

Sustainable Livelihood of Vulnerable Communities in Southern Coast of Bangladesh through the Utilization of Mangroves

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Abstract: It is well known that mangrove forests are enriched with a source of livelihood for coastal communities in developing countries which enhance coastal waters, yield commercial forest products, protect coastlines, and support coastal fisheries. Local communities in the coastal areas of Chittagong highly depends on fisheries and coastal resources for their livings. This study was conducted in three coastal villages, Bagachattar, Ichakhali and Kattoli, at Sitakunda-Mirsarai coast of Chittagong using Participatory rapid appraisal (PRA) tools. Participatory rapid appraisal was utilized to elucidate the mangrove related livelihood activities in the coastal communities. A total of 23,838 ha has plantation and exist in the 6528 ha in study areas. The main causes of destruction are river erosion, cyclone and human encroachment. The Ichakhali and Bagachattar area have no aquaculture practice commercially though the areas are suitable for commercial culture. In Kattoli area commercial aquaculture farm have been grown rapidly which increase the pressure on adjacent mangroves.

Key words: Mangrove forests, coastal communities, livelihood, river erosion, human encroachment, aquaculture.

Introduction

A large majority of the population in the world are living in the coastal zone and local resources like mangroves are considered as the primary sources of their livelihood development. Many researchers have recorded that mangrove forests support about hundred types of human activities starting from fuel wood collection to fisheries resources. In current times another new feather of carbon sequestration has been included to the circle of this fragile mangrove ecosystem. Earliest assessments indicate that the Above Ground Biomass (AGB) of World's mangrove forest can sequester 3,700 trillion gm of carbon and about 14-17 Trillion gm of carbon are sequestered by mangrove sediments/year (Banerjee et al., 2014; Mitra, 2015; Pal et al., 2016; Chowdhury et al., 2017).

Global climate alteration is one of the greatest challenges that humans will face in this century. Mangroves provide important provisioning (e.g., timber and food, including fisheries production), regulating (e.g., climate regulation, water purification, coastal protection, erosion control), cultural (e.g., recreation, aesthetic value, spiritual value), and supporting (e.g., nutrient cycling) services to millions of coastal residents in tropical and subtropical latitudes around the globe. By understanding these mangrove stands are able to survive unexpected natural changes. Building resilience with mangrove requires an understanding of how mangroves secure the community demand directly or indirectly. Resilience is the ability of a system to undergo, absorb, and respond to change and disturbance, while maintaining its functions (Carpenter et al., 2001; Polidoro et al., 2010; Barua et al., 2011; Donato et

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al., 2012; Atkinson et al., 2016). Mangrove forests are extremely important coastal resources, and are sources of highly valued commercial products and fishery resources and also as sites for developing a burgeoning eco-tourism (Kathiresan and Bingham, 2001; Warren-Rhodes et al., 2011; Costanza et al., 2014; Mukherjee et al., 2014).

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) which are vital to socio-economic development. Bangladesh Forest Department has been starting extensive afforestation activities along the coast and offshore islands to protect coastal lives and properties from tidal surges and cyclonic storms since 1966. Mangrove occurs in Sitakunda-Mirsarai coast as a planted stand. The world's biggest mangrove plantations have been established along the coastal belts and offshore islands of Bangladesh (Mittra and Banerjee, 2004; Hossain, 2009; Chowdhury et al., 2011). The planted mangrove areas in Bangladesh have been gradually expanding while the other forest types are shrinking mainly due to population pressure.

Coastal areas are highly populated in many parts of the world. It is estimated that 40% of the world population lives within 100 km of a coastline (UNDP, 2000) and this figure is expected to grow further in the coming half century. Bangladesh is one of the coastal marginal countries where coastal area represents an area of 47,211 km², 32 percent of the country's area. Meanwhile coastal areas population is increasing at a faster rate in urban areas. PDO-ICZMP (2004) showed a projection that population of Bangladesh would increase from 35 million (2001) to 42 million in 2015 and 58 million in 2050.

In the studied areas, coastal marginal communities' socio-economic and cultural life is closely interwoven with the surrounding flora and fauna, its lunar and tidal and seasonal cycle and their associated fish, shrimp, crab and other floral and faunal reproduction seasons. The fringe like root system of mangroves acts as a coastal stabilizer and binder of sediment and so aid in preventing erosion in the coastal areas (Dave, 2006; UNEP-WCMC, 2006). The objective of this study is to assess the spatial distribution and the dealings of marginal community for their livelihood amid mangrove forest.

Materials and Methods

Study Area

Sitakunda-Mirsarai area, one of the oldest sites of human

habitation in Bangladesh, is situated in the northwestern part of Chittagong district. The geographical location is in between 22°24' to 22°50' N latitude and 91°28' to 91°46' longitude (Figure 1) from the mouth of Big Feni River and in the newly formed coastal land beside Sandwip channel which put up largest planted mangrove forest in Bangladesh. Coastal afforestation programme in the Mirsarai and Sitakunda areas was started in 1968 and 1976 respectfully under Chittagong Coastal Afforestation Division (CCAD). According to the distribution of mangrove, three coastal villages named Bagachattar in Sayedpur union, Ichakhali (Chuni Mizirtake) in Ichakhali union and Uttar kattoli beside Salimpur union were selected for the survey. Moreover, these villages consist a total of 2970 households having population of around 23,000 with 53.7% male and 46.3% female.

Sampling Design

The study was carried out by means of extensive field survey and analyses with relevant document. Landsat TM image was used for the present study. Topographic maps at 1:10,000 scale, published by the Survey of Bangladesh and 1:50,000 scales, published by LGED (Local Government and Engineering Department) were used for ground verification.

Data Collection for the Research Work

Primary Data Collection

Semi-structured interview with five stakeholders groups e.g. fishing community, forest officers and staffs, local administrators (chairman and members of union parisad), local residents, and elite persons (school teacher, respectable elders) were done in the study period for collecting the information about the state of forest and status of dwellers livelihood. The collected data were synthesized and the useful data were extracted for study.

Participatory appraisal involves a series of qualitative multidisciplinary approaches to learn about local level conditions and local people's perspectives. Rapid Participatory Rural Appraisal (RRA/PRA) was carried out using field observations and community level group meeting with different stakeholder groups in the adjacent forest areas from March to October, 2008 in order to gather primary information following the approaches of Pido (1995), Pido et al. (1996), Townsley (1996), IIRR (1998) and Hossain et al. (2004) and also to know the available resources of the mangrove areas as well as their importance for community livelihoods. Direct observation prevents rapid appraisal from being misled

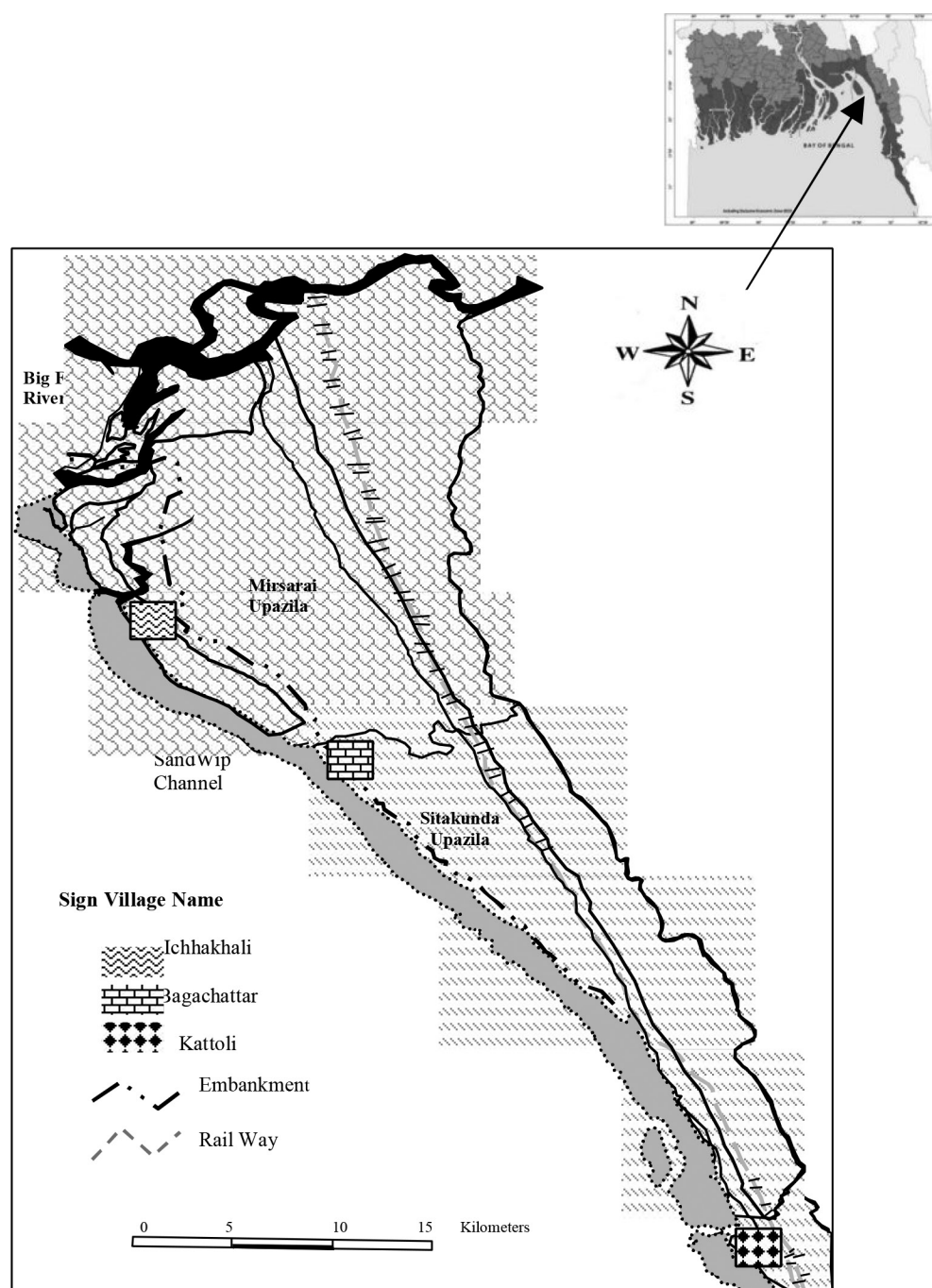


Figure 1: Geographical location of Sitakunda-Mirsarai coast at Chittagong district.

by myth (Chambers, 1980) and it often provides more valid and less costly information than other research methods (KKU, 1987). Group meetings with local communities are the important way of learning about local conditions and resources (Pelto and Pelto, 1978).

Two PRA tools were chiefly employed, the seasonal calendar and transects. The seasonal calendar technique is helpful for documenting regular cyclical periods (i.e., seasonal) and significant events that occur during a year

and influence the life of the community (Tripp and Woolley, 1989; IIRR, 1998; Townsley, 1996; Pido et al., 1996). Community members were asked questions in group meeting regarding the duration of the rainy and dry season, environmental conditions, land use patterns, and their activities.

Group meetings had several advantages, including access to a large body of knowledge and mutual checking. There was a self-correcting mechanism within

the group whereby if one person described an over-favourable picture of his/her own or group's behaviour, a peer may give a more realistic observation. In cross checking among different groups, a high degree of uniformity was maintained. Transect is simply a cross section of a territorial space where fields are mapped, cropping patterns and practices observed. Transects are relatively easy to do, depending on the ruggedness of terrain and visibility as affected by topography and vegetation (Rhoades, 1987). Among the advantages of transect is the simple portrayal of the resources present and the associated economic, social and environmental issues in spatial terms (Pido et al., 1996).

Results and Discussion

Rank of Plantation

From the 1960s structural measures have been undertaken to reduce the vulnerability of the coastal people to natural disasters (Islam, 2004). Under this vision the coast, up to 2007, total plantation was 23,838 ha (Table 1) where 6524 ha of coastal forest was raised with common mangrove species as Keora (*Sonneratia apetala*), Baen (*Avicennia officinalis*) and Gewa (*Excoecaria agallocha*). The plantations lie between 22° 30' N to 22° 59' N latitude and 91° 27' E to 91° 45' E longitude and extends from south to north with an area spreading about 6524 ha. The four beats of Sitakunda Forest Range are Bansbaria, Bhaterkhail, Bakhkhali and Bagachattar (with Kattoli area) covering a total existing area of 3830 ha. On the other side the four beats

of Mirsarai Forest Ranges are Domkhali, Moghadia, Ichhakhali and Bamansundar with the existing forest areas of 2694 ha. All the plantations were raised on a newly accreted flat, stable and muddy coastal land.

The plantation area was extended every year (Figure 2) by planting newly accreted lands on the seaside. Sitakunda area has strong fresh water influence by Domkhali and Badarkhali khal. The positive consequence of conservation options have been found in both natural and human state of affairs in Sitakunda forest area. These are as (a) Plantation continue by the coastal afforestation programme, (b) Natural regeneration and efficient growth of planted species, (c) Less human intervention, (d) Villagers have a positive attitude to protect and maintain the forest, and (e) Favourable environment, semi-diurnal tide, stable accreted land. Therefore another picture was found in Mirsarai area. Less positive consequence of conservation options in both natural and human state of affairs were found. These are as (a) Natural regeneration process and efficient growth of planted species are massively affected by big Feni river erosion, (b) Comparatively more human intervention especially as cattle grazing, and (c) Villagers have a positive attitude but have no protecting and maintaining action.

The present field observations as well as the satellite image (Landsat TM) with Coastal afforestation division data (Table 1) revealed that the forest area has been increased chronologically every year. The factors responsible for the destruction of plantation are mainly river erosion, cyclonic damage and human

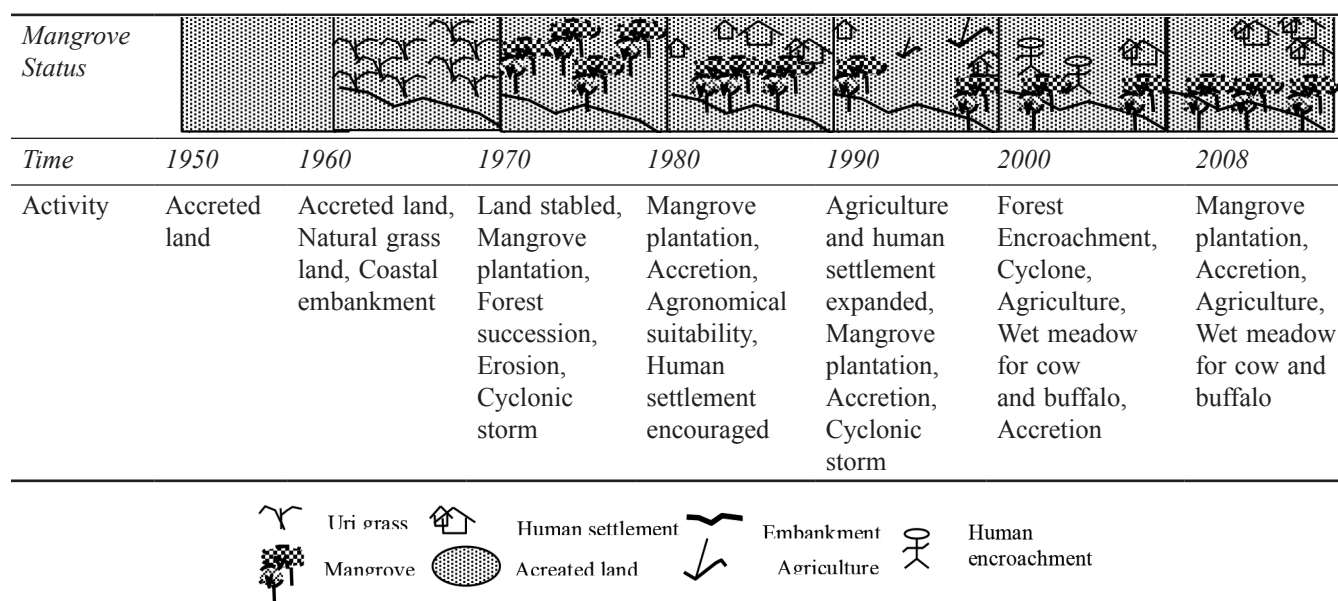


Figure 2: Historical trends of mangrove forest plantation for 50 years time scale in Chittagong coast.

encroachment (Table 2), where a total of 1561 ha was lost during recent years.

Table 1: Mangrove afforestation in the study areas

Year 1967-2007	Total (in ha)
Bamonsundar	2495
Domkhali	2010
Ichhakhali	3883
Mogadia	4966
Bagachattar	1637
Bakhkhali	2517
Bansbaria	3383
Bhatherkhali	79
Kattoli	2868

Source: Coastal afforestation division, Chittagong (Personal Communication, 2016).

Table 2: Chronological destruction options Sitakunda-Mirsarai coast at Chittagong

Year 1968-2007	Location	Total loss (in ha)	Surplus forest
Encroachment	Bagachattar	687	(Bagachattar, 1073;
	Ichakhali	477	Ichakhali, 3469;
	Kattoli		Kattoli, 2263)
Erosion	Bagachattar		
	Ichakhali	397 1561	6805
	Kattoli		
Cyclonic damage	Bagachattar		
	Ichakhali		
	Kattoli		

Source: Coastal afforestation division, Chittagong (Personal Communication, 2016).

Community Interaction and Approach

About 1150 fishermen were engaged straightforwardly for their daily subsistence. The role of the mangrove in the lives of the coastal communities has moved on from a simple view, based on the supply of goods and services, to recognizing the strategic role that mangrove play in helping the poor cope with poverty. Most of the households in these three villages enjoy diverse livelihoods year round from fishing to firewood collect. The respondents identified nine resource user groups of mangrove forest in Chittagong coast (Figure 3). Mangroves are characterized by a higher fisheries biodiversity as well as higher standing stock (Christensen, 1982; Sasekumar et al., 1994). The

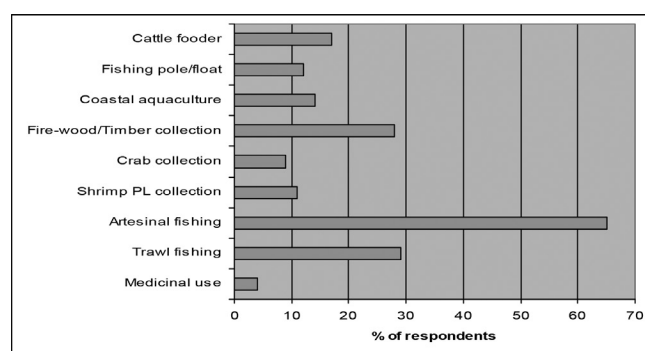


Figure 3: Resource user groups of mangrove forest in the Chittagong coast.

communities of the villages are extremely dependent on both onside (resident species) and offsite (transient species i.e. *Tenualosa ilisha*) fishing activities nearby canals, creeks, and sandwip channel. Shrimp fry (*Penaeus monodon*) and edible size crab (*Scylla serrata*) collection also stimulates the livelihood of the most marginal families, collected by the adolescent boys and girls of the fishermen families. A good number of households are engaged in coastal aquaculture mainly in the Kattoli area. However, ecological and economical significance of mangrove as community resilience are gaining considerable recognition in Sitakunda-Mirsarai coast. In Mirsarai area, buffalo, sheep, cow and goats are allowed to graze incredibly in mangrove areas as the *Avicennia* species are cheap and nutritive feed for the animals. For the everyday cooking villagers burn mangrove dry leaves and branches as favourite firewood to the neighbouring residents.

On the other hand, the larger scale damage of mangroves in the recent past is mainly attributed to a lack of or poor management. The frequency and intensity of catastrophic disturbances in tropical coastal areas has increased due to climate change. The respondents are to always keep in mind the cyclone which occurred on the 29th April, 1991 and this mangrove strip saved them as a natural barrier from massive destruction. However, recently serious human interferences have occurred to clear mangrove for construction of ship breaking yard due to lack of government concern about land zoning (Figure 4). From the SWOT analysis, the strength, weakness, opportunities and threat opportunities for mangrove ecosystem have been found that influence the livelihood development of coastal communities in the study area. In the study area, mangrove forests are acting as diverse habitat for many species, including fish, birds, reptiles, amphibians, mollusks, crustaceans and many other invertebrates. Mangroves act as root of

sea and for sediment control and land formation in the mangrove around the embankment of the study areas.

The study area is situated in the shipbreaking zone and for the expansion of shipbreaking area, mangrove forests are destroyed by the greedy people. Besides, coastal erosion is increasing in the study areas due to rough current and wave of sea around the area and because of absence of mangroves; people are losing their home and land in the study areas due to tidal flood and coastal erosion. Bangladesh Forest Department is planting mangrove species in and around the study area to protect the mangrove forest and coastal communities from cyclone and storm surges. But cattles destroying the nursery of mangrove species and shrimp and prawn fry collectors destroy the nursery beds to collect the fish and shrimp fry in the study area (Figure 4). It faces constant threats from ever-growing population and their demand for shelter and livelihood. Effective management of mangrove habitats can only be possible by the participation of local community and stakeholders.

Seasonal calendar provides a general picture of important environmental and socioeconomic trends throughout the year. Agricultural products are cultivated mainly in the plain land during rainy season beside the forest. Seasonal vegetables, peanuts, muskmelon,


watermelon, and betel nut grow in plain lands and hill slopes during the winter season. Transect analysis is clearly focused on the existing land use pattern, here particularly given of the Sitakunda area. Figure 5 shows the different livelihood activities, problems and available opportunities in this area.

Conclusion

The use of mangroves by humans is not an entirely new idea. The importance of mangrove needs to disseminate among the different stakeholder groups of Chittagong coast. A healthy mangrove forest endowment allows coastal people to live well at or near the subsistence level. The ecological and socio-economical values of Sitakunda-Mirsarai mangrove ecosystems have been recognized by the local users for their safe lives and livelihoods. Newly accreted areas need to be divided into different zones i.e. mangrove plantation zones, aquaculture zone, and grazing zone and also newly accreted lands have to be planted through a participatory approach. It is essential to keep the mangrove forest undisturbed to act as bio-shield to mitigate the effect of cyclones, tidal surges and other coastal natural calamities and to attract the mangrove dependent species to enhance biodiversity that promote coastal community resilience of this region.

Strengths (a) Suitable land formation (b) Potential soil structure (c) Seed availability (d) Nursery production surplus (e) Favorable tide fluctuation	Weakness (a) Community poverty (b) Lack of coordination of among department (c) Lack of institutional management (d) Cattle grazing (e) Wild shrimp fry collection (f) Undefined land utility
Opportunities (a) Afforestation continuity (b) Positive attitude of local community (c) Favorable physio-biological condition (d) Government concern	Threats (a) Ship breaking yard construction (b) River erosion (c) Shrimp & crab fry collection (d) Forest bandits (e) Fuel wood crisis (f) Landless people

Figure 4: SOWT analysis of mangrove conservation in Chittagong coast.



Land Use	Bay of Bengal	Mangrove Forest	Embankment	Human Settlement	Agriculture	Pond	Human Settlement	Agriculture	Highway Road	Sitakunda Hill
Resources	Fish, shrimp, Oyster, Mussel, Crab etc.	Aquatic and terrestrial flora and fauna	Land, Tree, Grass	Tree, livestock	Land	Culture of <i>Loboe rohita</i> , <i>Calia calla</i> , <i>Lates calcarifer</i> , <i>Macrobrachium rosenbergii</i> , <i>Tilapia nilotica</i>	Tree, livestock	Land	Tree beside the roads	Dense forest, birds, other organisms
Livelihood	Fishing, Shrimp fry collection	Fuel wood collection	Local transport, grazing	Housing, gardening, Poultry, Social forestry	Cultivation of rice & vegetable	Culture of <i>Loboe rohita</i> , <i>Calia calla</i> , <i>Lates calcarifer</i> , <i>Macrobrachium rosenbergii</i> , <i>Tilapia nilotica</i>	Housing, gardening, Poultry, Social forestry	Cultivation of rice & vegetable	Fuel wood collection	Employment
Problem/ Issue	Erosion, Accretion, Water pollution, Storm surges	Deforestation			Utilization of pesticides and chemical fertilizers	Commercial culture are not practice		Utilization of pesticides and chemical fertilizers	Busy	
Opportunities	Domestic consumption and export of fishery resources employment	Feeding, breeding and spawning ground, collection of forest resources	Protection, shelter	Family consumption and selling of chicken, duck, goat, Cow and different fruits	Family consumption and selling of product	Family consumption and selling of product	Family consumption and selling of chicken, duck, goat, Cow and different fruits	Family consumption and selling of product	Transport facility, market	Protection shelter, Tourism
Land type		Mangrove		Plain land	Plain land		Plain land	Plain land		Hill

Figure 5: Transect analysis showing present land use pattern of Sitakunda coast.

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