

LOGIT AND PRINCIPAL COMPONENT ANALYSES OF THE MANAGEMENT OF MARINE PROTECTED AREAS IN NORTH-EASTERN ILOILO, PHILIPPINES

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Marine protected areas (MPAs) are considered a common tool for the protection of coastal, marine and fishery resources. Recently, literature on fishery management has been paying attention to the importance of the social dimensions of MPAs and their impacts on MPA success. This paper presents an overview of the management of MPAs in the region of North-Eastern Iloilo, Philippines, and examines the interaction between the civil society and market forces of different institutional arrangements. Using the logit and principal component analyses, the paper shows that the conflicts between economic actors are still in existence today, and knowledge appears as a key factor for evaluating MPA success. Moreover, having MPAs does not seem to bring the communities any other benefit than the stated objectives, such as food security and marine conservation. The paper also discusses how contrasting objectives and expectations from various stakeholders could exacerbate conflict in the management of MPAs.

I. INTRODUCTION

As an archipelago, the Philippines is endowed with diverse fishery resources, 17,460 km of coastline and 2,200,000 km² of marine area. It is located entirely in the tropics of the western Pacific Ocean, near the centre of diversity for many marine organisms, such as molluscs and corals. Most types of tropical

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coastal ecosystems, such as coral reefs, sea grasses and mangrove forests, are found in the country. The country's marine resources are highly valued, both economically and socially, with fisheries contributing approximately to 4.3 per cent of the country's gross domestic product (GDP), or about 22 per cent of the country's total agricultural production sector (Philippines, 2008a). Since the beginning of Spanish colonization, Philippine fisheries and coastal management have been managed through a central authority, i.e. bureaucratic authority, until the fall of the Marcos regime in the mid-1980s (Pomeroy and Carlos, 1997). Throughout time, fishery resources, particularly mangroves, corals and fish, have been continuously threatened. High demand for natural resources in both local and international markets continues to increase. Moreover, the revising and consolidation of all laws and decrees affecting fishing and fisheries, or "Presidential Decree No. 704" of 1975, does not seem to encourage the protection of fisheries, and is considered "ineffective in promotion of sustainable management and development" of Philippine fisheries (Pomeroy and Carlos, 1997).

In the Philippines, the marine protected area (MPA) has been considered a fishery management tool for "integrated ocean management" since the early 1990s (Sumaila and Charles, 2002). The MPA became an important policy that involved a dynamic and a participatory process whereby an integrated strategy was employed for the conservation and sustained multipurpose use of the coastal zone. It also took into account traditional, cultural and historical perspectives (Webb, Maliao and Siar, 2004, p. 138). However, in some countries, managing MPAs is changing from management development to implementation. Examples include Canada (Guénette and Alder, 2007), Scotland (Staed and McGlashan, 2006) and the Philippines (Fernandez, 2006). Currently MPAs make up about 8 per cent of the area of South-East Asian coral reefs (Burke, Selig and Spalding, 2002). However, the success rate of MPAs in South-East Asia is low: an estimated 14 per cent of the 332 MPAs in South-East Asia are effectively managed and only about 10 to 38 per cent of MPAs in the Philippines are effectively or partially effectively managed (Pomeroy and others, 2007a; Gjertsen, 2005). This rate reflects the difficulty in implementing MPAs. Moreover, it shows that much work is still needed to make MPAs successful in South-East Asia.

Recently, two problems have been found in the management of MPAs in the Philippines: MPAs are not as effective as expected; and there are managerial or territorial conflicts among stakeholders. MPAs are not attaining their objectives. For example, Gjertsen (2005) and Alcala (2001) show that only 10 per cent of all MPAs are working effectively. The Haribon Foundation carried out surveys on coastal areas—environmentally critical areas that have, by law, been designated

marine recreation areas and seashore parks—and concluded that only 44 out of 439 MPAs (10 per cent) can be classified as “fully implemented” in the Philippines.

The literature on MPAs has shown that a combination of integrated social policies could be the key to achieving effective management of MPAs (Balgos, 2005; Anthoni, 2003; Jameson and others, 2002; White and others, 2002; Fernandez and others, 2000). According to Jones (2002) and Tyler (1999), public policies on the management of MPAs can generate conflicts over natural resources. Though MPA seems to be an effective solution, human development and overpopulation threatens the fishery sector. Therefore, the effectiveness of MPAs is still unclear. In the Philippines, and other developing countries where the population depends on coastal and marine resources, the management of MPAs is a continuing challenge for policymakers and practitioners.

Two of the main issues, therefore, in the management of MPAs in the Philippines that challenge many resource managers and national decision makers are: how MPAs could benefit society, and why poverty remains persistent even after MPAs have been implemented. Addressing these issues is the primary objective of managing conflicts over fishery resources in the interests of both long-term sustainability and short-term economic feasibility in South-East Asia, where fish is considered a primary source of dietary protein and income generation by more people than anywhere else in the world (Burke and others, 2002).

This paper presents an overview of the current management of MPAs in North-Eastern Iloilo, Philippines and examines whether the conflicts between various management regimes still exist. The paper is organized as follows. The next section begins with a brief review of MPAs and then describes the study area profile. Section III presents the methodology. In section IV, the interaction between the civil society and market forces are discussed. In this section, various economic players in MPA management are identified as well as the factors affecting the success or failure of MPAs. Key findings and concluding remarks follow in the last section.

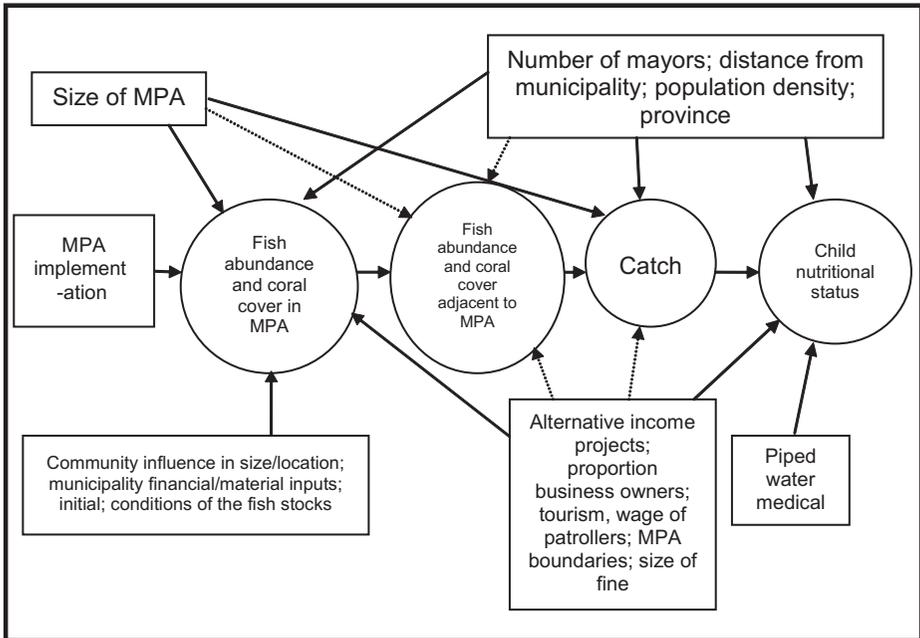
II. FOUNDATIONS AND STUDY AREA

The management of MPAs can be seen as a habitat protection and a fishery management tool in the Philippines (Philippines, 2001; Pomeroy and others, 2004). Management is also considered a process of policies that have been in place since the beginning (Pomeroy and Carlos, 1997; Fernandez and others, 2000; Balgos, 2005; Pomeroy and others, 2007a). In addition, the links between the

biological factors and the social factors play an important role in MPA management (Christie, 2004).

Gjertsen (2005) also observed the relationships between marine protected areas, coral reef health and the source of human well-being; this significance is shown in figure 1. MPAs can improve coral reef condition and can increase the fish population through spill-over effects. Since the MPA's implementation has an indirect effect on children's nutrition status, a rise in the fishermen's income, will likewise improve the quality and quantity of food for their children.¹ Therefore, ecosystem improvement and children's well-being are factors in the livelihood success of an MPA, but these indicators are dependent on exogenous variables (biological, social, political, economic conditions). Some other non-MPA activities, such as paying patrollers, financial inputs and availability of other income projects, are also essential to MPA success. However, livelihood schemes in the Philippines

Figure 1. Relationships between marine protected areas, coral reef health and human well-being



Source: Gjertsen, 2005, p. 202.

¹ For further details, see Gjertsen (2005) and the references therein.

do not work effectively because of such constraints as administration loans, and ineffective and inadequate planning and marketing infrastructures (Balgos, 2005).

Brief Demographic and Fisheries Profile of North-Eastern Iloilo

The Philippines is composed of three major island regions, namely Luzon, Visayas and Mindanao, which are predominantly rich fishing grounds. Iloilo Province is located in the Visayas region, bounded by the Province of Capiz to the north, Antique to the west, Panay Gulf and Iloilo Strait to the south, and the Visayan Sea to the east. The Visayan Sea has been identified as the most productive fishing area in the country (Ferrer, 2009). The province is the country's fourth largest fish producer and the second in terms of fish worth as reflected in fish prices (Philippines, 2008b). It has 42 municipalities, two cities and 1,721 *barangays*,² earning the status of a first-class province with a total voting population of 1,100,000 (Philippines, 2009).³ Thus, the province is a major player in the country's fisheries industry.

Even though the province is well developed, poverty afflicts 60 per cent of its municipalities, and there is a high incidence of child malnutrition (Fernandez, 2006). Most municipalities are classified as "low-income" (from third to fifth), and fishing is the main source of income (see table 1). Moreover, the population of each municipality ranges from 18,298 to 57,673, but the majority of the population are from coastal communities and fishing is, not surprisingly, the primary occupation. For example, 97 per cent of Carles is composed of coastal *barangays*, while Balastan has only 8.6 per cent. Carles, Concepcion and Ajuy have the highest numbers of registered fishermen.

Moreover, MPAs are established through local government mandates that are incorporated under the Integrated Coastal Resource Management (ICM) programme of the national Government.⁴ Costs, which range from PhP 50,000

² In the Philippines, a province is composed of several municipalities (towns). Each of these towns has several *barangays*, which is the native Filipino term for "village", "district" or "ward". *Barangays* are the smallest administrative divisions in the Philippines.

³ Philippine provinces and municipalities are broken up into six classes according to average annual income, based on the previous three calendar years. A first-class province is a province where annual income is at least PhP 300 million (US\$ 6 million), while a first class municipality has an income of at least PhP 55 million (US\$ 1.2 million). A second class municipality has PhP 45 million or more but less than PhP 55 million. A third class municipality has PhP 35 million or more but less than PhP 45 million. A fourth class municipality has PhP 25 million or more but less than PhP 35 million; and a fifth class municipality has PhP 15 million or more but less than PhP 25 million. The lowest class, the sixth, is reserved for those municipalities with an income below PhP 15 million.

⁴ The aim of ICM is development and conservation of coastal resources and conflict mediation as well as multisectoral participation in planning and management.

Table 1. Demographic and fisheries profile of the municipalities of North-Eastern Iloilo Province, Philippines

	Ajuy	Balasan	Batad	Carles	Concepcion	Estancia
Income classification	Third	Fourth	Fifth	Third	Fourth	Third
Total Population (2007)	47 113	27 384	18 298	57 673	36 881	39 479
Number of <i>barangays</i>	34	23	24	33	25	25
Land area (km ²)	175.52	57.3	52.61	103.52	97.2	30.55
No. coastal brgy (percentage of total)	18 (53 per cent)	2 (8.6 per cent)	6 (25 per cent)	32 (97 per cent)	18 (72 per cent)	16 (64 per cent)
Main source of income	Fishing	Farming, Fishing	Fishing	Fishing	Fishing	Fishing
Malnutrition	1 per cent: 34 (2004)	1.128 per cent (2000)	..	1 per cent: 34 (2007)
Surface area of municipal waters (km ²)	250	0.6	8	368	320	10
Length of shoreline (km ²)	74.83	3.5	8.2	94.7	120	28.51
No. of islands	0	0	2	30	17	3
Registered Municipal Fishermen	3 185	120	142	4 500	3 211	1 296
Wardens, patrol boats	65, 2	0	60, 3	100, 3	160, 6	45, 1
No. of MPAs	1	0	1	1	1	1

Sources: Iloilo, 2001; Fernandez, 2006; Philippine National Statistics Coordination Board, 2009.

Notes: San Dionisio, a municipality in Iloilo is not included in the study for logistical reasons. *Barangay* is the native Filipino term for "village", "district" or "ward"; a barangay is the smallest administrative division in the Philippines.

(US\$ 1,064) to 100,000 (US\$ 2,128) are usually shouldered by non-governmental organizations (NGOs) and local government (Fernandez, 2006). There are different phases of MPA establishment and management and related activities in which the proponents of management are *barangays*, local and national governments, NGOs and people's organizations (Philippines, 2001, p. 69).

Meanwhile, MPA protection can be set at a variety of levels—from total prohibition of activities to regulation at different intensities. There can also be a 'no-take' zone or a regulated zone. In "no-take" zones, human access is restricted.⁵ On the other hand, some fishing methods (such as hook and line) are allowed in "regulated" areas, but destructive fishing methods, such as trawling, are prohibited. The majority of MPAs have been established, designed and located (e.g., size has been determined) on the basis of socio-economic and political issues, the desire to restore depleted fishing stocks, and food security (Fernandez and others, 2000). Therefore, the establishment of an MPA is not restricted to specific organisms but can emanate from cultural heritage or even social concerns.

III. METHODOLOGY

This section describes the data collection process, firstly by discussing the survey interview and the survey questionnaire, followed by key informant interviews and focus-group discussions.

Our methodology for selecting appropriate procedures and key success factors is guided by several studies⁶ that highlight stakeholder perception and questionnaire surveys as relevant sources for MPA evaluation. For instance, Webb, Maliao and Siar (2004) used local area perception, while Himes (2007) used stakeholder analysis of biological, economic and socio-cultural indicators. In addition, Oracion, Miller and Christie (2005) used the Likert-scale to capture the perceptions of the fishery, tourist and business sectors.

Survey interview and social survey questionnaire

A total of 213 survey questionnaires were implemented in six municipalities of North-Eastern Iloilo. The municipality of San Dionisio was excluded due to logistics and safety considerations. Data collection based on questionnaires was

⁵ No-take zone refers to an area in which human access is totally prohibited while a regulated zone refers to areas with different levels of human access and use are implemented.

⁶ Such as Christie and others, 2002; Webb and others, 2004; Oracion and others, 2005; Pomeroy and others, 2007a; and Himes, 2007.

conducted through face-to-face interviews of 200 fishermen, 6 municipal agriculture officers (as the representatives of the public sector), and 7 fisherfolk association officers and NGO officers as representative of the private sector. The questionnaires were presented by two hired enumerators to fishermen at their homes, to public sector officers at the municipal town halls, and to private sector representative in their offices or residences. The first section of the questionnaire was composed of a classification section, which is also one of the two demographic sections. It includes the respondent's position and number of years involved with fishing, in addition to factual information relating to MPA.⁷

The second part of the survey presents Likert scale statements in response to eight questions.⁸ Two of the questions are about perceptions regarding changes after the establishment of MPAs and another one concerns knowledge of MPA regulations. If the MPA goal is to enhance or maintain food security, the appropriate indicators to use are S1 (local marine resource patterns) and S2 (local values and beliefs regarding the marine resources) (Pomeroy and others, 2004, p. 135). Since the main objective of MPA establishment in North-Eastern Iloilo is to enhance and maintain food security, then the S1 and S2 indicators of the International Union for the Conservation of Nature (IUCN) are appropriate.⁹ S1 is the way people use and affect coastal and marine resources and it determines if the MPA management strategies being implemented have impacts on income, livelihood patterns and cultural traditions. Moreover, it shows who is affected by MPA establishment as well as the activities involved in MPA management. On the other hand, the S2 indicator measures how people make choices and understand actions related to marine resource use and management based on their values concerning what is good, trustworthy and desirable, and their beliefs of social systems and processes (Pomeroy and others, 2004, p. 138). It reveals people's values and beliefs regarding marine resources as well as their usage and management practices. Decision makers should take these values into account in order to manage coastal resources effectively.

⁷ Factual information refers to MPA size, municipality and economic sector classification.

⁸ See subsequent subsections for a full description of the Likert scale used in this paper.

⁹ According to Pomeroy and others (2004), there are three indicators that reflect the goals and objectives of MPAs, namely, biophysical, socio-economic and governance. In this paper, we focused on the socio-economic indicators.

The last five questions in the survey ask whether there are conflicts among fishermen, the public sector and the private sector. Respondents have the opportunity to indicate whether conflicts are still prevalent, and, in the affirmative, to describe and assess them.¹⁰

The third section includes open-ended question on the perceived and actual costs and benefits to stakeholders of establishing an MPA. Demographic information, such as membership and activities in coastal management organizations or groups, belong to this section. In addition, it includes primary and secondary income information. Demographic information is essential to capture the characteristics of the respondents and to break down responses and opinions into meaningful groups in the analyses.

The last section includes open-ended questions on the reasons why an MPA should be established. Since conflict is assumed to be an important social dimension that may affect the effectiveness of an MPA, conflict scenarios are posed at the end of the questionnaire. These scenarios are adapted from previous work by Fernandez (2006).¹¹ The answers can capture the relationships among major players in MPA management.

All data collection took place in June and July 2008. However, due to inconsistencies and a lack of precise information on the fishing population per *barangay*, proportionate sampling has been done. In the municipality of Ajuy, 38 people were interviewed, 25 in Balasan, 40 in Batad, 26 in Carles, 40 in Concepcion, and 31 in Estancia. The snowball approach is used in determining the respondents (Weible and others, 2004). This approach is a type of purposive sampling that relies on the people in the community to direct the enumerators to particular sources of information. The respondents are therefore the stakeholders and, as such, are directly involved in MPAs. Moreover, it is oftentimes used if the budget of the study is small but it captures stakeholder attributes very well. It is appropriate to use this method since the target group of this paper are the fishing and management entities only.

¹⁰ These conflict statements are based on the findings of Fernandez (2006). Results show that there are conflicts among different economic actors in coastal resource management in North-Eastern Iloilo. Fernandez believed that there is no distinct management arrangement for effective management of MPAs.

¹¹ Conflicts adapted from the results of Fernandez's (2006) study and results show that there are conflicts among different economic actors in coastal resource management in North-Eastern Iloilo, Philippines.

Key informant interviews and focus-group discussions

Along with the questionnaires, key informant and focus group discussions are also used to determine current coastal management activities and the situation in the area. Face-to-face key informant interviews are conducted to address qualitative gaps. The main objective is to gather information from different sources in the community and, in this case, from different stakeholders. This method is relevant to the study because key informants have first-hand knowledge of the subject matter and can provide valuable insights regarding the nature of the problems and recommendations as well. According to the International Development Research Centre (IDRC) (2003), focus group discussion involves approximately 6 to 12 persons guided by a facilitator, during which group members talk freely and spontaneously about a certain topic. This method is a way to elicit different opinions that cannot be captured in a key informant interview. The researchers are able to initiate and expand the discussion because of the method's participative nature. Its main objective is to obtain in-depth information on concepts, perceptions and ideas of a group as well as to clarify some issues related to the survey proper. This gives a level of consistency between the data yielded by key informant interviews. Discussions were held in Barangay Nipa, in the town of Concepcion, where fishermen and other members of fisherfolk associations are present.

Likert scale, Logit and the Principal Component Analysis

A five-point Likert scale was adopted to analyse conflict scenarios and determine whether respondents have a thorough understanding of the regulations of an MPA. The scale is a type of psychometric response scale used in a questionnaire in order for respondents to specify their level of agreement with a particular statement. The scale adopted in the paper is (1) strongly disagree; (2) moderately disagree; (3) neither; (4) moderately agree; and (5) strongly agree. Its aim is to measure the knowledge and attitudes of respondents. This is the most convenient way of capturing respondents' attitudes and knowledge regarding the status of an MPA. Often, Likert scales are treated as summative scales using the analysis of variance and are treated as ordinal data using non-parametric tests.

In addition, the Principal Component Analysis (PCA) is a technique for reducing complexity in the data. Its purposes are the following: (1) to understand the variation in the data; (2) to form predictive models; and (3) to model response variable in terms of principal components (PCs) and to reduce the number of variables in the model (SAS Institute, 1985). The method provides an objective way of "aggregating" indicators so that variation in the data can be accounted for as concisely as possible (Jollands and others, 2004, p. 295). It approximates the

data into fewer dimensions. Each dimension, called the principal component, represents a linear combinations of the original variables.

Since the paper explores the sources of variation of MPA success in North-Eastern Iloilo, PCA captures the most variance of these data in low-dimensional subspace. This means that the PCA is a data reduction technique used to lessen the redundancy of the variables used. For example, data may be described into two or three dimensions. Meanwhile, the subspace will be formed by the span of the first few principal components, wherein a span of a set of vectors is the vector space consisting of all linear combinations of the vectors (SAS Institute 1985, p. 1). Results are usually shown through an eigenvalue matrix table, a correlation matrix and score plot figures.

Moreover, the use of logit regression is appropriate in this paper compared to the ordinary least squares regression (OLS) because OLS assumptions are violated when using a binary response variable.¹² The aim of the regression is to accurately predict the category of outcome for individual cases by calculating the probability of success over the probability of failure. The probability of success is expressed in odd ratios. The regression provides knowledge of the relationships and strengths among the variables. It also shows significance, wherein coefficients are statistically tested.

IV. RESULTS

Table 2 summaries the estimated results obtained from logit regressions, presenting several different conflict levels in the management of MPAs. Based on the tests of likelihood ratio and chi-square criterion, a conflict between NGOs and fishermen (C4) is dropped because it is not significant.

The likelihood ratio and chi-square are statistically significant (see table 2), implying that conflicts between fishermen and the public and private sectors, are still in existence today. As reflected by five-point Likert scale statements in which the highest mode is five and the lowest is one, the high value implies a higher level of conflict. Significant determinants of resource conflict in North-Eastern Iloilo include C1, C2, C3 and C5. For example, the modes of C1, C2 and C3 are equal to five; therefore, respondents strongly believe that there is conflict between fishermen and the government. These results are highly significant at $p > 0.001$.

¹² An OLS estimator is unbiased and has the minimum variance of all unbiased estimators. The residuals have constant variance and the errors are normally distributed.

Table 2. Goodness of fit tests – general logit for conflict variables

<i>Conflict variables</i>	<i>Likelihood ratio</i>		<i>Pearson chi-square</i>	
	<i>Value</i>	<i>Sig.</i>	<i>Value^a</i>	<i>Sig.</i>
<i>C1 (conflict between municipal and commercial fishermen)</i>	51.340***	.000	56.233***	.000
<i>C2 (conflict between government and commercial fishermen)</i>	21.623***	.000	21.921***	.000
<i>C3 (conflict between government and municipal fishermen)</i>	42.455***	.000	43.615***	.000
<i>C4 (conflict between NGOs and fishermen)</i>	2.070	.150	1.965	.161
<i>C5 (conflict between NGOs and People's Organization)</i>	15.372***	.000	13.818***	.000

Note: ^a * (0.025) $p > 5.02$, ** (0.01) $p > 6.64$, *** (0.001) $p > 10.83$; a people's organization is a bona fide association of citizens with a demonstrated capacity to promote the public interest and it has an identifiable leadership, membership, and structure. Its members voluntarily band together in order to work for their own betterment, development, and the greater good. An example of a people's organization is a fisherfolk association (Ajuy Development Office, 2006; Estancia Provincial Legal Office, 2004).

Factors affecting MPA establishment

Adopting the social factors as key indicators of success for examining the effects of an MPA management system, we examined two logit models with two different successful indicators: (1) improvement of the coastal environment (S1); and (2) improvement of the coral reef (S2).

Tables 3 and 4 show the analysis of fishermen's behaviour towards MPA success. Both regressions represent the corresponding independent variables, coefficients, odd ratio, z statistics (Wald test) and p-value.

The likelihood ratio chi-square of 102.15 with a p-value of zero in table 3 implies that the first model (S1) fits significantly. The significant variables in this model are C3 (municipal fishermen and the government), Knowledge (knowledge on MPA regulation indicator), and MPA (MPA size).

**Table 3. Logit model to determine factors associated with S1
(local marine resource patterns)**

Dependent Variable: S1; Log likelihood = -60.278665; LR chi-square (10) = 102.15;
Prob > chi-square = 0.0000

Variables ^a	Coefficient	Odd ratio	Z	P-value ^b
C1 (conflict between municipal and commercial fishermen)	0.9255	2.52	1.62	0.106
C2 (conflict between government and commercial fishermen)	-0.0946	0.91	-0.17	0.868
C3 (conflict between government and municipal fishermen)	1.4208	4.14	2.71	0.007***
C5 (conflict between NGOs and People's Organization)	0.7110	2.04	1.19	0.233
PrValue	-0.0004	1.00	-1.30	0.194
SecValue	-0.0017	1.00	-0.88	0.377
MemOrg	-0.6791	0.51	-1.00	0.315
Knowledge	0.6473	1.91	3.50	0.000***
MPA (size)	0.1538	1.17	2.38	0.017*
Priority	-0.7424	0.48	-1.26	0.209
_cons	-2.7138		-3.32	0.001***

Notes: ^a The dependent variable is a binary choice of 1 and 0: 1 = successful; 0 = not successful.

^b *p < 0.10, **p < 0.05, ***p < 0.01.

In Table 4, where S2 is the dependent variable, the significant variables are C1 (commercial and municipal fishermen) and Knowledge (knowledge on MPA regulation indicator). The likelihood ratio tests the overall fit of the model and shows that the second model also fits the data relatively well, with a chi-square distribution of 45.06 and a p-value of 0.000. Results of the two models show that the knowledge indicator is a key factor for evaluating and improving the condition of the coastal environment.

There is an a priori expectation that there will be overlapping and conflicting rules as well as varying regulations due to the existence of different MPA management regimes (McKean, 2000). It is clear that the effectiveness of managing coastal resources through an MPA depends on an appropriate mix of property rights (common, private and state).

**Table 4. Logit model to determine factors associated with S2
(local values and beliefs regarding the marine resources)**

Dependent Variable: S2; Log likelihood = -113.1969; LR chi-square (9) = 45.06;
Prob > chi-square = 0.0000

Variables ^a	Coefficient	Odd ratio	Z	P-value ^b
C1 (conflict between municipal and commercial fishermen)	0.8549	2.35	1.78	0.075*
C2 (conflict between government and commercial fishermen)	0.2289	1.26	0.60	0.550
C3 (conflict between government and municipal fishermen)	-0.3154	0.73	-0.78	0.437
C5 (conflict between NGOs and People's Organization)	0.3443	1.41	0.92	0.358
PrValue	0.0004	1.00	1.59	0.111
SecValue	-0.0001	1.00	-0.41	0.680
MemOrg	0.1379	1.15	0.31	0.755
Knowledge	0.4928	1.64	3.40	0.001***
MPA (size)	0.0156	1.02	0.39	0.700
Priority	-0.4438	0.64	-0.94	0.346
_cons	-2.5781		-4.00	0.000***

Notes: ^a The dependent variable is a binary choice of 1 and 0: 1 = successful; 0 = not successful.

^b *p < 0.10, **p < 0.05, ***p < 0.01.

These results are consistent with the study by Fernandez (2006), which revealed that, during the process of implementing various coastal development programmes and projects, there are “conflicts over management plans and strategies” between and among subsistence fishers, commercial fishing operators, politicians and their pressure groups, fish processing plants, barangays, and non-governmental organizations. Furthermore, due to a misunderstanding of the laws, there is a conflict between the local government and the Northern Alliance for Coastal Development and between municipal (small-scale) and commercial (large-scale) fishermen.

The Principal Component Analysis

The eigenvectors of the correlation matrix are given in table 5. The PCA was performed using the PRINCOMP procedure of the SAS system (SAS Institute, 1985), which standardizes data to zero mean and unit variance. This standardization is important in this study, given that the variables display widely different mean and relatively different standard deviation (see tables 1-4). Several tests are available for determining how many PCs to retain. The Cattel's Scree plot of eigenvalues (figures 2 and 3), the Jolliffe-amended Kaiser eigenvalue criterion (table 5) and an examination of proportion of variance accounted for by the PCs suggest retaining four PCs (which account for 69 per cent of the variation, as shown in table 6). Note that the order in which the PCs are listed in table 6 reflects the order in which they are derived from the PCA. The first PC (PC1) accounts for 41 per cent of the total variation in the data (table 6).

Algebraically, PC1 is shown as:

$$PC1 = -0.039X_1 + 0.196X_2 - 0.018X_3 - 0.009X_4 + 0.118X_5 + 0.082X_6 + 0.357X_7 + 0.352X_8 + 0.307X_9 + 0.337X_{10} + 0.288X_{11} + 0.330X_{12} \quad (1)$$

where X_1 - X_{12} are the original social economic variables and indicators used in the analysis.

Table 5 and the equation (1) above show that the first component (PC1) has high positive coefficients (weights) on knowledge (X_7) and conflict variables $X_8 - X_{12}$. The PC1 can be interpreted as a knowledge and conflicts indicator, with higher scores indicating higher knowledge and conflicts related the management regimes. It implies that the issue of the effectiveness of the MPA could be reflected in whether the actors have conflicts with each other or not. This has the same implication from the results of the logit regression (see table 2). The PC2 accounts for 13 per cent of the total variation, and has high positive weights on membership characteristics (X_5 and X_6). It can be called a membership indicator, with a higher PC2 indicating higher membership or experience. The PC3 accounts for 8 per cent of total variation and has high positive weights on income variables (X_3 and X_4), and the PC4 accounts for 7 per cent of the total variance and has high positive weight on MPA size (X_2) and the years in service or fishing (X_1).

However, the third and fourth PCs explain a small portion of the total variation and they are not as important as the first two PCs. The four principal components comprise approximately 69 per cent of total variation. These PCs are useful for decision makers.

Table 5. Correlation structures (eigenvectors) for principal components

	<i>PC1</i>	<i>PC2</i>	<i>PC3</i>	<i>PC4</i>	<i>PC5</i>	<i>PC6</i>
YrsServ (X_1)	-0.039	0.302	0.028	-0.551	0.577	0.390
Mpa (X_2)	0.196	0.180	-0.165	0.461	0.511	0.161
PrValue (X_3)	-0.018	-0.050	0.660	0.266	-0.236	0.634
ScValue (X_4)	-0.009	-0.062	0.674	0.090	0.442	-0.555
MemOrg (X_5)	0.118	0.588	0.086	0.014	-0.251	-0.209
MemYrs (X_6)	0.082	0.605	0.158	-0.181	-0.240	-0.068
Knowledge (X_7)	0.357	-0.066	0.015	-0.097	0.014	0.015
C1 (X_8)	0.352	-0.104	0.024	0.016	0.069	-0.049
C2 (X_9)	0.307	-0.151	0.012	-0.146	-0.131	-0.137
C3 (X_{10})	0.337	-0.028	0.056	-0.115	-0.057	-0.112
C4 (X_{11})	0.288	-0.227	-0.007	-0.156	-0.064	0.062
C5 (X_{12})	0.330	0.067	0.057	0.012	0.021	0.108

Table 6. Principal Component Analysis summary statistics

<i>PC number</i>	<i>PC</i>	<i>Decision variables (eigenvalues)</i>	<i>Variance (percentage)</i>
PC1	Conflict variables	Knowledge (0.357) C1 (0.352) C2 (0.307) C3 (0.337) C4 (0.288) C5 (0.330)	41 per cent
PC2	Membership Characteristics	MemOrg (0.588) MemYrs (0.605)	13 per cent
PC3	Income	PrValue (0.660) ScValue (0.674)	8 per cent
PC4	Other Factors	YrsServ (-0.551) Mpa (0.461)	7 per cent
			69 per cent of total variation

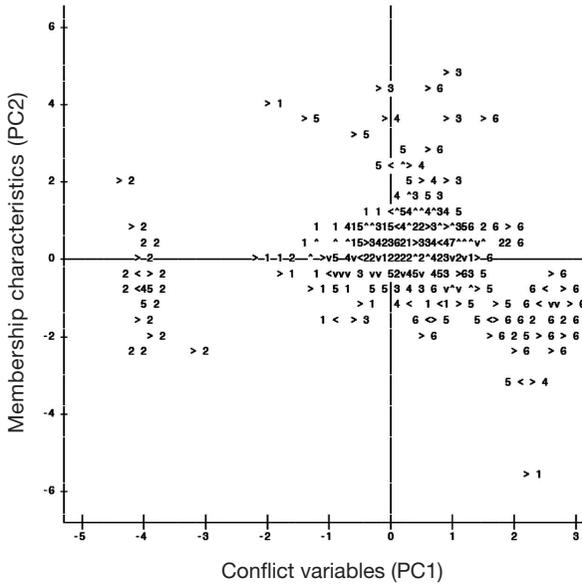
The PCA results confirm the logit regression results, where awareness of MPA rules and regulations does not directly influence fishing or secondary incomes. This could be explained by the externality and free riders, whereby fishermen may violate MPA regulations to enjoy a good service (i.e., without paying anything or making a contribution smaller than the benefit they derive). For instance, lenient implementation may cause disobedience from the fishermen.

Meanwhile, figures 2 and 3 present a summary of the relationships among observation and show relationship patterns among principal components. The observations labelled 1-6 are the municipalities in North-Eastern Iloilo. The figures show patterns of these observations among the principal components (PC1, PC2 and PC3). Relationships can be observed through the scores. For example, in figure 2, the horizontal axis represents PC1, in which the intensity of conflict increases along the x-axis from left to right. Therefore, intense conflict is characterized by a high PC1 score. The same interpretation goes for PC2 and PC3. A high score for PC2 means many years of membership in and experience with relevant organizations. Moreover, municipalities which score poorly in PC3 are characterized by little or no income.

Score plots are a good way to draw patterns from different components. Figure 2 shows the relationship of conflict to membership, wherein the knowledge variable can be drawn from the patterns of different municipalities. It is shown that the majority of the observations from the fourth quadrant are from Batad (3) and Carles (4), where respondents generally are not members of any coastal organization, but they strongly agree that there are conflicts in North-Eastern Iloilo. These observations reflect the profile of North-Eastern Iloilo municipalities. Balasan's observations agglomerate in the second and third quadrants. Fishermen in this municipality lack skills and knowledge about MPA regulations. Unlike other municipalities, Balasan does not have an MPA, and its residents are only familiar with other coastal programmes, such as mangrove reforestation and aquaculture development.

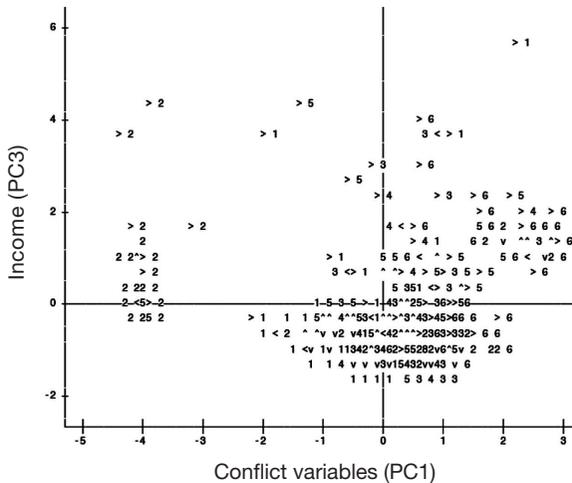
We observe that, in most areas with a long coastline and a large number of fishermen, local governments tend to prioritize MPAs over other fishery strategies, but there is high exposure to conflict among actors. For instance, Concepcion has many coastal communities in which fishing is the primary livelihood but, at the same time, an MPA is a priority project. Despite many patrol boats and wardens (sea/coastal police) among the North-Eastern Iloilo municipalities, conflicts are still rampant. Moreover, fishermen from nearby provinces take advantage and poach in these municipal waters. Membership in organizations is not popular in Batad probably because they have a smaller water surface area with fewer coastal *barangays*.

Figure 2. Score plots for Principal Component 1 (PC1) and Principal Component 2 (PC2)



Notes: 1- Estancia; 2- Balasan; 3-Batad; 4-Carles; 5-Ajuy; 6-Concepcion

Figure 3. Score plots for Principal Component 2 (PC2) and Principal Component 3 (PC3)



Notes: 1- Estancia; 2- Balasan; 3-Batad; 4-Carles; 5-Ajuy; 6-Concepcion

In figure 3, the majority of the observations from the municipality of Ajuy (5) strongly agree with the conflict statements, even if an MPA is not a priority fishery programme of the local government. Conflict statement scores are high, revealing the current political instability, which is reflected by large numbers of wardens and patrol boats in the municipality.

V. CONCLUDING REMARKS

Like many other countries, the Philippines has a problem with the management of MPAs. Threats to the successful establishment of MPAs are rapid population growth, high demand for marine products, lack of employment (other than resource extraction), law enforcement constraints and poverty (McManus, 1985). The Philippines has the highest per capita seafood consumption rate in South-East Asia (33.8 kg/year) and a high ratio of people to coastline (3,000/km²) (Wilkinson and others, 1994). The number of coastal inhabitants dependent on coral reef resources may reach several tens of thousands per square kilometre of coral reef. This situation places intense pressure on the remaining resources. As one of most important fishing grounds in the country, MPAs in Iloilo's north-eastern region are worth examining, for they reflect the conditions of a coastal-dependent region. This paper studies the relationship between socio-economic variables and the successful management of MPAs. Specifically, it attempted to observe factors that might explain MPA effectiveness, such as conflict, information and membership.

The study revealed that the success of managing MPAs depends on the success of managing social conflicts. The management of MPAs in North-Eastern Iloilo is not achieving its objectives because it failed to increase coral reef cover sustainably or improve the overall conditions of the coastal environment. In poor fishing communities of the areas studied in North-Eastern Iloilo, MPA is not an effective coastal management strategy and fishermen have very poor knowledge of MPA.

Researchers observed that, without taking into account the human dimension in the management of MPAs, *ceteris paribus*, the goal of establishing the MPAs could not be met. Fishermen who are not members of a social economics organization and lack knowledge of MPAs could earn more income than those who are members because of free-riding problems. In North-Eastern Iloilo, fishermen seem to believe that their right to fish in the fishing areas (MPA zone) is being violated, but fishing in a non-MPA zone could cost them more (in terms of fuel and time, for example).

The results of this research indicated that bureaucratic regimes have more conflicts than community-based and co-management regimes, especially MPA management solely operated by local government. The public sector has the bulk of the budgets for coastal management, and its influence cannot be disregarded. In addition, human (e.g., conflict) and non-human (e.g., size) threats to MPAs are not controlled, though there have had attempts at negotiation and dialogue in order to solve conflicts. The success of MPAs management could therefore be very limited in the absence of educational measures to increase fishermen's awareness regarding MPAs.

Since the management of MPAs in North-Eastern Iloilo is not attaining its objectives; policymakers should reconsider the strategies for establishing MPAs. The government and public sector should correct their overlapping mandates and regulations. Further studies should include more serious issues, such as pollution, waste management, and coastal population growth, to analyse the impact of MPAs. There should also be a focus on the links between MPAs and poverty alleviation.

ANNEX

The models used in this study are composed of a dependent variable that is binary (0, 1) and a set of independent variables. Two logit models are adopted, each given success indicators: improvement of the coastal environment (S1); and improvement of the coral reef (S2). Using the non-linear likelihood estimation, the probability P_i , is defined as follows:

$$\text{Prob } P_i(Z_i = 1) = \frac{\exp(\alpha + \beta X_i)}{1 + \exp(\alpha + \beta X_i)} \quad (\text{A.1})$$

where $Z_i = 1$ if MPA is successful and $Z_i = 0$ if otherwise.

The vector of X , $X = (X_1, X_2, X_3, \dots, X_n)$, is the set of independent variables for determining the success of MPA. In this paper, there are two regressions. The first determines which among the five conflict variables (C1, C2, C3, C4, C5) are significant. Any insignificant conflict variables are dropped from the analysis. The second regression is composed of the significant conflict variables and a set of independent variables.

Specifically, the first regressions have the following general form for all conflict variables.¹³

$$\text{logit}[\theta(S1)] = \log \left[\frac{\theta(S1)}{1 - \theta(S1)} \right] = \alpha + \beta_i \text{ conflictvariable} \quad (\text{A.2})$$

Equation A.2 is for the first success indicator, S1.

$$\text{logit}[\theta(S2)] = \log \left[\frac{\theta(S2)}{1 - \theta(S2)} \right] = \alpha + \beta_1 \text{ conflictvariable} \quad (\text{A.3})$$

Equation A.3 is for the second success indicator, S2.

On the other hand, the second logit regression will have the following forms:

¹³ Equations 1.1 and 1.2: conflict variable = (C1, C2, C3, C4, C5).

$$\begin{aligned}
 \text{logit}[\theta(\text{SUCCESS1})] &= \log \left[\frac{\theta(S1)}{1 - \theta(S1)} \right] \\
 &= \alpha + \beta_1 C1 + \beta_2 C2 \\
 &\quad + \beta_3 C3 + \beta_4 C4 + \beta_5 C5 + \beta_6 \text{Knowledge} \\
 &\quad + \beta_7 \text{mpa} + \beta_8 \text{priority} \\
 &\quad + \beta_9 \text{PrValue} + \beta_{10} \text{SecValue}
 \end{aligned} \tag{A.4}^{14}$$

Equation A.4 is for the first success indicator, S1.

$$\begin{aligned}
 \text{logit}[\theta(S2)] &= \log \left[\frac{\theta(S2)}{1 - \theta(S2)} \right] \\
 &= \alpha + \beta_1 C1 + \beta_2 C2 + \beta_3 C3 \\
 &\quad + \beta_4 C4 + \beta_5 C5 + \beta_6 \text{Knowledge} + \beta_7 \text{mpa} + \beta_8 \text{priority} \\
 &\quad + \beta_9 \text{PrValue} + \beta_{10} \text{SecValue}
 \end{aligned} \tag{A.5}$$

Equation A.5 is for the second success indicator, S2.

The above equations show that regressions have two dependent variables (S1, S2) which are run separately. On the other hand, the independent variables are the following: conflict between municipal and commercial fishermen (C1); conflict between government and commercial fishermen (C2); conflict between government and municipal fishermen (C3); conflict between NGO and fishermen (C4); conflict between NGOs and POs (C5); regulation knowledge (Knowledge); size of MPA (mpa); whether MPAs are priority coastal project (priority); membership to organizations (MemOrg); fishing income (PrValue); and secondary income (SecValue).

¹⁴ Equations A.4 and A.5 can be altered, depending on the previous logit regressions with conflict variables. Only conflict variables which are found to be significant are included in these equations.

Table A.1. Summary and description of variables for LOGIT regression

<i>Variable Name</i>	<i>Description</i>
<i>Statement Variables</i>	
S1	Referring to whether there is a improvement in the quantity or quality of coral reefs
S2	Referring to whether there is an improvement in the overall coastal environment
Knowledge	Whether respondents have knowledge with MPA regulations
C1	Whether there is conflict between municipal and commercial fishermen
C2	Whether there is conflict between the government and commercial fishermen
C3	Whether there is conflict between the government and municipal fishermen
C4	Whether there is conflict between NGO and fishermen
C5	Whether there is conflict between NGOs and POs
<i>Other Variables</i>	
Mpa	Size of MPA in hectares
Priority	Whether MPA is a priority coastal project
MemOrg	Whether respondent is member of any environmental/natural resource group
PrValue	Weekly primary income value, referring to fishing income, in PhP
SecValue	Weekly secondary income value, in PhP
YrsServ	Number of years in service
EcType	Economic type i.e. fisherman, public or private sector

REFERENCES

- Ajuy Development Office (2006). An ordinance providing for the sustainable management, conservation, and development of coastal and fisheries resources of the municipality of Ajuy Province of Iloilo, Iloilo Province, Ajuy Municipal Hall.
- Alcala, Angel C. (2001). *Marine Reserves in the Philippines: Historical Development, Effects and Influence on Marine Conservation Policy*. Makati City: Bookmark.
- Anthoni, J. Floor (2003). FAQ-Frequently Asked Questions about Marine Reserves and Marine Conservation. Available from www.seafriends.org.nz/issues/cons/faq.htm. Accessed 28 October 2008.
- Balgos, Miriam C. (2005). Integrated coastal management and marine protected areas in the Philippines: concurrent developments. *Ocean and Coastal Management*, vol. 48, Nos. 11-12, pp. 972-995.
- Baling, N. (1995). Philippine marine protected area management: country paper. In *The 3rd Regional Workshop for the Review of the Protected Areas of the IndoMalayan Realm*, Cisarua, Bogor, Indonesia, 23-35 January. Hong Kong: Asian Bureau for Conservation.
- Burke, Laretta, Elizabeth Selig, and Mark Spalding (2002). *Reefs at Risk in Southeast Asia*. Washington, D.C.: World Resource Institute. Available from pdf.wri.org/rrseasia_full.pdf.
- Christie, Patrick (2004). Marine protected areas as biological successes and social failures in Southeast Asia. *American Fisheries Society Symposium*, vol. 42, pp. 155-164. Available from www.sma.washington.edu/faculty/christie/MPAs.Christie.AFS.book.2004.pdf.
- _____ (2005). Is integrated coastal management sustainable? *Ocean and Coastal Management*, vol. 48, Nos. 3-6, pp. 208-232.
- _____, A. White, and E. Deguit (2002). Starting point or solution? Community-based marine protected areas in the Philippines. *Journal of Environmental Management*, vol. 66, No. 4, pp. 441-454.
- Estancia Provincial Legal Office (2004). Ordinance providing for the sustainable management, conservation, and development of coastal and fisheries resources of the municipality of Estancia Province of Iloilo. Iloilo Province: Estancia Municipal Hall.
- Fernandez, Pepito R., Jr. (2006). The relevance of governance institutions in marine protected area. *Science Diliman*, vol. 18, No. 1, pp. 18-34.
- _____, Yoshiaki Matsuda, and Rodelio F. Subade (2000). Coastal area governance system in the Philippines. *Journal of Environment and Development*, vol. 9, No.4, pp. 341-369.
- Ferrer, Alice Joan G. (2009). Evaluation of fisheries management options for the Visayan Sea, Philippines: the case of Northern Iloilo. Economy and Environment Program for Southeast Asia Research Report, No. 2009-RR5. Singapore. Available from www.idrc.ca/uploads/user-S/12601665381Alice_Ferrer2009-RR5.pdf.
- Gjertsen, Heidi (2005). Can habitat protection lead to improvements in human well-being? Evidence from the marine protected areas in the Philippines. *World Development*, vol. 33, Issue 2, pp. 199-217.
- Guénette, Sylvie, and Jackie Alder (2007). Lessons from marine protected areas and integrated ocean management initiatives in Canada. *Coastal Management*, vol. 35, pp. 51-78. Available from www2.fisheries.com/archive/members/sguenette/guenette_alder_2007.pdf.

- Himes, Amber H. (2007). Performance indicators in MPA management: using questionnaires to analyze stakeholder preferences. *Ocean and Coastal Management*, vol. 50, Nos. 5-6, pp. 329-351.
- Iloilo (2001). Provincial Capitol Development Plan 2001, Iloilo Province.
- International Development Research Centre (2003). Module 10C: focus-group discussion. In *Designing and Conducting Health Systems Research Projects: Volume 1 Proposal Development and Fieldwork*, Corlien M. Varkevisser, Indra Pathmanathan, and Ann Brownlee. Amsterdam: KIT/IDRC. Available from www.idrc.ca/en/ev-56615-201-1-DO_TOPIC.html. Accessed 13 January 2009.
- Jameson, Stephen C., Mark H. Tupper, and Jonathon M. Ridley (2002). The three screen doors: can marine 'protected' areas be effective? *Marine Pollution Bulletin*, vol. 44, pp. 1177-1183. Available from [www.coralseas.com/doc/Jameson et al. 2002 MPB.pdf](http://www.coralseas.com/doc/Jameson%20et%20al.%2002%20MPB.pdf).
- Javier, Esmyra Parado (2003). Do Institutions Affect the Performance of Marine Protected Areas? Evidences from the Philippines. Economy and Environment Program for Southeast Asia Research Report, No. 2003-RR5. Singapore. Available from <http://www.idrc.ca/uploads/user-S/10705034571EsmyraRRlayout.doc>.
- Jollands, Nigel, Jonathan Lermitt, and Murray Patterson (2004). Aggregate eco-efficiency indices for New Zealand – a principal component analysis. *Journal of Environmental Management*, vol. 73, No. 4, pp. 293-305.
- Jones, Peter J.S. (2002). Marine protected area strategies: issues, divergencies and the search for middle ground. *Reviews in Fish Biology and Fisheries*, vol. 11, No. 3, pp. 197-216.
- McKean, Margaret A. (2000). Common property: what is it, what is it good for, and what makes it work. In *People and Forests: Communities, Institutions, and Governance*. Cambridge, Massachusetts, United States: MIT Press. Available from <http://www.fao.org/docrep/006/x2104e/X2104E03.htm>.
- McManus, J.W. (1985). Marine speciation, tectonics and sea level changes in Southeast Asia. *Coral Reefs*, vol. 4, pp. 133-138.
- Oracion, Enrique G., Marc L. Miller, and Patrick Christie (2005). Marine protected areas for whom? Fisheries, tourism, and solidarity in the Philippine community. *Ocean and Coastal Management*, vol. 48, pp. 393-410. Available from [www.sma.washington.edu/Research/ICM_pubs/Oracion et al. MPAs.pdf](http://www.sma.washington.edu/Research/ICM_pubs/Oracion%20et%20al.%20MPAs.pdf).
- Philippines (1975). Revising and Consolidating All Laws and Decrees Affecting Fishing and Fisheries. Presidential Decree No. 704, May 16, 1975. Available from faolex.fao.org/docs/pdf/phi2064.pdf. Accessed 16 March 2010.
- _____, Department of Environment and Natural Resources; Bureau of Fisheries and Aquatic Resources of the Department of Agriculture; and Department of the Interior and Local Government (2001). *Philippine Coastal Management Guidebook No. 5: Managing Coastal Habitats and Marine Protected Areas*. Cebu City, Philippines: Coastal Resource Management Project. Available from [faspo.dentr.gov.ph/ProgramProjects/ListFASPs/ARCHIVE/for the webpage/CRMP pdf IEC/crmguidebook5.pdf](http://faspo.dentr.gov.ph/ProgramProjects/ListFASPs/ARCHIVE/for%20the%20webpage/CRMP%20pdf%20IEC/crmguidebook5.pdf).
- _____, Bureau of Fisheries and Aquatic Resources (2008a). Statistics Highlights. Available from www.bfar.da.gov.ph/styles/Publications03/statistics.htm. Accessed 3 March 2008.
- _____, National Statistics Coordination Board (2008b). Philippine Standard Geographic Code. Available from [www.nscb.gov.ph/activestats/psgc/province.asp?provCode=06300000&provName=ILOILO®Code=06®Name=REGION VI \(Western Visayas\)](http://www.nscb.gov.ph/activestats/psgc/province.asp?provCode=06300000&provName=ILOILO®Code=06®Name=REGION%20VI%20(Western%20Visayas)). Accessed 10 March 2008.

- _____ (2009). Philippine Standard Geographic Code. Available from www.nscb.gov.ph/activestats/psgc/default.asp. Accessed 13 January 2009.
- Pomeroy, Robert S., and Melvin B. Carlos (1997). Community-based coastal resource management in the Philippines: a review and the evaluation of programs and projects. *Marine Policy*, vol. 21, No. 5, pp. 445-464.
- _____, John E. Parks, and Lani M. Watson (2004). *How is MPA doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness*. Gland, Switzerland: International Union for Conservation of Nature and Natural Resources. Available from data.iucn.org/dbtw-wpd/edocs/PAPS-012.pdf.
- _____, M.B. Mascia, and R.B. Pollnac (2007a). Marine Protected Areas: The social dimension. In Report and documentation of the Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations, FAO Fisheries Report No. 825. Rome: FAO. Available from [ftp://ftp.fao.org/docrep/fao/010/a1061e/a1061e03.pdf](http://ftp.fao.org/docrep/fao/010/a1061e/a1061e03.pdf). Accessed March 5, 2008.
- _____, and others (2007b). Fish wars: conflict and collaboration in fisheries management in Southeast Asia. *Marine Policy*, vol. 31, No. 6, pp. 645-656.
- Rajasuriya, A., and others (2000). Status of coral reef in South Asia: Bangladesh, India, Maldives, Sri Lanka. In *Proceedings of the Ninth International Coral Reef Symposium*, Moosa, M.K., and others, eds. Bali, 23-27 Oct. 2000, vol. 2.
- SAS Institute (1985). *User's Guide: Statistics*. Cary, United States: SAS Institute.
- Staed, Selina M., and Derek J. McGlashan (2006). A coastal and marine national park for Scotland in partnership with integrated coastal zone management. *Ocean and Coastal Management*, vol. 49, Nos. 1-2, pp. 22-41.
- Sumaila, Ussif Rashid, and Anthony T. Charles (2002). Economic models of marine protected areas: an introduction. *Natural Resource Modeling*, vol. 15, No. 3, pp. 261-272. Available from rmmc.asu.edu/abstracts/nrm/vol15-3/intro.pdf.
- Tyler, Stephen R. (1999). Policy implications of natural resource conflict management. In *Cultivating Peace: Conflict and Collaboration in Natural Resource Management*. Ottawa, Canada: International Development Research Centre. Available from www.idrc.ca/openebooks/899-6/.
- Wilkinson, C.R., and others (1994). Status of coral reefs in Southeast Asia: threats and responses. In *Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards and History*. Miami, Florida: Rosentiel School of Marine and Atmospheric Science, University of Miami.
- Webb, Edward L., Ronald J. Maliao, and Susana V. Siar (2004). Using local user perceptions to evaluate outcomes of protected area management in Sagay Marine Reserve, Philippines. *Environmental Conservation*, vol. 31, pp. 138-148.
- Weible, Christopher, Paul A. Sabatier, and Mark Lubell (2004). A comparison of a collaborative and top-down approach to the use of science in policy: establishing marine protected areas in California. *Policy Studies Journal*, vol. 32, No. 2, pp. 187-207.
- White, Alan T, Catherine A. Courtney, and Albert Salamanca (2002). Experience with marine protected area planning and management in the Philippines. *Coastal Management*, vol. 30, No.1, pp. 1-2.