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Adaptation to climate change through mangrove rehabilitation involving local community participation◦

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Abstract
Since 1990, the International Society for Mangrove Ecosystems (ISME) has been conducting mangrove restoration and rehabilitation projects in many counties such as Brazil, India, Indonesia, Kiribati, Malaysia, Pakistan, Samoa, Thailand, Tonga, Tuvalu and Vietnam. The UN-REDD Program Strategy (2011−2015) emphasized that efforts to reduce emissions from deforestation and forest degradation will only succeed with the meaningful engagement of stakeholders such as indigenous people and other forest-dependent communities. At the UN Sustainable Development Summit on 25 September 2015, world leaders adopted the 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs) to end poverty, fight inequality and injustice, and tackle climate change by 2030. Most of these UN documents emphasize on the importance of community participation in the implementation of regional and national projects. When we implement our mangrove restoration and rehabilitation activities to address problems of climate change and forest degradation, we have always considered the involvement of local communities. However, we have encountered many difficulties. For instance, in most island countries of the Pacific, local authorities have stronger political powers than the central government, i.e. an official from the central government has little jurisdiction over local activities. Political and social conditions vary from country to country, and from area to area. We have had good and bad experiences from our activities. Let us share some information on lessons learned and on the achievements of our projects that are relevant to the goals of sustainable development.

Keywords: mangrove rehabilitation, local community participation, adaptation to climate change, collaboration and sustainability

Background

The International Society for Mangrove Ecosystems (ISME) is an international non-profit and non-governmental scientific society established in August 1990 with its headquarters in Okinawa, Japan. In 1992, ISME was certified a Foundation by the Japanese Law of Foundation and in 2003, the society was registered as a non-profit organization (NPO) under a new Japanese law of promoting specified non-profit activities. Revised at the Eighth General Assembly in 2012, the Statutes of ISME stipulate that ‘the Society shall collect, evaluate and disseminate information on mangrove ecosystems’, and ‘shall promote international cooperation’.

ISME has been carrying out its activities at the global level through application of knowledge to particular situations; training and education; and exchange of necessary information. Activities of the society have been supported through collaborations, and links with other organizations, universities, research institutes and local communities. Currently, the membership of ISME includes 40 institutions and over 1,150 individuals from 92 countries.

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With more than 20 years of experience in project management and implementation in 20 countries, ISME has developed the following expertise:

○ Rehabilitation of mangroves under different site conditions and climatic regimes with the involvement of local authorities and communities
○ Conducting research, training and eco-tours in support of conservation, and sustainable management and utilization of mangrove ecosystems
○ Publication of books for education, and materials for enhancing public awareness on the socio-economic and environmental importance of mangroves

In this paper, three of our on-going projects are described with comparisons made based on performance indicators and the involvement of community participation. They are the mangrove rehabilitation project in Tarawa, Kiribati; the mangrove plantation project in Gujarat, India; and the project on rehabilitation of degraded mangroves in Sabah, Malaysia.

Project in Tarawa, Kiribati

Kiribati is one of several island countries in the Pacific facing the serious threat of sea-level rise. Since 2004, ISME has been implementing a mangrove rehabilitation project in Tarawa, Kiribati. The objective of this project is to introduce techniques of planting mangroves to the local communities and to plant mangroves together with school children for environmental education purpose. The project is financed by Cosmos Oil Co., Ltd., Japan with strong support from Ministry of Environment Lands and Agriculture Development and Ministry of Education, Youth and Sports of Kiribati.

With more than 10 years of experience in planting mangroves on atolls and coral islands of Tonga, Kiribati and Tuvalu in the Pacific, ISME has successfully developed a unique silvicultural technique for establishing mangroves along the shores of sheltered lagoons of the islands. At Kiribati, site conditions are extremely harsh because of salt spray, low rainfall and absence of surface water. Kiribati has no rivers, the soil is mainly white coral sand which is nutrient poor and salt accumulates in the soil during prolonged dry season. The technique involves close-group planting of propagules of *Rhizophora stylosa* between mean water level and mean high water level. In successful sites, e.g. Ananau Causeway of Tarawa, survival can be 90% a year after planting and over 50% after 3 years. Height and diameter of seedlings can reach 1.2 m and 1.8 cm after 3 years, respectively. Propagules of *R. stylosa* are group-planted (three per group) at close spacing of 25 x 25 cm or 50 x 50 cm. An iron bar is often needed to create planting holes in the white coral sand.

When UN Secretary-General Ban Ki-moon planted *R. stylosa* at Tarawa in Kiribati during his visit on 5 September 2011, he adopted the same planting technique (Figure 1). About 800 local elementary school students and 230 environment youth club members have participated in planting activities since 2005 (Figure 2). The mangrove plantations are also extended to the other islands such as in Abemama, Butaritari and others using the same technique led by ISME and the Ministry of Environment Lands and Agriculture Development together with local communities. Currently, the massive effort of greening the bare white coral sand flats in Kiribati by school children and youth is yielding positive results (Figure 3), a move in the right direction towards addressing the problems of climate change.

Photo by Eskinder Debebe

Figure 1 UN Secretary-General Ban Ki-moon planting mangrove propagules in Kiribati using the close-group planting technique.

Figure 2 Teaching the school children in Kiribati the technique of group planting of *Rhizophora stylosa* propagules on the white coral sand under blistering heat.

Figure 3 The amazing greening effort of the bare white coral sand flats in Kiribati by the school children and youth is showing positive results (background).

Project in Gujarat, India

The objective of this project is to establish mangrove plantations on bare mudflats for coastal protection, to enhance mangrove biodiversity including habitats for endangered birds and to generate income for the local community. Located at the estuary of Sabarmati river near Vadgam, 80 ha of *Avicennia marina* plantation have been established each year since 2009. The project is funded by Tokio Marine Nichido and Fire Insurance Co. Ltd., Japan. Planting and nursery work are carried out by the womenfolk (Figure 4) supervised by Daheda Sangh, a local NGO, in collaboration with Dr. A. Untawale (Chief Technical Advisor) and Dr. Bharat Jethva. Planting was moderately successful (Figure 5) and the second phase of this project will continue for another five years (2014−2019).

Figure 4 Line planting of *Avicennia marina* propagules in perfect synchrony on the barren mudflats (left) and raising seedlings in the nursery (right) by the womenfolk in colourful sari.

Figure 5 One-year-old seedlings of *Avicennia marina.*

Project in Sabah, Malaysia

Funded by Tokio Marine Nichido and Fire Insurance Co. Ltd., Japan, this project aims to rehabilitate 50 ha of degraded mangrove sites annually in Sabah. The project is carried out by the Sabah Forestry Department (SFD) with technical advice from ISME. At the end of the first phase of the SFD-ISME project (2011−2014), over 150 ha of degraded mangroves in 20 project sites located in five forest reserves of four forestry districts (Figure 6) were successfully planted. The forest reserves (FR) are Sungai Gum-Gum & Sungai Loboh FR and Sibyte FR in Sandakan; Padas Damit FR in Beaufort; Kuala Bonggaya & Kuala Labuk FR in Beluran and Sandakan; and Kuala Tingkayu FR in Kunak. The three major habitat types of the project were areas encroached by oil palm, degraded riverine mangroves and areas cleared for shrimp ponds.

Nearly 200,000 propagules, cuttings, seedlings and seeds belonging to 11 species were planted. Students and teachers from schools and universities of Japan, including staff members of Tokio Marine Nichido and Fire Insurance Co. from three countries participated in the planting activities. The second phase of this project will continue for another five years (2014−2019). Project activities are implemented by a mangrove task force based in Sandakan and led by Dr. Joseph Tangah, the Project Leader (Figure 7). They work closely with the forestry staff in the districts and contractors of the project.

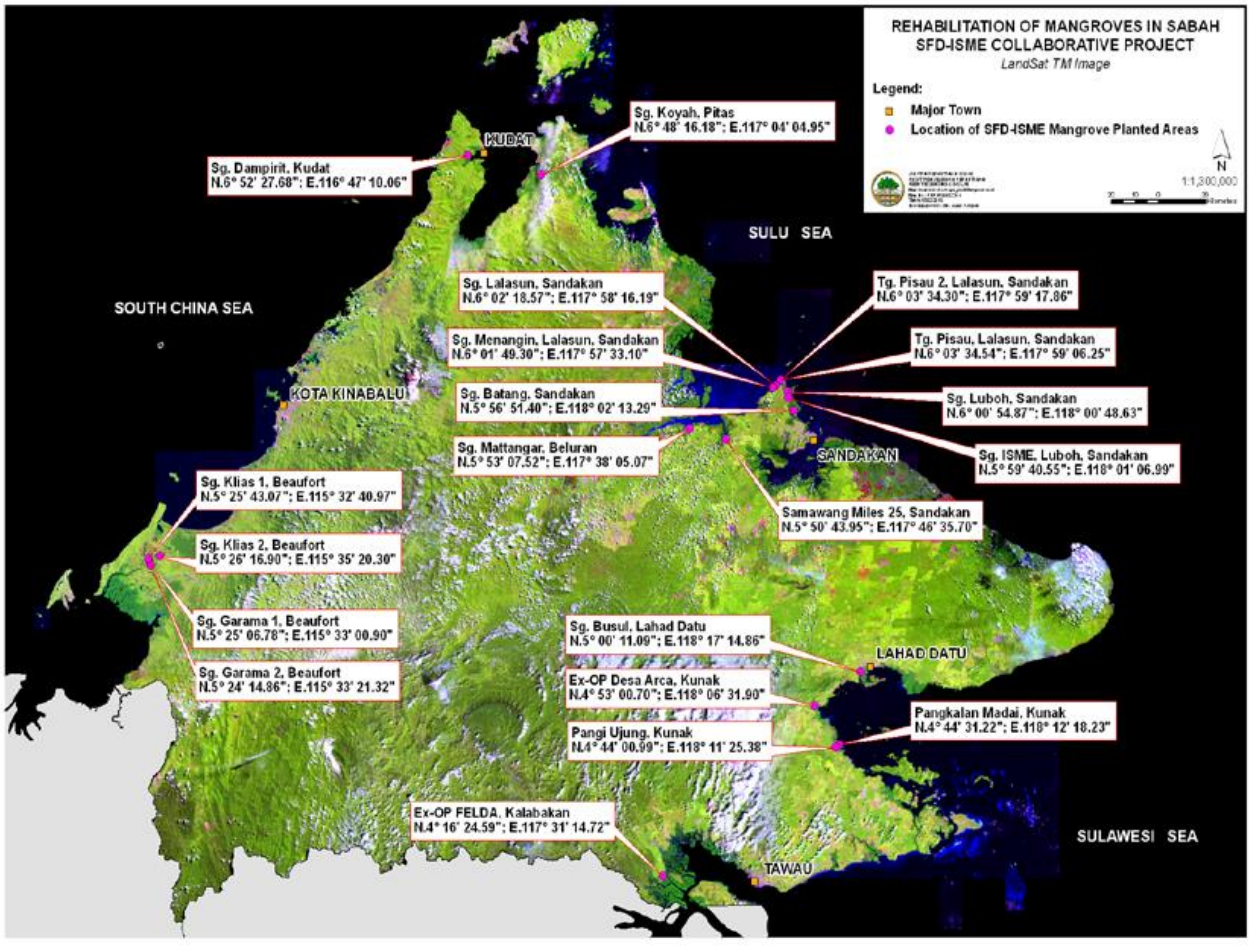

Figure 6 Map showing the 20 project sites in Sabah

Figure 7 The mangrove task force in Sandakan led by the Project Leader (top) with the forestry staff in the districts and contractors of the project (bottom row)

ISME and SFD officials visit the project sites twice a year during each meeting of the Project Steering Committee (Figure 8). The success of the project can been seen in Figures 9, 10 and 11. Wherever possible, other mangrove species such as *Nypa fruticans*, *Avicennia alba*, *Hibiscus tiliaceus* and *Aglaia cucullata* are also planted (Figure 12). As part of the project, a river near Sandakan has been officially named after ISME and the first phase of the project ended with a publication of a book (Figure 13).

Figure 8 ISME and SFD officials visit project sites twice a year during each PSC Meeting.

Figure 9 Growth of *Rhizophora* seedlings at Sg. Lalasun near Sandakan from 2011−2013.

Figure 10 Some saplings of *Rhizophora mucronata* started flowering three years after planting.

Figure 11 One-year-old *Terminalia catappa* seedlings planted on the bunds were more than two meters tall.

Nypa fruticans *Avicennia alba*

Hibiscus tiliaceus *Aglaia cucullata*

Figure 12 Other mangrove species planted by the project.

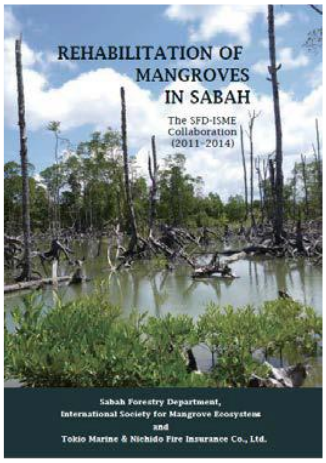

Figure 13 A river near Sandakan has been officially named after ISME (left) and the book to commemorate the first phase of the project (right).

The project in Sabah is currently in its second phase (2014–2019) with more sites planted in the eastern, northern and north-eastern coastal areas. They include Kunak and Kalabakan in the east coast, Kudat and Pitas in the north coast, and Sandakan in the northeast coast.

Project Overview

Our three mangrove rehabilitation projects do have some differences:

Tarawa

Objectives: To establish mangrove vegetation on low-lying atolls in anticipation of problems associated with climate change i.e. sea-level rise, storm damage and coastal erosion.
Forestry approach: Afforestation
Habitat: Nutrient poor and hyper-saline white coral sand flats with little freshwater inputs from the rain
Choice of species: Rhizophora stylosa
Planting technique: Close-group planting of propagules
Implementation: Planting by school children and youth

Gujarat

Objectives: To establish mangrove plantations for coastal protection, to create habitats for endangered birds and to generate income for the local community
Forestry approach: Afforestation
Habitat: Barren mudflats with strong tidal current during the high tide
Choice of species: *Avicennia marina*
Planting technique: Line planting of propagules and beating up with nursery raised seedlings
Implementation: Planting and nursery work by womenfolk from nearby villages, supervised by Daheda Sangh, a local NGO

Sabah

Objectives: To rehabilitate mangrove forests encroached illegally by oil palm plantations and shrimp ponds, and to enhance ecosystem recovery
Forestry approach: Reforestation
Habitats: Cleared and bunded degraded mangrove sites
Choice of species: Rhizophora in tidal sites, *Terminalia* on bund tops, *Rhizophora* and *Nypa* in abandoned shrimp ponds
Planting technique: Line, random and cluster planting of propagules, seeds, seedlings and stem cuttings
Implementation: Planting by contractors, supervised by the Mangrove Task Force of SFD

Project Performance

Based on 10 criteria (accessibility, collaboration, objectives, costs, publicity, capacity building, voluntary participation, community participation, conservation awareness and sustainability), we conducted a simple performance evaluation of our three projects (Table 1).

Table 1 Evaluation of the performance of ISME projects.

Evaluation Criteria	Tarawa, Kiribati	Gujarat, India	Sabah, Malaysia
Accessibility	+	++	+++
Collaboration	++	++	+++
Objectives	+++	+++	+++
Costs	++	+++	+
Publicity	++	+	+++
Capacity Building	++	+	+++
Voluntary Participation	++	+	+++
Community Participation	++	+++	+
Conservation Awareness	++	++	++
Sustainability	++	+	+++
Overall Performance	20	19	25

Tawara scores moderately in all criteria, except for accessibility due to its remoteness in the Pacific and difficulty in inter-island travel. Gujarat scores strongly in community participation and project costs, but weakly in publicity, capacity building and sustainability. It is very unlikely that the local NGO will be able to sustain the project after ISME. Sabah scores strongly in accessibility, collaboration, publicity, capacity building, voluntary participation and sustainability, but weak in community participation and project costs. However, a substantial part of the project costs such as salaries, subsistence and transportation of project personnel are borne by SFD. Two four-wheel drive vehicles have been assigned to the project. Under the second phase of the project, SFD has allocated USD156,000 in addition to the logistics and manpower provided.

Conclusion

Ranking of the three projects based on overall performance is Sabah > Tarawa ~ Gujarat. We are of the view that one should not over-emphasize on the importance of community participation, as it is only one of the criteria used for project evaluation. There are other important criteria that one should consider e.g. effective collaboration, meeting project objectives, capability building and project sustainability. With government support, the ability of the collaborating agency to continue with the project without external funding and without the technical assistance from ISME is most crucial.

The following issues need to be addressed when initiating and implementing a mangrove rehabilitation project involving participation of the local community:

Obtain the endorsement of the government
- ○ Seek a competent person among the local community to manage the project activities
- ○ Convey ideas to the local people through the head of the community
- ○ Get the support and collaboration from the local community
- ○ Provide information to the villagers to enhance their awareness of the project
- ○ Continue to support the community
- ○ Maintain project motivation and that of the community

Everyone emphasizes on the importance of community participation but our experience shows that we cannot work easily with any local community because each village has different social and political conditions. Proper analyses of these conditions are needed in order to work well with the local community.

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