

Full Length Research Paper

Assessing different land use pattern and livelihood of the local people in the mangrove area (Case study in Pyapon Township)

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In Ayeyarwady region, Pyapon Township, mangroves are unfortunately being degraded and destroyed on a large scale through overexploitation of mangrove products, and through habitat destruction by conversion to other land uses. To sustainably manage the sustainability of mangrove's services which all can meet the needs of social, environmental, and economical conditions, assessment on the different land use pattern and livelihoods of the local people is necessary. The main objective of this study was to assess the different land use pattern and livelihoods of the local people in the Pyapon Township to sustainably manage the mangrove's services which can meet the needs of social, environmental and economical conditions. An extensive field survey was performed throughout the study area using Global Positioning System (GPS) equipment. GIS analysis was also carried out in each village using the digital data of Landsat 7 satellite imagery for land use mapping for the year 2014. Simple random sampling with sampling intensity of 50% in War Kon village which has a total of 95 households, 25% in Kanyin Kon village which has 198 households and 50% in Padauk PinSeik which has 49 households, was carried out in order to focus on the different land use pattern and livelihood of local people. This study describes the study area is plagued by Agriculture followed by Mangrove plantation and Fish Pond. The main livelihood patterns of the three villages in the study area are almost the same; community forest plantation, Nipa plantation, home garden, fishery as they have shrimp and fish ponds and fuel-wood collection. For that reasons, awareness raising programs in reforestation, rehabilitation and conservation of the mangrove forests are paramount essential for the local people. At the same time, the technical support of a proper management system based upon ecological knowledge is mandatory in order to secure sustained yield of coastal resources.

Key words: GIS analysis, agriculture, simple random sampling, Nipa plantation, fish pond

INTRODUCTION

A mangrove is a woody plant or plant community which lives between the sea and the land, in areas which are folded by tide for part of the time. Mangroves make up

one of the world's most unique ecosystems because they thrive where no other trees can survive, in the transition zone between the ocean and land are found

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(Miththapala, 2008). Mangroves are found between the latitudes of 32°N and 38°S of the globe and also in the mouths of estuaries and in inner tidal areas.

Approximately one fourth of the world's coastline comprises mangrove ecosystems which are estimated to extend along an area of between 167,000 and 181,000 km², in 112 countries (Spalding et al., 1997; Kathiresan and Bingham, 2001). Forty percent of mangroves occur in South and Southeast Asia regions (Spalding, 1997) and single largest area of mangroves in the world lies in Bangladesh in the Sunderbans, extending over 600,000 ha (Bandaranayake, 1998). It is one of the most productive ecosystems and a natural renewable resource. The importance of mangroves can be recognized with its services as: (1) provisioning services: flora and fauna of mangroves provides many goods to humans, (2) regulating services: mangroves protect the shoreline, trapping pollutants, reducing floods, (3) supporting services: mangroves are important in carbon sequestration, promote land accretion, support the sustainability of coastal biodiversity, enriching nutrients, and (4) cultural services: mangroves provide aesthetic services (Miththapala, 2008). However, mangroves are unfortunately being degraded and destroyed globally on a large scale through overexploitation of mangrove products, and through habitat destruction by conversion to other land uses as agriculture, and shrimp farming and aquaculture. Therefore, assessment on the different land use pattern and livelihoods of the local people is necessary to manage the sustainability of its services which all can meet the needs of social, environmental, and economical conditions.

Mangrove Forests in Myanmar

Mangroves are generally accepted as a life-supporting and highly productive ecosystem. Particularly the people living in coastal areas are dependent on mangrove forests for their basic needs and livelihoods. Mangrove ecosystem is a breeding ground for fish, crustaceans and mollusks and also a natural habitat for a wide range of aquatic life. Being fragile, mangrove forests need to be prudently managed and conserved to ensure sustainable use of mangrove forest resources.

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 to have decreased by approximately 50% in by 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 extraction of fuelwood and charcoal and encroachment of agricultural expansion.

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. It is also necessary to assess the different land use pattern and livelihoods of the local people to manage social, environmental, and economical sustainability of mangrove forests.

The study was conducted to achieve the following objectives:

- (a) To assess different land use pattern in the study area
- (b) To investigate different livelihood patterns in the study area
- (c) To recommend suitable land use pattern for the sustainable livelihood improvements of local people in the study area.

LITERATURE REVIEW

Importance of Mangrove Ecosystem

Mangrove forests are extremely important coastal resources, which are vital to our socio - economic development. A vast majority of human population lives in coastal area, and most communities depend on local resources for their livelihood. The mangroves are sources of highly valued commercial products and fishery resources and also as sites for developing a burgeoning eco-tourism (Kathiresan and Bingham, 2001). The mangrove forests have been shown to sustain more than 70 direct human activities, ranging from fuel- wood collection to fisheries (Dixon, 1989; Lucy, 2006). The mangrove ecosystem values to society estimated around the world is given in the [Table 1](#), 1997.

Economic Benefits

The mangroves supply forestry products (firewood, charcoal, timber, honey etc.) and fishery products (fish, prawn, crab, mollusk etc.). Due to high calorific values, mangrove twigs are used for making charcoal and firewood. One ton of mangrove firewood is equivalent to

5 tons of Indian coal, and it burns producing high heat without generating smoke. The mangrove wood with high content of tannin is used as timber for its durability. The pneumatophores are used to make bottle stoppers and floats. *Nypa* leaves are used to thatch roofs, mats and baskets. Shells of mangrove mollusks are used to manufacture lime. Mangroves attract honey bees and facilitate apiculture activities in some areas. For instance, the Sundarbans provide employment to 2000 people engaged in extracting 111 tons of honey annually and this accounts for about 90% of honey production among the mangroves of India (Krishnamurthy, 1990). In Bangladesh, an estimated 185 tons of honey and 44.4 tons of wax are harvested each year in the western part of the mangrove forest (Siddiqi, 1997). The best quality honey is produced from *Aegialitis rotundifolia* and *Cynometra ramiflora*. The bulk of honey seems to come from *Ceriops*. Mangroves and especially *Avicennia* form cheap and nutritive feed for buffaloes, sheep, goats and camels. These animals are allowed to graze in mangrove areas and camels are periodically taken to uninhabited islands with a good mangrove cover for grazing. This is very common in India, Pakistan, Persian Gulf region and Indonesia (Qasim, 1998). To cite an example, about 16,000 camels are herded into the mangroves of Indus delta of Pakistan (Vannucci, 2002). Mangrove extracts are used in indigenous medicine; for example, *Bruguiera* species (leaves) are used for reducing blood pressures and *Excoecaria agallocha* for the treatment of leprosy and epilepsy. Roots and stems of *Derris trifoliata* are used for narcotizing fishes, whereas *Acanthus ilicifolius* is used in the treatment of rheumatic disorders. Seeds of *Xylocarpus* species have antidiarrhoeal properties and *Avicennia* species have tonic effect, whereas *Ceriops* produce hemostatic activity. Barks of *Rhizophora* species have astringent, antidiarrhoea and antemetic activities. Tender leaves of *Acrostichum* are used as a vegetable and a beverage is prepared from the fruits of *Sonneratia* spp. Extracts from mangroves seem to have a potential for human, animal and plant pathogens and for the treatment of incurable viral diseases like AIDS (Kathiresan, 2000). The mangroves provide seeds for aquaculture industries. To cite an example, 40,000 fishers get an annual yield of about 540 million seeds of *Penaeus monodon* for aquaculture, in the Sundarban mangroves of West Bengal (Chaudhuri and Choudhury, 1994). One hectare of mangroves can yield 767 kg of wild fish and crustaceans, which is more than the yield in extensive system that can yield $<500 \text{ kg ha}^{-1} \text{ yr}^{-1}$. Each hectare of a managed mangrove system produces as much as \$ 11,300 a year at par with an intensive shrimp farming (Primavera, 1991). Apart from these direct products, the mangrove ecosystems provide a number of ecological services.

Ecological Services

Much of the ecological service of mangroves lies in protecting the coast from solar UV - B radiation, "green house" effects, and fury of cyclones, floods, sea level rise,

wave action and coastal erosion. Mangrove swamps act as traps for the sediments, and sink for the nutrients. The root systems of the plants keep the substrate firm, and thus contribute to a lasting stability of the coast. The ecosystem provides a source of food, breeding grounds and nurseries for many food fishes and shellfishes, and they do very often encourage and attract other kinds of wildlife. They further help in offering protection to other associated flora and fauna of the ecosystems including the islands. The mangrove ecosystems are highly productive and comparable to good agricultural land. Benefits of mangroves are 25 fold higher than that of paddy cultivation.

MATERIALS AND METHODS

Description of the Study Site

The study area is located in the Pyapon District which is situated in Ayeyarwady Delta, Myanmar with an area of approximately 5517.42 km^2 . 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 gymnorhiza*, *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.



Figure 1: Study area

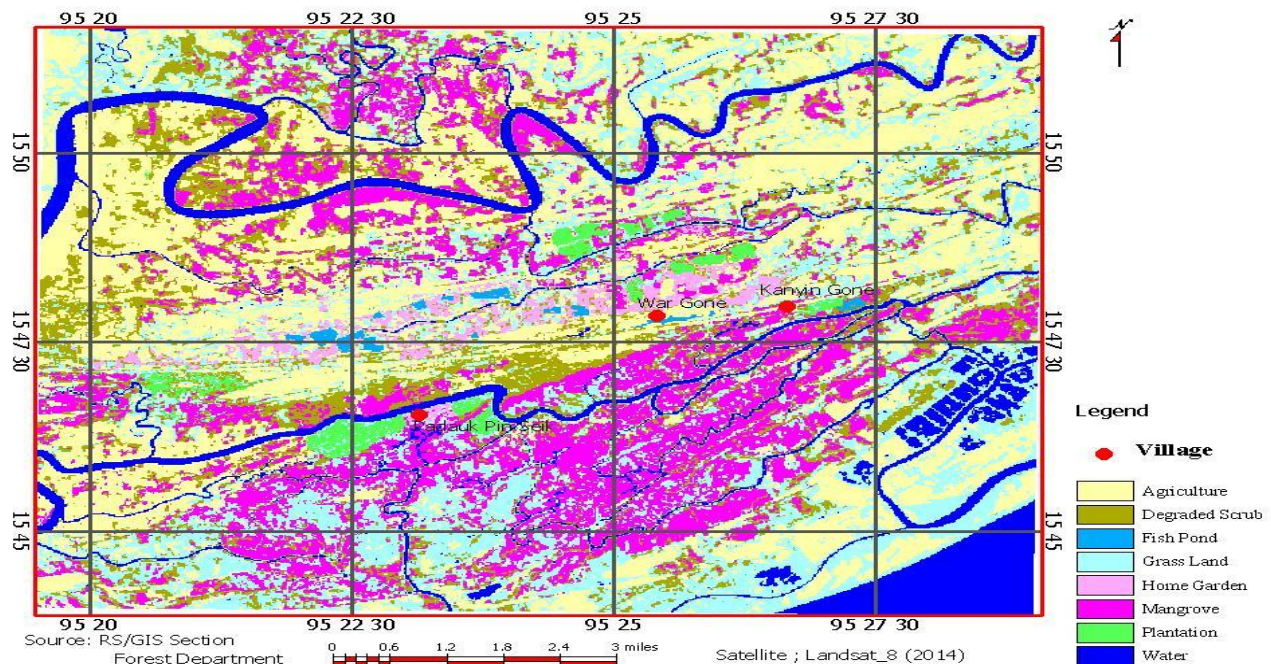


Figure 1b

Data Collection and Analysis

GIS analysis

GIS analysis was also carried out in each village using the digital data of Landsat 7 satellite imagery for land use mapping for the year 2014. Before the preprocessing 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.

Semi structure interview Survey, questionnaires with local people

Simple random sampling with sampling intensity of 50% in War Kon village which have has a total of 95 households, 25% in Kanyin Kon village which have has 198 households and 50% in Padauk PinSeik which has 49 households, was carried out in order to focus on the different land use pattern and livelihood of local people; 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 on local people. Focus group discussion was also carried out with different -aged of people. Before the interviews were administered, pre-test interviews were conducted to ensure that the questions were comprehensible and appropriate. Interviews took place face to face with the head of the household. The data was analysed using statistical tools.

RESULTS AND DISCUSSIONS

Different Land use Pattern in the Study Area

All the lands are state-owned in Myanmar but the farmers have the customary right to make use of the land with permission from the Government Authority concerned. Human settlement takes place in the reserve forest mainly for their livelihood. Most of them are farmers and the rest earn their living by the plantation establishment, home garden, fishing, catching crabs and traditional cultivation of prawn. The present land use pattern in study area is as follows; Physiognomically, *Nipa fruticans* (Nipa) is a prevailing mangrove species, particularly in the low ground levels. *Nipa fruticans* tend to establish homogenous stands but also mixed with *Kandelia candel* (Baing daung she), *Avicennia* species and *Sonneratia* species. The high ground area is dominated by *Phoenix paludosa* (Thinbaung) and *Hibiscus tiliaceus* (Thin ban) which is seldom reached by brackish water during high tide. In the southern coastal lines, high salinity tolerant species such as *Avicennia marina* (Thamephyu), *Avicennia alba* (Thamegyi) are widespread. The following figure shows different land use pattern in the study area by GIS analysis.

By observing the Figure 1b, the study area is overwhelmed by Agriculture followed by Mangrove plantation and Fish Pond.

Assessment on Socio-economic condition

Villages in coastal area

There is neither electricity and water supply nor gas in the houses. Even no car on the street is found. However, villagers are blessed with lots of blinking stars and fireflies at night. Their life might not be substantially rich, but the calm and serene time which is not felt in the city is flowing.

Topographic feature

Everywhere in Pyapon township is extremely low and flat. Topographically, it is categorized in tidal, coastal area and sand dune. Small tidal creeks are occurred anywhere in the area. Terrestrial forest on the land where is higher ground level are observed. The former is a coastal world of rich ecosystems; the latter is a rather dry area that various sizes of villages, paddy fields, coconut palms, home gardens and others are found.

Rainy and Dry season

During the rainy season, the full of fresh green is the right timing for coastal species planting. But, both sea and river are rough when it is stormy. It is very dangerous by small boat trip and much care should be taken. Although the best time for site visiting is December in winter and in dry season it is hard for mangroves to grow.

The world of creeks

Mangrove water ways look like the museum of boats. The Ayeyarwady Delta is the wetlands where tidal creeks run like fishnets. Most of the mangrove plantation sites are visited those tidal creeks. In recent years, engine boats have been increasing, but still a few. Most of them are rowing boats. Even children as well as adults can manage to row. Sails help making use of winds. Small boats with humble cloth sails or single nipa frond sails are found.

Livelihood of local people in the study area

The local people living in the study area depend on the nearby forest plantations and home garden for their subsistence needs as well as for their livelihoods. The number of households in three villages is about 350 having a population of about 1800. Almost all of the people are Myanmar, and the major religion is also Buddhism. The literacy rate is rather low because there is only two graduated persons and also people who finished their high school education can be found in a limited

number. Currently, there is only a middle school in the Kanyin Kon village.

According to the results of social survey, different livelihood patterns and percentage of sources of income of the local community in the study area is roughly described in the following chart.

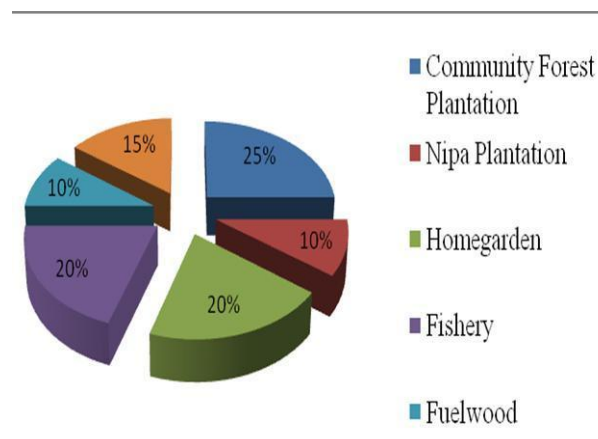


Figure 2: Livelihood of local people in the study area

In the study area, about 62 % of the households are poor in economic status and possessing the lowest plantations and home garden, and some are landless people. The main livelihood patterns of the three villages in the study area are almost the same; community forest plantation, Nipa plantation, home garden, fishery as they have shrimp and fish ponds and fuel-wood collection. Among all households, about 75 households possess community forest plantations having about 1 to 4 hectares respectively. The rest landless people collect firewood from the community forests and also the natural forests and this is also one of the livelihood options for local people as well as one of the drivers to deforestation. Some households, without having cultivated land, work as forest plantation labor in the others' lands, collect firewood and catching fish, pawns and crabs from the nearby forest.

All of the households use only firewood as energy for cooking because there is no electricity supply for their village. They usually collect those fuelwoods from the nearby forests and as a result, collecting and selling of fuelwood for salt and dried shrimp processing is one of the main threats of degrading and destroying coastal forests. Local people usually practice collecting fuelwood from the forests for their alternative income and also main income for landless people.

Nypa fruticans Wurmb (*Nypa*)

Nypa fruticans is locally called Dani. It is only one species under monocotyledonous family Arecaceae (Palmae) and genus *Nypa* which is monotypic and (Teo et al., 2010). It is widely distributed in South and Southeast Asia

(Hamilton & Dennis, 1988). It can achieve the height up to 10m (Tomlinson, 1986). The distinct characteristic of *Nypa* is the absence of an upright stem (Teo *et al.*, 2010). The plant is viviparous and is of true mangrove species. A cluster of erect, pinnate leaves is supported by the terminal shoots. The leaf stalk is 1-1.4 long and strongly projected at the base. There are 100-120 leaflets which are more or less 60-130 cm long and 5-8 cm in width in each leaf stalk. The upper surface of the leaflet is shiny-green (FAO, 2001). The inflorescences of flowers produce a fibrous chestnut-brown fruit and form a large spherical infructescence. There are air cavities in the seed coat and fruits are fibrous. The fruits are normally dispersed by means of water.

Traditionally, leaves are used for thatching and are also used to make umbrellas, raincoats, hats, mats, baskets, cigarette wrappers and also as a source of fuel wood. About eleven gallons of sweet syrup (sugar sap) can be extracted from the young inflorescence stalk in three months (Whitmore, 1977) and which has been used to produce alcohol, sugar and vinegar. The fibers from leaf stalk can be utilized to produce ropes, brooms and brushes.

Agriculture and Fishery

Farmland is very few in the study area. Crops cultivated and limited only on the sand bar are coconut, rice, sour leaves, betel leaves and others. Coconut is an important cash crop. Vegetables are cultivated in each home garden, but both quantities and varieties are not much. Paddy is poor by not only area but also harvest rate. More vegetables are obtained from home garden. It is necessary to develop home gardens for the improvement of the nutrition of villagers.

Fresh Water Problem

The diseases of the digestive system are commonly found because of the insanitary water. In the dry season, the villagers need to buy water that leads to a heavy burden for the household economy. Water problem is a serious matter of health and economy of local residents. It is necessary to encourage the clean water support with efficient and effective efforts.

Health Issue

The medical facility is necessary in most villages. They have only midwife and health problems are many, and the solution is not easy.

Disturbance

The disturbing factors for mangrove growth are not a few; grazing by water buffalo and cattle, insect attack, damage by crab, diseases and others. However, the most serious damage results from human activities such as the

invasion of shrimp ponds and fuelwood collection from coastal forests.

CONCLUSIONS AND RECOMMENDATIONS

These changes in mangrove forests cover were affected by two activities: deforestation and replanting, but planting capacity was slower than deforestation. Recent mangrove changes are due mainly to agricultural and shrimp farming expansion, which is developing in an unplanned way. Agricultural and Shrimp **shrimp** farmFishery development and degradation also caused environmental and natural re- sources problems with socio-economic consequences such as land degradation, environmental pollution, the conflicts among natural resource users and the gap between the rich and poor. Reforestation of abandoned agricultural farms shrimp ponds might be a good solution to improve the sustainability of this ecosystem before a new government master plan of land use for the coastal zone can be developed.

The main causes of deforestation in the Ayeyarwady mangrove forests are due to socio-economic problem of the local communities. In these areas, the local people are very poor and they don't know about the conservation and sustainable use of these invaluable natural resources. So awareness raising programs for local people to take part in reforestation, rehabilitation and conservation of the mangrove forests are also important. Moreover, coastal forests are one of the most productive ecosystems in the world and of great importance due to their protective values. It is mainly crucial for the Ayeyarwady Delta of Myanmar as a shelterbelt against natural calamities. A proper management system based upon ecological knowledge is mandatory in order to secure sustained yield of coastal resources.

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