ABSTRACT

In 2009, Hoi An officially declared its vision to become an eco-city by 2030, in the form of Hoi An eco-city strategy (UBND Hoi An, 2009). As part of this eco-city strategy, Hoi An has launched over forty different projects. A significant program towards resilience-building in Hoi An is the development of the Cham Islands Marine Protected Area (MPA), as well as the Biosphere Reserve. Establishment of the MPA and Biosphere Reserve aims to build long-term resilience in the face of climate change and extreme weather events. The protection and sustainable management of natural resources increases the capacity of the environment to cope with natural hazards and also decreases human vulnerability. This paper aims to describe how Hoi An came to support actions for mitigating climate change impacts and reducing disasters risk through the MPA establishment and management, as well as biosphere reserve criteria adoption process. The case study will focus on what the benefits have been, challenges local people face, as well as lessons learned from past experiences.

1. INTRODUCTION

Hoi An city is located in the Vu Gia –Thu Bon estuary (Figure 1), which empties into the Pacific Ocean. Its economy is based on its natural resources, such as fisheries, agriculture and tourism, all of which are severely affected by disasters and climate change impacts (Trinh, 2011b). The most significant stresses the city faces include natural hazards such as floods, typhoons, saline intrusion, coastal/riverbank erosion, and environmental and natural resource degradation. Regular floods during the rainy season incapacitate the city as people are unable to move around on the streets, buy food at the market or work. As a consequence, Hoi An’s tourism and agricultural industries shut down and electrical and power generation come to a halt. Furthermore, typhoons destroy crops, buildings, homes, schools, bridges, and infrastructure, and frequently endanger people’s lives. Saline intrusion is also a concern and has steadily been increasing, particularly during the summer dry season, when the river flow is low. This saltwater intrusion is found in shallow groundwater and in open wells, especially those from areas near the river mouth and along the coast. Hoi An has already had to move its drinking water supply station further inland twice in the last ten years (see Hoi An Biosphere Reserve Map, Figure 2) because of saline intrusion. Climate change projections indicate that by 2020 up to 2,700 hectares (ha) of the land area will be affected by saline intrusion if no preventive action is taken. This is 50% of the entire city area. Lastly, coastal and riverbank erosion is a serious hazard threatening Hoi An. Since 2009 the city has lost 8 kilometers (km) of beach coastline to erosion resulting from storm waves hitting deforested coastal areas that were once protected by mangrove forests. Additionally, erosion along the Hoi An riverbanks causes the loss of valuable arable soil and threatens homes located along the river.
In the face of such challenges, Hoi An’s work on the marine protected area, as well as the biosphere reserve concept have laid the foundation for its resilience-building work. The Cham Islands Marine Protected Area (MPA) was created for conservation of marine resources and biodiversity, as well as local livelihood improvement. There are about 2,500 people living on the Cham Islands. More than 80% of the islands’ population is reliant on fishing and other marine resources, which include coral, fish, lobster, squid, abalone and sea cucumber. According to recent research conducted by the Nha Trang Institute of Oceanography, the Cham Islands host 277 coral species, 270 reef fish species, 76 seaweed species, 5 sea grass species, 4 lobster species, 97 mollusks, and 11 species of echinoderms (Long, 2008). In addition to the natural beauty, the Cham Islands have an abundance of traditional/local knowledge and customs, archaeological heritage, forest resources and medicinal plant resources (Tuan, et al., 2004, Minh, 2005).
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Figure 1: The Quang Nam Province Thu Bon river where Hoi An city is located downstream and the Cham Islands on the coastal straight from the river estuary. (Photo: Bui Kien Quoc).

Cham Islands MPA was established under a decision of Provincial People's Committee of Quang Nam (Province) on 20 December 2005. The Cham Islands MPA project was implemented from October 2003 to September 2006, with the long-term objectives of (i) protecting natural resources and cultural and historical values of Cham archipelago, and (ii) using sustainable natural resources as well as cultural and historical values of Cham Islands to stimulate socio-economic development (Trinh, 2006). In 2009, Hoi An was recognized by UNESCO as a World Biosphere Reserve, because of the city’s unique relationship with the estuary, and its reliance on local mangrove, sea grass, and coral reef habitats. People in this area have always lived in harmony with nature and implemented sustainable livelihood practices. In order to hold the UNESCO World Biosphere Reserve certificate, Hoi An city had to adopt its criteria which included requirements on ecological and biodiversity conservation together with environmental friendly economic development (Trinh, 2013).

Figure 2: Hoi An Biosphere Reserve Map (Trinh, 2013)

The Hoi An Biosphere Reserve Map clearly shows the borders of the Hoi An Old Town, the Hoi An Biosphere Reserve, together with the Marine Protected Area as the core zone inside. The flooded river flows and upstream hydropower reservoir water discharge gradually impact the downstream area, especially the Hoi An Old Town, while typhoons occur from the ocean during rainy season. On the contrary, saltwater intrusion severely affects during dry season. Moreover, sediment river flows, river bank and beach erosion are found more often here in Hoi An.

2. METHODOLOGY

The research focuses on the process of establishment and management of the Cham Islands MPA and Biosphere Reserve. It is based on systematic analysis of qualitative and quantitative data from research activities, which have been conducted since 2003 until 2013. Research data include both primary source information collected by experimental activities, observations, participation, and questionnaire and in-depth interview and secondary reviews from reports, scientific articles, statistical yearbooks, monitoring database, and previous studies. In particular, some research tools, which are applicable to local circumstances have been used. DPSIR (Driving forces, Pressures, State of the environment, Impacts, Responses) logical framework (Bach, 2002) was used for gathering information amongst community workshops participants. The workshops focused on discuss issues on natural resources and environment protection as well as social economic development in the Cham Islands MPA and Biosphere Reserve, including of course causes and possible solutions. Simultaneously, SWOT (Strength, Weakness, Opportunity, Threats) matrix was also applied for analyzing Cham Islands communities’ strengths, weaknesses, opportunities and challenges related to marine resources and environment conservation and management (Trinh, 2008a).

3. RESULTS

Overall, the establishment of Cham Islands Marine Protected Area and Biosphere Reserve aim to build long-term resilience in the face of climate change and extreme weather events. The protection and sustainable management of natural resources increases the capacity of the environment to cope with natural hazards and also decreases human vulnerability (Trinh, 2013). Indeed, healthy ecosystems easily meet people needs for food and water, and protect them from hazards, through flood regulation and coastal protection against storms and erosion (Trinh, 2011a). The logical framework and priority actions for the Hoi An city resilient building work are described in Table 1.

Table 1: The Hoi An city resilient building work

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<th>Goal</th>
<th>Thematic issues</th>
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<td>Monitoring and enforcement program</td>
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<td>Biosphere Reserve criteria adoption</td>
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<td>Community based ecotourism homestay program</td>
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<td>Community participation in recovery and sustainable exploitation of Cham Islands land crabs (Gecarcoidea lalandii)</td>
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<td>Mangrove forests recovery</td>
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3.1 MPA ESTABLISHMENT AND MANAGEMENT

Zoning plan development

The Cham Islands MPA of 235 km² is divided into different zones, which respectively prioritize strictly protected (1.26 km²), ecological restoration (2.25 km²), controlled tourism development (1.39 km²), community development (1.39 km²), protected forestry (15.5 km²), reasonable fishing (94.58 km²), and buffer (120.02 km²) zones (Trinh, 2006). Each zone has its own characteristics and is managed according to different requirements to meet the needs of the ecosystem health and the local community benefits. (Figure 3).
Establishment of regulatory mechanism
The MPA management regulations demonstrate the commitment of local people to protect and use natural resources in a way that ensures preservation for future residents. The regulations were discussed and proposed by the local community, for review and approval by the state agencies. The approved regulations document is the legal platform to protect natural resources in the community. Their enforcement is the responsibility of the entire community. (Trinh, 2006).

MPA Co-management plan development
The MPA management plan was developed using the co-management model, which promotes the participation of the state and of the local community (Trinh, 2008a). The MPA Co-management plan approach is based on six target resources, which are coral reefs, sea grass beds, beaches, lobsters, land crabs, and limpets. Based on analysis of the status of these six target resources, a series of solutions was developed to ensure their protection. A five year financial plan was proposed to support these activities, which were funded through state budgets, entrance visiting fees, technical and monetary NGO supports, and local community implementation role (Trinh, 2008b).

Monitoring and enforcement program
The co-management approach has required fishing activities to be changed to follow the ecological aspect, which has proven effective in seasonal, zone, fishing gear, and size regulation for fish caught. (Figure 4).

Average fish catch was increasing annually from 1999 until 2004 with an average of 1,467 tonnes per year. However, the total fish catch was reduced gradually from 2004 to 2013 to an average yield of 865 tonnes per year, corresponding to the time when the Cham Islands MPA applied the fishing regulations. The Cham total fish catch and fish catch composition have changed gradually since the Cham Islands MPA was established up today. During the period from 1998 to 2004, fish catch revenue is recorded in increasing steadily from 10 billion dong to 21 billion dong per year. However, for the time over the period 2005 to 2013, the Cham Islands fishing grounds have been controlled through conservation, so that the fish catch and revenue dropped significantly to 8 billion dong in 2015, and has since been increasing gradually to 15 billion dong per year (Trinh, 2013).

The Cham Islands MPA is also a core zone of the Hoi An Biosphere Reserve, which is a very important role for resilience of the communities and their recovery after a disaster, through ecosystem services and goods, and livelihood diversification, as well as for awareness-raising about the role of nature for human well-being, especially in the face of climate change. The establishment of Cham Islands MPA has contributed to expanding the protection area of fisheries resources of Quang Nam Province. As of 2013, the total Quang Nam Province coastal area is around 3,000 km², in which there are 552 km² reserved for protection, accounting for 17% of total coastal area (Trinh, 2014). This protected area percentage was relatively high compared with the expected rate (30%). In the future, if the MPA models are replicated to six coastal districts/cities in Quang Nam Province, the conservation and protection of coastal resources will be expanded further and will be good for sustainable fisheries development. We hope also to expand the MPA/Biosphere Reserve model to the entire river basin.

3.2 BIOSPHERE RESERVE CRITERIA ADOPTION

Community based livelihood development and impact assessment
People in these local communities depend heavily on natural and environmental resources to meet their basic needs. Policies to preserve the local environment are more successful when people have a stake in the protection and use of natural resources, and receive benefits in return (Brown & Trinh, 2008). Activities in the Cham Islands sought to identify, build and develop alternative livelihoods such as home stays, local tour guide services, fish sauce, drying fish, forest tea product processing (Trinh, 2010).

Community based ecotourism homestay program
The community-based ecotourism home stay program has provided job opportunities and improved life standards for local people. The number of tourists that visit Cham Islands has increased dramatically since it was named a Biosphere Reserve site. In 2008, it welcomed 16,000 visitors, while in 2013 a record-setting 195,000 people visited the Islands (Figure 5) (Trinh, 2013). Increased tourism has contributed to local economic development. The community-based ecotourism home stay program is a model suitable for the Cham Islands MPA because it allows promoting socio-economic development, and providing opportunities for local income generation. This program ensures that local people reap the benefits of tourism directly, instead of outside tour operators.
Community participation in sustainable exploitation of Cham Islands land crabs

The land crab (*Gecarcoidea lalandii*) is one of the important marine resources that has historically contributed to the livelihoods of local people (Damholt, 2006). Nowadays, land crab has become a popular tourist product, and as a result it is facing a high risk of becoming overexploited (Anh & Hieu, 2011). To conserve and ensure sustainable exploitation of this resource, Cham Islands communities proposed a common guideline, which supports local people to form a land crab group that issued and approved regulations governing the use of this resource (Figure 6). This has allowed local people to buy-in to a conservation ethic, which has in fact increased the price of land crabs and their income (Damholt, 2006). To ensure participants are in compliance with the agreement, the collected land crabs must be labeled before they can be sold to customers (Trinh, 2010a) (Figure 7). In 2013, the total number of land crabs collected was 7,500, representing 25% of the amount that was collected previously. Thus, the measure allows conserving 75% of the land crab population, in comparison to previous years (Thao & Trinh, 2013) (Figure 8).
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Figure 7: Land crabs (Gecarcoidea lalandii) that have been harvested and gone through labeling process that are ready for sale. (Photo: Chu Manh Trinh)

Figure 8: Trend in land crabs (Gecarcoidea lalandii) harvested versus permitted catch limit (Trinh, 2013).

Mangrove forests recovery

As a first step to protect against coastal and riverbank erosion, Hoi An has developed some mangrove reforestation projects at the mouth of the river and along the banks of the river (Figure 9). The mangrove forests of Nypa Palm (Nypa fruticans Wurmb) have been replanted gradually for the last 14 years from 2000 until now. More than 39 ha of Nypa Palm were recovered by local people and projects which are supported by the Hoi An city and NGOs activities (Table 2) (Trinh, 2014).

Table 2: Trend in Nypa Palm area (Trinh, 2014).

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<tr>
<td>Area (ha)</td>
<td>150</td>
<td>99.86</td>
<td>92.04</td>
<td>91.97</td>
<td>54.40</td>
<td>54.89</td>
<td>57.68</td>
<td>58.02</td>
<td>84.69</td>
<td>89.54</td>
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Mangrove forests, particularly Nypa Palm (Nypa fruticans Wurmb), Tall-stilt Mangrove (Rhizophora apiculata Bl), Black Mangrove (Bruguiera gymorrhiza (L.) Lamk), and Golden Leather Fern (Acrostichum aureum L.) are expected to act as buffers against floods, high tides and extreme climatic events such as storms, typhoons and tsunamis (Dai, 2006). In addition, Hoi An has also built several small dikes and sea walls with the intent to combine green and grey infrastructures for disaster prevention.
ACKNOWLEDGMENTS

This work is dedicated to my loving Cham Islands people, who gave me a lot of helps for my research. My sincere thanks are also to Camille Buyck for her helpful comments, without which this work would be hardly perfect.

REFERENCES

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Gia-Thu Bon River basin. In the future, It is very important to establish a Vu Gia-Thu Bon River Basin Resilience Management Program (Gia-Thu Bon River basin Resilience Management Program) for mitigation of natural hazards of storms, typhoons, and floods. The MPA establishment and the establishment of Cham Islands Marine Protected Area, as well as the Biosphere Reserve constitutes efforts for resilience building, in order to become an eco-city by 2030. The Marine Habitats and Resource Surveys of Cu Lao Cham, Vietnam, N.1970/DA-UBND, Hoi An, Quang Nam, Viet Nam, N.

5. CONCLUSIONS

Potential issues to address collaboratively include; coordinated planning and regulation to the entire river basin, to manage deforestation, dam releases, agricultural practices, fishing, and coastal ecosystems also act as a barrier against natural hazards of storms, typhoons (Trinh, 2012, 2011b). Healthy coral reefs and coastal ecosystems also act as a barrier against natural hazards of storms, typhoons (Trinh, 2010b), economic development, and long term climate change adaptation in the Cham Protected Area allows Hoi An to regulate fishing activities and pollution to protect species and biodiversity, and compatible with economic growth.

By adopting the Biosphere Reserve criteria, Hoi An has increased and strengthened the community's natural resource protection (Trinh, 2014).

The establishment of Cham Islands Marine Protected Area, as well as the Biosphere Reserve has gradually not only improved local people's quality of life but also contributed to building friendly livelihoods based on home stay, labeled land crabs, and replanted mangrove forests and coastal ecosystems also act as a barrier against natural hazards of storms, typhoons (Trinh, 2012, 2011b). Healthy coral reefs and coastal ecosystems also act as a barrier against natural hazards of storms, typhoons (Trinh, 2010b), economic development, and long term climate change adaptation in the Cham Protected Area allows Hoi An to regulate fishing activities and pollution to protect species and biodiversity, and compatible with economic growth.

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