Innovative Coral Reef Restoration through Public and Private Sector Partnership in Chonburi, Thailand

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Key Message

- Marine and coastal conservation is not the sole responsibility of, nor should it be initiated only by, the government.
- The private sector, in collaboration with scientific research partners, can contribute significantly and, if properly facilitated, can attract more partners and volunteers.
- Support from the local government and adoption of participatory and collaborative approaches are important elements for facilitating participation of concerned line agencies and sectors, securing support and involvement from local stakeholders, and reducing potential use conflicts that may arise from marine conservation efforts.
- Incorporation of private sector-initiated conservation projects into the local government's integrated coastal management (ICM) program and/or local government development plan is imperative to ensure the sustainability of the initiative.

Abstract

Coral reef condition in the Gulf of Thailand including Samaesarn subdistrict in Sattahip district, Chonburi Province, has deteriorated since the late 1990s, due to natural and anthropogenic factors. Consequently, coral transplantation was carried out from 1995 to 2001 and was shown to be cost-effective and safe using PVC pipes to support coral fragments for coral transplantation. Such approach was adopted by a PVC pipe company in 2003 as part of its corporate social responsibility (CSR) program.

In 2007, the company targeted to plant 80,000 coral fragments in commemoration of His Majesty, the King of Thailand's 80th birthday, with collaboration from various

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sectors of society. When Samaesarn Subdistrict Administrative Organization (SAO) became an integral part of the Chonburi ICM Program in the same year, it facilitated local arrangements for the establishment of a coral nursery, transplantation areas, and marine conservation camps in consultation with local communities using ICM approaches. These activities were incorporated as part of the local government's ICM Action Plan with annual budget allocation, including the local government's Raks Talay Samaesarn (Love Samaesarn Sea) Project.

Since then coral colonies increased and Samaesarn became a popular learning center for marine conservation. The successes and social impacts have attracted the attention of other local governments, corporate partners, nongovernment organizations, and other stakeholders.

Background

Samaesarn is one of the eight subdistricts of Sattahip district, Chonburi Province, Thailand. It has a total area of 32 km^2, and a coastline of about 12.5 km (Figure 1). The total population in 2014 was 6,254. The area is under the authority of Samaesarn SAO, the local government unit, although some areas of the subdistrict are under

Figure 1. **Location of Samaesarn subdistrict, Chonburi Province, Thailand: (a) Samaesarn subdistrict in the Gulf of Thailand; (b) administrative boundary of Samaesarn subdistrict; and (c) Luang Pho Dam Temple coast, site of coral restoration.**

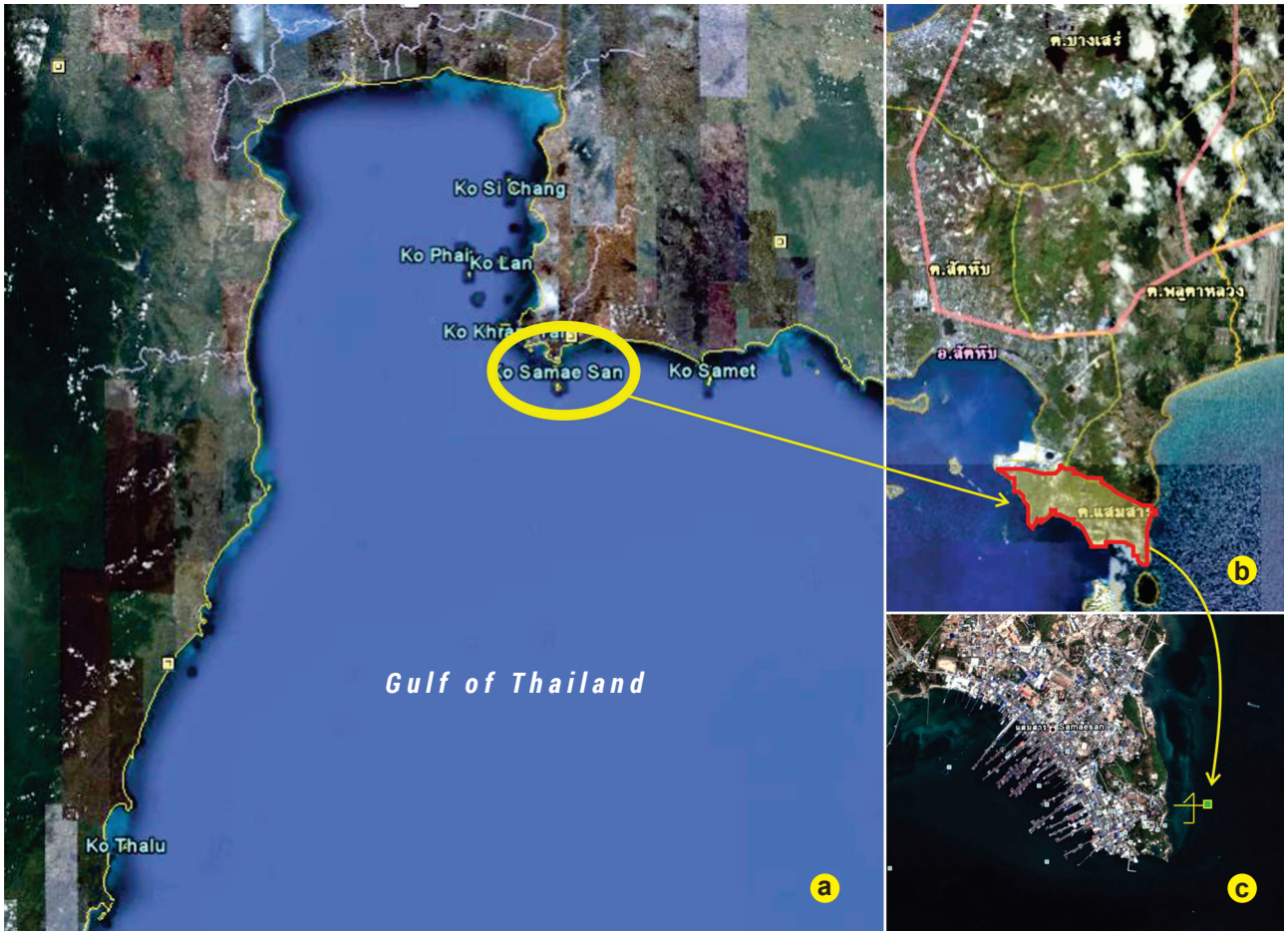

Figure 2. Bleaching of coral reefs at Samaesarn area in 2010.

the administrative authority of the Royal Thai Navy, particularly those designated for habitat conservation such as Koh Khram (Khram Island) and Koh Samaesarn (Samaesarn Island).

Coral reef management in Thailand rests on laws and regulations that apply to coral reef areas and marine protected areas. However, there is no designated marine national park in Chonburi Province despite it having a total coral reef area of 7.59 km^2 (UNEP, 2007).

Reefs in Sattahip district are among the important high biodiversity reef sites in the Gulf of Thailand. They support over 90 species of hard corals (33% live coral cover on average), and at least 40 species of algae, 29 species of sponges, 304 species of crustaceans, 134 species of echinoderms, 75 species of reef fishes, and 11 threatened species (UNEP, 2007).

A comprehensive national reef survey programme between 1995 and 1998 showed reef condition in the gulf to be variable (16% excellent, 29% good, 31% fair, 24% poor). Reef condition, however, worsened compared to the late 1980s. A bleaching event in 1998 also affected reefs in the gulf, killing 60–70% of live coral at Sattahip with *Acropora* being the most affected (Chou, 2000).

Coral reefs in the Sattahip area were moderately impacted by illegal and unregulated fishing, sedimentation associated with coastal development, land-based pollution, and natural events (storms and monsoons); and lightly impacted by tourism and recreation (UNEP, 2007). A coral bleaching event in 2010 contributed to further degradation of coral reefs in various areas of the gulf including Sattahip (Yeemin, et al., 2010; Figure 2).

In Samaesarn subdistrict, academic and scientific institutions, private sector, government agencies, local governments, and communities were cooperating in restoring damaged reefs since the mid-1990s (Vinythai PCL, n.d.). Such an initiative led to a successful demonstration of multi-agency and multisectoral cooperation in marine and coastal conservation, which received continuous public support and was also incorporated into the local development plan of Samaesarn subdistrict.

This case study showcases the efforts of a local educational institution in initiating coral

transplantation and subsequent cooperation and collaboration with a private corporation in expanding coral cultivation and conservation with multistakeholder participation.

Approach and Methodology

The Coral Reef Restoration Project

The approach and processes leading to coral transplantation, protection, and conservation in Samaesarn subdistrict of Chonburi Province are reflected through the following:

1. Scientific initiatives on coral cultivation;
2. Incorporation of coral cultivation as part of CSR of a private company;
3. Reinforcement of coral cultivation initiatives and scaling up by the company in collaboration with various agencies, institutions, and sectors including the Royal Navy;
4. Integration of coral cultivation and preservation into local government action plans through the ICM processes;
5. Using Samaesarn coast as a learning center for promoting marine conservation; and
6. Sharing experience and knowledge.

Scientific initiatives on coral cultivation

Reef degradation in various parts of Thailand inspired a team of researchers from the Rambhai Barni Rajabhat University (RBRU–Chantaburi Province) and Plutaluang Wittaya School in 1995 to identify possible ways of cultivating corals to support rehabilitation of coastal areas. Led by Mr. Prasarn Saengpaiboon, a lecturer at the Faculty of Science and Technology, RBRU, the team evaluated different materials to use as a frame for an underwater coral nursery; and concluded that PVC pipes were the best choice: they can support coral propagation effectively; they are stable and safe for deployment underwater without causing adverse effects to other marine organisms; and they are the least expensive. In 1998, an experimental coral nursery was initiated in the coastal area of Samaesarn subdistrict, particularly in the Luang Pho Dam Temple coast in Village No. 3, an area with clear waters and numerous corals. Beginning with a test nursery of six PVC sections containing 138 corals, the nursery was increased to 500 cultured corals by 2001 (Vinythai PCL, n.d.).

The method used for coral transplantation involved (Khunprom, 2014; Figure 3):

1. Attaching a coral fragment on a PVC pipe using screws to hold them in place;
2. Placing the coral fragments (with PVC pipe as a base) into a square frame also made from PVC pipes, serving as the "nursery";
3. Placing the PVC nurseries underwater and allowing the corals to grow for at least three years to become broodstock; and
4. Taking the nursery-grown corals and attaching them to rocks, dead corals, or other natural substrates, and leaving them to grow.

To reduce investment cost, the PVC pipes, being durable, were cleaned and reused for subsequent cultivation. The most commonly cultivated corals were staghorn corals (*Acropora* spp.) but other species such as *Pavona* spp. were also transplanted. (Figure 4).

In addition to the coral transplantation using PVC frames, other techniques were also applied including attaching coral fragments to a cement block (Marines Travel, 2014) or gluing to a hump coral *(Porites lutea)* with epoxy glue (Figure 5).

Figure 3. **Coral transplantation: divers deploying the PVC coral nurseries on the sea floor (left); coral branches attached to PVC pipes (right).**

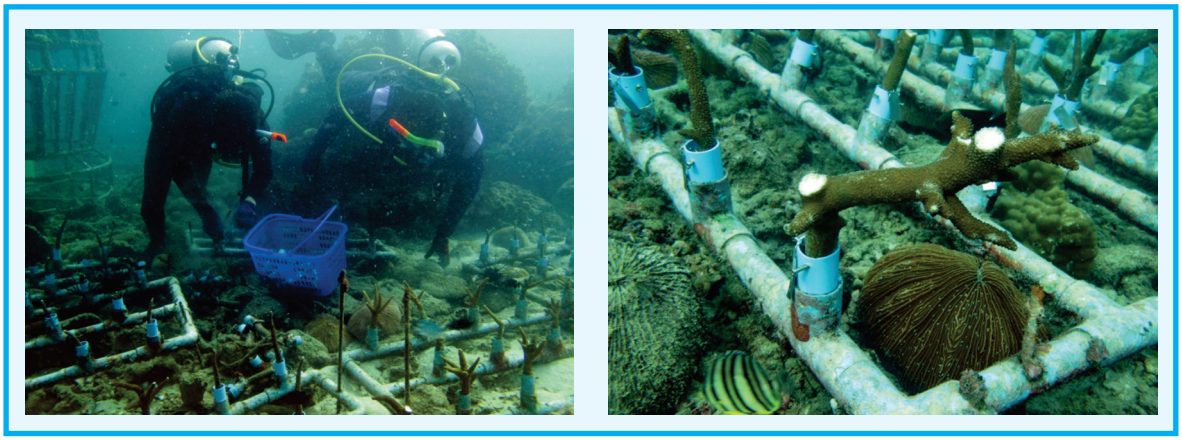

Figure 4. **Corals growing on PVC pipes after 2–3 years.**

Support by a private corporation as part of its CSR

In 2003, the coral cultivation initiative using PVC pipes came to the attention of Vinythai Public Company Limited (PCL), a company producing PVC pipes. Since the initiative was in line with the company's policy of supporting environmental conservation for sustainable development, discussions with the research team led to the establishment of a foundation, the Marine Science Activity and Conservation Foundation (MACF), in October 2003 to ensure

sustainability of the coral restoration initiative (Vinythai PCL, 2013). The foundation aimed to: (1) carry out conservation of marine and coastal resources; (2) help support activities of students, youth, faculty, scholars, and the general public, related to marine and natural resources; (3) educate students and the public about conservation, utilization, and management of natural resources and the marine environment; (4) coordinate volunteers, academics, and experts on marine science and conservation; (5) publish works on marine science and conservation; and (6) help other businesses regarding education, research, and conservation of natural resources and the marine environment. The foundation was chaired by Mr. Prasarn Saengpaiboon of Rambhai Barni Rajabhat University (Vinythai PCL, n.d.).

In 2003, the foundation committed to support the cultivation of 10,000 branches of coral fragments for transplantation with Vinythai PCL supplying the necessary PVC pipes (Khunprom, 2014). The project was undertaken in collaboration with local government departments, private businesses, the Royal Thai Navy, local residents, and fishing communities, and resulted in additional coral colonies as well as increased awareness and cooperation on marine conservation among the participants.

Scaling up the target for a cause

The initial project was such a success that the foundation initiated a second phase in 2007 to commemorate the 80th birthday of His Majesty, King Bhumibol Adulyadej of Thailand, in honor of his leading role in environmental protection and natural resource conservation (ASEAN Vinyl Council, n.d.).

The project aimed to: (1) support collaboration among relevant organizations to cultivate corals in honor of His Majesty; (2) increase awareness on natural resource preservation especially corals; (3) disseminate knowledge on coral cultivation using PVC pipes; and (4) develop case studies for future replication and scaling up (ASEAN Vinyl Council, n.d.).

The main target of the second phase five-year project (2008–2013) was to cultivate 80,000 coral branches in five locations: Koh Samed, Rayong Province (10,000 branches); Koh Wai, Trad Province (10,000 branches); Koh Talu, Prachuap Khiri Khan (10,000 branches);

Figure 5. **Other coral transplantation techniques: coral fragments attached to cement blocks (left), and other coral species attached to a PVC pipe then glued to *Porites lutea* (right).**

Koh Kam, Chonburi (10,000 branches); and Samaesarn subdistrict, Sattahip, Chonburi (40,000 branches) (ASEAN Vinyl Council, n.d.; SCB, 2014). The project was extended to 2015 following the extensive coral bleaching in the gulf in 2010 (SCB, 2015).

The project was implemented through collaboration among Vinythai PCL; MACF; Department of Marine and Coastal Resources, Ministry of Natural Resources and Environment; Faculty of Science and Technology, Rambhai Barni Rajabhat University; First Naval Area Command, Royal Thai Navy; Samaesarn Subdistrict, Sattahip, Chonburi; Network of Koh Samed Conservation Community Organization; Koh Talu, Prachuap Khiri Khan; and the International Cultural and Educational Foundation (ICEF) (ASEAN Vinyl Council, n.d.).

The project was officially launched by Her Royal Highness (HRH) Princess Maha Chakri Sirindhorn in September 2008 at a ceremony where she prepared the first coral branch for the project (Pattaya Daily News, 2008).

Since 2008, Vinythai PCL provided a total of 1.4 million Baht (US$ 40,000) annually to the MACF to support the coral reef restoration project, including provision of PVC pipes and supporting personnel. Every three years, the grown corals were removed for transplantation and their survival rates evaluated.

As the target of planting 80,000 coral branches in five locations was not fully achieved by 2015 due to the extreme damage from coral bleaching in 2010, the project was further extended to November 2016. A survey conducted in January 2011 showed that 32–63% of corals in three islands in Samaesarn perished from bleaching in 2010 (DMCR, 2011).

Integration of coral cultivation and conservation into the local development plan of Samaesarn SAO

Initially, the coral conservation project was implemented by MACF without the participation of villagers, and limited coordination with responsible agencies and the local government. In 2006, conflicts between coral growers and some members of the local community occurred over the growing of corals and the use of land along Luang Pho Dam Temple coast. The mayor of Samaesarn SAO intervened by inviting the head of the foundation and community representatives, including the subdistrict chief, village chief, and some local residents, to a meeting to resolve the conflicts. The meeting came to an agreement that MACF could expand its work in the Luang Pho Dam Temple area not only to implement the coral transplantation and conservation project but also to support the development of ecotourism to benefit the local community. In addition, it was agreed to use Samaesarn coast as an area for marine science learning and public education in collaboration with appropriate committees composed of representatives from concerned stakeholders.

Samaesarn SAO continued to facilitate the implementation of the coral transplantation and conservation project in Luang Pho Dam Temple coast by ensuring due consultation with the affected local stakeholders especially with the fishers who were unable to fish in the area. Communities were made aware of the benefits of coral reef restoration in improving fishery resources and facilitating future tourism development.

When Samaesarn SAO became a member of the Chonburi ICM project in 2007, it adopted and committed to implement the long-term coastal strategy for Chonburi. The Provincial Coastal

Strategy provided a shared vision and specific action plans for concerned local governments. As part of the ICM project, Samaesarn SAO developed a three-year ICM Action Plan (for 2008-2011), including coral reef restoration. In line with the ICM approach, the ICM Action Plan was incorporated into the SAO's annual development plan (specifically under the marine resources development plan) with allocated budget for implementation.

Following the incorporation of the ICM Action Plan in the local development plan of Samaesarn SAO, a project called Raks Talay Samaesarn (Love Samaesarn Sea) was launched. The project covered coral restoration along the Samaesarn coastal area, and expansion of the coral nursery in Luang Pho Temple Dam coast to supply corals to nearby coastal areas and islands. The project started in 2009 with a 20,000 Baht (US$ 600) allocation for the period from 2009–2011 to facilitate multisectoral participation in coral restoration along the Samaesarn coastal area. The budget allocation was increased annually, reaching close to 100,000 Baht (US$ 3,000) by 2016.

Under the Raks Talay Samaesarn Project, coral transplantation was organized at least twice a year, to celebrate the birthday of Her Majesty The Queen on August 12 and His Majesty The King's birthday on December 5. Community leaders, villagers, and students, together with local government leaders, officials and staff, government agencies, public enterprises, private companies, universities, and schools that have participated in earlier coral transplantation at Luang Pho Dam Temple, and a volunteer diver's association took part in the coral transplantation events. For example, on 5 December 2014, a total of 795 participants representing 12 organizations registered for the event. They were able to plant 87 coral branches (the age of His Majesty the King at that time), and released 100 sea turtles, planted 100 trees, and conducted coastal and underwater cleanup. Under the Raks Talay Samaesarn Project, release of fish fingerlings and other conservation activities involving tourists were also initiated.

Developing Samaesarn coast as a learning center for marine conservation

A marine science and conservation camp was established at the Luang Pho Dam Temple coast through the collaboration of Samaesarn SAO, MACF, and various partners. The camp conducted an education program on marine conservation for students, tourists, and volunteers from various sectors. Visitors could attend seminars on coral reef conservation, coral cultivation technique, use of diving/snorkeling equipment, and practical guidance on underwater deployment of coral fragments for cultivation (Figures 6 and 7).

The marine science and conservation camp was an open classroom and laboratory for students and young people in Samaesarn and other areas in Thailand. It provided:

1. Scientific initiatives on coral cultivation. Local schools, universities and learning institutions used the camp as a venue to teach students about natural resource conservation and environmental protection (Kennedy-Lugar-YES, 2011; Chan, 2013). Some schools incorporated marine conservation in their curriculum and use the camp as a venue for the students to see and gain hands-on experience on marine conservation. About 1,000–1,500 students from various schools and universities participated in the youth camp per month (Saengpaiboon, 2014).

2. A platform for private sector participation. The coral restoration project also provided a platform for the business/corporate sector

Figure 6. **Activities held at a marine science and conservation camp in Luang Pho Dam Temple coast: (a) Visitors in the camp, usually students, attending a seminar on coral reef conservation and restoration; (b) They are training on floating at the sea using a life vest and the appropriate use of a snorkel. They practice with trainers for two hours to ensure their safety; (c) They are then guided by trainers to snorkel and view the corals while holding on to a rope; and (d) Students who do not pass the training or have an emergency during the training cannot snorkel in the sea. These students view the corals aboard a glass-bottom boat.**

Figure 7. **Activities in the deployment of coral fragments: Visitors in the camp are taught on a raft at sea to cut and attach coral branches to a PVC pipe (left), and set the grafted corals into a rectangular PVC frame for underwater deployment (right).**

to contribute to marine conservation efforts as part of their respective CSR programs. In support of Vinythai's coral restoration project and/or the Rak Talay Samaesarn Project of Samaesarn SAO, many corporations, industries, banks, and other private entities participated in coral restoration in the marine science and conservation camp and other coastal areas in Samaesarn. Some private companies used it as a venue for their annual team-building activities (SCB, 2014, 2015). Even alumni organizations celebrated their reunions through participation in coral restoration (Kennedy-Lugar-YES, 2011).

As Vinythai PCL is a joint venture between Belgium-based Solvay Group, Charoen Phokphand Group and PTT Global Chemical, in 2013, HRH Princess Mathilde of Belgium visited Chonburi's Sattahip District to see the coral conservation project. The Princess was guided to attach a coral fragment to a PVC pipe, which was placed in a nursery in the coast of Samaesarn, near the first coral fragment prepared by HRH Princess Maha Chakri Sirindhorn in 2008 (The Nation, 2013).

3. A platform for community education and engagement. The coral restoration project also provided a platform for increasing awareness and participation of local communities in marine conservation through their involvement in coastal and coral conservation activities to honor the King and Queen.

Sharing conservation experience and knowledge with a wider audience

The coral restoration activities were sometimes covered by the media or extensively shared by the participants through their websites and various social media platforms. This helped to widely promote the coral restoration project in Samaesarn and further attracted visitors to the area.

Vinythai printed an information resource book about coral reef conservation in Thai and English. The book shares the objective of the project and included its activities such as, the coral nursery in Luang Pho Dam Temple, the target of transplanting 80,000 coral branches, the methodology for transplantation with PVC pipe, participation from various organizations, a picture of HRH Princess Maha Chakri Sirindhorn planting the first coral branch, and a picture of Princess Mathilde of Belgium visiting the area and planting a coral branch at Luang Pho Dam Temple.

Results

As of July 2016, around 41,000 branches of corals were cultivated and growing well in coral restoration areas in Samaesarn. Local fishers observed an increase in the diversity of fish species caught near the coral conservation areas. There were no systematic studies on the ecological impacts of the coral conservation project, but the ecological benefits in terms of coral restoration in Samaesarn were widely acknowledged by the communities.

The marine science and conservation camp in Luang Pho Dam Temple was regarded as a learning center where interested people could learn about marine ecosystems and their protection, conservation, and restoration. The nursery was serving as a source of corals for transplantation to various areas in Thailand.

Community awareness about marine conservation increased while thousands of participants in coral restoration and other marine conservation initiatives contributed to increasing advocacy for environmental protection and natural resource conservation in Chonburi Province and the country at large.

There was an apparent increase in the number of visitors to Samaesarn and the coral conservation areas. There was also an improvement in tourist facilities, and an increase in tourism-related services, such as dive suit rentals, dive courses, restaurants, gift shops and other coastal tourism enterprises. This translated to increased livelihood and job opportunities, and increased income for local people. There was no systematic data collection on tourist arrivals and increased incomes of local fishers and business owners. But based on interviews with shop owners, tourist arrivals were reported to have increased at least threefold in 2014 compared to 2009 when the coral conservation project was just starting.

With the success of the coral restoration project, Samaesarn was regarded as a venue for various sectors to collaborate and contribute to marine conservation.

The local government's capacity for marine and coastal protection and conservation and the application of the ICM approach and processes were obviously improved over the years. Coral conservation and other ICM program activities were integrated into the local government's annual development plan, with regular and increasing budget allocation.

Lessons Learned

Sustaining conservation efforts demand capacity building and stronger public-private partnerships. The coral restoration project in Samaesarn Subdistrict fully demonstrated that a nongovernment organization and private sector can make significant contributions and impacts in habitat restoration in partnership with local communities, academic institutions, and the local government. However, its sustainability can require greater efforts to: (a) mainstream into the local government long-term action plans with the appropriate budgetary commitments; (b) strengthen partnership between local government and concerned stakeholders in the protection and management of the coral nursery and cultivation areas especially in harmonizing use conflicts arising from fishing, vessel traffics, and increased tourist activities as well as effective control of waste dumping in the coastal area; and (c) continue monitoring of ecological, social, and economic impacts of coral rehabilitation.

A local chief executive facilitates dialogue and cooperation and can effectively resolve conflicts. The local government, especially the mayor, can play an important role in resolving conflicts between the affected communities, such as the fishers; and in coral rehabilitation activities, by facilitating dialogues and cooperation of the stakeholders. This was demonstrated in the case of initial conflicts at the Luang Pho Dam Temple coast.

Coral rehabilitation can be promoted as a noble objective in protecting wildlife and the environment. This can be linked to the Buddhist teachings and practice of releasing fish and turtles to their natural environment. The endorsement of the coral transplantation project by the much revered Royal Family promoted wider support and greater contributions from all sectors of society. By setting coral transplantation targets to celebrate the King and Queen's birthdays, the project was able to mobilize greater investments in human and financial resources.

Initial successes can be leveraged to scale up conservation efforts. The adoption of the ICM approach in Chonburi Province enabled Samaesarn SAO to incorporate the coral rehabilitation project as part of the ICM program and facilitated the scaling up of conservation efforts to other coastal areas in the province and the country at large.

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