

Study on the Establishment of Demonstration Site for Peatland Conservation through Integrated Management and Sustainable Utilization of Non-timber Forest Products (NTFPs)

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Abstract: A participatory action research was conducted in 2022, with the “Establishment of Demonstration Site for Peatland Conservation through Integrated Management and Sustainable Utilization of Non-Timber Forest Products (NTFPs)” to give recommendation on the development of guidelines on Sustainable Utilization of Non-Timber Forest Products (NTFPs) and peatland conservation. According to the peat soil assessment, it was found that peat soil content was very low and top soil was thin under the mangrove forest, and *Payena paralleloneura*-Kan Zaw bearing forest in March 2022. Organic material might be pressed by trespasser to collect Kan Zaw seed, to conduct horticulture and mining near the Kan Zaw bearing forest, or organic material might be damaged by burning with controlled fire in the previous years, under Kan Zaw trees to collect seeds. Organic material might have been carried to the downwards with running water due to the heavy rainfall, with 4,700 mm/year. Mangrove forest and Kan Zaw bearing evergreen forest can be assumed as “the major source of coastal peatland formation, with peat deposits eroded seawards”. It is assumed that the organic material will accumulate on top of the sands and it will lead to the formation of the peatland at coastal zone. It can be assumed that the accumulation of organic material found in mangrove forest and evergreen forests will promote the soil carbon storage, if we can adopt the ASEAN Policy on Zero Burning, which reflect ASEAN's commitment to controlling fires and haze, offering techniques, benefits, requirements, and challenges for implementing zero burning practices [1]. Sustainable utilization of NTFP including peat and Kan Zaw-*Payena paralleloneura* Kurz seed was studied at demonstration sites, and it is recommended to make a trial on silvicultural system at mangrove forest and apply suitable silvicultural system such as Clear-Felling (in blocks or in alternate strips) system, Selection System, and Shelter Wood System to ensure the sustainable utilization of NTFP from mangrove forest [2]. Gap planting and assisted natural regeneration are also recommended for mangrove forest and Kan Zaw-bearing forest.

Key words: Silvicultural system, mangrove forest, moist evergreen forest, peat soil, Kan Zaw-*Payena paralleloneura* Kurz seed.

1. Introduction

Sustainable Management of Peatland Forests in Southeast Asia SEA peat Project conducted “Peat Assessment in 2014” in Seven Townships in Tanintharyi Region [3], and collected sixty-six soil samples from seven locations. Soils which contain high organic matters were found under the close forest of Pa Law, Myeik and Boke Pyin Townships. Forest Resource Environment Development and Conservation Association (FREDA) team recommended making more detailed

assessment in Tanintharyi Region. So, we continued a research on the “Establishment of Demonstration Site for Peatland Conservation through Integrated Management and Sustainable Utilization of Non-Timber Forest Products” from January 2022 to September 2022. Research project site is located at (11°11'44.39" N, 98°44'18.15" E and 10°48'60" N, 98°40'57.96" E), Tanintharyi region, Kawthaung District, Bokpyin township, Thaephyu village, and Aye Mya Thar Yar village. The study was done with the objectives of the sustainable utilization of non-timber forest products

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(NTFPs) from mangrove forest, and conservation and management for sustainable utilization of Kan Zaw *Payena paralleloneura* tree.

2. Literature Review

Sustainability is identified by Myanmar forest policy (1995) to ensure sustainable development of the forest resource both for environmental and economic purposes. Sustainability is one of the six imperatives of Myanmar Forest Policy in managing the forests to ensure in perpetuity, the level of benefit both tangible and intangible for the present and future generations. It also implies the maintenance and rational use and enhancement of the forest resources base to ensure ecological resilience and its contribution to socio-economic growth on a continuous basis. It also aims to provide basic needs such as fuel, water, fodder, shelter, food and recreation from the forest in Myanmar forest policy. The Forest Law, enacted in 2018, also has the objective to implement sustainable forest management in order to support sustainable development¹. So research team made a study on the sustainable utilization of NTFPs at two community-owned ever green forest and Mangrove forest of Bokpyin township.

In National Forest Master Plan (2001-2030), it is targeted to establish 2.27 million acres of Community Forest areas and aimed to support about 25% of fuelwood requirement by local people from the Community Forests. Ministry of Natural Resources and Environmental Conservation issued the new Community Forestry Instructions in 2019. The objectives of the Community Forestry are to provide forest and tree-related basic needs such as wood and non-wood forest products for local communities; to enhance employment and income opportunities for local community and reduce poverty; to increase forest covered area in a sustainable manner and to ensure sustainable utilization; to promote participatory forest management system, and to enhance environmental services that can support

climate change mitigation and adaption through preventing deforestation and forest degradation. According to the Community Forestry Instruction (CFI), natural forests such as Kanzaw bearing evergreen forest near Aye Mya Thar Yar villages and mangrove forest along the coastal area of Tanintharyi region which were being conserved by the local communities in accord with their tradition pursuant, can be established as Community Forest (CF) with the permission of the government and authorized person or the owner(s) of private-owned land [4].

Mangrove forests reduce coastal erosion rates and help build up land and consolidate sediments. Benefits to the coastal region are also significant. Mangrove wetlands help maintain the coastal hydrological regime potentially reducing inland flooding. Myanmar is the largest country in mainland Southeast Asia with a continuous coastline extending along the Bay of Bengal and Andaman Sea. The Rakhine coastline is about 740 km long and extends from the Naff River to Mawtin Point. The deltaic coastal region extends about 460 km from Mawtin Point to the Gulf of Mottama (Martaban) and consists of the entire river-mouth areas of three major rivers: the Ayeyarwaddy, Sittaung and Thanlwin. The 900-km long Tanintharyi coastline extends from the Gulf of Mottama south to the mouth of the Pakchan River. It is fringed in the southern part by the Myeik (Mergui) Archipelago Island chain [5].

In many coastal areas there is high human population pressure, such as the rapid development of coastal areas, construction of deep sea ports for container shipping and adjacent industrial development, sand mining, urban area expansion, etc. In the coastal zone, mangroves, coral reefs, seagrass beds, sandy beaches and intertidal mudflats are widely distributed and are home to the Irrawaddy dolphin, the sea cow, five species of marine turtle, and many globally threatened water bird species, such as the spoon-billed sandpiper,

¹ The forest law, enacted in 2018.

Indian skimmer and Nordmann's greenshank. The Myanmar coastal zone is also important for fish stocks which support artisanal fisheries, and other livelihoods for local people. Rapid and often unsustainable development is jeopardizing the fragile relationship between these crucial habitats and the livelihoods of rural people who make up a high proportion of the population of Myanmar [5]. Unsustainable development in Myanmar has been damaging the coastal ecosystems (particularly mangroves forests and overfishing), which exacerbate rural poverty in coastal areas. Exploitation of coastal resources has increased to such an alarming rate that is now time for their improved management and sustainable utilization of coastal resources. Coastal resources management includes a wide array of management practices such as land use planning, institutional execution, inspection and control of adherence to decisions, wood and non-wood forest products, fishery resources, hunting, peat and the rights of different interest groups and so on. Conservation of mangrove forest along the coastal area is important to prevent from bank erosion, moreover, conservation of mangrove forest for pasture land of swiftlet bird is also important as they depend on aerial insects. Similarly, its management is too complex to be handled by a sectorial planning and management. To be effective, planning for integrated coastal area management (ICAM) must be coordinated between sectoral implementing agencies. Therefore, to solve this situation in Myanmar, "Union level Coastal Natural Resource Management Central Committee" was formed in 2016, after which, similar committees in State & Regional of coastal region in Yangon, Rakhine, Tanintharyi, Ayerwaddy, Mon and Bago were designated respectively.

Clear-felling (in blocks or in alternate strips) system, Selection System, and Shelter wood System can be applied for the sustainable utilization of NTFP from mangrove forest, if there are sufficient mother trees or seed trees. However, logger selective cutting system may cause permanent gap, if there is not natural

regeneration, and may lead to conduct reforestation at depleted area or gap planting or enrichment planting may require.

Peat swamp forests are tropical moist forests where waterlogged soil prevents dead leaves and wood from fully decomposing. Over time, this creates a thick layer of acidic peat. Large areas of these forests are being logged at high rates. Peat swamp forests are typically surrounded by lowland rain forests on better-drained soils, and by brackish or salt-water mangrove forests near the coast. Tropical peatlands, which coexist with swamp forests within the tropical and subtropical moist broadleaf forests biome, store and accumulate vast amounts of carbon as soil organic matter—much more than natural forests contain. Their stability has important implications for climate change; they are among the largest near-surface reserves of terrestrial organic carbon. Peat swamp forests, which have ecological importance, are one of the most threatened, yet least studied and most poorly understood biotypes. Since the 1970s, peat swamp forest deforestation and drainage have greatly increased. In addition, El Niño Southern Oscillation (ENSO) drought and large-scale fires are accelerating peatland devastation. This destruction enhances the decomposition of soil and organic matter, increasing the carbon release to the atmosphere as carbon dioxide. This phenomenon suggests that tropical peatlands have already become a large carbon-dioxide source, but related data and information are limited. Tropical peat swamp forests are home to thousands of animals and plants, including many rare and critically endangered species such as the orangutan, whose habitats are threatened by peatland deforestation.

NTFPs are useful foods, substances, materials and/or commodities obtained from forests other than timber. Harvest ranges from wild collection to farming. They typically include game animals, fur-bearers, nuts, seeds, berries, mushrooms, oils, sap, foliage, pollarding, medicinal plants, peat, mast, fuelwood, fish, insects, spices, and forage. Overlapping concepts include non-

wood forest products (NWFPs), wild forest products, minor forest produce, special, minor, alternative and secondary forest products.

Payena paralleloneura grows naturally and gregariously at ever green swamp forest, where fresh water is available for them. Seedling of *Payena paralleloneura* can be seen under mother trees. Natural regeneration is good. Ministry of Environmental Conservation and Forestry issued the notification for Kan Zaw *Payena paralleloneura* tree as reserved tree in Tanintharyi region on 14-2-2013 with notification number 17/2013 as it is economically important for rural people, who earn money by collecting Kan Zaw seeds. Kan-zaw (*Payena paralleloneura* Kurz.) plant, belonging to the family Sapotaceae, is naturally found in Tanintharyi Region of Myanmar [6]. It is naturally abundantly found in the Tanintharyi Region, particularly in the lowlands/peatland swamp forest areas of Myeik, Palaw, Kyunsu, Tanintharyi, and Bokpyin Townships. In the Tanintharyi region, there are 36,651 and 4,792 Kan-zaw trees, with 633 and 298 acres in Myeik and Kaungthaung Districts, respectively. Currently, it has been revealed that the communities are used to collecting Kan-zaw seeds in a variety of ways, causing damage to the mother trees and young plants.

Kan-zaw is generally valued for its seeds, which have an abundant amount of oil bearing capacity and are known for their traditional medicinal uses for benefiting against cancer. Traditionally, Kan-zaw seed oil has been used to treat breast, cervical, ovarian, and other cancers, as well as peptic ulcer, paralysis, bronchitis, rash, chest pain, injury, sores, burns, and other ailments via oral administration or external application [7].

The Forest Department is now noticing a reduction in Kan-zaw trees in certain areas and is concerned about valuable trees being lost to extinction. Hence, the Ministry of Natural Resources and Environmental Conservation (MONREC) declared it a reserved tree in 2013 [8, 9]. Kan-zaw tree is important not only for

MONREC but also for local communities since they may earn money by collecting and selling the seeds to purchasers who turn them into therapeutic seed oil that can be used to treat a variety of diseases and injuries.

Blood cockle/clam has ecosystem significance. Blood cockle (*Tegillarca granosa*) can clean water by eating waste, organic material along the coast. So they conserve natural environment of coastal line. Since the blood cockles “eat” the suspended organic material that is in the water, they also “clean up” the waters they reside in, resulting in clearer waters. This special characteristic of many bivalves could be used by humans to filter out harmful bacteria in natural areas. However, blood cockle/clam breeding site may be threatened by clam-killing snail. The moon snail secretes an acid that makes a hole into the shell, and then it inserts its mouth and eats the clam.

One of the NTFPs is bird’s nest in Bokpyin township, annual production of bird’s nest in Bokpyin township is 69.24 viss. (Source: Bokpyin township forest department). Research team made literature review on bird’s nest, to find the relationship with swiftlet birds, aerial insects and the forest found in study area. The grey-rumped swiftlet (*Collocalia marginata*), its natural habitat is subtropical or tropical moist lowland forests. Swifts are terrestrial species that require foraging habitat with high numbers of aerial insects. They are found in virtually any temperate or tropical area, appear over a variety of habitats, often associated with human habitation, and prefer humid areas to arid ones, in lowland rainforest zone. Literature review on “Ecology of Swiftlets for Commercial Edible Bird’s Nests” gives information on harvesting of commercial edible bird’s nests from the nests of the swiftlet species. Edible bird’s nests are made of the hardened glutinous secretion produced from the salivary glands of swiftlets. Commercial edible bird’s nests are mainly harvested from the nests of the swiftlet species: *Aerodramus fuciphagus* and *Aerodramus maximus*. *Aerodramus fuciphagus* is

famed for its high quality white bird's nest due to the small amounts of feathers within, whereas the bird's nests from *Aerodramus maximus* are at least 50% covered with its black feathers. Both types of swiftlet nests are found in limestone caves across the Indo-Pacific region such as Indonesia, Thailand, Malaysia, Myanmar and Vietnam. *Aerodramus fuciphagus* was also found to have built nests in man-made houses within urban areas. Inspired by this observation, man-made bird houses purposefully built to mimic cave conditions have been growing in number in the past few decades for the harvesting of white bird's nest. Swiftlets are insectivorous birds that feed on aerial insects such as Hymenoptera (winged ants, fig wasps and bees), Diptera (flies), Coleoptera (small beetles), etc. Ecologically, the swiftlets are important in controlling the population of insects. Swiftlets, aerial insects and forest are intricately interconnected. Insect predators and parasites are extremely important in controlling many insect, which can attack crops for human. Participation of local authorities and decision makers for the conservation of mangrove forest is required [10].

3. Objective

The objective of research is to recommend on the development of guidelines on sustainable utilization of NTFPs from evergreen forest near Aye Mya Thar Yar village and mangrove forest near Thae Phyu village with the aim of conserving the peatland by using integrated management approach and participatory approach.

4. Materials and Method

4.1 Research Method

Participatory action research (PAR) approach was used in this study [11].

4.2 Research Orientation

Consultation meeting, free, prior and informed consent (FPIC), public awareness raising, training was

made according to the participatory action research PAR approach.

4.3 Collection of Information from Mangrove Forest, and Ever Green Forest Managed by Community Forest User Group (CFUG) of Thae Phyu and Aye Mya Thar Yar Villages

The research team developed demonstration plot at Thae Phyu community forest and Aye Mya Thar Yar, proposed community forest and studied the current situation.

The research team conducted quick survey on utilization of NTFPs, by using survey questionnaires and made interviews at two villages to collect information. The research team discussed Thae Phyu CF management committee on the topic of silvicultural systems applied in managing mangrove forest. Clear-felling (in blocks or in alternate strips) system, Selection System, Logger selective cutting system, and Shelter wood System were discussed. Awareness on the advantages and disadvantages of these systems was raised. Moreover, field observation was made in the mangrove forest. The silvicultural system applied in Thae Phyu CF is selection system. It was found that the mother tree, or seed trees were protected. The seed falling from mother trees germinated naturally, and natural regenerations were found under the mother trees. Land clearing to change land use was not found in Thae Phyu CF. Kan Zaw-bearing forest near Aye Mya Thar Yar village is a remnant natural area, i.e. it is left over area due to the presence of Kan Zaw trees to be able to collect seeds from it, after the surrounding area had changed to oil palm, rubber, betel nut.

Integrated management committee was formed consisting the staff from forest department and management committee members from two CFUG members. Research team members communicated with the integrated management committee members to analyze the information, to assess the issues and develop the recommendations for the "Sustainable Utilization of Non-Timber Forest Products" at ever green forest and

Mangrove forest of Bokepyin township, Kawthaung District, Tanintharyi Region, Myanmar.

Moreover, research team raised questionnaires concerning the current status of community forestry in Bokpyin township. Staff officer and range officers from Bokpyin township forest department answered the questions.

Research findings were presented to government organizations and community forest management committee members by holding online exit workshop to get their comments and approval.

5. Result and Finding

5.1 Peat Soil Assessment

Peat soil assessment was conducted at Thae Phyu Community Forest and Aye Mya Thar Yar Proposed Community Forest. Peat soil assessment was done at the following places and soil samples were collected on 5th March, 2022. Top soil of tidal forest is covered with root, aerial root, clay soil, mud soil, and sand. Mud and claysoil, loamy soil is found up to two feet. Sand stone is found at three to four feet depth. Rock stone found at four feet, and cannot continue to dig, to explore. So, peat soil content is very low in mangrove

forest. (Table-1)

5.2 Peat Soil Assessment at Aye Mya Thar Yar Proposed Community Forest

Peat soil assessments were done at the following places and soil sample were collected.

It was also learnt that the fruits of kantzaw tree (*Payena paralleloneura*) were used to be collected by the local people for additional income by selling the seeds for medicinal purpose.

On 30 March, 2014, peat assessments were carried out by Forest Resource Environment Development And Conservation Association (FREAD) team and local Forest Department and Agricultural Department staff in Tanintharyi Region, under SEApeat Project (Myanmar Component). The team assessed the area of Bok Pyin Township, Tanintharyi Region: Aye Nyein Thar Yar Village. At that place, the team collected eighteen soil samples and measured the depth of soil. (Table-2) The thickest of soil was 1.92 m and the thinnest was 15 cm. Forest Resource Environment Development And Conservation Association (FREAD) survey team noticed that forest fire occurred during dry season. Burnings threaten peatlands particularly those that have dried out in 2014 [12].

Table 1 Location of the Peat soil assessment, conducted at Thae Phyu Community Forest.

Sr	N			E			Depth	Weight of soil sample
	Degree (°)	Minutes (')	Second (")	Degree (°)	Minutes (')	Second (")		
1	11 °	11'	44.39"	98 °	44'	18.15"	0'-2'	697 g
2	11 °	11'	43.15"	98 °	44'	17.38"	0'-2'	633 g
3	11 °	11'	41.64"	98 °	44'	17.54"	0'-2'	655 g
4	11 °	11'	40.65"	98 °	44'	18.49"	0'-4'	750 g
5	11 °	11'	39.25"	98 °	44'	18.79"	0'-4'	

Table 2 Location of the Peat soil assessment, conducted at Aye Mya Thar Yar Proposed Community Forest.

Sr	N			E			Depth	Weight of soil sample
	Degree (°)	Minutes (')	Second (")	Degree (°)	Minutes (')	Second (")		
1	10 °	48'	56.60"	98 °	40'	57.96"	2'-4'	657 g
2	10 °	48'	52.73"	98 °	40'	54.50"	0'-2'	9 g
3	10 °	48'	51.78"	98 °	41'	56.76"	0'-2'	742 g
4	10 °	48'	39.10"	98 °	41'	54.41"	Upper layer	454 g
5	10 °	48'	33.50"	98 °	41'	54.87"	0'-2'	

Peat soil in *Payena paralleloneura* Kan Zaw forest was damaged by Kan Zaw seed collectors, by pressing the organic material or by burning controlled fire in the previous years. Existence of horticultural land in surrounding area, illegal mining near peat soil, and trespassing of Kan Zaw seed collectors are the drivers of the loss of peat soil. Drainage and forest fire is not found in current year. On the other hand, the study area has heavy rainfall with mean annual rainy days being 133 days, mean annual rainfall being 185 inches per year or 4,700 mm/year, and organic material might have been carried to the downwards with running water. Driftwood at the mouth of stream in sea is collected by community to use as firewood.

5.3 Finding at Mangrove Forest

Research team studied the management plan of Thae Phyu community forest [13], and it is found that the forest type of Thae Phyu community forest is mangrove forest, and it is located at 11°11'44.39" N, 98°44'18.15" E, and near Thae Phyu village, Kamar chaung village tract, Bokpyin township. The area of Thae Phyu CF is 216 acres. Land use and land cover changes can be assessed in that area regularly.

Mangrove forest near Thae Phyu village is a part of the 900 km long Tanintharyi coastline extending from the Gulf of Mottama south to the mouth of the Pakchan River. This area is under the management of the regional level Coastal Natural Resource Management Committee, Tanintharyi region. According to the study on Google map near Thae Phyu village, it is visible that the coastal bank near Thae Phyu village had eroded and the village had to be relocated on the inner land. It can be compared that the coastal bank without mangrove tree has more bank erosion rate than the coastal bank where the mangrove trees are growing.

Mangrove stands recovered naturally and artificially. CFUG members tried gap planting. It has 54 CFUG members. Thae Phyu CF is managed by management committee, and management plan was formulated, and management activities are being implemented by

CFUG members. Thae Phyu village has 105 households as of March 2022. Thae Phyu villagers' livelihood is mainly fishing and horticulture.

NTFPs produced from the forest are poles, firewood, honey, *Phoenix paludosa* shoot, *Bruguiera gymnorhiza* shoot, Areca species (Wild betel nut), *Nypa fruticans* (Dani for roofing), *Merope angulata* (Taw Shauk) for subsistence use. There is small amount of honey collection for subsistence use. *Xylocarpus moluccensis* and *Xylocarpus granatum* Konig species are very rare in CF. *Nypa fruticans* (Dani/Nypa palm tree) were found only in the small area of CF.

According to the answer of CFUG members during questionnaire survey, and field observation, it was recorded that 37 mangrove species can be found in 2022 at Thae Phyu CF, which include *Acanthus ilicifolius* L., *Acanthus volubilis* Wall., *Acrostichum aureum* Linne, *Acrostichum speciosum* Willd., *Amoora cucullata* (Roxb), *Ardisia litoralis*, *Avicennia marina* (Forssk.) Vierh., *Avicennia officinalis* L., *Avicennia alba* Blume, *Bruguiera cylindrical* (L) Bl., *Bruguiera gymnorhiza* (L.) Lamk, *Bruguiera parviflora* (Roxb.) W. & A. ex Griff, *Bruguiera sexangula* (Lour.) Poir, *Ceryota urens*, *Ceriops decandra* (Griff.) Ding Hou, *Ceriops tagal* (Perr.) C.B Robinson, *Cynometra ramiflora* L., *Dalbergia spinosa* Roxb., *Dendrobium moschatum*, *Diospyros embryopteris*, *Excoecaria agallocha* L., *Heritiera fomes* Buch. Ham., *Heritiera littoralis* Dryand., *Hibiscus tiliaceus* L., *Merope angulata* (Willd.) Swingle, *Mucuna gigantea* DC., *Nypa fruticans* (Thumb.) Wurmb., *Phoenix paludosa* Roxb., *Phragmites karka* (Retz.) Trin. ex Steud., *Rhizophora apiculata* BL., *Rhizophora mucronata* Lamk., *Salacia prinoides* DC. *S. chinensis* L., *Sonneratia alba* J. Smith, *Sonneratia caseolaris* (L.) Engl., *Sonneratia griffithii* Kurz., *Xylocarpus granatum* Konig, *Xylocarpus moluccensis* (Lamk) M. Roem [14].

There is no land use change for agricultural land. So there is no loss of CF area from original 216 acres. CFUG members harvest 1,000 poles, under one feet

girth size annually for construction and repairing of house. Poles are harvested with selection felling system. Some villagers collect driftwood at the mouth of stream in sea to use as firewood. Spot or gap and open canopy is found after harvesting poles with selection system. Logger selection system conserve the mother tree in mangrove forest. Seed and fruit from mother trees germinate when they fall to the ground. The gaps become closed after five to six years, when the advanced growth grown up. Each household extracts poles for every three years for construction and repairing of house.

Clear felling system is not applied to prevent from deforestation. CFUG members harvest fuelwood from CF, however there is no charcoal burning and export of charcoal to Thai. CFUG harvest *Ceriops decandra* (Griff.) Ding Hou (Kabyai) tree as thinning, and it can be used as fence post, post for aquaculture and so on. Kabyai, a kind of mangrove tree species, which grows in dense, cannot grow more than wrist size (3-6 inches girth). Kabyai does not decay under water, and it can be used as post for netting for longer period.

According to the transplanting experience of the seedling of *Bruguiera gymnorhiza* (Saung/Byu Oaksaung) and *Rhizophora mucronata* (Payon/Byu Chay Htauk) from nursery to plantation site, survival percentage was very low. Research team asked U Win Maung, project director of World View International, why the survival (%) of seedling transplanting is lower than direct seed sowing. According to the answer from World View International, it is learnt that the seedling of mangrove species in nursery can penetrate into soil deeply when the age of seedling is older than five months, and root can get hurt while transplanting, and survival (%) can drop, due to the damage in root system while transplanting.

Prize awarding program was initiated to encourage to plant seeds of mangrove species at Thae Phyu Community Forest, for awarding 500/-Kyats for one survive seedling at survival counting period. CFUG

members planted 1,000 seeds of mangrove species in 2022 rainy season.

Natural regeneration was good enough for these species. CFUG members make patrolling to control illegal logging and illegal harvesting. Patrolling is done once a week. CFUG members need fund for regular patrolling their CF, and requested help fund to conduct.

It was found that number of CFUG members had increased. CFUG members has increased from 44 to 54. So, it can be assumed that the stakeholder participation is increasing in the Thae Phyu CF.

The issues found at Thae Phyu village was over harvesting of fuelwood for brick production, and bank erosion at coast line, the impact of sand mining for Bokpyin airport construction in the past, almost all households were relocated at upper land. According to the study on Google map near Thae Phyu village, it is visible that the coastal bank near Thae Phyu village had eroded and the village had to be relocated on the inner land. It can be compared that the coastal bank without mangrove tree has more bank erosion rate than the coastal bank where the mangrove trees are growing.

CFUG does not have other income from CF, they need fund raising for patrolling activity, from blood cockle breeding near CF. CFUG explained that blood cockle breeding is economically sound or profitable. This research project supported 1,200,000 Kyats for blood cockle trial breeding to be able to use the profit in patrolling activities at mangrove forest. CFUG can conduct patrolling their CF while breeding blood cockle (*Tegillarca granosa*).

The information found from internet shows that blood clam has ecosystem significance. Blood cockle (*Tegillarca granosa*) can clean water by eating waste, organic material along the coast. So they conserve natural environment of coastal line. Since the blood cockles “eat” the suspended organic material that is in the water, they also “clean up” the waters they reside in, resulting in clearer waters. This special characteristic of

many bivalves could be used by humans to filter out harmful bacteria in natural areas.

Moreover, it was learnt that, over harvesting of blood cockle (*Tegillarca granosa*) for export may have the impact on sustainability of fishery. It needs to make trial breeding of blood cockle (*Tegillarca granosa*) near the coastal beach of Thae Phyu CF.

However, according to the information and experience from CFUG of Irrawaddy region, care should be taken for clam-killing snail. The moon snail secretes an acid that makes a hole into the shell, and then it inserts its mouth and eats the clam, and it was not successful economically in Irrawaddy region. Chairman of Thae Phyu CF replied that they will take care of “clam-killing snail at their trial breeding site”.

The research team recorded the rainy days and annual rainfall from 2006 to 2021. The mean annual rainy days is 133 days, mean annual rainfall is 185 inches per year or 4,700 mm/year within sixteen years, to review the relation between rainfall, accumulation of organic material, and formation of the peatland in coastal area.

5.4 Finding at Evergreen Forest Located at Aye Mya Thar Yar Proposed Community Forest

Research team studied the prevention measure of Bokpyin township Forest Department to protect and conserve the Kan Zaw-bearing forest near Aye Mya Thar Yar village [15]. Bokpyin township Forest Department recommended that the Kan Zaw-bearing forest should be managed with the participation of seed collectors, seed buyers, local community near the forest, and this forest should be managed as community forest.

CFUG and management committee were formed with interested villagers, and application to establish CF was submitted to forest department. CFUG was formed with 10 members on 9th March, 2022. CF management committee was elected from CFUG

members. Chairman of MC of Aye Mya Thar Yar proposed Community Forest and signed the application for the establishment of community forest with Form A. Form A was submitted to Bokpyin Township Forest Department with receive letters number 381/Pa(3)CF on 14-3-2022. However, the proposed Community Forest at Kan Zaw-bearing forest is under the management of the Department of Agricultural Land Management, and Statistics (DALMS), and it may take several years to get the approval to establish Community Forest.

Community Forest proposed by Aye Mya Thar Yar is located at 10°48'56.60" N, 98°40'57.96" E, near Aye Mya Thar Yar village, Kaw Ba Mar village tract, Karathuri sub township, Bokpyin Township, Kawthaung district, Tanintharyi region.

The forest type is evergreen forest. The area of proposed CF is 33.725 acre, and 888 numbers of Kan Zaw *Payena paralleloneura* trees are abundantly growing, and it is managed under the Department of Agricultural Land Management, and Statistics (DALMS).

Bokpyin township Forest Department enumerated the *Payena paralleloneura* tree and recorded the number of trees in one-foot interval girth class, and research team estimated height as follow. (Table 3)

Drainage and forest fire is not found in current year. Lead mining was not found in Kan Zaw forest, however, the water in the stream was polluted with soil and low stream water level was found due to the lead mining around the Kan Zaw Forest. Being the destructive activity for the depletion of peat swamp forest ecosystem, care should be taken in the excess use of water for lead mining.

Payena paralleloneura trees are protected as reserved species with Forest Law, in Tanintharyi region with the notification number 17/2013 by the Ministry of Natural Resources and Environmental Conservation on 14th February 2013.

Table 3 Number of *Payena paralleloneura* tree, recorded by Bokpyin Township, Forest Department, in one-foot interval girth class.

Sr	Girth Class	Number of tree	Estimated height
1	1'0"-1'11"	33	20'-30'
2	2'0"-2'11"	236	30'-40'
3	3'0"-3'11"	177	40'-50'
4	4'0"-4'11"	144	50'-60'
5	5'0"-5'11"	124	60'-70'
6	6'0"-and over	174	70' and over
7	Total	888	

Source: Bokpyin Township, Forest Department.

CF proposed by Aye Mya Thar Yar is surrounded by rubber and betel nut plantations, and Kan Zaw trees are mainly found. Household number of Aye Mya Thar Yar village is 211 in 2022 March. Local community's livelihood depends on rubber and betel nut plantations, and they earn money from Kan Zaw seed at the end of summer and beginning of rainy season.

Associated species with Kan Zaw trees are Salu (*Licuala peltata*), Phat wun (*Hibiscus micropphyllus*), Yay ngan (*Zelacca wallichiana*), and Rattan (*Calamus rotang*). Villagers collect fuelwood, bamboo, bamboo shoot and seed of *Payena paralleloneura*.

Kan Zaw seedlings, saplings are growing naturally under the natural forest. Climber was found on the *Payena paralleloneura* trees. Weeds and climber are competing with natural regeneration of Kan Zaw seedling and sapling.

Research team demonstrated gap planting, assisted natural regeneration, climber cutting, weeding to enhance the growth of Kan Zaw seedling and sapling. Prohibition signboard was fixed to prevent from illegal felling of Kan Zaw, a reserved species.

During the fact finding process, sapling stage of Kan Zaw trees was found at the house compound of two villagers from Aye Mya Thar Yar village. They explained that they collected Kan Zaw seeds and planted at their home compounds last three and five years ago. Moreover, Chairman of Kaw Bamar village tract planted Kan Zaw seed on his land and near village tract office. He told that one Kan Zaw seedling grows about one feet within one rainy season. It needs to

evaluate by doing survival counting periodically.

Most households collect Kan-zaw seeds for commercial use. During the Kan-zaw seed collecting season, people from other places as well as local people came to collect Kan-zaw seeds. Some Kan-zaw seed collectors collect the seeds and sell directly to the buyer, while others extract the oil and sell it. Income from Kan-zaw varies from household to household members who can collect seeds. Kan-zaw seed can be collected in quantities ranging from 4 to 50 kg per family in 2021, however, in 2022 fruiting period most of the villager earn money by doing tin mining. Seed collectors come from various villages, and their records were not available. Birds eat Kan-zaw fruits and the seed spreads at other places. Kan-zaw trees have alternated fruit bearing cycles. So the productivity of seed from a Kan-zaw tree is not available.

The selling price of Kan-zaw seed is approximately 16,000 Myanmar Kyats (MMK) per kilogram. If Kan-zaw seed is extracted for oil, 0.33 kg of oil can be extracted from 1 kg of seed, and the price of Kan-Zaw oil is about 120,000 MMK per kilogram.

6. Recommendation on Peatland Conservation and Sustainable Utilization of NTFPs

(1) Although the content of organic material is very low in mangrove forest and *Payena paralleloneura*-Kan Zaw bearing forest, they should be conserved as they are the major source of coastal peatland formation, with peat deposits eroded seawards.

(2) Lead mining was not found in Kan Zaw forest, however, the water in the stream was polluted with soil and low stream water level was found due to the lead mining around the kan-zaw bearing forest. Being the destructive activity for the depletion of peat swamp forest ecosystem, care should be taken in the excess use of water for lead mining.

(3) It requires to apply sustainable forest management practice at the mangrove forest and Kan Zaw-bearing evergreen forest with the aims of sustainable utilization of NTFPs such as poles, firewood, honey, *Phoenix paludosa* (Thin baung/Luu) shoot, *Bruguiera gymnorhiza* (Byu Oak Saung) shoot, Areca species (Wild betel nut), *Nypa fruticans* (Dani for roofing), *Merope angulata* (Taw Shauk), and Kan Zaw seeds.

(4) It should conserve and protect the rare species such as *Xylocarpus moluccensis* and *Xylocarpus granatum* Konig species in Thae Phyu CF, and reserved species such as Kan Zaw.

(5) It requires sustainable livelihood and income generation for the local community. Mangrove forests are important for sustainable development of fishery aquaculture, and bird's nest breeding in Tanintharyi region. Mangrove forest should be protected and conserved for the sustainable production of crabs, shell fish, shrimp, etc.

(6) Mangrove forest should be conserved to prevent from coastal bank erosion, and natural disasters such as storm, tsunami wave, etc.

(7) According to lesson learnt from past experience of coastal bank erosion and loss of village resident area, sand mining along the coast should be banned. According to the study on Google map near Thae Phyu village, it is visible that the coastal bank near Thae Phyu village had eroded and the village had to be relocated on the inner land. It can be compared that the coastal bank without mangrove tree has more bank erosion rate than the coastal bank where the mangrove trees are growing. WAVEPLUS Sand bags should be used to prevent village compound area from coastal

bank erosion. Moreover, mangrove tree along the coastal bank should not be cut to prevent from coastal bank erosion.

(8) Conservation of mangrove forest along the coast of Bokpyin township is required for the sustainable bird's nest breeding at home along the coastal line of Bokpyin township, because swiftlet birds depend on aerial insects which come from forest.

(9) Care should be taken for urban development planning, encroachment of illegal houses, expansion of town, road construction across the stream, which can disturb flow of saline water for mangrove forest ecosystem.

(10) It requires to control use of wood from other parts of mangrove forest, at coastal line for charcoal burning for subsistence use and commercial purpose including illegal export of charcoal to Thailand.

(11) It is recommended to apply a silvicultural system such as Clear-Felling (in blocks or in alternate strips) system or Selection System or Shelter Wood System in managing the mangrove forest for sustainable utilization of NTFP and ecosystem services.

(12) Logger selective cutting system should not be applied, because this system does not take into consideration the existence of the regeneration, and it may cause degradation of forest, permanent gap or spot, loss of biodiversity, etc.

(13) Alternative fuel energy should be considered to substitute wood energy from mangrove forest especially for brick production.

(14) The Kan Zaw-bearing forest near Aye Mya Thar Yar village should be managed by the participation of community, because it is important for the livelihood of local community, and it should be protected from land use change for oil palm plantation, rubber plantation, betel nut plantation, and tin or lead mining.

(15) Systematic seed collection methods for Kan Zaw seeds should be applied to ensure the sustainable utilization of NTFP. Rules and regulation should be issued on zero burning in seed collection, land clearing, felling trees to collect seeds, collection of germinated

seeds, seed collection period, purchase of entry ticket to collect Kan Zaw seeds from CF. It is recommended to manage collecting, harvesting and utilizing NTFPs sustainably, and conduct awareness raising, training, and fixing notice signboards for sustainable utilization of NTFPs. It is recommended to develop guidelines to avoid extreme forest production and usage and inconsiderate NTFP utilization from Kan Zaw bearing forest.

(16) It needs to consider removal pass and collection of revenue if Kan Zaw seeds or Kan Zaw oil are transported outside of the township area, within country by Forest Department. It also needs to consider CFUG members and management committee members of Aye Mya Thar Yar who propose Community Forest, to raise fund for the maintenance and conservation of their CF.

(17) It needs to strengthen the protection, conservation, and sustainable management of territorial ecosystem, peat swamp forest, mangrove forest, and evergreen forest in Tanintharyi region, because these ecosystems are being threatened by oil palm, rubber, betel nut and so on.

(18) Conservation of remaining Kan Zaw-bearing forest is important, and land use change should be controlled, because most of the land had changed to oil palm, rubber, betel nut, and road construction in Tanintharyi region. In Tanintharyi region, 566,812 acre were permitted for oil palm planting, and 180,037 acre were planted with oil palm. There is a link between deforestation and oil palm plantations in Tanintharyi Region. Deforestation is concentrated in the southern plantation zone around Bokpyin and Kawthaung townships. The analysis shows that oil palm plantations have likely resulted in the loss of between 118,000 and 152,500 acres of forest since 2000. It was recommended that the Government of Myanmar review all oil palm permits in areas of intact forest, to align with the government's commitments under the Aichi Targets of the Convention on Biological Diversity and the United Nations Framework Convention on

Climate Change (UNFCCC) to achieve zero net deforestation [16]. Rubber plantations in Tanintharyi region is 343,052 acre in 2015-2016 [17].

(19) Most Kan-zaw plants do not develop fully in private plantations, and their tops are dried and then died, because Kan-zaw usually grows naturally in peat swamp forest. So, soil type and topography may have an impact on the growth and survival of the Kan-zaw plantation.

(20) It needs to develop optimum management approaches to sustain natural seedling regeneration in the forest, particularly in Kan-zaw. It is recommended to clear unwanted species around the Kan Zaw seedling, in order to increase the growth of Kan-zaw trees. It is recommended to sow Kan-zaw seeds directly as gap planting in the forest if there is enough space. It needs to prevent seed collectors who are coming from other regions to avoid excessive seed collection. Gap planting and assisted natural regeneration, thinning, improvement felling, climber cutting are also recommended to improve forest productivity and to ensure sustainable utilization of NTFP.

(21) For the stable market, it needs to estimate the contribution of NTFP income to the livelihoods of local community in terms of subsistence and cash income, investigate the national versus international market potentials of some of the high-value NTFPs, such as medicinal plants, bamboo products, etc., undertake a more detailed market survey and stakeholder livelihood analysis on specific NTFPs that already have markets or have a potential market, and control the quality of Kan-Zaw oil for trust building between producer and consumer. It needs to develop a detailed NTFP-management plan, update forest and land use policies with specific focus on NTFPs, to provide local communities with more incentives for NTFP-domestication initiatives that may include access to land and NTFP resources, credit, awareness programs, planting materials, and training on planting techniques, to conduct research on NTFP-related ecosystem restoration pilot projects in degraded forest areas and

develop strategies for sustainable NTFP management. Further study on market stability, value changes, demand and supply is required.

(22) Concerning biodiversity, extraction of rare species such as *Xylocarpus moluccensis* and *Xylocarpus granatum Konig* species, should be avoided and remaining rare species, reserved species such as Kan Zaw, should be conserved as mother trees or seed trees for their regeneration.

(23) The conservation of biodiversity and ecosystem should also be considered while improving forest productivity and ensuring sustainable utilization of NTFP.

(24) Participatory monitoring, evaluation and learning approach should be applied periodically for land use and land cover change assessment, implementation of CF management plan at the study area.

(25) Land use and land cover change assessment should be conducted regularly at 11°11'44.39" N, 98°44'18.15" E, and near Thae Phyu village, Kamar chaung village tract, Bokpyin township, and Kan Zaw bearing forest, 10°48'56.60" N, 98°40'57.96" E, near Aye Mya Thar Yar village, Kaw Ba Mar village tract, Karathuri sub-township.

7. Conclusion

Strengthening sustainable forest management at mangrove forest, peat swamp forest, Kan Zaw-bearing forest is important for the sustainable utilization of NTFP, and other ecosystem services. Stakeholder engagement and people participation are required for sustainable development.

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