Assessing the Impact of Marine Protected Areas: a Case Study of the Perhentian Marine Park, Malaysia

Gazi Md. Nurul Islam¹, Kusairi Mohd Noh¹, Tai Shzee Yew²

ABSTRACT

Malaysia is rich in coral reef ecosystem. The country has 9,323 km of coastline and 3,600km² of coral reef area. The coral reefs in the marine waters are the important habitats for fish species and destinations of tourists. This sector contributes benefits to the economy and livelihoods of many resource dependent households. The government has established Marine Parks to protect these coral reefs with a goal to conserve the habitats and to protect marine environment and valuable resources. However, fishing is not allowed in the marine protected areas (MPA) confined within two nautical miles from the shore. The marine habitats have been declined considerably over the years due to the use of destructive fishing gears, tourist activities and infrastructural development. The objective of this paper is to explore the importance of marine protected area through a community survey. The survey was conducted in Perhentian Island, east coast of Peninsular Malaysia to obtain opinions of the local people about the resource damage activities and preferences about community programmes. The results of this study are derived from a quota sample of 130 households who were interviewed with structured questionnaire and through informal discussions with various groups. The results showed that there were no major variations in the preference ranking among the various group of respondents. The findings of the study provide useful inputs for the policy makers for the planning and management of marine protected areas in Malaysia.

Keywords – marine protected area, preference ranking, coral reefs, fisheries

INTRODUCTION

Malaysia is unique for its huge and diverse marine resources in the South-East Asia region. The country has 9,323 km of coastline and 3,600km² of coral reef area. Malaysia enjoys benefits from the world’s most rapidly growing tourism industry. Marine Park attracted more than 500,000 domestic and foreign tourists annually since their establishment in 2000. The fishery sub-sector produced 1.538 mil mt in 2004 and is expected to increase to 1.9383 mil mt by 2010 where an extra production at 400,000 tonnes will be needed from capture fisheries. Malaysian fisheries sector play a significant role in providing employment, fish for consumption and income.

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The marine fisheries resources have declined considerably over the past decade primarily due to overfishing. The excessive fishing capacity have also damaged marine habitat. Several studies found that fishing vessels operated in various demarcated fishing zones have reached close to the full technical efficiency and capacity utilization. Talib et al. (2003) found that the demersal species are already overexploited and the level of fishing effort is beyond that needed for maximum sustainable yield. Stobutzki et al. (2006) found that biomass has declined in both east and west coast of Peninsular Malaysia.

The rich coral reefs of Malaysia are facing serious threats with loss of biodiversity occurring at an alarming rate. In Malaysia and Indonesia 85% of the coral reefs are threatened. The government has implemented various management strategies to promote rehabilitation and conservation of marine resources and ecosystem. The Department of Fisheries has established Marine Parks to manage the marine resources effectively. The coral reefs are mostly protected as Marine Parks under the Fisheries Act (1985), however, fishing is not allowed within the marine protected areas. These MPAs are likely to protect and manage these fish nursery areas to ensure survival of fish species. These nursing areas have been gazetted as closed fishing areas. MPAs are used to improve the situation where fisheries suffer from overfishing, in terms of both economic and biological terms (Holland and Brazee, 1996; Boncoeur et al., 2002). Marine Parks and MPAs have been created in many locations in marine waters in Malaysia with the aim of promoting conservation, recreation, education, research and management of coastal marine resources (Upton, 1992).

There are evidences that MPAs are effective at preserving marine habitat, restoring habitat to higher fish stocks. Many also argue that MPAs can provide fishery enhancements as well as protecting coral reefs that provide excellent recreation opportunities. The question is increasingly arising on how MPAs can affect local, regional, and national level interest groups who depend on the resources for their livelihood, recreation, and overall well being. In many instances, fishers are displaced by establishing MPA and therefore they are concerned about how this will affect their ability to make a living. Studies estimate that 80-90% of the MPAs worldwide have not succeeded in meeting their management objectives (McClanahan, 1999; Khelleher, Bleakley, & Wells, 1995).

Malaysia has 42 islands and the surrounding marine ecosystems of these islands have been gazetted as marine parks. The coral reefs are mostly protected as Marine Parks under the Fisheries Act 1985, however, fishing is not allowed in the marine protected areas (MPA) within two nautical miles of marine waters. Access and use of resources in the marine park areas have considerable economic importance to the local communities. It has been observed that the management of marine parks is less effective because of inadequate manpower, logistics and financial resources. The marine park resources may be subject to use of destructive gears, bombings, pollution by waste, and degradation of coral reefs.
Only few studies have addressed the biodiversity and the status of flora and fauna in marine waters in Malaysia (Harborne et al. 2000). Only two studies have addressed the recreational benefits of marine parks. Yeo (2004) has conducted study to examine the recreational benefits of coral reefs in Pulau Payar Marine Park, Kedah, Malaysia. Yacob et al. (2008) conducted another study to investigate economic valuation of eco-tourism services in Redang Island Marine Park, Terengganu, Malaysia. Despite the importance of sustainable management of Marine Parks, limited attempts have been made to study the economic and social value of the coral reefs in the marine waters in Malaysia.

The contributions of MPAs such as marine parks to fisheries resources and economy have not been studied well in Malaysia. It is difficult to quantify MPA impacts on fishing and other socioeconomic aspects of the community who depend on the resources for livelihoods. In the Marine Parks, the protection and conservation of coral reefs and habitats for breeding and feeding of juveniles are essential for enhancing fisheries and other biodiversity. The increasing numbers of tourists pose challenge to the park management, who is responsible to cater for the needs of the tourists. The management should ensure that whether economic concerns, environmental awareness, protection of marine ecosystem and habitat conservation are properly maintained.

The main thrust of the study to investigate whether the MPAs are protected in order to reduce further damage of marine resources surrounding the MPA. The study was conducted in Perhentian Island on the east coast of Peninsular Malaysia. The study will analyze impact of MPAs on the fishery enhancement as well as socio-economic impacts on local communities. This evidence is crucially important for the policy makers in formulating appropriate management approach which would promote economically viable and environmentally sustainable marine fisheries in Malaysia. In this study we describe the general characteristics of study area: Perhentian Island Marine Park MPA and its current management. The methodology, questionnaire and survey design is presented in section 3. Section 4 presents the results and discussions of the study, Conclusions and policy recommendations is presented in the final section.

THE STUDY AREA

In Peninsular Malaysia, the east coast islands have more extensive and more diverse coral reefs than those of the west coast that displaying 50-70% coral cover. There are 323 species of coral and 450 species of fish exist on the east coast. The Perhentian Island Marine Park (PIMP) is situated offshore of Terengganu state on the east coast of Peninsular Malaysia. It is located in the South China Sea and is situated approximately 90 kilometers away from the northern state of Terengganu. It is located at a latitude between 5° 54’ and 5° 54’30'' North, and a longitude of 102° 43’ to 102° 45’30''. Situated on the north of the equator, the Perhentian Islands have a tropical climate with generally calmer conditions from March until October when the annual south east monsoon season create high winds and periods of prolonged heavy rainfall.
The Perhentian Archipelago consists of two main islands of Pulau Perhentian Besar and Kecil as well as five smaller islets. Pulau Perhentian Besar means Perhentian large island and Perhentian Kecil means Perhentian Small Island. Perhentian Island Marine Park (PIMP) has a total area of 524 hectares and this area consist of three main topographic regions. The southern region consists of large steep-sided hill which rises from the water edge and peaks at 34m above sea level. The middle area consists of land lower than 15 meter. The northern region of the island consists of slightly higher, rocky areas peaking at 105m.

A study by Coral Cay Conservation in 2000 around the adjacent Marine Park Islands along this eastern coastline recorded 221 hard coral species and 298 fish species in what was by no means an exhaustive taxonomic study (Harborne et al., 2000). However, the shallow coral reef communities around the Perhentians are subject to a number of anthropogenic impacts and threats. Most of these impacts come from the development of the coastal zone on the mainland and on the islands themselves, where development is concentrated very tightly into the narrow near shore and maritime environments. These ecosystems are important habitats and nursery and feeding grounds for many juvenile fish and other economically important species.

PPMP was largely bound under the protection of the fisheries ‘prohibited areas’ Regulation, 1983 which declared a fishing activities prohibition within 8 km radius of maritime waters surrounding PPMP. The regulation was amended under the Fisheries ‘prohibited area’ Amendment Regulations 1985 which shrunk the prohibition areas to 3 nautical miles in order to enable more effective management and enforcement.

The waters around the PIMP Islands were gazetted as a Marine Park under the Establishment of Marine Park Malaysia Order of 1994, part of the Fisheries Act of 1995. Since this date the Marine Park Centre on Pulau Perhentian Besar was opened in March of 2003. The local population of PIMP resides on the south east side of the Perhentian Kecil (small island), at Pasir Hantu village which is an area of below 10 hectares. There are approximately 1500 people (225 households) living in this village. Subsistence fishing was the main economic activities before the 1980’s. Other supplementary income earning activities include cultivation of spices, coconut, and fruits.

The small scale tourism started since 1960’s. The accessibility for the foreign tourists began in 1992 with the development of international standard tourism related facilities and infrastructure. A growing number of local people shifted their income earning activities towards ecotourism services. The relatively younger males have acquired diving skills over the years. Their income level have greatly increased from other tourist related service activities such as boatmen, restaurant owner, selling home made food, working in the chalet and hotels.

About 25% of the village inhabitants are fishermen, however a majority of the households participate to fishing during the monsoon for subsistence. The fishermen community in the study village has been practiced fishing over the long period of time
using motorized boats with multiple gears in the shallow and deep waters. The pressure on the fisheries resources of Perhentian has increased over the years. The number of fishers increased from this village and fishers from other area used trawls in their fishing habitats near the shore areas.

Establishment of MPA has restricted artisanal fishers to fish in their fishing ground. Some fishers still fish using hooks, traps and artificial reefs in the waters surrounding the MPA. Majority of household participate to fish in the surrounding areas of MPA during the monsoon season from October to February. They have no employment in the tourism services during this period.

Figure 1: Map of Malaysia (Peninsular Malaysia and East Coast of Malaysia)
METHODOLOGY

The damage schedule approach and Paired Comparison

This study used the “damage schedule” approach. Damage Schedule approach is based on community judgments of the relative importance of different environmental resources can be used as suitable method for non-market valuation (Chuenpagdee, et al. 2001). The damage schedule approach has been applied to several fisheries and coastal area resources studies. This method was applied to examine coastal development issues surrounding shrimp farming and tourism in Southern Thailand (Chuenpagdee et al. 2001). Damages of coastal habitats and the factors may cause the damages in Mexico has been studied by Chuenpagdee et al. 2002. The relative severity of collateral impacts of the fishing gears used in the United States has been assessed by Chuenpagdee et al. 2003. Environmental damages in the urban coastal areas of Singapore have been studied by Quah et al. (2006). The main advantages of using paired comparison method over traditional valuation methods is that it provide predictability and enforceability by specifying the payments in the event of a loss in advance, rather than waiting until the damage has taken place. This method can be utilized by policy makers as guides for their decision making process on environmental resources.

The paired comparison method presents two scenarios for consideration at a time (David, 1998). Its basic unit is the comparison of two objects, A and B, and the comparison is presented to one or more judges. For each respondent, the total number of all possible pairs is \( N(N-1)/2 \). Under normal circumstances, each object has the same probability of being selected as all objects are paired an equal number of times. For each pair, the respondents are asked to choose only one scenario that they consider more important. Each of the selected scenarios is scored as being “preferred” by an individual respondent or aggregated across groups of respondents for further analysis (Chuenpagdee, 1998). The aggregated preference scores were then normalized to a scale of 0 to 100 using a proportional procedure (Dunn-Rankin 1983). These scores are referred to as aggregated preference scores or scale values, while 0 is the least importance and 100 is the highest importance. Ranks are assigned to the scenarios based on the scale values. The ranking obtained from this method is an interval ranking.

In the study site, two sets of paired comparison questions were used to obtain community’s opinion about the damages of resources and the factors responsible for damaging the marine resources in the MPA areas. A list of 7 ‘damage scenarios’ were included in one set and seven community programmes on the other set, that are relevant to the local community (Table 1). This will give a total of 21 pairs in each set. The damage schedule is related to sandy beaches, habitats for fish, coral reefs and seagrasses. Activity scenarios included fishing for subsistence need, non fishing employment opportunity, and micro credit supply for income generating activities.
Table 1: Objects for each set of Paired Comparisons.

Set A: Activities scenarios
1. Too many people fishing in one area
2. Fishing in spawning area
3. Fishing using hooks and line in the shallow part of the sea
4. Using too many motorized boats for tourists
5. Diving in the shallow part of the sea
6. Littering and polluting the beach water
7. Discarded fishing apparatus on the sandy beach

Set B: Community Programmes
1. Programme to promote small scale fish culture
2. Ensure fishing access for local fishers and other communities.
3. Programme to provide micro credit loans to expand alternative employment
4. Building a centre for technical training to promote employment generation
5. Building hotels or bungalows for tourists to generate local employment
6. Reducing the current restricted area of MPA to allow fishing activities
7. Creating an artificial habitat for fish and other animals in marine reserve.

These scenarios were chosen to represent exiting resource damages and activities taking place in the Perhentian Marine Park. This information was obtained from field visits and interviews with key informants before the actual survey. The survey was conducted at two groups of respondents, i.e., resource dependent local people and experts. Experts included researchers, scientists, government officials and representatives of non government organizations who are familiar with the PIPM or directly involved in the management of resources in the area.

We divided the local resource interest groups into four subgroups, according to the occupation, i.e., (1) fishers who are involved in fishing sometimes in a year; (2) people whose work are related to tourism, such as divers, tourist boat operators, tourist guide; (3) souvenir shop owners, restaurant and grocery trade; and (4) other people whose occupations are not directly related to marine resources such as teachers, housewives, etc. A quota sampling method was used to obtain a minimum of 30 respondents in each of the five occupation groups. In total, 128 respondents completed both the resource loss questions and activity questions. Each set comprises with seven objects, giving a total number of 21 pairs for each set Table 1. These 21 pairs in each set were included in the survey booklet making the total of 42 pairs. Face to face interview was conducted by a team of experience local enumerators. The respondents were asked to select one resource damage question that the respondent considered “severe” in the resource damage scenarios that affects the environment, social and economic conditions in the community.
Aggregate preference scores and rankings

The paired comparison data was used to compute score based on the individual preference for each object, i.e. the number of times a single respondent prefers one object over others in the choice pairs (Peterson and Brown 1998). In each set the total number of objects with \( N \), each object has a maximum individual score of \( N-1 \). Then the individual preference scores were aggregated across all respondents in each of the five groups. The aggregated preference scores were then normalized to a scale of 0 to 100 using a proportional procedure (Dunn-Rankin 1983). These preference scores or scale values were ranked in order to test for an agreement between the respondent groups using Kendall rank-order correlation coefficient \( T \) (Siegel and Castellan 1988).

RESULTS AND DISCUSSIONS

Household characteristics

Demographic characteristics of sampled respondents are presented in Table 2. The survey covered a total of 128 respondents for the survey, 107 were male and 21 were female. Average age for the occupations related to tourist related works and the grocery shop owners is less than 40 years. The young male and females are involved in the tourism related activities due to the development of this sector in the areas. The average size of the households ranges between 3 to 8 people which shows higher compared to the national average. This shows that the inhabitants of island have larger family size compared to the mainland in Malaysia. Majority of the respondents associated with occupations related to tourism have secondary and higher secondary level education.

Table 2. Demographic characteristics of sampled respondents

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Fishers, Tourist related work</th>
<th>Trader, shop owner</th>
<th>Others villagers</th>
<th>Experts</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of respondents</td>
<td>30</td>
<td>32</td>
<td>29</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Male (no)</td>
<td>30</td>
<td>31</td>
<td>15</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Female (no)</td>
<td>0</td>
<td>1</td>
<td>14</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Age (year)</td>
<td>48</td>
<td>38</td>
<td>39</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>Household size (no.)</td>
<td>6.8</td>
<td>3.3</td>
<td>7.4</td>
<td>8.4</td>
<td>6.7</td>
</tr>
<tr>
<td>Level of education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary (no. of respondents)</td>
<td>13</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Secondary and above</td>
<td>17</td>
<td>28</td>
<td>22</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>(no. of respondents)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Community view about Marine Resources

The individual preference scores or scale values for each of the five subgroups were aggregated: four resource dependent groups and one group of experts. A ranking was assigned to these values in order to test for an agreement between the respondent groups using Kendall rank-order correlation coefficient \( T \) (Siegel and Castellan 1988).

Table 3 shows the normalized score values and the rankings for paired comparison. The rankings obtained from both resource damage and activities scenarios for four resource dependent groups and one group of experts were correlated. The analysis indicates that the respondents from different categories have similar concerns about pollution on the beach at the MPA site. All subgroups agreed that pollution through littering and discarding fishing equipments on the beach and shallow water were the most damaging activities in the Perhentian Island. The scale value of these damaging activities ranging from of fishing by destructive gears such as fishing by hooks and line was considered the least important damaging factor by majority of the subgroups. Experts who have less connection to fishing, were found concerned about fishing in spawning areas to be the important damaging activity.

The activities such as fishing using destructive gear and the fishing in spawning area were not identified as serious damaging activity in the MPA areas by the respondents. The results support the effective enforcement of fishing restrictions in the MPA areas. However, damaging activities are taken place in the MPA areas through tourist related service and ecotourism activities which are serious concern for the loss of biodiversity in the marine waters.

Table 3. Aggregated performance scores for the damaging resources

<table>
<thead>
<tr>
<th>Damaging activities</th>
<th>Fishers</th>
<th>Tourist related work</th>
<th>Trader, shop owner</th>
<th>Others villagers</th>
<th>Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too many people fishing in one area</td>
<td>32 (5)</td>
<td>48 (4)</td>
<td>44 (4)</td>
<td>43 (4)</td>
<td>55 (4)</td>
</tr>
<tr>
<td>Fishing in spawning area</td>
<td>65 (3)</td>
<td>60 (3)</td>
<td>55 (3)</td>
<td>45 (3)</td>
<td>72 (2)</td>
</tr>
<tr>
<td>Fishing using hooks and line</td>
<td>12 (7)</td>
<td>13 (7)</td>
<td>16 (7)</td>
<td>18 (7)</td>
<td>19 (6)</td>
</tr>
<tr>
<td>Using too many motorized boats</td>
<td>19 (6)</td>
<td>14 (6)</td>
<td>23 (6)</td>
<td>24 (6)</td>
<td>29 (5)</td>
</tr>
<tr>
<td>Diving in the shallow part of the sea</td>
<td>58 (4)</td>
<td>30 (5)</td>
<td>29 (5)</td>
<td>29 (5)</td>
<td>19 (7)</td>
</tr>
<tr>
<td>Littering and polluting the beach water</td>
<td>75 (1)</td>
<td>85 (1)</td>
<td>83 (1)</td>
<td>87 (2)</td>
<td>93 (1)</td>
</tr>
<tr>
<td>Discarded fishing apparatus on the sandy beach</td>
<td>72 (2)</td>
<td>81 (2)</td>
<td>73 (2)</td>
<td>88 (1)</td>
<td>58 (3)</td>
</tr>
<tr>
<td>Number of respondents</td>
<td>30</td>
<td>32</td>
<td>29</td>
<td>14</td>
<td>23</td>
</tr>
</tbody>
</table>

Note: rankings are shown in parentheses
Table 4 shows the performance ranking for community programmes. Both resource dependent group and expert group preferred a programme to create artificial habitat for increasing fish stock and a programme to provide skill training to the local unemployed people in the areas. The preferred a programme to provide micro-credit loans for the expansion of other income generating activities. All these activities are to conserve fisheries resources and reduce fishing pressure in the MPA areas. They prefer training in order to acquire necessary skills for undertaking alternative employment at local level. The programme to provide fishing access to local fishers was the least preferred activity by both resource dependent group and expert group.

Table 4. Aggregated performance scores for the community programme activities

<table>
<thead>
<tr>
<th>Community activities</th>
<th>Fishers</th>
<th>Tourist related work</th>
<th>Trader, shop owner</th>
<th>Others villagers</th>
<th>Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme to promote small scale fish culture</td>
<td>52 (4)</td>
<td>48 (4)</td>
<td>51 (3)</td>
<td>43 (5)</td>
<td>46 (4)</td>
</tr>
<tr>
<td>Ensure fishing access for local fishers</td>
<td>31 (6)</td>
<td>31 (5)</td>
<td>34 (5)</td>
<td>36 (6)</td>
<td>36 (6)</td>
</tr>
<tr>
<td>Provide micro credit loans to expand alternative employment</td>
<td>54 (3)</td>
<td>68 (3)</td>
<td>59 (2)</td>
<td>76 (1)</td>
<td>64 (3)</td>
</tr>
<tr>
<td>Building a centre for technical training</td>
<td>59 (2)</td>
<td>70 (2)</td>
<td>62 (1)</td>
<td>85 (2)</td>
<td>71 (2)</td>
</tr>
<tr>
<td>Building hotels or bungalows for tourists</td>
<td>31 (6)</td>
<td>39 (5)</td>
<td>42 (4)</td>
<td>48 (4)</td>
<td>43 (5)</td>
</tr>
<tr>
<td>Reducing the current restricted area of MPA</td>
<td>44 (5)</td>
<td>22 (7)</td>
<td>27 (6)</td>
<td>23 (7)</td>
<td>23 (7)</td>
</tr>
<tr>
<td>Creating an artificial habitat for fish</td>
<td>77 (1)</td>
<td>71 (1)</td>
<td>62 (1)</td>
<td>61 (3)</td>
<td>83 (1)</td>
</tr>
</tbody>
</table>

Note: rankings are shown in parentheses

The scale values for the seven resource losses scenarios show a close correspondence among the various groups that confirms in the high correlation coefficient (Table 5).

Table 5. Pearson Correlation of Scale values of resource losses in Perhentian MPA

<table>
<thead>
<tr>
<th></th>
<th>Fishers</th>
<th>Tourist related work</th>
<th>Trader, shop owner</th>
<th>Others villagers</th>
<th>Experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishers</td>
<td>1.0000</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourist related work</td>
<td>0.9643</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trader, shop owner</td>
<td>0.9643</td>
<td>0.9915</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others villagers</td>
<td>0.9286</td>
<td>0.9643</td>
<td>0.9643</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Experts</td>
<td>0.7500</td>
<td>0.8571</td>
<td>0.8571</td>
<td>0.7857</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
This indicates that the levels of agreements were highly correlated among respondent groups in the scale values of resource losses. However the results show that the correlation coefficient for the experts slightly lower compared to the other groups.

CONCLUSION

The groups of various respondents expressed their positive opinions about perceived benefits from MPA. The villagers have increased income and employment through tourism related activities. All groups strongly agreed that the sandy beach and fish breeding habitat are being polluted by various damaging activities such as littering and discarded fishing equipment in the shallow water. Although, the fishers perceived the benefits from the MPA, the strict restrictions hamper their subsistence fishing in their fishing ground. All groups including the fishers agreed on establishing artificial habitats such as artificial reefs to increase fish stock where the fishers should access to fish for their subsistence need.

The results of the study indicate that community perceived the benefits from MPA and the importance of the marine resource conservation. The judgments obtained from various groups of respondents did not greatly vary, that can help to understand about the management of MPA. The opinions of knowledgeable experts on various issues provide valuable information that will help policy makers in designing management of MPAs. However, the agreement made by various interest groups on the resource use can be further validated through discussion.

Most of the respondents agreed that the main sources of pollution are tourist service facilities, such as residential hotels, chalets, restaurant and other recreational activities on the beach. The habitats of fish and other aquatic animals are at risk due to the pollution. The important scales on the damaging activities and preference of the community need to be agreed by the community and concerned authority. This could be done through organizing consensus building workshops where administrators, various resource users, and experts will be attended. These provide useful inputs to the policy makers to formulate implementation strategy of the MPAs for sustainable marine resource management.

REFERENCES


