

## **Climate Induced Vulnerability and Migration of the People from Islands of Bangladesh: A Case Study on Coastal Erosion of Kutubdia Island**

### **Shakhawat Hosen Tanim**

Assistant Urban Planner,  
Sheltech (Pvt.) Ltd., Dhaka.

### **Dipok Chandra Roy**

Program Manager, Practical Action,  
Bangladesh, Dhaka.

### **Background**

Climate vulnerability and climate change induced forced migration is the major issue now a day. According to Intergovernmental Panel on Climate Change (IPCC), Climate change induced forced migration is the greatest single impact of climate change. It estimates that by 2059, 150 million people may be displaced by climate change. Climate change refugees may reach 30 million in Bangladesh. Basically this migration is from coastal area to urban area. This migration is creating urban slum and a pressure on urban management.

Among the coastal area the Islands of Bangladesh are geographically very vulnerable. We have some major Islands like Bhola, Sandwip, Hatia, Kutubdia, Moheshkhali, Saintmartin. During high tide 30868 m<sup>3</sup> sea water flows upward through the canals of Kutubdia, Sandwip and Hatia. Coastal erosion, tide, manmade and natural disaster are the major problem here. All Islands are vulnerable regarding the location, economy and society. So these islands are creating push factor migration towards the urban areas and also creating urban slum and social vulnerability. Most of the people of the slums of urban area of Bangladesh are migrated from naturally vulnerable areas like these Islands. However, these islands are having lots of natural resources and scope of livelihood. People are living here with lots of economic activity especially fishing, processing and marketing. Despite these facilities, they are continually migrating. It is time to find out the probable solution to reduce the migration. This study presents the vulnerability scenario of Kutubdia Island and previous solution to protect coastal erosion and hazards.

**Introduction**

Kutubdia is a south eastern island to Cox’s Bazar. Cyclone and storm surges are the most common and frequent disaster of Kutubdia upazila which causes a lot of sufferings for the inhabitants. Kutubdia Island consists of six unions named- Ali Akbar Dail, North Dhurung, South Dhurung, Lemshikhali, Kaiarbil, Baraghope. (Figure 1)

It has a population of 1,25,279 with a growth rate of 1.54%. During the British regime a Light House was established at Kutubdia for the incoming ships to the Chittagong Port. This light house has no existence at present as most of the land area of Kutubdia has been eroded by the Bay of Bengal. (BBS, 2012).

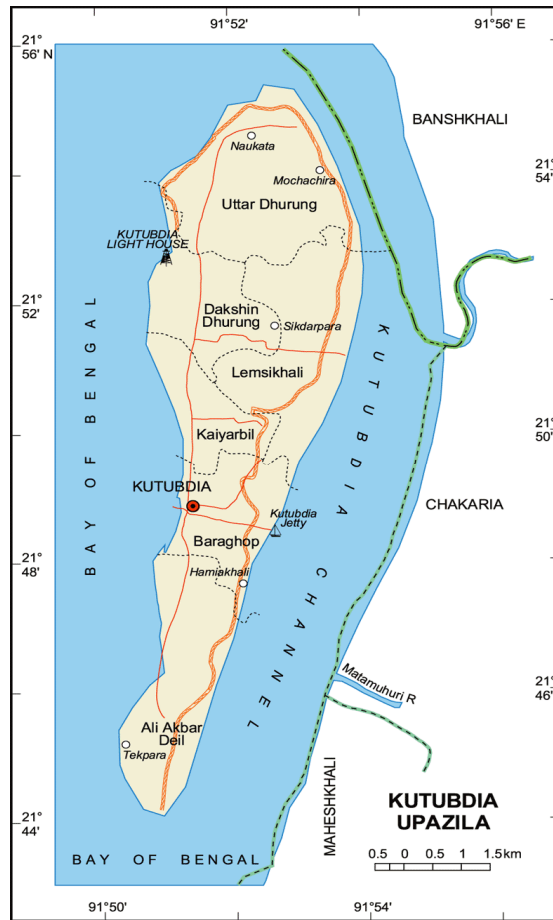


Figure 1: Map of Kutubdia

**Facts about Kutubdia**

Potential for tourist attraction: The small island, Kutubdia is famous for the light house. Kutubdia is surrounded by the Bay of Bengal. It has a sandy beach like Cox’s Bazar. People can enjoy sunset here. The landscape beside the beach has lots of variation in Kutubdia. Some contains *Jhau tree*, some contains villages, some contains salt farm. The main lacking of the tourist island is advertisements. Proper promotion can make the spot attractive for tourist.

Economy of Kutubdia: The economy of Kutubdia is much diversified. Urbanization is 20.34%. But there is little difference between urban and rural Kutubdia. People of this area engaged mostly agriculture (56%). (Figure 2) Most of them work in salt production. So, this profession dominates the economy of Kutubdia. They are also engaged in fishing. This Island is also a giant exporter of salt and fish. Main crops of Kutubdia are Paddy, potato, watermelon, ginger, tomato, bean, betel nut. Main cultivated fruits are Mango, banana, papaya, plum, coconut. People utilize 115 hectares of land for shrimp cultivation and 1416 hectare of land for salt production.

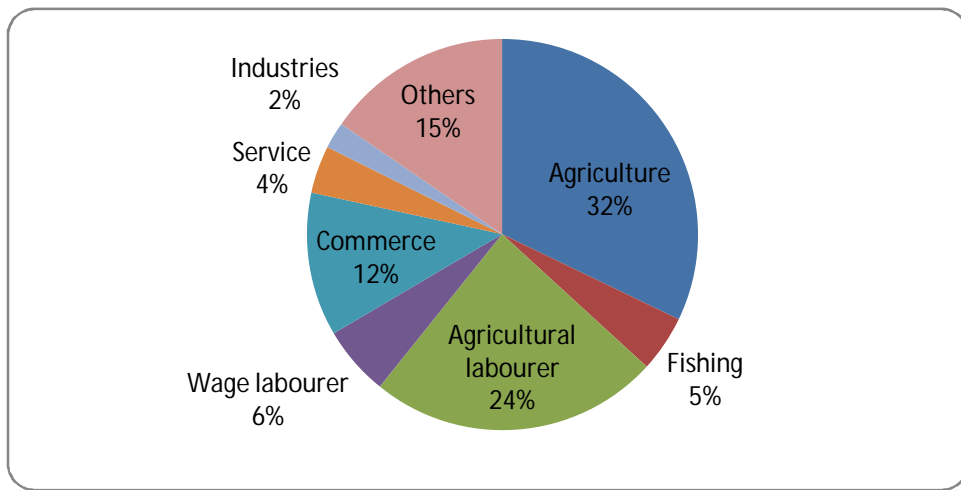


Figure 2: Economic activity of people of Kutubdia

Social condition of Kutubdia: Society of Kutubdia is very under developed. Here literacy rate is 34% which is very low compared to the national average. They also have limited access to social facilities. The health and hygiene condition was also poor at one time. But now it has been improved. However, only 7.8% people have

access to Electricity. It means people of this area are deprived of Electricity compared to other upazila. (Figure 3)

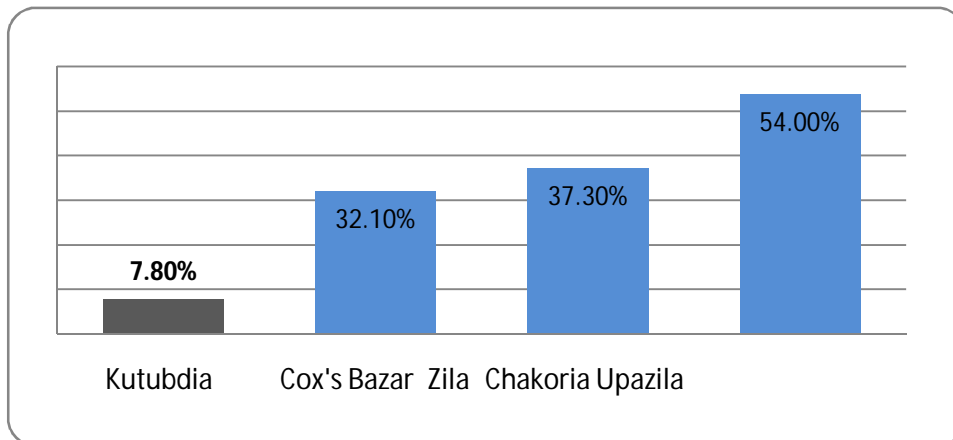


Figure 3: Comparative Peoples' access to Electricity

Natural Recourses: Kutubdia is also enriched with natural resources like Gas and Sulphur. In 1977 Petrobangla discovered the Kutubdia gas field with a reserve of 45.50 billion cubic feet of natural gas. Gas from Kutubdia through pipeline to be connected to the supply line from Sangu-11 and can contribute to help economic growth of Bangladesh.

Wind Power: Kutubdia has exceptional and potential natural resource which is wind for electricity generation. The maximum wind power is obtained from Kutubdia which is 138 W/m<sup>2</sup>. Compared to other location, Kutubdia has higher wind speed for power generation. (Figure 4)

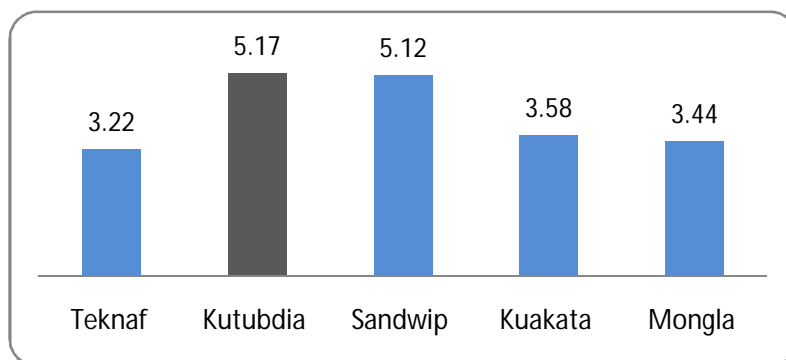


Figure 4: Mean wind speed (m/s) of different potential coastal area of Bangladesh

**Climate induced vulnerability and migration:**

Coastal Erosion: The main problem of the Kutubdia is continuous erosion of land. The land of Kutubdia is eroding in an enormous rate. The Coast trust estimates that if the erosion continues at the same rate, Kutubdia will vanish from the map completely in 70 years. But erosion also occurs every year during the high monsoon tides. A government-built embankment has change the world the erosion in recent years. But where the embankment does not exist or is broken, the sea continues to swallow up land. There is evidence that the rate of erosion has increased in Kutubdia in the past few years. This erosion is making the are more vulnerable. Figure 5 shows different sections of Kutubdia. It states that from 2006 to 2013 there is an excessive erosion of land.

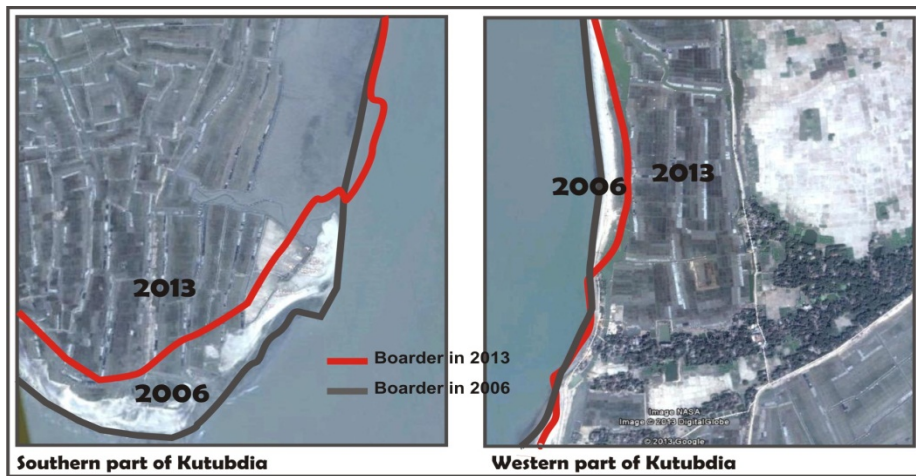


Figure 5: Erosion in different part of Kutubdia

With the ongoing erosion due to the stronger and bigger waves, the island continues to sink. (Table1)Fishermen and salt-workers have been swamped and about 40,000 people have fled from six villages of island since 1991.

**Table1: Area of Kutubdia Island (Zafar, n.d)**

Year	Area(square km)
1960	250
2012	60

Some marginal level of mangrove plantation have been so far done out of government initiatives. Mangroves are being destroyed gradually by the Shrimp culture and Salt fields.

On the other hand, Water Development Board built 40 kilometres of embankment to protect Kutubdia from erosion, of which 24 kilometres have been damaged in the cyclone of 1991. In the re-tender of the embankment reconstruction, Rajakhali, Khudiar Tek and Tabaler Char were deducted from the list of protected area by the embankment. It brings the total area of the Kutubdia Island to only 36 square kilometres. Though the damaged length of the embankment is around 10.5 km but reconstruction is only going on for 0.42 km. Under this situation nothing could save Kutubdia from natural hazards like cyclones, storm surges.

Sea level rise: No scientific monitoring of sea-level rise has been done on Kutubdia, but increases of nearly 8 mm a year have been recorded over 20 years at Cox's Bazar. This is nearly three times the average for Bangladesh and up to five times of the world average sea-level rise. Besides the continuous erosion, this sea level rise is also increase vulnerability of Kutubdia.

Financial vulnerability: It was previously said that Kutubdia is full of economic activity. Most of these activities are related to fishing and salt farming. Farming, one of the two main livelihoods on the island—the other being fishing—is gradually being abandoned due to shrinkage of arable land, while people are made homeless refugees. So people of this area are suffering from poverty. Although having lots of resources and potentiality of Kutubdia, people of this area are in debt. BRAC, Gana Swasthya Kendra, Prism Bangladesh, IFAD Unnayan Sahajogi Team, Grameen Bank are working here. They are trying to improve the lively hood of people. But people are making debt to return other debt. So they are in a cycle. Sometime their income is less than the expenditure. This situation is making them economically vulnerable. Besides, people of this area are detached from the mainland of Bangladesh. They have to cross the Kutubdia channel to do any kind of business or job in the main land. It takes around 30tk per person to cross the channel. So, if they can find some opportunity in the main land they do not find it feasible to cross the channel twice daily to do the job. They have to migrate there.

Locational vulnerability to cyclone and storm surge: Kutubdia is extremely prone to natural disaster mostly cyclone. In the cyclone of 1991 least 138,000 people were killed with around 22,000 dead in Kutubdia. Most of the families of Kutubdia lost their dearest ones in the cyclone of 1991. In other severe cyclone people of this area lost their property. Risk level of the unions has been determined by considering

amount of vulnerable features and number of different shelters. Large amount of vulnerable features and inadequate number of shelters make the area more risky. In case of 3-4m inundation, almost all the katcha roads of Ali Akbar Dail unions and Baraghope unions will be inundated. All the bazaars of Ali Akbar Dail unions and Baraghope unions will also be inundated. For Ali Akbar Dail unions, the number of unexposed cyclone shelter and school is four. For Baraghope unions, the number of unexposed cyclone shelter and school is one. Considering amount of vulnerable features and number of unexposed shelters, the most risky unions for 3-4 m inundation are Ali Akbar Dail unions and Baraghope unions of Kutubdia which will cover most of the area. (Ahmed & Anwar, 2012)

Migration: Due to these vulnerabilities people of this area are interested to migrate outside. There are some kinds of migration which are common here. Among them step migration, chain migration, seasonal migration are very common. People are well aware about the vulnerability of this island. They try to migrate outside if they can afford. But this Island is giving them lots of economic activity. So they have to abandon these activities for the sake of migration. So the opportunity cost they are leaving here to migrate to other land is huge. So they are always in dilemma to decide about the migration. It would be better for them if they are given protection here from erosion and disaster. Then this island would be a business attraction for other people. Even in Cox's Bazar city there is area named *Kutubdia para*. So people of Kutubdia are migrating at a large scale. (ChristianAid, 2006)

### **Consideration for protecting coastal erosion**

The key physical parameters that need to be understood to identify coastal erosion as a problem in the coastal area of Kutubdia:

- Coastal geomorphology: Coastline type and sensitivity to coastal processes of Kutubdia should be studied.
- Wind: The main force in wave generation; under the right environmental conditions, wind may transfer sediment from the beach environment landward on all open coastlines. Kutubdia has a higher wind speed than other coastal area. (Figure 4)
- Waves: They are the most important forces for sediment erosion and transport to the coastal zone.
- Tides: They are influential in beach morphodynamics. They modulate wave action, controlling energy arriving on the coast and drive groundwater fluctuation and tidal currents.

- Vegetation: Important for improving slope stability, consolidating sediments and providing some shoreline protection. Bangladesh applied vegetation scheme in many coastal areas.
- Human activity: Significant human activities must be considered over the range of spatial and time scales for protection coastal erosion. Activities along the coast: Kutubdia has lots of activity along the coastline. It has salt farming and shrimp farming which always hamper the plantation and the embankment.

### **Protecting coastal erosion**

**Current experience from Kutubdia:** Plantation measure can be a good solution to protect from the erosion. Government has taken some measure like this. But this was in very short scale. Creating a mangrove can protect this island like Moheshkhali. But the previous experiences say that these mangroves are destroyed by shrimp farmer. So plantation will not give the ultimate solution. It must need protection from the grabber. Spar/ stone dike also can be constructed.

Embankment can also give protection from erosion and the storm surge. Kutubdia lost numerous lives in 1991. It can be reduced if there is a strong embankment. Government also has taken initiative to build embankment. It should be a comprehensive scheme to protect the erosion.

### **Other measure option**

#### **Hard structural**

Hard structural options use structures constructed on the beach (seawalls, groynes, breakwaters/artificial headlands) or further offshore (offshore breakwaters). These options influence coastal processes to stop or reduce the rate of coastal erosion. To protect the erosion of Kutubdia there can be some options.

Groyne: A coastal structure constructed perpendicular to the coastline from the shore into the sea to trap longshore sediment transport or control longshore currents. It has the following disadvantages:

- Induces local scour at the toes of the structures.
- Causes erosion downdrift; requires regular maintenance.
- Typically more than one structure is required.



Seawall: A seawall is a structure constructed parallel to the coastline that shelters the shore from wave action. The disadvantages of this structure are:

- It creates wave reflections and promotes sediment transport offshore.
- Scour occurs at the toes of eroded beaches.
- It does not promote beach stability.
- It should be constructed along the whole coastline; if not, erosion will occur on the adjacent coastline.

Offshore breakwater: An offshore breakwater is a structure that parallels the shore (in the nearshore zone) and serves as a wave absorber. Their disadvantages are:

- They are large structures and relatively difficult to build.
- They need special design.
- The structure is vulnerable to strong wave action.

Flow diversification: The direction of current flow is important that continually hit the coastlines to cause erosion and need to do the study to find out permanent solution against the erosion protection.

### **Soft structural**

Soft structural options aim to dissipate wave energy by mirroring natural forces and maintaining the natural topography of the coast.

Beach nourishment: The aim of beach nourishment is to create a wider beach by artificially increasing the quantity of sediment on a beach experiencing sediment loss, improving the amenity and recreational value of the coast and replicating the way that natural beaches dissipate wave energy. This method requires regular maintenance with a constant source of sediment and is unlikely to be economical in severe wave climates or where sediment transport is rapid. It has been used in conjunction with hard structural/engineering options, i.e. offshore breakwaters, headlands and groynes to improve efficiency. This type of measure can create Kutubdia more attractive to tourist.

Dune building/reconstruction: Sand dunes are unique among other coastal landforms as they are formed by wind rather than moving waters; they represent a store of sand above the landward limits of normal high tides where their vegetation is not dependent on the inundation of seawater for stability. (French, 2001)

Coastal revegetation: Based on studies and scientific results, the presence of vegetation in coastal areas improves slope stability, consolidates sediment and reduces wave energy moving onshore; therefore, it protects the shoreline from erosion. However, its site-specificity means that it may be successful in estuarine conditions (low energy environment), but not on the open coast (high energy environment). In some cases, revegetation fails because environmental conditions do not favour the growth of species at the particular site or there is ignorance as to how to plant properly given the same conditions.

### **Combinations of options**

Combining hard and soft solutions is sometimes necessary to improve the efficiency of the options and provide an environmentally and economically acceptable coastal protection system. Hard solutions are known to:

- cause erosion and unnecessary accretion;
- be expensive and often further aggravate the problem; and
- spoil the aesthetic aspect of the beaches or coastlines they seek to protect, hence decreasing their economic value, especially for tourism purposes.

Meanwhile, many soft solutions can:

- take time to become effective (not overnight or quick-fix solutions), which generates negative public response; and
- be effective solutions only in medium- to long-term perspectives (five to ten years).

Understanding the key processes of coastal dynamics and how coasts developed in the past and present, as well as over the short and long term, is very important for managing coastal erosion problems because coastal erosion may occur without cause for concern. This can be very complex and possibly controversial where many conflicts of interests exist within the coastal environment. The main underlying principles for coastal erosion management are as follows

- Identify and confirm coastal erosion as a problem.
- Identify, confirm and quantify the cause of the problem and ensure that any management option is well thought out before implementing coastal erosion measures.
- Understand the key processes and characteristics of coastal dynamics and system boundaries that reflect the natural processes of the erosion problem.

- Determine the coastal erosion measure options and implement them using proper design, construction and maintenance with careful evaluation of the effects on adjacent shores.
- Consider the balance of the options' costs and their associated benefits.

### **Set up a green belt/buffer zone:**

The purposes of setting up coastal green belts must not be solely for preventing coastal erosion and mitigating other natural hazards, but also for addressing the socio-economic status of the local communities as well as ecological sustainability of Kutubdia.

The purposes of coastal green belts/buffer zones must serve to:

- control and stabilize the shoreline by holding and trapping sediments and consolidate land for areas such as intertidal mudflats with mangrove green belts and sandy coasts with identified trees;
- attenuate the force of devastating storm surges and waves that accompany cyclones and tsunamis;
- provide an amenity and a source of food, materials and income for local communities; and
- benefit biodiversity and create habitat corridors for wildlife that can be used for conservation activities and ecotourism development of Kutubdia.

In general, the underlying concepts of setting up green belt/buffer zones (Clark, 1996) are:

- **Social forestry:** This should not be considered as a source of government or private sector revenue, but to support sustainable livelihood development among the coastal community.
- **Eco-development:** This is beneficial for conservation activities, educational and recreational opportunities.
- **Participatory planning, implementation and monitoring:** The indigenous knowledge of local communities should be used in decision-making so they receive benefits directly.

## Conclusion

Bangladesh is a densely populated, disaster vulnerable and low income country. The trend of population growth rate is relatively high and predicts it may be double after 2030. The urbanization rate is also increasing day by day due to different sorts of factors acting behind this like disaster, erosion, unemployment, lack of basic service facilities, social insecurity etc. Now 30% people live in the urban areas and it may be reached up to 50% in 2030 due to the stated reasons. Another important consideration is that the amount of agricultural lands is decreasing 1% per year due to over population, unplanned settlement, industrial growth, top soil loss for brick production, erosion etc. On the other hand, Islands both new and old are our important natural resources and blessings that have lot of potential scope to rehabilitate or restrain population to reduce the burden of urbanization and poverty. So, it is necessary to think by the policy makers, decision makers and other influential about its protection, mobilization of resources, proper management and reduce gaps on different context from the main lands. Along with this, capacity building, awareness raising, public education, coordination and cooperation among sector actors and other stakeholders both national and international, communication and information sharing are important.

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