

Review

Some of the major environmental problems relating to land use changes in the coastal areas of Bangladesh: A review

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The present paper is a review to describe the causes of major changes in land use pattern of the coastal zone of Bangladesh and identify the effects on the environmental degradation obviously considered as a man-made disaster in the area. The paper shows that the way of using the lands in the coastal areas are gradually changing, that is, diverse, competitive and alarming. The land use of coastal areas is used in different purposes. This includes: Agriculture, shrimp farming, salt production, forestry, ship-breaking yards, ports, industry, settlements, wetlands etc. The study reveals that land use in this area in 1950 had been mainly used for paddy cultivation, but due to human interferences, the natural drainage systems are greatly hampered and gradually salinity intrusion polluted the water, soil etc in the area. Finally, the paper highlights the suggestive measures to address the problems in coastal land management.

Key words: Erosion, land use change, man-made disaster, water logging, ecosystem.

INTRODUCTION

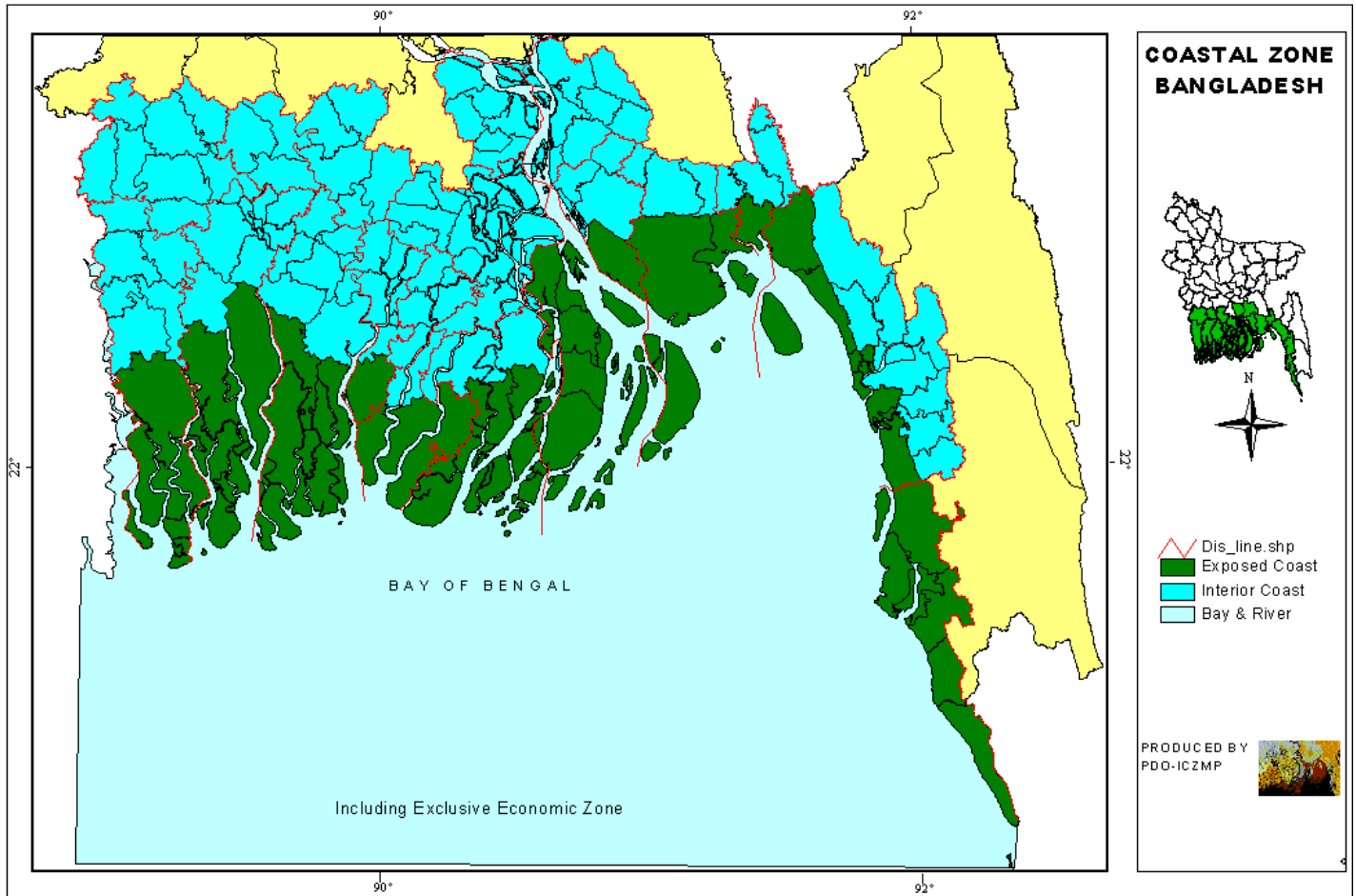
Land use refers to the uses of land for different purposes, which includes wildlife habitat, forest agriculture, settlement etc. It plays a vital role for many planning and management activities concerned with the surface of the earth. The coastal area of Bangladesh covers nineteen coastal districts, continental shelf and the exclusive economic zone (EEZ) of the Bay of Bengal. Natural disasters have direct and indirect impacts on land resources and its various uses. The trend of land uses in coastal areas of Bangladesh is remarkable over the last half century. In these areas, the major land uses comprise agriculture, shrimp and fish farming, forestry, urban development and other settlement needs. There is demand for expansion of all current land use, while the need for new exploitation is also emerging with a huge number of populations. Moreover, land is being degraded and lost due to the effects of increased salinity intrusion, inundation of low-lying marshy land, floods and land erosion by the unplanned and haphazard land use of people.

However, much remains to be done in implementing the recently adopted Coastal Zone Policy (2005) and the establishment of Integrated Coastal Zone Management

(ICZM)- coordination, demarcation of land zoning, mangrove afforestation through community participation, better preparedness against disaster and the introduction of modern land management systems.

Study area

The coastal zone of Bangladesh selected as a study area in this research. The coastal areas cover the nineteen districts in the south and south-east parts of Bangladesh. It occupies 32% of the total area and 28% of the population of Bangladesh (Islam, 2004). It covers an area from the shore of 37 to 195 k.m., whereas the exposed coast is limited to a distance of 37 to 57 k.m. (Islam et al., 2006) . The coastal belt of Bangladesh is divided into three distinct regions, that is, the western, central and eastern regions. The western and central zones are very flat and low. The land here is criss-crossed by numerous rivers and channels with a large number of islands. The western zone of Satkhira, Khulna, Bagerhat, Perojpur is home to the famous mangrove forest, the Sundarbans. A submarine canyon, Swatch of No Ground runs NE-SW up



Map 1. The coastal zone of Bangladesh. Source: Islam et al., 2006.

to about 24 km. South of the western coast of the country. The central region of Barguna, Patuakhali, Bhola, Barisal, Lakshimpur, Noakhali, Feni is geomorphologically most active land formation process making a new shape of land features. These areas are facing a lot of natural hazards that is cyclones, salinity intrusion, tidal surges, floods almost every year (Figure 1).

Moreover, the population is increasing at alarming rate in the coastal areas in Bangladesh. Agricultural laborers, small farmers, fisher folk and the urban poor make up 71% of the 6.85 million households (Ahmad, 2004). Among them about 54% of the people of coastal areas are functionally landless and more than 30% are absolutely landless. Among the landholders, 80% are small farmers, 18% are medium farmers and only 2% are large farmers (PDO-ICZMP, 2004). These have decisive impacts on major economic and livelihood activities, on land use and subsequently on the quality of land.

Objectives of the study

It is well established that the process of land use change

leads to the alteration of existing environmental conditions of any area. The research is fully devoted to visualize the dynamics of landuse change of coastal zone of Bangladesh and its consequential impacts on its landuse and land evaluation and other environmental areas. The specific objectives of the study were:

1. To identify the existing land use pattern of the selected area;
2. To explore the prime causes of landuse change and its effects on the environment of the study area, and
3. To give some suggestions based on the study findings.

MATERIALS AND METHODS

The methods used for this research are a combination of physical and human parameters. Relevant data for detecting landuse changes of the study area were collected directly from the field and also using a questionnaire which contained structured and open – ended questions. The sample size of the questionnaire was 120. The methodology adopted for the present study also makes extensive use of secondary material to build up and support the objectives of the study. Through reviewing available literature, a broad outline of different causal issues of landuse changes and its

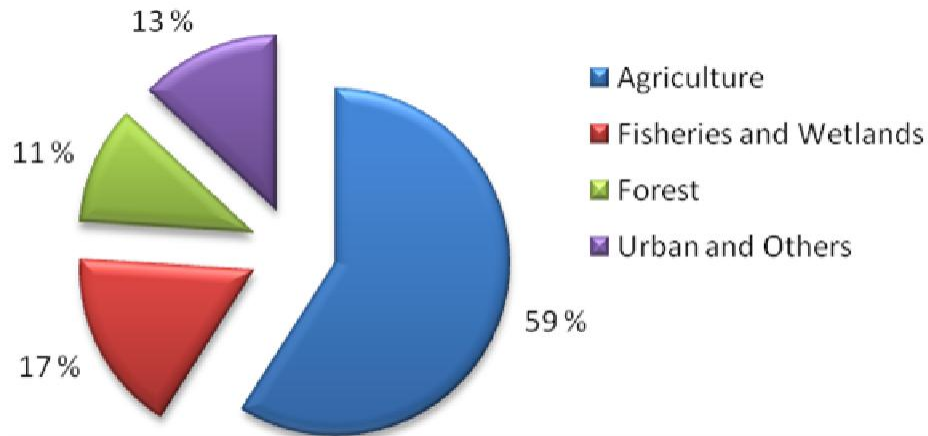


Figure 2. Major land uses in Coastal Bangladesh. Source: Field Study, 2010.

Table 1. Water bodies (ha) in the coastal areas of Bangladesh in 2002 to 2003.

Type of water bodies	Coastal zone		Bangladesh (total)
	Area (ha)	(%) of the total	
Beels	5,448	5	114,161
Semi-closed seasonal water bodies	1,655	3	5,0711
Baor	1,752	32	5,488
Ponds	115,959	40	290,500

Source: DoF., 2005.

consequential impacts on the environment have been gained. To fulfill the objectives of the study, an attempt was made to illustrate the current land use pattern and trends of land use change of the area. Cadastral maps of different periods and satellite images were used to bring out the trends of urbanization and the pattern of land use change. Data related to the previous land use of the study area were gathered from different secondary sources.

RESULTS AND DISCUSSIONS

Major land uses in coastal zone

Land use in Bangladesh is generally determined by physiography, climate and land levels (Brammer, 2002). However, lands in coastal areas in Bangladesh is used for agriculture, shrimp cultivation and fish farming, forestry, salt production, ship-breaking yards, ports, industries, human settlements and wetlands (Figure 2). As a result, land use in the coastal areas is diverse, competitive and often conflicting (Alam et al., 2002; Islam et al., 2006).

Agriculture

Like the other parts of Bangladesh, coastal livelihoods

are largely depended on agricultural crops, mainly rice, that is, agriculture predominates. The net cultivable land of areas in Bangladesh is 1.95 million hectares. However, it becomes limited at rainy season cropping because of highly soil salinity is in the dry season. Medium-high land dominates the coastal area, followed by highland, medium-low land and lowland. At present, coastal regions contribute approximately 16% of the total rice production of the country.

Fisheries

One of the main economic activities in the coastal area is aquaculture (Islam and Koudstaal, 2003). In 2002 and 2003, the fisheries sub sector contributed 5.23% of the GDP of Bangladesh. A vast network of river systems, 'beels' (natural depressions), 'baors' (dead river sections), flood lands and ponds, low-lying marshy lands provide opportunities for both capture and culture fisheries. The main land uses in fisheries are pond aquaculture and shrimp cultivation (Figure 3).

However, the significance of shrimp farming had grown rapidly over the last 30 years (Alam and Phillips, 2004). Shrimp cultivation areas have expanded from 51,812 in 1983 to 137,996 ha in 1994 and 218 649 ha in 2004 (Table 1) (DoF, 2005).

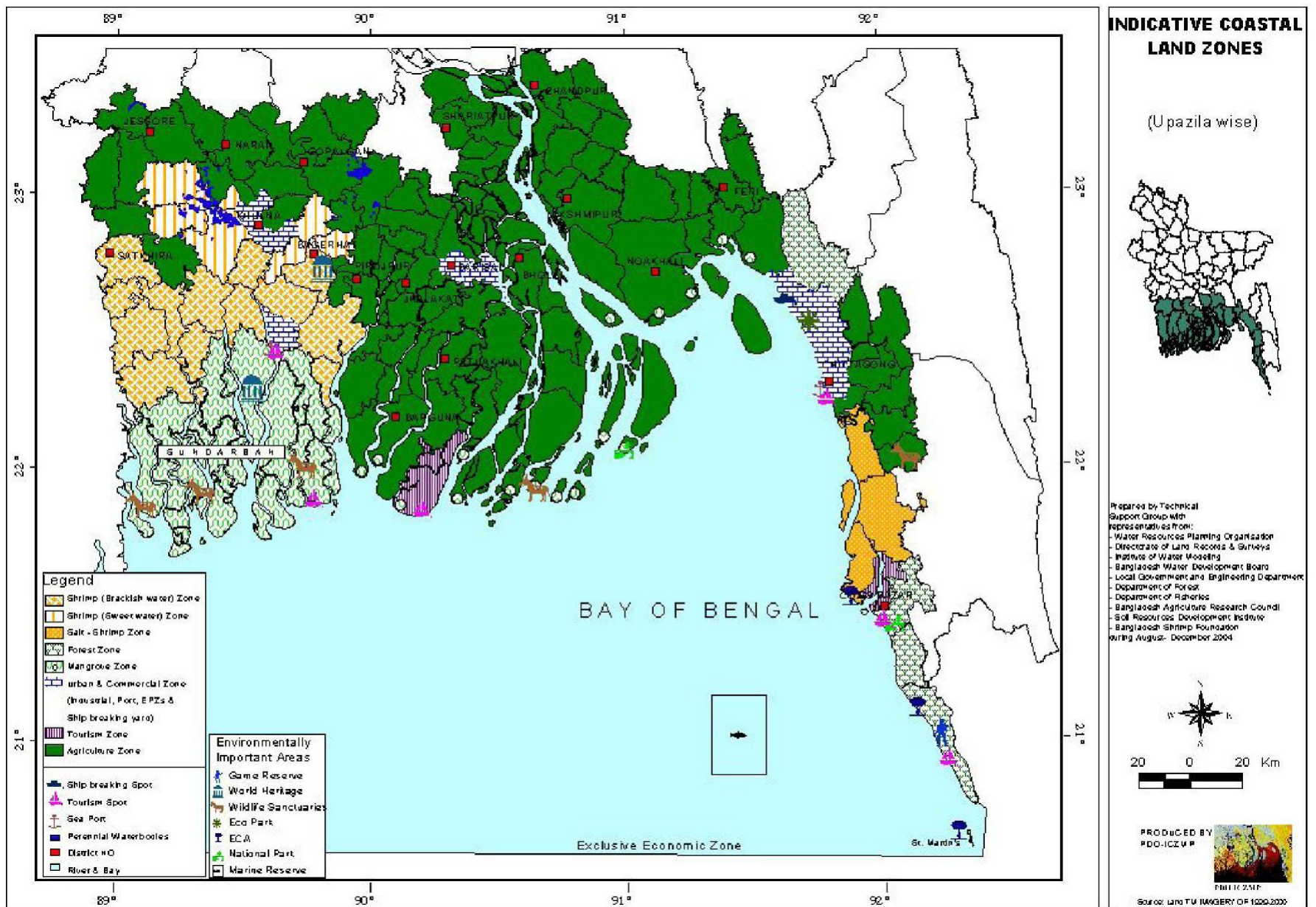


Figure 3. Indicative coastal land zones of Bangladesh. Source: Islam et al., 2006.

Forestry

About 50% (7,869,000 ha) forests of Bangladesh are in the coastal areas and it comprise both natural forests, including the Sunderbans, and planted forest. The natural forest area includes mangrove forest, mixed evergreen and deciduous forest and mixed thickets and forest in Teknaf, Ramu, Cox's Bazar, Ukhiya and Fatikchhari thanas of Cox's Bazar and Chittagong districts.

Salt production

In 1960, the Bangladesh Small and Cottage Industries Corporation started to produce salt on 2,742 hectares in Chittagong and Cox's Bazar districts in southeast of Bangladesh, where salt production continues to be concentrated. Since then, land use under salt production had been gradually increasing to meet the ever-growing demand. There are 41,000 listed salt producers. In 2003/2004, 0.9 million tonnes of salt were produced from 24,900 ha land.

Other land uses

Urban, commercial/industrial areas

The Barisal, Chittagong and Khulna Metropolitan cities, 74 municipalities and other urban areas are located along the coastal areas of Bangladesh. As a result, a large area of the coastal zone in Bangladesh is used for urbanization.

Tourism

The coastal area of Bangladesh is covered with natural sceneries. Many tourist attractive spots are located in the coastal zone. Cox's Bazar is the only well-developed beach town and is the most visited, as it has both natural and cultural diversity. Kuakata beach, St. Martin's Island and the Chakaria Sundarbans is other important tourist destinations in this area.

Environmental significant areas

The coastal zone possesses several ecosystems that have important conservation value.

The world's largest uninterrupted stretch of mangrove ecosystem, the Sundarbans, is a World Heritage Site. However, coral ecosystems are found around St. Martin's Island.

Changes in land uses - causes and impacts

Land use in coastal Bangladesh was predominantly for paddy cultivation, especially low-yielding locally adapted

varieties. In very limited areas of the south-western parts of Bangladesh, traditional shrimp culture was practiced. However, salt intrusion and tidal surges damage the crop almost every year. Crop failure due to saltwater intrusion or monsoon flooding had been reported in most areas once every three years (Nishat, 1988).

Due to the green revolution in the 1960, the land of Bangladesh starts being used for more intensive rice cultivation. The government recognized the need for protection of the coastal areas and construction of embankments took place in the coastal areas of the country. The Coastal Embankment Project (CEP) was taken up, with assistance from the World Bank, in 1967. The embankments included regulators and other structures to control water intake and drainage of the empoldered area. The primary purpose was to increase agricultural production. During the first phase, 92 polders were constructed with 4022 km of embankments and 780 drainage sluices. It became immediately apparent that empoldering increased the scale of production: The yields in certain places increased by 200 to 300% (Nishat, 1988). The dominant land use during the period was still paddy cultivation, primarily of traditional local varieties, but modern paddy varieties and technological packages were also introduced. Other land uses and land cover remained the same, that is, salt production, mangrove forest and traditional shrimp farming.

In 1970 and 1980, the government continued large-scale polderization of coastal areas of Bangladesh (Brown, 1997) (Figure 4). Polders became part of the natural coastal setting. A total of 123 coastal polders were constructed in this hydro-dynamically active delta. It was soon realized that internal water management had to be established within these polders in order to enhance further agricultural production. Changes in land use occurred due to intensification of paddy cultivation with attempted expansion of modern varieties and conversion of agricultural land to non-agricultural use. During this time, coastal afforestation was started with the objective of protecting the coast from cyclones and foreshore erosion, areas for industrial belts also started to expand.

Moreover, the study shows that in order to boost rice production in this area, the World Bank and others helped with large-scale polderization in 1960 to 1980. As a result, artificial embankment hampered the drainage system and the whole low-lying marshy land became water logged which increased the salinity intrusion within the next decade. Moreover, a historical tradition of shrimp farming, polders provided an opportunity for intensive shrimp farming. As a result, crop land and mangroves forest areas were gradually transferred to shrimp farming which created a social conflict in the locality.

Population pressure

Bangladesh has a population of 130 million living on a land area of 147,000 km² with an annual growth rate of

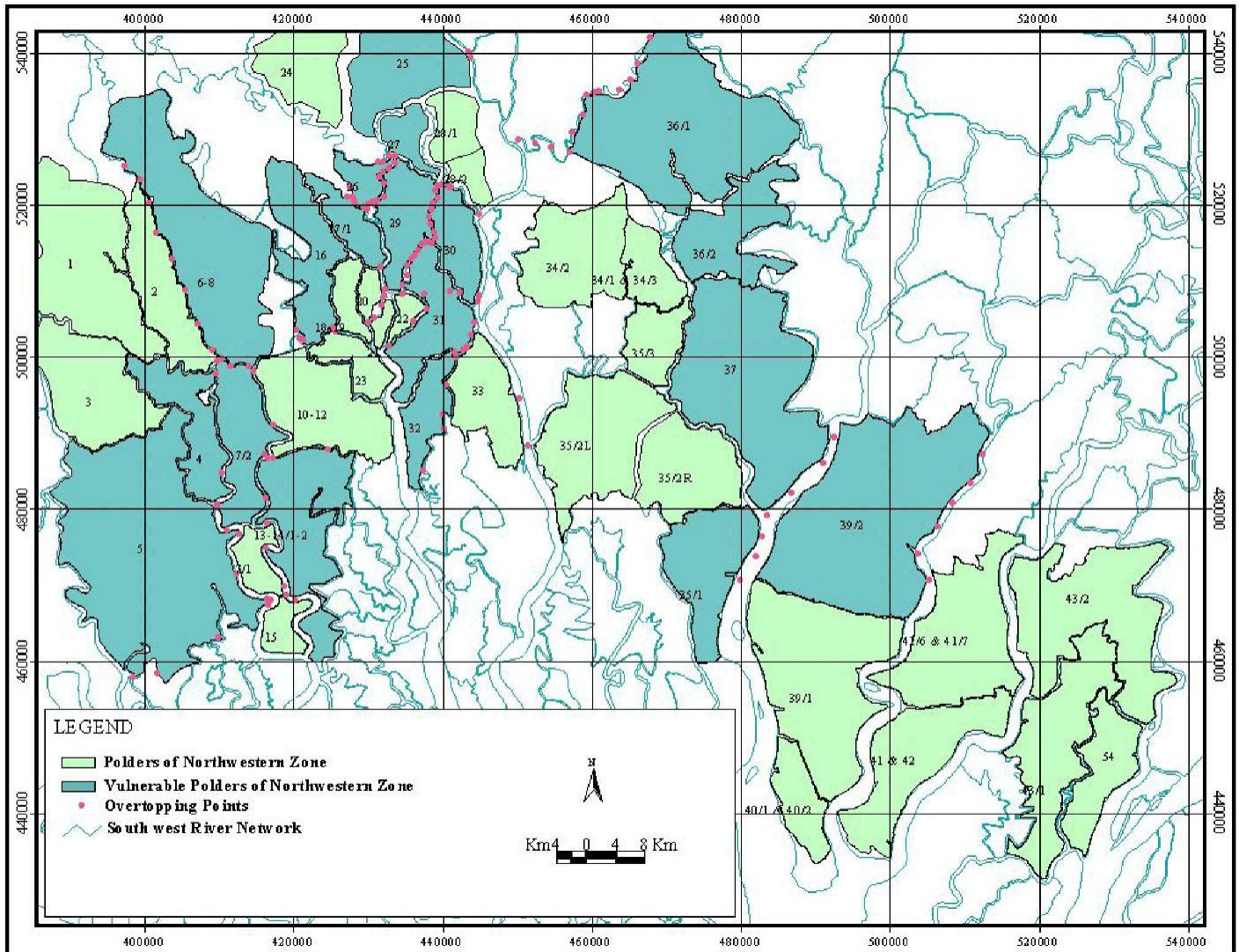


Figure 4. Coastal polders set-up in Bangladesh. Source: Islam et al., 2006.

1.48%. In the coastal zone alone, the population is expected to increase from 36.8 million in 2001 to 43.9 million in 2015 and to 60.8 million in 2030 (Ahmad, 2004). With the increasing population, land is being converted from productive purposes, such as crop cultivation, to other uses. Bangladesh is losing good quality agricultural land by approximately 80,000 ha annually to urbanization, building of new infrastructure and implementation of other development projects (World Bank, 2005).

Degradation of land

Land is being continuously degraded and lost owing to erosion, salinity, inundation and other anomalies. Moreover, at least 86,000 ha of land were lost to river/estuarine erosion from 1973 to 2000 (MES, 2001) although this was somewhat compensated for by land

formed through accretion. Seventy percent of the land of Barisal and Khulna divisions are affected by different degrees of salinity, which reduces agricultural productivity. Fifty percent of coastal lands are subjected to inundation of varying degrees and frequency that limits their effective use. This situation is expected to worsen due to climate changes due to global warming.

Emergence of commercial shrimp farming

Increased demand and the high price for shrimp at the international markets have led to increase commercial shrimp farming in the coastal areas in Bangladesh. The south-western parts of Bangladesh had a history of traditional shrimp farming, but polders provided a further opportunity to intensify this activity. The polders of the south-western coast of the country are experienced

Table 2. Erosion and accretion rate in the meghna estuary, 1973 to 2000.

Periods	Erosion and accretion in ha and ha/year					
	1973-1979	1979-1984	1984-1990	1990-1996	1996-2000	1973-2000
Accretion	50,175	45,550	33,505	56,520	23,850	137,168
Erosion	32,873	31,112	42,410	29,182	32,260	86,366
Net change	17,302	14,438	-8 905	27,338	-8,410	50,802
Annual rate of accretion	8,363	9,110	5,584	9,420	5,963	5,080
Annual rate of erosion	5,479	6 222	7,068	4,864	8,065	3 199
Annual rate of net change	2,884	2,888	-1,484	4,556	-2,103	1,882

Source: Meghna Estuary Study (MES), 2001.

severe internal drainage congestion and heavy external siltation. Areas became unsuitable not only for agriculture, but in extreme cases, even for human habitation. It was termed as a “man-made disaster” (Rahman, 1995) resulting in increased poverty and out migration from the area. At the same time, polders provided new opportunities for expanded shrimp farming using the control structures of the embankments. Subsequently, the land devoted to shrimp farming expanded and encroached on agriculture and forest lands. Many coastal polders, constructed to protect agricultural land from saltwater inundation, were turned into large shrimp farms. Saltwater was allowed into the polders in order to raise shrimps cultivation. Driven by commercial interests, land used for agriculture and mangroves was converted, often forcibly, to shrimp farming (Haque, 2004). This resulted in wide-scale land-use conflicts (Karim and Stellwagen, 1998; Deb, 1998), environmental pollution (Islam and Koudstaal, 2003) and social unrest situations in these areas (Firoze, 2003).

Several studies reported a reduction in land for cattle grazing (Maniruzzaman, 1998), the death of trees and other vegetation (Alauddin and Tisdell, 1998), increased salinity of soil and water, and a reduction of the drinking water supply. Firoze (2003) and Majid and Gupta (1997) reported the social and environmental impacts of industrial shrimp culture. As agricultural lands were converted into shrimp farms, sharecroppers and landless wage labourers lost their livelihoods. They began movements to resist the introduction of shrimp cultivation into their areas. This often resulted in violence. During the last two decades, more than 150 people have been killed and thousands injured in shrimp cultivation-related violence (Firoze, 2003).

Brackish water shrimp cultivation on an industrial scale had introduced large-scale environmental degradation (Islam and Koudstaal, 2003). Shrimp polders retain saline water for months and the salinity seeps into adjacent paddy farms and salinizes the soil.

The loss of mangrove areas to aquaculture is a common feature with Chakoria Sundarbans being the classic example. Between 1967 and 1988, Chakoria Sundarbans mangrove areas were reduced from 7,500 to only 973 ha.

The coastal area along the Meghna Estuary is morphologically one of the most dynamic areas in the world (MES, 2001). Land erosion and accretion are common natural phenomena in the coastal zone. To find out the land erosion and accretion rates in the Meghna Estuary, several LAND SAT satellite images were taken during the period 1973 to 2000 (MES, 2001) and analyzed. Land erosion and accretion of inter-tidal areas, that is mudflats, is not included in this analysis. The study shows an overall land gain for the Meghna Estuary system of about 50 800 ha (Table 2). The average annual gain for the entire study period was 1 880 ha/year.

Because of continual shifting of the coastline and erosion, shifting people are common in the community fabric of coastal Bangladesh. Hundreds of thousands people have been shifted 14 times in a year.

Suggestive measures

In consideration of the problems, causes and prospects of the present study, the following initiatives may reduce the hazardous situation and can play an effective role for ensuring a sustainable environment in the coastal areas in Bangladesh.

1. To ensure immediate establishment of the ICZM coordinating arrangement, as approved under the Coastal Zone Policy, 2005,
2. To coordinate and harmonize different agencies active in the coastal zone,
3. To demarcate land zoning, as approved under the Land Use Policy, 2001 and enforcing laws to prevent encroachment,
4. To prevent the deforestation at the coastal green belt by involving coastal communities in its maintenance,
5. Establishment of Tsunami preparedness measures (including community-based awareness and preparedness) in the most vulnerable area where at least 4.7 million people remain at risk,
6. To protect land reclamation through construction of cross dams,
7. To take initiatives for studying the impact of land use change and review regularly for the socio-economic and

environmental change detection,

8. To ensure a continuous monitoring system to understand land use changes and identifies the areas under land use change,

9. To ensure establishment of set-back distances along the coastline,

11. To prevent and discourage human settlement in highly erosion-prone areas,

12. To establish a network of expert groups on coastal and land-use planning and management,

13. To arrange technical support for countries in the region in order to establish a modern GIS-based land record system, and

14. To set up a commission for studying “planning and practices of land zoning in the coastal Bangladesh” and land zoning should be identified as an important instrument for sustainable land management for decades; its implementation still remains a concern.

Conclusion

In recent years, coastal planning and land-use management have received serious attention by the Government of Bangladesh. Adoption of the Land Use Policy (2001), Coastal Zone Policy (2005), Tsunami Vulnerability Map (2005) and Coastal Development Strategy (2006) are some of the milestone achievements. However, implementation of policy and strategy directives remains a key issue otherwise it would be a man-made disaster in the coastal zone of Bangladesh in the near future.

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