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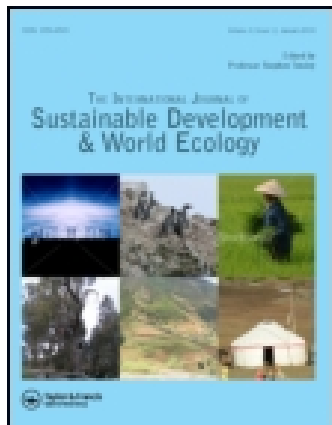
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## Mapping the economic costs and benefits of Coral Triangle Initiative (CTI) and Mangrove Rehabilitation Projects (MRP) in Solomon Islands: a study of two MPAs and one MRP

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This paper reports a study of costs and benefits of Coral Triangle Initiatives (CTI) and Mangrove Rehabilitation Projects (MRP) in the Solomon Islands. It was observed that the communities have different attitudes and perceptions toward climate change challenges. The different scales and magnitudes of climate change impacts that are perceived at these sites, and the different subsistence realities make them have varied responses and points of view regarding such impacts. For instance, respondents from Oibola experienced the most adverse impacts from climatic change events compared to those living in the Naro and Sairaghi sites. Introduction of CTI and MRP has driven the villagers to travel out far from their traditional fishing grounds to catch enough fish to sell and support their families. This implies higher fishing costs and time for commute. From a social perspective, this weakens the communal bond in the community. In spite of these trade-offs, the respondents expressed satisfaction with the level of benefits received from the projects, which included the rehabilitation of the ecosystems and breeding grounds for fish and habitats around the area. We mapped the costs and benefits of these projects to the villagers, and although no amounts or figures were disclosed, the benefits are compared against corresponding costs. One key factor for the success of the initiatives was the cooperation and involvement of recipient villagers, and even including the management MPAs.

**Keywords:** coral triangle initiatives; mangrove rehabilitation projects; mapping of cost and benefits; sustainable development

### 1. Introduction

The majority of the rural Solomon Islands communities are expecting higher economic benefits from the CTI implementation across the country (Household survey 2013). These expectations are particularly greater amongst the villagers that responded during the survey from the 2nd May to 8th June 2013. They anticipated high returns (benefits) from the CTI project since United State Agency for international development (USAID), Asian Development Bank (ADB), Global Environment Facility (GEF) and Solomon Islands government (SI) had provided huge financial assistance toward rehabilitation and conservation of the coral reefs in the country (MECDM 2010).

The rehabilitation of coral reefs was an important undertaking for the adjacent communities because of people's dependency on these resources for their livelihoods. According to Ahmed et al. (2004), the coral reefs form a unique ecosystem, richer in biodiversity than any other ecosystem in the world. These coral reefs have important ecosystem functions that provide crucial goods and services to hundreds of millions of people around the globe (Salm 2006). Villagers depend hugely on the richness of these coral reefs for their survival (Cesar & Chong 2004;

Dulvy et al. 2011). In Solomon Islands, 85% of its half a million population (Gagahe 2011) lives in the rural villages, close to the coral reefs and their dependency on the corals is evident and noticeable.

According to chief Cornelius of Naro site in Guadalcanal Province, the coral reef is a sacred place of the village, which stores most of the villages' marine resources, for either current or future use. Chief Cornelius further admitted that because of the declining yield in agricultural sector for the villagers in the late 1990s to early 2000s, majority of them turned to fishing as their main source of income. The dependency of the villagers on marine resources has strained the coral reef's productivity and destroyed most of its habitats because of over-harvesting through the practice of illegal fishing techniques and methods over the years (Albert et al. 2012; Burke et al. 2002).

The government, realizing the gravity of this slaughtering trend and the devastating effects the future generations of the country would face due to the food insecurity thus created, has secured financial assistance from foreign aid donors to ensure that the coral resources are revived and rehabilitated for the future generations' use and benefits (Sore 2010) The government has secured financial

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assistance of (SBD\$35.25M; equiv. USD\$4.7M) from the United State Aid Agency, Global Environment Facility and World Bank to assist with the CTI program in the country. According to Chief Benjamin Wale, this amount was relatively huge and the government should ensure that communities are benefited as intended.

The establishment of CTI is aimed at reinforcing a better management of the coral reefs and establishment of policies including marine protected areas (MPA), and how to manage and harvest the resources sustainably. This is enhancing the objective for the communities to be resilient to any food shortage from the adverse impact of climate change in future and also the objective of poverty reduction among the community (Van Beukering et al. 2007). The SI Government then implements MPAs as arena for management of the CTI projects.

The International Union for Conservation of Nature (IUCN) defines an MPA (Dudley 2008; Jones et al. 2013) as 'a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values' (p. 1). It includes a wider variety of governance types (including community-based areas) and includes but is not limited to no-take areas.

The objective of this study is to identify the costs that the communities have to incur (opportunity cost) to establish and implement these MPAs effectively. Often people are so enthusiastic about the potential economic benefits of the MPAs that they do not realize the associated costs that the establishment of such initiatives might incur socially and economically (McCrea-Strub et al. 2011). Furthermore, resources for biodiversity conservation are severely limited, requiring strategic investment (Naidoo & Ricketts 2006). The study therefore attempts a more impartial investigation of some of the costs and benefits of establishing these selected MPAs in the country as part of the tools of implementing the CTI projects at the respective sites.

## 2. Materials and methods

The study was carried out in conjunction with a research project that was used to assess the level of resilience to climate change impacts and socioeconomic attributes of three selected CTI and MRP sites in Solomon Islands. In order to evaluate the costs and benefits the projects have for the villagers, we primarily used household surveys and semi-structured interview questionnaires. These two instruments helped us to obtain and verify the level of benefit and costs the respondents had incurred from the projects.

### 2.1. Household surveys

We used the household survey as the instrument for obtaining the respondents' perceptions about the benefits and costs they incurred from the projects. We collected baseline information through the survey that helped us to gauge the level of benefits they have gained 'with or without' the project

implementation. This household survey thus not only focused on rising socioeconomic attributes of the respondents but also informed us about the perception level of the benefits they gained from CTI and MRP implementation at household and community levels. The household survey consisted of 177 questions, which were divided under 14 sections. To cover the three sites equally in the analysis, we used 30 questionnaires from each site, totalling 90 survey questionnaires as the basis of our data collection. The variables used to investigate the level of benefits and costs in our survey included things such as *the sources and level of income, the level of expenses by individual household unit, how do they judge their farm operations to the previous years, and the types of businesses in which participants were involved*. We requested the participants to respond to the survey by basing their responses against the 'benefits obtained' or 'expense incurred' from the CTI and MRP (Refer Table 1).

### 2.2. Semi-structured interview questionnaires

We also interviewed 40 respondents with semi-structured questionnaires during the visits. These 40 respondents' interviews were used to confirm and verify the household head respondents' views on the costs associated with establishing the CTI and MRP at these sites. We asked the respondents questions such as; *what are the benefits of the CTI and MRP initiatives to your family unit, why are CTI and MRP important to the communities, in which sector do you think the government and donor partners should invest more money in the economy, what are some advantages and disadvantages of establishing the projects in the area, what are the short-term benefits of the two projects, Why do you support the CTI and MRP projects, and what are some of the costs that establishment of projects has caused to your livelihood?* These questions are vital in obtaining a picture of the levels of benefits and costs the villagers have gained or incurred due to project's implementation. The questionnaire consisted of 4 sections with 50 open-ended questions.

### 2.3. Special group interviews

Aside from this, there was also a group of people interviewed during our trips to these sites. These were mainly fishermen aged from 25 to 60 years old. They were asked 'about the costs and benefits they have incurred or received' from the CTI and MRP initiatives. We interviewed them for things such as how much time it takes them to go fishing at the newly allocated fishing sites, what types of fishing methods they use at new sites, what kind of transport they use, whether they use fuel or paddle by canoe to the fishing sites, and how much of their farming time has been taken up by fishing.

In addition to the fishermen, we also interviewed peer groups from the sites for their perceptions about the projects. We asked why they support the CTI and MRP projects, what issues they think might cause the project to fail, and why they think conservation is important for their villages. Furthermore, we also examined the reasons why

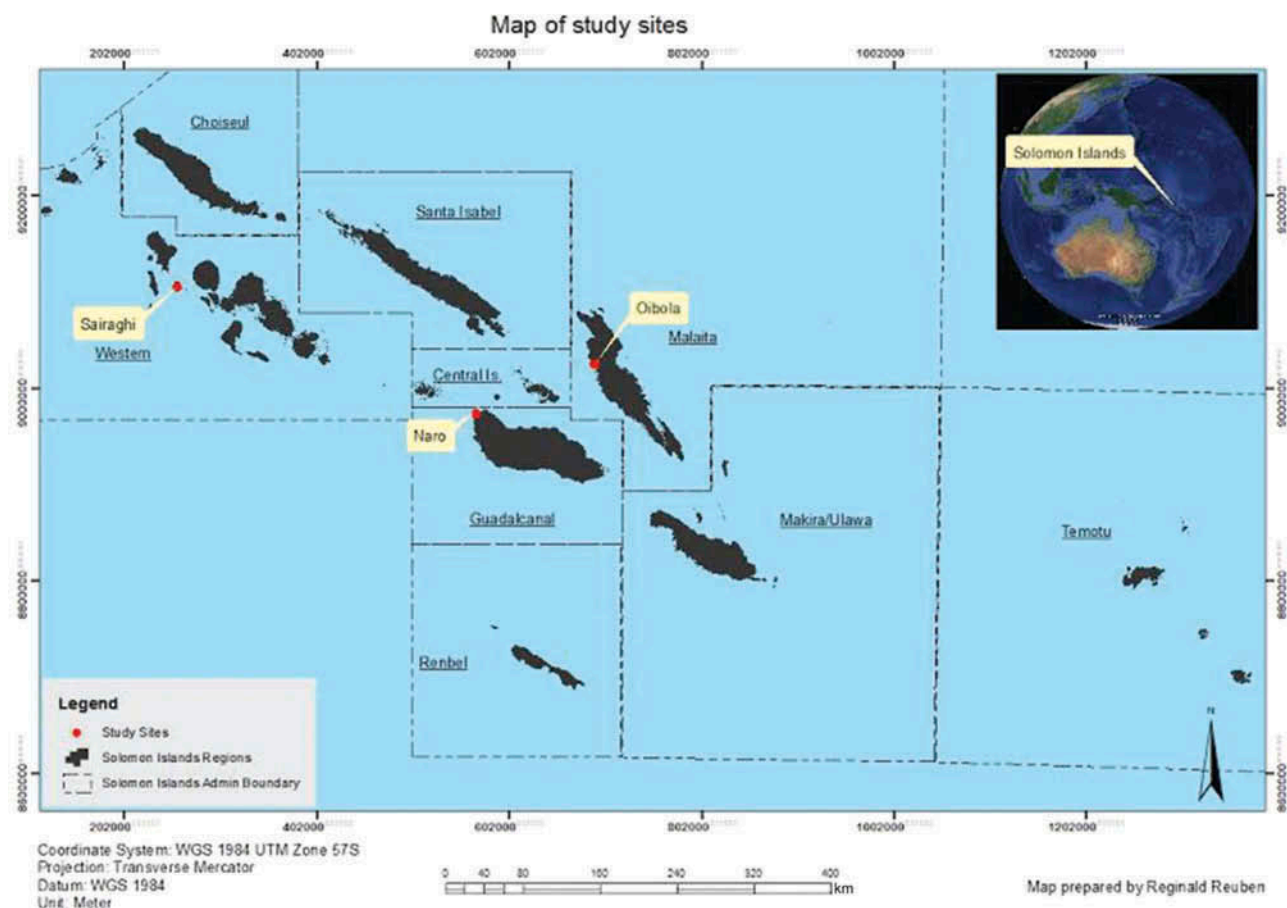


Figure 1. Map of the three coral triangle initiatives selected sites in Solomon Islands.  
Source: Reginald Reuben, GIS Specialist, Ministry of Environment, Climate Change, Disaster Management and Meteorology, Solomon Islands.

the respondents at home spend less time on the farms compared to fishing. In engaging the perception of the respondents, we requested them to narrate to the researchers their side of the projects. This information was collected, analyzed and used as the basis for compiling the mapping of the benefits and costs related to CTI and MRP study on the three sites. The interviewees comprised 27% senior government officials, 24% senior NGO officials, 20% ordinary community members, 17% youth representatives and 12% females representing the women's groups in this process. Figure 1 is a map of Solomon Islands showing the three project sites under study in the research project.

### 3. Study sites

The study covers two CTI and one MRP project sites in the country. The two CTI projects were Sairaghi and Naro in Western and in Guadalcanal Provinces, respectively and the MRP was at Oibola in Malaita Province. These sites were chosen since they all represent vulnerable areas, they are all likely to be affected – some quite seriously – by climate change, especially sea-level rise, and they are all involved in conservation and rehabilitation of their resources as part of their resilient program of adaptation to the impact of climate change in the country.

#### 3.1. Sairaghi project

The Sairaghi site villagers have been heavily dependent on marine resources as the main source of income over the years. The majority of the respondents from this community confirmed that their reliance on the marine sector would disappear if no initiatives were established to stop and rectify this declining trend for sale to support their families. All hopes were on this project to bring about the benefit to the community, as several projects of this nature were established, with notable lack of success in the past.

#### 3.2. Naro project

The Naro community leadership also confirmed that there had been several failed attempts in past years in trying to establish MPAs at this site. Each of these failed attempts has cost the community members their time and resources in trying to conserve their marine ecology. Now the idea to rehabilitate and conserve the reefs as part of the CTI was taken up enthusiastically by the village youth group members (aged from 15 to 30 years) and supported by the community elders and church leadership. This new initiative was supported by everyone across the community, embedded with the need to rehabilitate and conserve the

coral reefs against the impact of climate change together with the future benefits of such resources for the population.

### 3.3 Oibola project

In comparison to Sairaghi and Naro respondents, the Oibola community residents were under immense pressure with respect to their resilience to compromise food security as they face the impact of climate change in their community. Oibola community residents simply do not have adequate lands available for family farming and other agribusiness. This high degree of dependency on the marine resources has become unavoidable and the introduction of MRP at the site has had a mixed reception. Beside this, the Langa Langa lagoon people traditionally were not farmers but fishermen and fisherwomen. According to our research, both men and women of this site spent more than 95% of their time on non-farming ventures to sustain their livelihood. They have been depending on the fishing and marine resources for the last hundred years. Thus the 'Cost and Benefit' considerations of this project resonated with the community and were crucial for its continuance and support from the community.

## 4. Results and discussion

We have adapted Table 1 as a tool for qualitative analysis in the 'Costs and Benefits Analysis' of the 90 survey respondents and 40 semi-structured questionnaires that we collected as part of this study. The table summarizes qualitative responses encountered in the process of analyzing the 'Costs and Benefits' of establishing the projects at these three sites.

### 4.1. Benefits

In the real world, benefits were equated to monetary gains (figures) and weighted against the estimated costs incurred or have already occurred within the project. It was challenging for project designers to ascertain the exact amounts in dollars against the likely costs and the benefits of the project, but an estimated figure would provide decision

makers with a platform to select the best alternative investment option. In our study, we limit our discussion to cover only three main categories of benefits and costs as identified from the CTI and MRP during the field trip. The first benefit was received by extractive users, the second by non-extractive users and the third category by those in charge of management and implementers of the projects.

### 4.2. Extractive users

This refers to the project participants (fishermen) who use more than one technique to catch fish in these designated protected areas. According to the survey respondents, extractive users stated that there were increases in the size and number of species of fish surrounding the project sites. This was expected as the rehabilitation and replenishment of the coral reefs served to attract various types of fish to the surrounding coral reefs. Thus, the villagers had realized that establishing MPAs as part of the CTI benefited the community when they were allowed to fish after several years of abstinence from it. The respondents also confirmed that the introduction of the CTI project also enabled villagers' catch to be consistent, compared to the pre-CTI project period, when they had to travel further before finding the next fishing ground to catch enough for either household consumption or commercial purposes.

Villagers have confirmed that the fishermen now spent less time to catch some varieties of fish compared to the pre-CTI period. From households' perspective, less fishing time implies more time to attend village communal activities such as church, education, health and other alternate livelihood activities such as, farming, casual employment or tourism. As it was expressed by the chief Cornelius of Naro community, prior to the CTI project implementation more of their farming time was allocated to fishing. About 40% of the respondents did not practice any farming; however the remaining 60% dedicated between 0 and 12 months a year to farm activities.

According to the fishermen, the mix of one catch had also improved tremendously after the implementation of the CTI

Table 1. Identifying costs and benefit related to the coral triangle initiative.

Categories	Benefits	Costs
<ul style="list-style-type: none"> <li>• Extractive users</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in number of catches</li> <li>• Reduced variation in catches</li> <li>• Improved catch mix</li> </ul>	<ul style="list-style-type: none"> <li>• Decrease in catch</li> <li>• Congestion on the fishing grounds</li> <li>• Users' conflicts</li> <li>• High costs associated with choice of fishing location</li> <li>• Increase in safety risk</li> </ul>
<ul style="list-style-type: none"> <li>• Non-extractive users (e.g. divers, ecotourism, and existence value)</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain species diversity</li> <li>• Greater habitat complexity and diversity</li> </ul>	<ul style="list-style-type: none"> <li>• Damage to marine ecosystem</li> <li>• Loss of traditional fishing community</li> </ul>
<ul style="list-style-type: none"> <li>• Management</li> </ul>	<ul style="list-style-type: none"> <li>• High density level</li> <li>• Scientific knowledge</li> <li>• Hedge against uncertain stock</li> <li>• Assessments, skills and educational opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in monitoring and enforcement costs</li> <li>• Opportunity costs (forgone economic opportunities, e.g. oil, gas, and mineral exploration and non-bio prospecting.</li> </ul>

Source: Livelihood Survey 2013.

projects. The Naro community spokesman, chief Cornelius, expressed the opinion that prior to the implementation of CTI project, the community was unable to raise enough finance to complete their church building, a project that had dragged on for more than 20 years. The community members had tried all available means to raise funds for completion of the church project without success. It was only after the introduction of the CTI project that the community managed to raise enough funds from fishing, during the permitted times at the MPAs to make progress on the construction of the church building. During those past 5 years of the moratorium, they were allowed to fish in the protected area for less than 8 times. The community church building was 90% completed at the time of this field trip.

The communal achievement that villagers gained from these projects enabled them to cooperate in their efforts to ensure that these CTI and MRP initiatives were successful. This common achievement bred unity amongst the villagers to cooperate in their efforts and ensure this current project is successful. Such communal achievement strengthened the bonds among the villagers which is a social benefit to the community.

#### 4.3. Non-extractive users

There was also a group among the interviewees that was classified as non-extractive users or fishermen at the selected sites. These non-extractive users have adopted some fishing techniques and methods that are selective and aimed at catching enough fish and not exploiting them during the process. One of the benefits that respondents had experienced with this type of fishing was maintaining the various species of fish within the CTI project implemented areas compared to the pre-CTI and MRP implementation period. The fishermen claimed that the number of fish both in species and varieties was also increased at these sites. They perceived that there was also an increase in the habitat organisms living in the CTI and MRP implemented areas. The fishermen further felt that the increase meant there was complexity in the number of living organisms, which was seen as advantageous to the biodiversity in the area surrounding these MPA implemented sites.

In addition, another benefit that the respondents have perceived to experience was the increase in small business entrepreneurship such as eco-tourism in the surrounding MPA (CTI) designated areas. According to Chief Hebala, this benefit was never experienced before at this growth rate at the Sairaghi CTI project site. He stated that the introduction of the CTI project in this site has prompted villagers to invest in alternative revenue generating businesses. These micro-businesses that were established surrounding the coral reef protected area acted as positive externalities to the surrounding communities and greatly relieved the pressure villagers were putting on the marine resources. This has diversified the sources of income for the community dwellers at these three selected sites from

depending solely on marine and agricultural produce as their primary source of income.

#### 4.4. Management (benefits)

In terms of management benefits to the villagers and implementing agents, the CTI and MRP initiatives have provided opportunities to the management (especially locals) to gain some basic scientific knowledge about the technical nature of these projects. The project site managers have admitted having very little knowledge in general about the marine science skills prior to working for the projects. After working for the CTI projects they were quite familiar with the basic skills and knowledge of rehabilitating the coral reefs and enabling it to grow and pass on to the villagers as the project succeeded. According to La Mesa et al. (2012) knowledge of spatial-temporal movement patterns of fish is relevant to a number of marine management and conservation issues. Chief Cornelius further explained that this task required some technical skills and knowledge if this activity is to be performed effectively. However, as an advantage and benefit of the CTI project implemented sites, it was discovered that the project coordinators were able to effectively perform this form of skills learned through the CTI project implementation for the benefit of the communities.

The project site managers also attended various educational training opportunities during the course of the project, to foster better management of their respective project sites. This knowledge opportunity was important as it acted as the basis for educating the villagers and managing the project sites sustainably into the future. Some of the villagers were unable to support the projects because of their limited knowledge about the CTI and MRP objectives within the country.

#### 4.5. Costs

The CTI and MRP designers have also taken into account the factors that will have negative impacts on the communities. The general rule of thumb is that the expected benefits from the projects must outweigh associated costs and expenses that might be incurred during the establishment and implementation of the project. Costs of CTI projects were explored under the same three categories as benefits: extractive, non-extractive users and management.

#### 4.6. Extractive users

According to some respondents there was a huge decrease in number of catches in the selected fishing areas. This was a direct cost incurred from limiting the fishing grounds available to villagers closer to the project site. Besides, the MPAs were governed by policies and regulations preventing villagers from fishing at any time during the year. In one of the project sites, this has caused the extractive users to resort to illegal fishing techniques. According to chief Benjamin of Oibola community, the

extractive users often resorted to illegal fishing techniques, methods and techniques that would destroy the corals and marine ecosystems. The Oibola community MRP site villagers have confirmed that this was a common practice in this area which may result in congestion and over fishing in the allocated fishing ground. This was another consequence of MPAs.

Those who have decided to go further distances to fish in undisputed fishing grounds spent long hours traveling and incurred additional costs in making such trips. This made it difficult for the villagers to meet these expenses to find their next fishing ground. Often when the fishermen decided to go that far, they would transfer the cost of such fishing expeditions on the people when selling their catch. The prices fishermen charged on their fish sales from such a fishing trip were usually higher in order to cover their costs and expenses.

Furthermore, one of the costs evident amongst the villagers was safety risk of fishermen travelling to these fishing grounds especially under bad weather. In some earlier incidents, fishermen from these locations got lost out in the high seas after traveling long hours to some of these fishing grounds. For example, with every fishing trip the Oibola community fishermen had to travel in the open seas exposed to higher risk of losing their lives. The Naro community fishermen had to travel across to Gela in the Central Island province for their next fishing ground.

#### 4.7. Non-extractive users

Non-extractive users used part of the coral reefs to establish ecotourism development, paid beaches and other tourism related activities along the beaches and the surrounding reefs, diversifying the alternate sources of income. However, such ventures destroyed the ecosystem and marine ecology of the marine resources in long term, particularly of the coral reefs in the surrounding area. This was evidenced along the beaches of west side of Sairaghi. Chief Hebala stated that since the establishment of these facilities, users of the beaches have been destroying and disturbing the coherent existence of the marine ecology at these allocated tourism sites. As the number of tourists increases, so does the villagers' revenue (short-term benefit) but at the same time it also increases the chances for tourists and others users damaging the ecology which will be felt over a considerable length of time in future.

Furthermore, the growth of tourism in the area has also contributed to the loss of traditional fishing grounds and practices amongst the new generation of villagers in the respective communities. The traditional fishing grounds always associated with cultural fishing practices and traditions. The establishment of development options and initiatives has taken away the norms and some fishing techniques which were attached to those practices usually handed down from one generation to another. In the longer term, according to one of the village chiefs, such occurrences took away the community bonds that existed

amongst the villagers and thus contributed toward the disunity and breakdown of cultural values in the village.

#### 4.8. Management (cost)

The establishment of the CTI project within the country had brought higher direct and indirect costs to the management teams of all the project sites throughout the provinces. The Ministry of Environment, Climate Change, Disaster Reduction Management and Meteorology, which was the supervising ministry, all had incurred additional costs by employing two additional staff to oversee the management and administration of the CTI project nationwide. At the operational level after the establishment of the CTI project, the coral reef management team has brought in additional expenses such as training and enforcement and time and monetary costs to the project sites communities. According to Chief Hebala from Sairaghi, some villagers and potential investors had a huge interest in exploring the coral reef areas for sea mining and other mineral exploration but they have decided against this with the intention of conserving the coral reefs for present and future generations.

Furthermore, the destruction of these coral reefs would see the communities having to travel long distances in order to find protein and a balanced diet for their families' consumption. This was evidenced at the Oibola MRP area, where most of their coral reefs were ruined by the destructive fishing methods they have adopted over the past few decades. The villagers of this site have been using dynamites as their main method of fishing over the years and today they have reaped what they have sowed by having to go long distances for hours before finding the next fishing ground for fishing and gathering of other marine resources for either domestic or commercial consumption.

In addition, as a result of these two projects, villagers lost more of the individual time they would have devoted to household projects, having to channel it instead into community projects. This was evident when individual members spent long hours at the community project rather than on their own farming and fishing for the benefit of the individual households. While the project was vital to the unity and development of the community, it was also critical that the individual households gain maximum benefits from these projects, in order to guarantee their support toward the long-term sustainability in the respective sites. Under these circumstances, it was vital that the individual household maximize its time for the community project and at the same time for the individual objective.

#### 5. Conclusions

We outlined the benefits and costs related to CTI and MRP that were implemented in the country and how the community perception of the costs and benefits were critical for the success of the projects in the short and long run. These two projects have objectives aimed at conserving the surrounding marine biodiversity for the use and



benefits of both the present and future generations. With the CTI, it is vital that villagers bear the costs related with the congestions in fishing and higher costs associated to choices of fishing ground (usually far distant), increase in monitoring and enforcement expenses, loss of traditional fishing grounds and other administrative costs. These are significant in ensuring that the established MPA (at these CTI) are successful.

As with the MRP, villagers at this site will have to ensure that there is no disturbance to the mangrove areas (no cutting of trees for firewood, etc.). The villagers must ensure that they could sustain the cost of not harvesting the resources in the designated MPA as this could cost them time and monetary resources. They must manage any potential dispute that may destroy the communal bond and objectives of the MPAs.

The communities were expected to gain higher benefits from these projects. The MPA has increased the number of fish and other marine resources in the areas. The MRP also protect the villagers from events such as cyclones, marine current, etc.

The benefits that these communities may gain through income from sustainable management and harvesting of the resources would enable them to sustain their livelihood amidst increasing impact of climate change. For example, the project sites' villagers were able to have access to a variety of fish in their designated CTI and MPR areas which they could catch and sell for reasonable prices that may assist them to meet their basic livelihood needs and wants. Some of the villagers use this income to meet expenses such as children's school fees, a vital means in assisting them with their adaptation process in the longer term.

## 6. Policy recommendations

The findings of this study provide a basis and opportunity to make several policy recommendations.

- Firstly, the government, international, non-government organizations and communities should make efforts to improve ways of conserving the CTI through establishment of MPAs effectively at the selected sites. There should be proper implementation strategies in place so that the intended beneficiaries of these projects do in fact benefit from the projects.
- Secondly, in terms of decision making, it is important that the villagers also participate in the decision making processes about which and what type of project is available for them to invest in their area. The Oibola villagers have decided to establish the village-based MRP in their area. Regardless of receiving no government assistance, they continue to support the project, knowing its value and long-term benefit to the community.
- Thirdly, further research on the economic benefits of these projects for the local communities in the areas

is needed. It is recommended that a thorough cost-benefit analysis of the project be made so that aid donors and stakeholders know whether the projects are beneficial to the community. The project implementers may then improve areas of deficiencies in the management of the project.

- Finally, from the research it was evident that the likely benefits outweighed the costs of establishing the projects. It is, however, strongly recommended that the community approach in support of the projects is vital, to ensure long-term success of the projects. In case of Naro site, the village elders, church leaders, women's group, youth and ordinary villagers supported the establishment of the project. This has ensured that Naro site has been one of the successes of these projects in the country.

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