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## Understanding Factors Considered by Fishermen in Marine Protected Area Planning and Management: Case Study of Claveria, Philippines

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**Abstract:** This empirical study is an attempt to contribute to the understanding of what factors fishermen value or consider in Marine Protected Area (MPA) planning and management using choice experiment. Results showed that the fishermen in Taggat Norte consider more certain factors such as MPA size and patrol days when evaluating MPA plans. The attribute on expected increment in fish catch although relevant was not accorded significance in their choice behavior. The respondents did not seem to be willing to trade-off the benefit of an uncertain fish catch variable with the more definite cost of increased MPA size or number of patrol days. Policy implications include primary consideration of MPA size when designing MPA plans and considering to some extent voluntary fisher labor in MPA management.

**Key words:** Marine protected area, choice experiment, Claveria, Philippines, MPA size, multinomial logit model

### INTRODUCTION

World's coral reefs and associated invaluable resources continue to decline owing to pollution and human pressures (Wilkinson, 2004). Philippine marine fisheries are also characterized mainly by depleted fishery, degraded coastal environment and critical fisheries habitats (Luna *et al.*, 2004). To reverse this trend, several regulatory policies and non-regulatory management tools have been initiated and implemented in the past decades by regional fishery management organizations, national governments and concerned institutions. The establishment of MPAs in the Philippines, for example, began as early as in the 1970s (Balgos, 2005) with the aim to promote long-term conservation of and ensure sustainable income from marine resources. Pajaro *et al.* (1999) listed more than 400 community-based and local government-supported MPAs. In recent years, the estimated number of existing and proposed MPAs is over 1300 (Aliño *et al.*, 2000; Campos and Aliño, 2008). However, only 10 to 15% of this total number of MPAs in the country are effectively managed and protected (Aliño *et al.*, 2000; White *et al.*, 2002).

A major success factor in MPA sustainability as a coastal management tool is the participation and cooperation of local stakeholders or community involvement (Pollnac *et al.*, 2001; White *et al.*, 2002; Martínez, 2008). When the community or local stakeholders are involved in planning and decision-

making activities of an MPA, they have a sense of ownership for that MPA which increases their likelihood of supporting it. This is the premise behind the increasing number of small community-based marine conservation efforts in many parts of the country. In fact, most MPAs in the country were initiated by community-level organizations and many continue to be managed by these same organizations (Campos and Aliño, 2008). A generalization regarding application to individual communities, however, cannot be made because each success has its own identity and to a limited degree, each community and local government must navigate their own course before their program becomes sustainable (White, 2007).

This study takes the case of a quasi-MPA in Taggat Norte, Claveria, Philippines—described as government-initiated and legally backed by an ordinance, but is not currently being protected since it still has no deployed markers and fishing and seaweed gathering are still allowed even as it is supposed to be a no-take zone. Claveria is located in the Northwestern part of the province and bounded on the north by the Babuyan Channel, the most important marine fishing ground in the Cagayan valley region in Northern Luzon, Philippines. The Taggat landing center in Claveria is the second largest municipal landing center in the province considering the number of fishing boats and the average landed catch especially during the peak fishing season (Bureau of Agricultural Statistics, 2007).

Initial plans of establishing an MPA in the area were done in 1995 when a Fishery and Aquatic Resources Development Program (FARDP) was initiated by the Bureau of Fisheries and Aquatic Resources (BFAR) and the provincial local government of Claveria as a strategy for its coastal resource management. Accordingly, the program aimed to uplift the quality of life of the fisher folks through improved fishery technology and community-based participatory activities in order to attain sustainability and productivity without destroying the ecological integrity of nature. In 2000, the Local Government of Claveria, through Resolution No. 104, S-2000, enacted an ordinance providing for the development, conservation and regulation and management of the coastal fisheries and aquatic resources within the territorial jurisdiction of the municipality of Claveria. The ordinance provided for the classification of municipal waters and foreshore areas for the purpose of granting rights to fishing villages. This zoning provision also included the establishment of the municipal marine sanctuary area and reserve that included at least five geographically specified locations, the no-take sanctuary of which is near lakay-lakay point in Taggat Norte, including the Taggat Lagoon (Municipality of Claveria, 2000). The lakay-lakay point is an elongated enormous rock formation located near the rocky cliffs and shore on the western tip of Claveria Bay and east of Taggat Lagoon. It is surrounded with coral reefs and seaweed beds. Other provisions of the ordinance include: regulatory policies on the conservation and utilization of coastal and municipal waters, creation of fishery management council, municipal licenses and fees, registration and licensing procedures, prohibitions and restrictions and fines and penalties.

The establishment of the MPA in this area was initiated with the aim of protecting the marine habitats from over exploitation, at the same time take advantage of the natural beauty of the marine environment and promote this remote area for tourism. Eight years after the enactment of the ordinance, the policy provisions on registration of fishermen, licensing of fishing vessels and gears, organization of municipal fishery management council and apprehension of the use of illegal fishing gears and fishing or taking of endangered species continue to be implemented although not perfectly complied with. The setting of demarcation marks of the MPA and the prohibition of fishing activities within the designated marine sanctuary, however, is not being enforced yet.

The main purpose of this study is to contribute to the understanding of what factors in MPA management matter to fishermen in the area when considering MPA plans. Results will inform and provide some insights on the fishermen's value of MPA and their preferences on the MPA design and management.

## **MATERIALS AND METHODS**

### **Understanding preferences through choice experiments:**

Choice Experiment (CE) is a choice modeling approach under the wide umbrella of conjoint analysis techniques. It is based around the idea that any good or services can be described in terms of its attributes, or characteristics and the levels that these take (Bateman *et al.*, 2002). In a CE, respondents are presented with a series of alternatives and asked to choose their most preferred with the status quo baseline usually included in the choice set (Bateman *et al.*, 2002). In environmental applications, CE involves respondents being asked to select their preferred alternative from a range of potential resource management policies described in terms of a set of attributes (Benett, 2004). A review of the method and applications of conjoint analysis for environmental evaluation done by Alriksson and Oberg (2008) observed that choice experiments seem to have a comparatively stronger position in environmental studies than elsewhere. CE has been recently widely applied for non-market valuation of environmental goods and services (Adamowicz *et al.*, 1998; Blamey *et al.*, 1999; Rolfe *et al.*, 2000; Birol *et al.*, 2006). Wattage *et al.* (2005) applying CE to evaluate the importance of fisheries management objectives concluded that CE is a useful approach for evaluating management alternatives and programs in the field of fisheries. Hearne and Salinas (2002) used CE to study tourist preferences for ecotourism development and concluded that CE is a feasible mechanism to analyze user preferences for the management of protected areas in developing countries. Wallmo and Edwards (2008) used CE to estimate the non-market values of marine protected areas in the Northeast Region of the US and found that roughly half of the respondents saw reserve size as a normal economic good with positive, but diminishing marginal utility.

For this empirical study, we use CE to understand the attributes relevant to small-scale artisanal fishermen when presented with MPA plans. Results can be used to inform policy decision makers on the factors that matter to fishermen and the values fishermen put on MPAs or marine sanctuaries. The basic strength of CE technique is its being able to provide information on which attributes

Table 1: Attributes and levels used for MPA plans

| Attributes                       | Current status                                      | Levels                                                           |
|----------------------------------|-----------------------------------------------------|------------------------------------------------------------------|
| Size of MPA                      | ~200 m <sup>2</sup>                                 | Expansion by 200, 400 and 600 m to offshore                      |
| Expected increment in fish catch | Average fish catch of 10 to 15 kg day <sup>-1</sup> | 10, 20, 30% increase from the current average fish catch per day |
| Patrol days per year             | 0 days per year                                     | 10, 15 and 20 days per year                                      |

\*Approximate size from lakay-lakay point based on geographical coordinates

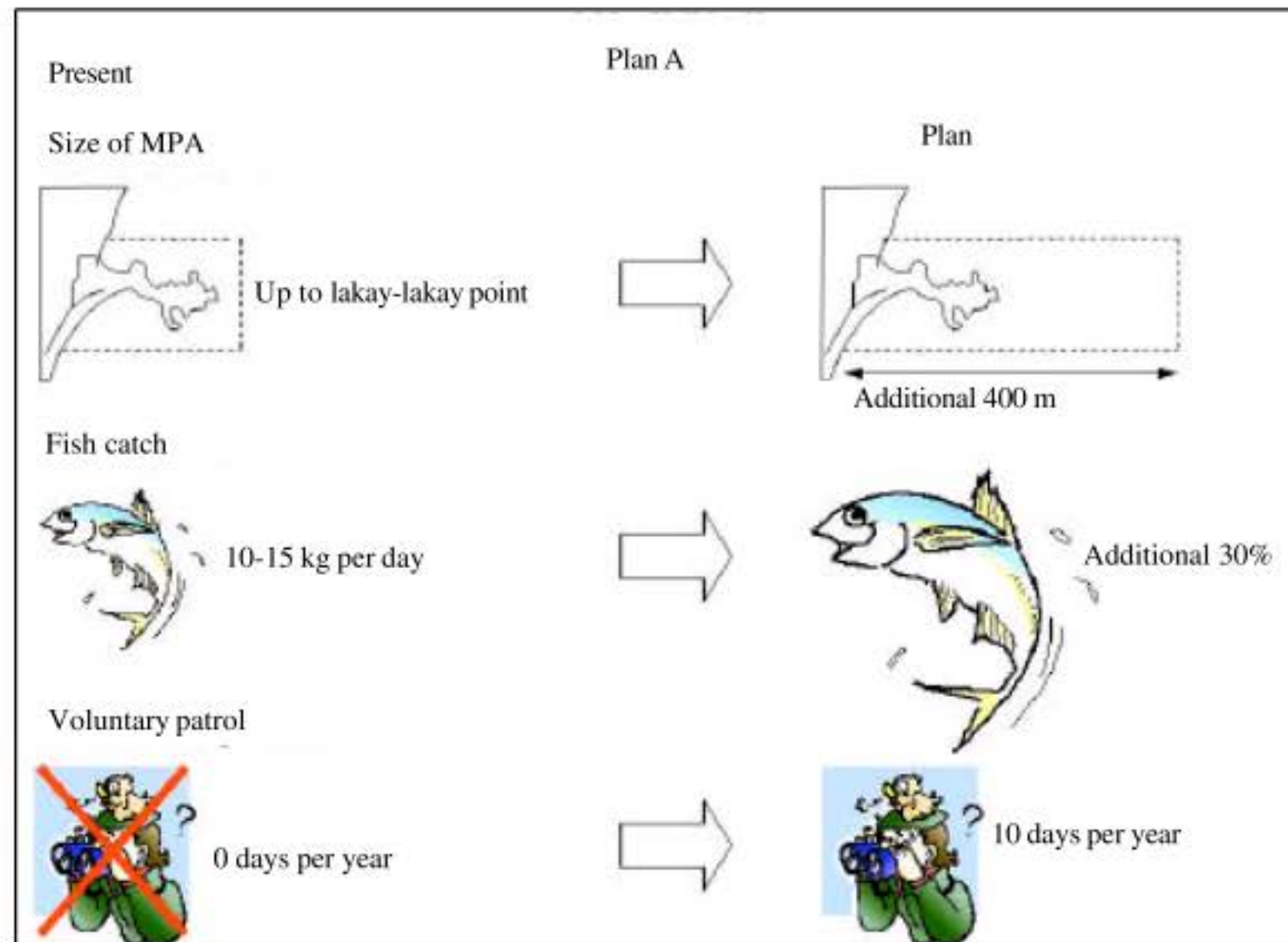


Fig. 1: Sample MPA plan

are significant determinants of the values people place on non-market goods and the implied ranking of these attributes (Bateman *et al.*, 2002).

**Attributes, experimental design and survey questionnaire:** Fishermen respondents were presented with a series of alternative MPA plans (choice sets) described using a common set of attributes, namely: the range or size of MPA, the expected increment in average fish catch and the volunteer patrol days per year, with varying levels (Table 1). These three attributes were selected based on field observation and discussion with key informants and fishermen in Taggat Norte. The levels were determined based on the status quo or the present MPA plan level and discussion with key informants in the village. Final levels were set following the analysis of the survey questionnaire pre-test and pilot surveys. The change from current condition to the proposed level was included in the visual presentation of each alternative so that the respondent is clear on the difference between the plans.

With three attributes and three levels for each attribute, a full factorial design would generate 27 possible plan combinations. It would, however, be difficult for fishermen respondents to choose from 27 set of alternatives. Respondents should not be asked to undertake tasks that are too difficult or complex because they might not perform them reliably and/or might resort to shortcuts or haphazard answers (Bateman *et al.*, 2002). Thus, nine plans of expanding MPA were generated using orthogonal array method. This full set of nine alternatives was further blocked into three subsets, with each subset containing three different plans, hence three questionnaire versions. Based on random assignment, each fisherman was presented with three alternative plans and an option not to choose any of the plans. Figure 1 shows a sample plan included in the choice set.

**Survey approach and data collection:** Most of the fishermen using the Claveria bay and adjacent fishing grounds and who were involved in the earlier meetings about the MPA, are from Taggat Norte, Claveria so it was

chosen to be the case study area. The 2006 village census indicated around 280 households, 95 of which have family members engaged in fishing activity. After confirming with the village chairman and other key informants and based on the list of fishermen from the municipal fishery technician, the total number of confirmed household residents was 238 and around 100 fishing households in Taggat Norte. Not including those covered in the pre-test and pilot surveys, we randomly sampled 50% of the fishing households. The total number of valid questionnaires used in the analysis was 48. Using face to face interview technique, each respondent was presented an introductory explanation and a choice set consisting of three alternatives. The respondent was then asked to choose one most preferred alternative. The survey was conducted in May, 2008.

**Econometric model:** The model used in the study is a case of discrete choice-unordered with more than two categories. Unordered-choice models can be motivated by random utility model (Greene, 2003). Accordingly, for the  $i$ th respondent faced with  $J$  choices, we assume the utility of choice  $j$  is of the Eq. 1 form:

$$U_{ij} = V_{ij} + e_{ij} \quad (1)$$

where,  $V_{ij}$  is the deterministic or observable component of utility and  $e_{ij}$  is the error component or the unobservable components influencing the choice. If the respondent chose plan  $j$ , then it is implied that the utility of choosing plan  $j$  ( $U_{ij}$ ) is higher than the utility of other plans ( $U_{ik}$ ). The probability that a respondent  $i$  will choose the alternative  $j$  from the set of  $J$  choices is Eq. 2:

$$\text{Prob}(j) = \text{Prob}(V_j + e_j > V_k + e_k) \text{ for all other } k \text{ in } J \text{ choice set; } k \neq j \quad (2)$$

For this study, we specified the deterministic component of utility ( $V_j$ ) to be of the Eq. 3 form:

$$V_j = b_0 + b_1 \text{MPA4}_j + b_2 \text{MPA6}_j + b_3 \text{FISH20}_j + b_4 \text{FISH30}_j + b_5 \text{PATR15}_j + b_6 \text{PATR20}_j \quad (3)$$

where, the dependent variable in this model is a variable that takes a value of 1 for the chosen alternative and zero for the alternatives not chosen. Independent variables, on the other hand, consist of six dummy variables representing the attributes of the alternatives:  $\text{MPA4}_j$  and  $\text{MPA6}_j$  which take a value of 1 if the MPA is expanded offshore by 400 and 600 m more than the current state, respectively and zero otherwise;  $\text{FISH20}_j$  and  $\text{FISH30}_j$  take a value of 1 if the expected fish harvest increases more

than the current state by 20 and 30%, respectively and zero otherwise;  $\text{PATR15}_j$  and  $\text{PATR20}_j$  take a value of 1 if the patrol days per year are 15 days and 20 days, respectively and zero otherwise. The corresponding  $b$ 's of the independent variables are the parameter estimates.

Since, there are three levels for each of the attribute dummy variables, the minimum condition (that is, 200 m from offshore, 10% expected increase in fish catch and 10 patrol days per year) was set as the reference or base level from which the other levels are compared with. This corresponds to the constant term  $b_0$  in the parameter estimates.

Under the assumptions of independently and identically distributed Type I extreme value error terms; that when no alternative plan is chosen, the current utility  $U_0$ 's deterministic utility  $V_0$  is 0 and the difference between  $e_0$  and  $e_j$  follows a logistic distribution, then the choice probability for plan  $j$  can be estimated as multinomial logit model (McFadden, 1973) which can be expressed as:

$$P(j) = \frac{\exp(\mu V_j)}{\sum_k \exp(\mu V_k)} \quad (4)$$

## RESULTS AND DISCUSSION

Table 2 shows estimated coefficients for the multinomial logit model. Initial analysis showed that the coefficients of the independent variables:  $\text{MPA4}$  and  $\text{MPA6}$  were both statistically significant at 1% level and  $\text{PATR20}$  was statistically significant at 5% level. On the MPA size, with the coefficient for the MPA size at 200 meters normalized to 0, the estimated significant negative coefficients -2.371 for  $\text{MPA4}$  and -1.818 for  $\text{MPA6}$  indicate that other factors constant, fishermen would less likely prefer 400 and 600 m MPA relative to the 200 m. In other words, fishermen in the study site would significantly prefer smaller size MPA. As it is expected that the coefficient of  $\text{MPA6}$  would be slightly smaller than  $\text{MPA4}$  and the coefficients showed otherwise, we tested whether the two coefficients are statistically different from each other and found that they are not statistically different. This implies that per respondent evaluation, the difference between 400 or 600 m is not important (or almost the same in a sense) relative with the other factors such as fish catch and patrol days. Hence, we re-estimated the model considering the same coefficient for  $\text{MPA4}$  and  $\text{MPA6}$  for use in the choice probability analysis.

In the case of fish catch, we also normalized to zero the 10% expected increase and compared it with the expected fish catch increase at 20% ( $\text{FISH20}$ ) and 30%

Table 2: Results of the Multinomial Logit Model, Taggat Norte, 2008

| Variables | Definition                                                         | Estimated coefficient | p-value  |
|-----------|--------------------------------------------------------------------|-----------------------|----------|
| Constant  | Alternative specific constant for Abase@ alternative               | 0.475                 | 0.3920   |
| MPA4      | Dummy variable = 1 if MPA is 400 m, otherwise zero                 | -2.044                | 0.000*** |
| MPA6      | Dummy variable = 1 if MPA is 600 m, otherwise zero                 | -2.044                | 0.000*** |
| FISH20    | Dummy variable = 1 if caught fish is 20% increased, otherwise zero | 1.011                 | 0.168    |
| FISH30    | Dummy variable = 1 if caught fish is 30% increased, otherwise zero | 1.053                 | 0.162    |
| PATR15    | Dummy variable = 1 if patrol is 15 days per year, otherwise zero   | -0.449                | 0.611    |
| PATR20    | Dummy variable = 1 if patrol is 20 days per year, otherwise zero   | -1.846                | 0.023**  |

Summary statistics; No. of respondents = 48; Log likelihood at zero = -56.5361; Log likelihood at convergence = -52.0862; McFadden's Pseudo R<sup>2</sup> = 0.0787; \*\*, \*\*\*Significant at 5 and 1%, respectively

Table 3: Forecasted probabilities of accepting MPA plan

| Case | MPA (m) | FISH (%) | PATR (days) | Probability of accepting plan |
|------|---------|----------|-------------|-------------------------------|
| 1*   | +200    | +10      | 10          | 0.62                          |
| 2    | +400    | +10      | 10          | 0.17                          |
| 3    | +600    | +10      | 10          | 0.17                          |
| 4    | +200    | +10      | 20          | 0.20                          |
| 5    | +400    | +10      | 20          | 0.03                          |
| 6    | +600    | +10      | 20          | 0.03                          |

\*Based on the constant coefficient

(FISH30). Both did not yield significant coefficients implying that the respondent's evaluations of plans with 10, 20 or 30% expected increase in fish catch did not differ significantly.

The coefficient of 10 patrol days' level was also normalized to zero and used as reference for PATR15 and PATR20. The negative coefficient for PATR15 was not significant compared with the reference 10 patrol days suggesting that the decrease in fishermen's utility for patrolling 15 days per year is not significantly different with patrolling for 10 days. However, PATR20 had a significant negative coefficient signifying that fishermen have significantly lower preference for any plan that would require them 20 patrol days per year, compared with 10 patrol days.

Table 3 shows the results of choice probability analysis (probability of agreement with proposed plans calculated by using estimated coefficients). As shown, the variables MPA4, MPA6 and PATR20 had statistically significant coefficients with reference to the minimum combination (MPA size expanded by 200 m and 10 days patrol). A plan, in which MPA will be expanded offshore to 200 m more than the current range, the expected fish catch will increase by 10% more than current average catch and the patrol days will be 10 days per year (case 1 in the table or constant in this model), for example, had a 0.62 probability of acceptance, that is, 62% of the fishermen are predicted to agree with the plan. Fishermen will unlikely prefer any plan of expanding the size of the sanctuary to 400 or 600 m, as shown by the 0.17 probability value. The forecasted choice probability values suggest that any plan with an MPA expansion of only 200 m would be selected by majority of the respondents.

In addition, the choice probability by fishermen will decrease to 0.20 if 20 patrol days will be served in a year

(case 4). This result suggests that any plan for fishermen patrolling would be more acceptable if it is within 15 days in a year. Finally, the probability of a plan of increasing the MPA size by 400 or 600 m and at the same time requiring 20 patrol days being preferred is almost nil (cases 5 and 6).

The abovementioned results confirmed that fishermen in the area are not entirely unwilling to support any plans of MPA establishment. The results, however, indicate that relative to the other factors, the MPA size is an overwhelmingly important factor to fishermen in the area. Lesser MPA size is much preferred as this would mean lesser reduction in fishing ground and thus perceived lower cost to them (The context of the study is that the marine sanctuary is a year-round no-take zone which is what is currently in the ordinance). Fishermen consider more the size of MPA even relative to any expected increase in fish catch. Some respondents mentioned during the face to face interviews that a 400 or 600 m would already imply that the sea basin in the remaining available fishing ground comprise mostly of sand and less coral reef and fewer fish can be caught. The longer range of MPA would also imply that they will be obliged to go farther to fish which will require more fishing effort despite the promise of increased average fish catch in the long-run.

The importance of size as a factor was also emphasized in Wallmo and Edwards (2008) in studying value of ecological reserves and analyzing trade-offs between reserve size and allowable uses. They suggested that smaller reserves with liberal uses may provide considerably more value than larger no-take reserves.

No statistically significant difference was found among the 10, 20 and 30% expected increment in fish catch. A possible explanation for this is that fishermen consider the attribute on fish catch an uncertain feature

relative to the certainty of MPA size and patrol day factors. Particularly on the short-run, an immediate increase in fish catch is less tangible compared with the reduced fishing ground and number of patrol days. Much scientific evidence is available on the ecological and biological positive impact of marine no-take zones, but some bio-economic exercises also present some uncertainties and conditionality particularly on the net economic benefits of MPAs. Alban *et al.* (2008) presented some literature review. The size of the no-take sanctuary relative to the total fishing ground in the area, for example, is crucial in the rehabilitating habitat and increasing fish productivity impacts of MPAs (Soliman *et al.*, 2002). Thus, despite the awareness of fishermen on the conceptual rationality of the benefits from MPA in improving fish stock and ecosystem conservation and the study context explained during the survey of the attainability of increased fish catch through MPA establishment, there is still much uncertainty attached to fish catch, for example, natural conditions such as weather, or occurrence of typhoon and other human-related factors that may explain the reservations fishermen may have on banking on expected fish catch. With socio-economic gain as the primary motivation of local communities to participate in resources management (Meñez, 2002), this reservation may explain the result of the choice behavior.

Finally, the factor on patrol days, like MPA size, is also more certain variable and can be set definitely. The use of time of fishermen is entirely their own decision and the number of patrol days maybe definitely set. Committing to 10 or 15 patrol days in a year or around one day per month, for example, is a clearly decidable factor for fishermen. The results presented also imply that fishermen are not unwilling to contribute effort in patrolling the MPA. A potential commitment of 10 or 15 patrol days in a year or around one day per month for one year for each fisherman can be a significant contribution in managing the MPA. Further, if we take the willingness to contribute labor as an indicator of willingness to pay for the MPA such as the approach taken by Muranaka and Terawaki (2005) and Casey (2003), then the analysis of the choice probability presented here may mean that fishermen have a positive willingness to pay for the MPA but up to a certain limit.

## CONCLUSIONS

Findings of the study contained in this paper point to the conclusion that fishermen's choice behavior consider more certain factors such as MPA size and patrol days when considering MPAs. The attribute on expected

increased fish catch, although it is an important consideration to them considering that fishing is their major source of income and livelihood, is an uncertain attribute and was not accorded much significance in their choice behavior. Based on the hypothetical plans, the respondents did not seem to be willing to trade-off the benefit of an uncertain increase in fish catch with the more certain cost of increased MPA size or number of patrol days. Some policy implications of the results are (1) that the size of MPA must be a prime factor that should be discussed with stakeholders when designing and establishing MPA plans and management options especially no-take zones, (2) that efforts to identify the potential losers in the MPA establishment and how to compensate them B for example, alternative or supplementary income sources for displaced artisanal fishers must be made clear in the planning and development of an MPA and (3) that fishers to a certain extent may be willing to contribute voluntary labor for MPA management. Information drive and educational campaigns showing first hand evidence on the value of MPAs in habitat improvement and conservation and eventually productivity enhancement will also be helpful.

For further research, investigation considering socioeconomic and biological factors would contribute to better understanding of choice behavior and MPA design and planning. In addition, particularly for the fishermen in the study area, direct elicitation of monetary values might be deemed unrealistic considering the cash constraints faced by artisanal fishermen. Designing the CE to extend analysis for valuing marine protected area in monetary terms via willingness to contribute labor is set for further study.

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