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GLOBAL CHANGE RESEARCH

ARCP Final Report

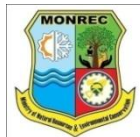


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Liang

Coastal forest management in the face of global change based on case studies in Japan, Myanmar and the Philippines

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Project Overview

Project Duration	: 2 years
Funding Awarded	: US\$ 40,000 for Year 1; US\$ 40,000 for Year 2
Key organisations involved	: <ol style="list-style-type: none">1. United Nations University, Japan (Liang Luohui, Kazuhiko Takeuchi, Evonne Yiu and Akira Nagata)2. University of the Philippines Los Baños, the Philippines (Leni D. Camacho, Antonio P. Carandang, Dixon T. Gevaña, Sofronio C. Camacho, and Lorena L. Sabino)3. Forest Research institute, Myanmar (Thaung Naing Oo, Chaw Chaw Sein, Billi Nay Win, Aung Soe and Htike San Soe)4. University of the Ryukyus, Japan (Nakama Yuei and Chen Bixia)5. Jawaharlal Nehru University (K.G. Saxena)

Project Summary

Coastal forests, such as mangroves, beach forests and plantations, should be included as part of the integrated approach to mitigate tsunami induced disasters and climate change impacts in the coasts. Nevertheless, there is little understanding how the natural sub-system and the human sub-system interact and can be better integrated to adapt to climate change impact, in particular, from a cross-country comparative perspective. The project examined policy impact on coastal forest management and community-based forest management, including local knowledge to recommend best practices of coastal forest management, integration with human settlement planning and facilities to strengthen community resilience to climate change impacts. It also assessed potential benefits of coastal forests in adaptation to and mitigation of climate change in addition to local livelihoods in food, medicines, construction and spiritual needs. The comparative perspective addressed how different countries and local communities facing a common challenge manage coastal forests and harness the regulating service of forests in adapting to climate change impacts under similar bio-physical conditions, but different socio-economic contexts. The project conducted policy reviews and case studies research in vulnerable coastal communities of three countries, namely the Philippines (Bohol and Palawan Province), Myanmar (Ayeyawady Delta) and Japan (Okinawa), assessed the effectiveness of bottom-up approaches, extracted lessons and identified needs of relevant policies for coastal forest management. The results of three country studies are compared and synthesized as a solid basis for policy recommendations and developing a wider network of coastal forest management beyond participating countries.

Keywords:

Coastal, forest, mangrove, disaster, mitigation

Project outputs and outcomes

Year I

- Project inception workshop held in Okinawa, Japan, 14-17 Sept 2014 to launch the project, refine the methodology, select three case study sites (one each in Japan, Myanmar and Philippines), and discuss communications plan for reaching out multi-

stakeholders, and visit the Okinawa study site.

- Community-based assessment of coastal forest management conducted through collection and review of secondary data, ground survey, semi-structure interview (PRA) and questionnaire
- UNU research mission to Myanmar jointly organised with the UNU-OJCB programme on 9-13 Feb 2015 and Japan on 21-24 Aug 2015 carried out to support consolidation of project results and capacity development.

Year II

- Policy dialogues/consultations with multi-stakeholders held to evaluate barriers for up-scaling good practices, effectiveness of coastal forest policies and programs, and discuss policy implications of the project findings
- UNU research mission to Japan on 20-28 Feb 2016 and Philippines jointly organised with UNU-OJCB programme on 13-18 Apr 2016 to support consolidation of project results and capacity development.
- Project synthesis workshop held in Bohol, Philippines, 27 May-1 June 2016 to review project findings and discuss policy implications and plan forward.
- Follow-up workshop jointly organised with UNU-OJCB programme in Myanmar, 17-22 Dec 2016 to discuss policy recommendations and review follow-up initiative, and support capacity development.

Project outcomes:

- Best practices of coastal forest management, integrating with planning of human settlement and facilities and agriculture and other local livelihoods identified.
- Approaches to up-scaling best practices and improving effectiveness of coastal forest management policy recommended
- A regional research network on coastal forest management expanded to include the Indian team
- Research capacity of young scientists enhanced through on-job training programme.
- Publishing of journal articles related to the project findings and outcomes contributed to academic and policy discussions on coastal forest managements and climate change mitigation

Key facts/figures

- In the study area of Myanmar: identification of 18 mangrove tree species, their mean diameter at breast height, mean height and mean productivity for each tree species in the secondary forest of. *Excoecaria agallocha* was found having the highest proportion. Soil carbon in natural forest was found nearly two times higher than those of plantation.
- In the study area of Okinawa, Japan: 11914 individual trees of Fukugi (*Garcinia subelliptica*), aged from 100 years old to 317 years old, were counted, and their heights measured in 10 communities and 1121 houses..
- In the Philippines: 8 policy consultations/meetings with various stakeholders were held.
- Seven presentations sharing project results were made at three international conferences.
- Two training courses, one each on “Participatory Agroforestry for Rural Development in the Face of Climate Change”, and “Management of Coastal Forest for Environmental Conservation, Food Security and Climate Change Mitigation” were

already organised in the Philippines and India, respectively to make full use of the project findings.

- Expanded research network beyond three participating countries (Philippines, Myanmar and Japan) to include India

Potential for further work

Apart from ongoing efforts to engage in policy debate around coastal forests, the project teams have started to make full use of project findings for capacity building and networking. The project teams in the Philippines and India submitted two training proposals to the UNU Programme “On-the-Job Research Capacity Building Programme for Food Security and Environmental Conservation in Developing Countries (OJCB)”, funded by the Ministry of Agriculture, Forestry and Fisheries of Japan and received positive approval. The two training proposals made full use of the project expertise and results for training of young scientists, including those involved in the project implementation. As a result, the Year II work programme of the project was extended to include the additional follow-up workshop in Myanmar on 17-22 Dec 2016 with generous support of OJCB to summarize project findings and discuss the full proposal on the follow-up research.

The project team also submitted to APN a summary proposal on a new project focusing on sustainable mangrove rehabilitation to follow up and received a favourable review. While mangrove planting has been promoted to restore vital ecosystem services most of such efforts were largely monoculture plantation and were not effective in restoring the wide range of vital ecosystem services. The proposed follow-up research will review past experiences of mangrove planting and identify best practices for sustainable rehabilitation to integrate global and local benefits, taking case studies in the Philippines and Myanmar where both countries has suffered serious damages caused by typhoons and cyclones in recent years. Synthesising findings from in-depth case studies of community-based mangrove rehabilitation efforts of both countries, the project aims to make policy recommendations to further improve mangrove rehabilitation strategies. The final output will contain technical final reports, sustainable mangrove rehabilitation guidelines and policy briefs that will be conveyed to policy-makers and relevant mangrove stakeholders beyond the Philippines and Myanmar. Following the APN favourable review of the summary proposal, the full research proposal has already been submitted to APN for consideration.

Publications

1. Chen, B., Nakama, Y., & Zhang, Y. (2017). Traditional village tree landscapes: tourists' attitudes and preferences for conservation, *Tourism Management*, 59, 1–11. (online first)
2. Chen, B., Nakama, Y., & Urayama, T. (2016). Dimensions and management of remnant *Garcinia subelliptica* tree belts surrounding homesteads- a case study from two villages on the Sakishima Islands, Okinawa Prefecture, Japan. *Journal of the Japanese Society of Coastal Forest*, 15 (2), 29-36.
3. Chen, B. (2016). The state of conservation and management of old *Garcinia Subelliptica* trees: a case study in Aguni Island, Okinawa Prefecture, *Journal of the Japanese Society of Coastal Forest*, 15 (1), 1-6.
4. Chen, B. (2015). Function of traditional forests for disaster prevention-a landscape design perspective. In: *Toward New Island Studies: Okinawa as an Academic Node Connecting*

- Japan, East Asia, and the Oceania*. International Institute for Okinawan Studies (IIOS), University of the Ryukyus (pp.67-70) (in Japanese)
5. Chen, B., and Nakama, Y. (2015). Residents' Preference and Willingness to Conserve Homestead Woodlands: Coastal Villages in Okinawa Prefecture, Japan. *Urban Forestry & Urban Greening*, 14(4), 919-931.
 6. Nakama, Y., Kurima, G. & Chen B. (2017). A Study of Sacred Site Landscape Conservation- Fukugi (*Garcinia subelliptica*) Tree Cutting and Pruning Issues in Uchimaudun, Nishihara Town, *The Science Bulletin of the Faculty of Agriculture, University of the Ryukyus*, 61, 1-18. (in Japanese)
 7. Sein, C. C., Oo, T. N., Win, B. N., & Chen, B. (2015). Assessing different land use pattern and livelihood of the local people in the mangrove area (Case study in Pyapon Township). *Global Journal of Wood Science, Forestry and Wildlife*. 3 (2), pp. 052-058

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“Unlike a single protective function of seawall, forests protect local communities from floods, tides and storms, but also provide a wide range of vital ecosystem services for global and local communities. Recognising multiple values of coastal forests, local communities have long conserved and planted forests around their houses and villages. Coastal forest policy making must take into account local concern and indigenous practices beyond global concern and scientific knowledge. Regional cooperation on research and capacity building could hasten the process of replication and further improvement of the known good practices. “

By Liang Luohui, the project leader, United Nations University

Acknowledgments

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1. Introduction

Coasts are home to a high proportion of world populations, particularly in Asia. Coasts are suffering the adverse effects of hazards related to climate and sea level, and the impact of climate change is exacerbated by increasing human-induced pressures. The tsunami induced disasters following the earthquake of magnitude 9.0 in Japan on 11 March 2011 warned the world of the limits and inadequacy of the conventional scope of coastal infrastructure (such as cement seawalls) in prevention of natural disasters. Coastal forests, such as mangroves, beach forests and plantations, should be included as part of the integrated approach to mitigate tsunami induced disasters and climate change impacts in the coasts. Nevertheless, there is little understanding how the natural sub-system and the human sub-system interact and can be better integrated to adapt to climate change impact, in particular, from a cross-country comparative perspective.

The proposed research aims to improve the understanding of interaction between the forest ecosystems, agriculture and human settlement on the landscape and develop integrated approaches to harnessing forest regulating services in the planning of human settlement and agriculture, and combining benefits of forests in adaptation to and mitigation of climate change in coastal areas. Specifically, the project objectives are as follows:

- To identify best practices of coastal forest management, integrating with planning of human settlement and facilities and agriculture and other local livelihoods
- To evaluate barriers for up-scaling best practices, and effectiveness of coastal forest management policy through a bottom-up process.
- To recommend integrated approaches to harnessing forest regulating services in the planning of human settlement, agriculture and local livelihoods in coastal areas.
- To establish a long-term research network on coastal forest management and enhance research capacity of developing countries through networking and learning from each other.

The project examined policy impact on coastal forest management and community-based forest management, including local knowledge to recommend best practices of coastal forest management, integration with human settlement planning and facilities to strengthen community resilience to climate change impacts. It also assessed potential benefits of coastal forests in adaptation to and mitigation of climate change in addition to local livelihoods in food, medicines, construction and spiritual needs. The comparative perspective will address how different countries and local communities facing a common challenge manage coastal forests and harness the regulating service of forests in adapting to climate change impacts under similar bio-physical conditions, but different socio-economic contexts.

The project conducted policy reviews and case studies in vulnerable coastal communities of three countries, namely the Philippines (Bohol and Palawan Province), Myanmar (Ayeyawady Delta) and Japan (Okinawa), assessed the effectiveness of bottom-up approaches, extracted lessons and identified needs of relevant policies for coastal forest management. Three study sites in the Philippines, Myanmar and Japan and Myanmar often suffer from typhoons or cyclones. The project was also networked with an associated case study in Sundarban, India on the Bay of Bengal, also vulnerable to tropical cyclones. The different situations of coastal forests in the Philippines, Myanmar and Japan are further introduced in the following sections.

1.1 The Philippines

At its natural state, mangroves provide many benefits to mankind. Its strict protection and conservation would ensure the sustainability of these benefits. Considerable benefits are also expected from the development of new mangrove plantations.

Despite the numerous laws in place, the country's mangrove resources continue to decline. A century before, the country had an estimated 400,000 ha of mangrove forests. Today, only around 154,000 ha remain. This area continues to shrink due to ever-increasing population pressure. Efforts to reclaim and rehabilitate degraded mangrove areas has been started some 30 years ago. However, mangrove restoration efforts pale in comparison with the magnitude of the tasks at hand.

The government provides many incentives to Community-Based Forest Management (CBFM) participants in its uplands sites such as security of tenure and exemption from forest charges

for planted forest crops. However, mangrove CBFM participants and other forest developers cannot avail of these because of prohibitions of RA 7161.

In view of the above premises, there is an urgent need to harmonize mangrove policies and institutions to truly push for an effective management and development of mangrove areas in the country. Mangrove areas continue to shrink due to population pressure. There is also a need to put more incentives to mangrove developers to develop more areas and gain direct economic benefits from their toils as well as strictly protect the remaining mangrove areas.

1.2 Myanmar

Myanmar has a total coast line of about 2,000 km in length and a continental shelf of nearly 270,000 km². There are three coastal regions in Myanmar, namely Rakhine, Ayeyarwady and Tanintharyi where mangroves are common. Mangroves were found with the coverage of 7,850 km² (785,000 ha) of which 3,200 km² (320,000 ha) were designated as reserved forests in 1920s. At the beginning of 1990s, the extent of mangroves was reported to be about 85,533 hectares which was reportedly decreased by approximately 50% in 2002.

The Ayeyarwady delta as a whole covers an area of 33,670 km² (3,367,000 ha) having a large network of creeks, streams, and rivers. The tidal action in the delta together with various other conditions creates an ideal ecological condition for mangrove vegetation. Mangroves support local livelihoods as well as protect local communities from storms and floods. In the past, the extent of mangrove forests in the Ayeyarwady delta was reported to be about 2,500 km² (250,000 ha). Reduction of mangrove forests in the Ayeyarwady Delta was taking place at a rapid pace as a result of different factors among which are over encroachment of agricultural expansion, and extraction of fuelwood. The rapid loss of mangroves put local people and their livelihoods at a high risk of cyclones in the coastal areas.

The tropical cyclone 'Nargis' severely damaged the lower parts of Myanmar, mainly Yangon and Ayeyarwady Division in May 2008 claiming many lives and causing enormous destruction to villages, plantations and forests including food supplies. Many inhabitants lost their means of livelihood. It was the worst natural disaster in the history of Myanmar. Therefore, rehabilitation by community-based forest management has already been conducted by forest department and NGOs with the participation of local people since 2009 after the Nargis.

1.3 Japan

In traditional coastal villages of Okinawa Islands, a traditional landscape integrated with planted trees is functional to protect the communities from natural disasters, such as typhoons, tsunamis and salty tides and etc. Traditional planted forest belts of "ho:go", which literally means "embracing protection" and usefully refers to a configuration of ideal Feng Shui landscape, was designed and established about 300 years ago. Forest belts were planted to circle all the houses, and even surround whole villages or several neighboring villages to protect the coastal communities in Okinawa. Such forest belts were cultivated in the early part of the 17th century by all households in the village under common management, and tree cutting was prohibited. Among these preserved forests, native tree species also regenerated inside the woods alongside planted species of Fukugi (*Garcinia subelliptica*) tree, and a rich biodiversity of herbaceous vegetation could be found. These woodlands were converted to protection forests or communal land during the Meiji Period (1868-1912). Unfortunately, the majority of the forests were destroyed through conversion to roads, residential areas or

cropland during the rapid urbanization and rural development after WWII. Thus, it is urgent to identify the appropriate conservation strategy under the transformed socio-economic conditions in the face of climate change.

2. Methodology

2.1. Study sites

In order to compare lessons and experiences across Asia, the project selected two clusters of coastal communities, one each from the Philippines (Bohol and Palawan Province) and Japan (Okinawa) vulnerable to typhoons in the northwest Pacific, and one cluster of coastal communities from Myanmar (Ayeyawady Delta) vulnerable to tropical cyclones in the North Indian Ocean as study sites. The project was also enriched with an associated case study in Sundarban, India on the Bay of Bengal, also vulnerable to tropical cyclones in the North Indian Ocean .

2.1.1 The Philippines.

The case study research in the Philippines was conducted in two sites in the Philippines by the University of the Philippines Los Baños team led by Professor Leni D. Camacho.

The Island of Banacon was chosen as the main site of case study (Figure 1). This Island is located in Bohol Province representing a case of a very vulnerable community with respect to strong waves and storm surges. A big mangrove plantation in its vicinity apparently saves it from destructive forces of these natural phenomena.

Another site of the study is in Palawan (Figure 2) which has good natural mangrove stands.

2.1.1.1 Bohol

The Province of Bohol is located at the central part of the Philippines i.e. 556.16 nautical miles from Manila (Figure 3). It is the 10th largest island in the country with a total area of 394,816.2 ha. Recent census revealed that this province is inhabited by around 1,230,110 individuals with an annual growth rate of 2.92% (PPDO, 2008).

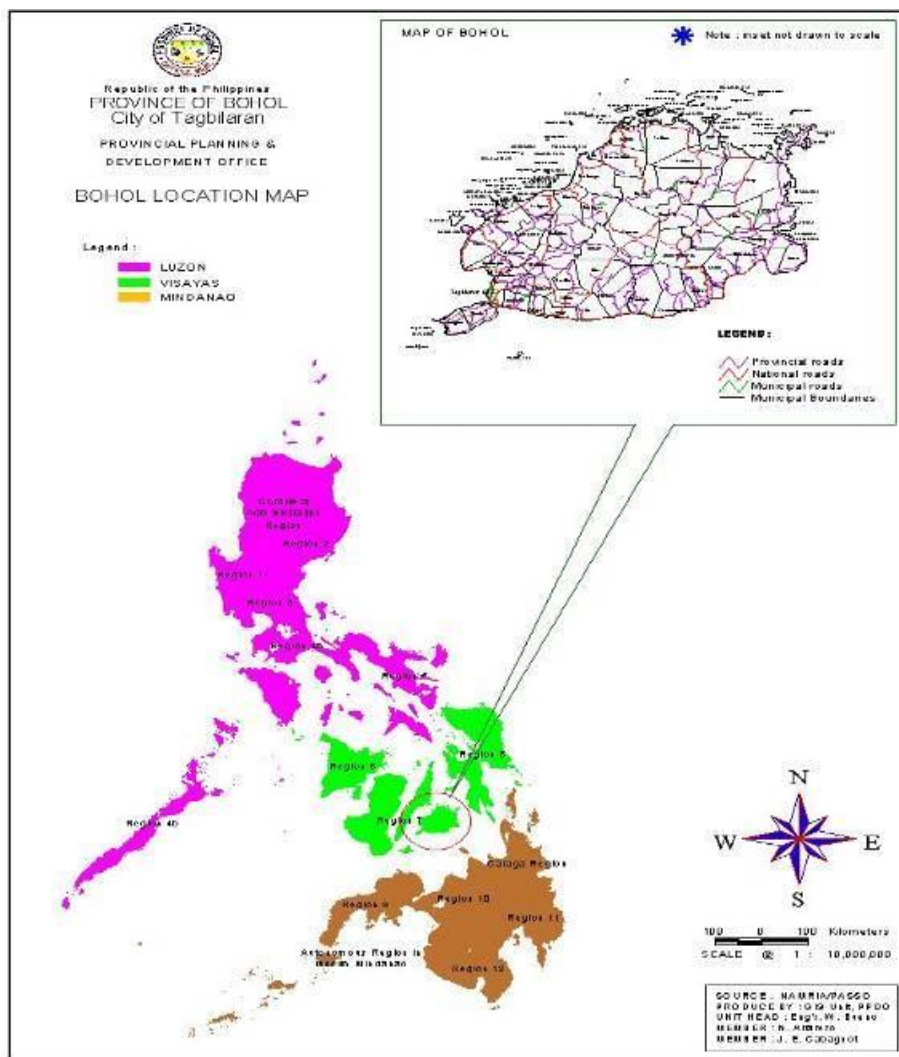


Figure 1. Map of Banacon Island, Bohol, Philippines

Agriculture is the predominant livelihood of the province (Table 1). Agricultural land comprised nearly half of the total land area of 169,678.4 ha. On the other hand, fishing serves as second major livelihood particularly of the 30 coastal municipalities. People regard the marine protection programs such as “bantay-dagat” (protect the sea) and mangrove reforestation essential efforts that sustain the vigorous condition of their sea for fish yield. Conservation therefore of 15,320 ha mangrove (Figure 2) became the banner program for conservation of the local government and DENR in the area.

Table 1. Landuse of Bohol Province.

Landuse	Area (ha)
Agriculture	169678.4
Upland Forest	41145.56
Mangrove (tree)	10597.62
Mangrove (palm)	4722.412
Beach	202.992
Fishpond	1137.767
Open/grassland	158007.8
Mining	1007.767

Unclassified	1744.035
Built-up areas	6571.811
Total	394816.2

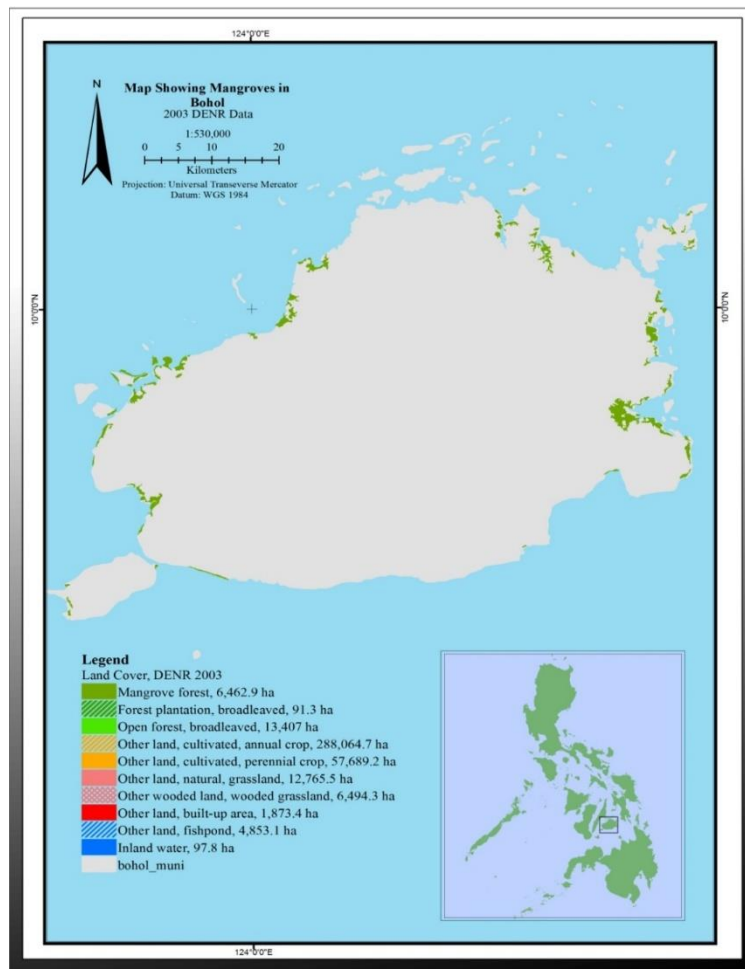


Figure 2. Map showing mangrove forest of Bohol

Among the mangrove areas, Banacon Island (Figure 3 and 4) in the municipality of Getafe is the most popular and well-documented site. It is a protected seascape covering an area of 1,775 ha. The Banacon mangrove project received several environmental awards including the “Likas Yaman Award” of the Department of Environment and Natural Resources (DENR) in 1981, and the “Outstanding Tree Farmer Award from the Philippines” by the FAO in 1991. Further, it is also renowned as largest man-made mangrove in Southeast Asia.

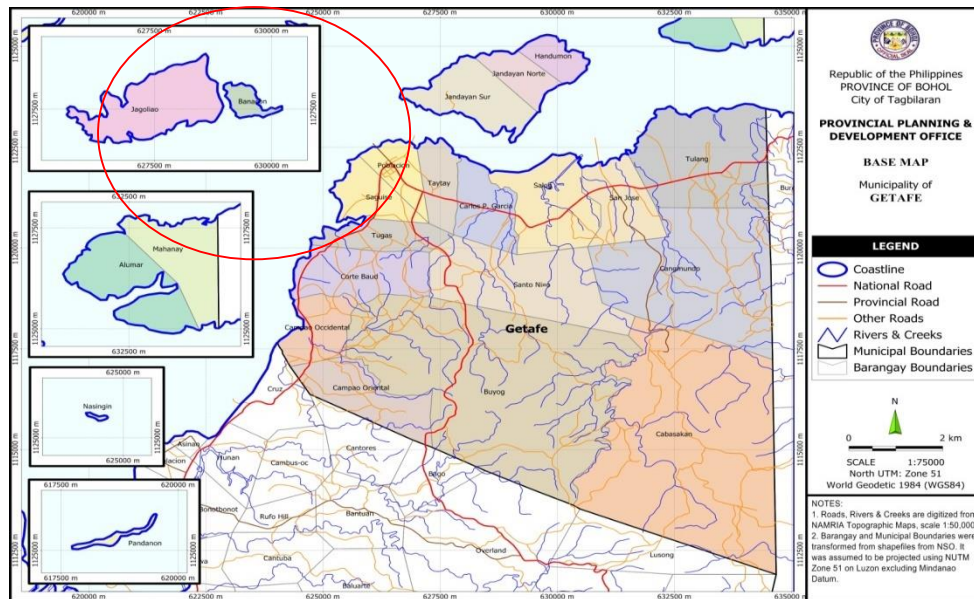


Figure 3. Location map of Banacon Island, Bohol

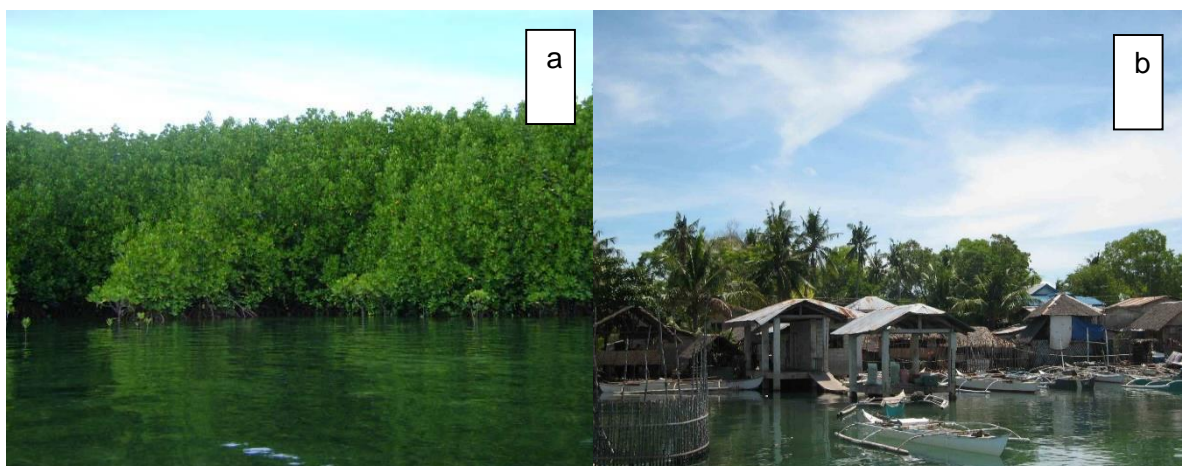


Figure 4. General view of Banacon Island (a. mangrove plantations mainly composed of bakawans or *Rhizophora sp.*; b. local community)

Banacon mangrove is generally a plantation forest comprising mainly of *Rhizophora stylosa* locally known as “bakawan bato”. This species is adaptive to high saline sandy loam to sandy corraline substrates. It is also resilient to frequent tidal surges compared with other *Rhizophora* species. Various ages of plantation are currently being managed in the area (Figure 5). Furthermore, sparse mixed or natural stands that are dominated by *Avicennia sp.* and *Sonneratia spp.* are also frequent in the island.

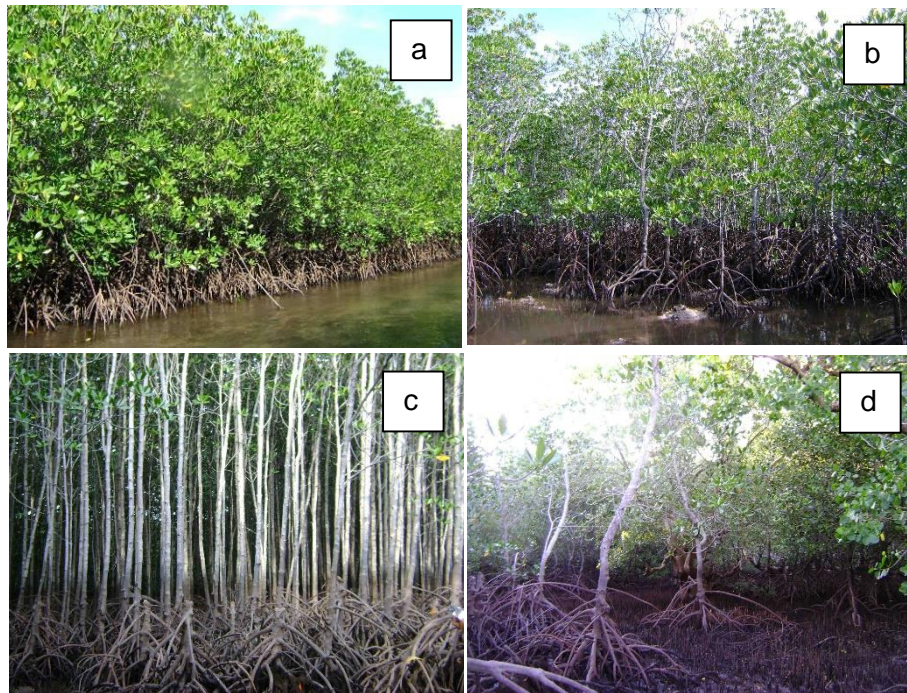


Figure 5. General view of *R. stylosa* plantations based on age (a. 15 years or P-15; b. 20 years or P-20; c. 40 years or P-40), and natural stand or P-N (d.)

2.1.1.2 Palawan

Palawan is the largest province and fifth largest island of the Philippines. It is located at the western part of the archipelago lying between South China Sea and the Sulu Sea. It has a total area of 14382.98 km² (Figure 6).

Agriculture is the primary form of local livelihood in the province while mining and logging used to be second in the economy. Based on the recent census, the population is around 682,152 with a density of 46.6 persons per km².

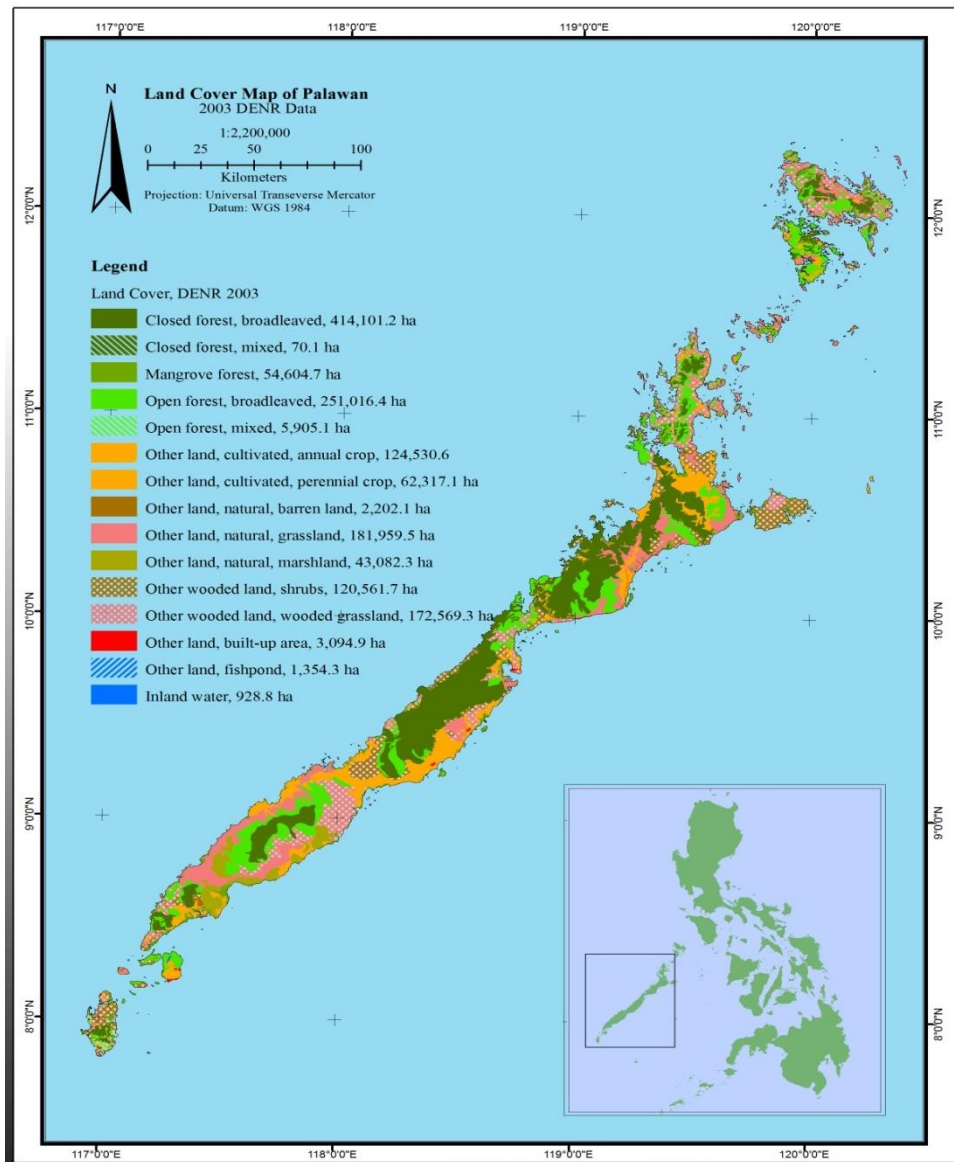


Figure 6. Map of Palawan, Philippines

Endowed with rich natural forest resources, Palawan serves as an abode for more than 200 species of fauna and more than 1,672 species of flora (Novellino, 2008). Serious forest conservation is not the major focus of the local government and various organizations such as the Palawan Council for Sustainable Development. Vast old growth forest can be found along ultramafic mountain ranges and mangrove areas. Mangroves constitute around 3.8% (54,604.7 ha) of the total land area of the province (Table 2 and Figure 7).

Table 2. Land use of Palawan.

Landuse	Area (ha)
Agriculture	186847.7
Upland forest	671092.8
Mangrove	54604.7
Open land/grassland	356730.9
Marshland	43082.3
Shrubland	120561.7

Fishpond and inland water	2283.1
Built-up areas	3094.9
TOTAL	1438298

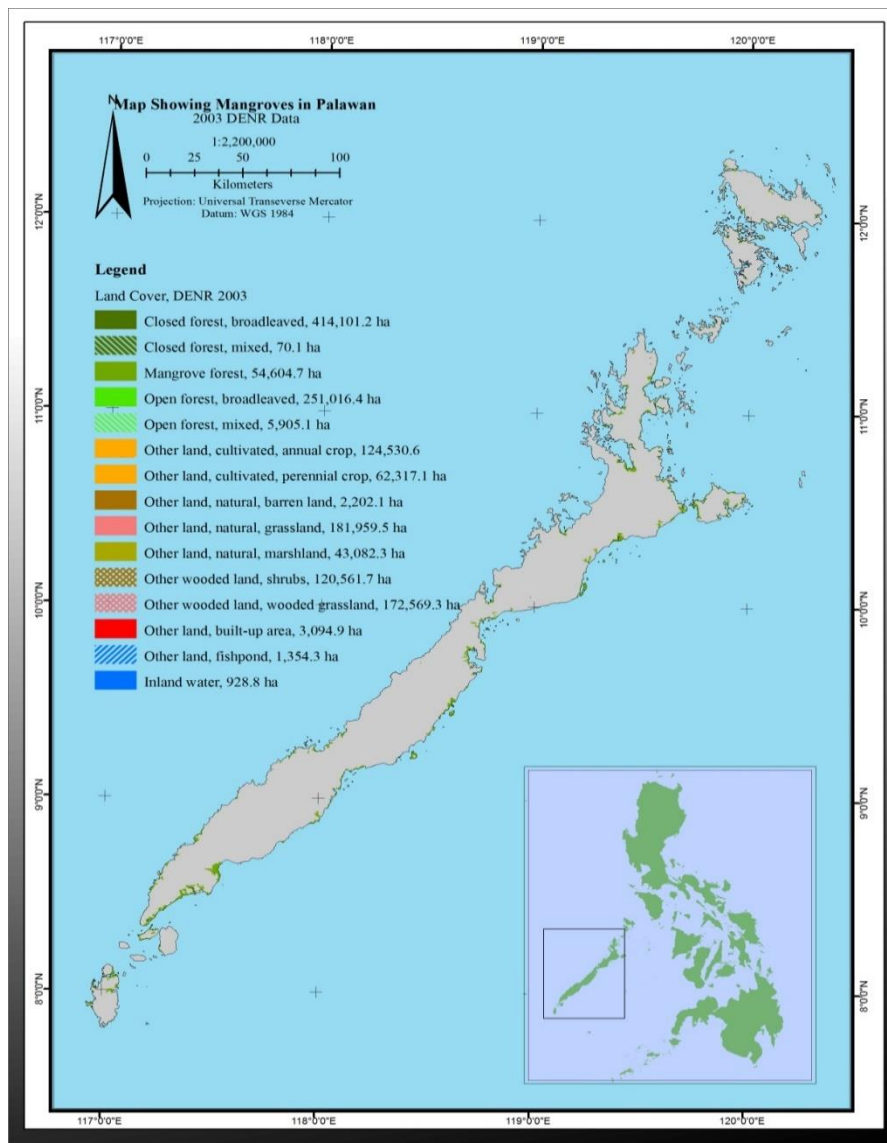


Figure 7. Map showing mangrove forest of Palawan

Mangrove stands in Puerto Princessa City in Palawan were considered in the study. Mangrove forest in this area is roughly around 4,425.9 ha by which large old growth stands can be found in Barangay¹ Kamuning (Figure 8). *Bakauan babae* (*R. mucronata*) is the most common tree species in these sites. In terms of age, most of the trees are at least 60 years old, while others are believed to be living for a century already.

¹ *Barangay* generally pertains to village, which is the smallest political unit of the Philippines.



Figure 8. General view of the old growth mangrove forest of Barangay Kamuning, Palawan

2.1.2 Myanmar

The study area in Myanmar is located in the Pyapon District, Pyapon Township which is situated in Ayeyarwady Delta, with an area of approximately 5517.42 km². The study site is situated in the Pyindaye reserve forest, and three nearby villages, namely War Kone, Padauk PinSeik and Kanyin Kon villages were also selected as the study areas (Figure 9).

Myanmar has a total coast line of about 2,000 km in length and a continental shelf of nearly 270,000 km². There are three coastal regions in Myanmar, namely Rakhine, Ayeyarwady and Tanintharyi where mangroves are common. Mangroves were found with the coverage of 7,850 km² (785,000 ha) of which 3,200 km² (320,000 ha) were designated as reserved forests in 1920s. At the beginning of 1990s, the extent of mangroves was reported to be about 85,533 hectares which was reportedly decreased by approximately 50% in 2002.

The Ayeyarwady delta as a whole covers an area of 33,670 km² (3,367,000 ha) having a large network of creeks, streams, and rivers. The tidal action in the delta together with various other conditions creates an ideal ecological condition for mangrove vegetation. In the past, the extent of mangrove forests in the Ayeyarwady delta was reported to be about 2,500 km² (250,000 ha). Reduction of mangrove forests in the Ayeyarwady Delta was taking place at a rapid pace as a result of different factors among which are over encroachment of agricultural expansion and extraction of fuelwood and charcoal and (Webb, et al, 2008).

The tropical cyclone 'Nargis' severely hit the lower parts of Myanmar, mainly Yangon and Ayeyarwady Division in May 2008 claiming many lives and causing enormous destruction to villages, plantations and forests including food supplies. Many inhabitants lost their means of livelihood. It was the worst natural disaster in the history of Myanmar. Therefore, rehabilitation by community-based forest management has already been conducted by forest department and NGO with the participation of local people since 2009 after Nargis.



Figure 9. Study area of Myanmar site

The study area is located in the Pyapon District which is situated in Ayeyarwady Delta, with an area of approximately 5517.42 km². The study site is situated in the Pyindaye reserve forest, and three nearby villages, namely War Kon, Padauk PinSeik and Kanyin Kon villages were also selected as the study areas. Around 29 mangrove species are found in the Pyindaye reserve forest. The most dominant species are *Heritiera fomes* and *Excoecaria agallocha*. There are seven common tree species found in Pyindaye reserve forest area (*Heritiera fomes*, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Bruguiera gymnorrhiza*, *Avicennia officinalis*, *Ceriops decandra*. and *Sonneratia apetala*).

In the Pyindaye reserve forest, different types of land uses are found. The majorities of the land uses are agriculture, aquaculture and mangroves. Others are salt pan, shrimp farming, mangrove plantations, and community forestry. In Pyindaye reserve forest, the population is about 100,000. And the number of households is about 160,000. The main livelihood activities

are agriculture, fuel-wood collection, fishery, salt pan, shrimp farming and laboring. The major drivers; human settlement in that reserve forests around 1960, over production of firewood and charcoal production for local use and to cater to the energy needs of Yangon city, conversion of mangrove forest to agricultural land (paddy field) starting from 1970 and conversion of degraded land to aquaculture account for the deforestation in the study area. Population pressure is the most important driver of deforestation in the area. Human settlement around 1960s forming villages in the reserve forest caused a large deforestation by the formation of agricultural land and aqua farms in the area. Conversion of mangrove forest to paddy field turned a large area of pristine natural forests to agricultural land around 1970. Over production of firewood and charcoal making also accelerated the rate of deforestation. To satisfy the energy needs of the Yangon city, mangrove forests in Ayeyarwady region were exploited for charcoal making and fuel wood production. As a result, mangrove forest in Ayeyarwady region decrease 84% over a thirty-year period.

2.1.3 Japan

The study site in Japan is located in Tarama island of Okinawa prefecture, Japan's southwestern most prefecture, at lat. 24~28° North and long. 123~132° East. Okinawa prefecture consists of 49 inhabited and 110 uninhabited islands. The islands are scattered over an area 1,000 km from east to west and 400 km from north to south. Okinawa is the only prefecture that is located in the subtropical climate zone, endowed with rich rare species. Although many species of animals that once lived on the Asian Continent have become extinct, these species have survived and evolved on the subtropical islands of Okinawa. Many rare species such as the Iriomote wildcat (*Prionailurus bengalensis iriomotensis*), Yambaru Kuina (*Gallirallus okinawae*), and Yambaru Noguchigera (*Sapheopipo noguchii*), are only seen in Okinawa.

The climate of Okinawa is influenced by the latitude, the surrounding ocean, the monsoon, the Black Current, and typhoons. In the long term, annual average temperature of the Okinawa area is, has been rising at a rate of 1.08 °C per 100 years (Okinawa Meteorological Observatory 2015). Present evidence suggests that elevated sea temperature is one among the leading factors responsible for large-scale coral reef bleaching, as a result, threats the coastal ecological environment.

Extreme high temperature have increased, while, extreme low temperature have decreased in the past 100 years. During the period of 1931-2013, the number of hot days (daily minimum temperature over 25°C) has increased at a rate of about 5.19 days every 10 years.

Okinawa has a long typhoon season, extending from June to November. The number of typhoon formed and moved through Okinawa Prefecture was showed in Figure 10, with an average of 25.6 and 7.4, respectively. The year of 2004 recorded the most active typhoon year in Okinawa with a total number of 15 typhoons moving through Okinawa Prefecture.

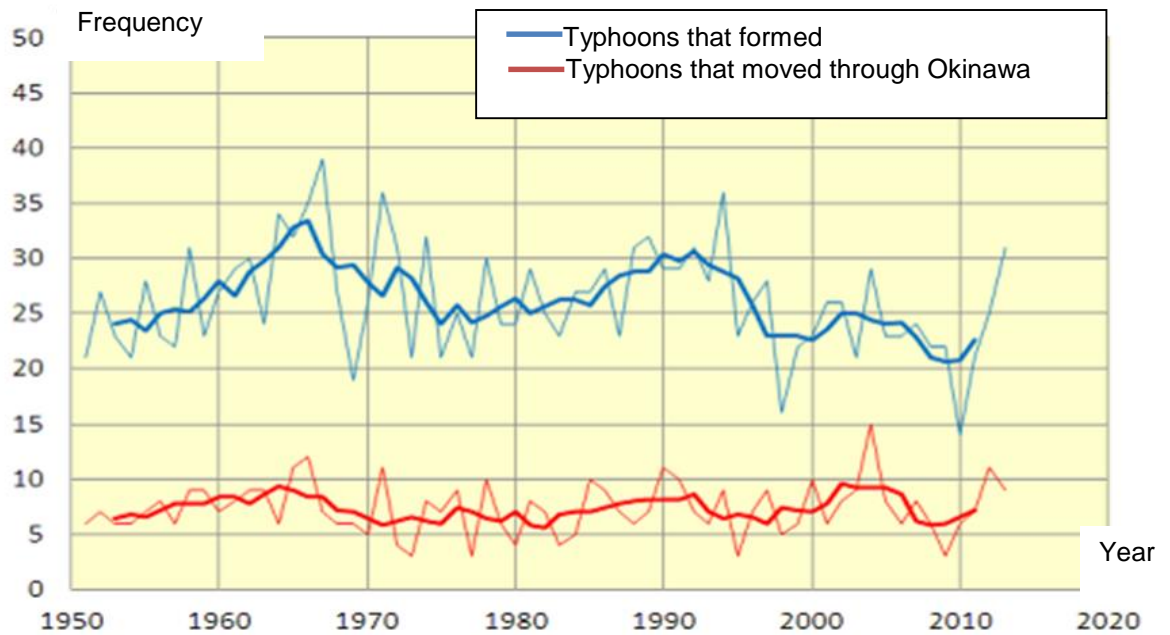


Figure 10. The number of typhoon formed and moved through Okinawa Prefecture.
 Note: the thin line is annual average, and, the thick line is an average of every 5 years
 Data source: Okinawa Meteorological Observatory (2015)

Traditional village landscape in Okinawa was established about 300 years ago, featuring multilayer of forest belts to protect settlements from strong typhoons and seasonal winds. Ho:go is one essential word for a Feng Shui village in Ryukyu Islands. The literal meaning of Ho:go is to embrace and protect by forest planting in order to retain the living energy. Ho:go also refers to a forest belt that encircles a house, a village, several neighboring villages, or the coastline, and is called House Ho:go (habitat-embracing forest), Village Ho:go, District Ho:go, and Coastline Ho:go, respectively. However, such Feng Shui village landscapes have disappeared rapidly since World War II because of the changing life styles.

In this part, Tarama Island was selected as survey site since it has the only currently existing Village Ho:go in Okinawa (Figure 11). According to the old document, the Village Ho:go in Tarama Island was planted in 1742. Around 1800m long forest belt of Village Ho:go were planted to curve along the front of the village and to be connected with the forested mountain in the back to shape a greening circle with a radius of about 400m.



Figure 11. Village houses (at the center of the photo) clustered in the northern part of Tarama Island. (1) Bummja: the center of village (2) The back hill covered with thick forest, where several Utaki (sacred spots) were located. (3) Jaejama to: midai (4) Tukapana (5) Village Ho:go curving in the front. (6)-(8): sacred sites

2.1.4 Sundarban, India

The associate study site in Sundarban is located in the southern part of West Bengal state of India in the expansive river delta on the Bay of Bengal. The village landscapes can be classified into the ones (i) mangrove belt forming the village boundary facing river front and (ii) the ones without such a belt, more vulnerable to the damage of cyclones. All villages have an earthen embankment to protect from floods. Village livelihoods consist of food crop cultivation (paddy in main field and vegetables on raised plot boundaries), betel leaf gardens, tree-crop mixed home gardens, fish ponds (natural fish production), aquaculture (crab and fish), natural mangrove forests, mangrove plantations and deep sea fishing.

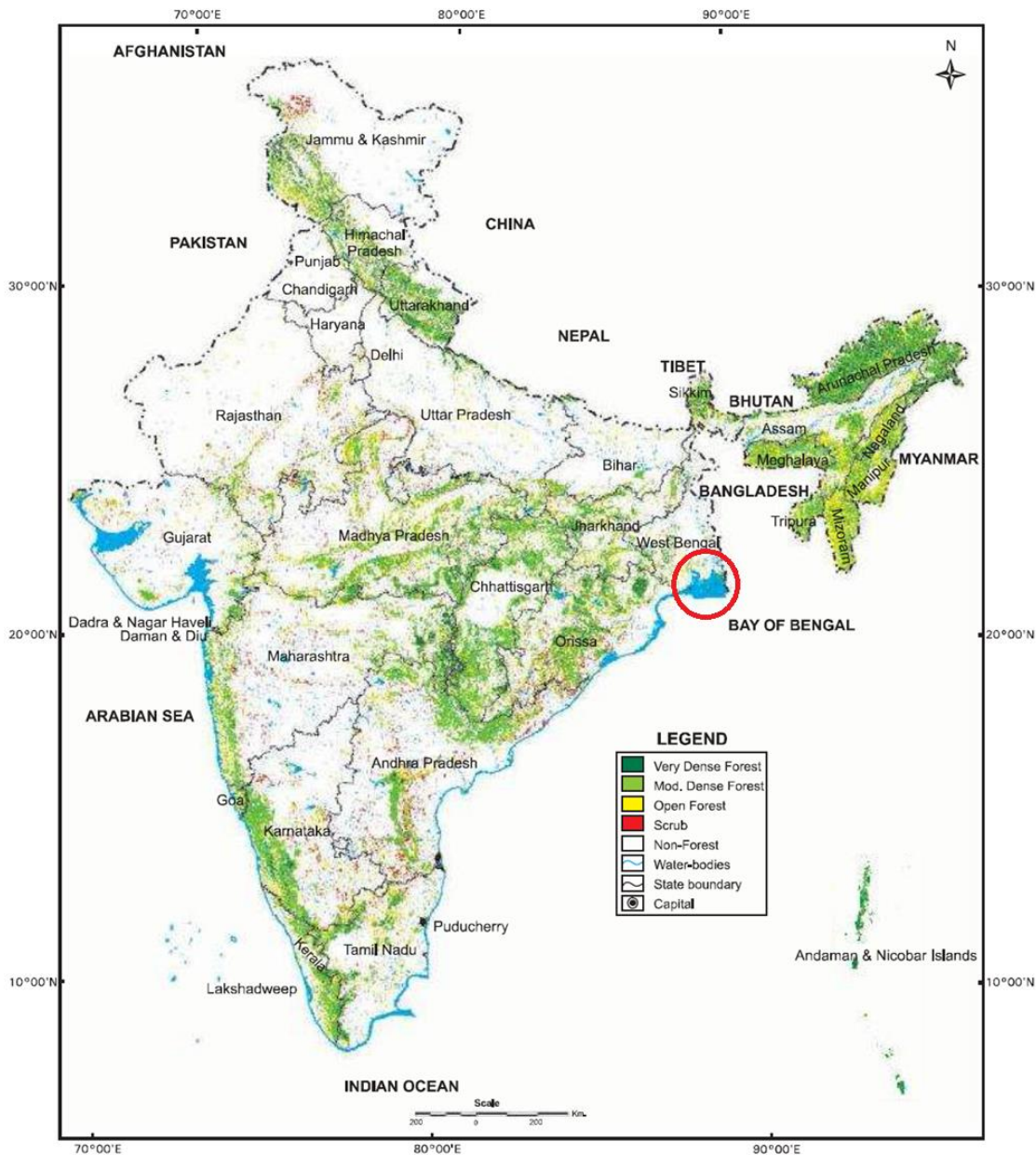


Figure 12 Indian part of Sundarban region, encircled on forest map prepared by Forest Survey of India (2011)

All villages have a drainage system allowing outflow of water from the settlement to the river and also from river to the settlement. For some activities, like cultivation of some fish or for conversion of shrimp larvae (which suffer mass mortality if not sold out within a day) to juveniles (which suffer less mortality), river water is used. However, for paddy it is the rainwater which is accumulated in banded fields or underground water drawn borewells is used for irrigation. However, during the high tide and rainy season, some inflow of river water is common in fields with low bunds. This provides advantage of catching easily the fish transported by river water but disadvantage of increase in salinity stress to rice crop.

The coastal forests are classified into (i) reserve and protected forests, (ii) community forests and (iii) roadside/riverside/seaside plantations. Mangroves (*Avicennia* spp) are planted towards river front, *Casuarina equisetifolia*, *Tamarix gallica* and *Accacia nilotica* on 2-3 m high

earthen bunds bordering river and *Accacia auriculiformis*, *Cassia fistula*, *Eucalyptus hybrid* and *Phoenix dactylofera* on roadside; natural forests are dominated by *Heritiera* forms, *Excocarpia agallocha*, *Avicennia alba*, *A. officinalis*, *A. marina*, *Bruguiera parviflora*, *Ceriops tagal* and *Nypa fruticans*.

2.2 Study components and methods

The research was an interactive process of community-based assessment and policy analysis. The community-based assessment of forest management at three study sites vulnerable to typhoons/tropical cyclones was carried out so as to identify good practices of coastal forest management and their integration with planning of human settlement and facilities, and local agriculture and gaps to strengthen community resilience to climate change impacts. The project selected three case study areas of the Philippines (Bohol Province), Myanmar (Ayeyawady Delta) and Japan (Okinawa) as all three countries that face the common challenges of dealing with typhoon and tropical storms. Yet all three countries are at different levels of social and economic development, different climates and cultures, which could provide a variety of experiences, traditional knowledge and best practices for sharing.

The community-based studies combined ground survey of coastal forest resources and their dynamics, semi-structure interview and questionnaire. A cultural landscape/seascape approach was taken to analyse land-/resource-use linked differentiation of ecosystems in interaction of coastal forests, resource utilization/regeneration mechanism, people's perceptions about climate change/sustainability/policy interventions. The field study comprised three activities: (1) biophysical survey and analysis through interviews, participatory field mapping, interpretation of satellite imagery and geographic information system (2) socio-economic survey through interviews and focused group discussions to elucidate community based practices and people's perceptions about interventions and problems; (3) identification of good land/resource use practices synergizing multiple benefits from coastal cultural landscapes/seascapes.

On the basis of the community-based assessments, the policy analysis proceeded through a bottom-up process approach to evaluate effectiveness, lessons, gaps of existing policies in supporting community-based forest management, coastal reforestation as well as to identify barriers for up-scaling of good practices and mainstreaming of regulating service of coastal forests in human settlement planning, and to feed into the process of local forest management and human settlement planning. The extensive knowledge and expertise of participating teams in the forest management in the region were built on to minimize project costs and duration. The collaboration amongst developed and developing nations resulted in the common understanding and coordinated strategies towards coastal forest management. The comparative perspective analysed how different countries and local communities facing a common challenge manage coastal forests under similar bio-physical conditions, but different socio-economic contexts so that regional difference can be taken into account in policy recommendations.

Specifically, the policy analysis reviewed existing policies in community-based forest management and identify gaps for effective coastal forest management vis-à-vis the findings from the community level study; identify barriers for mainstreaming coastal forests in human settlement planning and recommend solutions; exchange lessons learnt from effective policies

of other countries, and share knowledge and experience with the experts. A number of national stakeholders' consultations and three international workshops (one each in Okinawa, Japan on 15 – 17 Sept 2014; in Bohol, Philippines on 28-30 May 2016, and in Pyapon, Myanmar on 17- 22 Dec, 2016), involving officials, community leaders and policy researchers, were organised to synthesis results and experiences between the community level study and policy analysis under different socio-economic contexts, as well as encouraging dialogue and fostering cooperation amongst the stakeholders to fit the research findings into their policy making processes, including forest management plan, human settlement plan and land use regulations.

Capacity building has been an important part of the project implementation and the long-term research on coastal forests. Several young researchers in Myanmar, Philippines and India took part in the UNU Programme “On-the-Job Research Capacity Building for Food Security and Environmental Conservation in Developing Countries (OJCB)” held at University of the Philippines Los Baños, the Philippines in 2016 and at Jawaharlal Nehru University, India in 2015 and 2016. The field work of the OJCB was conducted at the study sites in Myanmar, Philippines and India for young researchers to appreciate experiences of coastal forest management across Asia.

Considering difference in data availability, socio-economic contexts and research focuses among three countries, the site-specific methodologies taken by each country teams are further clarified as follows:

2.2.1 The Philippines

Secondary data gathering on policies, statistics, and current management situation in the country were done. Primary data gathering was done to study in details the case of Banacon Island as compared with the case of Kamuning, Palawan. Community-based assessment carried out key informant interviews, focus group discussion and mangrove mapping. Policy analysis and local management practices were done in the light of the following criteria:

- Environmental soundness
- Socio-economic feasibility
- Social acceptability
- Administrative practicality
- Climate change sensitivity

After the study, the team provided policy recommendations particularly focusing on the weaknesses of current policies in addressing issues related to:

- a. Mainstreaming coastal forests in human settlement planning, and to feed into the process of local forest management and human settlement planning;
- b. Maximizing policy benefits in the context of socio-economic development in the coastal areas;
- c. Dealing with coastal hazards in the context of climate change; and
- d. Building local capacity through networking and sharing of expertise

Finally, a wider assessment on the benefits of mangrove forest development and management beyond the Philippine's case was done looking at cross- country and inter-country experiences in view current and future hazards from extreme climate and geologic events.

2.2.2 Myanmar

The research proceeded with the community-based assessment component in Year 1 and the policy analysis component in Year 2. The community-based assessment conducted inventory and monitoring of forest resources, GIS analysis and semi structure survey.

2.2.2.1 Inventory of forest resources

Ten 50 m x 50 m plots were chosen randomly in the local community plantation and three 50 m x 50 m plots of the natural forests in Wakon, Padauk PinSeik and Kanyin Kon villages in the the Ayeyarwady Delta. Diameter at breast height (DBH) and height of all trees in these plots were measured and recorded. A spacing of 1.8 m x 1.8 m was generally adopted in the rehabilitation program in the delta.

The aboveground biomass was estimated as follows:

- Measurement of felled trees

Four sample trees were felled at 0.3 m above the ground. All the boughs, twigs and leaves were cleared off the felled trunk. The height of the felled tree was measured before the trunk was being cut into logs for the convenience of weighing. Each log was weighed and noted in the field note. Boughs, twigs and leaves including saw dust were weighed and noted.

- Collection of samples for dry weight estimate

The samples of the trunk, bark, boughs, twigs and leaves were collected in separate paper bags for drying and weighing. Leaf sample of 10 kg, branch sample of 50 kg, 2 cm disks to represent trunks were collected.

- Drying samples

After felling, the trunk, branches and leaves of each sample tree were separated and weighed. Small samples were then extracted from each separated organ, weighed, dried for 96 hours (leaves, 48 hours) at 80°C, and re-weighed in order to determine their fresh to dry weight ratios. The biomass of each organ was calculated from the fresh weight and fresh to dry weight ratio thus obtained.

- Estimation of total dry weight of each sample tree

Total dry weight (TDW) of each organ of each sample tree was calculated from its total fresh weight (TFW), the fresh weight of its organ sample (SFW) and its dry weight (SDW) (JIFPRO & JOPP, 2004). The carbon content of tree biomass was estimated by using the carbon content default value of 0.5 as proposed by the IPCC (1996).

Estimation of soil Organic Carbon (SOC) started with collection of soil samples from all three plantation sites (War Kon, Kanyin Kon and Padauk Pin Seik). Five points were selected randomly in each plantation site. Then, soil samples were systematically collected from five depths, 0-10 cm, 10-20 cm, 20-30 cm, 30-40 cm and 40-50 cm. Samples for soil bulk density were also taken from each depth by dipping an improvised metal canister into each of the designated soil depths. Soil test was taken in the soil laboratory of the FRI, Yezin, Myanmar.

2.2.2.2 GIS analysis

GIS analysis was carried out in each village using the digital data of Landsat 7 satellite imagery for land use mapping for the year 2014. Before the pre-processing and classification of satellite imagery began, an extensive field survey was performed throughout the study area using Global Positioning System (GPS) equipment. This survey was performed in order to obtain accurate locational point data for each land use included in the classification. The satellite data was enhanced before classification using histogram equalization to improve the image quality and to achieve better classification accuracy. The whole process is guided by ground observations and local knowledge. The land use maps produced at year 2014, at a scale of 1:100000 include eight classes, depending on the characteristics and objectives of the study site.

2.2.2.3 Semi structure interview Survey, questionnaires with local people

Simple random sampling with sampling intensity of 50% in War Kon village which have total of 95 households, 25% in Kanyin Kon village which have 198 households and 50% in Padauk PinSeik which has 49 households was carried out in order to focus the impacts of coastal forest loss and impact on fisheries; human settlement management issues such as vulnerable zones to natural disturbances and institutional factors such as land regulations and ownership; traditional coastal management knowledge, social, economic and environmental impacts to local people.

2.2.2.4 Policy consultation

The consultation was focused on how coastal forests are managed and conserved for sustainable use and climate change adaptation on three levels over questionnaire surveys: (a) stakeholder discussion, (b) dialogue with village head and (c) questions to staff from forest department who is practically managing and conserving coastal forests (See Appendix1 for questions used). And finally it recommends the appropriate policy to manage coastal forests for the livelihood improvement of local people and adaptation to climate change.

2.2.3 Japan

The Okinawa case study was conducted around four research objectives. Combined approaches of field survey and in-depth interview were applied to achieve the objectives and individual tasks undertaken.

(1) Measure and record the distribution and location of huge trees in the coastal village; document in detail the demographical and socioeconomic background and transformation of coastal village.

Task 1.1: Using various sources of statistical data, residential maps and literature review, develop a basic information sheet of land use transformation of village settlement.

Task 1.2: Conducting field survey, develop a database of the huge tree inventory and tree distribution map.

Task 1.3: Interview local community to provide in-depth understanding of the background of land use change. Evaluate the impact of land use and other socio-economic changes on coastal forest management.

(2) Document in detail the information of the influence of coastal forest on farming and coastal fishing, and how coastal forests function to protect from typhoons, storm tide and tsunami.

Task 2.1: Using the snowball approach, identify the key informants and conduct interviews with key informants to clarify the ecological, social, cultural values of coastal forests, Specifically, the function of forest to the natural disasters, in particular in the face of climate change.

Task 2.2: Interview the key respondents identified at Task 2.1 to understand the challenges to the coastal forest management and potential risks to the natural disasters.

(3) Identify stakeholders of coastal forest conservation, and the good practice and challenges to coastal forest conservation.

Task 3.1: Identify stakeholders involved with coastal forest conservation, administrative people, community leaders, NPO, local community, and key persons who live in the urban away from their village home and highly concern about their home town's issue and have certain power inside the village.

Task 3.2: Use community-based participatory method to conduct semi-structured interviews and observational approach to understand stakeholders' specific interests in forest management. Understand the area's principal problems and aspirations for coastal forest conservation.

Task 3.3: Conduct questionnaire survey to assess the perception of local people on the management and conservation of the coastal forest.

Task 3.4: Conduct questionnaire survey to assess the perception of tourists on coastal forest landscape management and conservation.

(4) Assess the current coastal forest policy and propose community-based self-regulated conservation strategies through effective extension and outreach programming to house owners, NPOs, policymakers, and other stakeholders.

Task 4.1: Use the database developed in Objectives 1-3, analyses strong and weak points of current local coastal management policy. In combination with the results of literature studies and field surveys, propose the policy implication for sustainable coastal forest management.

Task 4.2: Organize and conduct workshop with local community, and NPO and policy makers to report the research findings for review.

3. Results & Discussion

Adaptive management of coastal forests

The community-based assessment of coastal forests found out that local peoples in all three study sites have long made efforts to establish man-made forests and conserve natural forests around houses and villages to protect them from windstorm. Extensive mangroves are conserved and planted in the windward side of the coastal villages in the study sites of Myanmar (Figure 12) and Philippines to mitigate impacts of the strong southwest monsoon. Many villages maintain man-made and natural mangrove belts at their boundaries facing river and sea front in the study sites of the Ayeyarwardy delta in Myanmar and the Indian region of Sundarban on the Bay of Bengal. The forest belts are planted and conserved at the village boundary over centuries in the study site of Okinawa islands, Japan (see Figure 11). In addition to the protection forest belts around the village, densely forested home gardens of

trees (coconut, bamboo, betel nut, mahogany, etc) forming canopy, and various annual/perennial/seasonal crops under the tree canopy are traditionally established around individual houses to protect individual houses from strong storms and provide shade in the study sites of Myanmar and India. The forest strips of the Fukugi trees *Garcinia subelleptica* resistant to windstorm are planted around houses in Okinawa to protect individual houses from windstorms and provide shade. As a traditional best practice, protection forests are conserved and planted on both village and family levels to reduce risk of windstorm damage in all study sites.

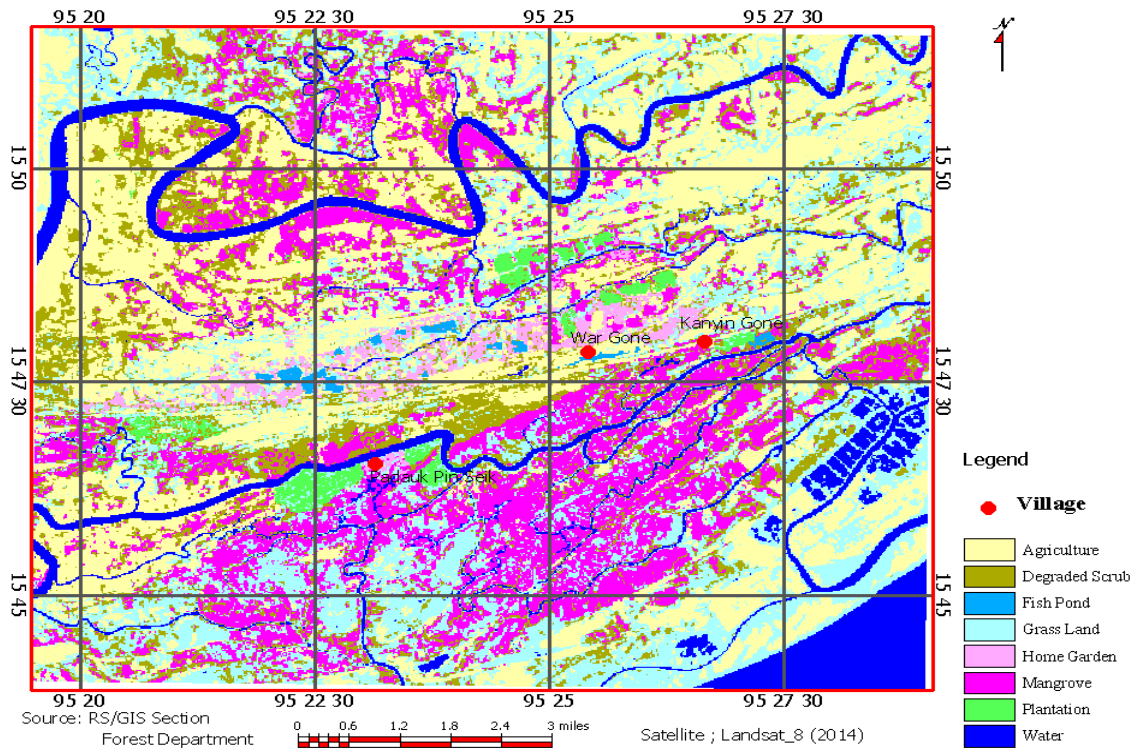


Figure 12 Different Land Use Pattern in the study site of Myanmar, noting expansive mangroves on the south of the study villages

The man-made mangrove forests play very important roles in local livelihoods, such as fishing, collection of fuelwood, honey and thatching materials in the cases of Myanmar, the Philippines and India in addition to their protecting villages from strong wind and storms. Sustainable use of forests is critical for coastal communities in Myanmar, the Philippines and India. Coastal communities manage nipa palm for thatching materials and fruits in tidal zone, and cultivate coconut in home garden on the higher ground beyond high tide in Ayeyarwardy delta of Myanmar. Most home gardens are attached with fish and crab ponds so as to support cash income and subsistence needs. Ongoing efforts of mangrove rehabilitation contribute to both local livelihoods as well as coastal protection. On the contrary, the man-made forest belts in Okinawa are mainly created for protection of houses and farms from strong winds and for cultural values of *Fengshui* that recognise a closed landscape as auspicious. Nowadays, these forest belts have become attractions for tourism development.

Apart from embracing regulating services of forests, local communities take into account risk of flooding and windstorm into their traditional architecture. Building houses on the stilts above

ground and water is a traditional way by coastal communities in both the Philippines and Myanmar sites to reduce risk of flooding damage to their houses in low-lying areas. The material of the stilts has recently been changed from the traditional wood structure to the concrete ones for stronger resistance to flooding and windstorm. On the contrary, a traditional house in Okinawa is often built in the man-made depression below the ground level so that the house is lowered inside the depression to minimize risk of windstorm (see Figure 13). Nevertheless, raised houses on stilts in the Ayeyarwady delta of Myanmar and the Bohol Island of the Philippines is not a feature of Indian region of Sundarban. Here, in almost settlements, houses are either far away from the river/sea front (beyond high tide) or by the side of an earthen embankment (opposite side of embankment facing river) lined by bricks and augmented or not by belts/strips of forest plantations. The embankment is high enough to protect from tides and floods but has succumbed to damage to extreme events. Sometime, biological and physical methods are integrated to reduce risks of flooding (see Figure 14). Mangroves (*Avicennia* spp.: air-drop) are maintained towards river front, and Casuarina, *Tamarix gallica* and *Accacia* are planted on embankment as in the study site of India. Along the coasts of Okinawa concrete seawall and structures are widely built to mitigate coast erosion. In the past, monastery may have served as cyclone shelters as their stilts are much taller than those of ordinary houses in the study site of Myanmar (See Figure 15). Cyclone shelters of concrete structure on the tall stilts are now established in school. Therefore, local communities in study sites integrate both forests and physical structures in protection of their houses and farms.



Raised house on stilts in Myanmar



Lowered houses in depression in Okinawa, Japan

Figure 13 Traditional house architectures are surrounded by forest strips in study sites of Myanmar and Japan



Figure 24 Forest belt and embankment are often integrated to reduce risk of flooding in the associate study site of Indian Sundarbans.



Monastery

School

Figure 35 Monastery and school raised on the tall stilts could serve as cyclone shelter to cope with risk of floods in the study site of Myanmar

Traditional coastal communities evolved livelihood systems that met their subsistence needs by utilizing resources in the sea/river and mangrove forests at sea-land interface regenerating exclusively by natural processes, husbanding a crops/livestock in land and culturing fish in inland ponds and provided protection from tide, storm surges and flood. Such systems are evident in all countries but with changes induced by economic globalization, changing socio-political conditions, technological advancements and global environmental changes; a land/resource use or landscape architecture considered “best” earlier may not the best one at present or in future because of changing scenarios. Thus, expansion of urbanization, industrialization, advanced technologies and outmigration after second world war resulted in loss and degradation of plantations along coast line and *Garcinia subelleptica* groves established centuries ago around dwellings leading to decline in carbon stocks and biodiversity and increase in dependence on expensive engineering methods of protection of dwellings from wind, cool temperatures. Though mere restoration of such a traditional forest

cover may be quite significant from the point of biodiversity conservation and climate change mitigation, it requires policies, financial support and proactive role of local government even in a developed country like Japan.

In a developing country like Philippines, *Tagbanua* people utilized only dead trees for charcoal and fuelwood for a belief that healthy mangroves were necessary for sustaining fish production at a time when mangroves occupied large tracts, were freely accessible, population pressure was low and huge quantities of dead wood were available because of natural mortality as was the case in November 2013 when Palwan and nearby islands were ravaged by *Typhoon Haiyan*, a category 5 storm. Exclusive dependence on dead trees was a “best practice” in the subsistence economy when natural forests were extensive but may not at present when natural intact forests have almost vanished, resource endowments have dramatically declined, plantations in private land or leased community forest land is a prospective source of income and a growing rather than a mature forest has higher potential of carbon sequestration and a landscape mosaic of forest at different stages of development is likely to harbour higher biodiversity than monotonous -homogeneous landscapes. Thus, access of land to people by leasing degraded forest land to them since introduction of Community Forestry programme and mobilization of funds from private companies to people for plantation since 1990s is a good practice but the outcomes can be further improved by developing silvicultural methods enabling simultaneous enhancement of multiple functions of plantations, demonstrating them and enhancing local capacity for adoption.

Homegardens in Ayeyarwady delta of Myanmar and Sundarbans of India exemplify the potential of indigenous knowledge in establishing a land use as species rich, productive and rich in regulating services as natural forests but in the absence of salinity and water stagnation. This traditional land use synergizing local livelihood concerns with global biodiversity conservation and climate change mitigation concerns however has been stagnant or declining in the absence of policies promoting supplementation of indigenous knowledge with scientific knowledge and encouraging indigenous innovations. In spite of widespread occurrence of homegardens in Ayeyarwady and Sundarban delta regions, cultivation of *Piper betel* (betel leaf) is an example of indigenous innovation confined to only some homegardens. Betel cultivation has enhanced both social bonding (linkages within farming community) and bridging (linkages between farmers, traders and consumers in far off places) enabling high profit of margin from this perishable crop and maintenance of a highly productive system by recycling local resources. Deposition of nutrient sediment removed from fish ponds in betel garden and irrigation of the crop by the water flushed out from these ponds maintains high production of betel with local inputs along with maintenance of high fish production. The locations of the gardens and ponds are selected such that water flows to the garden by gravitational force. Enterprising nature of betel leaf production and trade exposed the farmers to new resource management practices elsewhere. Since last 2-3 decades, they started cultivating *Sesbania rostrata* to serve the twin purposes of reducing salinity and nutrient enrichment in crop fields.

People do understand degradation of natural forests due to overgrazing by livestock and intensive pruning for fuelwood collection, susceptibility of grazed/trampled/pruned trees to pests and pathogens and increased incidences of encroachments of degraded forests, and direct loss of dense forests from conversion to shrimp farms and paddy fields. The local knowledge could however not advance in respect of accelerated restoration of degraded lands and sustainable resource use intensification in intact forests.

The system of Regeneration Improvement Felling developed in Myanmar favouring economic species over weedy growth developed for government forests is a good practice of coupling of concerns for income/material benefits among local people and the global concerns for biodiversity conservation and enhancement of regulating service. Such systems assume importance in extensively degraded regions in view of two times higher carbon stocks and plant species diversity in natural forests than monospecific plantations currently promoted.

In situations like Sundarbans deforestation/forest degradation was not so rampant, bonafide residents enjoyed rights of free subsistence uses of forest resources even after the land was taken over by the government the 1950s and deforestation/forest degradation was avoided by designing interventions that favoured income from honey requiring a healthy forested landscapes. Government authorities (i) organized groups for local people for honey collection from state forests, (ii) reduced the risks from high profile tiger by allowing collection only in groups and (iii) securing income to farmers by procuring the products and then marketing it at no costs to farmers. Nonetheless, attention has not been paid to many traditional good traditional practices from the point of their enhancement and replication: (i) integrated management of a highly heterogeneous landscape comprising paddy fields, fish ponds, homegardens, betel gardens and mangroves (ii) lunar cycle of collection of fish, crabs and shrimp larvae, (iii) creation of temporary ponds on river bank to collect dead wood/debris from mangrove forests in tidal flows, a labour intensive but ecologically efficient way of meeting fuel needs. Coexisting with these good practices are unsound practices like burning fecal pellets of goat, dung of cattle (in the form of cake) and coconut shells ; the resource can be better used as manure.

Challenge for adaptive management

Forests are widely harnessed to enhance local livelihoods and resilience to natural hazards in coastal areas. In mangrove areas, local people believe that reforestation will help improve the marine habitat hence fish catch. They also regard that the presence of thick mangrove cover provides them shelterbelt against the impact of storm surge. Owing to continuous planting activity of the local community, mangrove cover in the study site of the Philippines has improved as seen in the expansion of dense mature and intermediate plantations (Figure 16 and Table 3). Nevertheless, it is necessary to revisit national policies that totally ban mangrove cutting since they work in conflict with lower-level policies that allow limited harvesting for local communities with tenure instruments and discourage local communities in mangrove planting and conservation. The interest of local stakeholders whose livelihoods depend mainly on mangroves should be taken into consideration. Mangrove management plans should consider re-zoning coastal areas that will be intended for setting aside the lots for wood utilization, the carbon offset, tourism, and strict protection of biodiversity. The current mangrove planting does not give high regards on biodiversity since plantations are purely monoculture while afforestation areas are encroaching healthy seagrass beds where diverse marine organisms depend.

One of the major causes of mangrove depletion in the Ayeyawady Delta, Myanmar is change of mangrove areas to other land use systems. It is urgent to formulate a proper land use planning in the delta. To date, a suitable land use policy has yet to be promulgated. This made a big concern among the villagers in terms of sustainability of community plantation for long

term, 30 year land tenure right is permitted in Community Forestry Instruction (CFI) though. Forestry, agriculture and fishery sectors are highly competitive in land use. Many controversial issues still linger in implementation of CF in the delta. Therefore, a clear land-use plan and management system should be developed with the collaboration of multi stakeholders who are involving in the socioeconomic development programs for the people living in the Ayeyawady Delta of Myanmar.

Land use ordinance is not adequate to regulate cutting of old Fukugi trees in Okinawa. The current stipulations regarding total or partial cutting are vague. Private ownership of woodlands is considered the major limitation to restrict old trees cutting. Local residents and local officials are not fully aware of multiple values of Fukugi tree strips in windbreak, shading and cultural values. Without any scientific research, the collapse of stone fences side by side of Fukugi trees was attributed to the old tree root growth, and the old Fukugi trees are susceptible to typhoon damage.

3.1. The Philippines

3.1.1. Policy review on mangroves

The country's mangrove resources continue to decline despite numerous laws protecting it. A century before, the country had an estimated 400,000 ha of mangrove forests. At present, only around 154,000 ha remain.

A policy review has been conducted basically looking at the policy situation of mangroves in the Philippines.

Majority of the mangrove studies in the Philippines have dealt on restoration and rehabilitation of mangrove areas, productivity assessment of mangrove forests, economic value of mangrove goods, and assessment of key ecological services such as carbon sequestration. The critical discussions as far as the management of dwindling mangrove cover is concern are: 1) need to revert aquaculture ponds to mangrove forests; 2) conscious rehabilitation of mangrove areas by taking into consideration site-species suitability of reforestation species; 3) improvement of tenure system by allowing harvesting in plantations established by local communities; 4) proper economic valuation of mangrove goods and services for better appreciation of mangrove ecosystems; and 5) capacitating local stakeholders to become better managers of coastal resources. Indeed, policies are needed to address such issues and thereby pursue sustainable mangrove management.

Apparently, several research gaps were also raised in the papers reviewed. One is the need to further assess the ecological impacts of small-scale cutting the biodiversity and health of natural mangroves. Such assessment will capture the appropriate stand management techniques in order to sustain healthy mangrove cover. Secondly, there are limited studies concerning the profitability and marketability of mangrove goods and services hence many of these resources are undervalued. Third, impacts of tenure system on local communities needs a further look upon the realization that many disturbed mangrove sites are situated in areas where local rights are not properly in place. Lastly, there were not much studies on the drivers of mangrove deforestation. Ridge-to-reef assessments are needed to capture the likely impacts of upland forest activities on mangroves and other coastal ecosystems.

There are some constraints which inhibit the communities, private individuals and even the government in promoting the development of the mangroves. Specifically important is Republic **Act No. 7161** which is an Act amending **Sections 70, 71 and 72 of PD 705** (The Revised Forestry Code of the Philippines). **Section 4** of this Act provides the cutting ban for all mangrove species specifically for firewood purposes. This provision has been strictly interpreted to mean prohibition of cutting of all mangrove timber species for all purposes, even in mangrove plantations established with the use of private funds. This discourages the planting of mangroves through private and community initiatives because the planters would have no right to harvest what they planted. The government provides many incentives to Community-Based Forest Management (CBFM) participants in its uplands sites such as security of tenure and exemption from forest charges for planted forest crops. However, mangrove CBFM participants and other forest developers cannot avail of these. Because of prohibitions of RA 7161. Likewise, more mangrove areas have been included in the system of Protected Areas in the Philippines through RA 7586 (Integrated Protected Area System ACT, 1992). This is another Law that effectively outlawed the cutting of mangroves in the country.

The various studies conducted underscored the need to revisit national policies that totally ban mangrove cutting since they work in conflict with lower-level policies that allow limited harvesting for local communities with tenure instruments. This should take into consideration the interest of local stakeholders whose livelihoods depend mainly on mangroves, hence focusing on how social, economic and environmental benefits of mangrove can be harmonized. Further, there is a need to come up with policies or guidelines for suitable and sustainable mangrove rehabilitation strategies in order to revive the essential functions of mangrove forests.

3.1.2. Policy consultation on community-based mangrove management

This section summarizes the results of consultations with various mangrove stakeholders and managers on the impacts and implications of mangroves policies as far pursuing sustainable and equitable conservation and use of mangrove resources is concern. It also captured the varying perspectives on the proposed law in the Philippine Congress entitled *National Mangrove Conservation and Rehabilitation Act of 2010*. Below are the highlights of the policy consultation meetings:

The results of policy consultations are summarized in **Annex 2**. There were varying perspectives and concerns on the current and proposed mangrove policies on community-based mangrove management that transpired. These can be summarized into the following:

1. While the proposed bill generally aims to establish mangrove reservations, it is important to take note that many of our mangrove sites today are already under CBFM program through which local communities (represented by POs) have access and utilization rights over the mangrove trees they planted (according to EO 263 and DAO 1998-10). Totally depriving them of their already limited utilization rights will surely forgo the opportunities to further bolster their commitment and participation in the protection and conservation of our remaining mangrove forests. While it is understood that there is a current law that totally prohibits mangrove cutting (through RA 7161), it is however impossible to undo CBFM.

2. Recognizing that passing this bill (*National Mangrove Conservation and Rehabilitation Act of 2010*.) at its current form may create serious tenurial management rights overlaps, hence a question on *how will the designation of mangrove reservation areas complement those that are already under CBFM program? Will CBFM sites be exempted from this proposed bill?* where raised.
3. 'Preservation' or 'Conservation'? The concept of 'mangrove preservation' is not clearly defined in the bill, although the tone on how it was drafted is to pursue ecological development through strict protection and rehabilitation. In Section 2, 'sustainable development of the mangrove forests' was mentioned as its major goal. Unfortunately, this cannot be fully achieved through strict protection and rehabilitation efforts alone. There must be mechanisms/provisions for creating economic benefits (especially non-wood goods and services) and thereafter fair / equitable distribution of these benefits among stakeholders. Perhaps, 'conservation' is a more appropriate term as this implies conscious management of mangrove resources, by taking into consideration the requisite of meeting people's basic needs, forest protection and production, as well as careful rehabilitation/restoration through site-species suitability matching that will favor biodiversity and sustain other ecosystem services.

Overall, there are foreseen and unforeseen issues if the proposed *National Mangrove Conservation and Rehabilitation Act of 2010* will be passed as its current form. Participants of the policy consultations recognized that local communities will be negatively affected by the 'strictly no cutting' policy(s) hence they have indicated the need to: 1) conduct in-depth reviews of the existing policies coupled with case studies; 2) organize a national mangrove policy forum that will help stage discussion on how the needs and interests of mangrove stewards and governing institutions can be best harmonized into policy(s).

3.1.3 Case Study on Vulnerable Coastal Communities

3.1.3.1 Bohol Case Study

1. Background Information

Banacon Island was selected as a case for this study. It is one of the small islands in northern Bohol which covers about 660 ha. Lying between 10° 03' 30" to 10° 15' 30" N latitude and 124° 03' 30 – 124° 14' 30" E longitude, it forms part of the Sulu Sulawesi Seascape and showcases the largest man-managed mangrove plantation in Asia. Historical records show that the island was used to be devoid of forest in the early 1950s. With this dire economic condition and insufficient source of fuelwood and pole to repair their houses, boats and pens, the local community was then compelled to plant mangroves. This reforestation initiative began in 1957 when a local resident named Mr. Eugenio Paden developed an effective way of raising *Rhizophora stylosa* plantations along sand bars and idle mudflats (Melana *et al.* nd). At present, mangroves of Banacon Island amassed to about 500 ha, covering almost the entire island. The plantations are divided into blocks, which is also the basis of identifying ownership. Their success story has been well-recognized such that they were given the "Likas Yaman Award" of the DENR in 1981 for their exemplary performance in coastal reforestation. In 1991, they also received the prestigious "Outstanding Tree Farmer Award" from the Food and

Agriculture Organization (FAO).

As of 2003, there were 260 households, distributed among 7 sitios. The average income is PHP2,500/month/family. Being an island-barangay, the main source of livelihood is fishing using mostly motorized and non-motorized bancas. The fishing methods most commonly used are crab net/pot, drift gill net, fish pot, and fish corral. The use of beach seine and baby trawl is illegal, as provided by Presidential Decree 704 (Fisheries Code) and Republic Act 8550. Banacon abounds in marine resources such as different varieties of crabs, shrimps, shells, and fish, as well as mangrove resources. It was declared a wilderness area by virtue of Presidential Proclamation No. 2151 dated December 20, 1981, and a marine sanctuary in 2004.

Sari-sari stores (vending stores) and restaurants are the main business establishments on the island. The people mostly depend on rainwater for their water supply, but usually get potable or drinking water from the nearby barangay of Jandayan Island, and purified water from stores. Communication facilities include television, transistor radio, and cellphones. Power is provided through generator sets. For recreation, the barangay has a basketball court and a children's playground. The elementary school on the island has two (2) buildings, six (6) classrooms and six (6) teachers. A total of 244 pupils were enrolled in 2004. The major religions are Roman Catholic and Born-Again Christians. The health needs of the community are served mainly by a Barangay Health Center, which has health workers and a midwife.

Seizing the opportunity to bolster local efforts, the government (through the Department of Environment and Natural Resources or DENR) has installed Community-based Forest Management Program Agreement (CBFMA) in 2004. CBFMA is a stewardship agreement between the DENR and local community (represented by their People's Organization known as Banacon Fisherfolks and Mangrove Planters Association or BAFMAPA) that aims to empower local communities in managing state-owned mangroves. This tenure program has bestowed BAFMAPA with rights to utilize mangrove plantations for domestic and non-commercial purposes. Further, CBFMA provides financial and technical support for livelihood development that will promote forest protection and responsible utilization of mangrove resources.

Notwithstanding these progressive paces, the major problems confronting the community in Banacon Island are illegal fishing that has resulted in low fish catch; illegal drugs; potable drinking water; and unemployment. Illegal cutting also emerged as a subtle problem today. Few local residents have started cutting trees and sell them in the nearby towns of Bohol. The limited progress of CBFMA in creating alternative livelihoods (eg. ecotourism enterprise) has also contributed to continuous severing of the half century old plantations. By law, commercial utilization of all mangrove trees is strictly prohibited by the virtue of Republic Act 7586 also known as the National Integrated Protected Areas System Act (NIPAS of 1992) and Republic Act 7161 or Act of Incorporating Certain Sections of the National Revenue Code of 1977.

2. Survey Results

a. On the Sustainability of Mangrove Management

Criterion 1: Enabling condition for the sustainable management of mangrove Forest

The enabling conditions for SFM to materialize can be summarized into existence of policies, plans, and programs that will impose regulations on mangrove management and use; securing tenure rights; and improving capacities of the officers and members of the People's Organization in – BAFMAPA, to manage their mangrove plantations. In terms of policies, the existence of two major laws, namely, Republic Act 7161 or *Act of Incorporating Certain Sections of the National Revenue Code* in 1991, and Republic Act 7586 or *National Integrated Protected Areas System Act* (NIPAS) of 1992 was regarded by the DENR as an important platform for crafting its department-level policies (i.e., *Department Administrative Order* or DAO) to strengthen regulations on mangrove cutting. Some of these specific policies include:

- **DAO 76 (1987):** Establishment of buffer zones, 50 m fronting seas and oceans, and 20 m along riverbanks; Fishpond Lease Agreement (FLA) ponds required to plant 50 m mangrove strip;
- **DAO 34 (1987):** Guidelines on Environmental Clearance Certificate (applied to fishponds);
- **DAO 123 (1989):** Award of 25-year Community Forestry Management Agreement for small scale mangrove use, *Rhizophora* and *Nypa* plantation, and aquasilviculture;
- **DAO 15 (1990):** Policies on communal forest plantations; tenure through Mangrove Stewardship Contracts; revert abandoned ponds to forest; ban cutting of trees in FLA areas; prohibit conversion of thickly vegetative areas;
- **DAO 3 (1991):** Policies and guidelines for mangrove stewardship agreement; and
- **DAO 10 (1998):** Guidelines on the establishment and management of Community-based Forest Management (CBFM) Project within mangrove areas.

In terms of tenure security, the Executive Order 263 or *Community-based Forest management as the National Strategy to Ensure the Sustainable Development of the Country's Forestlands and Providing Mechanisms for Its Implementation* and DAO 10 (1998) or *Guidelines on the Establishment and management of CBFM Projects with Mangrove Areas* have provided the opportunities for BAFMAPA to gain legal access, management, and utilization rights (to some extent, that is, for domestic or subsistence purpose) over mangrove forests.

BAFMAPA also formed its own policies regarding mangrove management. Basically, these policies reflect their roles and responsibilities as CBFMA participants such as participation in PO meetings, mangrove planting and forest protection, and participating in trainings and seminars. Moreover, they are also deputized by the DENR to apprehend perpetrators of illegal cutting in the area. So far, there has been only one case of illegal cutting and selling in the island that was brought to criminal court.

In terms of SFM plans, BAFMAPA still awaits for DENR's approval of their Community Resource Management Framework (CRMF). This framework (expressed in a form of plan or

document) stipulates their harvesting and replanting plans. The approval process however takes a very long time since it was submitted to DENR in 2011 for review and approval. This problem is being reflected by the divided views of DENR officials on policies that ban cutting in all mangrove forests (RA 7586 and 7161) vis-à-vis policy that allows harvesting (DAO 10 in 1998). According to Camacho *et al.* (2011) and Yao (2001), there is not much hope for BAFMAPA to have its CRMF to be approved soon since there is no move to revise RA 7161 that could put an exemption on planted mangroves. But once it is approved, Banacon Island will be the first in the history of CBFMA that will have its commercial mangrove utilization.

Both DENR and BAFMAPA regarded capacity building as important mechanism to equip local community with technical forestry skills (e.g., inventory, forest patrol, silviculture, reforestation planning, etc.) in mangrove management. However, DENR lack regular fund for this kind of skills upgrading hence they relied on other institutions such as international aid agencies (e.g., US Agency for International Development or USAID and World bank) for collaboration. Training local community members was deemed advantageous to compensate the shortage in the technical workforce that will assist BAFMAPA in its forest management work. Currently, there are only two DENR foresters who are in-charge of five protected areas in northern Bohol, of which Banacon Island belongs.

Criterion 2: Extent and condition

Based on the landuse change analysis conducted by Gevana *et al.* (2015), mangrove cover in Banacon Island has improved as seen in the expansion of dense mature and intermediate plantations which can be owed to continuous planting activity of the local community (Figure 16 and Table 3). On the average, the area covered by dense plantations has increased from 147 to 285 ha after a decade. Zoning of mangrove stands was also done for better protected area management. As per DENR description, the protective zone includes natural mangroves, seagrass meadows, and reef banks while the productive or multiple-use zone covers mangrove plantations and seaweed farms (Yao 2001).

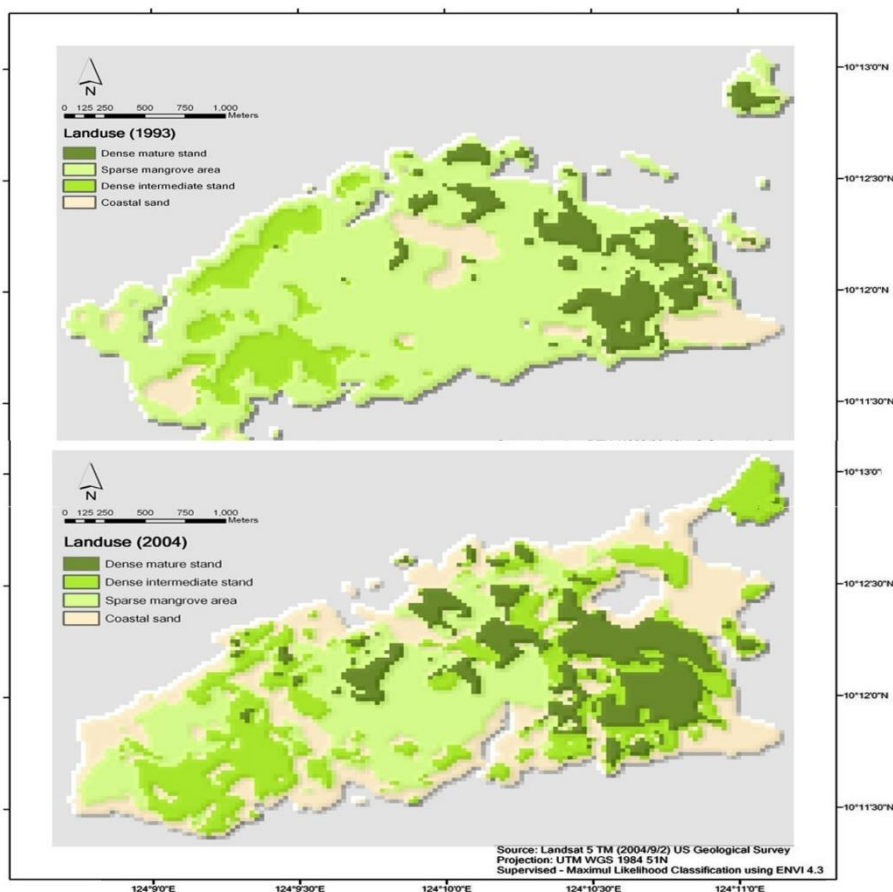


Figure 16. Forest landuse change in Banacon Island, Philippines between 1993 and 2004 (Gevana *et al.* 2015)

Table 3. Forest landuse distribution in Banacon Island, Philippines 1993 and 2004 (Gevana *et al.* 2015).

Landuse	Area (ha)	
	Y1993	Y2004
Dense mature stand	80.0	113.0
Dense intermediate	66.5	172.0
Sparse mangrove area	393.2	173.9
Coastal sand	56.7	203.4
Sea	952.0	886.2
Total	1548.5	1548.5

Criterion 3: Ecosystem health

Deforestation in Banacon Island was mainly anthropogenic. Findings in Gevana *et al.* (2015) showed that the cutting for poles and fuelwood were the major causes of cover loss. By estimate, there was at least 120 trees month⁻¹ being harvested in dense mature stand for seaweed poles, house construction posts, and fuelwood. This contributes to 1.6 ha yr⁻¹ denudation in the area.

In dense intermediate stands, fuelwood harvesting contributed to about 156 trees yr⁻¹ loss or 3 ha yr⁻¹ deforestation rate. Young trees are also being cut for seaweed fences with a rate of 200 trees household⁻¹ yr⁻¹. Despite its significance, mangrove planting has exceeded the area

loss with a net change of 7.5 ha yr⁻¹. Thus with more cover being added, larger carbon stocks are stored; and habitat and population of marine organisms are likewise improved.

Criterion 4: Forest production

Despite that mangrove plantations are continuously expanding and commercial thinning opportunities (i.e., thinning and selling trees for poles and fuelwood) suggest beneficial opportunities for the local community today, the absence of utilization rights (through CRMF) however prevents BAFMAPA to realize the economic benefits from mangrove wood. Furthermore, there has been limited effort in the part of BAFMAPA and DENR to conduct inventory on their stands thus making it difficult for them to plan out the harvesting and replanting targets in the future. With these limitations, it is therefore timely for DENR to seek feasible options to effectively manage mangroves and create rewards for local community for their toils in tending them. As this study proposed, a carbon offset project could be good option since their mangrove has the capacity to store 435 tC ha⁻¹ (Gevana 2014). Forest production plans should therefore consider re-zoning the areas that will be intended for the carbon offset project; and setting aside the lots for wood utilization, tourism, and strict protection as well.

Criterion 5: Biological diversity

Apparently, the current mangrove planting in the island does not give high regards on biodiversity since plantations are purely monoculture while afforestation areas are encroaching healthy seagrass beds where diverse marine organisms depend. Reiterating the need to designate productive and protective zones, the DENR and BAFMAPA should strategize their afforestation and reforestation target by diversifying the species in rehabilitating natural mangrove stands or protected zone and restricting monoculture plantations over logged-over plantation gaps. While there is now an increasing interest from private agencies to fund plantation projects in the area, it is also important to properly allocate plantation development areas on suitable sites to avoid habitat degradation.

Criterion 6: Coastal resource protection

Coastal resources protection is a shared responsibility of the DENR, Bureau of Fisheries and Aquatic Resources (DA-BFAR), local government units (from provincial to barangay), and BAFMAPA. This mandate largely includes sea patrolling and apprehending illegal fishing and mangrove cutting activities in marine protected areas. Some of the major policies on coastal management include RA 7586 which declared Banacon Island as a marine protected area; RA 7160 or *the Local Government Code* which decentralized some management roles of DA-BFAR and DENR to local government units; and RA 8550 or *The Fisheries Code* which provides a framework for the development, management, and conservation of the country's coastal fisheries (Congress of the Philippines n.d.). The latter also reaffirms the mandate of municipal and city governments over municipal waters and their important roles in enforcing fishery laws and managing coastal resources.

Began in 1998, the Coastal Resource Management Project (CRMP) was implemented by the DENR and DA-BFAR through the help of USAID. This project provided technical assistance and training to local government units, coastal communities, and non-government organizations in Bohol in terms of coastal planning and management.

Criterion 7: Social, cultural and economic aspect

CBFMA appears to be the only mechanism promoting equitable access to mangrove goods and services among BAFMAPA members and the local community. This tenure regime provides them rights to own and manage the mangroves they planted and continuously enjoy the benefits therein (e.g., income from fish, crab and shrimp catches, healthy seaweed farms, and wood for domestic subsistence). Moreover, CBFMA was regarded essential in sustaining their planting tradition of which they are really proud of.

Mangrove planting also provides few and occasional income benefits to local community. For instance, the current mangrove planting project funded by the Kanepackage Philippines Inc. (KPG) which started in late 2011 gives PhP 0.50 for every propagule planted in the field. This project targeted 200 ha of *R. stylosa* plantations by 2014. By estimate, the local community earns USD 465 ha⁻¹ from this project.

b. Awareness on Climate Variability and Climate Change

The occurrence of two recent strong storm events, Typhoon *Haiyan* (2013) and *Seniang* (2014) causing major disasters in lives and properties of the local community was underscored as a major evidence of climate change. Coastal communities are exposed to the risk of storm surge and coastal erosion hence the local community believe that keeping a good mangrove cover is vital to counter impacts.

1. On the average, from the range of 1-5 with 5 as the highest and 0 as totally not aware, the rate of awareness of key informants with the **term climate variability** was 3.57 while for members and non-member respondents were 3.76 and 3.41, respectively. The climate variability events that had been experienced by the community according to the respondents include: El Niño; La Niña; too much heat during summer; unpredictable weather condition; long rainy days/heavy rains; abnormal high tide, sea water going inside houses not like before; occurrence of more often typhoon, earthquake. Almost all of the respondents learned this term through the mass media and some from friends, family, school, and through personal observation.

2. The rate of awareness of key informants on the term **climate extreme** was 3.56 while for member and non-member respondents were 3.69 and 2.76, respectively. The climate extreme events that had been experienced according to most of the respondents include the following: prolonged/continuous rain (3-7days); La Niña; drought/ long dry season; very cold condition at night; extreme heat/ hotter/warmer condition during summer; much stronger typhoon/ earthquake; and, unpredictable weather condition. All other respondents don't know, not familiar or even said have not experienced any. The sources of information of the respondents were mostly from the mass media. Some came from local officials, friends, family, school, DENR, NGO and personal experiences.

3. The rate of awareness of the key informant respondents on **climate change/ global warming** was 3.65 while those of the member and non-member respondents were 3.31 and 3.10, respectively. As indicated by most of the respondents, most of the climate change events they experienced were: sudden change of weather condition/ unpredictable weather

condition; prolonged rain/ unpredictable rain; too much heat/ hot weather; colder nights; more typhoons/ extreme weather condition/ strong storm; not normal high tide causing inundation of some areas; and, long drought. The other respondents don't know, not familiar or have no answer. The sources of information of all the respondents were mostly from the mass media and some from school, friends, local officials, NGO, and DENR.

4. The rate of awareness of the key informant respondents on **greenhouse effect** was 3.19 while those of the member and non-member respondents were 1.34 and 1.21, respectively. Most of the respondents from the key informants, members and non-members were not able to identify, don't know or have no idea of the process involved on greenhouse effect. However, 31%, 28% and 28% of the KI, member and non-member respondents, respectively described the process involved as: carbon dioxide within ozone layer bounced back to earth which cause high temperature; open fire/"kaingin" burning result to high CFC, trapped and bounced back to earth causing hot temperature; carbon dioxide produced from CFC; too much carbon dioxide in the air results to high temperature. The source of information according to the respondents was mostly from the mass media. Other sources were from friends and local officials. Some of the respondents were not able to give answers to the sources of information related to greenhouse effect.

5. Evidential effects of climate change in your area. Seventy five percent of the key informants, almost all of the member respondents and all of the respondents identified one or more of the following as evidential effects of climate change in their community: too much heat/ very warm condition during summer; sudden heavy rain and thunderstorm/ unpredictable rain; too much cold at night; sea water rises/ abnormal high tide; unpredictable weather condition; storms/typhoons more often and stronger; decrease in fish catch; and, heavier/ prolonged/ continuous rain/ greater volume of water; Twenty- percent of the key informants and three percent of the member respondents and none of the non-member respondents have no idea or don't know of any.

6. Reasons for climate change/ global warming. Thirteen percent of the key informants, sixty nine percent of the member respondents and 86 % of the non-member respondents identified one or more of the following as reasons for climate change: illegal activities like burning of garbage and plastic/ open fire; improper waste disposal/ throwing of garbage anywhere; deforestation/ massive cutting of mangroves/ illegal cutting of trees; pollution; illegal fishing; industrialization/ smoke from factories; temperature imbalance due to decrease forest area; not enough trees; destruction of ozone layer; overpopulation; carelessness and hard-headedness of people; increased in motor vehicle use; too much use of CFC and plastic; and, use of body spray and spray net. The remaining respondents don't know of any reasons why there is climate change.

7. Mitigation measures to address climate change. Sixty-nine percent of the key informants, 100% of member respondents and 97% of non-member respondents associate one or more of the following as mitigation measures to address climate change: reforestation/ massive tree planting/ plant trees; solid waste management/ proper waste disposal/ segregation; strict law enforcement/ implementation of environmental protection laws; IEC/ educate people on climate change; sustainable development and full support to clean and green projects; stop burning/ adapt RA 9003/ no burning of plastics and garbage; stop illegal fishing; no cutting; forest protection and conservation; control factories and proper compliance of policies related

to industries; population control; and, minimize use of products that contain CFC. Thirty-one percent of the KI respondents and three percent of the non-member respondents said, there are no mitigating measures or simply don't know.

8. Adaptation measures to address climate change. The key-informants (81%), PO member respondents (97%) and non-member respondents (93%) identified one or more of the following as adaptation measures to address climate change: plant plenty of trees/tree planting program; IEC/proper orientation about climate change; involvement in clean and green projects; prepare for unpredictable weather condition; proper waste disposal and segregation; no burning of garbage; use of electric fan rather than an air-conditioning unit; and, building of stronger houses/shelter, among others. Nineteen percent of the key informants and three percent of the PO member respondents and seven percent of the non-member respondents said there are none or don't know of any adaptation measures to address climate change.

9. Policies and programs on climate mitigation and adaptation. Most of the key informants (63%), PO members (86%) and non-member respondents (72%) identified one or more policies and programs on climate mitigation and adaptation. These are as follows: mangrove tree planting program; clean and green project; no to illegal fishing; no cutting of mangroves; disaster preparedness program; no to illegal fishing; and other specific policies and regulations stated in various laws such as EO 26, RA 7586, Ra 7161, RA 9147, and NIPAS Act. The remaining respondents have no answer or don't know of any policies or programs on climate mitigation and adaptation.

10. Implementers of the policies and programs. Almost all of the respondents listed one or more of the following as major actors implementing policies and programs on climate mitigation and adaptation: government; DENR; community; LGU; barangay officials/ Barangay LGU; PO-BAFMAPA/ PO officials and members; private sector (KANEPACKAGE); students; Department of Agriculture, Bureau of Fisheries and Aquatic Resources, and Department of Education.

3.1.3.2 Palawan Case Study

1. Background Information

Barangay Kamuning is one of the four project sites of the STAGBAK-Mangrove Rehabilitation Subproject funded by the Japan Bank for International Cooperation and implemented in Puerto Princesa City, from 2001 to 2003. STAGBAK represents the four subprojects sites in the barangays of Sta Lourdes, Tagbueros, Bacungan, and Kamuning, all in Puerto Princesa City. Brgy. Kamuning is 65 km from the city proper and is accessible by land transportation. In 2003, the barangay population was 1,341 composed of 705 males and 636 females. Available facilities in the barangay include a chapel, daycare center, health center, and postal services. Water in the barangay is sourced from pumps, deep and open wells. Electricity is provided by the Palawan Electric Cooperative (PALECO). The main economic activities include fishing and farming.

The Mangrove Rehabilitation Project in Brgy. Kamuning started on June 29, 2000 with the awarding of contract to the Kamuning Coastal Residents Development Association, Inc. (KCRDAI) to start Comprehensive Site Development (CSD) in connection with STAGBAK-Mangrove Rehabilitation Subproject. Under the tree plantation component, 1,010.81 hectares were planted while 715.84 ha were subjected to enrichment planting. The species planted were *bakauan babae*, *bakauan bato*, and *bakauan lalaki*.

KCRDAI, a SEC registered non-stock and non-profit organization started out with 178 members in 2000. But as of 2003, membership has decreased to 90. It is the policy of KCRDAI that if a member incurs three absences in the general assembly, he/she can be expelled. Most members participated in the project activities which included livelihood, training, mangrove reforestation, and enrichment planting. The PO members were divided into working groups to facilitate the accomplishment of assigned tasks.

2. Survey Results

a. Sustainable Mangrove Management

Criterion 1: Enabling condition for the sustainable management of mangrove Forest

National policies that discourages mangrove cutting was regarded as a key facilitating factor in the conservation of old growth stands in Kamuning, Palawan. Furthermore, the creation of a multi-sectoral agency called the *Palawan Council for Sustainable Development (PCSD)* in 1992 was instrumental in effectuating mangrove-related regulations. This agency is composed of various governmental and non-governmental organization whose aim is to put forward natural resource conservation in the whole province. One of PCSD's landmark policies that are related to mangrove is the *Administrative Order No. 11, series of 2006* (Rules and Regulations Governing the Conservation and Protection of Mangrove Areas) which stipulates the strict regulatory access and use of mangrove areas in terms of aquaculture and tanbark production (for textile dyeing). Furthermore, mangrove reforestation is one of the major projects of this agency aside from continuous forest protection activities.

The presence of a local People's Organization known as *Kamuning Coastal Residence Development Association, Inc.* (KCRDAI) was also viewed helpful in ensuring the protection of old growth stands. Members of this organization are regarded of coastal vanguards. They report illegal activities (illegal cutting, occupancy and fishing) to DENR and PCSD, and cooperate in mangrove planting activities particularly during the celebration of *Love Affair with Nature* and Pistang Kagueban, which is an annual environmental festivity of the Puerto Princesa City.

With high regards to the value of natural mangroves, the local community particularly the major tribe of *Tagbanua* avoids cutting trees, and instead they only harvest dead trees to meet their domestic need for charcoal and fuelwood. They believe that keeping the mangroves green will give them more fish to harvest.

Criterion 2: Extent and condition

Mangrove cover was found increasing from around 39,131.6 ha in 1993 to 49,107.1 ha in 2004 (Figure 17). The respondents had attributed this increase from the continuous reforestation and forest protection activities in both coastal and landward forestlands. However, a considerable decrease of about 8,500 ha was observed between the period of 2004 and 2015. The respondents indicated that the largest portion of deforestation was due to the recent devastation brought by *Typhoon Haiyan*, a category 5 storm that ravaged Palawan and nearby islands in November of 2013.

In terms of other landuses, agriculture and built-up areas were also found to have slightly increased through time. Portions by which these landuses have occupied are forestlands that are open and eventually converted to production areas.

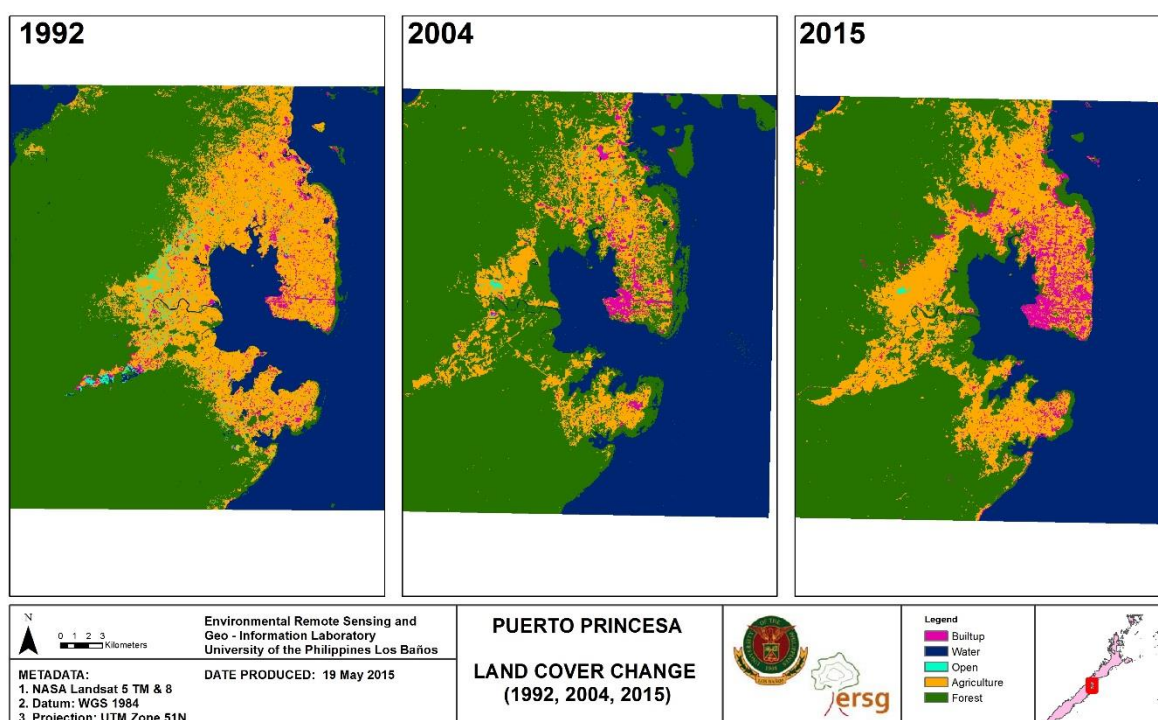


Figure 17. Landuse change in Kamuning, Palawan based on 1992, 2004 and 2015 data.

Table 4. Landuse distribution in Kamuning, Palawan based on 1992, 2004 and 2015.

Landuse	Area (ha)		
	Y1992	Y2004	Y2015
Agriculture	15635.9	8520.7	13525.1
Builtup	1433.9	1085.3	2692.8
Forest	39131.6	49107.1	40597.9
Water	33074.1	31195.8	33068.2
Open	724.6	91.2	26.0

Criterion 3: Ecosystem health

The lush and verdant mangrove cover of Kamuning depicts its stability to provide local communities with various ecosystem services particularly in terms of fisheries. According to Carandang *et al.* (2012), mangrove forest of Kamuning has a direct use value of USD 580 million per year, of which fisheries accounts to 87%.

Another indicator of a good mangrove health is the absence of major pest and diseases such as barnacles and blight. The respondents associated the clean coastal water and diversified species composition as the main contributing factors to ecosystem stability.

Criterion 4: Forest production

Kamuning mangroves contains an aboveground tree biomass of around 652 t ha⁻¹, a value that is equal to 293 t ha⁻¹ of carbon stock (AKECOP 2011). Donato *et al.* (2011) believed that mangrove soil has thrice the amount stock with that of the aboveground pool. This therefore provide huge economic opportunity to create incentives for the local community in conserving these stands, through a carbon offset project such as REDD.

Criterion 5: Biological diversity

In terms of vegetation, few tree species dominate the mangrove stand. These are *Rhizophora mucronata*, *Rhizophora apiculate*, *Ceriops tagal* and *Sonneratia alba*. Healthy mangrove habitats are home to the endemic wildlife such as the Palawan monitor lizard (*Varanus palawanensis*), salt-water crocodile (*Crocodylus porosus*), Philippine long-tailed macaque (*Macaca fascicularis philippensis*), crested serpent eagle (*Spilornis cheela*), among others. The respondents believe that wildlife population have started to decrease through time due to the increase in built-up areas which somehow disturb the nesting sites of these wildlife.

In order to protect the remaining wildlife, the local government has established the Palawan Wildlife Rescue Center. This agency is tasked to apprehend illegal wildlife trades, and conducts captive breeding for endemic wildlife species.

Criterion 6: Coastal resource protection

The local community recognized the need for continuous reforestation to help rebuild the coastal areas that were eroded during the event of *Typhoon Haiyan*. They believe that revegetating those damaged site will help improve the marine habitat hence fish catch. They also regard that the presence of thick mangrove cover provides them shelterbelt against the impact of storm surge.

Criterion 7: Social, cultural and economic aspect

Fisheries is the major livelihood. These include fishing, mollusc catching, fishpond production, and shrimp farming. Nipa (*Nypa fruticans*) thatching is also a major cottage-based industry for some of the local residents. All of these are just some of the direct benefits that members of KCRDAI enjoys being the participants of CBFM.

The cultural minority of *Tagbanua* represents the large portion of KCRDAI membership. Through CBFM, members enjoy access, utilization and management rights over the upland and coastal forest resources that were devolved to them for sustainable management. They regard CBFM as an important platform that will further elevate their level of ownership from that of being limited stewards (since CBFM tenure is only good for 25 years, and renewable for another term) to that of exclusive and perpetual owners of upland and coastal forests. This is through the Certificate of Ancestral Domain Claim (CADC) program of the government.

However, there is a need for more thorough discussions and consultations regarding this move since there are also non-*Tagbanuas* who are important stakeholders of the coastal resources.

Results of the interview revealed various perceptions on the socio-economic and cultural aspects of community-based mangrove management. These were:

1. Local livelihoods that utilize mangrove resources. Fifty percent of the key informants and 86% of the non-member respondents said there are local livelihoods that utilize mangrove resources. These are charcoal making using dead and fallen tree; fishing; gathering of crabs, shrimps and shells; making of nipa shingles in some areas; gathering of “tamilok”, and, collection of propagules and bakawan barks (dried as tanbarks).

2. Markets for mangrove products. The markets for mangrove products as indicated by 60% of the key informants and 71% of the non-member respondents are the community/ local buyers and quality products are transported and sold in Puerto Princesa City proper.

3. Policies and programs that help promote traditional knowledge systems. According to 53% of the key informants and 71 % of the non-member respondents, there are no policies and programs that help promote traditional knowledge systems. The remaining others said there are but, did not specify the policies.

4. Conflict resolution mechanisms. As indicated by 87% of the key informants and 86% of the non-member respondents, there are no existing mechanisms to resolve conflicts within the community, and with the government as far as mangrove management is concern. But according to the remaining respondents, there are some mechanisms that could be resolved through meetings/ barangay assembly and consultations.

5. Major threats to the sustainability of livelihood sources. Sixty seven percent of the key informants enumerated one or more of the following as major threats to sustainability of livelihood sources: illegal fishing, lack of funds/ assistance, cutting of mangroves since there’s no support coming, increase in population, the government policy itself, and intruders who illegally cut mangroves or collect other mangrove resources. Twenty nine percent of the non-member respondents identified either increase in population and cutting of mangrove as major threats. The other respondents said there are no threats or don’t know or have no answer.

6. Effects of increase in population on livelihood. One or more of the following were identified each by the various respondents as major threats on livelihood with the increase in population: many will engage in charcoal making; lead to competition in source of livelihood; increase in violators of laws/policies; there will be road access; and there will be more people, more needs and more pressure on mangrove resources.

b. Awareness on Climate Change

The occurrence of strong storms, prolonged drought, and extremely warm daily temperatures were enumerated as major climate change evidences observed in the study site. Respondents have various levels of awareness and perceptions of these issue.

1. On the average, from 1-5 with 5 as the highest and 0 as totally not aware, the rate of awareness of key informants with the **term climate variability** was 3.07 while for non-member respondents, 3.57. The climate variability events that had been experienced by the community according to the KI respondents include: El Niño/ drought; unpredictable weather condition, extreme heat during summer causing heat stroke/ people getting sick easily; and, potable water getting scarce. The non-member respondents identified one or more of the following as climate variability events that the community had experienced: drought/El Niño, extreme heat during summer, and unpredictable weather condition. The KI respondents learned this term through the mass media and local officials and some from friends, family, school, and through personal observation. Information sources of the non-member respondents are mostly the media, and also from friends and local officials.

2. The rate of awareness of key informants on the term **climate extreme** (prolonged drought, torrential rain, prolonged rain) was 2.93 while for non-member respondents was 2.86. The climate extreme events that had been experienced according to most of the KI respondents include the following: drought, unpredictable weather condition, extreme heat, and high incidence of floods causing death and loss to properties. More than half (57%) of the non-member respondents climate identified El Niño and unpredictable weather condition as the climate extreme events experienced by the community. All other respondents don't know, not familiar or even said have not experienced any. The sources of information of the respondents were mostly from the mass media, local officials, friends, and NGO.

3. The rate of awareness of the key informant respondents on **climate change/ global warming** was 3.2 while that of the non-member respondents was 2.0. As indicated by the key informants, most of the climate change events they experienced were: El Niño and drought; unpredictable weather condition; extreme heat and hotter summer; air pollution caused by smoke belching vehicles and burning of plastics; and, low tide and high tide which are unpredictable sometimes. Almost half of the non-member respondents identified drought and extreme heat during summer as the climate change events they have experienced. The other non-member respondents don't know, not familiar or have no answer. The source of information of key informants was mostly from the mass media and school, some from friends, local officials, NGO, and personal observation. The source of the non-member respondents was mostly from the mass media and sometimes from friends.

4. The rate of awareness of the key informant respondents on **greenhouse effect** was 1.6 while that of the non-member respondents was 0.14. The respondents both from the key informants and non-members were not able to identify the process involved in greenhouse effect. However, one key informant described it as, the ozone layer is covered causing extreme heat and temperature is not good since high. The source of information according to the key informants was mostly from the mass media. Other sources were from friends, local officials and school. The sources of some of the non-member respondents were from the local officials and NGO.

5. Significance of knowing climate change- According to 60 % of the key informants and 29% of the non-member respondents, the significance of climate change is to make them aware and be prepared to react or cope with climate change. Also, twenty percent of the key informants (20%) said, in order to be able to take care of the environment and come up with measures to prevent flood and drought. The last 20% of the key informants and 71% of the

non-member respondents have no answer or don't have any understanding at all of what climate change is all about.

6. Evidential effects of climate change in your area- Eighty percent of the key informants identified one or more of the following as evidential effects of climate change in their community: drought; unpredictable weather condition; extreme temperature and hotter summer; always visited by typhoon; and another important effect is that people become aware. Twenty percent of the key informants said there are no evidential effects or don't know of any. Almost half of the non-member respondents (43%) identified unpredictable weather condition, drought, and plants get damaged as evidential effects of climate change. Fifty-seven percent of the non-member respondents said there are no evidential effects or don't know.

7. Reasons for climate change/ global warming- Sixty-seven percent of the key informants identified one or more of the following as reasons for climate change: denudation of forests/ cutting of trees; industrialization; burning of plastics; man's abusing the environment; population growth; and, overuse of resources. Accordingly, with all of these, man is considered the root cause. More than half of the non-member respondents (57%) identified man's abusing the environment and cutting of trees as their reasons for climate change. The remaining respondents from both the key informants and non-member don't know of any reasons why there is climate change.

8. Mitigation measures to address climate change- Seventy-three percent of the key informants associate one or more of the following as mitigation measures to address climate change: planting more trees as identified by most of the respondents; followed by no burning; and obeying the policies and rules of local government that pertain to the environment. Twenty-seven percent of the KI respondents said, there are no mitigating measures or simply don't know. Fifty-seven percent of the non-member respondents identified one or more of the following mitigating measures: planting more trees, obeying the policies and rules of local government pertaining to the environment; proper garbage disposal; and, use of organic fertilizers and pesticides. Forty-three percent of the non-member respondents said, there are none or don't know of any mitigating measures.

9. Adaptation measures to address climate change- The key-informants (53%) identified one or more of the following as adaptation measures to address climate change: plant trees; plant short rotation varieties; participate in barangay activities related to the environment; and proper information campaign. Likewise, 71 percent of the non-member respondents identified water segregation/proper waste disposal; planting short rotation crops and proper information campaign as adaptation measures to address climate change. Forty-seven percent of the key informants and 29 percent of the non-member respondents said there are none or don't know of any adaptation measures to address climate change.

10. Policies and programs on climate mitigation and adaptation- Most of the key informants (67%) and non-member respondents (86%) believed that there are no policies and programs on climate mitigation and adaptation or don't know of any. However, thirty-three percent of the key informants indicated one or more specific policies such as the following: no burning of plastic and garbage; wastes/ garbage segregation; recycling; and planting of trees. Also, fourteen percent of the non-member respondents indicated the policy on garbage/waste segregation.

11. Implementers of the policies and programs – Most of the key informants (73%) listed one or more of the following as major actors implementing policies and programs on climate mitigation and adaptation: barangay/ government officials (as identified by most); followed by community; LGU; DENR; and, by all. Seventy-one percent of the non-members listed barangay/ government officials; LGU; and community as implementers of these policies and programs. Twenty-seven percent of the key informants and twenty-nine percent of the non-member respondents don't know of any implementers of policies and programs on climate mitigation and adaptation.

3. 2 Myanmar

3.2.1 Relationship between villagers and coastal/mangrove forests

The villagers' daily life in the study area totally depends on the mangrove forest for extraction of fuel wood, catching fish, crab, shrimp, or shells and processing mangrove products for their daily commodities or for market. Even farmers get part of their earnings by fishing or catching fish or prawn, which may account for a major part of their income. Human life in the area is closely linked with the mangroves or mangrove based products.

3.2.1.1 Livelihood activities of Mangrove in Myanmar

Due to increase of population, overexploitation of forest products for the energy consumption and extension of agricultural and aquaculture lands for food security are the key characters of human impacts on the mangrove forests of Myanmar. The Myanmar coastal mangroves are some of the most degraded or destroyed mangrove systems in the Indo-Pacific region. The mangroves have also been overexploited from forestry, agriculture, aquaculture, and development projects. Mangrove forests are subject to severe degradation because there is no clear-cut land-use system. Forestlands have been converted to agriculture and other development activities. If the situation between 1977 and 1986 is maintained, it is estimated that all the mangrove forests will disappear in fifty years (World wildlife, 2001).

One of the objectives of mangrove management in all the regions in Myanmar is biofuel production for domestic and industrial uses. Among the three areas, AYWD Delta is more important as the supplier of biofuels; for in addition to the needs of Ayeyarwady Division, Rangoon's firewood and charcoal requirements, which about 70,000 hoppus tons per year, have also to be supplied from Ayeyarwady Delta (Saw Han, 1992). Projection of woodfuel local consumption and export of the AYWD Delta for 2005 are 4.71 and 1.0 (million ADT). The production is 0.59 million ADT. Therefore, the deficit is estimated to be 4.82 million ADT (Gill, 1992). Rakhine and Tanintharyi mangrove areas are also not an exception in terms of the woodfuel deficit.

Philosophy of self sufficiency in paddy cultivation caused the conversion of the mangrove forests to paddy field without considering feasibility of sustainable landuse. It is heard that even Nipa plantations have been forcedly converted to the paddy fields in line with the philosophy. Moreover, many big companies have recently occupied the mangrove areas for the establishment of shrimp farms, especially Rakhine and Tanintharyi areas. Semi-natural shrimp farming that cause the denudation of mangroves with a great extent has been recently popular in the Delta.

3.2.1.2 Non Timber Forest Products

Most non-timber forest products from mangrove forests in the study area have less demand from local communities compared to the wood products. However, some non-timber forest products are collected and utilized for both domestic and commercial purposes. Compared to other non-timber forest products, Nipa thatches are produced widely throughout the study area. Especially, a commercial production of Nipa thatch is common in Ayeyarwaddy Delta. Because of large-scale production, the Nipa thatch and phoenix poles are currently the only two forest products in the study area, levied for revenue by FD. Other non timber forest products are rather small-scale production and more concentrated to domestic uses.

3.2.1.3 Current Situation of Agricultural Resource Use in the Study Area

According to an agro-ecological zone designated by the land-use division of the Myanmar Agriculture Service, the study area is categorized as the agro-ecological zone “R3S1” (“R3” indicates annual rainfall of above 100 inches (2,540mm) and with two continuous months of dry summer, and “S1” indicates soil of Fluvisols/Gleysols). The agro-ecological zone is normally regarded as poor drainage, low pH, and high salinity areas that are not always favorable for agriculture. However, agriculture is predominant land use in the study area, the dominant agricultural production is monsoon paddy, coconuts, and Nipa palms. Other than these three products, some legume species, oil plants, betel nuts and betel leaves, and bananas are found. Vegetables, fruits, and flowers do not appear in the table because of the small cultivation area and yield, mostly being cultivated in home gardens. Such production is supplemental activities that support marginal villagers’ income and nutrition.

3.2.2 Conservation and Management of Coastal/Mangrove in the Study Area

There are four approaches for conservation and management of coastal/ mangrove forests in the study area. They are as follow:

a. Public Forestry

- Roadside planting
- Coastal belt planting
- Riverbank protection planting
- Planting in communal land

b. Private forestry

- Planting in reserved forest land permitted by Forest Department

c. Community forestry

- Planting in reserved forest land permitted by Forest Department

d. Agro-forestry

- Cash crop planting in home garden traditionally owned by local people
- Planting in farm boundary area
- Silvo-fishery

a. Public Forestry

This approach mostly addresses to the public land that is available for planting trees. Under this approach, planting of roadside, coastal belt, river bank and communal land etc., is entitled. Mostly, this approach focuses on reduction of disaster risk rather than supporting livelihood.

Tree species in particular will be grown for the purposes of wind and wave resistance, amenity and protection of pollution along the motor road. Maintenance, particularly protection from uncontrolled grazing, has to be prioritized to be successful.

Roadside Planting

Roadside planting aims at sustainability of road, which can be used as an evacuation purpose when natural disaster takes place in the delta. Basically, tree species that can resist to wind and wave are planned to grow along the road. In addition, amenity is also included in the selection of species. Native species must be considered in priority of species selection. Exotic species are needed to choose if it is adaptable to site condition. Patching will be made along the old road where trees planted still remain. For new road, planting is conducted with suitable spacing and planting techniques. As uncontrolled grazing is widespread in the delta, care must be given intensively. Fencing for individual tree, raising people awareness, law enforcement and collaboration with Forest Department and local authorities are essential for maintenance of plantation.

Coastal belt planting

By planting of trees along the coastal belt could play a protective role from the destruction of wind and wave caused by storm or Tsunami. As vegetation is sparse or absent along the coast of the delta, vulnerability for natural disaster is found to be quite high. Sand beaches which are narrow and long occupy along the delta. As some parts of the beaches close to inland side are usually higher than neighboring areas, local dwellers usually cultivate paddy in that areas in rainy season. Some part of beach close to the sea is mostly unstable due to coastal erosion and sedimentation. Seasonal fishermen occupy this part for settlement so that they can easy to access their boats for works.

From the legal aspect, these lands in most areas are included in reserved forests. Local people have however invaded for many years for the purpose of livelihood. In fact, forests should be totally protected in these areas for the purpose of disaster risk reduction. As line agencies concern, it is not clear how to cope this situation for reforestation activities that will be done along the coast in post Nargis.

At present, organizations involved in reforestation organize the villagers living along the coast to participate in the reforestation program, with providing any form of subsidies and raising awareness on impact of disaster as well. As an incentive, land user right and subsidies for establishment of plantation can persuade them to take part in the activity. Technically speaking, site factors are so poor that selection of species should be carefully undertaken for the reforestation. Tree Species that will have to be grown on the beach are non-mangrove species because the land is free from tidal inundation. Mangroves can be successfully replanted in the only place where tidal inundation is pretty frequent.

Species in particular which are resistant to desiccation and adaptable for infertile soil must be chosen for planting in Coastal belt. *A. auriculiformis*, *Melaleuca leucadendron*, *E. camadulensis*, *Streblus asper*, *Calophyllum inophyllum*, *Casuarina equisetifolia* and *Pongamia pinnata* were suitable in coastal belt planting. Nargis cyclone proved that these species have not only resistance but also resilience to wind compared to other species, which were planted in the past.

River bank protection planting

A lot of efforts have been made in river bank protection planting in the delta. Field observation shows that planting for this purpose was not substantially successful in endeavor due to some constraints. It is assumed to be lack of integration on engineering and forestry aspects in the course of implementation, especially big river banks like Ayeyarwady, Pyanmalot, Ywe, Bogalay and Pyapon rivers. Along the small creeks, however, it was found to have visible impact of planting. If structures of engineering that can reduce the speed of river or tidal current are done, the cost would be higher than normal planting activities. But, this must be done for successful planting activities for the purpose of disaster risk reduction.

Planting in communal land

This approach is used for the land that belongs to community such as monastery, church, school compound etc. Purposes of planting are to support to some extent need of wood and a protective role of disaster for the community members in case. Usually, availability of land may be limited for villages in this approach. It is intended to grow the following species that are suitable for multiple uses. Non-mangrove and mangrove species are chosen depending on site conditions. As non-mangrove species, *Acacia auriculiformis*, *Eucalyptus camadulensis* and *Melaleuca Leucodandron* are examples of exotic species. As for indigenous species, *Albizzia procera* (Sit or Thit phyu), *Albizzia lebbek* (Kokko) and *Dipterocarpus* species meet the objective of planting in communal land.

Mostly, spacing to be used for this planting is 6 feet by 6 feet. Closer spacing has to be used to accommodate the site factors, if necessary. Management of plantation has to be done in a collective manner, and benefit sharing has to be decided how much individual contributes to the plantation establishment and maintenance.

b. Private forestry

As Forest Department has allowed Myanmar citizens to involve in private forestry, some of the citizens are participating in conservation and reforestation activities in the delta. By means of supporting technical know-how, distribution of seed and seedlings to these people, it could assist recovery of forests in the delta in post Nargis.

Planting on the land permitted by Forest Department

Forest Department is now promoting private forestry sector across the country, including the delta. Some people have been given permission to establish mangrove plantations in the reserved forest areas. As private forestry is just an initiative in the delta, it needs several inputs like technical backstopping, seed and seedlings, management of forest plantation and market opportunities etc. Forest Department only is not able to manage the whole process of private forestry.

Mangrove species share higher percentage in planting. As mangrove plantations are usually aimed at supply of fuelwood, 6 ft by 6 ft are put in spacing. More narrow spacing are used in plantation, depending on site factors and character of species to be grown. If slow growing mangrove species like *Ceriops decandra* (Madama) and *Heritiera fomes* (Kanazo) are intended to plant, spacing should be narrow to get straight pole and to get soil cover in short period.

c. Community Forestry

Community Forestry program in which land use certificates are issued to communities is used in Myanmar. Under the CF program, it can be generally said that two models are being widely used in Myanmar. One is that all the FUG members carry out entire activities of forestry at a communal land through collective action. It means that the land where forest plantations are established belongs to community, and activities are manipulated by management committee elected by all members. Benefit sharing is dependent upon extent of inputs contributed by individual members. Inputs basically imply financial, material and labor contributions to conservation and reforestation activities of CF.

A model in which land belongs to individual members, but all the issues related to CF are handled by management committee elected by all FUG members is being used in some parts of Myanmar. This model has been successful in a certain extent among communities of the delta. In terms of benefit sharing, 80% of net profit from communal plantation goes to individual members as they contributed. 10% out of total income is set aside for forestry works and the remaining 10% is spent for the community development affairs. This is benefit sharing example of ongoing project of FREDACTMANG in Ama-Sub Township, Pyapon Township. The model has been initiated since the project started in 1999.

Theoretically, the former (village model) is likely to be realistic in terms of the nature of community works. However, it is not easy to implement on ground in order to get achievement because intensive monitoring and recording system are highly required for individual contribution and benefit sharing. Experiences show that it works well during the project funded by outsiders, but many challenges remain after project. Capacity building is very crucial in the former model. This model could be fundamentally implemented in some areas where social capital is naturally rich. It would be difficult to conduct in the delta where social cohesiveness is rather weak, especially in reserved forests due to immigration from other areas.

The latter functions well on ground because the FUG members have individual user right on forest resources extracted from the land which has been transferred for 30 years. Monitoring for individual contribution and benefit sharing are not complicated in this system. Labor works for record of inputs can be reduced, to great extent. Many people in the delta have encroached into reserved forest land for years due to socio-economic circumstances. Most of the reserved forest areas have been covered with paddy fields, settlement areas, salt pan, shrimp farms and other land uses. When CF is planned to establish in reserved forests, it is necessary to organize these people to participate in CF.

According to past experience, some of them engaged in CF, with contribution of the land they have. If additional land is available nearby their village, land allocation for the landless who want to grow trees can be done with the permission of FD. Generally, size of land allocated for the landless in the CF program of the delta depends on numbers of population of each household. For example, up to 5 acres of land is distributed to a family having 5 people as an average. If a family has more than 10 people, 15 acres are allotted as a maximum. The size of FUG in the delta varies 20 to 80 households in general. Experiences show that the optimum size is about 40 households.

Management committee-MC comprising of 5 members is responsible for activities of nursery, plantation and natural forests. Management committee is a focal point with FD and other

related organizations such as NGOs and local authorities. Capacity of MC is essential for FUG to hold the achievement. MC has to monitor the activities done by FUG members so as to accommodate the works committed in management plan. Now, trees grown by some FUGs have been harvested by thinning operation. FD has issued a permit for selling fuelwood, pole and post extracted from their community plantation. After thinning operation, FUG members replanted seedlings again where coppice shoot did not re-sprout well. Generally, rotation of fuelwood plantation is set 10 years under the CF program.

Although CF is successful in some part of the delta, many constraints still remain in its implementation, especially maintenance of plantation and extraction of forest products. Illegal cutting is one of the great disturbances in maintenance of plantation. It is found that some FUGs' members also did not follow the regulations that they agreed in management plan. Monitoring and Evaluation of Forest Department was found to be weak in general. It seems to heavily rely on individual. It is therefore indicated that awareness on CF is highly decisive for all parties concern.

Reserved forest land permitted by FD

Myanmar Forest Department issued Community Forestry Instruction-CFI in 1995 to encourage rural people to participate in conservation and reforestation of forests. Forest Department transfers 30 year land tenure right to villagers who will involve in Forest User Group-FUG that is formed in line with CFI. The land tenure right is a great incentive for the villagers to engage in Community Forestry-CF. In other words, CF is a threshold of empowerment for the rural people. In the delta, reserved forest lands are mostly transferred to the FUGs for conservation and reforestation.

Therefore, in this strategy if land is available for CF in some villages, which is located inside or around reserved forests, organizations concern should encourage the villagers who are interested in establishment of community forest plantation. Forest Department can assist to draw forest management plan which is a prerequisite for transferring of land to FUGs. The management plan is a corner stone in implementation of CF. It is like a contract between Community and Forest Department that guides what FUG a member has to do and what Forestry staff have to assist the activities accordingly. Forest Department can take an action on FUG's members who do not follow the works that they have already committed in the plan. Extension of land tenure right is basically dependent on performance of each FUG and its desire that extends 30 years further.

CF is not a short term mission, but a long term, with full of challenges. No matter how it is challengeable, it is the only way for the rural poor to hold tenure right on forest and land resources. As environment is a cross cutting issue, collective action is highly significant in order to sustain natural resources and to maintain the quality of environment.

d. Agro-Forestry

In the delta, there are many homestead gardens in which Coconut, Betel nut, Mango, Gauva etc. have been traditionally grown as a source of income. Most of the gardens were severely destroyed during the cyclone Nargis. This caused profound impact on livelihood of local people. If organizations concern could supply for seedling of cash crops together with agro-forestry techniques, it would be very supportive for the income generation of the local people.

Agricultural land, especially paddy fields occupy most of the area of the delta. If agencies concern could organize farmers to participate in farm boundary planting, it would be very helpful for livelihood as well as disaster risk reduction.

Extension of shrimp and fish ponds has been common in the delta. Especially extensive shrimp farming has gradually increased in the lower part of the delta. In the upper part of the delta, fish ponds occupy in a small scale in earnings. It is essential to organize the shrimp farmers to involve in the reforestation in order to maintain the balance of ecosystem for the long run.

Homestead garden

Approximately, 50-60 percent of families in the delta are engaged in agriculture (PONJA, 2008). In every village of fresh water zone in the delta, traditionally established homestead gardens can be found, and they support to some extent of livelihood of local people after paddy cultivation. Sand ridge areas in the saline water zone are also favorable for home garden. It is saline water zone where vegetables can be grown only in rainy season in the delta.

In home garden, coconut, betel nut and banana are mostly planted as cash crops, followed by bamboo, guava, lime, mango, jackfruit, pepper and other vegetables. Almost all the gardens were destroyed during the cyclone Nargis. It is necessary to substitute the gaps in gardens with suitable multipurpose tree species for restoring livelihood of inhabitants. Spacing is dependent upon the species that are intended to replant. For instance, 20 ft by 20 ft spacing is normally applied for coconut.

Farm Boundary Planting

As most of the areas in the delta are paddy fields, if agencies concern could organize farmers to grow trees along their farm boundary, it would be very obliging for farmers in terms of food, timber, fodder and so on. Extension work for awareness is highly important in this activity. Tree species that can disturb paddy yield should not be chosen. For instance, *P. pinnata* that extends many horizontal roots causes a disturbance on growth of paddy. Farmers' needs and technical feasibility must be taken into account for farm boundary planting. According to the nature of ecological zones, species selection should be done.

Generally, land between river and outer embankment of paddy field is available for farm boundary planting. As an average, width of the land is about 30 feet (10 meters). These places are targeted to conduct the planting. It could be difficult to motivate the farmers to plant trees along the inner boundaries because they have anxiety that trees would disturb yield of crops. It should be noticed that ownership is also crucial for sustainable utilization of these plantations. Nitrogen fixing species such as *Sesbania grandiflora* (L) Poir. (Paukpan byu), *S. bispinosa* (Jacq.) Fawcett & Rendle (Nyan) and *Leucaena glauca* Benth. (Bawzagaing) must be encouraged because most of the soil is deficient in Nitrogen content. For the farmers who need fodder for their cattle, *L. glauca*, *Gliricidia sepium* (Jacq.) Walp. (Thinbaw Ngusat) and *Albizia lebbek* Benth. (Kokko) can be chosen. These species, to a certain extent, can reduce the wind speed so that transpiration rate of crops could be decreased. As transpiration rate drops, yield of crop could increase. Space between one tree to another depends on character of species, site factor and purpose of plantation.

Planting around shrimp and fish ponds

Planting mangroves or non-mangroves around shrimp and fish ponds is important because extension of aquaculture has been very speedy recently. Silvo-fishery practice integrating planting trees and raising shrimp or fish is one of the ways to balance economic gain and stability of ecosystem. This practice is not so familiar with the local people in the delta. Clear cutting of mangrove forests for extensive shrimp farm caused loss of biodiversity and land degradation in the delta.

Suitable species, spacing and planting techniques may depend on site factors of particular place where planting is conducted. *Rhizophoraceae*, *Aviceniaceae* and *Sonneratiaceae* species are suitable for the saline water areas. In fresh water areas, *Sesbania* spp., and *Moringa oleifera* Lam. (Drum stick) are usually grown on the raised beds of the fish ponds. Generally, the space between one to another tree is 9 ft by 9 ft. Other perennial species are also grown with trees.

Conservation approach for remaining natural forests

Clear cutting for establishment of plantation should not be encouraged in order to maintain the mangrove ecosystem. Regeneration Improvement Felling-RIF and Enrichment planting are being currently practiced in the delta as a sivicultural treatment for degraded forests. Under RIF operation, removal of unhealthy trees, climber cutting, cleaning and coppicing are undertaken to improve the quality of forests. Enrichment planting with suitable species is made in gaps where natural regeneration is lack. Then, these treated forests are placed under fully protection until certain period. Strong and healthy mother trees are conserved to produce seeds and propagules, some of which can be applied in reforestation. Due to population pressure, timber demand is getting higher and higher in the delta. Therefore, illegal cutting take place in the forests which are conserved for multipurpose.

All the above management and conservation activities are intended for adaptation to climate change as well as for sustainable utilization of coastal/mangrove forests in the delta.

3. 2. 3 Land Use Conflict

One of the major causes of mangrove depletion in the Ayeyawady Delta is change of mangrove areas to other land use systems. The most important issue is to have a proper land use planning in the delta. To date, a suitable land use policy has yet to be promulgated. This made a big concern among the villagers in terms of sustainability of community plantation for long term, 30 year land tenure right is permitted in CFI though. Forestry, agriculture and fishery sectors are highly competitive in land use. Many controversial issues still linger in implementation of CF in the delta. Therefore, a clear land-use plan and management system should be developed with the collaboration of multi stakeholders who are involving in the socioeconomic development programs for the people living in the Ayeyawady Delta of Myanmar.

3.2.4 Major Vulnerabilities to Climate Change

Mangroves, salt marshes and salt flats are particularly vulnerable to sea level rise. Increases in sea level should lead to an increase in the area of mangroves, and migration of mangroves, salt marsh and salt flats upslope. This scenario is likely in areas of the GBR with high tidal ranges, where rainfall is predicted to increase and where there are no barriers to landward

migration. Expansion of mangroves may be further enhanced with elevated CO₂, nutrient enrichment and warmer winter temperatures at southern latitudes. Reductions in area of mangroves, salt marsh and salt flats will occur in response to sea level rise if the soil surface elevation of the wetlands cannot keep pace with rising sea level.

This is most likely to occur in areas with low tidal ranges, where rainfall is reduced, where sediment inputs are not sufficient to contribute to the maintenance of surface elevation and where groundwater depletion leads to subsidence of sediments. Additionally high temperatures, low humidity and more severe storms could also lead to reduced productivity, subsidence and erosion. The presence of human created barriers to landward migration of wetlands will have a significant negative impact on intertidal wetland cover.

3.2.5 Disaster Risk Management

1. Community-based disaster preparedness and enhancing risk awareness

There is an opportunity to use community-based organizations to enhance disaster preparedness at the village level, including through the formation of village disaster preparedness committees and of specialized disaster management teams on various aspects of disaster preparedness (search and rescue, first aid, evacuation, etc.); community-based risk assessment, including mapping of past disasters and their impacts; and identification of priority interventions at the community level. These actions are not necessarily reduce future disaster risks but can enhance community preparedness to respond to disasters and minimize the loss of lives and livelihoods.

2. Strengthening local level elements of early warning systems:

Cyclone Nargis has exposed weaknesses in early warning systems. Under the leadership of the government, and in cooperation with regional and international agencies, an end-to-end review of the early warning systems is currently underway. Strengthening of early warning systems are required a comprehensive effort. The efforts to generate improved forecasts and warning need to be matched with effective communication systems, public awareness and social infrastructure at the community level so that the warnings can be acted on.

3. Introducing disaster risk reduction in reconstruction and recovery efforts

The rebuilding of permanent shelters is an opportunity to “build back better,” including through the use of locally appropriate construction technologies, training of building artisans, and manuals on construction technologies. There is a need to initiate the process of setting design and safety guidelines for the housing sector, as well as for settlement planning, infrastructure, health and education facilities, water and sanitation, and livelihoods.

In the short and medium term, a comprehensive multi-hazard risk assessment should be carried out, to guide the reconstruction process as well as future development. This could be accompanied by an assessment of the existing early warning system to clarify roles and

responsibilities, and a strengthening of institutional and legislative arrangements for disaster risk management systems, including strengthening local level disaster preparedness and response systems to increase capacity to manage risks. Fostering national public-private partnerships would contribute to a holistic approach towards DRR, and the creation and strengthening of national integrated disaster risk reduction mechanisms. Finally, exploring the development of micro-insurance mechanisms could serve to guard against natural hazards for small farmers as well as small and micro enterprises, while the construction of multi-purpose evacuation shelters would provide physical safety.

3.3 Japan

In the survey site of Tarama Island, the only currently existing Village Ho:go in Okinawa, about seven species were found in the upper story in the surveyed plots inside ho:go. Around 62% of the upstorey stand trees are Fukugi trees, followed by *Calophyllum inophyllum* (see Figure 18 left). About 46 species of grass and seedlings were found in the undergrowth of all surveyed plots in the front forest belt. According to the local informants, village houses were only built on the area inside the village Ho:go. On the aerial photo, we can see that settlements are clustered in the northern part of the island, close to the foot of the hills in the north (Figure 11).



Figure 18 (Left) Planted forest belt in the front of the village to protect the houses from strong typhoons in Tarama Island

(Right) The only remaining house with traditional coral reef stone fence in Tarama Island, which tells us the original premise vision. Soon after WWII, local people broken the coral reef stone fence into small pieces and used them to mix with cement to build houses.

3.3.1 Distribution and location of huge trees in the coastal village

In this part, our primary research focus concerns the actual structure, management, and regeneration of house-embracing *Garcinia subelliptica* trees. We chose to survey several best preserved villages in Okinawa, Tonaki Island, Hateruma Island, Aguni Island, Bise and Imadomari hamlets in Mainland Okinawa, and Karimata hamlet in Miyako Island. We reproduced the actual distribution and sizes of house-embracing *G. subelliptica* trees by HO CAD software.

We found tree lines were much thicker in the borderline of the village, in particular, those either facing the coast or standing in the north. In contrast, there was usually one tree line inside the village. The surveyed *G. subelliptica* trees on Tonaki Island were much smaller than those in Bise Village. More demand of *G. Subelliptica* trees for timber use in this small isolated island and better maintenance might be assumed to be the reasons for the difference in tree height between the two surveyed villages. Thus, proper maintenance in terms of cutting and cleaning are necessary to preserve house-embracing *G. subelliptica* tree lines in a traditional village.

Fukugi tree distribution by tree age is shown in Figure 19. In Bise, majority of the village house has homestead woods. We can also see a tendency for huge trees older than 200 yrs. to be clustered around

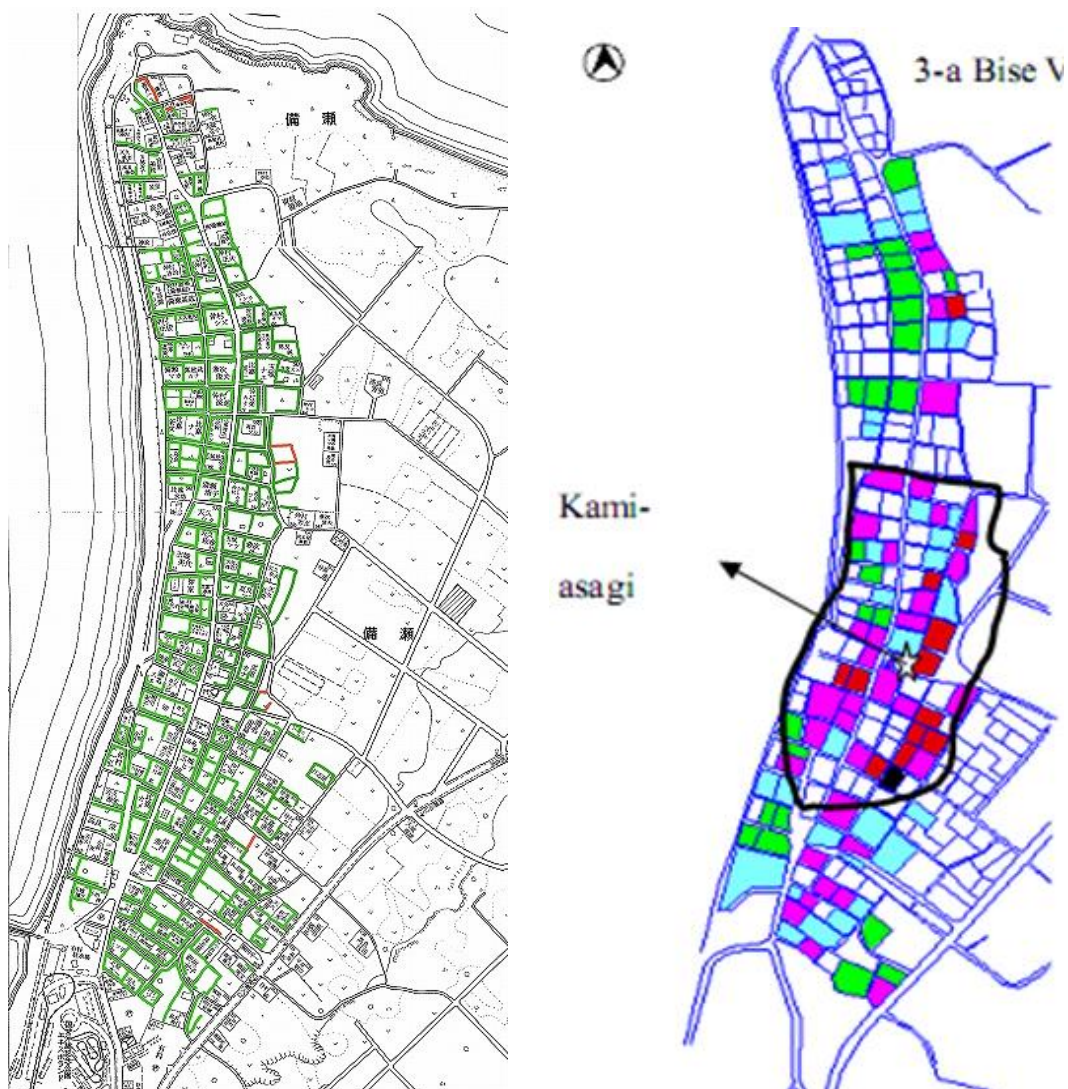


Figure 19 (Left) Planted forest belt (shown as the green lines) to protect the houses from strong typhoons in Bise village, Motobu Town, the north of Okinawa Island.

Legend for Figure 16

- House having trees older than 250 yrs.
- House having trees older than 200 yrs.
- House having trees older than 150 yrs.
- House having trees older than 100 yrs.

Table 5. The Number of remaining huge Fukugi trees in the selected villages (right) Distribution of old house-embracing Fukugi trees older than 100 yrs. inside Bise village.

Survey site		Number of Remnant Fukugi Trees						Estimated age of Biggest tree	Mean Tree Height (cm)	Max TH (cm)	Survey house numbers
		Total	≥ 300 yrs	250 ~ 299 yrs	200 ~ 249 yrs	150 ~ 199 yrs	100 ~ 149 yrs				
Okinawa Island	Bise	1,075	1	17	89	360	609	300	994	99	
	Imadomari	964	0	2	9	111	842	268	842	155	

Tonaki Island		1,293	0	15	85	307	886	294	900		165
Aguni Island	East & West	2,561	0	16	82	486	1,977	296	723	1,300	333
	Hama	500	0	3	6	55	436	281	713	1,308	85
Tarama Island	Shiokawa	1,089	0	1	8	157	923	257	1,010	1,610	124
	Nakasuji	1,592	0	1	17	240	1334	262	1030		160
	Village ho:go	458	0	1	14	107	336	297	1,031	1,170	
Taketomi Town	Hateruma	1,796	0	3	52	463	1,278	266	720	1,770	-
Miyako Island	Karimata	586	1	1	27	123	434	317	640	1,200	-

Note: the estimated tree age was calculated using the formula [Age (year) = DBH (cm)/2.98] that was developed by Hirata (2006).

Important sites in the hamlet, e.g., ashagi, hasagi or haisho. The Hasagi, also called kami-ashagi, is a small building in a sacred place, where guardian deities were summoned in order to hold ceremonies and rituals.

We have measured all house-embracing Fukugi trees older than 100 yrs, with a DBH bigger than 25cm in two selected hamlets in Mainland Okinawa, and another six hamlets in three isolated small island. It was found that Yae (combined with current East and West hamlets in Aguni Island) had the highest number of large trees, totaling about 2,500, while Hama, also in Aguni Island, had the fewest, totaling about 500 trees (Table 1). And the other hamlets had about 1,000 Fukugi trees older than 100 yrs old.

3.3.2 Residents' attitude toward the management and conservation of homestead woodlands

Fukugi (*Garcinia subelliptica* Merr.) homestead woodlands spread through the Ryukyu Islands, the southernmost part of Japan. Homestead woodlands have played a key role in protecting settlements from strong winds, as well as providing timber, green manure, and other services. However, with rapid urbanization and economic and societal change, homestead woodlands in Japan have largely vanished.

The primary purpose of this part was to assess residents' perceptions of the functions and management of homestead woodlands. The secondary purpose was to evaluate residents' willingness to conserve homestead woodlands using the contingent valuation method (CVM).

A survey was conducted in four hamlets with the best-preserved Fukugi homestead woodlands, Bise village, Imadomari, Tonaki Island and Aguni Island in Okinawa Prefecture. The overwhelming majority of respondents (91%) favored the conservation of homestead woodlands. Residents highly valued the amelioration of the microclimate by homestead woodlands such as serving as windbreaks (85.6%) and cooling the air in summer (60.9%). In contrast, the contribution to biodiversity was only modestly (16.8%) valued. An OLS model revealed that residents of small islands valued Fukugi trees highly for their function of

protection from typhoons. Fukugi homestead woodlands were considered as private goods by the residents as well as by local authorities. Approximately half of the respondents felt that homeowners and/or a local authority such as the hamlet community should be responsible for their conservation. Estimated mean and median WTP values were JPY 1,451 (approximately USD14)/household and JPY 1,000/household, respectively. The low CV value by the residents and perception of woodlands as private property suggests a relatively low concern for conservation. A BLR model suggested that respondents with better education and higher income were more concerned about conservation. It is suggested that fostering environmental education and awareness will contribute to better conservation of their homestead woodlands. This research result provides information to local policy makers for coastal settlement landscape planning and conservation strategies.

3.3.3 Alternative utilization as tourist attractiveness as a means of conservation strategy: a survey on tourists' Attitudes and Preference

In this part, a tourist perception towards to the traditional coastal forest and homestead woodlands was surveyed to provide information to policy makers for conservation strategy. Bise village was selected as a case study in this part.

Traditional village forest landscape amenities, as tourist attractiveness, which provides the tourists with integrative experience of local culture, history and specific nature were studied under this objective. It is found the tourists not only highly appreciated the scenery and naturalness of traditional village forest, but also stated dissatisfaction with tourist facilities of the parking lot and restroom. Payment card was used for WTP elicitation format, while OLS and the Cameron and Huppert (1989) models were applied for parametric analysis of data. The average willingness to pay per person was JPY 418.6 (equivalent to about USD 4) and an aggregate annual WTP was JPY 70.49 million (equivalent to about USD 704.9 thousand). It was found that the respondents who were younger than 40 years old, had received education above high school, and travelling with the family were likely to pay more for the tree landscape conservation fund. This study suggests that request for a "donation" or "entrance ticket" can be applied in order to collect conservation funds for the natural resources. However, taking consideration of the low values attached by the tourists regarding the tourist facility and information board setting, tourist facility should be greatly improved when request collecting financing conservation funds from the tourists.

It is found that the visitors from local residence value the tree landscape lower than the respondents from outside Okinawa Prefecture. This result suggests that the traditional property, local culture and local traditions by the local people, may attribute to the low awareness of the value of the local resources.



Figure 20. A traditional red tilted roof wooden house surrounded by tree lines in Bise



Figure 21. Tourists riding on a cattle cart to appreciate the green landscape created by the tree lines planted along the houses.

3.3.4 Assess the current coastal forest policy and propose community-based self-regulated conservation strategies

Interviews have been conducted in the selected survey sites regarding the traditional knowledge and current challenges of homestead woodland conservation. In particular, in depth interviews with the influential persons and the village heads were conducted regarding

a conservation strategy. Their concerns and difficult points will be analyzed, summarized and finally brought to the prefectural official staff for their advice.

3.3.4.1 No adequate landscape conservation regulations: a case of Tonaki Island

In this part, Tonaki Island was selected to illustrate the landscape conservation regulations at the village level. In terms of landscape conservation activities, only Tonaki Island has issued a village regulation to determine regarding tree pruning/cutting, and the surrounding houses.

In Article 6 of the Tonaki village regulations, it is established that when carrying out “the cutting down of trees” (regarding mainly embracing Fukugi trees), people had to have permission from the village education committee beforehand. However, in the second item of Article 6, regarding the cutting down of embracing Fukugi forests, it is mentioned that no permission is required under such situations as follows.

- ① Decayed or damaged trees, dangerous trees, or trees with diseases and insect pests may be cut down
- ② Trees may be cut down for the use of one’s own house or to let other trees grow.

In Article 6 of the Tonaki preservation regulations, no stipulations regarding total or partial cutting are legal control cannot be applied and the regulations turn out to be vague specified. For this reason, one point clearly understood by the requirements mentioned above is that the cut-down that do not need permission granted depends upon totally the decision of embracing Fukugi forests owner.

3.3.4.2 Low residents’ conservation awareness: a case of Aguni Island and Hateruma Island

Trees, in particular old trees, are sensitive to the environment and subject to irreversible damages. On the islands of Okinawa, tens of thousands of trees have been planted to provide humans a safer and more productive environment, but many have vanished due to rapid urbanization. In addition to natural hazards, e.g., typhoons, human activities have largely degraded tree habitat and health. Life style changes and population loss in the rural areas are among the major reasons contributing to decrease in the number of Fukugi trees. Private ownership of woodlands is considered the major limitation to restrict old trees cutting. Trees are chopped, pruned, and maintained at low heights within private properties at the owners’ will and responsibility.

The conservation and maintenance of old-growth trees within the homestead depends on both natural and human factors. Exposure to typhoons and monsoon winds are among the most important natural factors that contribute to tree damage. However, human factors are also important for tree cutting or conservation.

Management measures are urgently needed to protect the remnant trees from threats. The local government agrees that they should have played a more important role in tree management and conservation, but also recognizes that this is difficult, as most trees are in private properties. The lessons learnt from Aguni Island’s experience should alert scientists about the low awareness of the residents and local administrative staff toward these small and

fragmented woodlands, which have much higher ecological significance than their tangible economic values.

According to the local people in Hateru Island, many Fukugi trees were cut down to improve transportation infrastructure and by the owner of the homestead. Trees attacked by termites can be seen here and there. It was said that damage caused by past construction work and typhoons had fatally injured the old trees. These damaged trees develop hollows areas in their stems and are very vulnerable to future typhoons.

3.3.4.3 Neglected by local administrative staff: a case of historic site tree cutting

Uchima-udun (total area: 5,162 m²) is a national historic site located in Kadekaru, Nishihara Town, Okinawa Prefecture, in Japan. The former Lord of Uchima, Kanamaru, is believed to have lived in Kadekaru for 16 years in the mid-15th century before he became king of the Ryukyu Kingdom, Sho En. With its stone fence and old fukugi (*Garcinia subelliptica*) tree lines surrounding (Figure 22), the old residence represents unique historic landscape on the Ryukyu Islands. Today, it also serves as a place of worship for local people. We conducted a vegetation survey in 2013 and measured all the trees with a height of one meter or more on the property and tallied a total number of 180. Some of these trees were estimated to be more than 300 years old, and the majority were likely planted in the late 1830s. As it is pointed out by botanists, vegetation of this type—namely, that blends with artificial forests and a prototype of broad-leaved secondary evergreen forests—possesses an academic significance of lowland forest in the urban area. Uchima-udun's valuable fukugi trees were cut and pruned in May 2015 under reasoning that typhoons and exposing tree roots had caused the stone fences to collapse. It was said that nearby residents had also complained about potential risks from typhoon-damaged trees (Figure 23).

However, the tree cutting project moved forward without any scientific evidence proving that the collapsed fences influenced by tree root growth or made the trees more susceptible to typhoon damage. Uchima-udun's luxuriant forest landscape will disappear if the tree cutting and pruning plan is completed. Many valuable old trees inside the Agarie (the south part of Uchima-udun) and a coalesced female and male tree at the south entrance were pruned and all of their leaves or branches chopped. Inadequate conservation laws are a significant reason for the ease with which the cutting and pruning old, historically significant trees occurs. The Act on Protection of Cultural Properties and The Landscape Act already exist to protect historic and cultural landscapes. However, a "historic landscape conservation ordinance", complete with penal provisions, is needed in each community to effectively protect landscapes at the local level. Such a local conservation ordinance does not exist in Japan. Tourism is a major industry in Okinawa Prefecture. Uchima-udun's historic landscape is a valuable tourism resource, as well as an important sacred space. Therefore, landscape conservation ordinance at the community level in Okinawa is urgently required.



Figure 22 Fukugi tree lines along the entrance to the sacred site designated as the national cultural property



Figure 23 Fukugi trees were pruned to control their growth for the purpose to protect the stone fence surrounding the sacred site

3.3.5 Outreach activities to raise awareness of coastal forest conservation

We have worked closely with local government and communities to disseminate our research findings in order to raise local's awareness of coastal forest protection. University students have been sent to the hamlets to learn with the local knowledge of coastal village conservation. Study tours were organized to visit two villages in Mainland Okinawa, Bise and Imadamari (see Figures 24, 25).



Figure 24 A group discussion was organized for university students to learn about the challenges of coastal forest management and conservation with the hamlet head and a knowledgeable person in Bise village



Figure 25 University students attended a study tour guided by the local in Imadamari village

Our project team members have given public speech to the locals to explain our research findings (Figure 26). Speech topics include the actual distribution of old Fukugi trees, the functions of Fukugi trees to protect from natural disasters, and threats of vanishing Fukugi trees. A workshop was held with the locals in Aguni Island under the support from Education Committee of the village.

Policymakers in the local level need to be aware of the significance of homestead woodlands and also vanishing trend of greening in the village. Village heads and influential persons were

interviewed and invited to develop a coastal forest conservation strategy. Finally, the interview results will be brought to the prefectural government officials to raise their awareness.



Figure 23 Public speech to the village people

4. Conclusions

Coastal landscapes are undergoing a variety changes. With enormous variation in environmental and socio-economic conditions and interactions between forest, farming, aquaculture and sea/river systems, forest management need to be addressed as an integral component of cultural landscape/seascape rather than as an sectoral and independent activity of forestry. A comprehensive land use planning with site-appropriate land use ordinance is critical to harmonize different land uses for conservation, forestry, agriculture and human settlements at landscape level. Further, forest conservation and restoration should be integrated for strengthening multiple services of forests at a regional scale. Participatory forestry is a good approach but, apart from empowering people by leasing land and granting funds, there is a need of mobilizing people to apply and enhance indigenous knowledge on green infrastructure, such as Ho:go forests to harness protective functions of forests around houses and villages combined with the present approach of following top-down approach on early warning, cyclone shelter system and improved housing. Early, high and secured income from any occupation remains the top priority of people in poor countries. There is a need of setting out long term participatory research harmonizing this local concern with global concern for enhancing conserving biodiversity and regulating and supporting functions of coastal ecosystems.

Apart from participatory research in a given area, regional cooperation may hasten the process of replication and further improvement of the known good practices. Context-based approaches to coastal forest management vary from country to country.

4.1 Philippines

Mangrove was generally perceived to be a valuable resource in both sites. In terms of SFM criteria & indicator, current mangrove forest is 'sustainably being managed' in view of forest

cover, carbon stock capacity, and livelihood benefits. However, policy improvements are needed to strengthen / clarify tenure rights over timber and land access. Carbon offset project is a promising incentive-based conservation strategy since policies are bend towards strict forest protection rather than timber utilization.

In view of policies, there are foreseen and unforeseen issues if the *no harvesting policy of mangroves for wood* will still be enforced. The greatest impact will be on the poor coastal communities whose survival also largely dependent on access to various mangrove resources for subsistence particularly wood (intended for house construction, fuelwood, seaweed farming, among others). This study therefore recommends the: 1) conduct in-depth reviews of the existing policies coupled with case studies on the impacts of *no cutting policy over mangroves*; 2) organizing a national mangrove policy forum that will help stage discussions on how the needs and interests of mangrove stewards and governing institutions can be best harmonized into policy(s), plans and programs.

Some points for policy improvement include:

- Provision for a commercial timber cutting exemption on monoculture mangrove plantations in Banacon Island to help local community sustainably manage their plantations.
- Pursue *ancestral domain* tenure titling in Kamuning, Palawan since members belong to *Tagbanua* tribe. This will give the community an 'exclusive' right and responsibility to conserve mangroves according to their tradition.
- Ecologically conscious mangrove rehabilitation (through careful site-species suitability matching)
- Align proposed policies and programs to capture the climate change adaptation and mitigation aspects of mangrove rehabilitation.

4.2 Myanmar

It is essential for governments and people to understand that mangroves are a valuable social and economic resource. It is a fact of human nature that we tend to preserve and protect resources that are of economic importance; aesthetics is historically not high on the list of reasons why we conserve resources. Global climate change is one of the greatest challenges that humans will face in this century. The present rate of global warming threatens the survival of entire ecosystems. Among the most at-risk ecosystems are mangroves, which are especially vulnerable to sea-level rise, but the good news is that not all coastlines with mangrove forests are projected to experience a rise in relative sea level. In contrast, mangrove ecosystems with ample sediment supplies and/or room to move inland are likely to survive projected rates of sea-level rise. Mangrove species have demonstrated different tolerances to changes in sea level, salinity, and storms. If mangrove forests are not seen as a fundamental economic and ecological resource to be treasured, they will continue to be exploited at current rates until at least 2025. Hence, holistic approach covering economic, social, technical,

environmental and institutional aspects should be applied in order for sustainable utilization of mangrove forests in the delta.

4.2.1 Policy Recommendations

a. Strengthening of Institutional/ Organizational Developments for CF & Coastal Forest Management

Issues

Though there are movements for amendment of the Forest Law and CFI,

- Still concrete and practical strategies/ approaches/ plans on how to proceed CF and coastal management have not been fully developed yet.
- Up to now, there are not enough institutional / organizational arrangements as well as budget allocation in FD to practically implement CF and coastal management.
- There are various interpretations and understandings toward CF and CFI within FD (not fully clear consensus within FD yet. Also concrete and standardized procedures have yet to be established.)

Lessons Learned

Currently, there are many CF, and coastal conservation related projects on-going and scheduled in Myanmar. These projects are more of field level activities at various locations in Myanmar.

However, for better CF/ coastal forest managements, it is also important to emphasize upstream level strengthening, such as

- Policy, institutional and organizational arrangements/ development,
- Capacity development

Recommendations

Currently, MONREC is in the process for establishing a CF section and Mangrove Division. If CF and coastal management continue to be one of key areas for forest management, following activities shall be strengthened.

- National (Regional) level CF SOP (Standardized Operational Procedures) development
- SOP for CF Section
- Preparation of practical CF implementation plans
- SOP for Mangrove Division
- Preparation of practical mangrove/ coastal forest implementation plans
- Sufficient organizational / budgetary arrangements for new organizations

b. Strengthening Linkages between Livelihood Improvement /Capacity Development Activities and CF

Issues

Though, livelihood improvement and capacity development are included in most of past and existing CF implementation:

- CF activities based on current Community Forestry Instruction (CFI) are heavily dedicated to forestry aspect and less emphasis and linkages with livelihood improvement as well as community's capacity development.
- For FD officers, there are still tendency that their obligation with CF is to provide first year seedlings and technical guidance as per indicated in CFI.

Lessons Learned

For ensuring sustainability of CFUGs and CF activities:

- Require identifying methods, procedures, and basic information to strengthen linkages between CF and livelihood improvement activities
- Require livelihood / capacity development related activities to be covered in relevant instructions, operational procedures and etc.
- Strengthening Linkages between Livelihood Improvement /Capacity Development Activities and CF

Recommendations:

For ensuring sustainability of CFUGs and CF activities:

- Baseline information collection for linkages between CF and livelihood
- Action research to examine possible linkages between livelihood and CF
- Pilot planning and implementation based on the above.
- Amendment of CFI, and preparation of operational procedures including management and support for livelihood activities.

c. Strengthening Land Use Planning/ Zoning for Better Forest (CF) Management

Issues

Currently,

- There is no comprehensive land use planning yet. Existing land use delineation tends to be more of independent among each authority and less coordination.
- There are various land uses even inside forest areas, especially in the delta area. However, there is no practical and systematic zoning/ delineation reflecting the actual land use conditions yet.

Lessons Learned

To contribute to better forest management as well as interdisciplinary and multi-sector land use management:

- Requires re-clarifications of status and roles of forest areas reflecting the actual ground conditions.
- Requires to redefine positions and roles of CF in forest management.
- Shall consider resettlement issues, zoning, and exclusion of forest areas based on necessity.

Recommendations

- To contribute to better forest management as well as interdisciplinary and multi-sector land use management.
- Reflecting issues and lessons learned into upcoming land use policy and land use plans establishments.
- Formulation of standards and criteria for delineation of forest management areas and other land use areas inside and surrounding forest areas.

4.2.2 Establish Greenbelts and Buffer Zones

Mangrove greenbelts can provide significant coastal protection from erosion and should be established along erosion-prone coastlines and riverbanks and in areas which experience significant damage from typhoons, tidal surges, cyclones, and geomorphic erosion (Macintosh and Ashton 2004). Greenbelts should be a minimum of 100 m, but preferably up to 500 m or 1 km (advocated in Mekong Delta which is subject to typhoons) at the open coast and 30-50 m along riverbanks and lagoons, and >10 m on islands, creeks, and channels (Macintosh and Ashton 2002; Macintosh and Ashton 2004).

It is also important to establish buffer zones bordering the seaward and landward margins of protected mangrove areas to provide a transition between human settlements with intensively used lands and waters and the protected area. The landward zones are more critical for mangroves in areas experiencing sea-level rise to enable landward expansion. The seaward zones are more critical for mangroves in areas where land is prograding to enable seaward expansion. To proactively plan for landward migration in areas where mangroves have the potential to expand, the adjacent land gradients should be used to determine how wide a buffer is necessary to accommodate the mangrove migration for different sea-level rise projections. The land-use practices surrounding buffer-zones should be “biodiversity-friendly” wherever possible (such as pesticide-free farming, sustainable forestry, and well-drained roadways and bridges) (Barber et al. 2004).

4.2.3 Develop Adaptive Management Strategies

Climate changes such as sea temperature rise, sea-level rise, precipitation or salinity changes, and the frequency and intensity of storms will affect mangrove species distributions. If mangrove conservation strategies are to be successful in protecting species and habitats, they will need to adapt to the changing climate conditions. The ability to predict the location of future habitat sites, and build these potential sites into protected area design and adaptation, will be a crucial element of long-term planning to ensure sustainable protected areas in the face of global change. Flexible strategies and boundaries should be established and tracked to allow for adaptive management.

4.3 Japan

The traditional homestead woodland landscape established approximately 300 years ago was common on the islands in Okinawa Prefecture. In coastal villages of Okinawa Islands, planted trees is functional to protect the communities from natural disasters, such as typhoons, tsunamis and salty tides and etc. The ecological functions of protecting houses from strong winds and the aesthetics of the homestead woodland landscape were widely appreciated by residents.

Similar to the lessons from the other areas that the dynamic of old growth trees can be related to the biotic factors including diseases and abiotic factors such as air pollution the existence of these huge remnant trees on Okinawa islands also depends on natural and human factors.

Exposure to typhoons and monsoonal winds are among the most important factors for the resident's remaining tree belts at their homestead. However, human factors are also important for tree cutting or conservation. The residents' awareness on tree conservation determines whether the trees were preserved or felled. Older generations generally have higher conservation awareness with regard to Fukugi trees, while younger generations are much less aware. These old growth trees have been managed and maintained by the villagers; however, the current conservation scheme has placed these old trees to face the threats of being clear-cut or abandoned with the socio-demographic transformation in the future.

Unfortunately, conservation of homestead woodlands is not indicated in any of current local policy scheme in Japan. Moreover, a landscape ordinance is still not taken into consideration by the village leaders. Inadequate conservation laws are a significant reason for the ease with which the cutting and pruning old, historically significant trees occurs. In Japan, the Act on Protection of Cultural Properties and the Landscape Act already exist to protect historic and cultural landscapes. However, a "historic landscape conservation ordinance", complete with penal provisions, is needed in each community to effectively protect landscapes at the local level. Such a local conservation ordinance does not exist in Japan.

A new conservation network that includes the local government, urban residents, and volunteer groups is called for to conserve these old trees. Increasing environmental awareness through education programs directed at village inhabitants might be the most effective way to protect old trees and conserve the landscape.

Tourism is a major industry in Okinawa Prefecture. Historic landscape is a valuable tourism resource, as well as an important sacred space. Therefore, landscape conservation ordinance at the community level in Okinawa is urgently required.

5. Future Directions

Following the recommendations of the project synthesis workshop held in the Philippines on 27 May to 1 June, 2016, the project team submitted to APN a summary proposal on a new project focusing on mangrove rehabilitation to follow up this project and received a favourable review for submission of the full proposal. In addition, the project team submitted two training proposals to the UNU On-the-Job Research Capacity Building Programme for Food Security and Environmental Conservation in Developing Countries (OJCB), funded by the Ministry of Agriculture, Forestry and Fisheries of Japan and received positive approval. The two training proposals made full use of the project expertise and results for training of young scientists who involved in the project implementation. As a result, the Year II work programme of the project expanded to include an international training and follow-up workshop in Myanmar on 17-22 December 2016 with generous support of OJCB to summarize project findings and discuss the full proposal on the follow-up research for potential funding.

Mangrove forests in coastal areas provide a wide range of vital ecosystem services for global and local communities, such as climate change mitigation (through high carbon sequestration), climate change adaptation (through protection from floods, tides and storms), biodiversity conservation, and local livelihoods (through community fishery, aquaculture and forest products). However, overharvesting and land use change have resulted in widespread degradation of mangrove forests, leading to loss and reduction of the above vital ecosystem

services. While mangrove planting has been promoted to restore vital ecosystem services most of such efforts were largely monoculture plantation and were not effective in restoring the wide range of vital ecosystem services. Building on the project findings and relevant studies, the proposed follow-up research will review past experiences of mangrove planting and identify best practices for sustainable rehabilitation to integrate global and local benefits, taking case studies in the Philippines and Myanmar where both countries has suffered serious damages caused by typhoons and cyclones in recent years. Synthesising findings from in-depth case studies of community-based mangrove rehabilitation efforts of both countries, the project aims to make policy recommendations to further improve mangrove rehabilitation strategies. The final output will contain technical final reports, sustainable mangrove rehabilitation guidelines and policy briefs that will be conveyed to policy-makers and relevant mangrove stakeholders beyond the Philippines and Myanmar. Following the APN favourable review of the summary proposal, the full research proposal has already been submitted to APN for potential support.

6. References

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7. Appendix

Appendix 1 Conferences/Symposia/Workshops

Appendix 1.1 Inception Workshop, Japan, 15-17 Sept 2014



APN Project on Coastal Forest Management in the Face of Global Change Based on Case Studies in Japan, Myanmar and the Philippines

Inception Workshop: ***“Coastal forest management in the face of global change”***

Nishihara (Okinawa), Japan
15-17 September 2014

Background:

Forests are recognized for reduction of coastal hazards. However, there is little understanding how the forests and the human settlement interact and can be better integrated to adapt to climate change impact, in particular, from a cross-country comparative perspective. With support of Asia Pacific Network for Global Change Research (APN), Institute for the Advanced Study of Sustainability (UNU-IAS), University of the Philippines Los Baños (UPLB), Forest Research institute (FRI) and University of the Ryukyus are launching an joint research initiative on “Coastal forest management in the face of global change”. The research initiative will examine community-based forest management, including local knowledge in vulnerable communities to identify best practices and their integration with planning of human settlement and facilities to strengthen community resilience to climate change impacts as well as evaluate effectiveness and needs of policy interventions through a bottom-up process. The project will assess potential benefits of coastal forests in adaptation to and mitigation of climate change. Three project sites, one each in the Philippines, Myanmar and Japan, suffer frequent typhoons or tropical cyclones. The comparative perspective will explore how different countries and local communities manage coastal forests to cope with coastal hazards under similar bio-physical conditions, but different socio-economic contexts and draw on their experiences for developing context-based solutions.

As part of the above joint research initiative, the University of the Ryukyus and the UNU Institute for the Advanced Study of Sustainability are jointly organizing this inception workshop in Okinawa, on 15 – 17 September 2014 to bring together experts from UNU, Japan, Philippines and Myanmar to kick off the research initiative. The workshop will also provide an opportunity to exchange experience with other countries in Asia.

Objectives:

The main objectives of the workshop are:

- Review the project goals and expected outcome.
- Review and confirm project sites, and visit the project site in Japan
- Finalize the project methodology and work plan.

Workshop programme and agenda:

Sunday, 14 Sept 2014: Arrival of participants	
After arrival	Check in guesthouse in University of the Ryukyus
Monday, 15 Sept 2014: Field trip	
8:30–10:30 hrs	Group Travel to Imadomari of Nakijin Village
10:30-12:00 hrs	Field walk observing remnant Village Hogo: (Planned forest to surround the whole village) Group meeting with village group and local officials
12:00-12:15 hrs	Move from Imadomari to Bise Village
12:20-13:30 hrs	Lunch at Bise Misaki Restaurant
13:30-15:00	Field walk observing village landscape, land use and protection forests
15:00 – 16:00 hrs	Meet with village group and local officials to discuss problems, ideas and history of coastal forest management
16:00 -18:00	Return to Nishihara
18:30 - 21:00	Welcome Reception
Tuesday, 16 Sept 2014: University of the Ryukyus	
9:00–9:10 hrs	Welcome remarks <ul style="list-style-type: none"> • Tomiko Hokama, Vice President (University of the Ryukyus) • Kazuhiko Takeuchi (UNU)
9 :10–9:30 hrs	Overview of the project: goals and outcomes <ul style="list-style-type: none"> • Luohui Liang • Discussion
9:30–10:10 hrs	Coastal forest management in Japan (Satoshi Akahori, Forestry Agency Japan) Coastal forest management in Okinawa (Yuei Nakama, UoR)
10:10–10:50 hrs	Session I: Selection of project sites <ul style="list-style-type: none"> • Bixia Chen (UoR) • Leni D. Camacho (UPLB) • Zaw Win Myint (FRI) • Discussion
10:50-12:00 hrs	Session II: Proposed methodology at each site <ul style="list-style-type: none"> • Yuei Nakama (UoR) • Antonio P. Carandang (UPLB)

	<ul style="list-style-type: none"> • Chaw Chaw Sein (FRI) • Discussion
12:00–12:20 hrs	Coffee/tea break
12:20–13:00 hrs	Session III: Methodology framework/guidelines <ul style="list-style-type: none"> • Field assessment (Kazuhiko Takeuchi, UNU) • Discussion
13:00–14:00 hrs	Lunch
14:00–14:20 hrs	Session III: Methodology framework/guidelines (continued) <ul style="list-style-type: none"> • Policy analysis (Akira Nagata, UNU) • Discussion
14:20–15:50 hrs	Session IV: Proposed work plan at each site <ul style="list-style-type: none"> • Yuei Nakama (UoR) • Leni D. Camacho (UPLB) • Zaw Win Myint (FRI) • Discussion
15:50–16:10 hrs	Coffee/tea break
16:10–17:20 hrs	Session V: Project work plan <ul style="list-style-type: none"> • Introduction (Luohui Liang, UNU) • Discussion
18:00–19:00 hrs	Working Dinner
Wednesday, 17 September 2014: University of the Ryukyus	
9:00–10:30 hrs	Session VI: Project budget and contract <ul style="list-style-type: none"> • Introduction (Evonne Yiu, UNU) • Discussion
10:30–10:45 hrs	Coffee/tea break
10:45–11:40 hrs	International Experience
	<ul style="list-style-type: none"> • Coastal forest management in India (K.G. Saxena, JNU) • Mangrove forest management by local community in Indonesia (Iin Ichwandi, Bogor Agricultural University, Indonesia) • Restoration Practice on the Coastal Vegetation of Kimen Islands (Fujun Pan, Chinese Culture University)
11:40–12:30 hrs	Wrap-up and closing
12:30–13:30 hrs	Lunch
13:30–14:00 hrs	Courtesy visit to President of UoR
14:30–17:30 hrs	Optional Study Tour
18:00–20:00 hrs	Working Dinner
Thursday, 18 September 2014: Departure of participants	

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Appendix 1.2 Synthesis Workshop, Philippines, 27 May-1 June 2016



APN Project on Coastal Forest Management in the Face of Global Change Based on Case Studies in Japan, Myanmar and the Philippines

Synthesis Workshop: **“Coastal forest management in the face of global change”**

Bohol, Philippines
27 May - June 1 2016

Objectives:

As part of the joint research initiative on “Coastal forest management in the face of global change”, UPLB and UNU-IAS are jointly organizing the synthesis workshop in Bohol, Philippines on 28 – 30 May 2016 to review and summarize the research findings and draft policy recommendations based on studies in Japan, Philippines and Myanmar since the research started in 2014, and as well as provide a good opportunity to visit the study site in Bohol.

Programme

Friday, 27 May 2016: Arrival of participants in Manila	
Arrival	Check in at D' Circle Hotel, Manila
Saturday, 28 May 2016: Flight to Tagbilaran, Bohol, visit to Tarsier Sanctuary, Loboc Man-Made forest, Chocolate Hills and Talibon, Bohol	
9:20–10:35 hrs	Group Air Travel to Tagbilaran, Bohol
10:35-11:00 hrs	Move to Loay River (along mangroves)
11:00-11:30 hrs	Lunch at Loay River Cruise by boat
11:30-13:30 hrs	Move to Tarsier Sanctuary (tarsier is the smallest known primate)
13:30-14:00 hrs	Field Study At Tarsier Sanctuary
14:00-14:30 hrs	Move to Loboc Man-Made Forest
14:30-15:00 hrs	Field Study At Loboc Man-Made Forest
15:00-16:00 hrs	Move to Bohol Chocolate Hills
16:00-17:00 hrs	Field Study At Chocolate Hills
17:00-18:00 hrs	Move to Talibon, Bohol
18:00 hrs	Hotel Check Inn (AM Bayside Pension House) and Dinner at Vidasto Restaurant, Bohol

Sunday, 29 May 2016: Field Visit to Banacon Island Mangroves, Getafe, Bohol	
07:00-07:30 hrs	Breakfast at Vidasto Restaurant, Talibon
07:30-08:30 hrs	Move to Getafe, Bohol Port
08:30-09:15 hrs	Move to Banacon Island/Mangrove Site by Boat
09:15-14:00 hrs	Site Visit At Banacon Island/mangrove site/Meeting with the People's Organization and Local Leaders (Lunch with the People)
14 :00-14:45 hrs	Back to Getafe Port by Boat
14:45-17:40 hrs	Move to Tagbilaran City
17:40-18:00 hrs	Move to Restaurant for Dinner
18:00-19:00 hrs	Dinner at Golden Cowrie Restaurant, Tagbilaran City
19:00-19:30 hrs	Move to Panglao Island
19:30 hrs	Hotel Check in at Alona Kew White Beach Resort, Panglao Island
Monday, 30 May 2016: Workshop at Alona Kew White Beach Resort Function Room	
8:30–8:45 hrs	Welcome remarks <ul style="list-style-type: none"> • Leni Camacho (UPLB) • Kazuhiko Takeuchi (UNU)
8:45–9:00 hrs	Overview of the workshop <ul style="list-style-type: none"> • Luohui Liang Discussion
9:00–10:30 hrs	Session I: Philippines (UPLB) <ul style="list-style-type: none"> • Summary of Project Findings • Policy Recommendations
10:30-11:00 hrs	Coffee Break
11:00–12:30 hrs	Session II: Japan (UoR) <ul style="list-style-type: none"> • Summary of Project Findings • Policy Recommendations
12:30–13:30 hrs	Lunch Buffet at the Restaurant near the Function Hall
13:30–15:00 hrs	Session III: Myanmar (FRI) <ul style="list-style-type: none"> • Summary of Project Findings • Policy Recommendations
15:00–15:30 hrs	Session IV: International networking <ul style="list-style-type: none"> • Coast forest ecology and management in India (Prof. Saxena, JNU)
15:30–15:45 hrs	Coffee break
15:45–17:00 hrs	Discussion
17:00-17:30 hrs	Closing
18:00–20:0 hrs	Dinner (Buffet at the Restaurant near the Beach)

Tuesday, 31 May 2016: Departure of participants from Bohol (Flight From Tagbilaran to Manila: 11:15 hrs for Prof. Saxena, and, 16:10 hrs for other participants); Check In at D' Circle Hotel, Manila	
06:30-07:30 hrs	Breakfast at the Hotel
7:30-11:00 hrs	Field Study of Panglao Island
11:00-11:30 hrs	Hotel Check-Out/Flight also of Prof. Saxena back to Manila
11:30-11:50 hrs	Move to ICM Mall, Tagbilaran for Lunch at Prawn Farm Restaurant (located within the Mall)
11:50-13:30 hrs	Lunch at Prawn Farm Restaurant
13:30-13:50 hrs	Move to Tagbilaran Airport
13:50-14:10 hrs	Airport Check In
16:10-17:25 hrs	Flight back to Manila
17:25-18:00 hrs	Move to D'Circle Hotel/Check-in
18:00 hrs	Dinner at a restaurant near the hotel
Wednesday, 1 June 2016: Hotel Check Out/Departure of participants from Manila	

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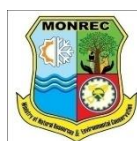
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Appendix 1.3 Follow-up Workshop, Myanmar, 17-22 Dec 2016



APN Project on Coastal Forest Management in the Face of Global Change Based on Case Studies in Japan, Myanmar and the Philippines

Follow-up Workshop: **“Coastal forest management in the face of global change”**

Pyapon, Myanmar
17- 22 Dec 1 2016

Background and Objectives

Following the recommendations of the project synthesis workshop held in the Philippines on 27 May to 1 June, 2016, the project team submitted to APN a summary proposal on a new project to follow up and received a favorable review for submission of the full proposal. In addition, the project team submitted two training proposals to the UNU On-the-Job Research Capacity Building Programme for Food Security and Environmental Conservation in Developing Countries (OJCB), funded by the Ministry of Agriculture, Forestry and Fisheries of Japan, and received approval of support. The two training proposals have made full use of the project expertise and results for training of young scientists. As a result, the Year II work programme of the project has extended to include an international training workshop in Myanmar on 17-22 December 2016 with generous support of OJCB .

As part of the joint research on “Coastal forest management in the face of global change” and the OJCB programme, FRI and UNU-IAS are jointly organizing the follow-up workshop in Pyapon, Myanmar on 18 – 21 Dec 2016 to summarize the Year II research findings, conduct the OJCB follow-up training of young researchers, discuss the follow-up project proposal and visit the study site in the Ayeyarwady Delta, Myanmar.

Programme

Saturday, 17 Dec 2016: Arrival of participants in Yangon	
Arrival	Check in at Tawwin Garden Hotel, Yangon
Sunday, 18 Dec 2016: Meeting Room, Yangon, Forest Department	
07:00-7: 30 hrs	Breakfast at the Hotel
7:30-12:00 hrs	Visiting around Yangon
12:30–13:30 hrs	Lunch

13:30–13:45hrs	Welcome remarks <ul style="list-style-type: none"> • Dr. Thaung Naing Oo (FRI) • Akina Nagata (UNU)
13:45–14:00hrs	Overview of the meeting <ul style="list-style-type: none"> • Luohui Liang • Evonne Yiu
14:00–14:30hrs	Session I: Philippines (UPLB) <ul style="list-style-type: none"> • Summary of research findings • Recommendations
14:30-15:00 hrs	Coffee Break
15:00–15:30 hrs	Session II: Myanmar (FRI) <ul style="list-style-type: none"> • Summary of research findings • Recommendations
15:30–16:30 hrs	Session III: OJCB trainee research in Myanmar (Prof. Saxena / Camacho) <ul style="list-style-type: none"> • Reviewing OJCB proposal of Ms. Win Win New • Reviewing OJCB proposal of Ms. Hteik San Soe
16:30–17:00 hrs	Discussion for Follow-up Project proposal (Prof. Camacho)
17:00-17:15 hrs	Closing remarks (Prof. Saxena)
19:00 hrs	Dinner
Monday, 19 Dec 2016: Travel to Pyapon Township	
6:30–7:25 hrs	Group Travel from Yangon to Pyapon (By car)
12:30-14:00 hrs	Lunch in Pyapon
17:00 hrs	Check in Oakphokwinchoung Guest House
18:00-19:00 hrs	Dinner
19:00-20:00 hrs	Introduction to the trip
Tuesday, 20 Dec 2016: Field Visit to mangrove areas	
07:00-12:00 hrs	Field trip to War Kone and Kanyin Kone Villages
12:30-14:00 hrs	Lunch
14:00-17:00 hrs	Field trip to Padaukpin Seik Village
18:00-19:00 hrs	Dinner
19:00 hr-20:00 hrs	Wrap up the trip

Wednesday, 21 Dec 2016: Back to Yangon(By Car)	
6:00–7:00 hrs	Breakfast
7:30 hrs	Check out Oakphokwinchoung Guest House
12:30-14:00 hrs	Lunch in Pyapon
17:00 hrs	Check in at Tawwin Garden Hotel, Yangon
19:00-20:00hrs	Dinner in Yangon
Thursday, 22 Dec 2016: Departure of participants from Yangon	

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Appendix 2 Funding sources outside the APN

		In-Kind (US\$)	Cash (US\$)
Details of support	Organizations		
Project coordination, synthesis and research missions, and support of OJCB	United Nations University	4,000	7,500
Field assessment, policy analysis, synthesis workshop organization	University of the Philippines	1,000	
Field assessment, policy analysis and consultations in Myanmar	Forest Research Institute, Myanmar	1,000	
Field assessment, policy analysis and consultations in Japan	University of the Ryukyu, Japan	4,000	
Associate study in India and supporting the project workshops in Japan and Philippines	Jawaharlal Nehru University	1,000	1,500
Total		11,000	9,000

Appendix 3 List of Young Scientists

- **Ms Hteik San Soe**

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She involved in inventory of forest resources and social survey of the project. She was also supported by OJCB to take part in the OJCB programme on Participatory Agroforestry For Rural Development in the Face of Climate Change” in Philippines on 2 Nov to 27 Nov 2016. Working with the project, she has developed a research proposal on agroforestry practice for local livelihood in Delta Region, Ayeyarwady Division.

- **Ms Win Win New**

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She involved in inventory of forest resources and social survey of the project. She was supported by OJCB to take part in the OJCB Programme on “Management of Coastal Forest for Environmental Conservation, Food Security and Climate Change Mitigation” in India on 1 Oct to 22 Nov, 2016. Working with the project, she has developed a research proposal on “assessing the potential of agroforestry in forest conservation and climate change mitigation and adaptation in the Ayeyarwady delta, Myanmar”.

- **Dr. Lorena Sabino**

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She involved as a Project Staff of the APN Project (Philippines). She is a young researcher in the department. She was involved in the APN project’s research works and policy

consultations from various sectors where she learned a lot in terms of the current mangrove situation in the country as well as the existing policies, policy recommendations, etc. as a result of the project. She is involved in drafting an article for the project for submission to international journal.

Appendix 4 Glossary of Terms

<i>acronyms and abbreviations</i>	Definition
ADT	air dried metric tonnes
AYWD	Ayeyarwady
BAFMAPA	Banacon Fisherfolks and Mangrove Planters Association
CADC	Certificate of Ancestral Domain Claim
CBFM	Community-Based Forest Management
CBFMA	Community-based Forest Management Program Agreement
CF	Community Forestry
CFC	Chloro-fluoron-carbon
CFI	Community Forestry Instruction
CRMF	Community Resource Management Framework
CRMP	Coastal Resource Management Project
CSD	Comprehensive Site Development (CSD)
CVM	contingent valuation method
DA-BFAR	Department of Agriculture, Bureau of Fisheries and Aquatic Resources
DAO	Department Administrative Order
DENR	Department of Environment and Natural Resources
FAO	Food and Agriculture Organization
FLA	Fishpond Lease Agreement
FUG	Forest User Group
FD	Forest Department, Myanmar
FREDA/ACTMANG	Forest Resource Environment Development and Conservation Association/Action for Mangrove Reforestation
FRI	Forest Research Institute, Myanmar
Ho:go	One essential word for a Feng Shui village in Ryukyu Islands. The literal meaning of Ho:go is to embrace and protect by forest planting in order to retain the living energy.
IAS	Institute for the Advanced Study of Sustainability
KCRDAI	Kamuning Coastal Residents Development Association, Inc.
KI	key informants
KPG	Kanepackage Philippines Inc.
NGOs	Non-governmental organizations
NIPAS	National Integrated Protected Areas System Act
OJCB	On-the-Job Research Capacity Building Programme for Food Security and Environmental Conservation in Developing Countries (OJCB), funded by the Ministry of Agriculture, Forestry and Fisheries of Japan.
PCSD	Palawan Council for Sustainable Development
POs	People's Organizations
R3S1	"R3" indicates annual rainfall of above 100 inches (2,540mm) and with two continuous months of dry summer, and "S1" indicates soil of Fluvisols/Gleysols
RIF	Regeneration Improvement Felling
SOC	soil Organic Carbon
SOP	Standardized Operational Procedures
SFM	Sustainable Forest Management
STAGBAK	Mangrove Rehabilitation Subproject funded by the Japan Bank for International Cooperation and implemented in Puerto Princesa City

TDW	Total dry weight
TFW	total fresh weight
UNU	United Nations University
UoR	University of the Ryukyu
UPLB	University of the Philippines Los Baños
USAID	US Agency for International Development

Appendix 5. Philippines

Appendix 5.1 Results of policy consultation meeting with various stakeholders and institutions in The Philippines

Based on Republic Act 7161 known as the “Revised Forestry Code of the Philippine” – Increasing the forest charges on Timber and other forest products. In this code, section 71 stated that commercial cutting in all mangrove species is not allowed. This code is contrary to DAO 10 of 1998 under Community Based Forest management (CBFM) that there is a component of cutting. In short, some sections of the policies in Community Based Forest Management (CBFM) are contradictory to RA 7161.

The challenge is we cannot undo the CBFM on the ground particularly in production areas. Many mangrove areas are under CBFM and PO's project sites are both CBFM. Mangrove policy is more on the protection/preservation rather than on the production and utilization, but when people are consulted, they want to harvest it for their subsistence. Communities want a provision for production or utilization in the bill since areas are CBFM.

In 17th Congress-Senate bill **1308 of 2016** (new proposed bill) in which the tone of this bill is strengthening the no mangrove cutting which is strictly more on preservation, conservation, reforestation, afforestation and sustainable development of mangrove forest which more on the ecological. In short, the new proposed bill is more on the protection and rehabilitation, although sustainability was mentioned but the real context of sustainability is not yet clear.

The challenge is what would be the impact of this new bill on CBFM communities and applicability of bill in the current CBFM areas.

Proposal

- To pilot Banacon site for sustainable management of mangrove through thinning and pruning in monoculture plantation. With this, amendments of including the thinning and pruning as part of silvicultural treatment, provided that capacity building and strict monitoring, compliance and accountability

With this, policy consultations were conducted in the following agencies:

- Local Mangrove Communities in Bohol (March 22, 2016); Palawan (April 15, 2016)
- Forestry Development Center (FDC) - August 09, 2016
- Biodiversity Management Bureau (BMB), July 26, 2016
- Ecosystem Research and Development Bureau (ERDB) - August 22, 2016
- NGO's for Fisheries Reform (NFR) - October 21, 2016
- Forest Management Bureau (FMB) - Policy section office and interviewed Ms. Edna Nuestro and staff - October 21, 2016
- Forest Management Bureau (FMB) - Office of the Director, interviewed Director Ricardo Calderon - October 21, 2016
- Bureau of Fisheries and Aquatic Resources (BFAR) - Melanie Guerra (OIC, Fisheries Policies and Economic Division)

Appendix 5. 2. Table 1. Summary of insights / perspectives on the implications of current and proposed policy (s) on community-based mangrove management.

Agency/Institution	Point of view	Suggestions
<p>1. Forestry Development Center (FDC)</p>	<ul style="list-style-type: none"> ▪ There is a need to assess the level of mangrove protected and production purposes. So, mangrove zoning should be done ▪ There is a need to look at the National Inventory of mangrove – how successful are the PO’s ▪ Determination of basic data such as: <ul style="list-style-type: none"> - Present condition of the mangrove - Total hectares of mangrove - Depleted area - PO actively doing rehabilitation and utilizations - Present policy and sections on mangrove - Status of logging - Benefits of mangrove - Reasons for protection - Any existing silvicultural treatments of mangrove species– such as pruning, thinning as one way of alternative livelihood sources? - Review of related literatures such as protected functions, livelihood and ecotourism opportunities, ecosystem services, economic values, income, food, livelihood, <p>Apprehensions:</p> <ul style="list-style-type: none"> ▪ Once you allow the community to do thinning, that is the opportunity for cutting. ▪ If amendments in mangrove forest code under CBFM to include utilization of timber, how different will it be in protected areas? ▪ In refining the bill, there should be a successful a model of sustainable forest management that will serve as a pilot site. 	<ul style="list-style-type: none"> - Conduct a policy forum, regional consultation - Invite all sectors concerns and speakers from different sectors to give point of view, experiences and related policies - Expected output of the workshop: A bill amending section 3 RA 6171
<p>2. Ecosystem Research and Development Bureau (ERDB)</p>	<ul style="list-style-type: none"> • Sustainable thinning use should be considered, given that monitoring is in place. Considering the opportunity losses if thinning is not done. • There is a need to do leveling off from the ground • They don’t want to encourage afforestation unless to revive the mangrove areas • Some LGUs allowed the POs to do thinning 	<ul style="list-style-type: none"> • To come up a policy paper and studies to support particularly on thinning for the policy paper • To conduct national policy forum inviting different

	<ul style="list-style-type: none"> • To have national mangrove committee or national council to monitor the mangrove. • Determine the use and alternative non-wood livelihood benefits • Policy gaps regarding Nipa • Secure profiles and maps on mangroves 	<p>stakeholders. ERDB will help in conducting a forum, provided that basic data about mangrove should support it.</p> <ul style="list-style-type: none"> • ERDB plans on Policy forum 2nd international mangrove congress to be held next year 2017 sponsored by ERDB.
<p>3. NGO's for Fisheries Reform (NFR)</p>	<ul style="list-style-type: none"> • Total log ban is not ideal. There is need for thinning • Production and utilization should be considered since the people in the communities also need poles for housing • No charcoal for commercial purposes • POs target wants to plant since it is their source of livelihood • There is a need of clear guidelines in physical reversion between BFAR and DENR. BFAR Converted areas to aquasilviculture just to keep the FLA holder areas • Sustainable development concept in mangrove areas should focus on ecotourism and non-wood benefits such as collection of shellfish. 	<ul style="list-style-type: none"> • Regular monitoring system should be well implemented. • Advocating with Multispecies and not on monoculture since forest is not just a trees it is about biodiversity.
<p>4. Forest Management Bureau (FMB)</p>	<p>1. Key points from Ms.Edna Nuestro (Policy section)</p> <ul style="list-style-type: none"> • If planted by the communities or production forest harvesting should be allowed as sustainable forest. • We cannot encourage farmers to plant if they are not allowed to harvest or do thinning. Thinning is just part of silviculture system treatment and thus is a way of improving the trees. • CBFM serves as a window for communities to access for consumption not in commercial purposes. CRMF should be included. 	<ul style="list-style-type: none"> • Inventory on planted trees through GEOTAG should be done to improve tracking system. • Conduct mangrove survey nationwide as data base for the mangrove areas using modern technologies

	<ul style="list-style-type: none"> • Forest landuse planning as focus activities for 2017-2018 • Lack of clear guidelines and files should be secured. <p>2. Key Points from Director Ricardo Calderon</p> <ul style="list-style-type: none"> • We should allow harvesting as long as mangrove trees are planted by the communities. • Planted mangrove as of 2016 planted should not be harvested and be treated as natural, however, mangrove to be planted by 2017 onwards allowed for utilization and sustainable use. • Established mangrove plantations should be registered and manage it well • Pilot site in Caranglan, Pantabangan, Nueva Ecija: Doing charcoal in legal way.. Charcoal bricketting as a business model. There is a hub and market. • Thinning is just part of silvicultural treatment or sanitation cutting even pruning particularly in urban areas. 	<ul style="list-style-type: none"> • Preserve the natural mangrove stands. But encourage investment in mangrove plantation and allow to harvest. • Newly planted that could be harvest even for fuel wood etc. • Conduct policy forum and invite Senators
<p>5. Bureau of Fisheries and Aquatic Resources (BFAR)</p>	<p>Points for consideration:</p> <ul style="list-style-type: none"> • Surface issues when it comes to rehabilitations on degraded or abandoned fishponds. • More on the statics and status and cases on aquasilviculture <p>Key points from Ms. Melanie Guerra</p> <ul style="list-style-type: none"> • Talks about 5 Year Development Plan on Aquasilviture (2012-2017) on mangrove rehabilitation • Communities Fisherfolks can start planting of mangrove trees with incentive of 1.50 per mangrove propagule once planted. Pag tumubo makakuha ng additional some of a total P 8.50 • Community organizer in partnership with 63 SUCs and LGUs. Specific intervention with the SUCs is to manage the lying 	<ul style="list-style-type: none"> • Currently, intensifying program for aquasilvi culture

	<p>in of hatchery of crabs and this will serve as aquasilvi culture.</p> <ul style="list-style-type: none"> • BFAR also provide fencing materials (wooden bamboo sticks) just to prohibit the cutting of mangrove para hindi na mag cut ng mangrove. • Statistics on FLAs will be acquired thought the Fisheries Regulatory and Quarantine Division (FRQB). In terms of abandoned, unproductive and underutilized fishponds. Contact: Atty. Annie Veto or Ms. Mary Ann Gonzales - National Aqua Brackish Technology Center based in Pagbilao (Dr. Romeo Dietha). Technologies adopted are based on their recommendations/guidelines. They would normally recommend that whatever species growing in the areas will be the same species in the areas to be rehabilitated. • No harvesting in mangrove forests, would be good for them. It gives them livelihood benefits (non wood) particularly, the gleaners. 	
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Appendix 5.3. List of conferences attended sharing APN project results:

Local

GEVANA D, CAMACHO L, CAMACHO S, IM S. 2017. Carbon sequestration of mangroves, Paper presented during the symposium on mangroves for climate adaptive and resilient communities held at Waterfront Cebu City Hotel, Lahug, Cebu City, Philippines last December 19 to 20, 2016

International

Camacho L, GEVAÑA d, CAMACHO s. 2017. Economic Valuation for Sustainable Mangrove Ecosystems Management in the Philippines. International Conference on Sustainable Mangrove Ecosystems 2017. Bali, Indonesia. 18-21 April 2017. (Oral Presentation)

GEVAÑA D, PULHIN J, PULHIN F. 2017. Community-based Mangrove Management in the Philippines: Experiences and Challenges of Forest Governance in the Context of Climate Change. International Conference on Sustainable Mangrove Ecosystems 2017. Bali, Indonesia. 18-21 April 2017. (Oral Presentation)

SOFRONIO C, GEVAÑA D, CAMACHO L. 2017. Potential Costs and Benefits of Carbon Sequestration in Mangrove Forest in Bohol, Philippines. International Conference on Sustainable Mangrove Ecosystems 2017. Bali, Indonesia. 18-21 April 2017. (Poster Presentation)

GEVAÑA D, CAMACHO L, CAMACHO S, IM S. 2017. Stand Density Management and Blue Carbon Stock Potential of *Rhizophora stylosa* Plantation in Bohol, Philippines. International Conference on Sustainable Mangrove Ecosystems 2017. Bali, Indonesia. 18-21 April 2017. (Poster Presentation)

GEVAÑA D, CAMACHO L, CAMACHO S, IM S. 2016. Reconciling the Environment and Economic Potentials of Community-managed mangroves for timber and blue carbon stocks: The Case of Bohol, Philippines. International Conference on Sustainable Forest Development in View of Climate Change (SFDCC2016). Kuala Lumpur, Malaysia. 8-11 August 2016. (Oral Presentation)

APPENDIX 5.4. PHOTO DOCUMENTATION OF THE STUDY SITES AND POLICY CONSULTATION MEETINGS IN THE PHILIPPINES

4A. Survey Community at Banacon Island, Bohol



Mangroves in Banacon Island



The Team during the survey activities in the community and visit to the study site





Appendix 4b. Survey Community at Barangay Kamuning, Puerto Princesa City, Palawan

Mangroves in Barangay Kamuning, Puerto Princesa City, Palawan





The Team during the survey activities in the community and visit to the study site









3C. Policy Consultation Meetings

Local Community, BAFMAPA, Banacon, Bohol





DENR-CENRO, Talibon, Bohol



Policy Consultation with DENR-CENRO



Local community in Puerto Princesa, Palawan





Forestry Development Center (FDC) - August 09, 2016





Ecosystem Research and Development Bureau (ERDB) - August 22, 2016



Biodiversity Management Bureau (BMB)





NGO's for Fisheries Reform (NFR) - October 21, 2016



Forest Management Bureau (FMB) - Policy section office and interviewed Ms. Edna Nuestro and staff - October 21, 2016





Forest Management Bureau (FMB) - Office of the Director, interviewed Director Ricardo Calderon - October 21, 2016



Bureau of Fisheries and Aquatic Resources (BFAR) - Melanie Guerra (OIC, Fisheries Policies and Economic Division)



Appendix 6. Myanmar

Appendix 6.1. Questions and Topics of Research for Stakeholder Discussion in Myanmar

- Who own the coastal forests in the study areas? Who is conserving the coastal forests for sustainability? Who has the main responsibility to manage the coastal forests? Do you also get the support and help from government organizations and others?
- Do you also participate in the establishment of plantations by forest department?
- Do you also have CF plantations and how do you organize CF and how do you share the benefits?
- Do you also have home garden or agroforestry or agro-silvo-pastro around your village or near your home? And if yes, how much?
- Is there any land use conflict whenever you establish coastal plantations?
- How do you share the benefit from coastal forest plantations?
- Do you also face climate change effects?(eg- increase in temperature, decrease in biodiversity, climate change, how do you feel currently?)
- How will you adapt if you face climate change effect like Nargis in future?(Will you move to more safety area or will you stay in here or will you conserve the forests)
- Do you think that coastal could survive/ protect for climate change like Nargis? Do coastal forests provide others services?
- How do you prepare to survive the climate change like Nargis?
- Do you prepare individually or with the arrangement of all members of the village?
- Is there any adaptation activities to climate change from Forest Department or NGOs or other governmental organizations?
- How do you prepare and protect the climate change activities?

Dialogue with head of the village

- Who own the coastal forests in the study areas? Who is conserving the coastal forests for sustainability? Who has the main responsibility to manage the coastal forests? Do you also get the support and help from government organizations and others?
- Do you also participate in the establishment of plantations by forest department?
- Do you also have CF plantations and how do you organize CF and how do you share the benefits?

- Is there any land use conflict whenever you establish coastal plantations?
- How do you share the benefit from coastal forest plantations?
- Do you also face climate change effects?(eg- increase in temperature, decrease in biodiversity, climate change, how do you feel currently?)
- How will you adapt if you face climate change effect like Nargis in future?(Will you move to more safety area or will you stay in here or will you conserve the forests)
- Do you think that coastal could survive/ protect for climate change like Nargis? Do coastal forests provide others services?
- How do you prepare to survive the climate change like Nargis?
- Do you prepare individually or with the arrangement of all members of the village?
- Is there any adaptation activities to climate change from Forest Department or NGOs or other governmental organizations?
- How do you prepare and protect the climate change activities?

Questions for Government Staff

- How do you conserve and manage coastal forests?
- Do you also have social problems for the conservation of coastal forests (eg- encroachment in reserved forest).
- Is there enough finance and staffs for conservation of coastal forests?
- Which kind of benefits do local people get from coast forest plantations?
- Do you think that coastal forests could survive/ protect for climate change like Nargis? Do coastal forests provide others services?
- How do you prepare to survive the climate change like Nargis?
- Is there any adaptation activity to climate change cooperation with NGOs or other governmental organizations?
- How do you prepare and protect the climate change activities?

APPENDIX 6.2. PHOTO DOCUMENTATION OF THE STUDY SITES AND POLICY CONSULTATION MEETINGS IN MYANMAR

Stakeholders discussion in Wah Kone Village



Stakeholders discussion in Padauk Pin Seik Village



Dialogue with village head in Padauk Pin Seik Village



Planting around shrimp and fish ponds





Nursery for private plantation



Agroforestry



Community Forest Plantation



Homegarden



Cyclone Shelter

