coral reef resources	0.33	0.20	0.20	0.17

Table 11. Weights of importance attributed to the indicators of *Economic Performance* criterion by the representatives of MFARMC of Sariaya, Quezon.

ECONOMIC PERFORMANCE INDICATORS	Fisherfolk 1	Fisherfolk 2	Local government unit (LGU)	Non-government organization (NGO)
Number of commercial fishing boats and banned fishing gears	0.47	0.25	0.25	0.65
Fisherfolk gross revenue from fishing	0.12	0.25	0.25	0.15
Assessment of fisherfolk gross revenue from fishing	0.12	0.25	0.25	0.15
Employment structure of small-scale fisheries	0.28	0.25	0.25	0.05

Table 12. Weights of importance attributed to the indicators of *Enforceability* criterion by the representatives of MFARMC of Sariaya, Quezon.

ENFORCEABILITY INDICATORS	Fisherfolk 1	Fisherfolk 2	Local government unit (LGU)	Non-government organization (NGO)
Presence of comprehensible laws and regulations related to management	0.21	0.07	0.07	0.23
Frequency of information dissemination about the management	0.17	0.09	0.08	0.21
Perception on suitability of enforcement techniques	0.18	0.05	0.05	0.22
Performance assessment of fisheries law enforcers	0.18	0.28	0.27	0.11
Financial support for fisheries law enforcement	0.15	0.29	0.29	0.12
Assessment of the allocated financial support for enforcement	0.11	0.21	0.24	0.11

Table 13. Weights of importance attributed to the indicators of *Equity* criterion by the representatives of MFARMC of Sariaya, Quezon.

EQUITY INDICATORS	Fisherfolk 1	Fisherfolk 2	Local government unit (LGU)	Non-government organization (NGO)
Profit distribution among different fishing gears	0.31	0.33	0.33	0.48
Amount of financial support for additional livelihood	0.21	0.24	0.24	0.15
Assessment of the success of additional livelihood implemented	0.21	0.24	0.24	0.15
Inclusion of women in the management process	0.27	0.19	0.19	0.23

The same procedure was extended to the staff of the Project Information Units (PIUs) of the DA-BFAR Regional Office 5, who served as the facilitators when the primary data were collected. There were 11 participants in the training-workshop held on 4-5 February 2002. These participants represented the four priority bays in the Bicol Region: Lagonoy Gulf (n=5), and Ragay Gulf (n=2), San Miguel Bay (n=2), and Sorsogon Bay (n=2). A series of lectures were given to introduce the participants to the principles and application of AHP. Practical examples and sample exercises were presented to familiarize them with the measurement and computation aspects of the method. Compared to the Sariaya MFARMC who only did the weighting of the criteria and indicators, the four bay groups proceeded with the computation to derive the weights of each indicator per criterion and the overall consistency ratio.

The length of time utilized to deliberate the weights of the criteria and do the computation is shown in Table 14. From this table, the Ragay Gulf group spent considerable time (i.e., 115 minutes) weighing the criteria and computing the consistency ratio compared to the other groups; this is mainly contributed by the *biotic diversity* criterion (40 minutes). It may be hypothesized that the the length of time utilized to complete the decision-making process is dependent on the number of participants involved in the decision-making process so that the more participants there are, the more time is required or utilized in order to deliberate and decide. This however, is contrary to the result of the Lagonoy Gulf group which had the most number of participants (n=5) yet was able to arrive at a decision the earliest (41 minutes).

The relationship between the total number of criteria/indicators and the length of time (in minutes) spent per bay in weighting the criteria and indicators was determined by calculating the Pearson's product moment correlation coefficient (r) (Wheater and Cook 2000). The result in Table 15 (using the Statistical Package for Social Sciences (SPSS) version 11) shows that the length of time is not correlated with the total number of criteria and indicators ($r= .140$, $df= 22$; $\alpha= >.05$).

Table 14. Total length of time (in minutes) utilized in weighting the criteria and indicators.

Criteria/Indicators	Total no. of criteria and indicators	Length of time per bay (minutes)			
		Lagonoy Gulf	Ragay Gulf	San Miguel Bay	Sorsogon Bay
Overall Criteria	5	4	15	5	20
Acceptability Indicators	6	15	20	35	24
Biotic diversity Indicators	6	10	40	20	10
Economic Performance Indicators	3	2	5	3	10
Enforceability Indicators	7	5	15	11	10
Equity Indicators	6	5	20	17	20
Total number of minutes		*41*	*115*	*91*	*94*
Total number of evaluators		*5*	*2*	*2*	*2*

Table 15. Output of a statistical analysis to compute for Pearson's product moment correlation coefficient using SPSS 11.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.374[a]	.140	.101	9.209	.140	3.586	1	22	.072

a. Predictors: (Constant), criteria/indicators

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	304.112	1	304.112	3.586	.072[a]
	Residual	1865.846	22	84.811		
	Total	2169.958	23			

a. Predictors: (Constant), criteria/indicators

b. Dependent Variable: length of time (minutes)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-1.351	8.429		-.160	.874
	criteria/indicators	2.829	1.494	.374	1.894	.072

a. Dependent Variable: length of time (minutes)

Lagonoy group weighted all criteria of equal importance (i.e. 0.20 each). *Economic performance* is considered as the most important criterion for the San Miguel Bay group, whereas, *acceptability* is for Ragay Gulf and Sorsogon Bay groups (Table 16). All four groups perceived that the *level of awareness of resource users in fisheries resource management* is an indicator that would best measure *acceptability* criterion (Table 17). Also, the groups found the conditions of the coastal habitats (i.e., *extent of mangrove areas* and *status of coral reef resources*) as important determinant of *biotic diversity* compared to the other indicators (Table 18). The indicator *number of commercial fishing boats and banned fishng gears* weighted highest for San Miguel Bay and Sorsogon Bay groups. It can be inferred that both bays (especially San Miguel Bay) have a problem with regards to the presence of commercial fishing boats and illegal fishing gears, therefore, reduction in their number would mean favorable economic performance. Lagonoy Gulf group viewed that the change in the *employment structure of small-scale fishers* is a better measure of the *economic performance criterion* (Table 19).

Both San Miguel Bay and Sorsogon Bay groups weighted *financial support for enforcement* as the most important indicator to assess the enforceability criterion (Table 20). For the groups Lagonoy Gulf and Sorsogon Bay, *inclusion of women in the management process* is considered as the most important indicator of *equity* (Table 21) while *profit distribution among different fishing gears* and *amount of financial support for additional livelihood* ranked highest for San Miguel Bay group and Ragay Gulf group, respectively.

It is interesting to note that San Miguel Bay group weighted *economic performance* (0.38) and *equity* (0.30) criteria as the two most important criteria in assessing fisheries management. For this group, the indicators that would best measure *economic performance* and *equity* are *number of commercial fishing boats and banned fishing gears* and *profit distribution among different fishing gears,* respectively.

Table 16. Weights of importance attributed to the criteria by the staff of DA-BFAR Regional Office 5 coordinating the four priority bays in the Bicol region.

CRITERIA	Lagonoy Gulf	Ragay Gulf	San Miguel Bay	Sorsogon Bay
ACCEPTABILITY	0.20	0.52	0.11	0.31
BIOTIC DIVERSITY	0.20	0.06	0.10	0.19
ECONOMIC PERFORMANCE	0.20	0.10	0.38	0.14
ENFORCEABILITY	0.20	0.22	0.11	0.26
EQUITY	0.20	0.10	0.30	0.11

Table 17. Weights of importance attributed to the indicators of *Acceptability* criterion by the staff of DA-BFAR Regional Office 5 coordinating the four priority bays in the Bicol region.

ACCEPTABILITY INDICATORS	Lagonoy Gulf	Ragay Gulf	San Miguel Bay	Sorsogon Bay
Resource users' participation in the fisheries management process	0.15	0.17	0.22	0.24
Level of awareness of resource users in fisheries resource management	0.36	0.29	0.51	0.40
Number of fishers who belong to an organization	0.28	0.25	0.16	0.16
Change in the level of intra-sectoral conflicts	0.08	0.14	0.05	0.12
Change in the level of inter-sectoral conflicts	0.14	0.14	0.05	0.07

Table 18. Weights of importance attributed to the indicators of *Biotic Diversity* criterion by the staff of DA-BFAR Regional Office 5 coordinating the four priority bays in the Bicol region.

BIOTIC DIVERSITY INDICATORS	Lagonoy Gulf	Ragay Gulf	San Miguel Bay	Sorsogon Bay
Abundance of reef fishes	0.13	0.20	0.05	0.14
Abundance of commercial fish catch	0.04	0.20	0.21	0.04
Species richness of reef fish	0.29	0.15	0.23	0.15
Extent of mangrove areas	0.23	0.15	0.30	0.36
Status of coral reef resources	0.31	0.29	0.22	0.32

Table 19. Weights of importance attributed to the indicators of *Economic Performance* criterion by the staff of DA-BFAR Regional Office 5 coordinating the four priority bays in the Bicol region.

ECONOMIC PERFORMANCE INDICATORS	Lagonoy Gulf	Ragay Gulf	San Miguel Bay	Sorsogon Bay
Number of commercial fishing boats and banned fishing gears	0.10	0.06	0.69	0.33
Fisherfolk gross revenue from fishing	0.21	0.32	0.14	0.24
Assessment of fisherfolk gross revenue from fishing	0.21	0.32	0.14	0.24
Employment structure of small-scale fisheries	0.48	0.31	0.04	0.19

Table 20. Weights of importance attributed to the indicators of *Enforceability* criterion by the staff of DA-BFAR Regional Office 5 coordinating the four priority bays in the Bicol region.

ENFORCEABILITY INDICATORS	Lagonoy Gulf	Ragay Gulf	San Miguel Bay	Sorsogon Bay
Presence of comprehensible laws and regulations related to management	0.15	0.29	0.08	0.06
Frequency of information dissemination about the management	0.23	0.14	0.07	0.13
Perception on suitability of enforcement techniques	0.12	0.08	0.10	0.10
Performance assessment of fisheries law enforcers	0.16	0.07	0.03	0.17
Financial support for fisheries law enforcement	0.21	0.20	0.45	0.40
Assessment of the allocated financial support for enforcement	0.14	0.23	0.27	0.14

Table 21. Weights of importance attributed to the indicators of *Equity* criterion by the staff of DA-BFAR Regional Office 5 coordinating the four priority bays in the Bicol region.

EQUITY INDICATORS	Lagonoy Gulf	Ragay Gulf	San Miguel Bay	Sorsogon Bay
Profit distribution among different fishing gears	0.10	0.08	0.54	0.30
Amount of financial support for additional livelihood	0.23	0.45	0.25	0.09
Assessment of the success of additional livelihood implemented	0.29	0.14	0.06	0.30
Inclusion of women in the management process	0.38	0.33	0.15	0.31

2. Revised and Corrected Questionnaire for the Ordinal Indicators

The Questionnaire for the 12 indicators was evaluated by the five members of the Barangay Fisheries Aquatic Resource Management Council (BFARMC) of barangay San Roque, municipality of Sariaya, Quezon. All participants commented on how well they understood the process and content of the Questionnaire including the translated version. Their comments and suggestions were incorporated in the modified version of the Questionnaire shown in Appendix 4.

An additional 13-point question (Appendix 5) intended to come up with an objective assessment of the level of awareness of resource users in fisheries resource management was also included.

B. Development of the Multi-criteria Impact Evaluation Technique for Fisheries Management

The elements of a multi-criteria evaluation technique can be categorized into three dimensions: *temporal, spatial* and *systemic* dimensions. The *temporal dimension* looks at the time line of impacts while *spatial dimension* characterizes geographic location (local, national or global) where management strategies were implemented. There is another dimension nested within the temporal and spatial dimensions and this can be termed as *systemic dimension.* Systemic dimension consists of the response of the interactions between human and natural systems.

a) *Temporal dimension*

Time is an important consideration in the measurement of impacts. The measurement of the indicators was done at two temporal scales, i.e., *before* and *after* implementation of fisheries management strategies. Data *before* implementation were taken anytime on or before the 1992-93 period while *after* implementation data were collected after 1992-93, when all management strategies would have been implemented. The temporal dimension in this research, however, is recognized as incomplete and limiting because of the unstandardized time of data collection prior to and after implementation of management.

b) *Spatial dimension*

Spatial dimension consists of the choice possibilities that have to be evaluated. Choice possibilities can be alternative plans, strategies, zones, etc. (Voogd 1983) and in this research, the fisheries management strategies are the choice possibilities. These fisheries management strategies are lodged within a particular geographic location such as a coastal area specifically, a coastal municipality. A coastal municipality then would represent a fisheries management strategy. There are seven coastal municipalities in San Miguel Bay; in the same manner there are seven sets of fisheries management strategies. These coastal municipalities are both interdependent and independent of each other. Their interdependence is structural and functional in nature- being situated close to each other making up the bay ecosystem; therefore, the aquatic environments where they operate are interconnected. While interdependence exists among coastal municipalities, the decision as to what fisheries management strategy to implement is independent of each other. The political setting or governance of the coastal municipalities in San Miguel Bay is independent of each other; for example, each municipality enacts its own Municipal Fisheries Ordinance. Coastal municipalities in a bay then would have similar management strategies (i.e., exactly the same set of management interventions per management strategy) with varying performance level or management strategies might differ but their performance level is almost the same.

c) *Systemic dimension*

The systemic dimension is basically concerned with the characteristics or nature of the information in the impact evaluation matrix. It is composed of the multiple criteria and indicators, their measurements, and the importance given to them. As mentioned earlier, systemic dimension is nested within the other two dimensions. This dimension will be discussed in detail in the following sections.

1. Determination of the weights of importance of criteria and indicators

The importance of five criteria (i.e., *Acceptability, Biotic Diversity, Economic Performance, Enforceability* and *Equity*) in evaluating the impacts of fisheries management strategies and the 24 indicators in measuring these criteria in San Miguel Bay was determined. The participants were the members of Municipal Fisheries and Aquatic Resource Management Councils (MFARMCs) from each of the seven coastal municipalities of the bay. A one-day workshop was conducted in each seven (7) coastal municipalities. The invitation to participate was sent through the Bureau of Fisheries and Aquatic Resources, Regional Office 5 and the Office of the Municipal Agriculturist. The workshops were conducted over a four-month period from 28 February to 03 May 2002 (Table 22). There were delays however, in the schedule because of unavailability of participants, bad weather conditions and peace and order situation that affected the ability to travel to the municipalities across the bay. Most sessions were held at the municipal halls.

Table 22. Schedule of workshop to obtain the weights of importance of criteria and indicators in each municipality.

Municipality	Workshop Date	Total Number of MFARMC Representatives	Number of sectors represented
Basud	April 16, 2002	5	2
Cabusao	May 3, 2002	17	4
Calabanga	February 28, 2002	8	4
Mercedes	April, 5, 2002	14	4
Sipocot	April 18, 2002	24	3
Siruma	April 23, 2002	8	3
Tinambac	March 8, 2002	8	2

At the start of the workshop, the participants were provided with the instructions on what they are expected to do. The purpose of the research, mechanics of the activity and the importance of their participation were discussed. A brief lecture on how fisheries management strategies/interventions and the management process (i.e. conceptualization, implementation, monitoring and evaluation) are defined in this research was also given. In order to understand further the decision-making process, every participant was furnished with the definition of the criteria and indicators, intensity scale of importance, and a hierarchical matrix that establishes the relationships among criteria and indicators. The local version (i.e., translated to Tagalog/Filipino) of the criteria, indicators, and intensity scale of importance was posted on the board where the participants could always refer to them. Comprehension problem was not encountered because the participants are also fluent in Tagalog/Filipino even if discussion and deliberation on the issues are done in their local dialects (i.e., Bicol). Several examples on pairwise comparisons were given so as to familiarize the participants with the decision-making process.

After the orientation, the participants were divided into four representative groups namely, *local government unit, fisherfolk, non-government organization, and private sector.* Each group was provided with a matrix where only pairwise comparisons were indicated. The rapporteur chosen from among the members of the group was assigned to moderate the discussion and record the agreed answers. The groups were asked to assess the importance of criteria and indicators in fisheries management impact evaluation in their respective coastal municipality. Further, they were instructed to do the following:

1) Record the total length of time spent to complete the process of decision-making by taking note of the time started and time finished.

2) Compare how important is one criterion over another in evaluating the impacts of fisheries management strategies using the intensity scale of importance. If it was agreed that both criteria are of equal importance, then a score of 1.0 is given for each criterion. If otherwise, only the criterion which is considered more important than the other will be given a score ranging between 2 to 9.

3) Compare how important is one indicator over another in measuring a particular criterion using the intensity scale of importance. If it was agreed that both indicators are of equal importance, then a score of 1.0 is given for each indicator. If otherwise, only the indicator which is considered more important than the other will be given a score ranging between 2 to 9.

The San Miguel Bay Coordinators of BFAR Regional Office 5 asssisted the researcher in facilitating the workshops. This is the same groups which was part of pre-testing the Analytic Hierarchy Process (AHP) method. A facilitator was assigned in each group should the latter require clarification (e.g., translation of the criteria and indicators in Bicol language). It was however, made clear that the facilitators are not to provide remarks or comments which in any way would influence the decision-making process. The researcher deals with the mechanics of the decision-making process and explanation or details of the issues being investigated.

a. *Participants and the period of decision-making*

The total number of participants in each group and the length of time each group completed the whole decision-making process are shown in Tables 23 and 24, respectively. Not all five groups were represented during the workshop; only the fisherfolk and local government unit groups were present in all seven coastal municipalities. Table 23 shows that Cabusao, Mercedes and Sipocot had the most number of participants but in terms of number of groups, Cabusao, Calabanga and Mercedes had the most number of groups (i.e., four each). The women were included under the fisherfolk group but in Cabusao, Sipocot and Siruma, they were separated since more than one woman was present in these municipalities; also, the total number of fisherfolk representatives, including women, exceeded five. The non-government organization was present only in the municipalities of Calabanga and Mercedes.

Table 23. Total number of Municipal FARMC representatives per group.

MUNICIPALITY	MFARMC GROUPS					*Total Number of Participants*
	Local Government Unit	Fisherfolk	Women	Private Sector	Non-government Organization	
Basud	2	3				*5*
Cabusao	6	6	3	2		*17*
Calabanga	2	4		1	1	*8*
Mercedes	5	5		1	3	*14*
Sipocot	8	10	6			*24*
Siruma	2	4	2			*8*
Tinambac	3	5				*8*
TOTAL	*28*	*37*	*11*	*4*	*4*	***84***

The length of time utilized by the different groups in each municipality is presented in Table 24. This table shows that the fisherfolk and non-government organization of Mercedes spent considerable time deliberating to arrive at a consensus, utilizing 100 and 90 minutes, respectively.

Table 24. Length of time (in minutes) to complete the decision-making process in each group per municipality.

MUNICIPALITY	Total number of minutes				
	Local Government Unit	Fisherfolk	Women	Private Sector	Non-government Organization
Basud	30	37	n.i.		
Cabusao	40	30	30	50	
Calabanga	31	37		41	40
Mercedes	30	100		n.i.	90
Sipocot	50	60	52		
Siruma	50	28	51		
Tinambac	35	80			

*n.i.- not indicated

It can be hypothesized that the length of time needed to complete the decision-making process is dependent on the number of participants. The more individuals are involved, the longer it would take to arrive at an agreement and ultimately, a decision. In order to test the relationship between length of time and number of participants, the data were analyzed using Pearson correlation coefficient (r). The data in Tables 23 and 24 were pulled as shown in Table 25 then, used in the analysis. The output of the statistical analysis using SPSS 11 is shown in Table 26 and Figure 6, illustrating that length of time is not correlated with the number of participants ($r= .206$, $df= 19$, $\alpha= >.05$).

Table 25. Relationship between the number of participants per group and the time to complete the decision making process.

Number of participants per group	Time used to complete the decision-making process (in minutes)
3	30
6	40
2	31
5	30
8	50
2	50
3	35
2	37
6	30
4	37
5	100
10	60
4	28
5	80
3	30
6	52
2	51
2	50
1	41
1	40
3	90

Table 26. Correlation analysis between the number of participants and length of time to complete the decision making process (SPSS version 11 output).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.206[a]	.042	-.008	20.370	.042	.843	1	19	.370

a. Predictors: (Constant), Number of participants

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	349.858	1	349.858	.843	.370[a]
	Residual	7883.951	19	414.945		
	Total	8233.810	20			

a. Predictors: (Constant), Number of participants

b. Dependent Variable: Length of time (minutes)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	40.156	8.902		4.511	.000
	PARTICIP	1.792	1.952	.206	.918	.370

a. Dependent Variable: MINUTES

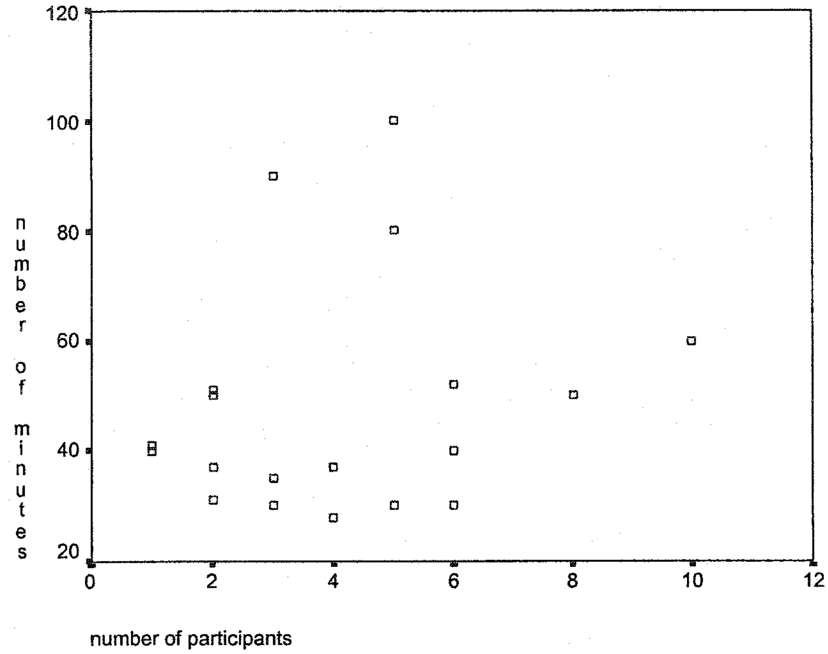


Figure 6. Scatterplot diagram of the relationship between number of respondents and time utilized to complete the decision-making process.

b. *Weights of importance of the criteria in evaluating fisheries management*

The value of a criterion weight ranges from 0 to 1.0 but all criteria sum to 1.0 for a group of evaluators. There were 23 groups from San Miguel Bay who participated in the weighting system. The criteria are said to be of equal importance when their weight of importance is the same in all criteria; in this case a weight equivalent to 0.20 per criterion. Table 27 shows that although some groups (i.e., Calabanga NGO; Mercedes LGU, Private sector and NGO; Sipocot women; and Siruma fisherfolk) perceived all criteria to equally contribute in evaluating the impacts of fisheries management strategies, a number of groups think otherwise. The weighting of these groups are discussed as follows:

Basud municipality: Both local government unit and fisherfolk of Basud consider *acceptability* as the most important criterion in evaluating the impacts of fisheries management strategies. As for women, *equity* is the most important.

Cabusao municipality: The criterion *biotic diversity* ranks highest for the local government unit and fisherfolk of Cabusao while *enforceability* is highest for the private sector. Similar to Basud, the women of Cabusao believe that *equity* should be a priority.

Calabanga municipality: Again, *acceptability* has been regarded as the most important criterion for the local government unit and fisherfolk of Calabanga. Although the private sector ranks *economic performance* highest, its weight of 0.23 is not so much higher than the other criteria.

Mercedes municipality: The local government unit, private sector and non-government organization of Mercedes view all criteria of equal importance. Only the fisherfolk group perceives that *economic performance* is important than the other criteria with respect to assessing the impacts of fisheries management strategies.

Sipocot municipality: The local government unit weighs *equity* the most important criterion while the fisherfolk group considers *acceptability.*

Siruma municipality: The local government unit group of Siruma considers *enforceability* as the most important criterion whereas, women group thinks it is *acceptability* criterion.

Tinambac municipality: While *economic performance* and *biotic diversity* are most important for local government unit and fisherfolk, respectively, their weights are not so much higher compared to the other criteria.

Table 27. Weights of importance attributed to the criteria by different groups in seven coastal municipalities of San Miguel Bay

Municipality	GROUPS	CRITERIA				
		Acceptability	Biotic Diversity	Economic Performance	Enforceability	Equity
Basud	Local Government Unit (LGU)	0.37	0.26	0.12	0.13	0.13
	Fisherfolk	0.30	0.19	0.19	0.15	0.19
	Women	0.19	0.13	0.19	0.09	0.40
Cabusao	Local Government Unit (LGU)	0.04	0.48	0.18	0.13	0.17
	Fisherfolk	0.06	0.48	0.17	0.1	0.19
	Women	0.18	0.11	0.19	0.18	0.35
	Private Sector	0.06	0.21	0.21	0.43	0.08
Calabanga	Local Government Unit (LGU)	0.53	0.07	0.03	0.13	0.25
	Fisherfolk	0.30	0.20	0.20	0.13	0.17
	Private Sector	0.20	0.20	0.23	0.20	0.18
	Non-government Organization (NGO)	0.20	0.20	0.20	0.20	0.20
Mercedes	Local Government Unit (LGU)	0.20	0.20	0.20	0.20	0.20
	Fisherfolk	0.19	0.15	0.28	0.19	0.19
	Private Sector	0.20	0.20	0.20	0.20	0.20
	Non-government Organization (NGO)	0.20	0.20	0.20	0.20	0.20
Sipocot	Local Government Unit (LGU)	0.10	0.08	0.20	0.09	0.54
	Fisherfolk	0.42	0.17	0.12	0.17	0.12
	Women	0.20	0.20	0.20	0.20	0.20
Siruma	Local Government Unit (LGU)	0.22	0.08	0.19	0.29	0.22
	Fisherfolk	0.20	0.20	0.20	0.20	0.20
	Women	0.24	0.06	0.32	0.19	0.18
Tinambac	Local Government Unit (LGU)	0.22	0.12	0.27	0.14	0.25
	Fisherfolk	0.16	0.24	0.20	0.20	0.20

c. *Weights of importance of the indicators in measuring the criteria*

The discussion on the weights of importance of the indicators in measuring the criteria is limited to the indicators that are considered as the most important measure of a particular criterion according to a group of resource users.

Basud municipality. There are two indicators that dominated the criterion *acceptability* for the fisherfolk, i.e., *resource users' participation* and *level of awareness of resource users.* The *number of fishers who belong to an organization* however, is the most important measure for the local government unit and women groups. The highest measure of *biotic diversity* and *equity* for the women group are *status of coral reef resources* and *assessment of the success of additional livelihood implemented,* respectively. The fisherfolk and women groups perceive *employment structure of small-scale fishers* as the best indicator of *economic performance.* The *presence of comprehensible laws and regulations* for the local government unit is the best measure of *enforceability.*

Table 28. Weights of importance of the indicators per criterion in the municipality of *Basud.*

Acceptability Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Resource users' participation in the fisheries management process	0.07	0.38	0.10
Level of awareness of resource users in fisheries resource management	0.19	0.39	0.27
Number of fishers who belong to an organization	0.36	0.09	0.46
Change in the level of intra-sectoral conflicts	0.21	0.07	0.04
Change in the level of inter-sectoral conflicts	0.18	0.07	0.13
Biotic Diversity Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Abundance of reef fish	0.34	0.20	0.15
Abundance of commercial fish catch	0.10	0.23	0.03
Species richness of reef fish	0.13	0.18	0.07
Extent of mangrove areas	0.18	0.20	0.27
Status of coral reef resources	0.26	0.20	0.47
Economic Performance Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Number of commercial fishing boats & banned fishing gears	0.11	0.38	0.05
Fisherfolk gross revenue from fishing	0.41	0.13	0.16
Assessment of fisherfolk gross revenue from fishing	0.41	0.13	0.16
Employment structure of small-scale fisheries	0.08	0.38	0.62
Enforceability Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Presence of comprehensible laws and regulations related to management	0.49	0.17	0.02
Frequency of information dissemination about the management	0.07	0.17	0.28
Perception on suitability of enforcement techniques	0.13	0.17	0.09
Performance assessment of fisheries law enforcers	0.19	0.17	0.28
Financial support for fisheries law enforcement	0.08	0.17	0.28
Assessment of the allocated financial support for enforcement	0.04	0.17	0.06
Equity Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Profit distribution among different fishing gears	0.11	0.31	0.05
Amount of financial support for additional livelihood	0.30	0.24	0.24
Assessment of the success of additional livelihood implemented	0.25	0.31	0.59
Inclusion of women in the management process	0.34	0.14	0.12

Cabusao municipality. The weights of importance of the indicators per group in Cabusao are presented in Table 29. The local government unit and women groups rank *resource users participation in the fisheries management process* as the most important indicator in measuring *acceptability* criterion. The women group of Basud weighs the indicator *abundance of commercial fish catch* the highest indicator of *biotic diversity.* The local government unit and women groups rank *number of commercial fishing boats and banned fishing gears* and *employment structure of small-scale fisheries*, respectively of equal importance in measuring *economic performance.* The women in coastal fisheries have always belonged to the underrepresented group in terms of decision-making. Their regard for *inclusion of women in the management process* as the most important indicator is indicative of their clamor for recognition and participation in coastal management.

Table 29. Weights of importance of the indicators per criterion in the municipality of *Cabusao.*

Acceptability Indicators	Local Government Unit (LGU)	Fisherfolk	Women	Private Sector
Resource users' participation in the fisheries management process	0.46	0.11	0.51	0.03
Level of awareness of resource users in fisheries resource management	0.11	0.19	0.11	0.29
Number of fishers who belong to an organization	0.31	0.25	0.27	0.20
Change in the level of intra-sectoral conflicts	0.06	0.16	0.06	0.27
Change in the level of inter-sectoral conflicts	0.06	0.29	0.06	0.21
Biotic Diversity Indicators	Local Government Unit (LGU)	Fisherfolk	Women	Private Sector
Abundance of reef fish	0.26	0.14	0.08	0.19
Abundance of commercial fish catch	0.11	0.32	0.46	0.14
Species richness of reef fish	0.09	0.29	0.08	0.32
Extent of mangrove areas	0.37	0.11	0.17	0.19
Status of coral reef resources	0.16	0.15	0.21	0.16

Economic Performance Indicators	Local Government Unit (LGU)	Fisherfolk	Women	Private Sector
Number of commercial fishing boats & banned fishing gears	0.55	0.10	0.30	0.22
Fisherfolk gross revenue from fishing	0.12	0.35	0.07	0.30
Assessment of fisherfolk gross revenue from fishing	0.12	0.35	0.07	0.30
Employment structure of small-scale fisheries	0.22	0.21	0.55	0.18
Enforceability Indicators	Local Government Unit (LGU)	Fisherfolk	Women	Private Sector
Presence of comprehensible laws and regulations related to management	0.21	0.17	0.11	0.15
Frequency of information dissemination about the management	0.20	0.17	0.24	0.17
Perception on suitability of enforcement techniques	0.21	0.17	0.15	0.16
Performance assessment of fisheries law enforcers	0.13	0.17	0.11	0.13
Financial support for fisheries law enforcement	0.13	0.17	0.22	0.12
Assessment of the allocated financial support for enforcement	0.13	0.17	0.17	0.25
Equity Indicators	Local Government Unit (LGU)	Fisherfolk	Women	Private Sector
Profit distribution among different fishing gears	0.23	0.11	0.05	0.32
Amount of financial support for additional livelihood	0.38	0.42	0.11	0.28
Assessment of the success of additional livelihood implemented	0.23	0.35	0.24	0.16
Inclusion of women in the management process	0.16	0.12	0.60	0.24

Calabanga municipality. Just like the municipality of Cabusao, the local government unit of Calabanga also considers *resource users participation in the fisheries management process* as the most important measure of *acceptability*. Whereas, the private sector assigned the indicators *status of coral reef resources* and *employment structure of small-scale fishers* the highest weighting for *biotic diversity* and *economic performance,* respectively. *Inclusion of women in the management process* appears to be the most important indicator of *equity* for local government unit and private sector groups while for fisherfolk it is the *profit distribution among different fishing gears* (Table 30).

Table 30. Weights of importance of the indicators per criterion in the municipality of *Calabanga*.

Acceptability Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Resource users' participation in the fisheries management process	0.53	0.19	0.11	0.03
Level of awareness of resource users in fisheries resource management	0.11	0.35	0.16	0.22
Number of fishers who belong to an organization	0.07	0.24	0.18	0.24
Change in the level of intra-sectoral conflicts	0.15	0.09	0.24	0.14
Change in the level of inter-sectoral conflicts	0.15	0.13	0.31	0.37
Biotic Diversity Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Abundance of reef fish	0.08	0.22	0.05	0.14
Abundance of commercial fish catch	0.03	0.15	0.06	0.16
Species richness of reef fish	0.15	0.28	0.18	0.16
Extent of mangrove areas	0.37	0.17	0.31	0.25
Status of coral reef resources	0.37	0.17	0.40	0.29
Economic Performance Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Number of commercial fishing boats & banned fishing gears	0.14	0.61	0.06	0.25
Fisherfolk gross revenue from fishing	0.40	0.13	0.16	0.29
Assessment of fisherfolk gross revenue from fishing	0.40	0.13	0.16	0.29
Employment structure of small-scale fisheries	0.06	0.14	0.63	0.18
Enforceability Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Presence of comprehensible laws and regulations related to management	0.04	0.17	0.07	0.10
Frequency of information dissemination about the management	0.14	0.15	0.06	0.09
Perception on suitability of enforcement techniques	0.07	0.16	0.06	0.13
Performance assessment of fisheries law enforcers	0.13	0.17	0.13	0.25
Financial support for fisheries law enforcement	0.26	0.24	0.30	0.22
Assessment of the allocated financial support for enforcement	0.36	0.11	0.37	0.21

Equity Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Profit distribution among different fishing gears	0.06	0.61	0.10	0.15
Amount of financial support for additional livelihood	0.28	0.13	0.12	0.16
Assessment of the success of additional livelihood implemented	0.13	0.13	0.17	0.26
Inclusion of women in the management process	0.53	0.14	0.61	0.44

Mercedes municipality. In Table 31, both fisherfolk and private sector find that the best measure of *acceptability* criterion is *level of awareness of resource users in fisheries resource management.* The local government unit and private sector groups regard the *extent of mangrove areas* and *status of coral reef resources* as the most important indicators of *biotic diversity. Employment structure of small-scale fishers* and *number of commercial fishing boats and banned fishing gears* receive the highest weighting from non-government organization and private sector, respectively for the indicators of *economic performance.* Among the groups, the local government unit and non-government organization weighted all indicators of *enforceability* equally.

Table 31. Weights of importance of the indicators per criterion in the municipality of *Mercedes.*

Acceptability Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Resource users' participation in the fisheries management process	0.28	0.15	0.11	0.11
Level of awareness of resource users in fisheries resource management	0.24	0.33	0.35	0.36
Number of fishers who belong to an organization	0.11	0.11	0.32	0.40
Change in the level of intra-sectoral conflicts	0.19	0.12	0.11	0.07
Change in the level of inter-sectoral conflicts	0.19	0.30	0.11	0.05

Biotic Diversity Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Abundance of reef fish	0.14	0.19	0.10	0.20
Abundance of commercial fish catch	0.18	0.16	0.13	0.20
Species richness of reef fish	0.18	0.25	0.07	0.20
Extent of mangrove areas	0.31	0.19	0.34	0.20
Status of coral reef resources	0.18	0.19	0.36	0.20
Economic Performance Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Number of commercial fishing boats & banned fishing gears	0.04	0.49	0.75	0.04
Fisherfolk gross revenue from fishing	0.32	0.10	0.08	0.16
Assessment of fisherfolk gross revenue from fishing	0.32	0.10	0.08	0.16
Employment structure of small-scale fisheries	0.32	0.31	0.08	0.64
Enforceability Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Presence of comprehensible laws and regulations related to management	0.17	0.23	0.24	0.17
Frequency of information dissemination about the management	0.17	0.13	0.10	0.17
Perception on suitability of enforcement techniques	0.17	0.16	0.17	0.17
Performance assessment of fisheries law enforcers	0.17	0.16	0.14	0.17
Financial support for fisheries law enforcement	0.17	0.16	0.20	0.17
Assessment of the allocated financial support for enforcement	0.17	0.16	0.14	0.17
Equity Indicators	Local Government Unit (LGU)	Fisherfolk	Private Sector	Non-government Organization (NGO)
Profit distribution among different fishing gears	0.17	0.17	0.15	0.25
Amount of financial support for additional livelihood	0.15	0.36	0.23	0.25
Assessment of the success of additional livelihood implemented	0.37	0.23	0.23	0.25
Inclusion of women in the management process	0.30	0.23	0.39	0.25

Sipocot municipality. Table 32 illustrates that the local government unit of Sipocot gives the indicators *change in the level of intra-sectoral conflicts* and *species richness of reef fish* for *biotic diversity criterion* the highest weighting in measuring *acceptability* and *biotic diversity*, respectively. Both fisherfolk and women groups consider *employment structure of small-scale fishers* as the most important measure of *economic performance.* Just like Cabusao, the women group of Sipocot perceives that in terms of *equity* criterion, *inclusion of women in the management process* is the best measure.

Table 32. Weights of importance of the indicators per criterion in the municipality of *Sipocot.*

Acceptability Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Resource users' participation in the fisheries management process	0.04	0.25	0.08
Level of awareness of resource users in fisheries resource management	0.08	0.25	0.13
Number of fishers who belong to an organization	0.26	0.15	0.41
Change in the level of intra-sectoral conflicts	0.48	0.15	0.18
Change in the level of inter-sectoral conflicts	0.14	0.20	0.21
Biotic Diversity Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Abundance of reef fish	0.09	0.20	0.20
Abundance of commercial fish catch	0.21	0.20	0.23
Species richness of reef fish	0.46	0.20	0.14
Extent of mangrove areas	0.14	0.20	0.16
Status of coral reef resources	0.10	0.20	0.27
Economic Performance Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Number of commercial fishing boats & banned fishing gears	0.07	0.04	0.36
Fisherfolk gross revenue from fishing	0.32	0.22	0.07
Assessment of fisherfolk gross revenue from fishing	0.32	0.22	0.07
Employment structure of small-scale fisheries	0.28	0.52	0.50

Enforceability Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Presence of comprehensible laws and regulations related to management	0.07	0.06	0.16
Frequency of information dissemination about the management	0.29	0.04	0.21
Perception on suitability of enforcement techniques	0.07	0.19	0.13
Performance assessment of fisheries law enforcers	0.16	0.21	0.07
Financial support for fisheries law enforcement	0.33	0.26	0.21
Assessment of the allocated financial support for enforcement	0.09	0.25	0.21
Equity Indicators	**Local Government Unit (LGU)**	**Fisherfolk**	**Women**
Profit distribution among different fishing gears	0.23	0.17	0.05
Amount of financial support for additional livelihood	0.23	0.23	0.15
Assessment of the success of additional livelihood implemented	0.39	0.37	0.35
Inclusion of women in the management process	0.15	0.23	0.46

Siruma municipality. According to the local government unit of Siruma, the best indicator to measure *acceptability* criterion is the *change in the level of inter-sectoral conflict* (Table 33). They also think that for *economic performance* it is the *employment structure of small-scale fishers*. Analogous to the women of Cabusao and Sipocot, the women group of Siruma also perceives that *equity* is best measured by the indicator *inclusion of women in the management process.*

Table 33. Weights of importance of the indicators per criterion in the municipality of *Siruma.*

Acceptability Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Resource users' participation in the fisheries management process	0.03	0.20	0.12
Level of awareness of resource users in fisheries resource management	0.07	0.38	0.14
Number of fishers who belong to an organization	0.12	0.07	0.40
Change in the level of intra-sectoral conflicts	0.23	0.19	0.15
Change in the level of inter-sectoral conflicts	0.55	0.16	0.19

Biotic Diversity Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Abundance of reef fish	0.10	0.29	0.13
Abundance of commercial fish catch	0.16	0.12	0.16
Species richness of reef fish	0.08	0.12	0.17
Extent of mangrove areas	0.12	0.17	0.35
Status of coral reef resources	0.37	0.29	0.18
Economic Performance Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Number of commercial fishing boats & banned fishing gears	0.26	0.04	0.04
Fisherfolk gross revenue from fishing	0.08	0.32	0.31
Assessment of fisherfolk gross revenue from fishing	0.08	0.32	0.31
Employment structure of small-scale fisheries	0.59	0.31	0.33
Enforceability Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Presence of comprehensible laws and regulations related to management	0.07	0.17	0.16
Frequency of information dissemination about the management	0.05	0.17	0.22
Perception on suitability of enforcement techniques	0.11	0.17	0.16
Performance assessment of fisheries law enforcers	0.24	0.17	0.15
Financial support for fisheries law enforcement	0.24	0.17	0.16
Assessment of the allocated financial support for enforcement	0.29	0.17	0.16
Equity Indicators	Local Government Unit (LGU)	Fisherfolk	Women
Profit distribution among different fishing gears	0.13	0.25	0.23
Amount of financial support for additional livelihood	0.33	0.25	0.23
Assessment of the success of additional livelihood implemented	0.30	0.25	0.15
Inclusion of women in the management process	0.25	0.25	0.39

Tinambac municipality. Both local government unit and fisherfolk groups of Tinambac consider the *status of coral reef resources* as the most important measure of *biotic diversity* criterion (Table 34). The indicator *number of commercial fishing boats and banned fishing gears* receives higher weights in measuring *economic performance* criterion than the other indicators from the fisherfolk group. While the local government unit views *assessment of additional livelihood implemented* as the best measure for *equity* criterion, the fisherfolk thinks it is the *amount of financial support for additional livelihood.*

Table 34. Weights of importance of the indicators per criterion in the municipality of *Tinambac.*

Acceptability Indicators	Local Government Unit (LGU)	Fisherfolk
Resource users' participation in the fisheries management process	0.20	0.10
Level of awareness of resource users in fisheries resource management	0.23	0.13
Number of fishers who belong to an organization	0.13	0.31
Change in the level of intra-sectoral conflicts	0.19	0.31
Change in the level of inter-sectoral conflicts	0.25	0.15
Biotic Diversity Indicators	Local Government Unit (LGU)	Fisherfolk
Abundance of reef fish	0.20	0.10
Abundance of commercial fish catch	0.19	0.06
Species richness of reef fish	0.20	0.14
Extent of mangrove areas	0.05	0.27
Status of coral reef resources	0.35	0.43
Economic Performance Indicators	Local Government Unit (LGU)	Fisherfolk
Number of commercial fishing boats & banned fishing gears	0.08	0.70
Fisherfolk gross revenue from fishing	0.40	0.13
Assessment of fisherfolk gross revenue from fishing	0.40	0.13
Employment structure of small-scale fisheries	0.12	0.05
Enforceability Indicators	Local Government Unit (LGU)	Fisherfolk
Presence of comprehensible laws and regulations related to management	0.04	0.18
Frequency of information dissemination about the management	0.08	0.11
Perception on suitability of enforcement techniques	0.23	0.19
Performance assessment of fisheries law enforcers	0.10	0.16
Financial support for fisheries law enforcement	0.36	0.18
Assessment of the allocated financial support for enforcement	0.18	0.18

Equity Indicators	Local Government Unit (LGU)	Fisherfolk
Profit distribution among different fishing gears	0.08	0.16
Amount of financial support for additional livelihood	0.11	0.38
Assessment of the success of additional livelihood implemented	0.50	0.23
Inclusion of women in the management process	0.30	0.23

d. *Interpretation of the weights of importance of the criteria and indicators*

The fisherfolk group of the municipalities of Basud, Calabanga, and Sipocot considered acceptability as the most important criterion in evaluating the impacts of fisheries management. The municipality of Sipocot has the least number of documented management interventions. Despite exposure to major research projects and activities in the past, the fisherfolk may still find their participation in the management process rather weak and insufficient thus, acceptability was given more attention than the other criteria. The municipality of Sipocot also experienced institutional problems such as weak fisherfolk organizational structure, lack of opportunity to involve resource users in capacity building and decision-making process, and a passive local government unit to deal with coastal resource management issues. These issues were also reflected when the fisherfolk from Basud and Sipocot ranked the indicators *resource users' participation in the management process* and *level of awareness of resource users* as the most important indicators that measure the criterion acceptability.

The municipality of Calabanga harbors both small-scale and commercial fishers. In fact, its barangay Sabang is considered as one of the major landing sites for trawlers within the bay (Silvestre and Cinco 1992, Smith and Salon 1987). The presence of these two fisheries sectors within the same geographical area has created resentment and conflicts between them. For instance, majority of large trawlers would fish along the way to and from their base of operations in Sabang (Silvestre and Cinco 1992). While it may be assumed that the fisherfolk of Calabanga would rank change in the level of inter-sectoral conflicts as the best measure of acceptability because of this situation, analysis of the weighting revealed a different result. For the fisherfolk, the *level of awareness of resource users* followed by the *number of fishers who belong to an organization* were the most important measures of acceptability perhaps because they might have observed a diminishing involvement of many fisherfolk in coastal resource management.

Although weighted a little higher than the other criteria, economic performance is the most important criterion for the fisherfolk of Mercedes. This result may have been influenced by the presence of a major fishing port in this municipality, where fish catch from commercial fishing boats was also landed. Large-scale trawling fleet based in other areas (e.g., Naga City, Navotas and Cavite) would usually fish outside the bay but on occasion in the mouth (Silvestre and Cinco 1992, Smith and Salon 1987). In fact, the change in the *number of commercial fishing boats and banned fishing gears* is seen as the best measure of economic performance.

The most important criterion for the local government unit concurred with that of the fisherfolk group at least in the municipalities of Basud (acceptability), Calabanga (acceptability) and Cabusao (biotic diversity). This would mean that fisheries policies or management plans should give more consideration on the level of acceptability of any management intervention by the coastal communities of Basud and Calabanga. The involvement of coastal resource users in the conceptualization, implementation, monitoring and evaluation of management strategy, as well as their degree of knowledge and understanding with respect to coastal fisheries and aquatic resources issues are of prime importance. Whereas, for the fisherfolk and local government unit groups of Cabusao the biological aspect of fisheries management particularly the extent of mangrove areas and abundance of commercial fish catch deserves a great deal of attention. The coastal habitat base map of San Miguel Bay in the study of Garces et al. (1995b) showed fishpond areas in the southern part of the bay where mangrove areas used to be abundant. Even with reforestation efforts initiated (Garces et al. 1995b), the fisherfolk and local government unit of Cabusao may have felt the need to strengthen mangrove reforestation and rehabilitation. This could have been the reason why biotic diversity is very much important for the fisherfolk and local government unit of Cabusao.

Equity issue in the bay was highlighted in early researches such as that of Smith and Mines (1982) which found that despite the few fishing units and a very low contribution to labor force, small-trawlers earned 50% of the total annual value of fish catch in 1980-81. Another group which has always been subjected to equity issue is the the women. Despite recognition of the important role of women in economic and social production in San Miguel Bay (Yater 1982), their overall function in coastal resource management has always been undervalued. The desire to obtain equal access to opportunities (e.g., alternative livelihood) and to be included in the management process for the women of Basud and Cabusao has placed equity as the most important criterion in evaluating the impacts of fisheries management. Dalusung (1992) reported a high literacy rate in the coastal municipalities of San Miguel Bay and that more females are literates at the level of the coastal municipality especially in Basud, Sipocot, Siruma and Tinambac.

This may indicate the ability of women to participate in decision-making process related to coastal resource management.

e. *Selection Procedure for the Final Weights of Importance*

1) Simple Averaging

The final evaluation process incorporates the weighting of importance of the criteria and indicators; thus, each municipality would have its own set of weighting. Since the weighting comes from more than one group of resource users, the concern now is to determine which weighting of importance to use in the final analysis. The simplest way is to take the average weighting of the criteria and indicators for all groups of evaluators in each municipality as shown in Table 35. In Table 35, the shaded cells are the criteria, and the numerical value per criterion is equal to the sum of the indicators below it. When weightings of the criteria and indicators from the different groups were combined, it was interesting to note that the northern- and easternmost coastal municipalities in the bay (i.e., Mercedes, Siruma and Tinambac) considered *economic performance* as the most important criterion in evaluating the impacts of fisheries management strategies. For Basud and Calabanga, *acceptability* criterion remained to be of highest priority, whereas, Cabusao and Sipocot preferred *biotic diversity* and *equity,* respectively.

Table 35. Average weights of importance of the criteria and indicators from all groups of evaluators in each municipality.

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY	0.29	0.08	0.30	0.20	0.24	0.22	0.19
1. Resource users' participation in the management process	0.05	0.03	0.09	0.03	0.04	0.03	0.03
2. Level of awareness of resource users in resource management	0.08	0.01	0.06	0.06	0.05	0.04	0.04
3. Number of fishers who belong to an organization	0.08	0.02	0.05	0.05	0.06	0.05	0.04
4. Change in the level of intra-sectoral conflicts	0.04	0.01	0.04	0.02	0.05	0.04	0.04
5. Change in the level of inter-sectoral conflicts	0.04	0.01	0.06	0.03	0.05	0.07	0.04
BIOTIC DIVERSITY	0.19	0.32	0.17	0.19	0.15	0.11	0.18
6. Abundance of reef fish	0.05	0.06	0.02	0.03	0.03	0.02	0.02
7. Abundance of commercial fish catch	0.02	0.06	0.02	0.03	0.03	0.02	0.02
8. Species richness of reef fish	0.03	0.06	0.03	0.03	0.03	0.01	0.03
9. Extent of mangrove areas (ha)	0.04	0.07	0.04	0.05	0.03	0.02	0.04
10. Status of coral reef resources	0.06	0.05	0.05	0.04	0.03	0.03	0.07
ECONOMIC PERFORMANCE	0.17	0.19	0.16	0.22	0.17	0.24	0.24
11. Number of commercial fishing boats & banned fishing gears	0.03	0.06	0.05	0.08	0.03	0.02	0.08
12. Fisherfolk gross revenue from fishing	0.03	0.04	0.03	0.04	0.04	0.06	0.07
13. Assessment of fisherfolk gross revenue from fishing	0.03	0.04	0.03	0.04	0.04	0.06	0.07
14. Employment structure of small-scale fishers	0.07	0.06	0.05	0.08	0.07	0.09	0.02
ENFORCEABILITY	0.12	0.21	0.17	0.20	0.15	0.23	0.17

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
15. Presence of comprehensible laws and regulations	0.03	0.03	0.02	0.04	0.02	0.03	0.02
16. Frequency of information dissemination about the management	0.02	0.04	0.02	0.03	0.03	0.03	0.02
17. Perception on the suitability of enforcement techniques	0.02	0.04	0.02	0.03	0.02	0.03	0.03
18. Performance assessment of law enforcers	0.03	0.03	0.03	0.03	0.02	0.04	0.02
19. Financial support for enforcement	0.02	0.03	0.04	0.03	0.04	0.04	0.04
20. Assessment of the allocated financial support for enforcement	0.01	0.04	0.04	0.03	0.03	0.05	0.03
EQUITY	0.24	0.20	0.20	0.20	0.29	0.20	0.23
21. Profit distribution among different fishing gears	0.03	0.03	0.04	0.04	0.05	0.04	0.03
22. Financial support for additional livelihood implemented	0.06	0.05	0.04	0.05	0.06	0.05	0.05
23. Assessment of the success of additional livelihood implemented	0.11	0.05	0.03	0.05	0.11	0.05	0.09
24. Inclusion of women in the management process	0.04	0.07	0.09	0.06	0.07	0.06	0.06
TOTAL	1.00	1.00	1.00	1.00	1.00	1.00	1.00

2) Application of consistency in judgment

The Analytic Hierarchy Process (AHP) establishes the relationships between the indicators through pairwise comparisons and the impacts of these indicators on the criteria. Correspondingly, pairwise comparisons of the criteria would satisfy the requirement of the next level which is the evaluation of impacts of fisheries management. However, in the application of AHP method the degree of consistency in judgments has to be considered. This is important to make sure that the judgments made by the resource users do not appear to be random. The consistency in judgment follows the transitivitity principle which is if A is more preferred than B and B is more preferred than C then, A is more preferred than C. It is measured by means of a *consistency ratio* (CR) derived as the ratio of the consistency index and random consistency index (Saaty 2001). The consistency ratio does not presuppose to arrive at the best decision but how consistent is the judgment of the participants in a decision-making process. It assumes, however, that the more knowledgeable a person or group is with respect to the problem or situation, the more it is expected that the said person or group is consistent in his/its judgment about the problem. A CR of 10% or less is considered acceptable (Saaty 2001) and this level has been applied in many decision problems in urban planning, environmental management and transportation.

When the judgments of all groups of resource users from the seven coastal municipalities of San Miguel Bay are consistent based on the consistency ratio of 10% or less for all criteria and criterion indicators, then the average weight of importance is computed and used in the final evaluation process. This is simply not the case in San Miguel Bay where there are groups of resource users whose consistency ratios in comparing the importance of criteria in evaluating the impacts of fisheries management and indicators in measuring each criterion are more than 10%. There is no single group whose judgment of the weights of importance is consistent in all indicators and criteria as presented in Table 36.

In Table 36, the values in columns 4-8 are consistency ratios of the weights of importance of the indicators that measure a particular criterion. The values in column 9 (Overall Criteria) are the consistency ratios of the groups that weighed the importance of the criteria in evaluating the impacts of fisheries management strategies. The result of this research confirms the study of Soma (2003) on the shrimp fishery sector of Trinidad and Tobago which demonstrated that high inconsistencies in the judgment of some sectors (as high as 0.41, 0.23 and 0.25 for the vendor, inshore fisher and fishermen-crew, respectively) in the shrimp fishery industry are apparent. In this research, a number of groups demonstrated inconsistent judgment in both criteria and indicators, some even reached consistency ratio values more than 1.0 such as that of the local government unit of Calabanga who weighed the indicators of enforceability and women of Basud who weighed the importance of the five criteria in evaluating the impacts of fisheries management strategies. In contrast, there were also groups whose judgments are consistent 100% of the time (i.e., CR= 0%) and these groups are mostly found in the municipalities of Calabanga, Mercedes, Sipocot and Siruma. And the same groups considered all five criteria of equal importance.

Table 36. Consistency ratios of the 23 groups of resource users in San Miguel Bay.

Municipality	GROUPS	Code	CRITERION INDICATORS					Overall Criteria
			Acceptability Indicators	Biotic Diversity Indicators	Economic Performance Indicators	Enforceability Indicators	Equity Indicators	
Basud	Local Government Unit (LGU)	a	0.22	0.16	0.03	0.3	0.41	0.17
	Fisherfolk	b	0.09	0.01	0	0	0.22	0.11
	Women	c	0.33	0.39	0.13	0.42	0.28	1.08
Cabusao	Local Government Unit (LGU)	d	0.12	0.43	0.24	0.5	0.19	0.93
	Fisherfolk	e	0.13	0.1	0.02	0	0.14	0.08
	Women	f	0.23	0.21	0.28	0.77	0.28	0.23
	Private Sector	g	0.48	0.42	0.16	0.27	0.37	0.17
Calabanga	Local Government Unit (LGU)	h	0.07	0.3	0.13	1.55	0.51	0.49
	Fisherfolk	i	0.29	0.26	0	0.78	0.43	0.22
	Private Sector	j	0.13	0.26	0.19	0.22	0.06	0.01
	Non-government Organization (NGO)	k	0.88	0.13	0.02	0.18	0.08	0
Mercedes	Local Government Unit (LGU)	l	0.16	0.15	0	0	0.25	0
	Fisherfolk	m	0.33	0.03	0.28	0.07	0.13	0.08
	Private Sector	n	0.31	0.4	0	0.34	0.25	0
	Non-government Organization (NGO)	o	0.18	0	0.19	0	0	0
Sipocot	Local Government Unit (LGU)	p	0.46	0.31	0.01	0.67	0.25	0.75
	Fisherfolk	q	0.02	0	0.05	0.11	0.16	0.18
	Women	r	0.39	0.71	0.1	0.96	0.78	0
Siruma	Local Government Unit (LGU)	s	0.36	0.48	0.23	0.19	0.5	0.26
	Fisherfolk	t	0.88	0.29	0	0	0	0
	Women	u	0.1	0.13	0	0.06	0.25	0.22
Tinambac	Local Government Unit (LGU)	v	0.1	0.07	0.02	0.58	0.21	0.02
	Fisherfolk	w	0.37	0.28	0.08	0.74	0.19	0.73

While it is recommended to repeat the decision-making process should inconsistency in judgment occur (consistency ratio greater than 10%), in some decision processes this may be difficult. In coastal fisheries management, repeating the whole decision-making process is difficult since it would entail additional expenses and time on the part of the researcher and participants. Extended time attending a workshop such as this would mean economic loss on the part of the participants especially the fisherfolk; therefore, it is undesirable to compel them to further participate. Membership in the FARMCs does not insure compensation for whatever lost economic opportunity. Given this consideration, the question still remains as to which weights of importance of the criteria and indicators from among the groups of resource users should be considered in the final evaluation process? There are two approaches to deal with this difficulty. The first one is to select only the group or groups in each municipality whose consistency ratio is 10% or less in at least one of the criterion indicators and overall criteria. These groups are summarized in Table 37. Out of the 23 groups, 18 have at least one consistency ratio $\leq$10%. However, when the consistency ratio of the overall criteria is considered, only 10 (or 43.5%) of the groups have CR$\leq$ 10%. This approach however, is rather weak since a number of groups have criterion indicators with a CR value very much higher than 10%.

Table 37. Consistency ratios of the 18 groups of resource users.

Municipality	Groups	Code	CRITERION INDICATORS					Overall Criteria
			Acceptability Indicators	Biotic Diversity Indicators	Economic Performance Indicators	Enforceability Indicators	Equity Indicators	
Basud	LGU	a	0.22	0.16	0.03	0.30	0.41	0.17
	Fisherfolk	b	0.09	0.01	0.00	0.00	0.22	0.11
Cabusao	Fisherfolk	e	0.13	0.10	0.02	0.00	0.14	0.08
Calabanga	LGU	h	0.07	0.30	0.13	1.55	0.51	0.49
	Fisherfolk	i	0.29	0.26	0.00	0.78	0.43	0.22
	Private Sector	j	0.13	0.26	0.19	0.22	0.06	0.01
	NGO	k	0.88	0.13	0.02	0.18	0.08	0.00
Mercedes	LGU	l	0.16	0.15	0.00	0.00	0.25	0.00
	Fisherfolk	m	0.19	0.03	0.28	0.07	0.13	0.08
	Private Sector	n	0.10	0.40	0.00	0.34	0.25	0.00
	NGO	o	0.20	0.00	0.19	0.00	0.00	0.00
Sipocot	LGU	p	0.46	0.31	0.01	0.67	0.25	0.75
	Fisherfolk	q	0.02	0.00	0.05	0.11	0.16	0.18
	Women	r	0.39	0.71	0.10	0.96	0.78	0.00
Siruma	Fisherfolk	t	0.88	0.29	0.00	0.00	0.00	0.00
	Women	u	0.10	0.13	0.00	0.06	0.25	0.22
Tinambac	LGU	v	0.10	0.07	0.02	0.58	0.21	0.02
	Fisherfolk	w	0.37	0.28	0.08	0.74	0.19	0.73

The second approach is the application of a statistical method called the non-metric Multidimensional Scaling (MDS) technique. MDS is a multivariate statistical technique intended to find the structure of similarity of judgments; and the perceived relatedness among items or groups is transformed into a visual representation of distance called a *configuration* (Stalans 1995). The consistency ratios of the 23 groups of resource users were utilized to determine the choice of weights. They were subjected to a non-metric MDS analysis using Statistical Package for Social Sciences (SPSS) version 11 (ALSCAL). In this case, the non-metric MDS represents the 23 groups of resource users geometrically by 23 points in space so the points closer to each other are presumed to be closer with respect to preference. Here, we are looking for groups whose consistency in judgment is closer to the ideal consistency ratio of 0-10%. Thus, the values 0 and 10% serve as the ideal points in space; groups that come closer to these points are chosen.

Table 38 and Figure 7 present the groups of resource users in a two dimensional space. The stress in the configuration is 11.5%, somewhat fair goodness of fit and therefore, there is no need to consider higher dimensionality. The results of the MDS analysis indicate that there are three distinct categories (i.e., A, B and C) as illustrated in Figure 7. The two ideal points (CR= 0 and 10%) are included in category A. The groups comprising categories A, B and C are presented in Tables 39, 40 and 41, respectively.

Table 38. Two-dimensional configuration for the 23 resource user groups.

Stimulus Number	Stimulus Name	Dimension 1	Dimension 2
1	a	-0.0313	0.0178
2	b	1.1414	0.4684
3	c	-1.4573	1.6775
4	d	-1.3810	1.3688
5	e	1.0767	0.2111
6	f	-0.8816	-0.2064
7	g	-0.0235	-0.2511
8	h	-3.5493	-0.8655
9	i	-0.9630	-0.4176
10	j	0.6651	-0.0403
11	k	1.1352	-1.0589
12	l	1.0536	-0.0939
13	m	0.9444	0.1737
14	n	0.1230	-0.4927
15	o	1.3298	0.2849
16	p	-1.4250	0.4638
17	q	0.6844	0.5983
18	r	-0.9161	-1.6926
19	s	-0.1802	-0.1383
20	t	1.5011	-0.9867
21	u	0.5518	0.4531
22	v	-0.2197	-0.5215
23	w	-1.4573	0.4408
24	i1	1.4828	0.2952
25	i2	0.7962	0.3122

Note: The values for i1= 0; i2= 0.10

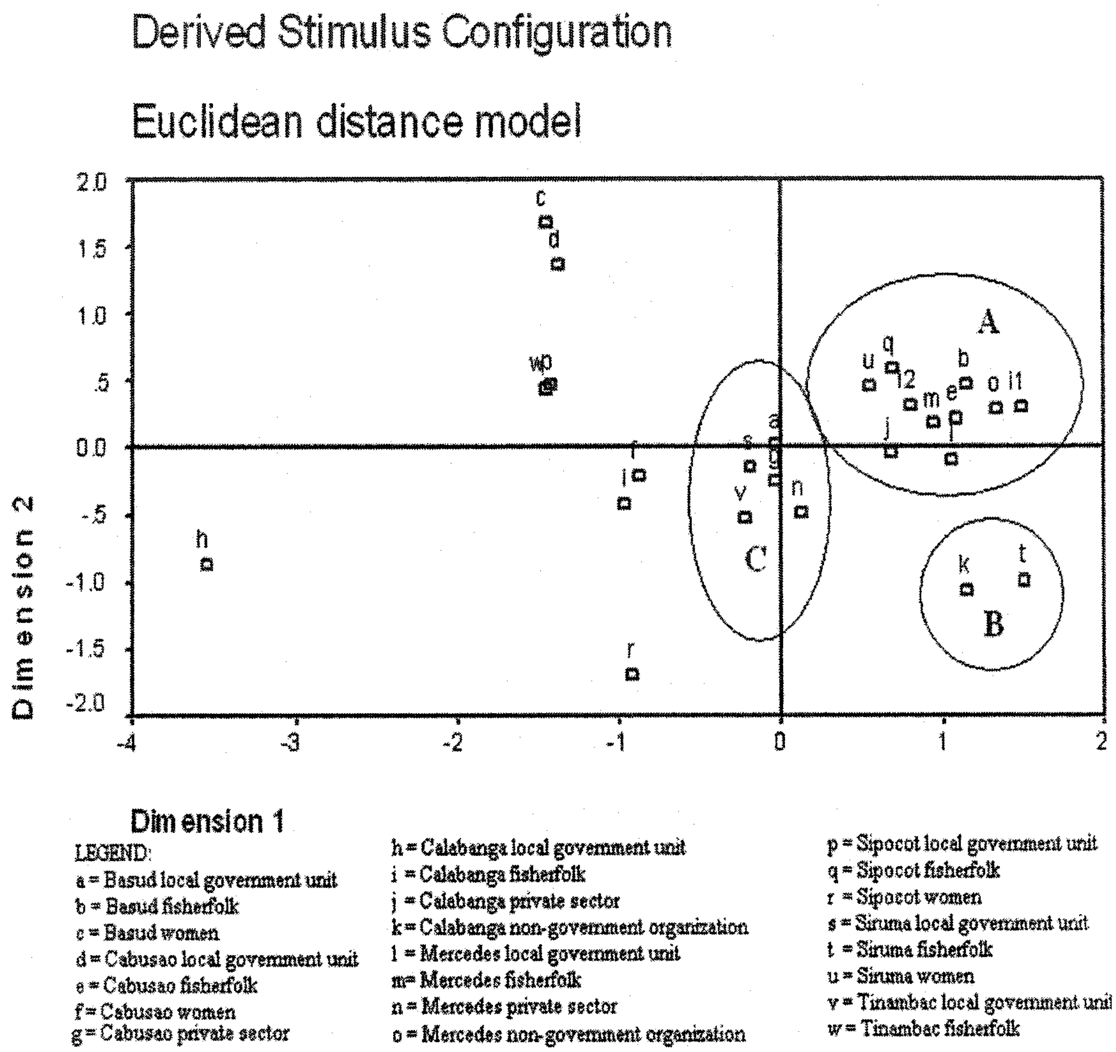


Figure 7. Configuration derived in two dimensions.

Table 39. Category A

Municipality	Groups	Code	CRITERION INDICATORS: Acceptability Indicators	Biotic Diversity Indicators	Economic Performance Indicators	Enforceability Indicators	Equity Indicators	Overall Criteria	Number of groups with CR 10% or less	Average CR
Basud	Fisherfolk	b	0.09	0.01	0.00	0.00	0.22	0.11	4	0.07
Cabusao	Fisherfolk	e	0.13	0.10	0.02	0.00	0.14	0.08	4	0.07
Calabanga	Private Sector	j	0.13	0.26	0.19	0.22	0.06	0.01	2	0.15
Mercedes	LGU	l	0.16	0.15	0.00	0.00	0.25	0.00	3	0.09
	Fisherfolk	m	0.19	0.03	0.28	0.07	0.13	0.08	3	0.13
	NGO	o	0.20	0.00	0.19	0.00	0.00	0.00	4	0.07
Sipocot	Fisherfolk	q	0.02	0.00	0.05	0.11	0.16	0.18	3	0.09
Siruma	Women	u	0.10	0.13	0.00	0.06	0.25	0.22	3	0.13

If the only basis for choosing the groups of evaluators in the final weighting of the criteria and indicators is how close their consistency ratios are to the ideal consistency ratio which is 0-10%, then Category A satisfies such requirement. Compared to categories B and C, category A has the lowest consistency ratios across criterion indicators and among groups of resource users. But in choosing just category A, the municipality of Tinambac is not represented. The next basis would be to look at the number of criterion indicators such that categories with more number of criterion indicators comparable to that of category A (between 2 to 4) were considered. Although the average consistency ratios in category B (Table 40) are high (because of a very high CR for acceptability indicators in both groups), the numbers of criterion indicators and overall criteria whose consistency ratio is less than 10% are 3 for Calabanga and 4 for Siruma. Examination of category C (Table 41) indicates that only two groups (i.e., private sector in Mercedes and local government unit in Tinambac) are able to satisfy the second basis for choosing the groups. These groups have a high number of criterion indicators and overall criteria whose consistency ratio is less than 10% and their average consistency ratios are also comparable to category A. By including the two groups in category C, the problem with Tinambac having no representative groups is resolved.

Table 40. Category B.

Municipality	Groups	Code	CRITERION INDICATORS					Overall Criteria	Number of groups with CR 10% or less	Average CR
			Acceptability Indicators	Biotic Diversity Indicators	Economic Performance Indicators	Enforceability Indicators	Equity Indicators			
Calabanga	NGO	k	0.88	0.13	0.02	0.18	0.08	0.00	3	0.22
Siruma	Fisherfolk	t	0.88	0.29	0.00	0.00	0.00	0.00	4	0.20

Table 41. Category C.

Municipality	Groups	Code	CRITERION INDICATORS					Overall Criteria	Number of groups with CR 10% or less	Average CR
			Acceptability Indicators	Biotic Diversity Indicators	Economic Performance Indicators	Enforceability Indicators	Equity Indicators			
Basud	LGU	a	0.22	0.16	0.03	0.30	0.41	0.17	1	0.22
Cabusao	Private Sector	g	0.48	0.42	0.16	0.27	0.37	0.17	0	0.31
Mercedes	Private Sector	n	0.10	0.40	0.00	0.34	0.25	0.00	3	0.18
Siruma	LGU	s	0.36	0.48	0.23	0.19	0.5	0.26	0	0.34
Tinambac	LGU	v	0.10	0.07	0.02	0.58	0.21	0.02	4	0.17

By applying the non-metric MDS to the consistency ratios, 12 groups of resource users were selected for the final evaluation (Table 42). The corresponding weights of importance given to these indicators are presented in Table 43 however, for municipalities (i.e. Calabanga, Mercedes and Siruma) with more than one group of resource users, the average weights were computed. The final weights of importance for the criteria and indicators are shown in Table 44. The results in Table 44 on the average weights of the criterion indicators are similar to that of Table 35 that considered all groups of resource users. The highest weightings of criterion indicators are the same in both tables with respect to the municipalities of Basud (*acceptability*), Cabusao (*biotic diversity*), Mercedes (*economic performance*), Siruma (*economic performance*) and Tinambac (*economic performance*).

Table 42. Consistency ratios of 12 groups of resource users.

Municipality	Groups	Code	CRITERION INDICATORS					Average CR of the criterion indicators	Overall Criteria
			Acceptability Indicators	Biotic Diversity Indicators	Economic Performance Indicators	Enforceability Indicators	Equity Indicators		
Basud	Fisherfolk	b	0.09	0.01	0	0	0.22	0.07	0.11
Cabusao	Fisherfolk	e	0.13	0.10	0.02	0	0.14	0.07	0.08
Calabanga	NGO	k	0.88	0.13	0.02	0.18	0.08	0.22	0
	Private Sector	j	0.13	0.15	0.01	0.22	0.06	0.15	0.01
Mercedes	Fisherfolk	m	0.19	0.13	0.08	0.07	0.13	0.13	0.08
	LGU	l	0.16	0.09	0	0	0.25	0.09	0
	NGO	o	0.20	0.07	0	0	0	0.07	0
	Private Sector	n	0.10	0.18	0	0.34	0.25	0.18	0
Sipocot	Fisherfolk	q	0.02	0.09	0.18	0.11	0.16	0.09	0.18
Siruma	Fisherfolk	t	0.88	0.20	0	0	0	0.20	0
	Women	u	0.10	0.13	0.22	0.06	0.25	0.13	0.22
Tinambac	LGU	v	0.10	0.17	0.02	0.58	0.21	0.17	0.02

Table 43. Weights of importance of the indicators per criterion from the 12 groups of resource users.

INDICATORS	Basud	Cabusao	Calabanga		Mercedes				Sipocot	Siruma		Tinambac
	b	e	k	j	m	l	o	n	q	t	u	v
ACCEPTABILITY												
1. Resource users' participation in the management process	0.38	0.11	0.03	0.11	0.15	0.28	0.11	0.11	0.25	0.20	0.12	0.20
2. Level of awareness of resource users in management	0.39	0.19	0.22	0.16	0.33	0.24	0.36	0.35	0.25	0.38	0.14	0.23
3. Number of fishers who belong to an organization	0.09	0.25	0.24	0.18	0.11	0.11	0.40	0.32	0.15	0.07	0.40	0.13
4. Change in the level of intra-sectoral conflicts	0.07	0.16	0.14	0.24	0.12	0.19	0.07	0.11	0.15	0.19	0.15	0.19
5. Change in the level of inter-sectoral conflicts	0.07	0.29	0.37	0.31	0.30	0.19	0.05	0.11	0.20	0.16	0.19	0.25
BIOTIC DIVERSITY												
6. Abundance of reef fish	0.20	0.14	0.14	0.05	0.19	0.14	0.20	0.10	0.20	0.29	0.13	0.20
7. Abundance of commercial fish catch	0.23	0.32	0.16	0.06	0.16	0.18	0.20	0.13	0.20	0.12	0.16	0.19
8. Species richness of reef fish	0.18	0.29	0.16	0.18	0.25	0.18	0.20	0.07	0.20	0.12	0.17	0.20
9. Extent of mangrove areas (ha)	0.20	0.11	0.25	0.31	0.19	0.31	0.20	0.34	0.20	0.17	0.35	0.05
10. Status of coral reef resources	0.20	0.15	0.29	0.40	0.19	0.18	0.20	0.36	0.20	0.29	0.18	0.35
ECONOMIC PERFORMANCE												
11. Number of commercial fishing boats & banned fishing gears	0.38	0.10	0.25	0.06	0.49	0.04	0.04	0.75	0.04	0.04	0.04	0.08
12. Fisherfolk gross revenue from fishing	0.13	0.35	0.29	0.16	0.10	0.32	0.16	0.08	0.22	0.32	0.31	0.40

INDICATORS	Basud	Cabusao	Calabanga		Mercedes				Sipocot	Siruma		Tinambac
	b	e	k	j	m	l	o	n	q	t	u	v
13. Assessment of fisherfolk gross revenue from fishing	0.13	0.35	0.29	0.16	0.10	0.32	0.16	0.08	0.22	0.32	0.31	0.40
14. Employment structure of small-scale fishers	0.38	0.21	0.18	0.63	0.31	0.32	0.64	0.08	0.52	0.31	0.33	0.12
ENFORCEABILITY 15. Presence of comprehensible laws and regulations	0.17	0.17	0.10	0.07	0.23	0.17	0.17	0.24	0.06	0.17	0.16	0.04
16. Frequency of information dissemination about the management	0.17	0.17	0.09	0.06	0.13	0.17	0.17	0.10	0.04	0.17	0.22	0.08
17. Perception on the suitability of enforcement techniques	0.17	0.17	0.13	0.06	0.16	0.17	0.17	0.17	0.19	0.17	0.16	0.23
18. Performance assessment of law enforcers	0.17	0.17	0.25	0.13	0.16	0.17	0.17	0.14	0.21	0.17	0.15	0.10
19. Financial support for enforcement	0.17	0.17	0.22	0.30	0.16	0.17	0.17	0.20	0.26	0.17	0.16	0.36
20. Assessment of the allocated financial support for enforcement	0.17	0.17	0.21	0.37	0.16	0.17	0.17	0.14	0.25	0.17	0.16	0.18
EQUITY 21. Profit distribution among different fishing gears	0.31	0.11	0.15	0.10	0.17	0.17	0.25	0.15	0.17	0.25	0.23	0.08
22. Financial support for additional livelihood implemented	0.24	0.42	0.16	0.12	0.36	0.15	0.25	0.23	0.23	0.25	0.23	0.11
23. Assessment of the success of additional livelihood implemented	0.31	0.35	0.26	0.17	0.23	0.37	0.25	0.23	0.37	0.25	0.15	0.50

INDICATORS	Basud	Cabusao	Calabanga		Mercedes				Sipocot	Siruma		Tinambac
	b	e	k	j	m	l	o	n	q	t	u	v
24. Inclusion of women in the management process	0.14	0.12	0.44	0.61	0.23	0.30	0.25	0.39	0.23	0.25	0.39	0.30

Table 44. Average weights of importance of the indicators selected by considering the consistency ratios in each municipality

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY	0.3	0.06	0.20	0.20	0.42	0.22	0.22
1. Resource users' participation in the management process	0.11	0.01	0.01	0.03	0.11	0.04	0.04
2. Level of awareness of resource users in resource management	0.12	0.01	0.04	0.06	0.11	0.06	0.05
3. Number of fishers who belong to an organization	0.03	0.02	0.04	0.05	0.06	0.05	0.03
4. Change in the level of intra-sectoral conflicts	0.02	0.01	0.04	0.02	0.06	0.04	0.04
5. Change in the level of inter-sectoral conflicts	0.02	0.02	0.07	0.03	0.08	0.04	0.06
BIOTIC DIVERSITY	0.19	0.48	0.20	0.19	0.17	0.13	0.12
6. Abundance of reef fish	0.04	0.07	0.02	0.03	0.03	0.03	0.02
7. Abundance of commercial fish catch	0.04	0.15	0.02	0.03	0.03	0.02	0.02
8. Species richness of reef fish	0.03	0.14	0.03	0.03	0.03	0.02	0.02
9. Extent of mangrove areas (ha)	0.04	0.05	0.06	0.05	0.03	0.03	0.01
10. Status of coral reef resources	0.04	0.07	0.07	0.04	0.03	0.03	0.04
ECONOMIC PERFORMANCE	0.19	0.17	0.22	0.22	0.12	0.26	0.27
11. Number of commercial fishing boats & banned fishing gears	0.07	0.02	0.03	0.07	0.00	0.01	0.02

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
12. Fisherfolk gross revenue from fishing	0.02	0.06	0.05	0.04	0.03	0.08	0.11
13. Assessment of fisherfolk gross revenue from fishing	0.02	0.06	0.05	0.04	0.03	0.08	0.11
14. Employment structure of small-scale fishers	0.07	0.04	0.09	0.07	0.06	0.08	0.03
ENFORCEABILITY	0.15	0.10	0.20	0.20	0.17	0.20	0.14
15. Presence of comprehensible laws and regulations	0.03	0.02	0.02	0.04	0.01	0.03	0.01
16. Frequency of information dissemination about the management	0.03	0.02	0.02	0.03	0.01	0.04	0.01
17. Perception on the suitability of enforcement techniques	0.03	0.02	0.02	0.03	0.03	0.03	0.03
18. Performance assessment of law enforcers	0.03	0.02	0.04	0.03	0.04	0.03	0.01
19. Financial support for enforcement	0.03	0.02	0.05	0.04	0.04	0.03	0.05
20. Assessment of the allocated financial support for enforcement	0.03	0.02	0.06	0.03	0.04	0.03	0.03
EQUITY	0.19	0.19	0.19	0.20	0.12	0.19	0.25
21. Profit distribution among different fishing gears	0.06	0.02	0.02	0.04	0.02	0.05	0.02
22. Financial support for additional livelihood implemented	0.05	0.08	0.03	0.05	0.03	0.05	0.03
23. Assessment of the success of additional livelihood implemented	0.06	0.07	0.04	0.05	0.04	0.04	0.13
24. Inclusion of women in the management process	0.03	0.02	0.10	0.06	0.03	0.06	0.08

The similarity between municipalities with respect to the weights of importance they placed on the indicators was also determined by the non-metric MDS. Calabanga, Mercedes and Siruma are closer to each other in a two-dimensional space (Figure 8). The stress in the configuration is 3.4%, somewhat good goodness of fit and thus, there is no need for higher dimensionality. The groupings of these municipalities in the configuration may be associated with some characteristics of the indicators. And to identify which indicators influence such association, linear multiple regression was done. The indicator as a dependent variable was regressed over the independent variables which are the coordinates of the configuration (Dimensions 1 and 2 in Table 45). The result of the multiple regression analysis is shown in Table 46. Only seven indicators namely, *level of awareness of resource users in fisheries resource management, abundance of reef fish, abundance of commercial fish catch, species richness of reef fish, fisherfolk gross revenue from fishing, assessment of the fisherfolk gross revenue from fishing,* and *financial support for additional livelihood* provided significant to highly significant regression results meaning that these are the indicators which affect the similarity of municipalities in terms of the weights of importance of the indicators.

Table 45. Two-dimensional configuration for the seven coastal municipalities.

Stimulus Number	Stimulus Name	Dimension 1	Dimension 2
1	Basud	0.6059	1.1670
2	Cabusao	-2.6869	0.3513
3	Calabanga	0.2587	-0.3627
4	Mercedes	0.1065	0.0894
5	Sipocot	1.3222	0.5479
6	Siruma	0.2917	-0.2093
7	Tinambac	0.1047	-1.5836

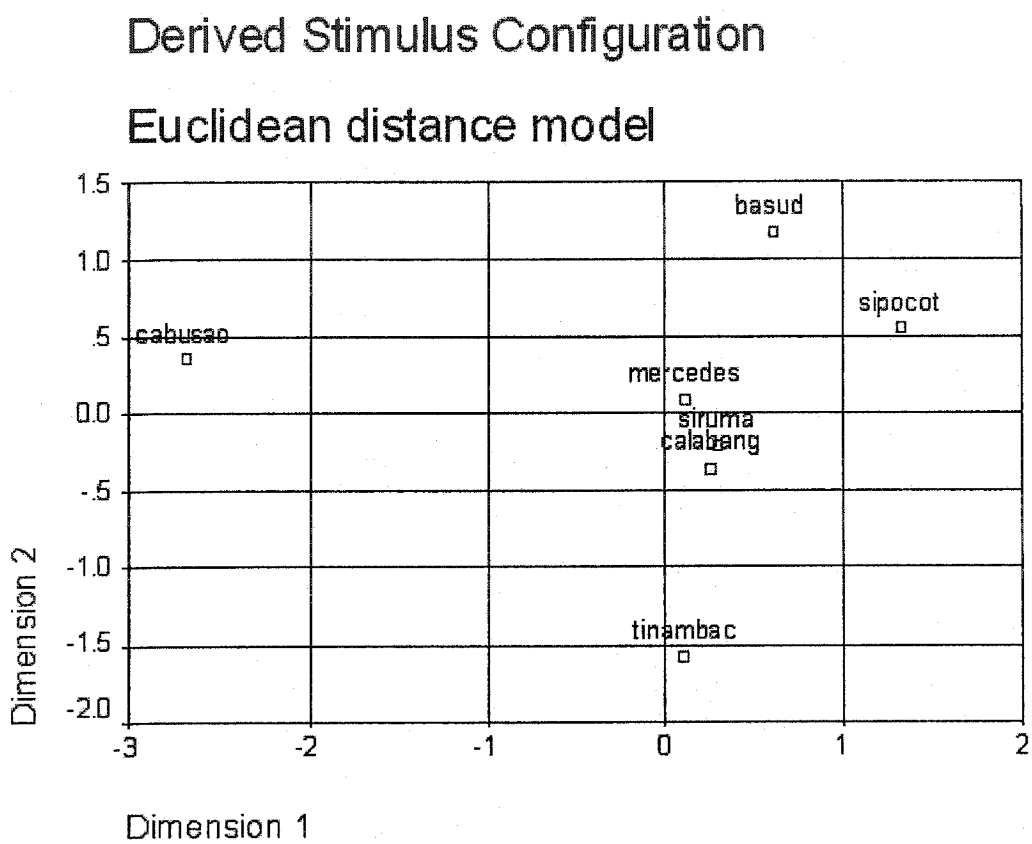


Figure 8. Configuration derived in two dimensions.

Table 46. Multiple regression of each indicator on two-dimensional configuration.

INDICATOR	Multiple Correlation (R)	Significance
Resource users' participation in the fisheries management process	0.825	0.102
Level of awareness of resource users in fisheries resource management	0.930	0.018*
Number of fishers who belong to an organization	0.725	0.225
Change in the level of intra-sectoral conflicts	0.781	0.152
Change in the level of inter-sectoral conflicts	0.704	0.255
Abundance of reef fish	0.967	0.004**
Abundance of commercial fish catch	0.965	0.005**
Species richness of reef fish	0.961	0.006**
Extent of mangrove areas	0.577	0.444
Status of coral reef resources	0.686	0.280
Number of commercial fishing boats & banned fishing gears	0.349	0.771
Fisherfolk gross revenue from fishing	0.927	0.020*
Assessment of fisherfolk gross revenue from fishing	0.927	0.020*
Employment structure of small-scale fisheries	0.552	0.484
Presence of comprehensible laws and regulations related to management	0.380	0.732
Frequency of information dissemination about the management	0.326	0.799
Perception on suitability of enforcement techniques	0.659	0.320
Performance assessment of fisheries law enforcers	0.729	0.219
Financial support for fisheries law enforcement	0.862	0.066
Assessment of the allocated financial support for enforcement	0.519	0.533
Profit distribution among different fishing gears	0.544	0.496
Financial support for additional livelihood	0.940	0.013*
Assessment of the success of additional livelihood implemented	0.679	0.290
Inclusion of women in the management process	0.793	0.138

3) Implication in choosing different kinds of weightings

In this research, two types of weighting scheme are presented, i.e., weights derived from *a) all representatives of the coastal resource users,* and *b) in consideration of consistency in judgments* which are referred to as *non-selective* and *selective* weightings, respectively. In both types of weighting, *economic performance* is the most dominant criterion for San Miguel Bay with respect to evaluating the impacts of fisheries management. The *number of commercial fishing boats and banned fishing gears* and *change in the employment structure of small-scale fishers* were seen as the best indicators that measure economic performance (Figures 9 and 10). This finding is similar to the pre-test result wherein the staff of DA-BFAR Regional Office 5 assigned in San Miguel Bay also considered economic performance as the most important criterion. The most dominant criteria in the municipalities of Sipocot and Calabanga, however, changed with the change in weighting from non-selective to selective. Acceptability criterion replaced equity for Sipocot, while economic performance took the place of acceptability for Calabanga. These changes were the consequences of eliminating groups perceived to be inconsistent based on the calculation of consistency ratios. Also, when selective weighting is chosen, the weighting from the fisherfolk of Calabanga and Tinambac are not considered.

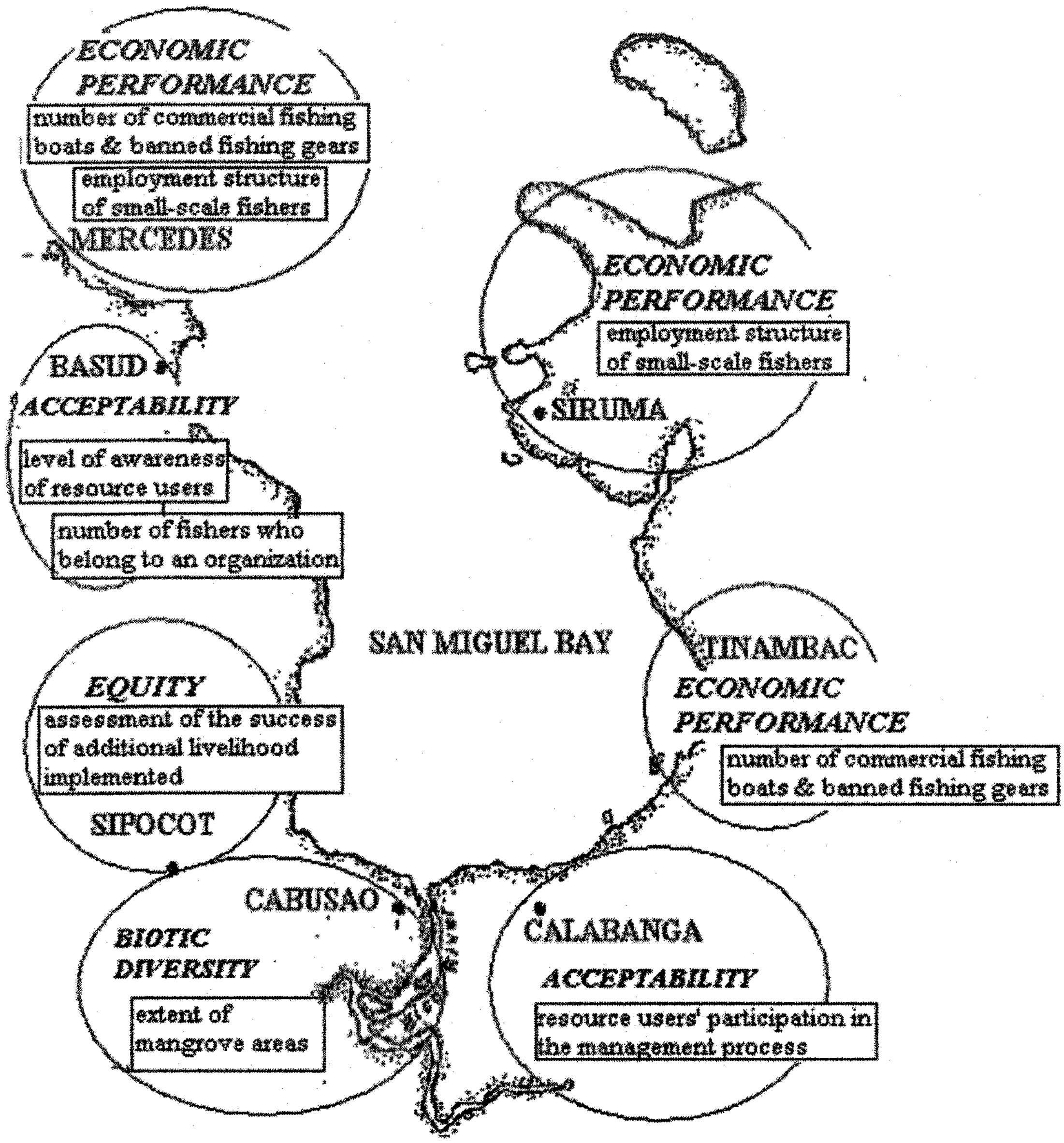


Figure 9. The most important criteria and indicators per criterion for the non-selective weighting scheme

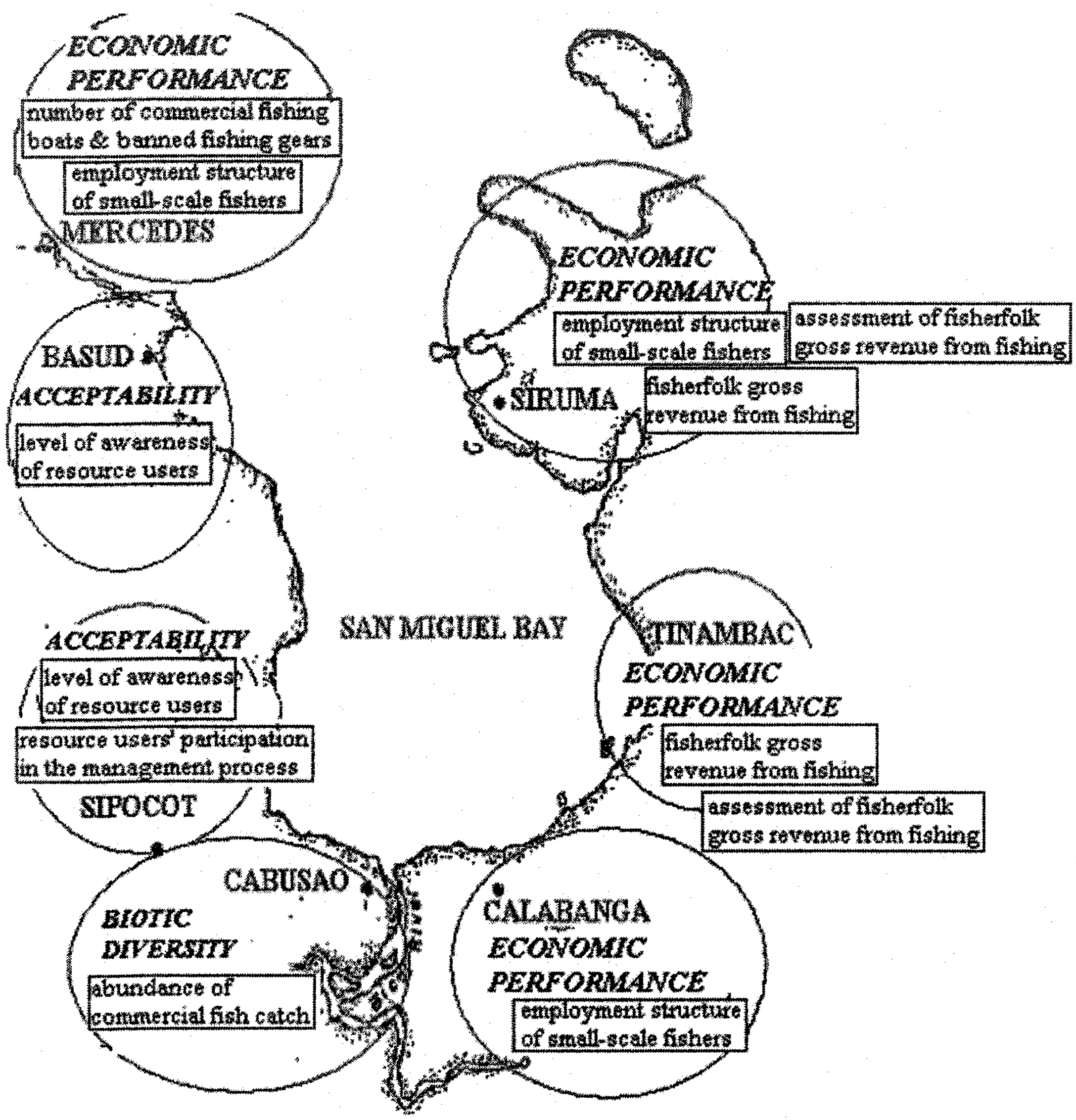


Figure 10. The most important criteria and indicators per criterion for the *selective* weighting scheme.

2. Deriving the Indicator Scores

In a multi-criteria type of evaluation, the multiplicity of levels of measurement is always a consideration. In fact, this characteristic makes multi-critieria method different or unique from a unidimensional one. In this research, the levels of measurement for the 24 indicators are *ordinal, interval* or *ratio.* Ordinal scale positions the object in ranks relative to the other and whose distances may not essentially be equal, whereas, interval and ratio scales provide equal intervals between objects. (Hwang and Yoon 1981, Wheater and Cook 2000).

The way a particular indicator is measured also determines the evaluation analysis to use. The12 indicators that were assessed by the representatives of the coastal resource users are categorized as ordinal data. But can these ordinal data be considered as continuous data for statistical purposes? Vogt (1999) said that as a rule of thumb, ordinal data can be treated as continuous when there are many ranks however, they did not mention how many is many. Hwang and Yoon (1981) presented a way of converting qualitative data into an interval scale utilizing a bipolar scale (e.g., a 10-point scale calibrated into one or several ways). This type of scaling assumes that the distance between points is equal. And the way in which the 12 ordinal indicators in this research were measured may fall under this assumption. The other 12 indicators can be classified as interval or ratio data and their units of measurement are actual count, weight (kg), areas (hectares), percentages, ratios or monetary values. These 12 indicators were measured using secondary information.

Most secondary information available for San Miguel Bay are aggregated, thus, one of the challenges in measuring these indicators is the process of disaggregating them so that each municipality would have its own indicator information. The method by which the scores for the indicators were derived is discussed below.

a. *Profile of the Resource Users who determined the Scores for the 12 Ordinal Indicators*

The scores of the 12 indicators were determined from the members of the Barangay Fisheries and Aquatic Resource Management Councils (BFARMCs) in each coastal municipality of San Miguel Bay. There were 211 BFARMC representatives who participated in this research from 51 barangays (Table 47). Although there were more male representatives, the females made up about 21% of those present. The BFARMC representatives are knowledgeable, experienced and have lived in the coastal site for years thus, making them a good choice. About 98% of them attended school; 49% had an average 6 years experience in coastal resource management; and 60% and 46% have lived in the municipality and barangay, respectively since birth. The profile of BFARMC representatives in each municipality is discussed in the succeeding paragraphs.

Table 47. Total number of representatives in each coastal municipality of San Miguel Bay.

Municipality	Total number of coastal barangays	Number of Coastal barangays represented	Percentage representation of the coastal barangays per municipality	Number of BFARMC representatives per municipality
Basud	2	2	100%	28
Cabusao	6	4	66.7%	25
Calabanga	10	10	100%	46
Mercedes	26	12	46.2%	24
Sipocot	7	5	71.4%	24
Siruma	10	7	70.0%	30
Tinambac	15	11	73.3%	34
TOTAL	*76*	*51*		

Basud. There were 28 respondents (male= 21; female= 7) in Basud whose ages ranged between 22 to 70 years. More participants (93%) reached either elementary, high school, vocational school or college. All females were educated; two have actually reached college. Fifty percent of the participants lived in the municipality and barangay for more than 39 and 27 years, respectively. Although 11 did not specify whether they were involved in any coastal resource management activity in the past, 17 actively participated from 1988 to 2001.

Cabusao. Compared to Basud, the participants in Cabusao (male= 21; female= 4) were slightly older. Their age ranged between 28 to 77 years; 50% of them were more than 47 years old. Fifty percent have lived in the municipality and barangay for more than 41 and 38 years, respectively. All participants were educated, 14 reached elementary or high school while 11 attained college or vocational level. Sixteen have extensive involvement in coastal resource management activities since 1990.

Calabanga. Of all 7 municipalities, Calabanga had the most number of participants (N= 46); and 23 are fishers. It is also the municipality with the highest percentage of women participating (33%). The age of the participants ranged between 19 to 70 years old; 50% of them were 46 years old and above. Thirty-two reached elementary or high school while 12 attained college or vocational level. One of them is a medical doctor while one participant failed to indicate his educational attainment.

Mercedes. There were 24 participants (male= 19; female= 5) in Mercedes with age ranging between 21 to 63 years old. More than 50% however, were 45 years and above. Also, 50% have lived in the municipality and barangay for more than 39 and 32 years, respectively. Although 10 participants did not indicate any experience in coastal resource management activities, 14 were involved from 1987 to 2001.

Sipocot. The age of participants in Sipocot (male= 18; female= 6) ranged between 30 to 69 years old, where 50% of them were 50 years old and above. Half of them have lived in the municipality and barangay for more than 48 and 46 years, respectively. All were educated; 20 of them have reached either elementary or high school while the rest attained college or vocational level. Sixteen participants have participated in coastal resource management projects since 1982.

Siruma. There were 25 male and 5 female participants in Siruma. With an age range between 32 to 72 years old, they are much older compared to the participants from the other six municipalities. Fifty percent of the participants have lived in the municipality and barangay for more than 46 and 42 years, respectively. All participants were educated; 26 have reached high school and elementary while 4 attained college or vocational level. Twenty-two participants have extensive experience in coastal resource management activities since 1990.

Tinambac. There were 34 participants from Tinambac and out of these, only two are women. There was a wide age difference among them; ages ranged between 14 to 73 years old. Half of the respondents were more than 49 years old. Fifty percent of the participants have lived in the municipality and barangay for more than 44 and 40 years, respectively. All were educated; 64.7% reached high school and elementary, 17.6% were in college or vocational level while the other two obtained graduate degrees. Seventeen participants have been involved in coastal resource management activities since 1969.

b. *Indicator Scores*

1) Resource users' participation in fisheries management process

There are no data to measure resource users' participation *before* fisheries management strategies were implemented. The study of Pomeroy et al. (1995) which is part of the 1992-93 resource and ecological assessment (REA) of San Miguel Bay, however, indicated an apparent participation by fishers and fishing organizations in fisheries management. They found that resource users' strong support for equal sharing of responsibilities for management between fishers/fishers organizations and the government is preferred. Also, the respondents in this research perceived that shared management is imperative and beneficial; with fishers assuming a much higher responsibility than the government claiming that the former are more knowledgeable of the biological and technical conditions of the bay.

The scores for this indicator *after* management implementation were gathered from the assessment done by the members of the Barangay FARMCs in each municipality using the measurement scale 0 to 10:

0	1	2	3	4	5	6	7	8	9	10
None		Sometimes			Moderate (50% of the time)		Often		Always	

The results in Table 48 show that resource users participation in the management of the bay's fisheries resources ranges from 3 to 7.

Table 48. Mean scores of the assessment on resource users' participation in the fisheries management process *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	27	4.61
Cabusao	25	3.94
Calabanga	46	5.00
Mercedes	18	4.83
Sipocot	24	3.73
Siruma	30	6.97
Tinambac	34	4.71

2) Level of awareness of resource users in resource management

There was no measurement on the level of awareness of resource users in resource management *before* the implementation of management strategies. The only awareness assessment was documented in the study of Pomeroy et al. (1995) where municipal and local government officials were interviewed to assess their awareness of environmental problems and possible solutions to fisheries management issues.

The scores for this indicator *after* management implementation were determined from the assessment of the members of the Barangay FARMCs in each municipality using the measurement scale 0 to 10:

0 1 2 3 4 5 6 7 8 9 10

None/very low   low   moderate   high   very high

The results are found in Table 49.

Table 49. Mean scores on the assessment of the level of awareness of resource users *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	25	7.04
Cabusao	23	3.78
Calabanga	46	5.17
Mercedes	22	5.55
Sipocot	23	5.96
Siruma	28	5.71
Tinambac	34	4.88

In addition, the level of awareness of the members of BFARMCs from the seven coastal municipalities was assessed through a Questionnaire. The results were percentage scores (Table 50) that were arcsine transformed for the One-Way Analysis of Variance (ANOVA). Statistical analysis using SPSS 11 shows that there is a highly significant difference in the mean percentage scores between municipalities ($\alpha = < 0.01$) (Table 51). Tukeys Honestly Significant Difference (HSD) multiple comparisons indicate that percentage scores of Basud, Calabanga and Mercedes are significantly higher than Cabusao (α=.01); Mercedes is also significantly higher than Tinambac (α=.01). Among the seven municipalities, Mercedes and Cabusao received the highest and lowest scores, respectively.

Table 50. Mean percentage scores of BFARMCs per municipality in the objective assessment of level of awareness on resource management

Municipality	Number of participants (N)	Mean Percentage Scores of BFARMCs (%)
Basud	27	72.6
Cabusao	24	56.7
Calabanga	46	70.9
Mercedes	24	76.9
Sipocot	23	69
Siruma	30	66.9
Tinambac	34	62

Table 51. One-Way ANOVA (using SPSS 11) for percentage scores among coastal municipalities of San Miguel Bay

SCORE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.667	6	.278	4.685	.000
Within Groups	11.918	201	.059		
Total	13.584	207			

Further analysis was done to determine whether the results of the assessment on the level of awareness (Table 49) and the objective assessment (Table 50) are correlated. Spearman's rho correlation analysis (SPSS 2001, Wheater and Cook 2000) shows that these two variables are significantly related for the municipalities of Calabanga, Mercedes and Sipocot (Table 52).

Table 52. Correlation analysis (Spearman rho)

Municipality	Number of participants (N)	Spearman's rho correlation coefficient	Significance level (2-tailed)
Basud	25	-0.355	0.082
Cabusao	23	0.166	0.448
Calabanga	46	0.313**	0.034
Mercedes	22	0.502**	0.017
Sipocot	23	0.531***	0.009
Siruma	27	0.077	0.702
Tinambac	34	-0.09	0.958

3) <u>Number of fishers who belong to an organization</u>

In 1992-93, a total of 73 organizations existed in the bay and out of this, 30 fisheries associations and cooperatives were active (excluding Basud) (Sunderlin and Gorospe 1997). Of the 552 fishers interviewed in 1992-93, only 115 (21%) belonged to fisheries organizations. For those fishers who were members, 73% of them found these organizations beneficial. The number of fishers who are members of an organization *before* management were implemented were obtained from (Sunderlin and Gorospe 1997) and the FSP-CD while the *after* information was drawn from the files of BFAR-DA Regional Office 5— FSP Fisheries Data as of August 1994.

Table 53. Number of fishers who are members of a fisheries organization *before* and *after* management strategies were implemented.

Municipality	Membership to fisheries organization	
	Before	*After*
Basud	26	24
Cabusao	58	56
Calabanga	113	51
Mercedes	31	28
Sipocot	41	36
Siruma	1	35
Tinambac	20	34

*FSP-CD

4) Change in the level of intra-sectoral conflicts

Intra-sectoral conflicts during the 1992-93 resource and ecological assessment of the bay were apparent and these were indicated in the study of Gorospe (1995) stating that conflicts ensued among small-scale fishers from the same barangay or other barangays as a result of illegal fishing or fishing using explosives, chemicals and fine mesh nets. Twenty six percent of the local officials interviewed then reported that conflicts transpired between small-scale fishers as the latter increased in number. Given this information, members of BFARMCs in each municipality were asked to assess the change in the degree of intra-sectoral conflicts compared to 10 years ago, *before* the implementation of fisheries management strategies. The measurement scale -10 to +10 was used in the assessment:

-10	-8	-6	-4	-2	0	2	4	6	8	+10
worst than before	increased very much		increased/ present most of the time		no change/ same level		decreased		decreased highly	no more conflicts

The number of participants who signified the level of change in the intra-sectoral conflicts as a result of the management strategies is summarized in Table 54. The municipality of Mercedes reported the highest decrease in the level of intra-sectoral conflicts compared to the other municipalities while Siruma indicated a highest increase is outlined.

Table 54. Mean scores on the change in the level of intra-sectoral conflicts *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	19	0.11
Cabusao	22	-0.18
Calabanga	46	0.78
Mercedes	19	5.47
Sipocot	22	-1.82
Siruma	28	-2.29
Tinambac	30	1.53

5) <u>Change in the level of inter-sectoral conflicts</u>

Inter-sectoral conflicts have always been a major concern in San Miguel Bay since the 1970s. In the study of Gorospe (1995), about 65% of respondents indicated a much more intensified conflict between small-scale fishers and trawlers as trawling activities became more frequent. Given this information, members of BFARMCs in each municipality were asked to assess the change in the degree of inter-sectoral conflicts compared to 10 years ago, *before* the implementation of fisheries management strategies. The measurement scale -10 to +10 was used in the assessment:

-10 -8 -6 -4 -2 0 2 4 6 8 +10

worst than before | increased very much | increased/ present most of the time | no change/ same level | decreased | decreased highly | no more conflicts

The assessment of this indicator is found in Table 55. Unlike the change in the level of intra-sectoral conflicts, Mercedes shows only a slight decrease and no other municipalities showed a decrease. The other municipalities observed that inter-sectoral conflict has increased even after fisheries management strategies were implemented and the degree of increase is greater than that reported for intra-sectoral conflicts.

Table 55. Mean scores on the change in the level of inter-sectoral conflicts after implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	19	-2.32
Cabusao	23	-4.0
Calabanga	44	-2.14
Mercedes	22	1.55
Sipocot	22	-3.91
Siruma	27	-5.56
Tinambac	33	-2.91

6) Abundance of reef fishes

Information on the abundance of reef fish indicator before management strategies were implemented was obtained or re-analyzed from the database of FSP. The species composition and abundance of reef fish communities were collected in December 1992 and May 1993 at specific sites in San Miguel Bay. Coral reefs occur mainly in the northwestern and northeastern areas of the bay (Garces et al. 1995b) thus, determination of reef fish abundance was only conducted in the municipalities of Mercedes and Siruma.

Sampling locations for Mercedes were *Apuao Grande Island, Canimo Island, Caringo Island, Canton Island, Malasugue Island, Pambuan Point, Quinapaguian Island* and *Sihan Point* while Siruma has only *Butauanan Island.* Reef fish surveys were conducted during the northeast monsoon (Dec. 20-22, 1992) and southwest monsoon (May 13-21, 1993) (Garces et al. 1995a). The total frequency of reef fish was used to measure abundance. The average frequency of 4,808 from the two sampling dates (Dec. 20-22, 1992 and May 13-21, 1993) for the municipality of Mercedes became the input *before* implementation of management strategies. Siruma, however, was sampled only once (May 13-21, 1993), with reef fish abundance of 9,558.

Data on the abundance of reef fish *after* fisheries management strategies were implemented were obtained from (Diaz et al. 1994). Sampling in Quinapaguian and Malasugue for Mercedes and Penitan for Siruma was conducted in 1994. The mean estimated count of individuals for Mercedes and Siruma are 7,287 and 7,292, respectively (Table 56). These are the inputs *after* the implementation of fisheries management.

Table 56. Estimated abundance of reef fish in Mercedes and Siruma in 1994 *(Source: Diaz et al. 1994)*

Municipality	Site	Date	No. of species	No. of families	Estimated count of individuals	Average
Mercedes	Quinapaguian AR	24-Mar-94	22	13	629	**7,287**
		4-Aug-94	46	19	20,378	
	Malasugue FS		86	16	855	
Siruma	Penitan Pre1 FS		56	9	576	**7,292**
	Penitan 001 FS		118	17	14,008	

The most recent information on the abundance of reef fish in Mercedes is found in Meñez et al. (2002); they reported that fish abundance in the coral reef areas of Mercedes is very low. This means that rehabilitation of coral reef areas have not contributed to increase fish abundance. Because the raw data on the abundance of reef fish were not presented, the values were estimated from the graphical presentation, i.e., Figure 3, of Meñez et al. (2002) (Table 57). Estimates of fish abundance in most sites in Table 57 increased from 1992 to 1993 but decreased from 1993 to 2001.

Table 57. Abundance estimates (individuals/1000 m^2) of reef fish determined from Figure 3 of Meñez et al. (2002).

Site	Year		
	1992	1993	2001
Apuao Grande	90	400	390
Canimo (SW)	450	450	350
Caringo (SW)	630	280	370
Canton (S)		460	200
Malasugue (NW)	160	350	105
Malasugue (SW)	230	260	360
Quinapaguian (NW)	180	514	305
Quinapaguian (N)			510
Average	*249*	*340*	*324*

The data that will be used for this indicator before and after implementation of fisheries management strategies are summarized in Table 58.

Table 58. Mean scores on the change in the abundance of reef fish.

Municipality	Fish abundance estimates (frequency)	
	Before	*After*
Basud	-	-
Cabusao	-	-
Calabanga	-	-
Mercedes	4,808	7,287
Sipocot	-	-
Siruma	9,558	7,292
Tinambac	-	-

7) Abundance of commercial fish catch

Over 90% of the fish caught in San Miguel Bay are sold therefore, fish catch can be classified as commercial. The most recent study conducted by Hilomen et al. (2002) reported that of the 83 species (in 20 families), 23 species are commercially important ones. And of the total fish abundance recorded, these commercially important species accounted for only 8%, appearing only once or rarely in many sites and their sizes are usually small (e.g., under 15 cm in total length). The data for this indicator were actually fish catch statistics of fishing gears in the coastal municipalities of the bay obtained from the research conducted in 1992-93 and 1995-96 (Silvestre and Cinco 1992, Soliman and Dioneda 1997). The weight in tons of commercial fish catch used to measure this indicator is summarized in Table 59. An 8.1% increased in total fish catch in San Miguel Bay was recorded from 1993 to 1996.

Table 59. Estimated total fish production *before* and *after* implementation of fisheries management strategies.

Municipality	Estimated total fish production (tons)	
	Before	*After*
Basud	461	536
Cabusao	4,592	2,107
Calabanga	3,067	4,148
Mercedes	2,474	3,693
Sipocot	857	644
Siruma	1,607	1,338
Tinambac	3,718	5,668
Total	*16,776.30*	*18,134.82*

8) Species richness of reef fish

The species richness (H) of reef fish *before* and *after* implementation of management strategies was computed from the abundance of reef fish species available from FSP database and Diaz et al. (1994), respectively. Similar to the abundance of reef fish, the information for this indicator is only available for the municipalities of Mercedes and Siruma. The species richness (H) *after* fisheries management strategies were implemented is presented in Table 60; and Table 61 summarizes the inputs for this indicator where an apparent decreasing trend in species richness is observed at two time scales.

Table 60. Species richness (H) of reef fish in Mercedes and Siruma *(Source: Diaz et al. 1994).*

Municipality	Site	Diversity H	Average H
Mercedes	Malasugue FS	1.692	**1.6920**
Siruma	Penitan Pre1 FS	1.687	**1.1445**
	Penitan 001 FS	0.602	

Table 61. Species richness of reef fish in the municipalities of Mercedes and Siruma before and after implementation of fisheries management strategies.

Municipality	Shannon Wiener Diveristy Index (H)	
	Before	*After*
Basud	-	-
Cabusao	-	-
Calabanga	-	-
Mercedes	3.5217	1.6920
Sipocot	-	-
Siruma	2.5958	1.1445
Tinambac	-	-

The latest data about this indicator found in the reports of Hilomen et al. (2002) and Meñez et al. (2002) will not be included as inputs in this research because the raw data needed to compute for the Shannon Index (H) are unavailable. They only reported that species richness of reef fish (number of species/1000 m^2) in Mercedes fell under poor to very poor categories (0-47 species/1000 m^2). Similar to the case of the abundance of reef fish where no raw data were presented, the values of species richness were estimated from the graphical presentation (Figure 4) of Meñez et al. (2002) (Table 62). This information may somehow support my estimates of species diversity, i.e., decreasing from before to after implementation of fisheries management.

Table 62. Species richness estimates (number of species/1000 m^2) of reef fish determined from Figure 4 of Meñez et al. (2002).

Site	Year		
	1992	1993	2001
Apuao Grande	21	61	35
Canimo (SW)	51	41	30
Caringo (SW)	59	36	37
Canton (S)		51	29
Malasugue (NW)	23	55	19
Malasugue (SW)	33	31	19
Quinapaguian (NW)	18	66	28
Quinapaguian (N)			41
Average	34.17	48.71	29.75

9) Extent of mangrove areas

Mangrove resource assessment in 1992 indicated that out of the 3,377 ha of mangrove areas existing in 1950s, only 1,402 ha (41.5%) remained. These are mostly concentrated in the northeast (Siruma), east, southeast (Tinambac) and northwest (Mercedes and Basud) sectors of the bay. (Vega et al. 1995). In order to rehabilitate these denuded mangrove areas, mangrove reforestation projects were undertaken. It is usually accomplished through a contract agreement with individuals, families, communities and corporations under the regular government projects administered by the Department of Environment and Natural Resources. The contract is a 3-year comprehensive contract amounting to ₱11,600/ha. (Samonte et al. 1995). In 1992, the Fisheries Sector Program-Department of Environment and Natural Resources Mangrove Project executed an agreement to four contractors to reforest over 310 ha of mangroves in Siruma, Tinambac and Calabanga (Vega et al. 1995). The accumulated areas (ha) of mangroves from the time when the first mangrove reforestation activities were implemented upto the time when the most recent data are available served as the scores for this indicator and these are presented in Table 63.

Table 63. Total areas of mangroves reforested in each coastal municipality.

Municipality	Year Implemented	Implementors	Area (ha)	Source of Information
Basud	2000	LGU, PO, MAO	20	Meñez et al. (2002)
Cabusao	1996-1999	MAO, BFARMC, Barangay councils, fisherfolks	80	Meñez et al. (2002)
Calabanga	1993, 1999	BFAR RO5, LGU, MAO, individuals	216	Samonte et al. (1995); Meñez et al. (2002)
Mercedes	1997	Prov. Govt, LGU, MAO	20	Meñez et al. (2002);
Siruma	1993		10	Samonte et al. (1995)
Tinambac	1993		100	Samonte et al. (1995)

10) Status of coral reef resources

About 3.27% of the bay's 1,152.4 km^2 total area consists of coral reef and rocky areas (Garces et al. 1995b). The status of coral reef resources in the bay was only assessed in two municipalities namely, Mercedes and Siruma, where coral reefs are situated. The percentage of living coral cover, which includes soft and hard corals, was used to assess the status of coral reef resources. The data for this indicator *before* management strategies were implemented were obtained from the 1992-93 survey of Garces et al. (1995b) and Diaz et al. (1994) and summarized in Table 64.

Table 64. Percentage live coral cover *before* implementation of management strategies.

Municipality	Sampling Sites	Percentage live coral cover
Mercedes	Apuao Grande Island	49.7
	Apuao Island	63.3
	Canimo Island	68.6
	Caringo Island	61.4
	Canton Island	55.5
	Malasugue Island	65.4
	Pambuan Point	41.2
	Quinapaguian Island	39.8
	Sihan Point	52.8
	Average	*55.3*
Siruma	Butuanan Island	63.2
	Butuanan Bay	38.4
	Penitan Fish Sanctuary	75.07
	Average	*58.89*

The data for this indicator *after* management strategies were implemented were obtained from the Diaz et al. (1994) and Hilomen et al. (2002) and summarized in Table 65. The average of percentage live coral cover in sampling sites (both for 1994 and 2001 data) was computed and used in the final evaluation. The final input for the impact evaluation is presented in Table 65.

Table 65. Percentage live coral cover *after* implementation of management strategies.

Municipality	Sampling Sites	Percentage live coral cover
Mercedes	Canimo Island	14.26
	Caringo Island	51.85
	Canton Island	51.76
	Malasugue Island	28.85
	Quinapaguian Island	47.16
	Average	*38.78*
Siruma	Penitan Fish Sanctuary	*29.74*

Table 66. Percentage live coral cover used *before* and *after* implementation of fisheries management strategies.

Municipality	Percentage live coral cover	
	Before	*After*
Basud	-	-
Cabusao	-	-
Calabanga	-	-
Mercedes	55.3	38.78
Sipocot	-	-
Siruma	58.89	29.74
Tinambac	-	-

11) Number of commercial fishing boats and banned fishing gears

Gorospe (1995) reported that the only commercial fishing boats operating in the bay are bagnets and trawls. Vakily (1982) categorized trawls into mini, small (also 'baby'), medium, and large trawls depending on their size and mode of operation. Mini trawler (locally known as *itik itik*) are the smallest among the four, with engines from 10-16 hp. The small trawler, also known as baby trawl, is <3 gross tons, having engines from 68- 160 hp (Vakily 1982). The medium and large trawls are considered commercial fishing gears and are prohibited from operating in municipal waters. Although mini- and small trawls have always been regarded as municipal fishing gears, the current law prohibiting the operation of active fishing methods in municipal waters and bays included them in the ban. Comparing this indicator before and after measures the change in the number of commercial fishing boats and fishing methods and gears banned from operating in municipal waters and bays as stipulated in Republic Act No. 8550 (also known as the Philippine Fisheries Code of 1998).

The data for this indicator *before* the implementation of management strategies were collected in 1992 and are available from the FSP database and Silvestre and Cinco

(1992) and Silvestre et al. (1994) whereas, the data *after* the implementation of management strategies were gathered in 2001 and reported in Torres Jr. et al. (2002). These *before* and *after* data are summarized in Tables 67 and 68, respectively.

Table 67. Number of commercial fishing boats in the municipalities of San Miguel Bay (1992 to 1993).

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Large	0	0	7*	0	0	0	0
Medium	0	0	26*	11	0	0	1
Small	0	25	6	9	1	0	9
Mini-trawl	0	152	47	8	11	0	42
Drift gillnet	9	99	64	302	75	15	98
Danish seine	20					4	
Bagnet							
TOTAL	*29*	*276*	*150*	*319*	*87*	*19*	*150*

*data from the Provincial Fisheries Data for the Camarines Sur and Camarines Norte, Department of Agriculture (Silvestre and Cinco 1992) were added to the initial data collection.

Table 68. Number of commercial fishing boats in the municipalities of San Miguel Bay (2001).

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Large							
Medium							
Small		65	68	12			14
Mini-trawl		229	237	18	19	14	104
Drift gillnet		3	1	42	8	27	53
Danish seine	14			6		5	
Bagnet				9			
TOTAL	*14*	*297*	*306*	*87*	*27*	*46*	*171*

12) Fisherfolk gross revenue from fishing

Fisherfolk gross revenue is defined here as the money generated by all major municipal fishing operations before deduction of expenses. From the study of Padilla et al. (1994) which recorded the average catch (kg) per trip and catch value per trip (PhP), the catch value per kilogram (PhP) was computed for each major municipal fishing gear (Table 69). In order to compare before and after data, the value of catch per gear in 1992 was converted to 1996 values by considering an inflation rate of 15% per year (from 1992 to 1996) (Table 70). Fisherfolk gross revenue per period was computed by multiplying the values (kg) in Tables 71 and 72 with the corresponding 1996 values (PhP) in Table 70. The total gross revenues from fish caught by major municipal fishing gears per municipality for 1992-93 and 1995-96 are shown in Tables 73 and 74, respectively.

Table 69. Catch value (PhP) per kilogram of fish caught by major municipal fishing gears (1992-93)

Fishing Gear Type	Average catch/trip (kg)	Catch value/trip (Peso)	Catch value per kg (Peso)
Filter net	12.53	120.5	9.62
Fish corral	15.64	322.46	20.62
Gillnet	9.82	306.84	31.25
Liftnet	30.58	355.34	11.62
Scissor net/push net	1.49	59.01	39.60

Table 70. Yearly catch value (PhP) per kilogram of fish caught by major municipal fishing gears (1992-96) (15% annual inflation rate)

	Yearly fish catch value (PhP/kg)				
	1992	1993	1994	1995	1996
Inflation factor	*1*	*1.15*	*1.32*	*1.52*	*1.75*
Filter net	9.62	11.06	12.72	14.63	16.82
Fish corral	20.62	23.71	27.27	31.36	36.06
Gillnet	31.25	35.93	41.32	47.52	54.65
Liftnet	11.62	13.36	15.37	17.67	20.32
Scissor net/push net	39.60	45.54	52.38	60.23	69.27

Table 71. Estimated fish production (kg) for the major municipal fishing gears in each municipality in 1992-93.

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		193,440	115,320	22,320		3,720	632,400
Fish corral	1,770	30,093	23,013	123,914	14,162	19,472	5,311
Gillnet	55,660	983,104	1,436,589	536,732	662,511	1,099,410	1,799,762
Liftnet	221,260	4,608	78,525	549,862		122,212	69,923
Scissor net/push net	6,720	282,240	221,760	104,160	10,080	147,840	50,400
TOTAL	285,410	1,493,486	1,875,206	1,336,988	686,753	1,392,654	2,557,796

Table 72. Estimated fish production (kg) for the major municipal fishing gears in each municipality in 1995-96.

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		76,545	65,610				710,773
Fish corral		56,184	56,184	322,123	11,237	78,658	3,746
Gillnet	205,496	497,433	1,154,636	1,547,007	357,194	975,571	2,371,200
Liftnet	3,204	254	4,856	54,208	53	107	3,950
Scissor net/push net		48,605	60,409	41,662		694	7,638
TOTAL	208,700	679,021	1,341,695	1,964,999	368,484	1,055,030	3,097,307

Table 73. Total value of fish catch (PhP) by major municipal fishing gears in each municipality *before* implementation of management strategies, adjusted to 1996 PhP.

Fishing Gear Types	TOTAL VALUE OF CATCH (PhP)						
	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		3,253,671	1,939,688	375,424		62,571	10,637,001
Fish corral	63,834	1,085,180	829,843	4,468,388	510,673	702,175	191,502
Gillnet	3,041,842	53,726,853	78,509,882	29,332,506	36,206,388	60,082,978	98,357,385
Liftnet	4,496,772	93,651	1,595,897	11,175,115		2,483,773	1,421,082
Scissor net/push net	465,479	19,550,113	15,360,803	7,214,923	698,218	10,240,535	3,491,092
TOTAL	8,067,927	77,709,467	98,236,114	52,566,355	37,415,279	73,572,032	114,098,062

Table 74. Total value of fish catch (PhP) of fish caught by major municipal fishing gears in each municipality *after* implementation of management strategies (1996).

Fishing	TOTAL VALUE OF CATCH (PhP)						
Gear Types	Basud	Cabusao	Calabang	Mercedes	Sipocot	Siruma	Tinambac
Filter net		1,287,487	1,103,561	0	0	0	11,955,241
Fish corral		2,026,025	2,026,025	11,615,876	405,205	2,836,435	135,068
Gillnet	11,230,390	27,184,809	63,101,122	84,544,270	19,520,709	53,315,174	129,586,598
Liftnet	65,125	5,157	98,683	1,101,686	1,086	2,171	80,270
Scissor net/push net		3,366,777	4,184,423	2,885,809	0	48,097	529,065
TOTAL	11,295,515	33,870,254	70,513,813	100,147,641	19,926,999	56,201,877	142,286,242

13) Assessment of fisherfolk gross revenue from fishing

Fisherfolk gross revenue from fishing was also assessed by the members of the Barangay FARMCS in each municipality using the measurement scale 0 to 10:

-10	-8	-6	-4	-2	0	2	4	6	8	+10
decreased very much	decreased		decreased slightly		no change		increased slightly		increased	increased very much

All participants perceived no improvement in the fisherfolk gross revenue even after fisheries management strategies were implemented.

Table 75. Mean scores on the assessment of fisherfolk gross revenue from fishing *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	23	-8.09
Cabusao	19	-7.05
Calabanga	44	-5.09
Mercedes	22	-5.55
Sipocot	24	-6.42
Siruma	28	-6.61
Tinambac	29	-6.0

14) Employment structure of small-scale fishers

In 1992-93, San Miguel Bay supported 4,800 fulltime and 500 part time fishers (Sunderlin 1994); a ratio of 10:1, in favor of fulltime fishers. The raw data *before* the implementation of management strategies are available from the FSP database (i.e., Dalusung 1992) summarized in Table 76. However, only the municipalities of Cabusao and Calabanga have information *after* the implementation of management strategies (Table 77). This information was obtained from DA-BFAR Regional Office 5 and the Office of the Municipal Agricultural Officer. Cabusao and Calabanga have often maintained a higher fulltime to part time ratio, and increased even after fisheries management strategies were implemented.

Table 76. Ratio of fulltime to part time fishers *before* (1992-93) implementation of fisheries management strategies

Municipality	Fulltime Fishers	Part-time Fishers	Ratio
Basud	103	150	0.69
Cabusao	2371	568	4.17
Calabanga	1153	289	3.99
Mercedes	1	10	0.10
Sipocot	132	66	2.06
Siruma	4,000	1,000	4.0
Tinambac	709	1,318	0.54

Table 77. Ratio of fulltime to part time fishers *after* implementation of fisheries management strategies

Municipality	Fulltime Fishers	Part-time Fishers	Ratio
Basud	-	-	-
Cabusao[1]	756	45	16.8
Calabanga[2]	311	89	3.49
Mercedes	-	-	-
Sipocot	-	-	-
Siruma	-	-	-
Tinambac	-	-	-

[1] Data obtained from FRMP Database Form No. 01 (Municipal Coastal Environmental Profile Form)- 1996, Department of Agriculture Regional Office 5

[2] Raw data obtained from the Office of the Municipal Agricultural Officer (2001)

15) <u>Presence of comprehensible laws and regulations related to management</u>

The management of San Miguel Bay's fisheries resources is constantly supported with local and national laws. The most important national law was the Presidential Decree No. 704 (or Fisheries Decree of 1975) which was superseded by Republic Act 8550 (or The Philippine Fisheries Code of 1998). These national laws then became the basis in passing municipal fisheries ordinances. All seven coastal municipalities of San Miguel Bay have actually passed and approved their municipal fisheries ordinances whether, in accordance with P.D. 704 or the current RA 8550. However, the question is not only whether substantial fisheries laws and regulations are present but how understandable are they to the resource users. There was no previous assessment to determine this indicator.

The scores for this indicator *after* management implementation were gathered from the assessment done by the members of the Barangay FARMCS in each municipality using the measurement scale 0 to 10:

0 1 2 3 4 5 6 7 8 9 10
Incomprehensible slightly moderately strongly very strongly
comprehensible comprehensible comprehensible comprehensible

The participants were also asked whether their municipalities have fisheries laws and regulations and if they have read any. It is surprising to learn that there were participants who indicated that despite the fact that they know of the presence of fisheries laws and regulations in their municipalities, they have not actually read them. The percentages of participants who have not read the laws and regulations with respect to fisheries management are as follows: *Basud*- 46%; *Cabusao*- 80%; *Calabanga*- 24%; *Mercedes*- 38%; *Sipocot*- 54%; *Siruma*- 33%; *Tinambac*- 47%. Those who have read them were able to assess their comprehensibility and are shown in Table 78. According to the participants the fisheries laws are slightly to moderately comprehensible.

Table 78. Mean scores on the presence of comprehensible fisheries laws and regulations *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	14	2.36
Cabusao	4	2.75
Calabanga	35	5.0
Mercedes	15	4.93
Sipocot	10	3.0
Siruma	17	5.53
Tinambac	13	3.92

16) <u>Frequency of information dissemination about the management</u>

Information dissemination has always been an integral part of projects and programs in the management of coastal resources in San Miguel Bay. Laws, livelihood programs, resource conservation, etc. are usually disseminated in the form of seminars and workshops, even *before* the implementation of management strategies. Assessment as to how regular these activities were before implementation is not available.

The scores for this indicator *after* management implementation were gathered from the assessment done by the members of the Barangay FARMCS in each municipality using the measurement scale 0 to 10:

0 1 2 3 4 5 6 7 8 9 10
Never irregular sometimes regularly Always

Information dissemination in the seven municipalities was perceived to be irregular to sometimes (Table 79). Perhaps, the only time that this particular activity takes place is when there are coastal management projects.

Table 79. Mean scores of the frequency of information dissemination *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	26	4.31
Cabusao	25	2.64
Calabanga	46	5.65
Mercedes	24	5.75
Sipocot	22	2.36
Siruma	28	3.07
Tinambac	33	2.52

17) <u>Perception on the suitability of enforcement techniques</u>

Enforcement techniques correspond to the methods applied in enforcing coastal fisheries laws such as patrol, use of markers to designate boundaries, media/press intervention, and offering of training and seminars. All of these techniques may be present in the coastal municipalities of San Miguel Bay but how appropriate are the combinations of these was assessed by the members of the Barangay FARMCS in each municipality using the measurement scale 0 to 10:

0 1 2 3 4 5 6 7 8 9 10

not applicable — slightly applicable — moderately applicable — strongly applicable — very strongly applicable

The participants in most municipalities perceived that fisheries enforcement techniques are strongly applicable (Table 80).

Table 80. Mean scores on the perception on the suitability of enforcement techniques *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	27	7.85
Cabusao	24	7.98
Calabanga	46	4.71
Mercedes	24	6.58
Sipocot	24	8.98
Siruma	30	8.03
Tinambac	33	6.70

18) Performance assessment of fisheries law enforcers

The performance of law enforcers was assessed by the members of the Barangay FARMCS in each municipality using the measurement scale 0 to 10:

0 1 2 3 4 5 6 7 8 9 10

poor — slightly effective — moderately effective — strongly effective — very strongly effective

Although some participants have been or are still members of the localized fisheries enforcement team known as *Bantay Dagat*, it is assumed that they are able to objectively assess the overall performance of the fisheries law enforcers in their respective municipalities. The participants were asked to assess the performance of fisheries law enforcers *before* and *after* management strategies were implemented. The response was separated for *before* and *after*; results presented in Table 81. The assessment is higher before than after management strategies were implemented in the municipalities of Cabusao, Calabanga and Siruma. Cabusao is the only municipality whose fisheries law enforcers perform poorly.

Table 81. Mean scores of the indicator performance assessment of law enforcers *before* and *after* implementation of management strategies

Municipality	Number of respondents (N)	Mean Score *Before*	Mean Score *After*
Basud	26	2.69	3.31
Cabusao	21	2.10	0.6
Calabanga	39	5.10	2.61
Mercedes	23	5.35	6.61
Sipocot	22	4.09	4.36
Siruma	28	6.04	5.64
Tinambac	29	3.10	3.59

19) Financial support for fisheries law enforcement

The amount of financial support for fisheries enforcement *before* and *after* implementation of fisheries management strategies was only available for some municipalities. The data before the implementation of management strategies were obtained from "The San Miguel Bay Integrated Coastal Fisheries Management Plan" (Draft Revised as of May 1994). In this report, the budget estimates to improve law enforcement capabilities in all seven coastal municipalities for 5 years (1994-98) totalled to PhP7,152,000.00 broken down as follows:

Table 82. Budget estimates for fisheries law enforcement in San Miguel Bay (1994-98).

Items	Budget (PhP)
Personal Services	1,662,000.00
Maintenance and Operating Expenses (travels, training, maintenance of patrol boats)	4,356,000.00
Equipment, vehicle, patrol boats	1,134,000.00
Total	7,152,000.00

The total value in Table 82 was divided among the seven coastal municipalities for five years. Thus, the annual budget in each municipality before the implementation of management strategies was about PhP204,343.00.

Cabusao, Calabanga, Mercedes and Tinambac are the only municipalities with information *after* management strategies were implemented. The data were obtained from the files of the Department of Agriculture Regional Office 5 and summarized in Tables 83-86. Because no data were available for the other municipalities, only the municipalities of Cabusao, Calabanga, Mercedes and Tinambac were included in both *before* and *after* implementation of management strategies.

Table 83. Annual budget (PhP) for fisheries law enforcement activities in **Cabusao** *after* implementation of management strategies. *(Source: Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Cabusao, Camarines Sur)*

Fisheries Law Enforcement Activities	Annual Budget (PhP)
Training for fisheries law enforcement team (FLET members)	54,675
Attendance to legal seminars for judges	4,800
Honoraria for Bantay-Dagat members	60,000
TOTAL	119,475

Table 84. Annual budget (PhP) for fisheries law enforcement activities in **Calabanga** *after* implementation of management strategies. *(Source: Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Calabanga, Camarines Sur)*

Fisheries Law Enforcement Activities	Annual Budget (PhP)
Training for fisheries law enforcement team (FLET members)	28,800
Attendance to legal seminars for judges	2,600
Other trainings/seminars	14,400
Honoraria for Bantay-Dagat members	320,000
TOTAL	365,800

Table 85. Annual budget (PhP) for fisheries law enforcement activities in **Mercedes** *(Source: Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Mercedes, Camarines Norte)*

Fisheries Law Enforcement Activities	Annual Budget (PhP)
Maintenance and operation of existing patrol boats	200,000
Incentive for Bantay-Dagat members	120,000
TOTAL	320,000

Table 86. Annual budget (PhP) for fisheries law enforcement activities in **Tinambac** *(Source: Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Tinambac, Camarines Sur)*

Fisheries Law Enforcement Activities	Annual Budget (PhP)
Training for fisheries law enforcement team (FLET members)	13,000
Attendance to legal seminars for judges	1,550
Maintenance and operation of existing patrol boats	32,560
Maintenance and operation of new patrol boats	146,750
Maintenance and operation of new motorcycle	19,338
Maintenance and operation of vehicle	12,000
Incentive for Bantay-Dagat members	48,000
Licensing of base radio	1,000
Licensing of handheld radio	2,100
TOTAL	276,298

Table 87. Summary of financial support for enforcement *before* and *after* implementation of management strategies.

Municipality	Budget for Fisheries Law Enforcement (PhP)	
	Before	*After*
Basud	204,343.00	-
Cabusao	204,343.00	119,475
Calabanga	204,343.00	365,800
Mercedes	204,343.00	320,000
Sipocot	204,343.00	-
Siruma	204,343.00	-
Tinambac	204,343.00	276,298

20) Assessment of the allocated financial support for enforcement

The allocated financial support for enforcement was assessed by the members of the Barangay FARMCS in each municipality using the measurement scale 0 to 10:

0	1	2	3	4	5	6	7	8	9	10
not sufficient			slightly sufficient		moderately sufficient		strongly sufficient		very strongly sufficient	

Most of the scores were very low and in the range of 'not efficient'. Among the municipalities, Mercedes received the highest assessment for the allocated financial support for enforcement (Table 88).

Table 88. Mean scores of the assessment of allocated financial support for enforcement *after* implementation of management strategies.

Municipality	Number of participants (N)	Mean Score
Basud	23	0.13
Cabusao	6	0.33
Calabanga	44	1.98
Mercedes	14	3.57
Sipocot	21	0.43
Siruma	26	1.46
Tinambac	30	0.73

21) Profit distribution among different fishing gears

This indicator measures the proportion (%) of two dominant gears in the bay, trawls and gillnets, in terms of gross profit (PhP) derived from fishing. The gross profits (PhP) of major fishing gears in each municipality *before* and *after* implementation of fisheries management strategies were computed by multiplying the 1996 fish catch value (PhP/kg) in Table 89 and total fish catch (kg) (Tables 90 and 91). (Note that for each municipality, Tables 89-91 include the data from Tables 70, 71 and 72 with the addition of the commercial fishing gears). The total gross profits for each fishing gear *before* and *after* implementation of fisheries management strategies are shown in Tables 92 and 93, respectively. The percentage contribution of each gear was computed and shown in Tables 94 and 95. The trawls and gillnets have always been the most dominant fishing gears in the bay and their percentage contribution is summarized in Table 96.

Table 89. Yearly catch value (PhP) per kilogram of fish caught by major fishing gears (1992-96) (15% annual inflation rate)

Fishing Gear Types	Yearly fish catch value (PhP/kg)				
	1992	1993	1994	1995	1996
Inflation factor	*1.0*	*1.15*	*1.32*	*1.52*	*1.75*
Filter net	9.62	11.06	12.72	14.63	16.83
Fish corral	20.62	23.71	27.27	31.36	36.06
Gillnet	31.25	35.93	41.32	47.52	54.65
Liftnet	11.62	13.36	15.37	17.67	20.32
Scissor net/push net	39.60	45.54	52.38	60.23	69.27
Large trawls	14.93	17.17	19.75	22.71	26.12
Medium trawls	31.16	35.83	41.21	47.39	54.50
Baby/small trawls	31.16	35.84	41.21	47.39	54.50
Mini trawls	14.62	16.82	19.34	22.24	25.58

Table 90. Estimated fish production (kg) for the major fishing gears in each municipality in 1992-93.

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		193,440	115,320	22,320		3,720	632,400
Fish corral	1,770	30,093	23,013	123,914	14,162	19,472	5,311
Gillnet	55,660	983,104	1,436,589	536,732	662,511	1,099,410	1,799,762
Liftnet	221,260	4,608	78,525	549,862		122,212	69,923
Scissor net/push net	6,720	282,240	221,760	104,160	10,080	147,840	50,400
Large			24,748				
Medium			230,816				76,939
Small		1,952,440	468,586	702,878	78,098		702,878
Mini-trawl		1,111,485	343,683	58,499	80,436		307,121
TOTAL	285,410	4,557,410	2,943,038	2,098,366	845,287	1,392,654	3,644,734

Table 91. Estimated fish production (kg) for the major fishing gears in each municipality in 1995-96.

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		76,545	65,610				710,773
Fish corral		56,184	56,184	322,123	11,237	78,658	3,746
Gillnet	205,496	497,433	1,154,636	1,547,007	357,194	975,571	2,371,200
Liftnet	3,204	254	4,856	54,208	53	107	3,950
Scissor net/push net		48,605	60,409	41,662		694	7,638
Large							
Medium							
Small		378,976	521,091	331,604			2,084,366
Mini-trawl		1,046,740	2,229,700	724,115	265,270	28,678	200,745
TOTAL	208,700	2,104,737	4,092,487	3,020,718	633,754	1,083,708	5,382,417

Table 92. Total value of catch (PhP) of fish caught by major fishing gears in each municipality *before* implementation of management strategies, adjusted to 1996 PhP values.

Fishing Gear Types	TOTAL VALUE OF CATCH (PhP)						
	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net	0	3,254,713	1,940,310	375,544	0	62,591	10,640,408
Fish corral	63,841	1,085,304	829,938	4,468,898	510,731	702,255	191,524
Gillnet	3,042,189	53,732,981	78,518,837	29,335,852	36,210,518	60,089,832	98,368,604
Liftnet	4,496,767	93,650	1,595,895	11,175,102	0	2,483,770	1,421,081
Scissor net/push net	465,432	19,548,125	15,359,241	7,214,189	698,147	10,239,494	3,490,737
Large trawls	0	0	646,236	0	0	0	0
Medium trawls	0	0	12,579,238	0	0	0	4,193,079
Baby/small trawls	0	106,406,095	25,537,463	38,306,194	4,256,244	0	38,306,194
Mini trawls	0	28,421,190	8,788,131	1,495,852	2,056,797	0	7,853,224
TOTAL	8,068,229	212,542,059	145,795,290	92,371,632	43,732,437	73,577,941	164,464,852

Table 93. Total value of catch (PhP) of fish caught by major fishing gears in each municipality *after* implementation of management strategies.

Fishing Gear Types	TOTAL VALUE OF CATCH (PhP)						
	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		1,287,900	1,103,914				11,959,070
Fish corral		2,026,256	2,026,256	11,617,201	405,251	2,836,758	135,084
Gillnet	11,231,671	27,187,909	63,108,320	84,553,914	19,522,935	53,321,255	129,601,379
Liftnet	65,125	5,157	98,683	1,101,685	1,086	2,171	80,270
Scissor net/push net		3,366,434	4,183,997	2,885,515		48,092	529,011
Baby/small trawls		20,653,804	28,398,981	18,072,079			113,595,924
Mini trawls		26,765,639	57,014,478	18,515,956	6,783,073	733,305	5,133,136
TOTAL	11,296,796	81,293,100	155,934,629	136,746,350	26,712,345	56,941,582	261,033,875

Table 94. Percentage contribution of major fishing gears to the total gross profits *before* the implementation of management strategies.

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		1.53	1.33	0.41	0.00	0.09	6.47
Fish corral	0.79	0.51	0.57	4.84	1.17	0.95	0.12
Gillnet	37.71	25.28	53.86	31.76	82.80	81.67	59.81
Liftnet	55.73	0.04	1.09	12.10		3.38	0.86
Scissor net/push net	5.77	9.20	10.53	7.81	1.60	13.92	2.12
Large trawls			0.44				
Medium trawls			8.63				2.55
Baby/small trawls		50.06	17.52	41.47	9.73		23.29
Mini trawls		13.37	6.03	1.62	4.70		4.78

Table 95. Percentage contribution of major fishing gears to the total gross profits *after* the implementation of management strategies.

Fishing Gear Types	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Filter net		1.58	0.71				4.58
Fish corral		2.49	1.30	8.50	1.52	4.98	0.05
Gillnet	99.42	33.44	40.47	61.83	73.09	93.64	49.65
Liftnet	0.58	0.01	0.06	0.81			0.03
Scissor net/push net		4.14	2.68	2.11		0.08	0.20
Baby/small trawls		25.41	18.21	13.22			43.52
Mini trawls		32.92	36.56	13.54	25.39	1.29	1.97

Table 96. Percentage contribution of trawls and gillnets to the total gross profits *before* and *after* the implementation of fisheries management strategies.

Municipality	Before	After
Basud	37.71	99.42
Cabusao	88.72	91.78
Calabanga	86.47	95.25
Mercedes	74.85	88.59
Sipocot	97.24	98.48
Siruma	81.67	94.93
Tinambac	90.43	95.13

22) Amount of financial support for additional livelihood implemented

Financial support for additional livelihood *before* and *after* implementation of fisheries management strategies was not recorded for all municipalities. The data before the implementation of management strategies were obtained from the report, "The San Miguel Bay Integrated Coastal Fisheries Management Plan" (Draft Revised as of May 1994). In this report, additional livelihood and budget allocation for all seven coastal municipalities are given and summarized in Table 97. Thus, the amount of PhP296,587.00 was allocated for the alternative livelihood projects in each municipality.

Table 97. Budget allocation for the additional livelihood in San Miguel Bay.

Additional Livelihood Activities	Financial support (PhP))
Swine fattening	16,828
Broiler Production	103,570
Goat fattening	970
Small-scale tomato gardening	2,713
Small-scale eggplant gardening	2,836
Small-scale pepper gardening	2,895
Mud-crab fattening	1,629
Oyster culture	6,020
Mussel culture	6,180
Fish processing	152,946
Total	296,587

Cabusao, Calabanga, Mercedes and Tinambac are the only municipalities with information *after* management strategies were implemented. The data were obtained from the files of the Department of Agriculture Regional Office 5 and summarized in Tables 98-101. Because no data were available for the other municipalities, only the municipalities of Cabusao, Calabanga, Mercedes and Tinambac were included in both *before* and *after* implementation of management strategies.

Table 98. Financial support (PhP) for livelihood programs in **Cabusao** after implementation of management strategies *(Source: Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Cabusao, Camarines Sur)*

Additional Livelihood Activities	Financial support (PhP)
Microenterprise development	417,200

Table 99. Financial support (PhP) for livelihood programs in **Calabanga** *after* implementation of management strategies.

Additional Livelihood Activities	Financial support (PhP)	Source
Promotion of microenterprise	4,800	Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Calabanga, Camarines Sur
Livelihood projects	992,218	FRMP Accomplishment report for 2001, LGU-Calabanga, Camarines Sur
TOTAL	997,018	

Table 100. Regular financial support (PhP) for livelihood programs in **Mercedes** *after* implementation of management strategies *(Source: Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Mercedes, Camarines Norte)*

Additional Livelihood Activities	Financial support (PhP)
Livelihood entrepreneurial training	20,000
Livelihood project assistance	200,000
Total	220,000

Table 101. Financial support (PhP) for livelihood programs in **Tinambac** *after* implementation of management strategies.

Additional Livelihood Activities	Financial support (PhP)
Livelihood & skills training and development[1]	124,400
Livelihood projects[2]	264,200
Total	388,600

[1]Source: Fisheries Resource Management Project LGU Work & Financial Plan, CY 2000, Tinambac, Camarines Sur

[2]Source: Highlight of accomplishments, Fishery Resource Management Project, LGU Tinambac, Camarines Sur (CY 2001)

23) Assessment of the success of additional livelihood implemented

The success of additional livelihood implemented was assessed by the members of the Barangay FARMCS in each municipality using the measurement scale 0 to 10:

0 1 2 3 4 5 6 7 8 9 10

failure; slightly successful; moderately successful; strongly successful; Very strongly successful

A higher number of participants (i.e. 15 individuals out of 19) from Cabusao responded that no additional livelihood was implemented in their municipality so only four participants contributed to this score. Those who indicated that additional livelihood is present assessed its impact shown in Table 102. Mostly observed that the livelihood projects are slightly successful.

Table 102. Mean scores of the assessment of the success of additional livelihood *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	22	4.05
Cabusao	4	3.25
Calabanga	21	3.52
Mercedes	13	2.62
Sipocot	22	3.32
Siruma	18	4.17
Tinambac	21	4.62

24) Inclusion of women in the management process

Although the role of women is recognized as crucial in the management of the bay fisheries, no assessment was done with respect to their participation in the management process. All members of the Barangay FARMCS in each municipality assessed this indicator, not just by women representatives. The measurement scale used is from 0 to 10 and is illustrated below:

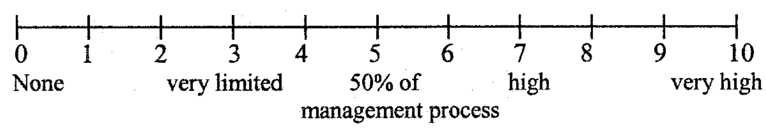


Table 103. Mean scores of the assessment of the participation of women in the management process *after* implementation of management strategies

Municipality	Number of participants (N)	Mean Score
Basud	24	5.17
Cabusao	21	4.43
Calabanga	46	3.44
Mercedes	22	4.32
Sipocot	22	5.14
Siruma	28	5.29
Tinambac	34	4.09

3. Appraisal of Management Impacts through Aggregation Process

a. Impact Evaluation Matrix: *Before and After Matrices*

So far, the important elements or dimensions of an evaluation have been discussed. The integration of these elements forms an evaluation matrix at a particular period of time. Since the multi-criteria evaluation technique being investigated here is essentially an impact evaluation method, at least two time frames were considered, i.e. *before* and *after* implementation of fisheries management strategies.

Tables 104 and 105 present the scores of the indicators *before* and *after* implementation of fisheries management strategies, respectively. A little more than half of the cells in Table 104 and a number of them in Table 105 are empty for the following reasons: (a) the method of measuring some indicators are not comparable or not as explicit as the current approach; (b) the data (for some reasons) are not purposely obtained thus, unavailable; or (c) it is not possible to measure a certain indicator because a municipality may not have the essentials of the said indicator. For example, only the municipalities of Mercedes and Siruma have information on the indicators *abundance and species diversity of reef fish* and *status of coral reef resources* because these are the only municipalities in the bay with substantial coral reef habitat. There are also indicators that don't necessarily require *before* information depending on how the survey questions were phrased. There are three indicators of this sort (i.e., *change in the level of intra-sectoral conflicts*, *change in the level of inter-sectoral conflicts,* and *assessment of fisherfolk gross revenue from fishing*) whose scores were obtained by openly asking questions that lead to impacts of fisheries management. Thus, these indicators have directly measured impacts or they can be called as *impact indicators*. This situation however, does not discount the possibility that in the future these indicators would have both *before* and *after* data.

The following ordinal indicators only have *after* information because of the way the questions were asked:

1. Resource users participation in fisheries management process
2. Level of awareness of resource users in resource management
15. Presence of comprehensible laws and regulations related to management
16. Frequency of information dissemination about the management
17. Perception on the suitability of enforcement techniques
20. Assessment of the allocated financial support for enforcement
23. Assessment of the success of additional livelihood implemented
24. Inclusion of women in the management process

Therefore, it is assumed that the score for these indicators (although not shown in Table 104) is zero—used as a benchmark or starting point being the lowest point in the measurement scale. The only ordinal indicator with *before* and *after* information is the *performance assessment of fisheries law enforcers*. The participants who scored this indicator were asked to recall then assess the performance of law enforcers at two separate time, i.e. 10 years ago (before management strategies were implemented) and now (after management strategies were implemented). Despite the missing information in some cells of Table 104, the data collected *after* the implementation of management strategies are sufficient for the final impact matrix.

Table 104. Summary of indicator scores *before* the implementation of fisheries management strategies.

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY 1. Resource users' participation in the management process	-	-	-	-	-	-	-
2. Level of awareness of resource users in resource management	-	-	-	-	-	-	-
3. Number of fishers who belong to an organization	26	58	113	31	41	1	20
4. Change in the level of intra-sectoral conflicts	-	-	-	-	-	-	-
5. Change in the level of inter-sectoral conflicts	-	-	-	-	-	-	-
BIOTIC DIVERSITY 6. Abundance of reef fishes (frequency)	-	-	-	4,808	-	9,558	-
7. Abundance of commercial fish catch (tons)	461	4,592	3,067	2,474	857	1,607	3,718
8. Species richness of reef fish (diversity H)	-	-	-	3.5217	-	1.692	-
9. Extent of mangrove areas (ha)	-	-	-	-	-	-	-
10. Status of coral reef resources (%)	-	-	-	55.3	-	58.89	-
ECONOMIC PERFORMANCE 11. Number of commercial fishing boats & banned fishing gears	29	276	150	319	87	19	150
12. Fisherfolk gross revenue from fishing (PhP)	8,067,927	77,709,467	98,236,114	52,566,355	37,415,279	73,572,032	114,098,062
13. Assessment of fisherfolk gross revenue from fishing	-	-	-	-	-	-	-
14. Employment structure of small-scale fishers (ratio)	0.69	4.17	3.99	0.10	2.00	4.00	0.54
ENFORCEABILITY 15. Presence of comprehensible laws and regulations	-	-	-	-	-	-	-

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
16. Frequency of information dissemination about the management	-	-	-	-	-	-	-
17. Perception on the suitability of enforcement techniques	-	-	-	-	-	-	-
18. Performance assessment of law enforcers	2.69	2.1	5.1	5.35	4.09	6.04	3.1
19. Financial support for enforcement	204,343	204,343	204,343	204,343	204,343	204,343	204,343
20. Assessment of the allocated financial support for enforcement	-	-	-	-	-	-	-
EQUITY 21. Profit distribution among different fishing gears (%)	37.71	88.72	86.47	74.85	97.24	81.67	90.43
22. Financial support for additional livelihood implemented	296,587	296,587	296,587	296,587	296,587	296,587	296,587
23. Assessment of the success of additional livelihood implemented	-	-	-	-	-	-	-
24. Inclusion of women in the management process	-	-	-	-	-	-	-

Table 105. Summary of indicator scores *after* the implementation of fisheries management strategies.

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY							
1. Resource users' participation in the management process	4.61	3.94	5.00	4.83	3.73	6.97	4.71
2. Level of awareness of resource users in resource management	7.04	3.78	5.17	5.55	5.96	5.71	4.88
3. Number of fishers who belong to an organization	24	56	51	28	36	35	34
4. Change in the level of intra-sectoral conflicts	0.11	-0.18	0.78	5.47	-1.82	-2.29	1.53
5. Change in the level of inter-sectoral conflicts	-2.32	-4	-2.14	1.55	-3.91	-5.56	-2.91
BIOTIC DIVERSITY							
6. Abundance of reef fishes (frequency)				7,287		7,292	
7. Abundance of commercial fish catch (tons)	536	2,107	4,148	3,693	644	1,338	5,668
8. Species richness of reef fish (diversity H)				2.5958		1.1445	
9. Extent of mangrove areas (ha)	20	80	216	20		10	100
10. Status of coral reef resources (%)				38.78		29.74	
ECONOMIC PERFORMANCE							
11. Number of commercial fishing boats & banned fishing gears	14	297	306	87	27	46	171
12. Fisherfolk gross revenue from fishing (PhP)	11,295,515	33,870,254	70,513,813	100,147,641	19,926,999	56,201,877	142,286,242
13. Assessment of fisherfolk gross revenue from fishing	-8.09	-7.05	-5.09	-5.55	-6.42	-6.61	-6.00
14. Employment structure of small-scale fishers (ratio)	-	16.8	3.49	-	-	-	-
ENFORCEABILITY							
15. Presence of comprehensible laws and regulations	2.36	2.75	5	4.93	3	5.53	3.92
16. Frequency of information dissemination about the management	4.31	2.64	5.65	5.75	2.36	3.07	2.52
17. Perception on the suitability of enforcement techniques	7.85	7.98	4.71	6.58	8.98	8.03	6.7

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
18. Performance assessment of law enforcers	3.31	0.6	2.61	6.61	4.36	5.64	3.59
19. Financial support for enforcement		119,475	365,800	320,000			276,298
20. Assessment of the allocated financial support for enforcement	0.13	0.33	1.98	3.57	0.43	1.46	0.73
EQUITY 21. Profit distribution among different fishing gears (%)	99.42	91.78	95.25	88.59	98.48	94.93	95.13
22. Financial support for additional livelihood implemented		417,200	997,018	220,000			388,600
23. Assessment of the success of additional livelihood implemented	4.05	3.25	3.52	2.62	3.32	4.17	4.62
24. Inclusion of women in the management process	5.17	4.43	3.44	4.32	5.14	5.29	4.09

Although impact may be defined simply as the observed change or difference of an indicator after an activity was in place, deriving the said change or difference is more complicated than the mathematical expression: [$X_c = T_2 - T_1$ where, X_c= change; T_1= before; T_2= after]. The level or kind of measurement used for a particular indicator must be considered. Here, change is computed in several ways- it can be a difference, ratio or percentage. And how the values in Table 104 were derived is discussed for each indicator:

1) _Resource users' participation in fisheries management process_- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

2) *Level of awareness of resource users in resource management*- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

3) *Number of fishers who belong to an organization*- the impact scores are the change in the number of fishers per organization computed as the ratio of the number of fishers after to before management strategies were implemented (or after value divided by before value). A score of 1.0 indicates that there is no change; less than 1.0 score is a negative change while more than 1.0 is a positive change which means that the number of fishers have increased.

4) *Change in the level of intra-sectoral conflicts*- this indicator is already an evaluation of change therefore, the maximum and minimum change would be +10 and –10.

5) *Change in the level of inter-sectoral conflicts*- this indicator is already an evaluation of change therefore, the maximum and minimum change would be +10 and –10, respectively.

6) *Abundance of reef fish*- the impact scores are percentage change computed by subtracting the frequencies of reef fish before from after then taking the percentage. A positive percentage change indicates an increase in the abundance of reef fish while a negative one is a decrease.

7) *Abundance of commercial fish catch*- the impact scores are percentage change computed by subtracting the weight (tons) before from after then taking the percentage. A positive percentage change indicates an increase in the abundance of commercial fish catch while a negative percentage is a decrease.

8) *Species richness of reef fish* - the impact scores are percentage change computed by subtracting the diversity H before from after then taking the percentage. A positive percentage change indicates an increase in the species richness of reef fish while a negative percentage is a decrease.

9) *Extent of mangrove areas*- the impact scores are the total areas (ha) of mangroves reforested from the time management strategies were implemented up to the time the most recent data are available.

10) *Status of coral reef resources*- the impact scores are percentage change computed by simply subtracting the percentage live coral before from after. For this indicator, the maximum and minimum change would be +100% and –100%, respectively.

11) *Number of commercial fishing boats and banned fishing gears*- this is a cost indicator. The impact scores are percentage change computed by subtracting the number of commercial fishing boats and banned fishing gears before from after then taking the percentage. A positive percentage change indicates an increased change in the number of commercial fishing boats and banned fishing gears; a negative percentage is a decrease which indicates a better condition in the fisheries as a result of management.

12) *Fisherfolk gross revenue from fishing*- the impact scores are percentage change computed by subtracting the estimated gross revenue from fishing before from after then taking the percentage. A positive percentage change indicates an increase in the gross revenue from fishing while a negative percentage is a decrease.

13) *Assessment of fisherfolk gross revenue from fishing-* this indicator is already a measure of change thus, the maximum and minimum values would be +10 and –10, respectively.

14) *Employment structure of small-scale fishers*- this is a cost indicator computed as the change in the ratio of fulltime to part time fishers (before ratio divided by after ratio). A ratio lower than 1.0 is preferred because it means that there are less fulltime than part time fishers. The minimum change is 0 while the maximum is infinite.

15) *Presence of comprehensible laws and regulations related to management*- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

16) *Frequency of information dissemination about the management*- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

17) *Perception on the suitability of enforcement techniques*- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

18) *Performance assessment of fisheries law enforcers*- the impact scores are computed by subtracting before from after. The maximum and minimum change would be +10 and –10, respectively.

19) *Financial support for fisheries law enforcement*- the impact scores are percentage change computed by subtracting the amount of financial support for fisheries law enforcement before from after then taking the percentage. A positive percentage change indicates an increased monetary support for fisheries enforcement while a negative percentage is a decrease.

20) *Assessment of the allocated financial support for enforcement*- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

21) *Profit distribution among different fishing gears*- the values are percentage change computed by simply subtracting the percentage contribution of trawls and gillnets to the total gross profits before from after. For this indicator, the maximum and minimum change would be +100% and –100%, respectively. A percentage change below 0% indicates that total gross profits of trawls and

gillnets decreased. This is a cost indicator such that the lower the value, the more preferred.

22) *Amount of financial support for additional livelihood implemented* - the impact scores are percentage change computed by subtracting the amount of financial support for additional livelihood before from after then taking the percentage. A positive percentage change indicates an increased monetary support for additional livelihood while a negative percentage is a decrease.

23) *Assessment of the success of additional livelihood implemented*- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

24) *Inclusion of women in the management process*- the impact scores are computed by subtracting zero (assuming that before score is zero) from the scores after fisheries management strategies were implemented. For this indicator, the maximum and minimum change would be +10 and –10, respectively.

Table 106. Impact matrix (indicator change).

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY							
1. Resource users' participation in the management process	4.61	3.94	5	4.83	3.73	6.97	4.71
2. Level of awareness of resource users in resource management	7.04	3.78	5.17	5.55	5.96	5.71	4.88
3. Number of fishers who belong to an organization	0.92	0.97	0.45	0.90	0.88	35.00	1.70
4. Change in the level of intra-sectoral conflicts	0.11	-0.18	0.78	5.47	-1.82	-2.29	1.53
5. Change in the level of inter-sectoral conflicts	-2.32	-4	-2.14	1.55	-3.91	-5.56	-2.91
BIOTIC DIVERSITY							
6. Abundance of reef fish (%)				51.56		-23.71	
7. Abundance of commercial fish catch (%)	16.27	-54.12	35.25	49.27	-24.85	-16.74	52.45
8. Species richness of reef fish (%)				-26.29		-32.36	
9. Extent of mangrove areas (ha)	20	80	216	20	0	10	100
10. Status of coral reef resources (%)				-16.52		-29.15	
ECONOMIC PERFORMANCE							
11. Number of commercial fishing boats & banned fishing gears (%)	-51.72	7.61	104.00	-72.73	-68.97	142.11	14.00
12. Fisherfolk gross revenue from fishing (%)	40.01	-56.41	-28.22	90.52	-46.74	-23.61	24.71
13. Assessment of fisherfolk gross revenue from fishing	-8.09	-7.05	-5.09	-5.55	-6.42	-6.61	-6
14. Employment structure of small-scale fishers (ratio)		4.02	0.87				
ENFORCEABILITY							
15. Presence of comprehensible laws and regulations	2.36	2.75	5	4.93	3	5.53	3.92
16. Frequency of information dissemination about the management	4.31	2.64	5.65	5.75	2.36	3.07	2.52
17. Perception on the suitability of enforcement techniques	7.85	7.98	4.71	6.58	8.98	8.03	6.7
18. Performance assessment	0.62	-1.5	-2.49	1.26	0.27	-0.4	0.49

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
of law enforcers							
19. Financial support for enforcement (%)		-41.53	79.01	56.60			35.21
20. Assessment of the allocated financial support for enforcement	0.13	0.33	1.98	3.57	0.43	1.46	0.73
EQUITY 21. Profit distribution among different fishing gears (%)	61.71	3.06	8.78	13.74	1.24	13.26	4.7
22. Financial support for additional livelihood implemented (%)		40.67	236.16	-25.82			31.02
23. Assessment of the success of additional livelihood implemented	4.05	3.25	3.52	2.62	3.32	4.17	4.62
24. Inclusion of women in the management process	5.17	4.43	3.44	4.32	5.14	5.29	4.09

b. Relevance of the Aggregation Methods

In the paper of Eigenraam (2000), it was felt that aggregation of indicators to parameter level was too simplistic and cautioned the danger of combining indicators into a single index of a system and basing the decisions on that single measure. While his point may be valid, sometimes aggregation of indicators is essential or unavoidable in impact evaluation. The difficulties and challenges in aggregating the indicators are discussed in the succeeding sections.

The following aggregation methods were used to determine the impacts of fisheries management strategies in the coastal municipalities of San Miguel Bay.

1) Concordance Analysis (also known as ELECTRE method)-

Concordance analysis makes use of an outranking principle. This method consists of a pairwise comparison of municipalities based on the degree in which the evaluation of the municipalities and preference weights confirm or contradict the pairwise dominance relationships between municipalities. It examines both the degree wherein preference weights are in agreement with pairwise dominance relationships and the degree in which the weighted evaluation differ from each other. The pairwise comparison of the municipalities is done through the use of scores that form the impact matrix. One assumption in the application of this method is that it assumes that the scores and weights are cardinals. Thus, in applying Concordance Analysis in this research, ordinal indicator scores were cardinalized. The procedure in the application of Concordance Analysis in this research is illustrated in Figure 11. The mechanics of the method found in Hwang and Yoon (1981) and Voogd (1983) are discussed here.

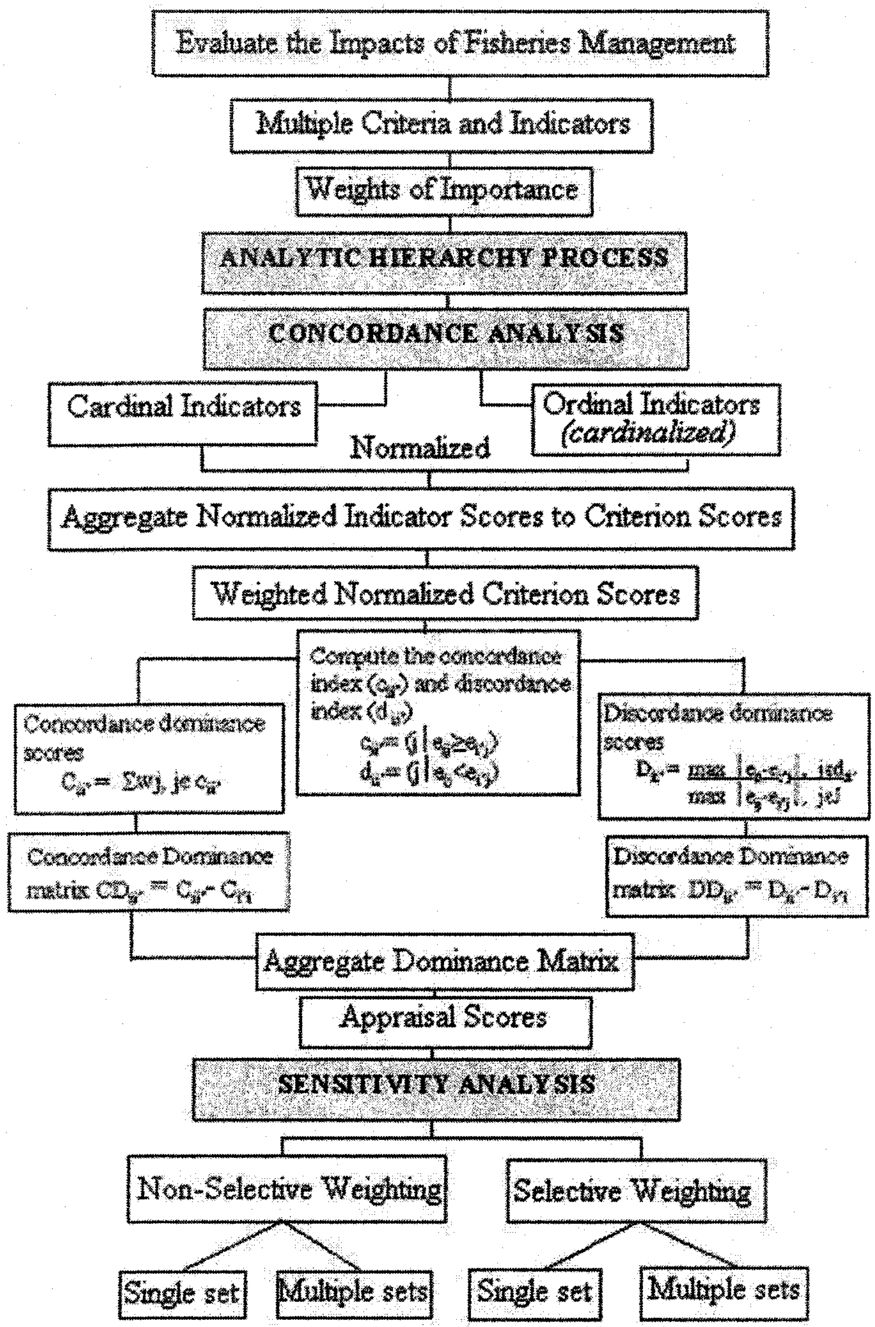


Figure 11. Procedure in the application of Concordance Analysis to fisheries management

i. Normalizing the units of measures

The scores of the impact matrix in Table 106 are not comparable because they were measured in different scales and units. This calls for normalization that transforms the indicators into comparable scales since they are all measured in dimensionless units. This means that inter-indicator comparison is then possible. In this research, the linear scale transformation was applied so that the relative order of magnitude of the outcome remains equal; since the indicators can be grouped as benefit or cost indicators, linear transformation uses two equations (Hwang and Yoon 1981):

$$e_{ij} = (x_{ij} - x_j^{min})/(x_j^{max} - x_j^{min}) \text{ , for } \textit{benefit} \text{ criterion or,}$$

$$e_{ij} = (x_j^{max} - x_{ij})/ (x_j^{max} - x_j^{min}) \text{, for } \textit{cost} \text{ criterion}$$

where, e_{ij} = normalized score

x_{ij} = indicator score

x_j^{max} = maximum indicator score

x_j^{min} = minimum indicator score

The scale of measurement using the above transformation varies from 0 to 1; the worst outcome of an indicator implies $e_{ij} = 0$ while the best outcome implies $e_{ij} = 1$ (Hwang and Yoon 1981). All indicators are benefit indicators except for the *number of commercial fishing boats and banned fishing gears; employment structure of small-scale fishers;* and *profit distribution among different fishing gears* which are considered cost indicators. Table 107 becomes the transformed final evaluation matrix.

The linear scale transformation considers maximum and minimum values and these values can be determined in two ways: *a)* specify the possible maximum and minimum values of the indicators (values are constant); and *b)* use the highest and lowest values from among the seven coastal municipalities being compared (values are variable). Both ways were utilized for this research. The 12 ordinal indicators that were assessed by the representatives of resource users specified the maximum and minimum values as +10 and –10, respectively. As for the cardinal indicators, the maximum and minimum values vary per indicators and would depend on the municipalities. The normalized values of the indicators ranged between 0 and 1.0. A particular management strategy (represented by a municipalitiy) is said to perform better with respect to a given indicator when its normalized value is highest or equal to 1.0. The effect of these maximum and minimum values on the rankings of the municipalities when the weights of the indicators were taken into account is discussed in the succeeding sections.

Table 107. Normalized impact evaluation matrix.

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY 1. Resource users' participation in the management process	0.73	0.70	0.75	0.74	0.69	0.85	0.74
2. Level of awareness of resource users in resource management	0.85	0.69	0.76	0.78	0.80	0.79	0.74
3. Number of fishers who belong to an organization	0.01	0.01	0.00	0.01	0.01	1.00	0.04
4. Change in the level of intra-sectoral conflicts	0.51	0.49	0.54	0.77	0.41	0.39	0.58
5. Change in the level of inter-sectoral conflicts	0.38	0.30	0.39	0.58	0.30	0.22	0.35
BIOTIC DIVERSITY 6. Abundance of reef fish				1.00		0.00	
7. Abundance of commercial fish catch	0.58	0.23	0.68	0.75	0.38	0.42	0.76
8. Species richness of reef fish				1.00		0.00	
9. Extent of mangrove areas	0.07	0.27	0.72	0.07		0.03	0.33
10. Status of coral reef resources				0.42		0.35	
ECONOMIC PERFORMANCE 11. Number of commercial fishing boats & banned fishing gears	0.90	0.63	0.18	1.00	0.98	0.00	0.60
12. Fisherfolk gross revenue from fishing	0.70	0.22	0.36	0.95	0.27	0.38	0.62
13. Assessment of fisherfolk gross revenue from fishing	0.10	0.15	0.25	0.22	0.18	0.17	0.20
14. Employment structure of small-scale fishers		0.00	1.00				

INDICATORS	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ENFORCEABILITY 15. Presence of comprehensible laws and regulations	0.62	0.64	0.75	0.75	0.65	0.78	0.70
16. Frequency of information dissemination about the management	0.72	0.63	0.78	0.79	0.62	0.65	0.63
17. Perception on the suitability of enforcement techniques	0.89	0.90	0.74	0.83	0.95	0.90	0.84
18. Performance assessment of law enforcers	0.53	0.43	0.38	0.56	0.51	0.48	0.52
19. Financial support for enforcement		0.29	0.90	0.78			0.64
20. Assessment of the allocated financial support for enforcement	0.51	0.52	0.60	0.68	0.52	0.57	0.54
EQUITY 21. Profit distribution among different fishing gears	0.00	0.97	0.88	0.79	1.00	0.80	0.94
22. Financial support for additional livelihood implemented		0.70	1.00	0.00			0.22
23. Assessment of the success of additional livelihood implemented	0.70	0.66	0.68	0.63	0.67	0.71	0.73
24. Inclusion of women in the management process	0.76	0.72	0.67	0.72	0.76	0.76	0.70

In using the concordance analysis, I decided to aggregate the scores of the normalized indicators in Table 107 by taking the average scores of the indicators in each criterion. The average scores then became the normalized criterion scores shown in Table 108.

Table 108. Normalized criterion scores.

CRITERIA	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY	0.50	0.44	0.49	0.58	0.44	0.65	0.49
BIOTIC DIVERSITY	0.32	0.25	0.70	0.65	0.38	0.16	0.55
ECONOMIC PERFORMANCE	0.57	0.25	0.45	0.73	0.48	0.18	0.47
ENFORCEABILITY	0.65	0.57	0.69	0.73	0.65	0.68	0.64
EQUITY	0.49	0.76	0.81	0.54	0.81	0.76	0.65

ii. Calculation of the weighted normalized matrix

In the section on choice of weights for criteria and indicators, I presented two ways of deriving the final weighting of the criteria and indicators. These two ways are referred to as *non-selective* and *selective* weightings. The *non-selective* weighting considers all groups of evaluators in each municipality (Table 35); the average weighting per criterion or indicator is used in the final process. The *selective* weighting does not include all groups of evaluators in each municipality (Table 43). Instead, the consistency ratios in the application of the AHP method and non-metric Multidimensional Scaling technique were used in the choice of weights. The weighted normalized criterion scores for the *non-selective* and *selective weightings* are shown in Tables 109 and 110, respectively.

Table 109. Weighted normalized criterion scores for *non-selective weighting*.

CRITERIA	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY	0.1491	0.0263	0.0976	0.1139	0.1857	0.1426	0.1077
BIOTIC DIVERSITY	0.0616	0.1191	0.1396	0.1211	0.0639	0.0209	0.0657
ECONOMIC PERFORMANCE	0.1075	0.0421	0.0958	0.1595	0.0571	0.0478	0.1278
ENFORCEABILITY	0.0979	0.0567	0.1379	0.1444	0.1106	0.1320	0.0899
EQUITY	0.0925	0.1452	0.1531	0.1057	0.0969	0.1440	0.1622

Table 110. Weighted normalized criterion scores for *selective weighting.*

CRITERIA	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY	0.1433	0.0367	0.1494	0.1145	0.1056	0.1430	0.0931
BIOTIC DIVERSITY	0.0614	0.0799	0.1168	0.1222	0.0570	0.0181	0.0990
ECONOMIC PERFORMANCE	0.0945	0.0472	0.0740	0.1604	0.0832	0.0426	0.1105
ENFORCEABILITY	0.0789	0.1192	0.1147	0.1441	0.0997	0.1541	0.1088
EQUITY	0.1164	0.1513	0.1600	0.1066	0.2322	0.1520	0.1463

*iii. Determination of the **concordance** and **discordance** sets*

Concordance analysis quantifies differences in the impacts of the management strategies by comparing the municipalities in a pairwise manner. The degree by which a municipality dominates the other municipality in terms of weights of importance is reflected by a concordance measure while the degree by which a municipality dominates the other municipality in terms of its associated criterion scores is reflected by a discordance measure. Pairwise comparison of municipalities is done by grouping the criteria into two sets namely, concordance and discordance sets. The *concordance set* is composed of all indicators for which municipality *I* is said to perform better than or equal to municipality *I'*; whereas, the *discordance set* is complementary to the concordance set. To determine the relative values of the concordance and discordance sets, concordance and discordance indices are computed for both. A *concordance index* denoted as $c_{ii'} = (j|e_{ij} \geq e_{i'j})$, is equal to the total weights associated with the indicators in the concordance set and the index is recorded in a concordance matrix. A higher value of concordance index reflects the relative dominance of a certain municipality over another with respect to management impacts. Conversely, the *discordance index* denoted as $d_{ii'} = (j|e_{ij} < x_{i'j})$, looks at how much worse are the evaluations of, for example, municipality *I* compared to *I'*. A higher value of discordance index means that the impacts of fisheries management are lesser than the other while a lower value is the opposite.

Since the weights of importance of the criteria vary per municipality, sensitivity of the method to changes in the weighting was determined. Two sets of weights were used for *non-selective* and *selective weightings* namely, 'single set' and 'multiple sets'. The *single set* would simply take the average weights of a criterion or indicator for all municipalities. Thus, only one set of weights is considered in computing the *concordance index*. Whereas, *multiple sets* consists of a number of sets of weightings derived by taking the average weights of a criterion or indicator of the municipalities being compared. The total sets of weights are determined using the equation: [Z (Z-1)]/2 where, Z is the number of municipalities. The *single set* and *multiple sets* are determined for both *non-selective* and *selective weightings*.

1. *Non-selective weighting*- the single set and multiple sets are shown in Tables 111 and 112, respectively. Using the single set and multiple sets of weights, the concordance indeces for non-selective weighting were computed and summarized in Tables 113 and 114. The discordance matrix is composed of weighted normalized criterion scores and therefore, remains unchanged for both sets of weights. This means that there is only one discordance matrix whether single set or multiple sets of weights were used. The discordance matrix for non-selective weighting is presented in Table 115.

Table 111. Average weights for single set of non-selective weighting.

CRITERIA	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Average
ACCEPTABILITY	0.29	0.08	0.30	0.20	0.24	0.22	0.19	0.22
BIOTIC DIVERSITY	0.19	0.32	0.17	0.19	0.15	0.11	0.18	0.19
ECONOMIC PERFORMANCE	0.17	0.19	0.16	0.22	0.17	0.24	0.24	0.20
ENFORCEABILITY	0.12	0.21	0.17	0.20	0.15	0.23	0.17	0.18
EQUITY	0.24	0.20	0.20	0.20	0.29	0.20	0.23	0.22

Table 112. Average weights for multiple sets of non-selective weighting.

MUNICIPALITIES BEING COMPARED	ACCEPTABILITY	BIOTIC DIVERSITY	ECONOMIC PERFORMANCE	ENFORCEABILITY	EQUITY
Basud-Cabusao	0.19	0.25	0.18	0.16	0.22
Basud-Calabanga	0.30	0.18	0.17	0.14	0.22
Basud-Mercedes	0.24	0.19	0.19	0.16	0.22
Basud-Sipocot	0.27	0.17	0.17	0.14	0.26
Basud-Siruma	0.26	0.15	0.20	0.17	0.22
Basud-Tinambac	0.24	0.19	0.20	0.15	0.23
Cabusao-Calabanga	0.19	0.24	0.18	0.19	0.20
Cabusao-Mercedes	0.14	0.25	0.20	0.20	0.20
Cabusao-Sipocot	0.16	0.23	0.18	0.18	0.24
Cabusao-Siruma	0.15	0.22	0.21	0.22	0.20
Cabusao-Tinambac	0.14	0.25	0.21	0.19	0.21
Calabanga-Mercedes	0.25	0.18	0.19	0.18	0.20
Calabanga-Sipocot	0.27	0.16	0.17	0.16	0.24
Calabanga-Siruma	0.26	0.14	0.20	0.20	0.20
Calabanga-Tinambac	0.25	0.17	0.20	0.17	0.21
Mercedes-Sipocot	0.20	0.19	0.22	0.20	0.20
Mercedes-Siruma	0.22	0.17	0.20	0.18	0.24
Mercedes-Tinambac	0.21	0.15	0.23	0.21	0.20
Sipocot-Siruma	0.23	0.13	0.21	0.19	0.24
Sipocot-Tinambac	0.22	0.17	0.20	0.16	0.26
Siruma-Tinambac	0.21	0.15	0.24	0.20	0.21

Table 113. Concordance matrix for single set of non-selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Basud	-	0.42	0.42	0.44	0.60	0.60	0.22
Cabusao	0.59	-	0.18	0.22	0.36	0.61	0.40
Calabanga	0.59	0.82	-	0.63	0.58	0.82	0.80
Mercedes	0.56	0.78	0.38	-	0.78	0.39	0.78
Sipocot	0.40	0.64	0.42	0.22	-	0.61	0.44
Siruma	0.40	0.40	0.18	0.62	0.40	-	0.62
Tinambac	0.78	0.60	0.20	0.22	0.56	0.39	-

Table 114. Concordance matrix for multiple sets of non-selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Basud	-	0.37	0.46	0.46	0.61	0.61	0.24
Cabusao	0.64	-	0.19	0.20	0.42	0.63	0.40
Calabanga	0.54	0.81	-	0.63	0.59	0.80	0.80
Mercedes	0.54	0.80	0.37	-	0.80	0.37	0.80
Sipocot	0.40	0.59	0.41	0.20	-	0.58	0.47
Siruma	0.39	0.37	0.20	0.64	0.42	-	0.62
Tinambac	0.77	0.60	0.20	0.20	0.53	0.38	-

Table 115. Discordance matrix for both single set and multiple sets of non-selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Basud	-	0.37	1.00	1.00	1.00	1.00	0.72
Cabusao	1.00	-	1.00	1.00	1.00	1.00	1.00
Calabanga	0.42	0.04	-	1.00	1.00	0.39	0.68
Mercedes	0.46	0.41	0.62	-	1.00	0.40	0.84
Sipocot	0.33	0.29	0.83	0.61	-	0.67	0.49
Siruma	0.70	0.58	1.00	1.00	1.00	-	1.00
Tinambac	1.00	0.15	1.00	1.00	1.00	0.62	-

2. *Selective weighting*- the single set and multiple sets are shown in Tables 116 and 117, respectively. Using the single set and multiple sets of weights, the concordance indeces for selective weighting were computed and summarized in Table 118 and 119. Similar to the non-selective weighting, the discordance matrix in selective weighting is the same for both single set and multiple sets of weights (Table 120).

Table 116. Average weights for single set of selective weighting.

CRITERIA	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	*Average*
ACCEPTABILITY	0.3	0.06	0.20	0.20	0.42	0.22	0.22	*0.23*
BIOTIC DIVERSITY	0.19	0.48	0.20	0.19	0.17	0.13	0.12	*0.21*
ECONOMIC PERFORMANCE	0.19	0.17	0.22	0.22	0.12	0.26	0.27	*0.21*
ENFORCEABILITY	0.15	0.1	0.20	0.20	0.17	0.20	0.14	*0.16*
EQUITY	0.19	0.19	0.19	0.20	0.12	0.19	0.25	*0.19*

Table 117. Average weights for multiple sets of selective weighting.

MUNICIPALITIES BEING COMPARED	ACCEPTABILITY	BIOTIC DIVERSITY	ECONOMIC PERFORMANCE	ENFORCEABILITY	EQUITY
Basud-Cabusao	0.18	0.34	0.18	0.13	0.19
Basud-Calabanga	0.19	0.29	0.19	0.15	0.19
Basud-Mercedes	0.19	0.26	0.20	0.16	0.19
Basud-Sipocot	0.24	0.25	0.18	0.16	0.18
Basud-Siruma	0.23	0.23	0.20	0.17	0.18
Basud-Tinambac	0.23	0.21	0.21	0.16	0.19
Cabusao-Calabanga	0.13	0.34	0.19	0.15	0.19
Cabusao-Mercedes	0.15	0.29	0.20	0.17	0.19
Cabusao-Sipocot	0.22	0.26	0.18	0.17	0.17
Cabusao-Siruma	0.22	0.23	0.20	0.17	0.18
Cabusao-Tinambac	0.22	0.21	0.21	0.17	0.19
Calabanga-Mercedes	0.20	0.19	0.22	0.20	0.19
Calabanga-Sipocot	0.27	0.19	0.19	0.19	0.17
Calabanga-Siruma	0.26	0.17	0.20	0.19	0.17
Calabanga-Tinambac	0.25	0.16	0.22	0.18	0.19
Mercedes-Sipocot	0.31	0.18	0.17	0.18	0.16
Mercedes-Siruma	0.28	0.16	0.20	0.19	0.17

MUNICIPALITIES BEING COMPARED	ACCEPTABILITY	BIOTIC DIVERSITY	ECONOMIC PERFORMANCE	ENFORCEABILITY	EQUITY
Mercedes-Tinambac	0.26	0.15	0.22	0.18	0.19
Sipocot-Siruma	0.32	0.15	0.19	0.18	0.16
Sipocot-Tinambac	0.29	0.14	0.22	0.17	0.19
Siruma-Tinambac	0.22	0.13	0.27	0.17	0.22

Table 118. Concordance matrix for single set of selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Basud	-	0.60	0.44	0.23	0.61	0.65	0.61
Cabusao	0.40	-	0.00	0.40	0.40	0.40	0.21
Calabanga	0.57	1.00	-	0.40	0.77	0.79	0.35
Mercedes	0.77	0.60	0.60	-	0.79	0.56	0.77
Sipocot	0.39	0.60	0.23	0.21	-	0.61	0.57
Siruma	0.35	0.60	0.21	0.44	0.39	-	0.38
Tinambac	0.40	0.79	0.65	0.23	0.44	0.63	-

Table 119. Concordance matrix for multiple sets of selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Basud	-	0.49	0.38	0.19	0.61	0.66	0.61
Cabusao	0.53	-	0.00	0.48	0.43	0.61	0.21
Calabanga	0.63	1.00	-	0.38	0.73	0.74	0.34
Mercedes	0.82	0.52	0.62	-	0.69	0.55	0.81
Sipocot	0.40	0.57	0.27	0.31	-	0.66	0.60
Siruma	0.35	0.39	0.26	0.45	0.34	-	0.39
Tinambac	0.40	0.79	0.66	0.19	0.40	0.61	-

Table 120. Discordance matrix for both single set and multiple sets of selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
Basud	-	0.47	1.00	1.00	0.72	0.86	1.00
Cabusao	1.00	-	1.00	1.00	1.00	1.00	1.00
Calabanga	0.66	0.00	-	1.00	1.00	0.38	0.43
Mercedes	0.59	0.34	0.74	-	0.70	0.34	1.00
Sipocot	1.00	0.35	0.86	1.00	-	1.00	0.91
Siruma	1.00	0.84	1.00	1.00	0.91	-	1.00
Tinambac	0.60	0.62	1.00	0.98	1.00	0.53	-

iv. Determination of the aggregate dominance matrix-

To determine which fisheries management strategies from among the seven coastal municipalities have shown a higher impact compared to the others, the dominance scores were derived from the concordance and discordance matrices. The concordance dominance score (***$C_{ii'}$***) and discordance dominance score (***$D_{ii'}$***) are computed for each municipality using the following equations:

$$C_{ii'} = \Sigma\, C_{ii'} - \Sigma\, C_{i'i}$$

$$D_{ii'} = \Sigma\, D_{ii'} - \Sigma\, D_{i'i}$$

The concordance dominance scores and discordance dominance scores for single set and multiple sets of *non-selective* and *selective weightings* are presented in Tables 121 to 126.

Table 121. Concordance dominance scores for single set of non-selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Total Row (R) ($\Sigma C_{ii'}$)	Difference (R-C) ($\Sigma C_{ii'} - \Sigma C_{i'i}$)
Basud	-	0.42	0.42	0.44	0.60	0.60	0.22	*2.70*	-0.62
Cabusao	0.59	-	0.18	0.22	0.36	0.61	0.40	*2.36*	-1.30
Calabanga	0.59	0.82	-	0.63	0.58	0.82	0.80	*4.24*	2.46
Mercedes	0.56	0.78	0.38	-	0.78	0.39	0.78	*3.67*	1.32
Sipocot	0.40	0.64	0.42	0.22	-	0.61	0.44	*2.73*	-0.55
Siruma	0.40	0.40	0.18	0.62	0.40	-	0.62	*2.62*	-0.80
Tinambac	0.78	0.60	0.20	0.22	0.56	0.39	-	*2.75*	-0.51
Total Column ($\Sigma C_{i'i}$)	*3.32*	*3.66*	*1.78*	*2.35*	*3.28*	*3.42*	*3.26*		

Table 122. Concordance dominance scores for multiple sets of non-selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Total Row (R) ($\Sigma C_{ii'}$)	Difference (R-C) ($\Sigma C_{ii'} - \Sigma C_{i'i}$)
Basud	-	0.37	0.46	0.46	0.61	0.61	0.24	*2.75*	-0.53
Cabusao	0.64	-	0.19	0.20	0.42	0.63	0.40	*2.48*	-1.06
Calabanga	0.54	0.81	-	0.63	0.59	0.80	0.80	*4.17*	2.34
Mercedes	0.54	0.80	0.37	-	0.80	0.37	0.80	*3.68*	1.35
Sipocot	0.40	0.59	0.41	0.20	-	0.58	0.47	*2.65*	-0.72
Siruma	0.39	0.37	0.20	0.64	0.42	-	0.62	*2.64*	-0.73
Tinambac	0.77	0.60	0.20	0.20	0.53	0.38	-	*2.68*	-0.65
Total Column ($\Sigma C_{i'i}$)	*3.28*	*3.54*	*1.83*	*2.33*	*3.37*	*3.37*	*3.33*		

Table 123. Discordance dominance scores of non-selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Total Row (R) ($\Sigma C_{ii'}$)	Difference (R-C) ($\Sigma C_{ii'} - \Sigma C_{i'i}$)
Basud	-	0.37	1.00	1.00	1.00	1.00	0.72	*5.09*	1.18
Cabusao	1.00	-	1.00	1.00	1.00	1.00	1.00	*6.00*	4.16
Calabanga	0.42	0.04	-	1.00	1.00	0.39	0.68	*3.53*	-1.92
Mercedes	0.46	0.41	0.62	-	1.00	0.40	0.84	*3.73*	-1.88
Sipocot	0.33	0.29	0.83	0.61	-	0.67	0.49	*3.22*	-2.78
Siruma	0.70	0.58	1.00	1.00	1.00	-	1.00	*5.28*	1.20
Tinambac	1.00	0.15	1.00	1.00	1.00	0.62	-	*4.77*	0.04
Total Column ($\Sigma C_{i'i}$)	*3.91*	*1.84*	*5.45*	*5.61*	*6.00*	*4.08*	*4.73*		

Table 124. Concordance dominance scores for single set of selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Total Row (R) ($\Sigma C_{ii'}$)	Difference (R-C) ($\Sigma C_{ii'} - \Sigma C_{i'i}$)
Basud	-	0.60	0.44	0.23	0.61	0.65	0.61	*3.14*	0.26
Cabusao	0.40	-	0.00	0.40	0.40	0.40	0.21	*1.81*	-2.38
Calabanga	0.57	1.00	-	0.40	0.77	0.79	0.35	*3.88*	1.75
Mercedes	0.77	0.60	0.60	-	0.79	0.56	0.77	*4.09*	2.18
Sipocot	0.39	0.60	0.23	0.21	-	0.61	0.57	*2.61*	-0.79
Siruma	0.35	0.60	0.21	0.44	0.39	-	0.38	*2.37*	-1.27
Tinambac	0.40	0.79	0.65	0.23	0.44	0.63	-	*3.14*	0.25
Total Column ($\Sigma C_{i'i}$)	*2.88*	*4.19*	*2.13*	*1.91*	*3.40*	*3.64*	*2.89*		

Table 125. Concordance dominance scores for multiple sets of selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Total Row (R) ($\Sigma C_{ii'}$)	Difference (R-C) ($\Sigma C_{ii'} - \Sigma C_{i'i}$)
Basud	-	0.49	0.38	0.19	0.61	0.66	0.61	*2.94*	-0.19
Cabusao	0.53	-	0.00	0.48	0.43	0.61	0.21	*2.26*	-1.50
Calabanga	0.63	1.00	-	0.38	0.73	0.74	0.34	*3.82*	1.63
Mercedes	0.82	0.52	0.62	-	0.69	0.55	0.81	*4.01*	2.01
Sipocot	0.40	0.57	0.27	0.31	-	0.66	0.60	*2.81*	-0.39
Siruma	0.35	0.39	0.26	0.45	0.34	-	0.39	*2.18*	-1.65
Tinambac	0.40	0.79	0.66	0.19	0.40	0.61	-	*3.05*	0.09
Total Column ($\Sigma C_{i'i}$)	*3.13*	*3.76*	*2.19*	*2.00*	*3.20*	*3.83*	*2.96*		

Table 126. Discordance dominance scores of selective weighting.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Total Row (R) ($\Sigma C_{ii'}$)	Difference (R-C) ($\Sigma C_{ii'} - \Sigma C_{i'i}$)
Basud	-	0.47	1.00	1.00	0.72	0.86	1.00	*5.05*	0.21
Cabusao	1.00	-	1.00	1.00	1.00	1.00	1.00	*6.00*	3.38
Calabanga	0.66	0.00	-	1.00	1.00	0.38	0.43	*3.47*	-2.13
Mercedes	0.59	0.34	0.74	-	0.70	0.34	1.00	*3.72*	-2.26
Sipocot	1.00	0.35	0.86	1.00	-	1.00	0.91	*5.11*	-0.23
Siruma	1.00	0.84	1.00	1.00	0.91	-	1.00	*5.76*	1.65
Tinambac	0.60	0.62	1.00	0.98	1.00	0.53	-	*4.72*	-0.62
Total Column ($\Sigma C_{ii'}$)	*4.85*	*2.62*	*5.60*	*5.98*	*5.34*	*4.11*	*5.34*		

The municipality whose fisheries management strategy has considerable impacts has a higher net concordance dominance score and lower net discordance dominance score. Table 127 summarizes the results of Tables 121 to 123 for *non-selective weighting* while Table 128 sums up Tables 124 to 126 for *selective weighting.* The results of the concordance analysis is a little vague for *non-selective weighting* because the municipality with the highest concordance dominance score is Calabanga but only ranked second to Sipocot in terms of the lowest discordance dominance score. When *selective weighting* was employed, it was able to satisfy the requirement of the analysis and clearly identify the dominant municipality or municipalities. The impacts of fisheries management strategies from the municipalities of Mercedes and Calabanga are higher compared to the other municipalities because they are not dominated or outranked (i.e., both have high concordance dominance scores and low discordance dominance scores for *selective weighting*). It does not matter however, whether single set or multiple sets of weights is used because the analysis still yields the same results (i.e., Calabanga and Mercedes are ranked highest). However, when equal weighting is assigned to all criteria, results of the dominance matrix shown in Table 129 for both net concordance and discordance dominance scores are not complementary. The municipality of Mercedes has the highest net concordance dominance score while Calabanga has the lowest net discordance dominance score. This would indicate that this method is sensitive to weight changes. In Table 130, *selective weighting* is found to yield consistent result with respect to the municipalities of Mercedes and Calabanga having both high net concordance and low net discordance scores.

Table 127. Aggregate dominance matrix for *non-selective* weighting

NET CONCORDANCE DOMINANCE SCORES				NET DISCORDANCE DOMINANCE SCORES	
Single set	Municipality	Multiple sets	Municipality	Net discordance dominance scores	Municipality
2.46	Calabanga	2.34	Calabanga	-2.78	Sipocot
1.32	Mercedes	1.35	Mercedes	-1.92	Calabanga
-0.51	Tinambac	-0.53	Basud	-1.88	Mercedes
-0.55	Sipocot	-0.65	Tinambac	0.04	Tinambac
-0.62	Basud	-0.72	Sipocot	1.18	Basud
-0.80	Siruma	-0.73	Siruma	1.20	Siruma
-1.30	Cabusao	-1.06	Cabusao	4.16	Cabusao

Table 128. Aggregate dominance matrix for *selective* weighting

NET CONCORDANCE DOMINANCE SCORES				NET DISCORDANCE DOMINANCE SCORES	
Single set	Municipality	Multiple sets	Municipality	Net discordance dominance scores	Municipality
2.18	Mercedes	2.01	Mercedes	-2.26	Mercedes
1.75	Calabanga	1.63	Calabanga	-2.13	Calabanga
0.26	Basud	0.09	Tinambac	-0.62	Tinambac
0.25	Tinambac	-0.19	Basud	-0.23	Sipocot
-0.79	Sipocot	-0.39	Sipocot	0.21	Basud
-1.27	Siruma	-1.50	Cabusao	1.65	Siruma
-2.38	Cabusao	-1.65	Siruma	3.38	Cabusao

Table 129. Aggregate dominance matrix for *equal* weights

NET CONCORDANCE DOMINANCE SCORES		NET DISCORDANCE DOMINANCE SCORES	
Net concordance dominance scores	Municipality	Net discordance dominance scores	Municipality
3.20	Mercedes	-4.08	Calabanga
2.80	Calabanga	-1.60	Tinambac
0.00	Basud	-1.43	Mercedes
-0.40	Sipocot	-1.01	Sipocot
-1.20	Siruma	1.88	Siruma
-1.20	Tinambac	2.42	Basud
-3.20	Cabusao	3.82	Cabusao

Table 130. Results of ranking using non-selective, selective and equal weightings.

Means of Weighting	Types of weights	Net Concordance Dominance	Net Discordance Dominance
Non-selective	Single set	Calabanga>Mercedes	Sipocot<Calabanga<Mercedes
	Multiple sets	Calabanga>Mercedes	
Selective	Single set	Mercedes>Calabanga>Basud> Tinambac	Mercedes<Calabanga<Tinambac <Sipocot
	Multiple sets	Mercedes>Calabanga>Tinambac>	
Equal weights		Mercedes>Calabanga>Basud	Calabanga<Tinambac<Mercedes< Sipocot

2) Regime Method

Regime Method is a type of qualitative multi-criteria evaluation which is an ordinal generalisation of pair-wise comparison (Nijkamp and Torrieri 2000). It allows inclusion of both qualitative and quantitative data wherein analysis is accomplished by treating the cardinal data as ordinal (De Montis and Nijkamp 1999). The principle of the Regime Method is similar to the Concordance Analysis, i.e., it makes use of pairwise comparisons. Nijkamp & Torrieri (2000) discussed its operation and summarized as follows: A concordance index ($C_{ii'}$) is also computed which is the sum of the weights of the criteria/indicators for which the management strategy in municipality *I* is said to perform better than that of municipality *I'*. The same procedure is also done when comparing municipality *I'* with *I* ($C_{i'i}$). The difference between $C_{ii'}$ and $C_{i'i}$ yields the value of the index. Unlike in the Concordance Analysis whose focal point is the concordance index, in the Regime Method, it is the sign of the difference for each pair of municipalities (Moriki and Karydis 1994). The numerical size of the difference of the indicator for each pair of comparison is ignored (Nijkamp and Torrieri 2000). For example, a positive sign of the difference between $C_{ii'}$ and $C_{i'i}$ would indicate that the management strategy in municipality *I* is better than *I'*. Thus, the aggregation matrix for the Regime Method would only show positive or negative signs. Then the different management strategies represented by the municipalities are ranked based on the sign of the difference for each pair of comparisons. The Regime Method was applied to the impact evaluation data for this research and the procedure is illustrated in Figure 12.

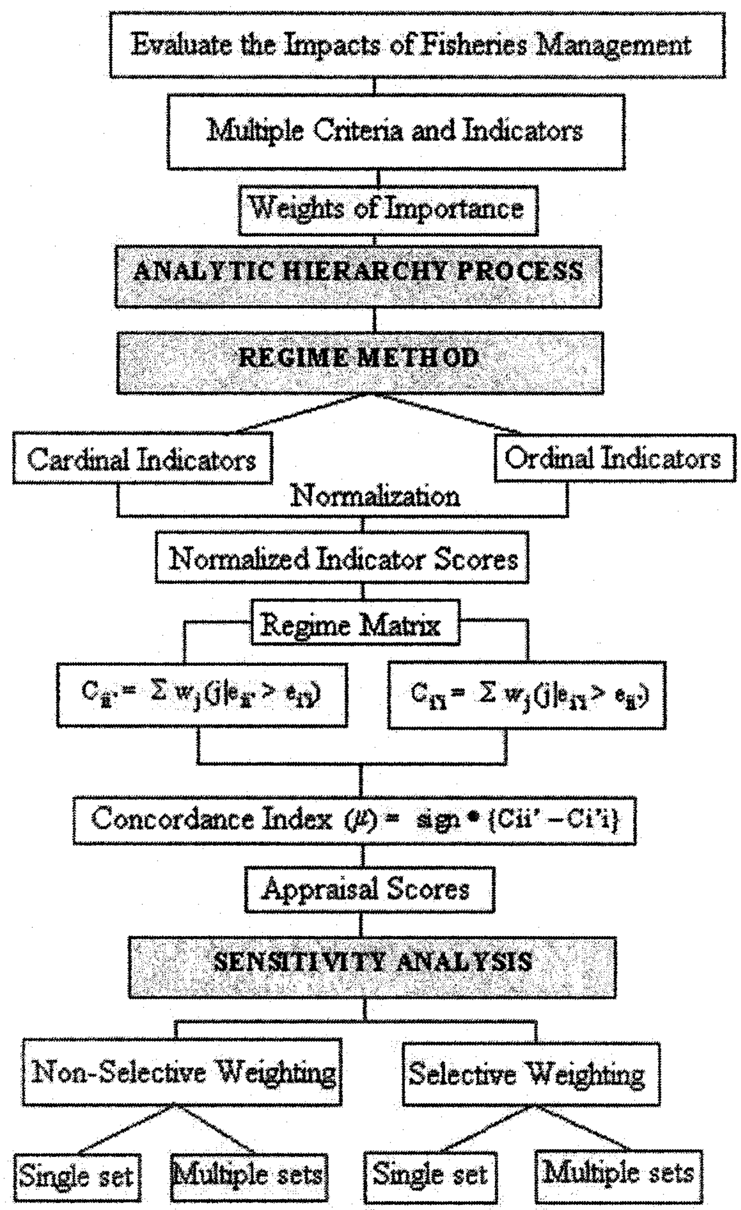


Figure12. Procedure in the application of Regime Method to fisheries management

The indicators were used to pairwise compare the municipalities. Only indicators whose scores are available for the municipalities being compared are included in the analysis. Indicators with missing data as well as those whose difference of scores is equal to zero were dropped during the comparison. The sensitivity of the Regime Method is examined by applying it to non-selective and selective weightings. It does not matter however, whether single or multiple sets of weightings are utilized because the results are exactly the same (Tables 131-132 for non-selective while Tables 133- 134 for selective). Although not exactly the same, the ranking of municipalities for non-selective and selective weightings are comparable (Table 134). The management strategy of Mercedes outperforms the other municipalities. However, Tinambac and Siruma were both ranked second when the weighting shifted from non-selective to selective. Nijkamp & Torrieri (2000) referred to this result as an ambiguous one (i.e., the rank order is not unique) because results are mainly based on the sign of the index. They proposed a solution to the problem of ambiguity by calculating numerous weights through a random generator. But this proposal was not applied for this research because the problem involves only two municipalities.

Table 131. Regime analysis for single set of non-selective weighting

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		+	+	-	+	-	-	+++
Cabusao	-		-	-	-	-	-	-
Calabanga	-	+		-	+	-	-	++
Mercedes	+	+	+		+	+	+	++++++
Sipocot	-	+	-	-		-	-	+
Siruma	+	+	+	-	+		-	++++
Tinambac	+	+	+	-	+	+		+++++

Table 132. Regime analysis for multiple sets of non-selective weighting

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		+	+	-	+	-	-	+++
Cabusao	-		-	-	-	-	-	-
Calabanga	-	+		-	+	-	-	++
Mercedes	+	+	+		+	+	+	++++++
Sipocot	-	+	-	-		-	-	+
Siruma	+	+	+	-	+		-	++++
Tinambac	+	+	+	-	+	+		+++++

Table 133. Regime analysis for single set of selective weighting

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		+	-	-	+	-	-	++
Cabusao	-		-	-	-	-	-	-
Calabanga	+	+		-	+	-	0	+++
Mercedes	+	+	+		+	+	+	++++++
Sipocot	-	+	-	-		-	-	+
Siruma	+	+	+	-	+		-	++++
Tinambac	+	+	0	-	+	+	*	++++

Table 134. Regime analysis for multiple sets of selective weighting

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		+	-	-	+	-	-	++
Cabusao	-		-	-	-	-	-	-
Calabanga	+	+		-	+	-		+++
Mercedes	+	+	+		+	+	+	++++++
Sipocot	-	+	-	-		-	-	+
Siruma	+	+	+	-	+		-	++++
Tinambac	+	+		-	+	+		++++

Table 135. Results of ranking for the Regime Method using non-selective and selective weightings

Means of Weighting	Ranking of the Municipalities
Non-selective weighting	Mercedes>Tinambac>Siruma>Basud>Calabanga>Cabusao
Selective weighting	Mercedes>Tinambac=Siruma>Calabanga>Basud>Cabusao

The Regime Method was further examined. Instead of the indicators, the criteria were used in the pairwise comparisons. The criterion scores were computed by taking the average scores of the indicators in each criterion (similar to the Concordance Analysis). The results are found in Tables 136 to 139 and summarized in Table 140. These results showed that ranking of the municipalities is more ambiguous when criteria are used; a number of municipalities were ranked equally in either non-selective or selective weighting. Also, there is a tendency for the top two municipalities, i.e., Calabanga and Mercedes, to exchange ranks as the weighting changes from non-selective to selective one.

Table 136. Regime analysis for single set of non-selective weighting *(using the criteria)*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		-	-	-	+	+	-	++
Cabusao	+		-	-	-	+	-	++
Calabanga	+	+		+	+	+	+	++++++
Mercedes	+	+	-		+	-	+	++++
Sipocot	-	+	-	-		+	-	++
Siruma	-	-	-	+	-		+	++
Tinambac	+	+	-	-	+	-		+++

Table 137. Regime analysis for multiple sets of non-selective weighting *(using the criteria)*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		-	-	-	+	+	-	++
Cabusao	+		-	-	-	+	-	++
Calabanga	+	+		+	+	+	+	++++++
Mercedes	+	+	-		+	-	+	++++
Sipocot	-	+	-	-		+	-	++
Siruma	-	-	-	+	-		+	++
Tinambac	+	+	-	-	+	-		+++

Table 138. Regime analysis for single set of selective weighting *(using the criteria)*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		+	-	-	+	+	+	++++
Cabusao	-		-	-	-	-	-	-
Calabanga	+	+		-	+	+	-	++++
Mercedes	+	+	+		+	+	+	++++++
Sipocot	-	+	-	-		+	+	+++
Siruma	-	+	-	-	-		-	+
Tinambac	-	+	+	-	-	+		+++

Table 139. Regime analysis for multiple sets of selective weighting *(using the criteria)*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	No. of + signs
Basud		-	-	-	+	+	+	+++
Cabusao	+		-	-	-	+	-	++
Calabanga	+	+		-	+	+	-	++++
Mercedes	+	+	+		+	+	+	++++++
Sipocot	-	+	-	-		+	+	+++
Siruma	-	-	-	-	-		-	-
Tinambac	-	+	+	-	-	+		+++

Table 140. Results of ranking for the Regime Method using non-selective and selective weightings

Means of Weighting	Types of weights	Ranking of the Municipalities
Non-selective	Single set	Calabanga>Mercedes>Tinambac>Basud=Cabusao=Sipocot=Siruma
	Multiple sets	Calabanga>Mercedes>Tinambac>Basud=Cabusao=Sipocot=Siruma
Selective	Single set	Mercedes>Calabanga=Basud>Sipocot=Tinambac>Siruma>Cabusao
	Multiple sets	Mercedes>Calabanga>Basud=Sipocot=Tinambac>Cabusao>Siruma

3) Mixed-Data Evaluation (or EVAMIX)

The operation of the Mixed-Data Evaluation Method or EVAMIX is introduced in detail in Voogd (1983) but will be re-introduced in this paper. EVAMIX is based on the principle of analyzing information having both quantitative and qualitative properties. The difference between two management strategies can be expressed in a condense way by means of two dominance measures: a) one measure based on the qualitative indicators (ordinal) and b) one measure based on the quantitative (cardinal) indicators. Both measures are standardized to be comparable to each other. By weighting these standardized dominance measures with the aggregated weights of the constituent indicators a new overall dominance score can be created which represents the degree in which a management strategy performs better (or worse) than another. Also, on the basis of this overall measure an appraisal score for each management strategy can be determined. The steps in the application of Mixed Data Evaluation (EVAMIX) are illustrated in Figure 13.

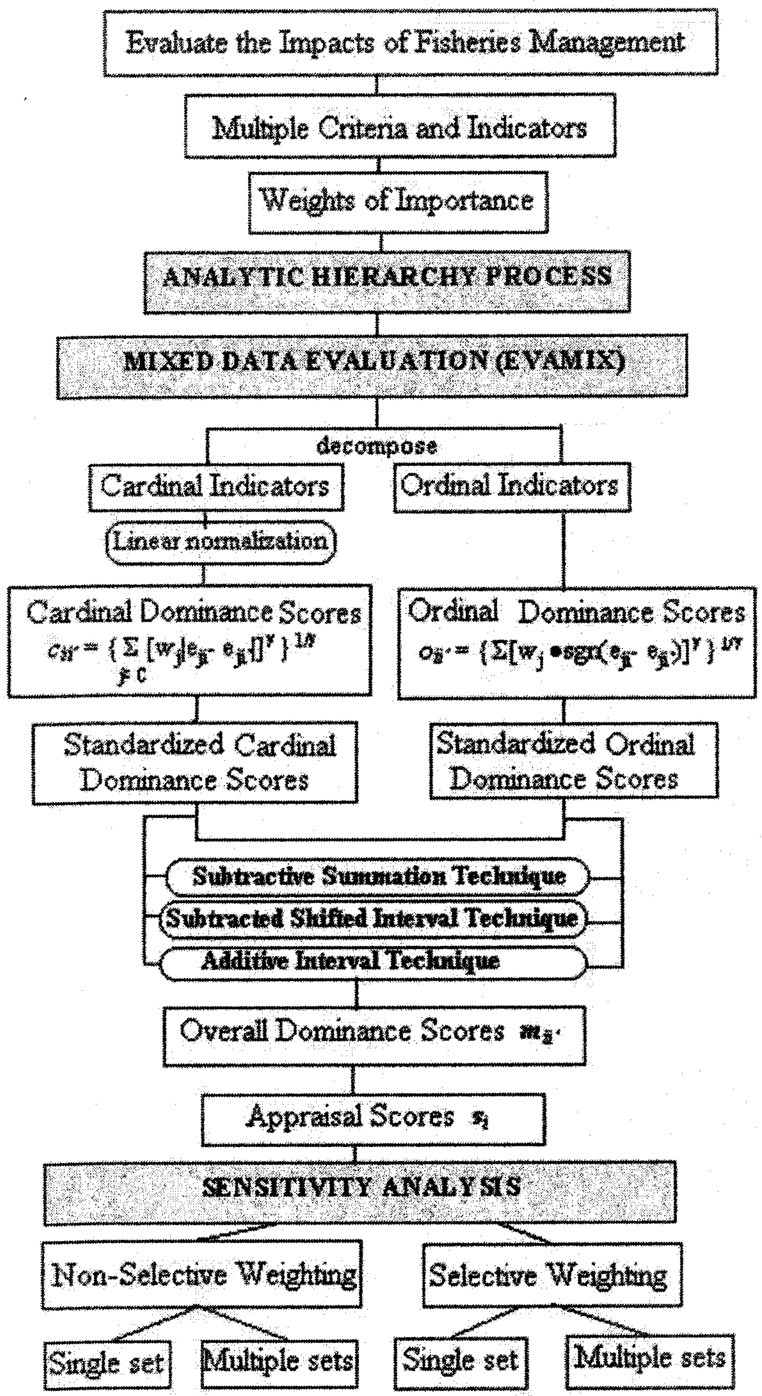


Figure 13. Procedure in the application of Mixed Data Evaluation (EVAMIX) to fisheries management

The following is the general procedure in computing the mixed data evaluation technique:

a. Classify the indicators into two: ordinal (o) and cardinal (c) scores

b. Normalize the cardinal indicators using the following linear equation:

$$e_{ij}= (x_{ij}-x_j^-)/(x_j^+ - x_j^-)\ ,\ 0\leq x_{ij} \leq 1$$

where

e_{ij} = the standardized evaluation score of alternative i and indicator j,

x_j^- = the lowest x_{ij} score of the indicator j,

x_j^+ = the highest x_{ij} score of the indicator j,

All normalized scores will have the same direction (i.e. a higher score means better score). In the same manner, the evaluation score for the ordinal indicators ($j \varepsilon o$) will follow "the higher, the better".

c. Compute the dominance scores for the ordinal ($o_{ii'}$) and cardinal (c_{ii}) indicators:

i) *Ordinal dominance score ($o_{ii'}$)*

$$o_{ii'} = \{\sum_{j\varepsilon O}[w_j \bullet \mathrm{sgn}(e_{ji}- e_{ji'})]^{\gamma}\}^{1/\gamma}$$

where,

$$\mathrm{sgn}(e_{ji}- e_{ji'}) = \begin{cases} +, & \text{if } e_{ji}> e_{ji'}, \\ 0, & \text{if } e_{ji}= e_{ji'}, \\ -, & \text{if } e_{ji}< e_{ji'}. \end{cases}$$

ii) *Cardinal dominance score ($c_{ii'}$)*

$$c_{ii'} = \{\sum_{j\varepsilon C} [w_j|e_{ji}- e_{ji'}|]^{\gamma}\}^{1/\gamma}$$

where, e_{ji} represents the score of indicator j and management strategy i and w_j the weight attached to indicator j. The γ denotes an arbitrary scaling parameter which in this case will be assigned a value 1. In the determination of $o_{ii'}$ only the ordinal characteristics of e_{ij} variables are considered while for $c_{ii'}$ also the metric properties are considered.

d. Standardization of dominance scores $o_{ii'}$ and $c_{ii'}$ - since the ordinal and cardinal dominance scores are incomparable, the standardized dominance scores O and C are computed, respectively. There are three techniques to arrive at appraisal scores whose computations for the standardized dominance scores differ.

  i) *Subtractive Summation Technique* - this is based on the assumption that $m_{ii}= s_i - s_{i'}$ which implies that the standardization functions of O and C should be such that $m_{ii} = -m_{i'i}$. Thus, the standardized ordinal (O) and cardinal (C) dominance measures are computed as follows:

$$O_{ii'} = o_{ii'} (\sum_{-i,i'}|o_{ii'}|)^{-1},$$

$$C_{ii'} = c_{ii'} (\sum_{-i,i'}|c_{ii'}|)^{-1}$$

  Then the overall dominance measure $m_{ii'}$ is calculated for each pair of management such that $m_{ii'} = w_O\delta_{ii'} + w_C d_{ii'}$. The appraisal score is computed as: $s_i = 1/I \sum m_{ii'}$ where, I is the number of choice possibilities. The higher the score for s_i, the better is management i for the given weight set w_j.

ii) *Subtracted Shifted Interval Technique* – the standardization that used for this technique is different from the subtractive summation technique:

$$O_{ii'} = [(o_{ii'} - o^{-})/(o^{+} - o^{-})] - 0.5,$$

$$C_{ii'} = [(c_{ii'} - c^{-})/(c^{+} - c^{-})] - 0.5 \text{ where,}$$

o^{-} is the lowest odinal dominance score for any pair of management,

c^{-} is the lowest cardinal score ….,

o^{+} is the highest ordinal score ….., and

c^{+} is the highest cardinal score …..

The appraisal score is computed as:

$$s_i = 1/I \sum_{i'} m_{ii'}$$

iii) *Additive interval technique*- this technique assumes that $m_{ii} = \mathrm{k}(s_i, s_{i'})$ can have the form: $m_{ii} = \mathrm{si}/(s_i + s_{i'})$ which implies that $m_{ii'} + m_{i'i} = 1$. The standardized dominance measures is computed as follows:

$$O_{ii'} = (o_{ii'} - o^{-})/(o^{+} - o^{-})$$

$$C_{ii'} = (c_{ii} - c^{-})/(c^{+} - c^{-})$$

The appraisal score is computed as:

$$s_i = 1/I \sum_{i'} m_{ii'} / m_{i'i}$$

Table 141. Appraisal scores for the **subtractive summation technique** using *non-selective and single set of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{ii'}$	Appraisal Score (s_i)
Basud		1.0	-1.0	-1.0	0.0	-1.0	-1.0	-3.0	-0.43
Cabusao	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0	-6.0	-0.86
Calabanga	1.0	1.0		0.0	0.0	-1.0	1.0	2.0	0.29
Mercedes	1.0	1.0	0.0		1.0	0.0	1.0	4.0	0.57
Sipocot	0.0	1.0	0.0	-1.0		0.0	-1.0	-1.0	-0.14
Siruma	1.0	1.0	1.0	0.0	0.0		0.0	3.0	0.43
Tinambac	1.0	1.0	-1.0	-1.0	1.0	0.0		1.0	0.14

Table 142. Appraisal scores for the **subtractive summation technique** using *non-selective and multiple sets of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{ii'}$	Appraisal Score (s_i)
Basud		1.0	-1.0	-1.0	0.0	-1.0	-1.0	-3.0	-0.43
Cabusao	-1.0		-1.0	-1.0	0.0	0.0	0.0	-3.0	-0.43
Calabanga	1.0	1.0		0.0	0.0	-1.0	1.0	2.0	0.29
Mercedes	1.0	1.0	0.0		1.0	0.0	1.0	4.0	0.57
Sipocot	0.0	0.0	0.0	-1.0		-1.0	-1.0	-3.0	-0.43
Siruma	1.0	0.0	1.0	0.0	1.0		-1.0	2.0	0.29
Tinambac	1.0	0.0	-1.0	-1.0	1.0	1.0		1.0	0.14

Table 143. Appraisal scores for the **subtractive summation technique** using *selective and single set of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{ii'}$	Appraisal Score (s_i)
Basud		1.0	-1.0	-1.0	0.0	-1.0	-1.0	-3.0	-0.43
Cabusao	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0	-6.0	-0.86
Calabanga	1.0	1.0		0.0	0.0	0.0	1.0	3.0	0.43
Mercedes	1.0	1.0	0.0		1.0	0.0	1.0	4.0	0.57
Sipocot	0.0	1.0	-1.0	-1.0		0.0	-1.0	-2.0	-0.29
Siruma	1.0	1.0	0.0	0.0	0.0		0.0	2.0	0.29
Tinambac	1.0	1.0	-1.0	-1.0	1.0	0.0		1.0	0.14

Table 144. Appraisal scores for the **subtractive summation technique** using *selective and multiple sets of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Σm_{it}	Appraisal Score (s_i)
Basud		1.0	-1.0	-1.0	0.0	-1.0	-1.0	-3.0	-0.43
Cabusao	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0	-6.0	-0.86
Calabanga	1.0	1.0		0.0	0.0	-1.0	0.0	1.0	0.14
Mercedes	1.0	1.0	0.0		1.0	0.0	1.0	4.0	0.57
Sipocot	0.0	1.0	0.0	-1.0		0.0	-1.0	-1.0	-0.14
Siruma	1.0	1.0	1.0	0.0	0.0		-1.0	2.0	0.29
Tinambac	1.0	1.0	0.0	-1.0	1.0	1.0		3.0	0.43

Table 145. Appraisal scores for the **subtracted shifted interval technique** using *non-selective and single set of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Σm_{it}	Appraisal Score (s_i)
Basud		0.95	-0.24	-1.14	0.90	-0.50	-0.25	-0.29	-0.04
Cabusao	-0.95		-1.67	-0.54	-1.74	-1.50	-1.84	-8.24	-1.18
Calabanga	0.24	1.67		0.20	-0.23	-0.47	0.33	1.74	0.25
Mercedes	1.14	0.54	-0.20		0.00	0.50	0.89	2.88	0.41
Sipocot	-0.90	1.74	0.23	0.00		0.27	-0.62	0.72	0.10
Siruma	0.50	1.50	0.47	-0.50	-0.27		0.13	1.83	0.26
Tinambac	0.25	1.84	-0.33	-0.89	0.62	-0.13		1.36	0.19

Table 146. Appraisal scores for the **subtracted shifted interval technique** using *non-selective and multiple sets of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{it'}$	Appraisal Score (s_i)
Basud		0.90	-0.44	-1.04	1.29	-0.79	-0.35	-0.43	-0.06
Cabusao	-0.90		-1.49	-0.46	-0.48	-1.02	-2.11	-6.46	-0.92
Calabanga	0.44	1.49		0.12	-0.14	-0.45	0.31	1.77	0.25
Mercedes	1.04	0.46	-0.12		-0.11	0.45	0.99	2.72	0.39
Sipocot	-1.29	0.48	0.14	0.11		0.13	-0.58	-1.02	-0.15
Siruma	0.79	1.02	0.45	-0.45	-0.13		-0.40	1.28	0.18
Tinambac	0.35	2.11	-0.31	-0.99	0.58	0.40		2.14	0.31

Table 147. Appraisal scores for the **subtracted shifted interval technique** using *selective and single set of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Σm_{ii}	Appraisal Score (s_i)
Basud		1.01	-0.39	-1.21	1.02	-0.41	-0.28	-0.27	-0.04
Cabusao	-1.01		-1.84	-0.75	-1.73	-1.54	-2.14	-9.01	-1.29
Calabanga	0.39	1.84		0.14	0.10	-0.34	0.46	2.60	0.37
Mercedes	1.21	0.75	-0.14		0.19	0.69	0.96	3.66	0.52
Sipocot	-1.02	1.73	-0.10	-0.19		0.36	-0.60	0.18	0.03
Siruma	0.41	1.54	0.34	-0.69	-0.36		-0.31	0.93	0.13
Tinambac	0.28	2.14	-0.46	-0.96	0.60	0.31		1.91	0.27

Table 148. Appraisal scores for the **subtracted shifted interval** using *selective and multiple sets of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Σm_{ii}	Appraisal Score (s_i)
Basud		0.86	-0.41	-1.35	1.46	-0.48	-0.47	-0.39	-0.06
Cabusao	-0.86		-1.68	-0.49	-1.40	-1.29	-2.11	-7.83	-1.12
Calabanga	0.41	1.68		-0.17	0.11	-0.36	0.03	1.69	0.24
Mercedes	1.35	0.49	0.17		0.03	0.27	1.02	3.34	0.48
Sipocot	-1.46	1.40	-0.11	-0.03		0.13	-0.87	-0.95	-0.14
Siruma	0.48	1.29	0.36	-0.27	-0.13		-0.29	1.45	0.21
Tinambac	0.47	2.11	-0.03	-1.02	0.87	0.29		2.69	0.38

Table 149. Appraisal scores for the **additive interval technique** using *non-selective and single set of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{ii} + m_{ii}$	Appraisal Score (s_i)
Basud		0.97	0.38	-0.08	0.93	0.25	0.37	45.60	0.02
Cabusao	0.03		-0.33	0.23	-0.36	-0.24	-0.41	-0.67	-1.49
Calabanga	0.62	1.33		0.60	0.37	0.27	0.67	2.14	0.47
Mercedes	1.08	0.77	0.40		0.50	0.77	0.94	11.41	0.09
Sipocot	0.07	1.36	0.63	0.50		0.64	0.20	0.98	1.02
Siruma	0.75	1.24	0.73	0.23	0.36		0.56	2.69	0.37
Tinambac	0.63	1.41	0.33	0.06	0.80	0.44		3.61	0.28

Table 150. Appraisal scores for the **additive interval technique** using *non-selective and multiple sets of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{ji} \div m_{ij}$	Appraisal Score (s_i)
Basud		0.92	0.28	-0.06	1.14	0.10	0.33	2.27	0.44
Cabusao	0.10		-0.25	0.25	0.28	0.02	-0.46	0.33	3.06
Calabanga	0.72	1.25		0.56	0.46	0.27	0.66	1.95	0.51
Mercedes	1.07	0.75	0.44		0.45	0.74	0.99	63.28	0.02
Sipocot	-0.14	0.72	0.55	0.56		0.56	0.21	6.45	0.16
Siruma	0.89	0.97	0.72	0.27	0.43		0.31	70.47	0.01
Tinambac	0.67	1.45	0.34	0.01	0.79	0.69		5.34	0.19

Table 151. Appraisal scores for the **additive interval technique** using *selective and single set of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{ji} \div m_{ij}$	Appraisal Score (s_i)
Basud		1.00	0.30	-0.12	1.00	0.30	0.36	1206.21	0.001
Cabusao	0.00		-0.42	0.12	-0.36	-0.26	-0.56	-0.98	-1.02
Calabanga	0.70	1.42		0.57	0.54	0.34	0.73	4.63	0.22
Mercedes	1.12	0.88	0.43		0.60	0.86	0.97	41.04	0.02
Sipocot	0.00	1.36	0.46	0.40		0.68	0.21	0.08	13.04
Siruma	0.70	1.26	0.66	0.14	0.32		0.34	0.68	1.46
Tinambac	0.64	1.56	0.27	0.03	0.79	0.66		5.17	0.19

Table 152. Appraisal scores for the **additive interval technique** using *selective and multiple sets of weighting*

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	$\Sigma m_{ji} \div m_{ij}$	Appraisal Score (s_i)
Basud		0.91	0.30	-0.22	1.33	0.26	0.26	5.04	0.20
Cabusao	0.11		-0.41	0.20	-0.15	-0.11	-0.50	-0.47	-2.14
Calabanga	0.72	1.42		0.43	0.59	0.32	0.52	2.57	0.39
Mercedes	1.23	0.80	0.58		0.52	0.65	1.02	-50.38	-0.02
Sipocot	-0.32	1.15	0.42	0.49		0.61	0.00	-4.83	-0.21
Siruma	0.75	1.11	0.69	0.35	0.39		0.38	-3.32	-0.30
Tinambac	0.76	1.50	0.49	-0.02	1.00	0.62		3.50	0.29

Table 153. Results of ranking for the Mixed Data Evaluation (EVAMIX) using *selective and multiple sets of weighting*

EVAMIX Technique	NON-SELECTIVE WEIGHTING				SELECTIVE WEIGHTING			
	Single set		Multiple sets		Single set		Multiple sets	
	Municipalities	Appraisal Scores	Municipalities	Appraisal Scores	Municipalities	Appraisal Scores	Municipalities	Appraisal Scores
Subtractive Summation Technique	Mercedes	0.57	Mercedes	0.57	Mercedes	0.57	Mercedes	0.57
	Siruma	0.43	Calabanga	0.29	Calabanga	0.43	Tinambac	0.43
	Calabanga	0.29	Siruma	0.29	Siruma	0.29	Siruma	0.29
	Tinambac	0.14	Tinambac	0.14	Tinambac	0.14	Calabanga	0.14
	Sipocot	-0.14	Basud	-0.43	Sipocot	-0.29	Sipocot	-0.14
	Basud	-0.43	Cabusao	-0.43	Basud	-0.43	Basud	-0.43
	Cabusao	-0.86	Sipocot	-0.43	Cabusao	-0.86	Cabusao	-0.86
Subtracted Shifted Interval Technique	Mercedes	0.41	Mercedes	0.39	Mercedes	0.52	Mercedes	0.48
	Siruma	0.26	Tinambac	0.31	Calabanga	0.37	Tinambac	0.38
	Calabanga	0.25	Calabanga	0.25	Tinambac	0.27	Calabanga	0.24
	Tinambac	0.19	Siruma	0.18	Siruma	0.13	Siruma	0.21
	Sipocot	0.10	Basud	-0.06	Sipocot	0.03	Basud	-0.06
	Basud	-0.04	Sipocot	-0.15	Basud	-0.04	Sipocot	-0.14
	Cabusao	-1.18	Cabusao	-0.92	Cabusao	-1.29	Cabusao	-1.12
Additive Interval Technique	Sipocot	1.02	Cabusao	3.06	Sipocot	13.04	Calabanga	0.39
	Calabanga	0.47	Calabanga	0.51	Siruma	1.46	Tinambac	0.29
	Siruma	0.37	Basud	0.44	Calabanga	0.22	Basud	0.20
	Tinambac	0.28	Tinambac	0.19	Tinambac	0.19	Mercedes	-0.02
	Mercedes	0.09	Sipocot	0.16	Mercedes	0.02	Sipocot	-0.21
	Basud	0.02	Mercedes	0.02	Basud	0.00	Siruma	-0.30
	Cabusao	-1.49	Siruma	0.01	Cabusao	-1.02	Cabusao	-2.14

Table 154. Summary of the ranking for the Mixed Data Evaluation (EVAMIX)

Means of Weighting	*Subtractive Summation Technique*	*Subtracted Shifted Interval Technique*	*Additive Interval Technique*
Non-selective, single set	Mercedes>Siruma>Calabanga>Tinambac>Sipocot>Basud>Cabusao	Mercedes>Siruma>Calabanga>Tinambac>Sipocot>Basud>Cabusao	Sipocot>Calabanga>Siruma>Tinambac>Mercedes>Basud>Cabusao
Non-selective, multiple sets	Mercedes>Calabanga=Siruma>Tinambac>Basud=Cabusao=Sipocot	Mercedes>Tinambac>Calabanga>Siruma>Basud>Sipocot>Cabusao	Cabusao>Calabanga>Basud>Tinambac>Sipocot>Mercedes>Siruma
Selective, single set	Mercedes>Calabanga>Siruma>Tinambac>Sipocot>Basud>Cabusao	Mercedes>Calabanga>Tinambac>Siruma>Sipocot>Basud>Cabusao	Sipocot>Siruma>Calabanga>Tinambac>Mercedes>Basud>Cabusao
Selective, multiple sets	Mercedes>Calabanga>Siruma>Tinambac>Sipocot>Basud>Cabusao	Mercedes>Tinambac>Calabanga>Siruma>Basud>Sipocot>Cabusao	Calabanga>Tinambac>Basud>Mercedes>Sipocot>Siruma>Cabusao

Tables 153 and 154 summarize the results in Tables 141 to 152 which are the three techniques used in the application of EVAMIX. Any of these three techniques can be used in determining the appraisal scores. The ranking of the municipalities across single set and multiple sets of non-selective and selective weightings is almost similar for the subtractive summation and subtracted shifted interval techniques. The municipalities of Mercedes and Cabusao ranked highest and lowest, respectively for both techniques. However, in the additive interval technique, the ranking of municipalities shifted across single set and multiple sets of non-selective and selective weightings. Thus, it is preferable to use either subtractive summation technique or additive interval technique in determining the appraisal scores.

CHAPTER V

DISCUSSION AND CONCLUSION

A. Multi-criteria Evaluation Methods: Potentials and Limitations in Fisheries Management

Efforts to assess the impacts of fisheries management are usually directed towards determining the effects of a single management intervention (e.g., deployment of artificial reef). However, the current state and future directions of many coastal fisheries make this approach questionable. It is because no single management intervention is able to satisfy the multi-level and conflicting goals of coastal fisheries such as poverty alleviation, food security, prevention of continued degradation of fisheries resources, equitable access to resources, availability of sound employment and incomes in many tropical developing countries. The achievement of fisheries goals is determined by the interaction of various management interventions collectively referred to as *management strategy.* The assessment should be based on a general framework of a multi-criteria evaluation consisting of the problem or issue that needs investigation, choice possibilities such as policy alternatives or management plans, multiple criteria, preference system of decision-makers, and an aggregation procedure. However, the literature presents limited frameworks in dealing with the multi-dimensional impacts of fisheries management.

This research investigated the impacts of fisheries management strategies in achieving the multi-level goals of fisheries using multiple criteria and indicators. A number of multi-criteria evaluation methods applied in operational research and decision analyses were examined to ascertain their applicability or potentials in the field of fisheries. Many of them were originally developed for urban and regional planning and management, water resources, and transportation. Their application was later on recognized as a useful aid in decision-making on environmental and resource management issues. These methods were examined using the information on San Miguel Bay- a bay in the Philippines that has experienced tremendous resource degradation and thus, regarded of high priority with respect to management.

In the application of the multi-criteria analysis to fisheries management evaluation, the general structure of a multi-criteria evaluation was followed. In this case, the structure appears suitable for a multi-level assessment that the fisheries require. The problem or issue that needs to be addressed is to evaluate the impacts of fisheries management strategies in San Miguel Bay. The choice possibilities are the fisheries management strategies represented by the coastal municipalities surrounding the bay. There are seven fisheries management strategies in the bay summarized in Table 155 and each one is composed of management interventions (shaded portions). The coastal municipalities can be grouped into three based on the similarities of their fisheries management strategies: *Group A* consists of Mercedes and Siruma and can be characterized as having implemented all seven management interventions. There are four municipalities for *Group B* namely, Basud, Cabusao, Calabanga, and Tinambac while only the municipality of Sipocot belongs to *Group C.*

Table 155. Fisheries management strategies present in the coastal municipalities of San Miguel Bay (shaded portions).

Fisheries Management Interventions	Fisheries management strategy in each coastal municipality						
	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
1. Mangrove Reforestation							
2. Artificial Reef Deployment							
3. Establishment of Marine Fishery Reserves/Fish Sanctuaries							
4. Ban in Commercial Fishing							
5. Gear and vessel restrictions							
6. Implementation of additional livelihood							
7. Modification of licensing system							

1. Levels of Measurement of Criteria and Indicators

Five evaluation criteria were selected to determine impacts: *acceptability, biotic diversity, economic performance, enforceability* and *equity.* Since there is no single measure for each criterion, potential indicators per criterion were identified and selected. The coastal resource users did not identify nor choose the indicators. They were only involved in evaluating the utility of the indicators in measuring the criteria during the pretest. The indicators were measured at varying scales and levels; some were measured on a cardinal scale while others on an ordinal scale. What is salient in impact evaluation is the determination of the indicator scores not only once but in at least two time periods: *before* and *after* management strategies were implemented. The issue of deriving indicator scores in a temporal dimension affects the reliability of the measured impacts, which are actually the change attributed to an indicator after implementation of the fisheries management strategies. When a criterion is measured on a cardinal scale (i.e., all indicators are quantitative), the arithmetic operation can readily be applied. However, this becomes complicated and difficult when a criterion is composed of either all ordinal indicators or a mixture of quantitative and qualitative indicators. Such is the case of the criteria in Table 156 except biotic diversity whose indicators are all cardinal in nature.

Table 156. Level of measurement for the 24 indicators.

Criteria	Number of Cardinal Scores	Number of Ordinal Scores	Total Number of Indicators
Acceptability	1	4	5
Biotic Diversity	5	0	5
Economic Performance	3	1	4
Enforceability	1	5	6
Equity	2	2	4
Total	***12***	***12***	***24***

The cardinal scores were obtained from secondary information on past and current research projects. The validity of the data for the cardinal indicator scores was not examined because of the limited availability of comparable information at two time periods. The problem of measuring change within a very short time interval is recognized in this research. The impact scores of the indicators such as *species richness* and *abundance of reef fish* measured within a short period of time could have resulted from factors or variables other than the management strategy. Thus, these indicators were verified using the most recent reports. For example, the impact scores of the indicators *species richness of reef fish* and *abundance of reef fish* were supported by the study of Meñez et al. (2002) which indicated that abundance of reef fish decreased from 1993 to

2001. This means that the direction of change in this present research concurred with the findings of Meñez et al. (2002).

The ordinal scores however, were derived through the knowledge and perception of the representatives of coastal resource users. The sampling method utilized was a purposive type wherein the respondents were already identified. I selected an institutionalized group (i.e., Barangay Fisheries and Aquatic Resource Management Councils or BFARMCs) to serve as the participants with the assumption that as sectoral representatives, they are relatively knowledgeable of the coastal and fisheries resource issues. Their educational background, length of residence in the community, and involvement in coastal resource management supported my claim that the participants are knowledgeable and experienced when it comes to coastal fisheries management.

A number of ordinal scores were derived only at one time period, i.e., after implementation of fisheries management strategies. In order to resolve the difficulty in performing arithmetic operation on ordinal indicators, the questions were phrased in such a way that what is being measured are actually the impacts. This has been demonstrated in three indicators namely, *change in the level of intra-sectoral conflicts*, *change in the level of inter-sectoral conflicts*, and *assessment of fisherfolk gross revenue from fishing*. The ordinal scores after implementation of fisheries management strategies were also the impact scores. However, one drawback with this kind of approach is the uncertainty in the recollection of events by the resource users especially when the time difference between before and after management implementation is long and the resource users are unable to relate the past to a certain project or activity. Since a major activity, i.e., the Fisheries Sector Program (FSP), was initiated in the past, this research assumed that the resource users were able to recall the situations then. It was during the FSP when most management interventions were implemented in the bay. Despite uncertainty in the available information for some indicators (especially the indicators of biotic diversity), their inclusion in this research was imperative because of their direct relationship with many management interventions. The indicators of the biological component of fisheries management for example, have been constantly monitored in many coastal and fisheries projects from other parts of the country.

2. Preference System and Consistency in Judgment

The preference system of decision-makers attached to the criteria and indicators is another important consideration in a multi-criteria evaluation analysis. The members of the Municipal Fisheries and Aquatic Resource Management Council (MFARMC) in each municipality weighted the importance of criteria and indicators. The determination of the weights of importance can be done through direct rank assignment or comparison in a stepwise process. In the application of existing multi-criteria evaluation methods, the measurement of weights is crucial. Most methods require that the weights of importance attributed to the indicators or criteria be measured on a cardinal scale. In this research, a quantitative method was used to weigh the importance of criteria and indicators and this is the Analytic Hierarchy Process (AHP) developed by Thomas Saaty. The weights of importance were determined in two ways: a) all representatives of coastal resource users were included, and b) only the groups with the most consistent judgments were considered. The former is referred to as *non-selective weighting* while the latter is *selective weighting*.

In the *selective weighting* scheme, the choice of weights of importance considers consistency in judgment such that groups that are inconsistent are eliminated from the analysis. AHP has an integral mechanism that would determine whether judgment on the weighting is consistent or not. It computes a consistency ratio (CR) which should be 10% or less when judgment is consistent. A consistency ratio of 10% or less may have been acceptable to decision problems on urban planning, water resources or transportation but with respect to dealing with decision-making on multi-faceted coastal and fisheries resources this value may not be realistic. Thus, a stepwise approach was devised using a statistical method, the non-metric multi-dimensional scaling (MDS) technique, to objectively cluster groups whose judgments are closer to the recommended consistency ratio. There are 23 representative groups of resource users from the seven coastal municipalities of San Miguel Bay. MDS analysis narrowed the choice of representative groups to 12. Based on the results of the analysis, it was decided to accept average consistency ratios for this type of decision-problem (i.e., fisheries management evaluation) up to 22%. This means that a group of resource users may be inconsistent in their judgment 22% of the time, despite efforts to adopt approaches (e.g., local language translation and verbal explanation of the criteria and indicators; assistance from the facilitators) intended to help the participants weigh the criteria and indicators. Thus, instead of strictly saying that 10% consistency ratio as the only acceptable value, a consistency ratio of 22% is realistic for fisheries management evaluation processes.

The groups of resource users that were eliminated because of very inconsistent judgment were examined to determine where inconsistencies occur. A step-wise analysis was done for the five evaluation criteria. The results in Table 157 show that inconsistencies in judgment of the ten groups commenced when three criteria (i.e., acceptability, biotic diversity and economic performance) are being compared. Although the women group of Sipocot shows consistent judgment irrespective of the number of criteria being compared, this group was eliminated because of the number of consistency ratios more than 10% when comparing indicators per criterion. The local government units in five of the seven coastal municipalities of San Miguel Bay appeared to be the most inconsistent sector compared to the others. This would indicate that the local government units may have found it difficult to determine which among the criteria are important in impact evaluation mainly because of their insufficient knowledge and experience concerning the issues in coastal fisheries.

Table 157. Consistency ratios of the eliminated groups per number of criteria being compared.

Municipality	Groups	Number of criteria being compared			
		2	*3*	*4*	*5*
Basud	Local Government Unit	0.0	0.41	0.38	0.22
	Women	0.0	3.86	2.41	1.08
Cabusao	Local Government Unit	0.0	0.47	0.22	0.93
	Private Sector	0.0	0.19	0.27	0.17
	Women	0.0	0.33	0.24	0.23
Calabanga	Fisherfolk	0.0	0.05	0.32	0.22
	Local Government Unit	0.0	0.41	0.50	0.49
Sipocot	Local Government Unit	0.0	0.32	1.46	0.75
	Women*	0.0	0.0	0.01	0.0
Siruma	Local Government Unit	0.0	1.30	0.57	0.26
Tinambac	Fisherfolk	0.0	1.14	1.41	0.73

The inconsistencies in judgments could have been improved by repeating the decision-making process as recommended by Saaty (2001). But this was not done because of logistic and financial constraints. To repeat the whole process would mean compensating the participants for lost economic opportunity. Despite these constraints, consistency ratios can still be improved when participants are encouraged to actively participate in the discussion, and the indicators or criteria being compared are thoroughly defined and translated to the level that they are understandable to the resource users. The acceptability of AHP as an aid in impact evaluation process depends on two factors: *a) the level of familiarity of the participants of the method,* and *b) the mechanics of implementation of the method.* The participants who are unfamiliar with AHP may find it very difficult to focus on the problems that need to be evaluated. Also, when they are provided with just a matrix or table of pairwise comparisons, they can get easily confused or disoriented during the evaluation process. Thus, this research recommended a modified and more simplified approach so that the resource users would focus more on the problem and not the mechanical operation of the method.

The results of the preference analysis is remarkable because among the representative groups of coastal resource users, most fisherfolk groups from the different coastal municipalities of San Miguel Bay exhibited consistencies in their judgment. Among these are the fisherfolks from Basud, Cabusao, Mercedes and Sipocot whose average consistency ratios for the criterion indicators are 7%, 7%, 13% and 9%, respectively. These results strengthen the role of fishers in the decision-making process. The fishers having maintained close association with the marine environment have sufficient knowledge and experience in order for them to qualify as probably the best evaluators of what goes on within the coastal waters and what is best for the coastal communities. Less consistency in judgment of other groups may reflect less familiarity with the fisheries or simply reflect diversity of opinion in what is recognized as a complex social, economic, and ecological system: the fishery.

What then is the consequence of excluding the other groups of resource users from the final evaluation process? The criterion with the highest average weights of importance did not change from non-selective to selective weighting scheme for the municipalities of Basud, Cabusao, Mercedes, Siruma and Tinambac. *Economic performance* is the most important criterion for Mercedes, Siruma and Tinambac; whereas, *acceptability* and *biotic diversity* is the most important indicator for Basud and Cabusao, respectively. (Tables 158 and 159) Among the coastal municipalities of San Miguel Bay, only Mercedes maintained similar results in both non-selective and selective types of weighting scheme because no group was eliminated. For this municipality, the most important measure of economic performance is equally contributed by the indicators *change in the number of commercial fishing boats and banned fishing gears* and *employment structure of small-scale fishers.*

The most important criteria for Sipocot and Calabanga however, changed with the change in weighting from non-selective to selective type. Acceptability criterion replaced equity for Sipocot, while economic performance in lieu of acceptability for Calabanga. These changes were due to the elimination of representative groups perceived to have the most inconsistent judgments. These two types of weighting scheme can be used to determine the sensitivity of some multi-criteria evaluation methods to changes in weightings.

Table 158. Ranking of the average weights of importance of the criteria from all 23 groups of resource users.

CRITERIA	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY	1	5	1	2	2	3	3
BIOTIC DIVERSITY	3	1	3	3	4	5	4
ECONOMIC PERFORMANCE	4	4	4	1	3	1	1
ENFORCEABILITY	5	2	3	2	4	2	5
EQUITY	2	3	2	2	1	4	2

Table 159. Ranking of the average weights of the criteria from the 12 groups of resource users selected through the determination of consistency ratio.

CRITERIA	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac
ACCEPTABILITY	1	5	2	2	1	2	3
BIOTIC DIVERSITY	2	1	2	3	2	5	5
ECONOMIC PERFORMANCE	2	3	1	1	3	1	1
ENFORCEABILITY	3	4	2	2	2	3	4
EQUITY	2	2	3	2	3	4	2

3. Potential of the Concordance Analysis, Regime Method and Mixed-Data Evaluation Method

The final step in multi-criteria analysis is the aggregation of information in the impact evaluation matrix. The result would be a set of appraisal scores indicating the fisheries management strategies (represented by the coastal municipalities) with the greatest impacts. The three aggregation methods examined are the Concordance Analysis, Regime Method and Mixed Evaluation Method. These methods were initially applied to urban and regional planning and management but were later used for environmental management issues. Common among these three is the pairwise comparisons of choice possibilities, in this case the fisheries management strategies.

The ***Concordance Analysis*** is an outranking method wherein a management strategy that is dominated or outranked the most is eliminated. The basic feature of this method is the determination of the concordance dominance scores and discordance dominance scores whose results are complementary (i.e., a management strategy that is non-dominated has the highest concordance dominance score and the lowest discordance dominance score). The concordance dominance scores represent the weights attached to the criteria while the discordance dominance scores represent the measurement of the criteria. Through the years, the Concordance Analysis has evolved and been modified to correspond to a decision-making problem; however, this has not yet been explored in the field of fisheries or coastal resource management. This research uses the earlier version of the Concordance Analysis as presented in the works of Voogd (1983), Hwang and Yoon (1981) and Van Delft (1990). The strength of this method is that it is able to underscore two most important components of an evaluation matrix- the *weighting* and *evaluation scores* of the criteria or indicators. No assumption was made that the importance of the criteria or indicators is implicit in the evaluation scores rather, weighting is explicitly considered. This method, however, assumes that the weighting and scores are derived quantitatively; although use of ordinal scores can be accommodated. Because the method clearly assumes that scores are cardinal in nature, the ordinal scores are cardinalized to satisfy such assumption. This cardinalization of ordinal indicators is an indirect approach of transforming qualitative information into quantitative and this is especially useful in mixed type of evaluation (Nijkamp and Vindigni 1999). Then, all indicator scores are normalized to be comparable. In this research, the linear scale transformation was chosen since the evaluation is composed of benefit and cost indicators (i.e., a high score for the benefit indicator and a low score for the cost indicator are preferred). Another limitation in the application of concordance analysis is the number of indicators to be compared. Aggregation of indicator scores into a single criterion score is viewed possible after normalization- this was done by taking the average of the indicator scores to derive the criterion score. Although aggregation through averaging seems too simplistic, I find it as a way of handling missing data and to ascertain that the contribution of the indicators in measuring a criterion is considered.

Three means of weighting were used to determine the sensitivity of the methods to the variation in weights: *non-selective weighting, selective weighting* and *equal weighting*. The non-selective weighting considers all 23 groups of resource users while the selective weighting included only the 12 groups that were selected based on consistency ratio. The non-selective and selective weightings were further subdivided into types of weights- the *single* and *multiple weight sets*. The *single set* is simply the average weight of a criterion from all municipalities, whereas, *multiple sets* is composed of a number of sets of weightings derived by taking the average weight of a criterion from the municipalities being pairwise compared.

The results of the concordance analysis is a little vague for *non-selective weighting* because the municipality with the highest concordance dominance score is Calabanga but only ranked second to Sipocot in terms of the lowest discordance dominance score (refer to Table 127). When *selective weighting* was employed, it was able to satisfy the requirement of the analysis and clearly identify the dominant municipality or municipalities. The impacts of fisheries management strategies in Mercedes and Calabanga are higher compared to the other municipalities because they are not dominated or outranked (i.e., both have high concordance dominance scores and low discordance dominance scores for *selective weighting*) (refer to Table 128). It does not matter however, whether single set or multiple sets of weights is used because the analysis still yields the same results (at least for the top two municipalities). Selective weighting is found to yield consistent result with respect to Mercedes and Calabanga, both of which have high net concordance and low net discordance scores. However, when a third municipality is included, only the multiple sets of selective weighting satisfies the complementarity of concordance and discordance dominance scores. (refer to Table 130). Based on this result, it is recommended to choose evaluators whose judgments are relatively consistent (consistency ratio closer to 10%) and use the multiple sets of weights instead of only a single set for all comparisons. Concordance analysis is indeed sensitive to changes in the weighting scheme especially in the computation of net discordance dominance scores wherein normalized scores are weighted.

The ***Regime Method*** is a qualitative multi-criteria evaluation method that permits the application of both cardinal and ordinal data by treating cardinal data as ordinal. A regime vector is constructed through the sign of the arithmetic difference (+ or – signs) between the evaluation scores of the two choice possibilities with respect to the criterion (De Montis and Nijkamp 1999). In contrast to the Concordance Analysis, Regime Analysis allows the incorporation of ordinal weighting. It is the simplest method among the three and its more relaxed assumptions make it easy to understand and apply. In the application of this method, the indicators were not aggregated in each criterion; instead, the indicators were used in the pairwise comparisons. Only the indicators that have scores in the municipalities being pairwise compared were included in the analysis. Indicators with missing data as well as those whose difference of scores is equal to zero were dropped during the comparison. The sensitivity of the Regime Method was determined through the non-selective and selective weightings. The analysis revealed comparability in ranking the municipalities for non-selective and selective weightings (refer to Table 135). The management strategy of Mercedes outperforms the other municipalities. However, Tinambac and Siruma were both ranked second when the weighting shifted from non-selective to selective.

The Regime Method was further examined by aggregating the indicators per criterion. The aggregation procedure used is the same as that of Concordance Analysis. The analysis revealed ambiguous results since a number of municipalities were ranked equally in either non-selective or selective weighting (refer to Table 140). Also, the top two municipalities (i.e., Calabanga and Mercedes) exchanged ranks as the weighting changes from non-selective to selective one. The ambiguity in the results when indicators were aggregated into a criterion is apparent in the Concordance Analysis and Regime Method. This would therefore, indicate that aggregating indicator scores into just one criterion score through simple averaging causes variability and vagueness in the ranking of municipalities.

The ***Mixed-Data Evaluation Method*** separates the quantitative and qualitative information of an evaluation matrix. The advantage of the Mixed-Data Evaluation Method is the decomposition of the indicators into cardinal and ordinal measures. In the end, when aggregation is employed to determine the appraisal scores, the values are standardized so that arithmetic operation (e.g., addition or subtraction) is possible. When I applied this method to the data of San Miguel Bay, the five criteria were disregarded;

instead the analysis focuses on the indicators. I find this approach logical because of the characteristic of the criteria (having both ordinal and cardinal measures). The weights of importance selected through the calculation of the consistency ratio were used—the average weight was computed for each indicator. This method utilizes three techniques: *subtractive summation technique, subtractive shifted interval technique* and *additive shifted interval technique.* The operations of these techniques were fully discussed in the Review of Literature. The ranking of municipalities in the subtracted summation technique and subtracted shifted interval technique are similar (refer to Table 154). The municipalities of Mercedes and Cabusao ranked highest and lowest, respectively for both techniques. As for the additive interval technique, the results of ranking are somewhat ambiguous because ranking tends to shift from one weighting scheme to another. Thus, it is suggested to use either subtractive summation technique or subtracted shifted interval technique.

In all three multi-criteria evaluation methods, the impacts of management are highest in the municipality of Mercedes. As presented earlier, Mercedes is one of the coastal municipalities bordering San Miguel with the most number of management interventions (the other municipality is Siruma). Although the number of management interventions may not be directly related to improved conditions of coastal fisheries, the appropriateness of these interventions to respond to the complex linkage between fisheries resources and human resources produced substantial impacts in Mercedes.

4. Typology of Uncertainties in the Application of the *Concordance Analysis*, *Regime Method* and *Mixed-data Evaluation Method* to Fisheries Management

There are some criticisms in the application of multi-criteria evaluation methods and these were mentioned in Voogd (1983) as insufficient use of the available information, disregard of the spatial diversity, complexity of arithmetical operations, un-measurability of many criteria and the tendency to reduce a complex system into a single number. While some authors may argue that Voogd's (1983) criticisms have nothing to do with the capability of the methods, they can still be regarded as essential when developing a multi-criteria impact evaluation method.

Theoretically, I categorized the elements of a multi-criteria impact evaluation technique into three dimensions: *temporal, spatial* and *systemic* dimensions. The *temporal dimension* deals with the time line of impacts while *spatial dimension* characterizes geographic location (local, national or global) where management strategies are implemented. The third one, *systemic dimension*, is nested within the temporal and spatial dimensions. Systemic dimension consists of the response of the interactions between human and natural systems.

a) Temporal Dimension

Time is an essential element in the measurement of management impacts. This may also be important in establishing causal link. When the temporal dimension is considered in the evaluation, what we are concerned with is the change in the performance of the criteria or indicators with time. Collection of comparable data for the indicators at different temporal scales may often be difficult especially in developing countries where resources are limited. Given these constraints, data collected at two points in time (before and after) would then be sufficient to measure impacts. In dealing with the temporal dimension, I inferred that the impacts of all management interventions from the time that the first intervention was implemented up to the last one (regardless of whether modification of an intervention was done prior to the most current assessment) are cumulative.

In the analysis of the impacts of management in San Miguel Bay, some data for the indicators before management strategies were implemented are lacking. Missing data (because they were not initially gathered) have always been a source of uncertainty in the results. But information on the multiple dimensions of the fisheries may not be available at all times because of so many constraints that have to be dealt with. The three multi-criteria evaluation methods were not so much concerned with the type of data being measured, i.e., whether they are time-specific, since most of them were used for priori assessments.

b) Spatial Dimension

Spatial dimension consists of the choice possibilities that have to be evaluated. Choice possibilities can be alternative plans, strategies, zones (Voogd 1983) or even management strategies in different places. These fisheries management strategies are lodged in a particular geographic location such as a coastal area specifically, a coastal municipality. A coastal municipality then may represent a fisheries management strategy composed of two or more management interventions. The seven coastal municipalities in San Miguel Bay are both interdependent and independent of each other. Their interdependence is structural and functional in nature- being situated close to each other making up the bay ecosystem, therefore, the aquatic environments where they operate are interconnected. While interdependence exists among coastal municipalities, the decision as to what fisheries management interventions to implement was autonomous. Spatial interdependence is inevitable in a bay, which means that the impacts of one set of management strategy are not isolated from the other management strategies.

c) Systemic Dimension

The systemic dimension is basically concerned with the characteristics or nature of the information in the impact evaluation matrix. It is composed of the multiple criteria and indicators, their measurements, and the importance given to them. An evaluation criterion is measured by a number of interrelated indicators since no single indicator is able to precisely measure a criterion. Some authors may argue of double counting the indicators but because of the interdependent nature of the criteria, double counting is unavoidable. The aggregation of these indicators into a single criterion is never dealt with in the three methods, particularly the Concordance Analysis which assumes that criteria are few and measurable and therefore there is no need to use sub-criteria or indicators. Although the determination of the indicator scores may not be the concern of the evaluation method, the kinds of indicators chosen matter. When the indicator scores are all cardinal, aggregation is not a problem because the average of the indicator scores may be regarded as the criterion scores. The uncertainty is apparent when indicators are ordinal because no aggregation technique is established.

B. Proposed Diverse-data Aggregation Technique for Fisheries Management Evaluation (DATFME)

The principles presented in the Concordance Analysis and Mixed Data Evaluation (EVAMIX) Techniques were applied in the conceptualization of a modified approach I call Diverse-data Aggregation Technique for Fisheries Management Evaluation (DATFME). The strengths and limitations in each of these methods are recognized. The proposed method is a combination of three multi-criteria methods: Analytic Hierarchy Process (for the preference system), Concordance Analysis and EVAMIX (for the determination of the appraisal scores). Prior to the discussion of the proposed aggregation technique, important points are discussed in the following sections:

1. Structure of the Impact Matrix-

The impact evaluation matrix is composed of temporal, spatial and systemic dimensions. The temporal dimension is the change between Time $1_{(initial)}$ and Time $2_{(final)}$ or it can be the rate of change that establishes the trend of the impacts depending on the monitoring and evaluation schedule. As for San Miguel Bay, the data for the criteria and indicators were theoretically collected at two time periods, i.e., before and after management strategies were implemented. Although it may be possible to standardize the time when initial data were collected for all criteria and indicators, I experienced that standardizing the time of data collection after fisheries management strategies were implemented is somewhat difficult. Some information about the indicators may be collected on a regular basis while others would have to wait until a project or activity is implemented; it is only then that the information can be updated. The second scenario on data availability is common in fisheries management. The secondary information in my research were measured presumably from the most reliable available data.

Reliability in measuring the indicators would be improved if some kind of a monitoring program is established so as to track-down the changes in the performance of criteria and indicators particularly those indicators whose perceived change was measured by the coastal resource users. Burt (2003) defines monitoring as *" the process by which the behavior of the environment is kept in view; it provides essential information on how systems are changing and how fast, and should indicate the adjustments required to get the best out of the system."* The frequency of monitoring has always been problematic because it entails costs. It is common for environmental data monitoring be done only when projects are initiated. In contrast, indicators that would require perception of the resource users can be monitored more frequently compared to monitoring of technical information. This can be done through a group representing the different sectors of resources users. For example, this research utilized an institutionalized group of coastal resource users in San Miguel Bay- the Fisheries and Aquatic Resource Management Councils (FARMCs) to measure the change in the ordinal indicators. Monitoring schedule may coincide with the term in office of the group such that prior to the end of their term an assessment about the indicators can be conducted.

Essentially, a fisheries management strategy is interlinked with the characteristics of the coastal area where such strategy is situated. Compared to the choice possibilities or alternative plans being evaluated in the fields of urban planning which are usually unique, it is more likely that fisheries management strategies in nearby municipalities would have exactly the same set of interventions. This is demonstrated in San Miguel Bay wherein the coastal municipalities of Basud, Cabusao, Calabanga and Tinambac have similar number and types of management interventions.

a) Multiple criteria and indicators

There is an apparent relationship between criteria and indicators of fisheries management. In this research, the deductive approach was applied to the multiple criteria and indicators: from criteria to indicators (Figure 5). First, the five criteria were identified, selected and defined then based on the definition and understanding and scope of the criteria, the indicators, which served as the units of measures were chosen. Another approach is the inductive one in which the indicators are first identified then aggregated into a criterion. In the deductive approach, the criteria have to be comprehensively defined so that only the indicators that would appropriately measure the criteria are selected; whereas, in the inductive approach the indicators define the criteria. The general assumption in both approaches is that all indicators contribute to the measurement of the criteria. Only the indicators have units of measures; the criteria are unit-less. It is essential to make sure that the indicators are normalized and unidirectional which means that they are either benefit or cost indicators. When both benefit and cost indicators are present in the impact matrix, normalization is a prerequisite.

b) Preference Weighting

The importance of the evaluation criteria and indicators as perceived by the coastal resource users has to be incorporated in the evaluation process. Pairwise comparison approach such as the Analytic Hierarchy Process (AHP) proves to be a good measure of perception because it allows consensus building among resource users.

c) *Aggregation Technique*

The final analysis in the Diverse-data Aggregation Technique for Fisheries Management Evaluation (DATFME) is an aggregation process to determine the appraisal results of the coastal municipalities. The focal point of the proposed aggregation technique is the elements of the impact evaluation matrix. Figure 14 presents the structure and illustrates the steps used in the analysis.

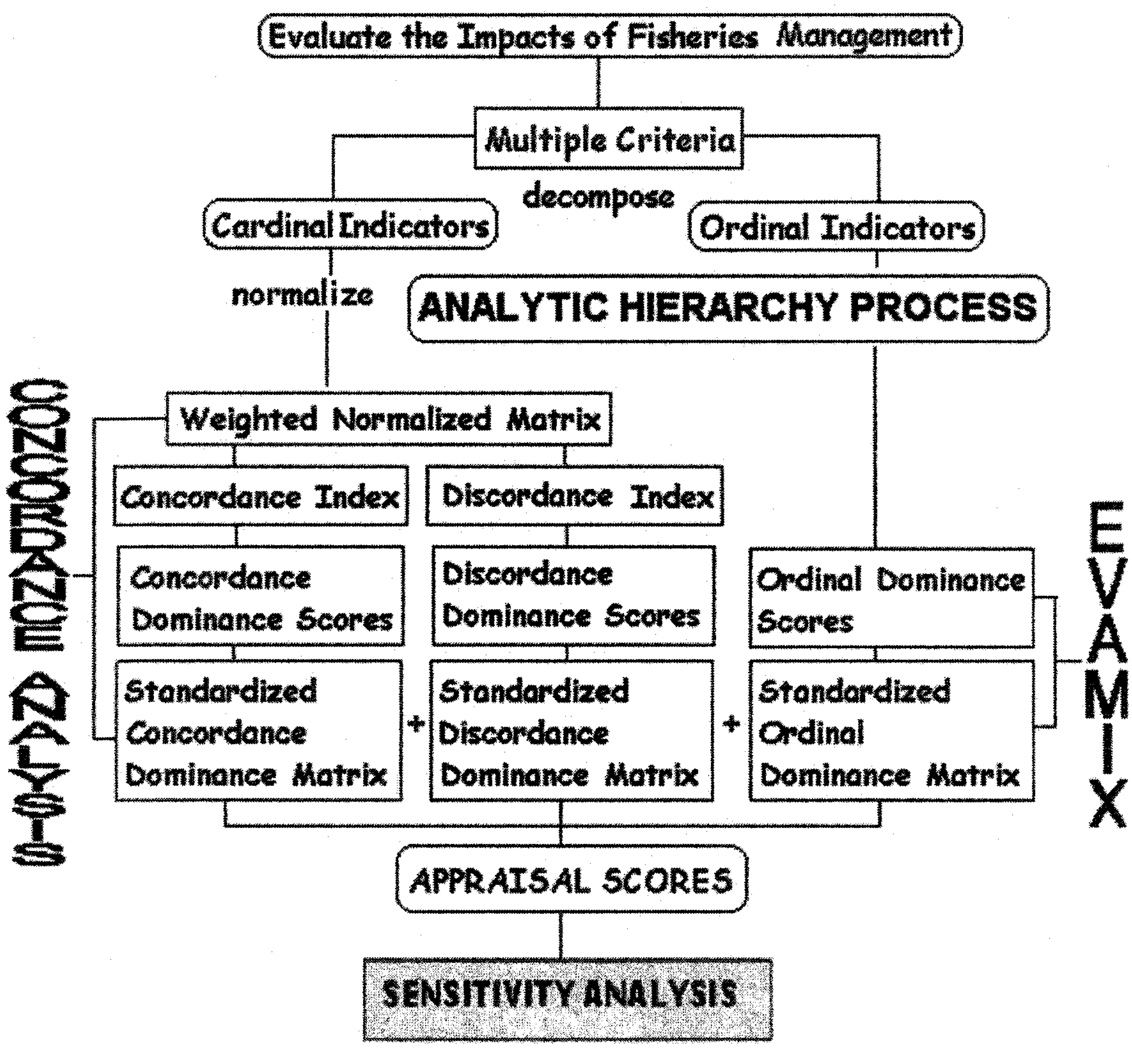


Figure 14. Structure of the Proposed Diverse-data Aggregation Technique for Fisheries Management Evaluation.

The indicators were used to pairwise compare the municipalities. From the multiple criteria, they are decomposed according to the type of measurement scale used and categorized as cardinal indicators and ordinal indicators. What is included in the analysis are the indicators whose scores are available in the two municipalities being compared at the same time. Indicators with missing data were dropped during the comparison. The cardinal indicators are analyzed through the Concordance Analysis. First, the cardinal indicators are normalized using linear scale transformation with the following formula:

$e_{ij}= (x_{ij}-x_j^{min})/(x_j^{max}- x_j^{min})$, for *benefit* criterion or,

$e_{ij}= (x_j^{max}-x_{ij})/ (x_j^{max}- x_j^{min})$, for *cost* criterion

where, e_{ij} = normalized score

x_{ij}= indicator score

x_j^{max} = maximum indicator score

x_j^{min} = minimum indicator score

Then, the normalized scores are weighted prior to the computation of *concordance index* ($c_{ii'} = (j|e_{ij} \geq e_{i'j})$) and *discordance index* ($d_{ii'}= (j|e_{ij}<e_{i'j})$). From these two indices, the concordance dominance score ($C_{ii'}= \sum wj,\ j \varepsilon c_{ii'}$) and discordance dominance score ($D_{ii'}$= [max|e_{ij}- $e_{i'j}$|, j$\varepsilon d_{ii'}$]/[max|e_{ij}- $e_{i'j}$|, jεJ] are computed and inputted in the dominance matrices. The scores in the concordance and discordance matrices are complementary, i.e., a high concordance dominance score and a low discordance dominance score. However, in this proposed technique, the scores in the discordance

dominance matrix will be transformed by subtracting each score from 1.0 so that the scores in the discordance dominance matrix would have the same direction as the scores in the concordance dominance matrix. Then, the concordance dominance matrix scores ($CD_{ii'}$) and discordance dominance matrix scores ($DD_{ii'}$) are computed as $C_{ii'} - C_{i'i}$ and $D_{ii'} - D_{i'i}$, respectively. Note that the $CD_{ii'}$ and $DD_{ii'}$ are equal to $-CD_{i'i}$ and $-DD_{i'i}$. In order to be comparable, both concordance dominance scores and discordance dominance scores were standardized using the equations below:

Standardized Concordance Dominance scores ($SCD_{ii'}$)= $CD_{ii'}/\sum_i\sum_{i'}|CD_{ii'}|$

Standardized Discordance Dominance scores ($SDD_{ii'}$)= $DD_{ii'}/\sum_i\sum_{i'}|DD_{ii'}|$

As for the ordinal indicators, the EVAMIX technique is applied. An ordinal dominance score is computed as follows:

$$O_{ii'} = \sum_{j \varepsilon O}[w_j \bullet \mathrm{sgn}(e_{ji} - e_{ji'})]$$

where, $\mathrm{sgn}(e_{ji} - e_{ji'})$ = +, if $e_{ji} > e_{ji'}$; 0, if $e_{ji} = e_{ji'}$; -, if $e_{ji} < e_{ji'}$.

The ordinal dominance scores are standardized to be comparable to the concordance and discordance dominance scores as:

Standardized Ordinal Dominance scores ($SOD_{ii'}$) = $O_{ii'}/\sum_i\sum_{i'}|O_{ii'}|$

In order to compute the appraisal scores for the municipalities and rank them, the standardized concordance dominance scores ($SCD_{ii'}$), standardized discordance dominance scores ($SDD_{ii'}$) and standardized ordinal dominance scores ($SOD_{ii'}$) are all added. The values of the total standardized dominance scores ($TSD_{ii'}$) are between –1.5 to +1.5. An appraisal score (S_i) in each municipality is calculated as the summation of the total standardized dominance scores or $\sum TSD_{ii'}$. The maximum (Si_{max}) and minimum (Si_{min}) appraisal scores can be determined through the following formulas:

$$Si_{max} = (n-1) \times 1.5$$

$$Si_{min} = (n-1) \times -1.5$$

where, n = number of municipalities being compared

In this research, the maximum and minimum appraisal scores are 9.0 and –9.0, respectively. The coastal municipality with the highest appraisal score is considered as the municipality whose management strategies have the greatest impacts. Although this technique disregards the multiple criteria and instead used the indicators, the nature of the analysis still falls within the concept of multi-criteria evaluation, i.e., the evaluation criteria which became the basis in the choice of indicators, represented the multi-level dimensions of the coastal fisheries.

The proposed DATFME was examined using the data from San Miguel Bay. The results are shown in Tables 160- 163 and summarized in Table 164. The results showed that Mercedes ranked highest in both single set and multiple set of selective weighting while Basud and Cabusao consistently ranked lowest in non-selective and selective weightings regardless of the types of weight sets used.

Table 160. Appraisal scores for the *single set of non-selective weighting*.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Appraisal Scores	Rank
Basud	-	0.00	-0.50	-0.50	0.50	-0.50	-1.50	-2.50	6
Cabusao	0.00	-	-1.50	-0.50	-1.50	-0.50	-1.50	-5.50	7
Calabanga	0.50	1.50	-	-0.50	-0.50	-1.50	0.50	0.01	4
Mercedes	0.50	0.50	0.50	-	1.50	0.50	0.50	4.00	1
Sipocot	-0.50	1.50	0.50	-1.50	-	-0.50	-1.00	-1.49	5
Siruma	0.50	0.50	1.50	-0.50	0.50	-	1.50	4.01	1
Tinambac	1.50	1.50	-0.50	-0.50	1.00	-1.50	-	1.51	3

Table 161. Appraisal scores for the *multiple set of non-selective weighting*.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Appraisal Scores	Rank
Basud	-	0.50	-1.50	0.50	-0.50	-1.50	-1.50	-4.00	6
Cabusao	-0.50	-	-0.50	-0.50	-1.50	-0.50	-0.50	-4.00	6
Calabanga	1.50	0.50	-	0.50	-0.50	-0.50	1.50	3.00	1
Mercedes	-0.50	0.50	-0.50	-	1.50	0.50	0.50	2.00	2
Sipocot	0.50	1.50	0.50	-1.50	-	0.50	0.00	1.50	3
Siruma	1.50	0.50	0.50	-0.50	-0.50	-	-0.50	1.00	4
Tinambac	1.50	0.50	-1.50	-0.50	0.00	0.50	-	0.50	5

Table 162. Appraisal scores for the *single set of selective weighting*.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Appraisal Scores	Rank
Basud	-	0.50	-0.50	-1.50	0.50	-0.50	-0.50	-2.02	6
Cabusao	-0.50	-	-0.50	-1.50	-1.50	-0.50	-0.50	-5.00	7
Calabanga	1.00	0.50	-	-0.50	-0.50	-0.50	0.50	0.50	4
Mercedes	1.50	1.50	0.50	-	1.50	0.50	0.50	6.00	1
Sipocot	-0.50	1.50	0.50	-1.50	-	-0.50	-1.00	-1.50	5
Siruma	0.50	0.50	0.50	-0.50	0.50	-	0.50	2.00	2
Tinambac	0.50	0.50	-0.50	-0.50	1.50	-0.50	-	1.00	3

Table 163. Appraisal scores for the *multiple of selective weighting*.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Appraisal Scores	Rank
Basud		0.50	-0.50	-1.50	0.50	-0.50	-1.50	-3.02	6
Cabusao	-0.50	-	-1.50	-1.50	-1.50	-0.50	-0.50	-6.00	7
Calabanga	1.00	1.50	-	0.00	-0.50	0.50	-0.50	2.00	3
Mercedes	1.50	1.50	0.00	-	1.50	0.50	1.00	6.00	1
Sipocot	-0.50	1.50	0.50	-1.50	-	-0.50	-1.00	-1.50	5
Siruma	0.50	0.50	-0.50	-0.50	0.50	-	-0.50	0.00	4
Tinambac	1.50	0.50	0.50	-1.00	1.50	0.50	-	3.50	2

Table 164. Results of ranking for the Diverse-data Aggregation Technique for Fisheries Management Evaluation (DATFME) using non-selective and selective weightings

Means of Weighting	Types of weights	Ranking of the Municipalities
Non-selective	Single set	Mercedes=Siruma>Tinambac>Calabanga>Sipocot>Basud>Cabusao
	Multiple sets	Calabanga>Mercedes>Sipocot>Siruma>Tinambac>Basud=Cabusao
Selective	Single set	Mercedes>Siruma>Tinambac>Calabanga>Sipocot>Basud>Cabusao
	Multiple sets	Mercedes>Tinambac>Calabanga>Siruma>Sipocot>Basud>Cabusao

d) **Sensitivity Analysis**

A sensitivity analysis was done to determine the performance of the proposed method when some indicators were removed. Six indicators were removed namely, *abundance of reef fish, species richness of reef fish, status of coral reef resources, employment structure of small-scale fishers, financial support for enforcement,* and *financial support for additional livelihood.* The single set of selective weighting was used for the sensitivity analysis. The results in Table 162 and the sensitivity analysis in Table 165 are comparable. Although the municipality of Cabusao still remained lowest, Calabanga moved two ranks higher and is tied with Siruma and bypassing Tinambac while Sipocot moved one rank lower making it the municipality with the least impact of fisheries management. The municipalities of Mercedes, Siruma and Calabanga now occupy the top position in terms of the performance of management strategies. While the change in ranking of the municipalities could have been attributed to the removal of some of these indicators, it would be difficult to determine what made the rankings changed unless a stepwise sensitivity analysis is done. What is certain is that Mercedes, being the municipality with the highest impacts of fisheries management, is unaffected by the removal of these indicators, especially the indicators of biotic diversity criterion. Among the five criteria, the biotic diversity criterion has the most number of indicators whose information were unavailable or incomplete for most of the municipalities.

Table 165. Sensitivity analysis of the proposed method.

Municipalities	Basud	Cabusao	Calabanga	Mercedes	Sipocot	Siruma	Tinambac	Appraisal Scores	Rank
Basud	-	0.50	-0.50	-1.50	0.50	-0.50	-0.50	-2.00	5
Cabusao	-0.50	-	-1.50	-1.50	-0.50	-0.50	-1.50	-6.00	7
Calabanga	0.50	1.50	-	-0.50	1.50	-1.50	1.50	3.00	2
Mercedes	1.50	1.50	0.50	-	1.50	-0.50	1.50	6.00	1
Sipocot	-0.50	0.50	-1.50	-1.50	-	0.50	-1.50	-4.00	6
Siruma	0.50	0.50	1.50	0.50	-0.50	-	0.50	3.00	2
Tinambac	0.50	1.50	-1.50	-1.50	1.50	-0.50	-	0.00	4

The seven coastal municipalities of San Miguel are not so much different from each other. They experienced related issues such as resource degradation, poverty, lack of employment, income inequality, poor health and nutrition, limited access to safe water, and inadequate infrastructure (Dalusung 1992). Despite such similarities, there are municipalities that are consistently placed at the top mainly because of the interactions between the impact scores and the preference weights of criteria and indicators. For example, Mercedes stood out as the municipality with the highest impacts of management strategies in almost all of the multi-criteria evaluation methods (including the proposed one) because it outperforms the other municipalities in both the impact scores and weights of importance.

C. Conclusion

The application of multi-criteria framework in the evaluation of tropical coastal fisheries should not be viewed as a panacea but rather as a tool to make the most justifiable decisions resulting from multidisciplinary efforts. Often, political leaders or decision-makers are faced with the problem of what to do with the types of information and how to integrate them so that they can become usable for policy-making purposes. The issue of integration though essential is quite problematic in fisheries management because of alleged insufficiency in analytical methods. This is the main objective of this research-- to respond to this alleged insufficiency in analytical methods for fisheries impact evaluation by exploring existing methods from other disciplines. It is the purpose of this research to critically evaluate existing methods in order to modify or re-define them to be suitable for fisheries impact evaluation. While *multi-criteria analyses* show potentials in fisheries management because of their ability to: a) *provide a balance and integrate the various components of fisheries encompassing ecological, biological, social, economic and institutional objectives*; b) *incorporate judgments of the various stakeholders in fisheries*; c) *handle mixed information;* and c) *allow interactions between the objective and subjective measures of the criteria and indicators*, there are limits as to their application and these are summarized in Table 166.

Table 166. Limitations in the application of m*ulti-criteria evaluation methods* in fisheries management.

Factors	Limitations
Data management	- too laborious unless a computer program is developed to make computation easier; - although not seen as a crucial factor, complete data for the indicators are ideal to increase reliability of the results
Acceptability of the approach	- new in the field of fisheries management therefore the approach has to evolve into a more simplified one (i.e., the basic rule should be easily understood)
Capability of the resource users to apply it	- resource users with technical and analytical knowledge may be able to apply the multi-criteria approach but they would require extensive training
Financial Constraints	- multi-criteria evaluation is quite expensive because it involves participation of different stakeholders and extensive data collection thus, this should be part of a major coastal project or activity

To measure the outcomes of management in a holistic or integrated manner is often problematic and therefore, only fragments of change were usually dealt with (Hanson 2003) because there are restrictions and limitations in the measurement of change. Contributing to the limitations is the sense that each discipline (e.g., ecological/biological, social, political) has its own assumptions that need to be satisfied.

For example, Hruby (1999) indicated that statistical properties of decision-making models are different from that of ecological models, i.e., statistical approaches based on analysis of variance and normality of data are not appropriate when mixed qualitative and quantitative data or subjective judgments are incorporated.

A multi-criteria impact evaluation technique, Diverse-data Aggregation Technique for Fisheries Management Evaluation (DATFME), has been proposed in this research. It is based on the principles of three existing multi-criteria evaluation methods—Analytic Hierarchy Process (AHP), Concordance Analysis and Mixed-Data Evaluation Method (EVAMIX). The strengths and limitations of the Concordance Analysis and EVAMIX methods are considered in developing this technique. It recognizes the contribution of quantitative and qualitative data as well as the value judgment of coastal resource users in evaluating the impacts of fisheries management strategies. *Impact* is a measure of the deviation of the performance from a standard; however, at present there is no multi-dimensional standard or ideal situation in fisheries. Without any standard, change in criteria and indicators may be best estimated through pairwise comparisons.

In developing the proposed Diverse-data Aggregation Technique for Fisheries Management Evaluation (DATFME), the following issues were identified that could be addressed in future researches so as to increase reliability of the results:

1. *Choice of criteria and indicators*- select the criteria and indicators that are able to provide a clear link between goals/objectives of fisheries and fisheries management strategies. This would increase the certainty that the resulting impacts are actually due to management strategies and not any other factor.

Ideally, there should be a complete data set for the criteria and indicators. This however, may be a problem since as I mentioned earlier, no data set will ever be complete. The problem of having missing data was handled in this research by including in the analysis only the indicators that are common to the coastal areas being pairwise compared.

2. *Data collection, quality and analysis* - the temporal scale (initial and final) and methods of data collection have to be standardized so as to facilitate comparability of results. While impacts are usually analyzed by getting before and after data, a trend or time series analysis can be incorporated. This is possible in a long-term project or an activity that has a follow-up. And in order to increase the statistical power of quantitative and qualitative data analysis, it is recommended to increase the number of samples. Therefore, careful planning should be done prior to project implementation.

3. *Consistencies and reliability of human judgments and perceptions-* the perception of the resource users in judging the importance of the criteria and indicators and measuring the indicators are highlighted in this research. Chesson et al. (1999) emphasized that when the results of the analysis are not sensitive to different points of view, it is impractical to invest in trying to measure subjective weights by different stakeholders. This research, however, is sensitive to different view points—i.e., different resource users show varied preference as to what criteria or indicators would best characterize impacts of management. Since the Analytic Hierarchy Process is a new approach in coastal fisheries in the Philippines, the application of this

method has to be refined so that the problem of inconsistencies in judgment is resolved.

4. *Issue of interdependence and independence of coastal areas* - the proposed technique assumes that the coastal areas are independent, although management interventions may be similar for the coastal areas being compared. There is however, no sufficient evidence to correlate results of the appraisal scores with the independence of the coastal areas. Its application in this research is only limited to coastal fisheries that are geographically related. Further research is still needed to determine its utility when comparing distinct coastal fisheries. Through further research, it may be possible to determine whether geographical distance is a factor affecting appraisal scores. Does it mean that coastal areas geographically close to each other would have similar appraisal score difference, whereas, coastal areas far from each other would have the reverse case? The maximum appraisal score attainable is dependent on the number of coastal areas being compared. There is no restriction then to add new coastal area in the analysis.

5. *Measurement of overall impacts* - another issue that needs to be addressed in future research is whether it would be possible to calculate an overall impact or appraisal score of management strategies in the bay based on individual impacts. By elevating the technique to a higher level, it might be feasible to compare the impacts of collective management strategies between or among bays. The results then would provide policy-makers with an overall picture of

change as a result of management efforts so that they would know where efforts and resources be directed.

6. *Technical aspects* - it is not hard to understand the proposed technique; the difficulty was encountered when it was being developed because the process of combining Concordance Analysis and EVAMIX methods have to be carefully examined. To some extent the technique is labor intensive and time demanding, as data analysis requires extensive computation. Although computer programs such as Microsoft Excel made the analysis of the seven coastal municipalities and 24 indicators manageable, processing large amount of data can be problematic. Future research could focus then on developing computer software for DATFME.

This research supports the advocacy of local and international fisheries agreements such as the UN Agenda 21, Philippine Agenda 21, 1992 Rio Declaration on Environment and Development, 1995 Code of Conduct for Responsible Fishing to integrate social, economic, and environmental factors and incorporate stakeholders or resource users in decision-making. The process of integration, though essential in impact evaluation (because impacts have to be examined in a holistic approach) is quite problematic because of lack of mechanism to implement it. This largely affects the usability of research data that are continuously collected. Most of these data usually end up in government offices and research institutions, basically untapped and unanalyzed. The present and future direction in tropical developing fisheries evaluation is through the measurement of multiple effects of composite management strategies. This research was able to offer insights into the problems of complexity of tropical fisheries– that tools can be developed despite limited and uncertain information. The complex interactions of humans and the environment (especially in tropical coastal fisheries) create a difficult situation to rely on single level impact evaluation. Therefore, multi-disciplinary type of evaluation may take precedence over single-disciplinary ones.

Overall, the multi-criteria evaluation technique proposed in this research is a tool for integration of fragmented information. It is able to transform qualitative and quantitative information for decision-making purposes. To a certain degree, it can be cost-effective since one has the option to choose only information with policy implications. It creates a channel of information exchange between government, local communities and resource users therefore, facilitating multi-sectoral participation. It provides a way of dealing with scientific uncertainty through the knowledge and experience of the stakeholders with respect to management even in the face of diversity of opinions regarding impacts. It was able to use the inputs of the fishers without disregarding the science of fisheries management in an analytical framework.

APPENDIX 1

TYPICAL PROCEDURE FOR PAIRWISE COMPARISON IN THE ANALYTIC HIERARCHY PROCESS METHOD

CRITERIA	Acceptability	Biotic Diversity	Economic Performance	Enforceability	Equity
Acceptability	1.0				
Biotic Diversity		1.0			
Economic Performance			1.0		
Enforceability				1.0	
Equity					1.0

Acceptability Indicators	Resource users' participation in the fisheries management process	Level of awareness of resource users in fisheries resource management	Number of fishers who belong to an organization	Change in the level of intra-sectoral conflicts	Change in the level of inter-sectoral conflicts
Resource users' participation in the fisheries management process	1.0				
Level of awareness of resource users in fisheries resource management		1.0			
Number of fishers who belong to an organization			1.0		
Change in the level of intra-sectoral conflicts				1.0	
Change in the level of inter-sectoral conflicts					1.0

Biotic Diversity Indicators	Abundance of reef fish	Abundance of commercial fish catch	Species richness of reef fish	Extent of mangrove areas	Status of coral reef resources
Abundance of reef fish	1.0				
Abundance of commercial fish catch		1.0			
Species richness of reef fish			1.0		
Extent of mangrove areas				1.0	
Status of coral reef resources					1.0

Economic Performance	Number of commercial fishing boats & banned fishing gears	Fisherfolk gross revenue from fishing	Assessment of fisherfolk gross revenue from fishing	Employment structure of small-scale fisheries
Number of commercial fishing boats & banned fishing gears	1.0			
Fisherfolk gross revenue from fishing		1.0		
Assessment of fisherfolk gross revenue from fishing			1.0	
Employment structure of small-scale fisheries				1.0

Enforceability Indicators	Presence of comprehensible laws and regulations related to management	Frequency of information dissemination about the management	Perception on the suitability of enforcement techniques	Performance assessment of fisheries law enforcers	Financial support for fisheries law enforcement	Assessment of the allocated financial support for enforcement
Presence of comprehensible laws and regulations related to management	1.0					
Frequency of information dissemination about the management		1.0				
Perception on the suitability of enforcement techniques			1.0			
Performance assessment of fisheries law enforcers				1.0		
Financial support for fisheries law enforcement					1.0	
Assessment of the allocated financial support for enforcement						1.0

Equity Indicators	Profit distribution among different fishing gears	Amount of financial support for additional livelihood	Assessment of the success of additional livelihood implemented	Inclusion of women in the management process
Profit distribution among different fishing gears	1.0			
Amount of financial support for additional livelihood		1.0		
Assessment of the success of additional livelihood implemented			1.0	
Inclusion of women in the management process				1.0

APPENDIX 2

WORKSHOP ON WEIGHTING THE INDICATORS AND CRITERIA
(Simplified Method to Record the Consensus Weighting)

DATE ________________________________ TIME STARTED: __________
TIME END: ______

MUNICIPALITY _______________________

FARMC MEMBERS PARTICIPATING:

NAME	AGE	ADDRESS	EMPLOYMENT	POSITION IN THE FARMC

GUIDE QUESTION: How important is one indicator against another indicator in measuring a criterion? *(Gaano kahalaga ang isang palatandaan kung ikukumpara sa isa pang indicator upang gamiting panukat ng isang kriterion?)*

ACCEPTABILITY CRITERION

(Gaano kinilala, tinanggap at sinuportahan ng mga gumagamit ng baybaying dagat ang mga gawain sa pangangalaga nito)

Indicators for Acceptability

RESOURCE USERS' PARTICIPATION IN THE FISHERIES MANAGEMENT PROCESS *Pakikilahok ng mga gumagamit ng baybayin sa pamamaraan ng pangangasiwa*		LEVEL OF AWARENESS OF RESOURCE USERS IN FISHERIES RESOURCE MANAGEMENT *Antas ng kamulatan o kaalaman ng mga mga mamamayang inyong nasasakupan sa pangangasiwa ng baybayin*	

RESOURCE USERS' PARTICIPATION IN THE FISHERIES MANAGEMENT PROCESS *Pakikilahok ng mga gumagamit ng baybayin sa pamamaraan ng pangangasiwa*		NUMBER OF FISHERS WHO BELONG TO AN ORGANIZATION *Bilang ng mga mangingisda na kabilang ng organisasyon*	

RESOURCE USERS' PARTICIPATION IN THE FISHERIES MANAGEMENT PROCESS *Pakikilahok ng mga gumagamit ng baybayin sa pamamaraan ng pangangasiwa*		CHANGE IN THE LEVEL OF INTRA-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iisang sektor (halimbawa, di pagkakaunawaan sa pagitan ng mga maliliit na mangingsida)*	

RESOURCE USERS' PARTICIPATION IN THE FISHERIES MANAGEMENT PROCESS *Pakikilahok ng mga gumagamit ng baybayin sa pamamaraan ng pangangasiwa*		CHANGE IN THE LEVEL OF INTER-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iba't ibang sektor (halimbawa, sa pagitan ng mga maliliit na mangingisda at komersyal na mangingisda)*	

LEVEL OF AWARENESS OF RESOURCE USERS IN FISHERIES RESOURCE MANAGEMENT *Antas ng kamulatan o kaalaman ng mga mga mamamayang inyong nasasakupan sa pangangasiwa ng baybayin*		NUMBER OF FISHERS WHO BELONG TO AN ORGANIZATION *Bilang ng mga mangingisda na kabilang ng organisasyon*	

LEVEL OF AWARENESS OF RESOURCE USERS IN FISHERIES RESOURCE MANAGEMENT *Antas ng kamulatan o kaalaman ng mga mga mamamayang inyong nasasakupan sa pangangasiwa ng baybayin*		CHANGE IN THE LEVEL OF INTRA-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iisang sektor (halimbawa, di pagkakaunawaan sa pagitan ng mga maliliit na mangingsida)*	

LEVEL OF AWARENESS OF RESOURCE USERS IN FISHERIES RESOURCE MANAGEMENT *Antas ng kamulatan o kaalaman ng mga mga mamamayang inyong nasasakupan sa pangangasiwa ng baybayin*		CHANGE IN THE LEVEL OF INTER-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iba't ibang sektor (halimbawa, sa pagitan ng mga maliliit na mangingisda at komersyal na mangingisda)*	

NUMBER OF FISHERS WHO BELONG TO AN ORGANIZATION *Bilang ng mga mangingisda na kabilang ng organisasyon*		CHANGE IN THE LEVEL OF INTRA-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iisang sektor (halimbawa, di pagkakaunawaan sa pagitan ng mga maliliit na mangingsida*	

NUMBER OF FISHERS WHO BELONG TO AN ORGANIZATION *Bilang ng mga mangingisda na kabilang ng organisasyon*		CHANGE IN THE LEVEL OF INTER-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iba't ibang sektor (halimbawa, sa pagitan ng mga maliliit na mangingisda at komersyal na mangingisda)*	

CHANGE IN THE LEVEL OF INTRA-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iisang sektor (halimbawa, di pagkakaunawaan sa pagitan ng mga maliliit na mangingsida*		CHANGE IN THE LEVEL OF INTER-SECTORAL CONFLICTS *Pagbabago sa antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iba't ibang sektor (halimbawa, sa pagitan ng mga maliliit na mangingisda at komersyal na mangingisda)*	

BIOTIC DIVERSITY CRITERION

(Kakayahan ng mga gawain sa pangangalaga ng baybaying dagat na mapanatili ang dami ng mga hayop at halaman sa dagat)

Indicators for Biotic Diversity

ABUNDANCE OF REEF FISH *Dami ng mga isdang matatagpuan sa bahura*		ABUNDANCE OF COMMERCIAL FISH CATCH *Dami ng mga isdang komersyal o binibenta*	

ABUNDANCE OF REEF FISH *Dami ng mga isdang matatagpuan sa bahura*		SPECIES RICHNESS OF REEF FISH *Dami ng uri o klase ng mga isdang matatagpuan sa bahura*	

ABUNDANCE OF REEF FISH *Dami ng mga isdang matatagpuan sa bahura*		EXTENT OF MANGROVE AREAS *Kalawakan ng lugar na tinamnan ng bakawan*	

ABUNDANCE OF REEF FISH *Dami ng mga isdang matatagpuan sa bahura*		STATUS OF CORAL REEF RESOURCES *Kondisyon ng mga bahura*	

ABUNDANCE OF COMMERCIAL FISH CATCH *Dami ng mga isdang komersyal o binibenta*		SPECIES RICHNESS OF REEF FISH *Dami ng uri o klase ng mga isdang matatagpuan sa bahura*	

ABUNDANCE OF COMMERCIAL FISH CATCH *Dami ng mga isdang komersyal o binibenta*		EXTENT OF MANGROVE AREAS *Kalawakan ng lugar na tinamnan ng bakawan*	

ABUNDANCE OF COMMERCIAL FISH CATCH *Dami ng mga isdang komersyal o binibenta*		STATUS OF CORAL REEF RESOURCES *Kondisyon ng bahura*	

SPECIES RICHNESS OF REEF FISH *Dami ng uri o klase ng mga isdang matatagpuan sa bahura*		EXTENT OF MANGROVE AREAS *Kalawakan ng lugar na tinamnan ng bakawan*	

SPECIES RICHNESS OF REEF FISH *Dami ng uri o klase ng mga isdang matatagpuan sa bahura*		STATUS OF CORAL REEF RESOURCES *Kondisyon ng mga bahura*	

EXTENT OF MANGROVE AREAS *Kalawakan ng lugar na tinamnan ng bakawan*		STATUS OF CORAL REEF RESOURCES *(Kondisyon ng bahura)*	

ECONOMIC PERFORMANCE CRITERION

(Mga kapakinabangang dulot ng mga gawaing pangangalaga ng baybaying dagat)

Indicators for Economic Performance

NUMBER OF COMMERCIAL FISHING BOATS *Bilang ng mga komersyal na nangingisda sa baybayin*		FISHERFOLK GROSS REVENUE FROM FISHING *(Kabuuang kita mula sa pangisda)*	

NUMBER OF COMMERCIAL FISHING BOATS *Bilang ng mga komersyal na nangingisda sa baybayin*		ASSESSMENT OF FISHERFOLK GROSS REVENUE FROM FISHING *(Pagtatasa ng kabuuang kita mula sa pangisda)*	

NUMBER OF COMMERCIAL FISHING BOATS *Bilang ng mga komersyal na nangingisda sa baybayin*		EMPLOYMENT STRUCTURE OF SMALL-SCALE FISHERIEs *(Istruktura ng trabaho ng maliliit na mangingisda)*	

FISHERFOLK GROSS REVENUE FROM FISHING (Kita ng maliliit na mangingsida mula sa pangingsida)		ASSESSMENT OF FISHERFOLK GROSS REVENUE FROM FISHING *(Pagtatasa ng kabuuang kita mula sa pangisda)*	

FISHERFOLK GROSS REVENUE FROM FISHING (Kita ng maliliit na mangingsida mula sa pangingsida)		EMPLOYMENT STRUCTURE OF SMALL-SCALE FISHERIES *(Istruktura ng trabaho ng maliliit na mangingisda)*	

ASSESSMENT OF FISHERFOLK GROSS REVENUE FROM FISHING *(Pagtatasa ng kabuuang kita mula sa pangisda)*		EMPLOYMENT STRUCTURE OF SMALL-SCALE FISHERIES *(Istruktura ng trabaho ng maliliit na mangingisda)*	

ENFORCEABILITY CRITERION

(Gaano kaakma ang mga batas at regulasyon tungkol sa pangangalaga ng baybaying dagat at gaano kadali ang pagpapatupad ng mga ito)

Indicators for Enforceability

PRESENCE OF COMPREHENSIBLE LAWS AND REGULATIONS RELATED TO MANAGEMENT *(Pagkakaroon ng mga nauunawaang batas, regulasyon o ordinansa sa pangisda)*		FREQUENCY OF INFORMATION DISSEMINATION ABOUT THE MANAGEMENT *(Dalas ng pagkalat ng mga impor,asyon tungkol sa pangangasiwa ng baybaying dagat o CRM)*	

PRESENCE OF COMPREHENSIBLE LAWS AND REGULATIONS RELATED TO MANAGEMENT *(Pagkakaroon ng mga nauunawaang batas, regulasyon o ordinansa sa pangisda)*		PERCEPTION ON THE SUITABILITY OF ENFORCEMENT TECHNIQUES *(Pananaw tungkol sa pagiging angkop ng mga pamamaraan na ginagamit sa pagpapatupad ng mga batas pangisdaan)*	

PRESENCE OF COMPREHENSIBLE LAWS AND REGULATIONS RELATED TO MANAGEMENT *(Pagkakaroon ng mga nauunawaang batas, regulasyon o ordinansa sa pangisda)*		PERFORMANCE ASSESSMENT OF FISHERIES LAW ENFORCERS *(Pagtatasa ng kakayahan ng mga tagapagpatupad ng batas pangisda)*	

PRESENCE OF COMREPHENSIBLE LAWS AND REGULATIONS RELATED TO MANAGEMENT *(Pagkakaroon ng mga nauunawaang batas, regulasyon o ordinansa sa pangisda)*		FINANCIAL SUPPORT FOR FISHERIES LAW ENFORCEMENT *(Suportang pinansyal na inilaan at ginagamit sa pagpapatupad ng batas pangisda)*	

PRESENCE OF COMREPHENSIBLE LAWS AND REGULATIONS RELATED TO MANAGEMENT *(Pagkakaroon ng mga nauunawaang batas, regulasyon o ordinansa sa pangisda)*		ASSESSMENT OF THE ALLOCATED FINANCIAL SUPPORT FOR ENFORCEMENT *Pagtatasa ng pinansyal na suporta sa pagpapatupad ng batas sa baybayign dagat)*	

FREQUENCY OF INFORMATION DISSEMINATION ABOUT THE MANAGEMENT *(Dalas ng pagkalat ng mga impor,asyon tungkol sa pangangasiwa ng baybaying dagat o CRM)*		PERCEPTION ON THE SUITABILITY OF ENFORCEMENT TECHNIQUES *(Pananaw tungkol sa pagiging angkop ng mga pamamaraan na ginagamit sa pagpapatupad ng mga batas pangisdaan)*	

FREQUENCY OF INFORMATION DISSEMINATION ABOUT THE MANAGEMENT *(Dalas ng pagkalat ng mga impor,asyon tungkol sa pangangasiwa ng baybaying dagat o CRM)*		PERFORMANCE ASSESSMENT OF FISHERIES LAW ENFORCERS *(Pagtatasa ng kakayahan ng mga tagapagpatupad ng batas pangisda)*	

FREQUENCY OF INFORMATION DISSEMINATION ABOUT THE MANAGEMENT *(Dalas ng pagkalat ng mga impor,asyon tungkol sa pangangasiwa ng baybaying dagat o CRM)*		FINANCIAL SUPPORT FOR FISHERIES LAW ENFORCEMENT *(Suportang pinansyal na inilaan at ginagamit sa pagpapatupad ng batas pangisda)*	

FREQUENCY OF INFORMATION DISSEMINATION ABOUT THE MANAGEMENT *(Dalas ng pagkalat ng mga impor,asyon tungkol sa pangangasiwa ng baybaying dagat o CRM)*		ASSESSMENT OF ALLOCATED FINANCIAL SUPPORT FOR ENFORCEMENT *Pagtatasa ng pinansyal na suporta sa pagpapatupad ng batas sa baybayign dagat)*	

PERCEPTION ON THE SUITABILITY OF ENFORCEMENT TECHNIQUES *(Pananaw tungkol sa pagiging angkop ng mga pamamaraan na ginagamit sa pagpapatupad ng mga batas pangisdaan)*		PERFORMANCE ASSESSMENT OF FISHERIES LAW ENFORCERS *(Pagtatasa ng kakayahan ng mga tagapagpatupad ng batas pangisda)*	

PERCEPTION ON THE SUITABILITY OF ENFORCEMENT TECHNIQUES *(Pananaw tungkol sa pagiging angkop ng mga pamamaraan na ginagamit sa pagpapatupad ng mga batas pangisdaan)*		FINANCIAL SUPPORT FOR FISHERIES LAW ENFORCEMENT *(Suportang pinansyal na inilaan at ginagamit sa pagpapatupad ng batas pangisda)*	

PERCEPTION ON THE SUITABILITY OF ENFORCEMENT TECHNIQUES *(Pananaw tungkol sa pagiging angkop ng mga pamamaraan na ginagamit sa pagpapatupad ng mga batas pangisdaan)*		ASSESSMENT OF ALLOCATED FINANCIAL SUPPORT FOR ENFORCEMENT *(Pagtatasa ng pinansyal na suporta sa pagpapatupad ng batas sa baybayign dagat)*	

PERFORMANCE ASSESSMENT OF FISHERIES LAW ENFORCERS *(Pagtatasa ng kakayahan ng mga tagapagpatupad ng batas pangisda)*		FINANCIAL SUPPORT FOR FISHERIES LAW ENFORCEMENT *(Suportang pinansyal na inilaan at ginagamit sa pagpapatupad ng batas pangisda)*	

PERFORMANCE ASSESSMENT OF FISHERIES LAW ENFORCERS *(Pagtatasa ng kakayahan ng mga tagapagpatupad ng batas pangisda)*		ASSESSMENT OF ALLOCATED FINANCIAL SUPPORT FOR ENFORCEMENT *(Pagtatasa ng pinansyal na suporta sa pagpapatupad ng batas sa baybayign dagat)*	

FINANCIAL SUPPORT FOR FISHERIES LAW ENFORCEMENT *(Suportang pinansyal na inilaan at ginagamit sa pagpapatupad ng batas pangisda)*		ASSESSMENT OF ALLOCATED FINANCIAL SUPPORT FOR ENFORCEMENT *(Pagtatasa ng pinansyal na suporta sa pagpapatupad ng batas sa baybayign dagat)*	

EQUITY CRITERION

(Wastong pamamahagi ng mga likas yaman at malayang paggamit ng mga ito)

Indicators for Equity

PROFIT DISTRIBUTION AMONG DIFFERENT FISHING GEARS *(Pagbabaha-bahagi ng kita mula sa ibat ibang klase ng lambat pangisda)*		AMOUNT OF FINANCIAL SUPPORT FOR ADDITIONAL LIVELIHOOD *(Pinansyal na suporta para sa karagdagang pinagkukunan ng kabuhayan)*	

PROFIT DISTRIBUTION AMONG DIFFERENT FISHING GEARS *(Pagbabaha-bahagi ng kita mula sa ibat ibang klase ng lambat pangisda)*		ASSESSMENT OF THE SUCCESS OF ADDITIONAL LIVELIHOOD IMPLEMENTED *(Pagtatasa ng tagumpay ng mga programang dagdag kabuhayan)*	

PROFIT DISTRIBUTION AMONG DIFFERENT FISHING GEARS *(Pagbabaha-bahagi ng kita mula sa ibat ibang klase ng lambat pangisda)*		INCLUSION OF WOMEN IN THE MANAGEMENT PROCESS *(Antas ng partisipasyon ng mga kababaihan sa pangangasiwa ng baybaying dagat)*	

AMOUNT OF FINANCIAL SUPPORT FOR ADDITIONAL LIVELIHOOD *(Pinansyal na suporta para sa karagdagang pinagkukunan ng kabuhayan)*		ASSESSMENT OF THE SUCCESS OF ADDITIONAL LIVELIHOOD IMPLEMENTED *(Pagtatasa ng tagumpay ng mga programang dagdag kabuhayan)*	

AMOUNT OF FINANCIAL SUPPORT FOR ADDITIONAL LIVELIHOOD *(Pinansyal na suporta para sa karagdagang pinagkukunan ng kabuhayan))*		INCLUSION OF WOMEN IN THE MANAGEMENT PROCESS *(Antas ng partisipasyon ng mga kababaihan sa pangangasiwa ng baybaying dagat)*	

ASSESSMENT OF THE SUCCESS OF ADDITIONAL LIVELIHOOD IMPLEMENTED *(Pagtatasa ng tagumpay ng mga programang dagdag kabuhayan)*		INCLUSION OF WOMEN IN THE MANAGEMENT PROCESS *(Antas ng partisipasyon ng mga kababaihan sa pangangasiwa ng baybaying dagat)*	

WORKSHOP ON WEIGHTING THE CRITERIA

ACCEPTABILITY		BIOTIC DIVERSITY	

ACCEPTABILITY		ECONOMIC PERFORMANCE	

ACCEPTABILITY		ENFORCEABILITY	

ACCEPTABILITY		EQUITY	

BIOTIC DIVERSITY		ECONOMIC PERFORMANCE	

BIOTIC DIVERSITY		ENFORCEABILITY	

BIOTIC DIVERSITY		EQUITY	

ECONOMIC PERFORMANCE		ENFORCEABILITY	

ECONOMIC PERFORMANCE		EQUITY	

ENFORCEABILITY		EQUITY	

APPENDIX 3

INTENSITY SCALE OF IMPORTANCE

VALUE	IMPORTANCE	EXPLANATION
1	Equally important	Two criteria contribute equally to the evaluation of the impacts of management strategies
2	Equally to Moderately important	
3	Moderately important	Experience and judgment slightly favor one criterion over another
4	Moderately to Strongly important	
5	Strongly important	Experience and judgment strongly favor one criterion over another
6	Strongly important to Very Strongly important	
7	Very Strongly important	A criterion is strongly favored and its dominance is demonstrated in practice
8	Very Strongly important to Extremely important	
9	Extremely important	The evidence favoring one criterion over another is of the highest possible order of affirmation

DALHOUSIE
University

APPENDIX 4

QUESTIONNAIRE

CODE: ______________

PETSA: ______________

Name *(Pangalan)*: ____

Address *(Tirahan)*: Barangay/Sitio ____________________ Municipality ____________________

How many years have you been living in the following? *(Ilang taon ka nang naninirahan sa mga sumusunod?)*

This Barangay ________________ This municipality ______________

Sex *(Kasarian) (Lagyan ng tsek)*: Male *(Lalake)* ________ Female *(Babae)* ______

Age *(Edad)*: _________

Educational attainment *(Antas ng pag-aaral na naabot- Lagyan ng tsek kung ano ang akma sa inyo)*

None *((Wala)* _____ Elementary _____ High School ____Vocational/Technical _____

College ______ Masters/PhD _______

Marital Status *(Lagyan ng tsek)*:

Single _____ Married (*May-asawa*) _____ Separated (*Hiwalay*) _____ Live-in ______

Number of children *(Bilang ng mga anak)* ________

Employment *(ano ang iyong trabaho?)* ____________________________________

Address of employer *(Saan nagtatrabaho?)* ____________________________________

Do you belong to any of the following? *(Ikaw ba ay kabilang sa mga sumusunod?)*

Sector *(Sektor)*	To which group do you belong? Put a check. *(Saang grupo ka kabilang? Lagyan ng tsek)*	Name of the organization *(Pangalan ng organisasyon)*	Position *(Katungkulan)*
Fisherman *(Mangingsida)*			
People's Organization (PO)			
Non-government organization (NGO)			
Local Government Unit (LGU)			
Women *(Kababaihan)*			
Youth *(Kabataan)*			
Others *(Iba pa..)*			

When did you start to participate in Coastal Resource Management (CRM) activities? *(Kailan ka nagsimulang sumali sa CRM?)*

____

CODE: ______________

WORKSHOP ON THE ASSIGNMENT OF SCORES FOR THE INDICATORS
(Workshop sa Pagtatalaga ng mga Marka o Iskor sa mga Indicators)

1. RESOURCE USERS' PARTICIPATION IN THE FISHERIES MANAGEMENT PROCESS *(PAKIKILAHOK NG MGA GUMAGAMIT SA BAYBAYIN SA MGA PAMAMARAAN NG PANGANGASIWA NG BAYBAYING DAGAT)*

a) Using the table below, do the following:
- Check column 2 for corresponding activity in column 1
- If you are part of the intervention but present in another barangay, put the name of the barangay in column 2
- If the intervention is present in your community but your sector is not part of it, check column 3
- If the intervention is present in your community and your sector is part of it, then check which of the management process is your sector part of)

(Sa pamamagitan ng table sa ibaba, gawin ang mga sumusunod:
- *lagyan ng tsek ang kolum 2 kung ang gawain sa kolum 1 ay makikita sa inyong lugar*
- *kung kasama ka sa isang gawain ngunit makikita sa ibang barangay, ilagay ang pangalan ng barangay sa kolum 2*
- *kung ang isang gawain ay nasa inyong lugar ngunit di kasama ang inyong sektor sa pagpaplano, pagpapatupad, pagmomonitor at ebalweyt, lagyan ng tsek ang kolumn 3*
- *kung ang inyong sektor ay parte ng proseso, tsekan kung anong proseso kayo kasama.*

Fisheries Management Interventions *(Mga gawain sa pangangasiwa ng baybaying dagat)*	Put a check if activity is present in your community *(Lagyan ng tsek kung meron sa inyong lugar)*	Present but my sector is not part of it *(Meron ngunit di kasama ang sektor na aking kinakatawan (lagyan ng tsek)*	Present and my sector is part of the following: *(Meron at kasama ang aking sektor sa mga sumusunod na proseso)*			
			Conceptualization *(Pag-iisip at pagpaplano ng mga gawain)*	Implementation *(Pagpapatupad ng mga plano)*	Monitoring *(Pagmomonitor ng mga pinatutupad na plano)*	Evaluation *(Pagtatasa ng mga pinatupad na plano)*
Mangrove Reforestation *(Pagtatanim ng mga bakawan)*						

Fisheries Management Interventions *(Mga gawain sa pangangasiwa ng baybaying dagat)*	Put a check if activity is present in your community *(Lagyan ng tsek kung meron sa inyong lugar)*	Present but my sector is not part of it *(Meron ngunit di kasama ang sektor na aking kinakatawan (lagyan ng tsek)*	Present and my sector is part of the following: *(Meron at kasama ang aking sektor sa mga sumusunod na proseso)*			
			Conceptualization *(Pag-iisip at pagpaplano ng mga gawain)*	Implementation *(Pagpapatupad ng mga plano)*	Monitoring *(Pagmomonitor ng mga pinatutupad na plano)*	Evaluation *(Pagtatasa ng mga pinatupad na plano)*
Establishment of Marine Fishery Reserves and Fish Sanctuary *(Pagtatatag ng mga reserves at sanktuwaryo ng isda)*						
Deployment of artificial reefs *(Paglalagay ng mga bahura)*						
Gear and vessel restrictions *(Pagbabawal sa mangilan-ngilang lambat at bangka)*						
Alternative livelihood *(Pagkakaroon ng karagdagang pinagkakakitaan)*						
Modification of licensing system *(Pagbabago ng sistema ng pagbibigay ng lisensiya sa pangisda)*						
Others *(Iba pa)*						

b) How would you rate resource users' involvement in the management of fisheries resources? Encircle the score below.
Ano ang masasabi mo sa pakikilahok ng sektor na iyong kinakatawan sa pamamaraan ng pangangasiwa ng baybaying dagat? Bilugan ang iskor sa ibaba.)

Conceptualization *(Pag-iisip at pagpaplano ng mga gawain)*	0 1 2 3 4 5 6 7 8 9 10 None *(walang pakikilahok)* Sometimes *(paminsan-minsan)* Moderate *(50% of the time* Often *(madalas)* Always *(palagi)*
Implementation *(Pagpapatupad ng mga plano)*	0 1 2 3 4 5 6 7 8 9 10 None *(walang pakikilahok)* Sometimes *(paminsan-minsan)* Moderate *(50% of the time* Often *(madalas)* Always *(palagi)*
Monitoring *(Pagmomonitor ng mga pinatutupad na plano)*	0 1 2 3 4 5 6 7 8 9 10 None *(walang pakikilahok)* Sometimes *(paminsan-minsan)* Moderate *(50% of the time* Often *(madalas)* Always *(palagi)*
Evaluation *(Pagtatasa ng mga pinatupad na plano)*	0 1 2 3 4 5 6 7 8 9 10 None *(walang pakikilahok)* Sometimes *(paminsan-minsan)* Moderate *(50% of the time* Often *(madalas)* Always *(palagi)*

2. **LEVEL OF AWARENESS OF RESOURCE USERS IN FISHERIES RESOURCE MANAGEMENT *(ANTAS NG KAMULATAN/KAMALAYAN NG MGA MAMAMAYAN NG BARANGAY SA PANGANGASIWA NG BAYBAYING DAGAT)***

a) What is the level of awareness of resource users? *(Ano ang antas ng kamulatan/kamalayan ng mga mamamayan ng inyong barangay sa baybaying dagat?)*

0 1 2 3 4 5 6 7 8 9 10

None/very low *(waa/napakababa)* — low *(mababa)* — moderate *(bahagya)* — high *(mataas)* — very high *(napakataas)*

Other answer *(Iba pang sagot, halimbawa may alam ngunit walang aksyon)* ______________________

____

3. **CHANGE IN THE LEVEL OF INTRA-SECTORAL CONFLICTS *(PAGBABAGO SA ANTAS NG ALITAN NG MGA KASAPI NA NABIBILANG SA IISANG SEKTOR (HALIMBAWA, DI PAGKAKAUNAWAAN SA PAGITAN NG MGA MALILIIT NA MANGINGISDA)***

a) In the past 10 years, was there a conflict between small-scale fishers? *(Sa nakalipas na 10 taon, meron ka bang napapansing alitan sa pagitan ng mga maliliit na mangingisda?)*

Yes *(Meron)* ____
None *(Wala)* ____
I don't know *(Hindi ko alam)* ____

If yes, answer the following *(Kung meron, sagutin ang mga sumusunod)*
- What kind of conflict? *(Anong klaseng alitan?)* ____

____

b) When management interventions were introduced, did you notice a change in the relationship between small-scale fishers? Was there a change in the level of conflict? *(Nang magkaroon ng mga CRM, may pagbabago ba sa relasyon ng mga maliliit na mangingisda? Nabawasan ba ang alitan?)*

Yes *(Oo)* ______ No *(Wala)* _____

If yes, rate the level of change. Encircle your answer below. *(Kung oo, nasa ano nang lebel ang pagbabago, bilugan ang iyong sagot sa ibaba).*

-10	Worst than before *(Mas malala kesa dati)*
-8	Increased very much *(Napakalaki ang pagtaas)*
-6	
-4	Increased/Present most of the time *(Madalas ang di pagkakaunawaan)*
-2	
0	No change/the same level *(Walang pagbabago)*
2	
4	Decreased (bumaba)
6	
8	Decreased highly *(Nabawasan ng malaki)*
10	No more conflicts *(Nawala ang di pagkakaunawaan)*

Comments *(Komento)* ____

____

4. **CHANGE IN THE LEVEL OF INTER-SECTORAL CONFLICTS *(PAGBABAGO SA ANTAS NG ALITAN NG MGA KASAPI NA NABIBILANG SA IBA'T IBANG SEKTOR (HALIMBAWA, SA PAGITAN NG MGA MALILIIT AT KOMERSYAL NA MANGINGISDA)***

a) In the past 10 years, was there conflicts between fisheries sectors (e.g., small fishers vs. trawlers)? *(Sa nakalipas na 10 taon, meron ka bang napapansing alitan sa pagitan ng iba't ibang sektor tulad ng mga maliliit na mangingisda at komersyal (e.g., trawlers)?)*

Yes *(Meron)* ____
None *(Wala)* ____
I don't know *(Hindi ko alam)* ________

If yes, answer the following *(Kung meron, sagutin ang mga sumusunod)*

- What kind of conflict? *(Anong klaseng alitan*____
____
- When management interventions were introduced, did you notice a change in the relationship between small-scale and commercial fishers? Was there a change in the level of conflict? *(Nang magkaroon ng mga CRM, may pagbabago ba sa relasyon ng mga maliliit at komersyal na mangingisda? Nabawasan ba ang alitan?)*
  Yes *(Oo)* ______ No *(Wala)* _____

If yes, rate the level of change. Encircle your answer below. *(Kung oo, nasa ano nang lebel ang pagbabago, bilugan ang iyong sagot sa ibaba).*

-10	Worst than before *(Mas malala kesa dati)*
-8	Increased very much *(Napakalaki ang pagtaas)*
-6	
-4	Increased/Present most of the time *(Madalas ang di pagkakaunawaan)*
-2	
0	No change/the same level *(Walang pagbabago)*
2	
4	Decreased (bumaba)
6	
8	Decreased highly *(Nabawasan ng malaki)*
10	No more conflicts *(Nawala ang di pagkakaunawaan)*

Comments *(Komento)* ____
____

5. ASSESSMENT OF FISHERFOLK GROSS REVENUE FROM FISHING *(PAGTATASA SA KABUUANG KITA MULA SA PANGISDA)*

a) How would you assess the annual gross revenue from fishing before and after the implementation of management interventions? Or compared to 10 years ago? *(Ano po ang masasabi nyo sa kabuuang kinikita sa isang taon mula sa pangisda matapos ilagay ang mga gawaing may kinalaman sa pangangasiwa ng baybaying dagat? O kung ikumpara 10 taon na ang nakalilipas?)*

-10	Decreased very much *(Bumaba ng malakii)*
-8	Decreased *(Bumaba)*
-6	
-4	Decreased slightly *(Bahagyang bumaba)*
-2	
0	No change *(Walang pagbabago/pareho ng dati)*
2	
4	Increased slightly *(Bahagyang tumaas)*
6	
8	Increased *(Tumaas)*
10	Increased very much *(Malaki ang pagtaas)*

b) Please indicate how much was the change. *(Pakilagay kung ilang persentahe ang ibinaba o itinaas ng kita.)* ____________________

Comments *(Komento)* ____________________

6. **PRESENCE OF COMPREHENSIBLE LAWS AND REGULATIONS RELATED TO MANAGEMENT *(PAGKAKAROON NG MGA NAUUNAWAANG BATAS, REGULASYON O ORDINANSA SA PANGISDA)***

a) Are there laws, regulations, ordinance on fisheries in your barangay and municipality? *(Meron po bang mga batas, resolusyon o ordinansa tungkol sa pangisda sa inyong barangay at munisipyo?*

Yes *(Meron)* ____
None *(Wala)* ____
I don't know *(Hindi ko alam)* ________

If yes, answer the following: *(Kung oo, sagutin ang mga sumusunod)*

- Have you read them? *(Nabasa mo ba ang mga ito?)* Yes *(Oo)* ___ No *(Hindi)* ____
- If yes, how comprehensible are they? *(Kung oo, gaano mo nauunawaan ang mga ito?)*

0 — Incomprehensible *(Hindi nauunawaan)*
1
2
3 — Slightly comprehensible *(Bahagyang nauunawaan)*
4
5 — Moderately comprehensible *(Malinaw ang pagkakasulat at naiintindihan ang kabuuan,*
6 *may ilang tao ang nakakaunawa)*
7 — Strongly comprehensible *(Nauunawaan ng marami dahil malinaw at naiintindihan ang*
8 *pagkakasulat)*
9
10 — Very strongly comprehensible *(Madaling maiintindihan)*

- In what language are they written? *(Sa anong wika insinulat ang mga ito?)*
  Barangay? Ingles ____ Tagalog ______ Others ________________________________
  Municipality *(Munisipalidad)*? Ingles ____ Tagalog ______ Others _________

- If written in English, were they translated to local dialect? *(Kung isinulat sa Ingles, naisalin ba ito sa wikang lokal?)*
  Yes *(Oo)* _____ No *(Hindi)* ______ I don't know *(Hindi ko alam)* ________

- If not written or translated to local dialect, would you want them to be translated?
  Yes *(Oo)* _____ No *(Hindi)* ______ I don't know *(Hindi ko alam)* ________

- Do you have reading materials (e.g., comics, pamphlet, newsletter, etc.) which have helped you understand the laws, regulations and ordinance? *(Meron ba kayong dagdag na babasahin tulad ng komiks, pamplet, newsletter, etc. na nakatulong sa inyong pag-unawa ng mga batas, regulasyon o ordinansa?)*
  Yes *(Oo)* _____ No *(Hindi)* ______ I don't know *(Hindi ko alam)* ________

Comments *(Komento)* ____
____

7. **FREQUENCY OF INFORMATION DISSEMINATION ABOUT THE MANAGEMENT *(DALAS NG PAGKALAT NG MGA IMPORMASYON TUNGKOL SA PANGANGASIWA NG BAYBAYING DAGAT O CRM)***

How frequent are information on the management of fisheries resources disseminated to the community? *(Nakakaabot ba sa inyong kalaman ang mga impormasyon patungkol sa wastong pangangasiwa ng baybaying dagat?)*

0 — Never *(Hindi nakakaabot)*
1 —
2 — Irregularly *(Madalang na nakakaabot, isang beses isang taon)*
3 —
4 —
5 — Sometimes *(Nakakaabot paminsan-minsan, 2-3 beses isang taon)*
6 —
7 —
8 — Regularly *(Madalas na nakakaabot, regular na nakakatanggap)*
9 —
10 — Always *(Palaging nakakaabot)*

Comments *(Komento)*____

8. PERCEPTION ON THE SUITABILITY OF ENFORCEMENT TECHNIQUES *(PANANAW TUNGKOL SA PAGIGING ANGKOP NG MGA PAMAMARAAN NA GINAGAMIT SA PAGPAPATUPAD NG MGA BATAS PANGISDAAN SA INYONG BARANGAY)*

a) Do you know if the following enforcement techniques are present in your municipality? Pls. check. *(Alam mo ba kung ang mga sumusunod na enforcement teknik ay meron sa inyong munisipalidad? Paki-tsek.)*

ENFORCEMENT TECHNIQUES *(PAMAMARAAN SA PAGPAPATUPAD NG MGA BATAS PANGISDAAN)*	**YES *(Oo)***	**NONE *(Wala)***	**I DON'T KNOW *(Di ko alam)***
Patrol *(Pagpapatrolya ng baybaying dagat)*			
Placing of markers to determine boundaries *(Paglalagay ng mga marka tulad ng boya upang malaman kung hanggang saan sa baybaying dagat ang sakop ng munisipyo)*			
Use of media to expose illegal activities *(Paggamit ng media upang ihayag ang mga ilegal na gawain sa baybaying dagat)*			
Presence of training or seminars *(Pagkakaroon ng training o seminar)*			
Others *(Iba pa)*			

b) How suitable are these enforcement techniques utilized in enforcing the laws and regulations related to the management of fisheries resources? *(Gaano kaangkop ang mga pamamaraan sa pagpapatupad ng mga batas pangisdaan sa inyong barangay o munisipyo?)*

0 — Not applicable *(Hindi angkop)*
1 —
2 — Slightly applicable *(Bahagyang angkop, 1 2 teknik lamang)*
3 —
4 —
5 — Moderately applicable *(Marami sa mga teknik ay angkop ang kabuuan, may ilang tao ang nakakaunawa)*
6 —
7 —
8 — Strongly applicable *(Napaka-angkop at epektibo ang mga teknik)*
9 —
10 — Very strongly applicable *(Walang kaduda-dudang angkop at epektibo ang mga teknik)*

Patrol *(Pagpapatrolya ng baybayin)*	0 1 2 3 4 5 6 7 8 9 10 Not Applicable · Slightly · Moderately · Strongly · Very Strongly
Placing of markers to determine the boundaries *(Paglalagay ng mga marka tulad ng boya upang malaman kung hanggang saan sa baybaying dagat ang sakop ng munisipyo)*	0 1 2 3 4 5 6 7 8 9 10 Not Applicable · Slightly · Moderately · Strongly · Very Strongly
Use of media to expose illegal activities *(Paggamit ng media upang ihayag ang mga ilegal na gawain sa baybaying dagat)*	0 1 2 3 4 5 6 7 8 9 10 Not Applicable · Slightly · Moderately · Strongly · Very Strongly
Presence of training or seminars *(Pagkakaroon ng training o seminar)*	0 1 2 3 4 5 6 7 8 9 10 Not Applicable · Slightly · Moderately · Strongly · Very Strongly
Others *(Iba pa)*	0 1 2 3 4 5 6 7 8 9 10 Not Applicable · Slightly · Moderately · Strongly · Very Strongly

c) Aside from the above, do you know of any other enforcement techniques? *Bukod sa nabanggit, may alam pa po ba kayong pamamaraan na sa inyong palagay ay makakatulong sa pagpapatupad ng mga batas, regulasyon o ordinansa na maaaring gamitin ngunit hindi pa ginagawa?)*

Yes *(Oo)* _____ None *(Wala)* ______

If yes, what are these? *(Kung oo, ano-ano ang mga ito?)* ________________________________

Comments *(Komento)* ____

9. **PERFORMANCE ASSESSMENT OF FISHERIES LAW ENFORCERS *(PAGTATASA NG KAKAYAHAN NG MGA TAGAPAGPATUPAD NG BATAS PANGISDA)***

a) When the management interventions were put in place, were there fishery law enforcers? *(Nang itatag ang mga gawaing may kinalaman sa pangangasiwa ng baybaying dagat (halimbawa, noong taon ng FSP) o CRM, mayroon ba kayong tagapagpatupad ng batas pangisda tulad ng Bantay Dagat?*

Yes *(Oo)* _____ No *(Hindi)* ______ I don't know *(Hindi ko alam)* ________

- If yes, what are they called? *(Kung oo, ano ang tawag sa kanila?)* ____________________
- Are you a member of Bantay Dagat, Deputized Fishery Warden (DFW), Fishery Law Enforcement Team (FLET)?
  Yes *(Oo)* _____ No *(Hindi)* ______
- How effective are the fishery law enforcers? Assess their performance over time using the table below. *(Gaano ka-epektibo ang mga tagapagpatupad ng batas pangisda? I-assess ang kanilang gawain sa pamamagitan ng table sa ibaba.)*

Before (10 years ago) *(Noong araw, 10 taon na nakalipas)*	0 1 2 3 4 5 6 7 8 9 10 Poor *(hindi epektibo laganap pa rin ang ilegal)* · Slightly *(bahagyang epektibo)* · Moderately *(50% epektibo)* · Strongly *(75% epektibo)* · Very strongly *(Napaka-epektibo)*
Now *(Sa kasalukuyan)*	0 1 2 3 4 5 6 7 8 9 10 Poor *(hindi epektibo laganap pa rin ang ilegal)* · Slightly *(bahagyang epektibo)* · Moderately *(50% epektibo)* · Strongly *(75% epektibo)* · Very strongly *(Napaka-epektibo)*

Comments *(Komento)*

____

____

10. ASSESSMENT OF THE ALLOCATED FINANCIAL SUPPORT FOR ENFORCEMENT *(SUPORTANG PINANSYAL NA INILAAN AT GINAGAMIT SA PAGPAPATUPAD NG BATAS PANGISDA)*

a) Does your municipality provide financial support for enforcement? *(Mayroon po bang suportang pinansyal na ibinibigay ang munisipyo hinggil sa pagpapatupad ng batas pangisda?)*

Yes *(Oo)* _____ No *(Hindi)* ______ I don't know *(Hindi ko alam)* ________

- If yes, how much? *(Kung mayroon, magkano?)* ______________________________
- Is this support for enforcement given regularly? Encircle answer below. *(Regular bang ibinibigay ang suportang ito? Bilugan ang sagot sa ibaba.)*

0 — Not regular *(Hindi regular, kung maisipan o may mag-request)*
1 —
2 — Once a year *(Isang beses bawat taon)*
3 —
4 — Twice a year *(Dalawang beses bawat taon)*
5 —
6 — Quarterly *(Tuwing ika-apat na buwan)*
7 —
8 — Monthly *(Buwan-buwan)*
9 —
10 — Every 15th day *(Kada kinsenas)*

b) How sufficient is the financial support? *(Sa inyong palagay, sapat ba ang suportang pinansyal na ibinibigay sa pagpapatupad ng batas pangisda?)*

0	1	2	3	4	5	6	7	8	9	10
not sufficient *(hindi sapat)* *sapat)*		slightly *(bahagyang sapat)*			moderately *(50% na sapat)*			strongly *(75% na sapat)*		very strongly *(napakasapat)*

Comments *(Komento)* ____
____

11. **ASSESSMENT OF SUCCESS OF ADDITIONAL LIVELIHOOD IMPLEMENTED *(TAGUMPAY NG MGA PROGRAMANG DAGDAG KABUHAYAN)***

a) Were there alternative livelihoods to reduce exploitation of fisheries resource? *(Nagkaroon po ba ng programang dagdag kabuhayan upang mabawasan ang exploytasyon sa inyong baybaying dagat?)*

Yes *(Oo)* _____ No *(Hindi)* ______ I don't know *(Hindi ko alam)* ________

- If yes, what are these? *(Kung oo, ano-ano ang mga programang ito?)*

  ____

- Are the alternative livelihoods successful? *(Sa inyong pananaw, ang mga programang ito ba ay naging matagumpay upang mabawasan ang exploytasyon ng inyong baybaying dagat?)*

0	1	2	3	4	5	6	7	8	9	10
failure *(hindi matagumpay)*		slightly successful *(bahagya)*			moderately successful *(matagumpay ng50%)*			strongly successful *(matagumpay ng 75%)*		very strongly *(napakatagumpay, umangat ng malaki an maliliit na mangingsida)*

Comments *(Komento)* ____

____

12. **INCLUSION OF WOMEN IN THE MANAGEMENT PROCESS *(ANTAS NG PARTISIPASYON NG MGA KABABAIHAN SA PANGANGASIWA NG BAYBAYING DAGAT)***

a) Do women participate in the management process? *(May pakikilahok ba ang mga kababaihan sa proseso ng pangangalaga ng baybaying dagat?)*

Yes *(Oo)* _____ No *(Hindi)* ______ I don't know *(Hindi ko alam)* ________

If yes, what is the level of women's participation in the management of fisheries resources? *(Kung oo, ano ang antas ng partisipasyon ng mga kababaihan sa pangangasiwa ng baybaying dagat?)*

0	1	2	3	4	5	6	7	8	9	10
None *(wala)*		Very limited *(napakalimitado)*			50% of the management process *(50% ng proseso ng pangangasiwa)*		High (mataas)			Very high *(sa lahat ng proseso)*

Comments *(Komento)* ____

____

APPENDIX 5

ADDITIONAL QUESTIONS

Pls. check your answer. (DAGDAG NA KATANUNGAN—(Lagyan ng tsek ang inyong sagot)

1. Are there laws or regulations that prohibit trawling in your coastal area? *(May batas po ba na nagbabawal ng trawling sa inyong baybayin?)*
   Yes *(Oo)* _____ None *(Wala)* ____ I don't know *(Hindi ko alam)* ______

2. Are there mangroves in your barangay? *(May bakawan ba sa inyong barangay?)*
   Yes *(Oo)* _____ None *(Wala)* ____ I don't know *(Hindi ko alam)* ______

3. Have you been involved in the planting of mangroves? *(Nakapagtanim na po ba kayo ng bakawan)*
   Yes *(Oo)* _____ Not yet *(Hindi pa)* ____

4. Are there posters or notices in your coastal barangays where prohibited fishing practices are indicated? *(May nakikita po ba kayong mga babala, paunawa na nakasulat sa mga buletin board na naglalahad ng inyong ordinansa tungkol sa pangisda?)*
   Yes *(Oo)* _____ None*(Wala pa)* ____

5. Has your municipal waters been partitioned into zones? *(Na-sona na ba ang inyong baybaying dagat?)*
   Yes *(Oo)* _____ None *(Hindi pa)* ____ I don't know *(Hindi ko alam)* ______

6. Are there artificial reefs installed in your coastal barangay? *May inilagay na po bang bahura sa inyong lugar?)*
   Yes *(Oo)* _____ None *(Wala)* ____ I don't know *(Hindi ko alam)* ______

   If yes, when was it established? *(Kung meron, kailan ito inilagay?)* ________________________

7. Is there a fishery reserve/sanctuary in your barangay? *(May sanktuwaryo po ba ng isda sa inyong lugar?)*
   Yes *(Oo)* _____ None *(Wala)* ____ I don't know *(Hindi ko alam)* ______

8. Can one fish inside the sanctuary? *(Maaari po bang mangisda sa loob ng sanktuwaryo?)*
   Yes *(Oo)* _____ None *(Wala)* ____ I don't know *(Ewan ko)* ______

9. Does your municipality have a municipal fisheries ordinance? *(Meron bang ordinansa tungkol sa pangisda sa inyong munisipyo?)*
   Yes *(Oo)* _____ None *(Wala pa)* ____ I don't know *(Hindi ko alam)* ______

10. Have you read something about coastal resource management?
    Yes *(Oo)* _____ None *(Wala pa)* ____

11. Have you attended a training or seminar on fisheries *(Naka-atend ka na ba ng seminar o training sa fisheries?)*
    Yes *(Oo)* _____ Not yet *(Wala pa)* ____
    If yes, about what and when *(Kung oo, ano at kailan?)* ________________________________

12. Are you still getting large fishes in your coastal area? *(Malalaki pa ba ang mga nahuhuling isda sa inyong baybay?)*
    Yes *(Oo)* _____ No *(Hindi na)* ____ I don't know *(Hindi ko alam)* ______

13. Are there fisherfolk organizations in your barangay or municipality? *(May organisasyon ba ng mangingisda sa inyong barangay o munsipyo?)*
    Yes *(Oo)* _____ None *(Wala)* ____ I don't know *(Hindi ko alam)* ______
    If yes, what are these? *(Kung oo, ano-ano ang mga ito?)* ________________________________

APPENDIX 6

EXPLANATION OF THE CRITERIA AND INDICATORS (TRANSLATED TO TAGALOG/FILIPINO)

CRITERIA (KRITERYA)	INDICATORS	TAGALOG/FILIPINO VERSION OF THE INDICATORS
ACCEPTABILITY *(Tumutukoy kung gaano tinanggap, kinilala, at sinuportahan ng mga gumagamit ng baybayin ang mga pamamaraan ng pangangasiwa nito o mga gawaing Coastal resource Management (CRM))*	Resource users participation in the fisheries management process	*Pakikilahok ng mga gumagamit ng baybayin sa pamamaraan ng pangangasiwa*
	Level of awareness of resource users in fisheries resource management	*Antas ng kamulatan o kaalaman ng mga mga mamamayang inyong nasasakupan sa pangangasiwa ng baybayin*
	Number of fishers who belong to an organization	*Bilang ng mga mangingisda na kabilang ng organisasyon*
	Change in the level of intra-sectoral conflicts	*Pagbabago ng antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iisang sektor (halimbawa, di pagkakaunawaan sa pagitan ng mga maliliit na mangingsida)*
	Change in the level of inter-sectoral conflicts	*Pagbabago ng antas ng di pagkaka-unawaan ng mga kasapi na nabibilang sa iba't ibang sektor (halimbawa, sa pagitan ng mga maliliit na mangingisda at komersyal na mangingisda)*
BIOTIC DIVERSITY *(Tumutukoy sa kakayanan ng mga pamamaraan ng pangangasiwa ng baybaying dagat o CRM na mapanatili ang dami at uri ng mga hayop at halaman sa karagatan.)*	Abundance of reef fishes	*Dami ng mga isdang matatagpuan sa bahura*
	Abundance of commercial fish catch	*Dami ng mga isdang komersyal o binibenta*
	Species richness of reef fish	*Dami ng uri o klase ng mga isdang matatagpuan sa bahura*
	Extent of mangrove areas	*Kalawakan ng lugar na tinamnan ng bakawan*
	Status of coral reef resources	*Kondisyon ng mga bahura*
ECONOMIC PERFORMANCE	Number of commercial fishing boats	*Bilang ng mga komersyal na nangingisda sa baybayin*

CRITERIA (KRITERYA)	INDICATORS	TAGALOG/FILIPINO VERSION OF THE INDICATORS
(Mga kapakinabangang dulot ng mga pamamaraan ng pangangasiwa ng baybaying dagat o gawaing CRM)	Fisherfolk gross revenue from fishing	*Kabuuang kita mula sa pangisda ng inyong nasasakupang barangay*
	Assessment of fisherfolk gross revenue from fishing	*Pagtatasa ng kabuuang kita mula sa pangisda ng inyong nasasakupang barangay*
	Employment structure of small-scale fisheries	*Istruktura ng hanapbuhay ng mga maliliit na mangingsida*
ENFORCEABILITY *(Sinasaalang-alang kung gaano kaakma ang mga batas at regulasyon patungkol sa pangangasiwa ng baybaying dagat o CRM at gaano kadali ang pagpapatupad ng mga ito.)*	Presence of comprehensible laws and regulations related to management	*Pagkakaroon ng batas, regulasyon o ordinansa hinggil sa pangangasiwa ng babybayin na nauunawaan ng mga komunidad*
	Frequency of information dissemination about the management	*Dalas ng pagkalat ng mga impormasyon tungkol sa pangangasiwa ng baybayin o CRM*
	Perception on the suitability of enforcement techniques	*Pananaw tungkol sa pagiging angkop ng mga pamamaraan na ginagamit sa pagpapatupad ng mga batas pangisdaan sa inyong barangay*
	Performance assessment of fisheries law enforcers	*Pagtatasa ng kakayahan ng mga tagapagpatupad ng batas pangisda*
	Financial support for fisheries law enforcement	*Suportang pinansiyal na inilalaan at ginagamit sa pagpapatupad ng mga batas pangisda*
	Assessment of the allocated financial support for enforcement	*Pagtatasa sa suportang pinansyal na inilalaan para ipatupad ang mga batas pangisda*
EQUITY *(Tinutukoy ang wastong pagbabaha-bahagi ng mga likas yaman at malayong paggamit ng mga ito)*	Profit distribution among different fishing gears	*Pagbabaha-bahagi ng mga kita mula sa ibat'ibang klase ng pangingisda.*
	Amount of financial support for additional livelihood	*Suportang pinansyal para sa mga programang dagdag kabuhayan.*
	Assessment of the success of additional livelihood implemented	*Pagtatasa sa tagumpay ng mga programang dagdag kabuhayan*
	Inclusion of women in the management process	*Antas ng partisipasyon ng mga kababaihan sa pangangasiwa ng baybaying dagat*

DALHOUSIE University

APPENDIX 7

KASULATANG NAGPAPAHINTULOT (CONSENT FORM)

Workshop I: Pagtatalaga ng Marka o Iskor sa mga Palatandaan*

Pangunahing Tagapagsiyasat: Merlina N. Andalecio, Graduate Student of Dalhousie University

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Superbisor: Dr. Gary Newkirk

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Makipag-ugnayan kay: Dir. Marciano Carreon III, Director, Fisheries Resource Management Project (FRMP)

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Address: 2/F Estuar Building 880 Quezon Ave., 1103 Quezon City Philippines

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* "Sakaling kayo ay may suliranin o nais sabihin patungkol sa anumang aspeto ng inyong pakikilahok sa pag-aaral na ito, maaaring makipagbigay-ugnayan sa Coordinator ng Human Research Ethics/ Integrity. Ang tanggapan ng Human Research Ethics and Integrity ay matatagpuan sa Dalhousie University, Halifax, Nova Scotia Canada. Telepono: (902) 4941462."

Workshop I: Pagtatalaga ng Marka o Iskor sa mga Palatandaan*

Pasimula

"Inaanyayahan po namin kayong makilahok sa pag-aaral na ito ng Dalhousie University. Ang pakikilahok ay kusang-loob ngunit maaari ninyong itigil ang partisipasyon anumang oras. Nakasaad sa mga sumusunod na talata ang mga kinakailangan ninyong gawin at anumang abala o pagkabalisa na maaari niyong maranasan. Maaaring hindi kayo makinabang sa pakikilahok sa pag-aaral na ito ngunit maaari din namang matuto ng mga bagay na magiging kapakinabangan sa iba. Anumang katanungan ay maaaring idulog sa mga taong magpapaliwang ng pag-aaral na ito."

Hangarin ng Pag-aaral

Sa pag-aaral na ito, nais kong malaman kung ang paggamit ng ibat-ibang *criteria* sa pagtatasa ng epekto ng mga gawain sa pangangasiwa ng karagatan at baybaying dagat [tulad ng pagtatanim ng bakawan, pagtatatag ng sanktuwaryo ng isda, pagkakaroon ng karagdagang kabuhayan, paglalagay ng mga artipisyal na bahura, pagbabawal sa mga komersiyal na mangingisda, at iba pa] ay akmang gamitin sa isang tropikong bansa na tulad ng Pilipinas. Labing isang (11) palatandaan ang pinili na nangangailangan ng pagpapasiya mula sa mga gumagamit ng baybaying dagat.

Disenyo ng Pag-aaral

May 11 palatandaan na nangangailangan ng pagpapasiya ng mga kasapi ng Barangay ***Fisheries and Aquatic Resource Management Councils*** (FARMCs). Isang sesyon ang iaayos para sa mga kinatawanan ng mga grupo. May palatanungan (questionnaire) na ibibigay sa bawat isang kalahok kung saan makikita ang 11 palatandaan. Ang bawat palatandaan ay may sukatan kung saan ilalagay ng mga kalahok ang kanilang sagot. Mapapansin na may mga palatandaang may mga dagdag na katanungan. Ito ay kinakailangan upang bigyang linaw, paliwanag o pagtibayin ang sagot sa sukatan.

Ang mga kalahok ay pakikiusapang sagutin ang isang palatandaan pagkaraang-pagkaraan na ipaliwanag ito ng mananaliksik. Bibigyan din ang mga kalahok ng pagkakataong magtanong at manghingi ng paglilinaw sa bawat palatandaan.

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* "Sakaling kayo ay may suliranin o nais sabihin patungkol sa anumang aspeto ng inyong pakikilahok sa pag-aaral na ito, maaaring makipagbigay-ugnayan sa Coordinator ng Human Research Ethics/ Integrity. Ang tanggapan ng Human Research Ethics and Integrity ay matatagpuan sa Dalhousie University, Halifax, Nova Scotia Canada. Telepono: (902) 4941462."

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Sino ang Maaaring Makilahok

*"Maaari kayong lumahok sa pag-aaral na ito kung kayo ay kasapi ng **Barangay** Fisheries and Aquatic Resource Management Council (FARMC) sa isa sa mga 7 baybaying munisipyo ng San Miguel Bay."*

Sino ang Mamamahala sa Pananaliksik

Ang pag-aaral ay pamamahalaan ni Merlina Andalecio sa tulong ng mga teknikal na kawani ng Tanggapang Rehiyon ng Bureau of Fisheries and Aquatic Resources.

Ano ang Hinihiling sa Inyong Gawin

Hinihiling sa mga kalahok na sagutin ang palatanungan bilang mga kinatawan ng kanilang sektor at base sa kanilang kaalaman at karanasan sa pangangasiwa ng kanilang baybaying nasasakupan. Marami sa mga katanungan ay patungkol sa pangkasalukuyang kalagayan ng mga palatandaan at ang mga pagbabagong dulot ng mga gawain sa pangangasiwa ng baybaying dagat. Inaasahang matatapos ang workshop na ito ng isang araw.

Tinatayang Pagkabalisa

Ang tinatayang pagkabalisa na maaaring makita at maranasan ng mga kalahok ay ang mahaba at nakakapagod na pagsasagawa ng palatanungan.

Posibleng Kapakinabangan

Isang kapakinabangan na maaaring ibunga ng ganitong gawain ay ang pagkilala na ang pananaw, karanasan at kaalaman ng mga gumagamit ng baybaying dagat sa pangangasiwa ng mga likas na yaman nito ay mahalagang ipagpagsaalang-alang.

Kabayaran

Dahil sa pinansiyal na limitasyon ng pag-aaral na ito, ang maaaring maibigay sa mga kalahok ay libreng pananghalian at merienda.

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Workshop I: Pagtatalaga ng Marka o Iskor sa mga Palatandaan*

Pagka-kompidensiyal ng Pag-aaral

Ang mga kaalaman na magmumula sa workshop na ito ay hahawakan na may masusing pag-iingat. Sa palatanungan at report na isusulat, mananatiling nakatago ang pagkakakilanlan ng mga kalahok. Ang bawat palatanungan ay may kodigo at ang listahan ng mga kalahok ay makikita lamang ni Merlina at ng kanyang supervisor. Analisadong resulta lamang ang isasama sa kahuli-hulihang report.

Lahat ng kaalamang nakalap sa pag-aaral na ito ay mananatili sa loob ng 5 taon, pagkatapos paglalathala.

Tanong

Lahat ng tanong o paglilinaw patungkol sa pag-aaral na ito ay maaaring ilapit kay Merlina (email: mandalec@is2.dal.ca), Dr. Gary Newkirk (gnewkirk@kilcom1.ucis.dal.ca or gnewkirk@idrc.ca o Marco Carreon ng BFAR-FRMP (telepono blg. 63-2- 4109990). Sakaling may mga bagong impormasyong makukuha na maaaring makaapekto sa desisyon ng mga nakilahok, ang mga ito ay ipagbibigay alam sa kanila.

Pagtatapos

Sakaling di komportable ang mga kalahok, maaring pakikiusapang ipatigil ang kanilang paglahok sa pag-aaral. Ang pag-aaral ay maaring itigil sa anumang oras.

* "Sakaling kayo ay may suliranin o nais sabihin patungkol sa anumang aspeto ng inyong pakikilahok sa pag-aaral na ito, maaaring makipagbigay-ugnayan sa Coordinator ng Human Research Ethics/ Integrity. Ang tanggapan ng Human Research Ethics and Integrity ay matatagpuan sa Dalhousie University, Halifax, Nova Scotia Canada. Telepono: (902) 4941462."

Workshop I: Pagtatalaga ng Marka o Iskor sa mga Palatandaan*

LAGDA

"Nabasa ko ang lahat ng paliwanag ng pag-aaral na ito. Ako ay binigyan ng pagkakataong pag-usapan ito at ang aking mga tanong ay nasagot ng may kaluguran. Sa pamamagitan nito ako ay pumapayag na makilahok sa pag-aaral na ito. Gayon pa man, nauunawaan ko na ang aking pakikilahok ay kusang-loob at may layang tumigil anumang oras.

Pangalan ng Nakilahok: ______________________________
Lagda: ______________________________
Petsa: ______________________________

Pangalan ng Mananaliksik: MERLINA N. ANDALECIO
Lagda: ______________________________
Petsa: ______________________________

* "Sakaling kayo ay may suliranin o nais sabihin patungkol sa anumang aspeto ng inyong pakikilahok sa pag-aaral na ito, maaaring makipagbigay-ugnayan sa Coordinator ng Human Research Ethics/ Integrity. Ang tanggapan ng Human Research Ethics and Integrity ay matatagpuan sa Dalhousie University, Halifax, Nova Scotia Canada. Telepono: (902) 4941462."

DALHOUSIE
University

<u>KASULATANG NAGPAPAHINTULOT</u>

(CONSENT FORM)

Workshop II: Pagbibigay Halaga sa mga *Criteria* at Palatandaan sa Pamamagitan ng Analytic Hierarchy Process (AHP) *

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* "Sakaling kayo ay may suliranin o nais sabihin patungkol sa anumang aspeto ng inyong pakikilahok sa pag-aaral na ito, maaaring makipagbigay-ugnayan sa Coordinator ng Human Research Ethics/ Integrity. Ang tanggapan ng Human Research Ethics and Integrity ay matatagpuan sa Dalhousie University, Halifax, Nova Scotia Canada. Telepono: (902) 4941462."

Workshop II: Pagbibigay Halaga sa mga *Criteria* at Palatandaan sa Pamamagitan ng Analytic Hierarchy Process (AHP) *

Pasimula

"Inaanyayahan po namin kayong makilahok sa pag-aaral na ito ng Dalhousie University. Ang pakikilahok ay kusang-loob ngunit maaari ninyong itigil ang partisipasyon anumang oras. Nakasaad sa mga sumusunod na talata ang mga kinakailangan ninyong gawin at anumang abala o pagkabalisa na maaari niyong maranasan. Maaaring hindi kayo makinabang sa pakikilahok sa pag-aaral na ito ngunit maaari din namang matuto ng mga bagay na magiging kapakinabangan sa iba. Anumang katanungan ay maaaring idulog sa mga taong magpapaliwang ng pag-aaral na ito."

Hangarin ng Pag-aaral

Sa pag-aaral na ito, nais kong malaman kung ang paggamit ng ibat-ibang *criteria* sa pagtatasa ng epekto ng mga gawain sa pangangasiwa ng karagatan at baybaying dagat [tulad ng pagtatanim ng bakawan, pagtatatag ng sanktuwaryo ng isda, pagkakaroon ng karagdagang kabuhayan, paglalagay ng mga artipisyal na bahura, pagbabawal sa mga komersiyal na mangingisda, at iba pa] ay akmang gamitin sa isang tropikong bansa na tulad ng Pilipinas. Kinakailangan kong timbangin ang kahalagahan ng mga *criteria* at palatandaan sa pamamagitan ng Analytic Hierarchy Process (AHP).

Disenyo ng Pag-aaral

Ang kahalagahan ng mga *criteria* at palatandaan ay maaaring malaman sa pamamagitan ng pagsasagawa ng *Analytic Hierarchy Process (AHP).* Ang mga kasapi ng Fisheries and Aquatic Resource Management Councils (FARMCs) sa bawat munisipyo ay hahatiin sa grupo. Pagsasamahin sa isang grupo ang mga may parehong interes. Ang mga kalahok ay mag-uusap-usap at pagkakasunduan ang timbang na ibibigay sa mga *criteria*. Magkakaroon ng paghahalintulad ng mga *criteria*, halimbawa, gaano kahalaga ang *criterion X* sa *criterion Y* sa pagtatasa ng epekto ng mga gawain sa pangangasiwa ng baybaying dagat. Sa isang banda, magkakaroon din ng paghahalintulad ang mga palatandaan bilang sukatan ng isang *criterion.*

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Sino ang Maaaring Makilahok

*"Maaari kayong lumahok sa pag-aaral na ito kung kayo ay kasapi ng **Municipal** Fisheries and Aquatic Resource Management Council (FARMC) sa isa sa mga 7 baybaying munisipyo ng San Miguel Bay."*

Sino ang Mamamahala sa Pananaliksik

Ang pag-aaral ay pamamahalaan ni Merlina Andalecio sa tulong ng mga teknikal na kawani ng Tanggapang Rehiyon ng Bureau of Fisheries and Aquatic Resources.

Ano ang Hinihiling sa Inyong Gawin

Ang mga kalahok ay aanyayahang makisali sa isang 'pokus na talakayan'. Gagamitin ang Analytic Hierarchy Process (AHP) upang malaman ang kahalagahan ng mga criteria at palatandaan sa pagtatasa ng mga gawain tungkol sa pangangasiwa ng baybaying dagat. Ang mga teknik at operasyon sa paggamit ng AHP ay tatalakayin sa mismong workshop. Magkakaroon ng masusing pagtatalakay at pagkakasunduan ang mga kasapi ng bawat grupo nang sa gayon ay makuha ang timbang ng mga criteria. Kinakailangan ng 2 araw upang matapos ang workshop na ito. Ang 'pokus na talakayan' ay ire-rekord sa pamamagitan ng *video-camera* o *tape recorder*.

Tinatayang Pagkabalisa

Ang tanging tinatayang pagkabalisa na maaaring makita at maranasan ng mga kalahok ay kung humantong ang talakayan sa matinding pagtatalo at di pag-kakaunawaan.

Posibleng Kapakinabangan

Ang mga kapakinabangan na maaaring ibunga ng ganitong gawain ay: pagsali ng mga kalahok sa isang pormal na sistema ng pagtatasa, pagkakataong maibahagi ang kaalaman at karanasan sa iba, karagdagang pagpapahalaga sa sarili sa kadahilanang ang mga pananaw ng mga kalahok ay itinuturing na mahalaga sa paraan ng pagpapasiyo.

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Kabayaran

Dahil sa pinansiyal na limitasyon ng pag-aaral na ito, ang maaaring maibigay sa mga kalahok ay libreng pananghalian at merienda.

Pagka-kompidensiyal ng Pag-aaral

Bagama't hihilingin ng mananaliksik sa mga kalahok ng 'pokus na talakayan' na kung maaari ang mga impormasyon na pinag-usapan sa workshop ay manatiling kompidensiyal, hindi niya ito magagarantiyahan. Dahil sa ang 'pokus na talakayan ay ire-rekord sa pamamagitan ng video camera o tape recorder, may pag-iingat na itatago ng mananaliksik ang lahat ng dokumento na may kinalaman dito.

Tanong

Lahat ng tanong o paglilinaw patungkol sa pag-aaral na ito ay maaaring ilapit kay Merlina (email: mandalec@is2.dal.ca), Dr. Gary Newkirk (gnewkirk@kilcom1.ucis.dal.ca or gnewkirk@idrc.ca o Marco Carreon ng BFAR-FRMP (telepono blg. 63-2- 4109990). Sakaling may mga bagong impormasyong makukuha na maaaring makaapekto sa desisyon ng mga nakilahok, ang mga ito ay ipagbibigay alam sa kanila.

Pagtatapos

Sakaling di komportable ang mga kalahok, maaring pakikiusapang ipatigil ang kanilang paglahok sa pag-aaral. Ang pag-aaral ay maaring itigil sa anumang oras.

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Workshop II: Pagbibigay Halaga sa mga *Criteria* at Palatandaan sa Pamamagitan ng Analytic Hierarchy Process (AHP) *

LAGDA

"Nabasa ko ang lahat ng paliwanag ng pag-aaral na ito. Ako ay binigyan ng pagkakataong pag-usapan ito at ang aking mga tanong ay nasagot ng may kaluguran. Sa pamamagitan nito ako ay pumapayag na makilahok sa pag-aaral na ito. Gayon pa man, nauunawaan ko na ang aking pakikilahok ay kusang-loob at may layang tumigil anumang oras.

Pangalan ng Nakilahok: ______________________________
Lagda: ____
Petsa: ____

Pangalan ng Mananaliksik: MERLINA N. ANDALECIO
Lagda: ____
Petsa: ____

* "Sakaling kayo ay may suliranin o nais sabihin patungkol sa anumang aspeto ng inyong pakikilahok sa pag-aaral na ito, maaaring makipagbigay-ugnayan sa Coordinator ng Human Research Ethics/ Integrity. Ang tanggapan ng Human Research Ethics and Integrity ay matatagpuan sa Dalhousie University, Halifax, Nova Scotia Canada. Telepono: (902) 4941462."

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