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Sea-level Rise and Population Displacement in Bangladesh: Impact on India

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Bangladesh is one of the most vulnerable countries in the world due to climate change and sea level rise (SLR). This has caused large-scale population displacement, human insecurity and illegal migration to India. This paper first analyses the environmental crisis of Bangladesh taking into considerations the problem of SLR, tropical cyclones, soil salinity and mangrove depletion. The second part of the paper discusses its impact on India with special emphasis on the problem of illegal Bangladeshi migration on three areas – North Bengal, Indian Sunderbans Region and North East India. It discusses the possibilities of retaining back the climate-induced migrants through climate change adaptation techniques, people's participation and the bilateral cooperation between India and Bangladesh.

Climate change and sea level rise (SLR) are now a reality. The recent finding of the fourth assessment report of the world scientific community, represented by the

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Intergovernmental Panel on Climate Change (IPCC), demonstrates that human activities are responsible for global warming,[1] which is expected to contribute to an increase in global mean SLR during this century and beyond.[2] The major environmental effects of SLR include the loss of habitats and biodiversity due to inundation, shoreline retreat, increased coastal flooding, landslide and beach erosion[3] during storm surges and rainstorms, and the intrusion of salt water into aquifers, estuaries and wetlands.[4]

Bangladesh is a disaster-prone country. The total geographic area of Bangladesh is approximately 14.40 million hectares (ha) of which 13.46 million ha are land surface and 0.94 million ha are rivers and other inland water bodies.[5] Bangladesh's geographical vulnerability lies in the fact that it is an exceedingly flat, low-lying, alluvial plain covered by over 230 rivers and rivulets with approximately 710 km of exposed coastline along the Bay of Bengal. As a result of its geography, Bangladesh frequently suffers from devastating floods, cyclones and storm surge, tornadoes, riverbank erosion and drought as well as constituting a very high-risk location for devastating seismic activity. [6] Total population living in the coastal zone is 35.1 million that represent 28% of the total population of the country[7] and the people of Bangladesh are among the most poverty stricken in the world.[8]

Climate Change Scenarios for Bangladesh

The atmospheric concentration of carbon dioxide (CO_2), which is the primary driver of recent climate change, has reached 400 parts per million (ppm) for the first time in human history, as per the information given by Mauna Loa Observatory (Hawaii)[9] in 2013. This will cause more SLR, coastal flooding and submergence of lands in tropical countries and Bangladesh is no exception to this. In a study, Karmakar and Shrestha (2000) predict that annual total rainfall over Bangladesh is likely to increase by 295.94 mm in 2050 and 542.55 mm in 2100. They also studied that global warming will increase the intensity of south-west monsoon, which will, in turn, bring about catastrophic ravages like erosion, land sides and floods, and that may have far reaching consequences on Bangladesh's agriculture, habitat and economy.

SLR in Bangladesh

Bangladesh is highly vulnerable to SLR, as it is a densely populated coastal country of smooth relief comprising broad and narrow ridges and depressions.[10] Several factors

such as non-uniform rise in temperature, geological subsidence and sedimentation influence this rate. Various scenarios have been predicted about SLR in Bangladesh. An estimate of World Bank (2000) showed that Bangladesh will be affected by SLR of 10, 25 and 100 cm by the years 2020, 2050 and 2100.[11] According to this projection, it is seen that in the last half of the present century, which is from 2050 to 2100, the SLR will be 75 cm. National Adaptation Programme of Action (NAPA)[12] showed that there would be 14, 32 and 89.4 cm SLR in Bangladesh coast by the years 2030, 2050 and 2100 respectively. The projections given by IPCC showed that for a 1-m SLR 15 million people of coastal areas will be affected and 17,000 km^2 land along the coastal areas will be submerged under water. And for a 1.5-m SLR 18 million people will be affected and 22,000 km^2 land will be submerged under water. A. Ali (2000) pointed out in his article "Vulnerability of Bangladesh Coastal Region to Climate Change with Adaptation Option" that "the SLR will inflict its impacts on Bangladesh in the coastal area and through the coastal area, on the whole of Bangladesh. About 2,500, 8,000 and 14,000 km^2 of land (with a corresponding percentage of 2%, 5% and 10% with respect to the total land area of the country) will be lost due to SLR of 0.1m, 0.3m and 1.0m respectively".[13]

Coastal areas of Bangladesh are formed of silty and sandy soils, which make them vulnerable to SLR and coastal erosion. A study by Hutton and Haque (2003) observed that people even displaced 10 times during the period 1981–1993, because of river bank erosion of the Jamuna River.[14] O. E. Frihy (2003) in his article "The Nile Delta–Alexandria Coast: Vulnerability to Sea-Level Rise; Consequences and Adaptation, Mitigation and Adaptation Strategies" states that "1.0 cm per year sea level rise in Bangladesh is going on".[15] Barnett (2003) states that "5.5 million people living on the Ganges delta in Bangladesh who will be forced to relocate with a 45 cm rise in sea level may seek to move inland within Bangladesh".[16]

Tropical Cyclones and Storm Surges

The Bay of Bengal is a favourable breeding ground of tropical cyclones and Bangladesh is the worst suffer of all cyclonic casualties in the world. About 5.5% cyclonic storms (wind speed greater than or equal to 62 km/hour) form in the Bay of Bengal and about 1% cyclonic storm of the global total hit Bangladesh.[17] Ali (2000),[18] states that due to the occurrence of any tropical cyclones in Bangladesh, if the death toll reaches to 5000, it signifies that a death toll of about 53% of the global

total has occurred in Bangladesh. Thus it is seen that with 1% cyclones hitting Bangladesh, it is the worst sufferer in terms of human casualty.

Two major aspects of cyclones that are most likely to be affected by climate change are cyclone frequency and cyclone intensity, as well as the storm surges accompanying a cyclone. The height of the surge generally reaches to even 9 m during the time of cyclones in Bangladesh. A recent study by Singh[19] states that the annual frequency of tropical cyclones over the North Indian Ocean (the Bay of Bengal and the Arabian Sea) has shown a decreasing trend of one cyclone per hundred years but the intensity of cyclone has increased, which will further increase the storm surge heights and the horizontal extent of coastal flooding in Bangladesh. Similar conclusions can also be drawn from Ali's work (2000), which shows that all the cyclones that formed in the Bay of Bengal during the period 1877–1997 showed no corresponding increase in cyclone frequency in the Bay of Bengal but its intensity has increased. Cyclones like Sidr (2007), Nargis (2008) and Aila (2009), which invaded coastal Bangladesh, had much higher intensity of occurrence than those cyclones that took place in the early 1990s.

Problem of Salinity

More than 30% of the cultivable land in Bangladesh is in the coastal area. About 1.0 million ha of arable lands are affected by varying degrees of salinity. Farmers grow mostly low-yielding, traditional rice varieties during the wet season. Most of the lands remain fallow in the dry season (January–May) because of soil salinity and the lack of good-quality irrigation water.[20] Water salinity and its distribution in the coastal area are increasing with the increase of SLR.[21] This has drastically reduced the agricultural productivity and forced to grow more salt-tolerant crops.

Impacts on Ecosystem

Sundarbans is the world's largest chunk of mangrove forest, located at the south of the tropic of cancer, which covers the southwest part of Bangladesh (Khulna, Satkhira and Bagerhat district)[22] with an area of 6017 km^2 and extends into neighbouring India.[23] It is one of the most threatened habitats in the world.[24] The increased population with few alternative livelihood opportunities,[25] the rapidly expanding shrimp farming industry, illegal cutting of trees and poaching of wildlife, excessive exploitation of the reserve forest, and negligence of restocking, are the main causes of overall depletion of

growing stocks of Sundarban forest.[26] To date, it is a major source of subsistence for almost 5 million people of Bangladesh.[27] This forest ecosystem also has become vulnerable to pollution, which may have changed the ecosystem's biogeochemistry. Further threats arise from global climate change, especially SLR, which has submerged a considerable portion of the forest area. According to the World Bank's estimate (2000), Sundarbans will be completely lost with a 1-m SLR. Loss of the Sundarbans means a great loss of heritage, loss of biodiversity and livelihood and overall loss of a very highly productive ecosystem. The area of the Sundarbans varies each year because of soil erosion or land accretion. SLR will cause a rise in the salinity concentration in the water and soil of the Sunderbans, which may further alter the habitat pattern of the mangrove forest.

Bangladeshi Illegal Migrants in India

About one million people are displaced every year by the floods and erosion in Bangladesh.[28] This displaced coastal population moves from south to north for shelter, food and other basic amenities of life, and this has caused massive illegal Bangladeshi infiltration to Indian states over the years. Bangladesh has the highest population density of the world, 1000 individuals per 1 km^2, which is four times more than in Germany. There are no free areas left in Bangladesh. Its neighbour India is already very concerned about the past and present illegal immigration of Bangladeshi.[29] As Sanjoy Hazarika in his article "Illegal Migration from Bangladesh: Problem and Long-term Perspective", rightly points out, "they (Bangladeshi) move because of a situation of desperation" and "it (migration) is really a strategy of survival".[30] The issue of illegal migration is highly emotive and sensitive in Bangladesh and all governments have regularly denied the existence of the phenomenon.[31]

Bangladeshis form the largest group of migrants in India. As per 2001 census data, there are 3,084,826 people (more than 30 million) in India who came from Bangladesh. There is no consensus about the exact numbers of Bangladeshis who have entered illegally in India and have never returned to Bangladesh. Different agencies with different numbers have collated the data so far, thus making it really difficult for any exact estimation. Figure 1 represents the spatial distribution of Bangladeshi illegal migrants all over India. Illegal migrants are clustered all over North Eastern states of India and around the adjoining areas of the four megalopolies – Delhi, Mumbai, Kolkata and Chennai.

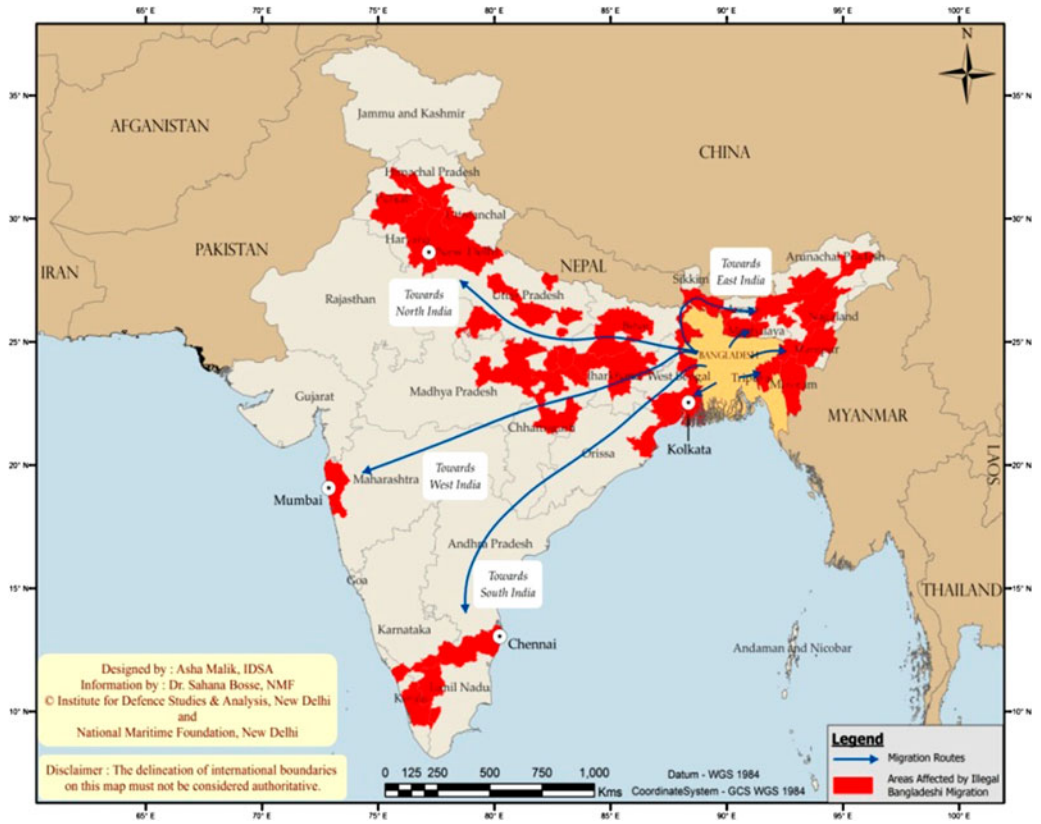

Fig. 1. Spatial Distribution of Bangladeshi Migrants in India.

The 1971 liberation war and continued political and economic turmoil in Bangladesh in the following decades forced many Bangladeshis to seek refuge in India. Most of them migrated to the Border States, particularly West Bengal and Assam and other north-eastern Indian States. The issue became more visible when the high growth rates of Muslims were observed among all these states after the release of the 1991 Census Data by Government of India. The data also reveals that the growth rates of Muslim population among these states were much higher than the growth rates of the local Hindu population even after adjusting for the usual higher growth rate of Muslims observed throughout the country. This issue of illegal migration in North East India has further aggravated the existing political turmoil, which was there in the region even before and after 1947.

This paper focuses on the three particular areas to study the problem of illegal Bangladeshi migration in India: 1) North Bengal (Malda and Murshidabad District); 2) Indian Sunderbans Region; and 3) North East India, as demarcated in Figure 2.

Bangladeshi Illegal Migration in North Bengal (Malda and Murshidabad Districts)

The Farakka Barrage was built by Indian Government in 1975 in North Bengal of India across the upper stream of the River Ganga with the intension of inducing water into the Hugli River, to flush out the sediment load of the Hugli estuary and to keep the Kolkata Port functional. The Barrage in due course of time has altered the main motive behind its construction. It has increased the intensity of Ganga River erosion in its upper bank and floods downstream. India's Ganges River water diversion at

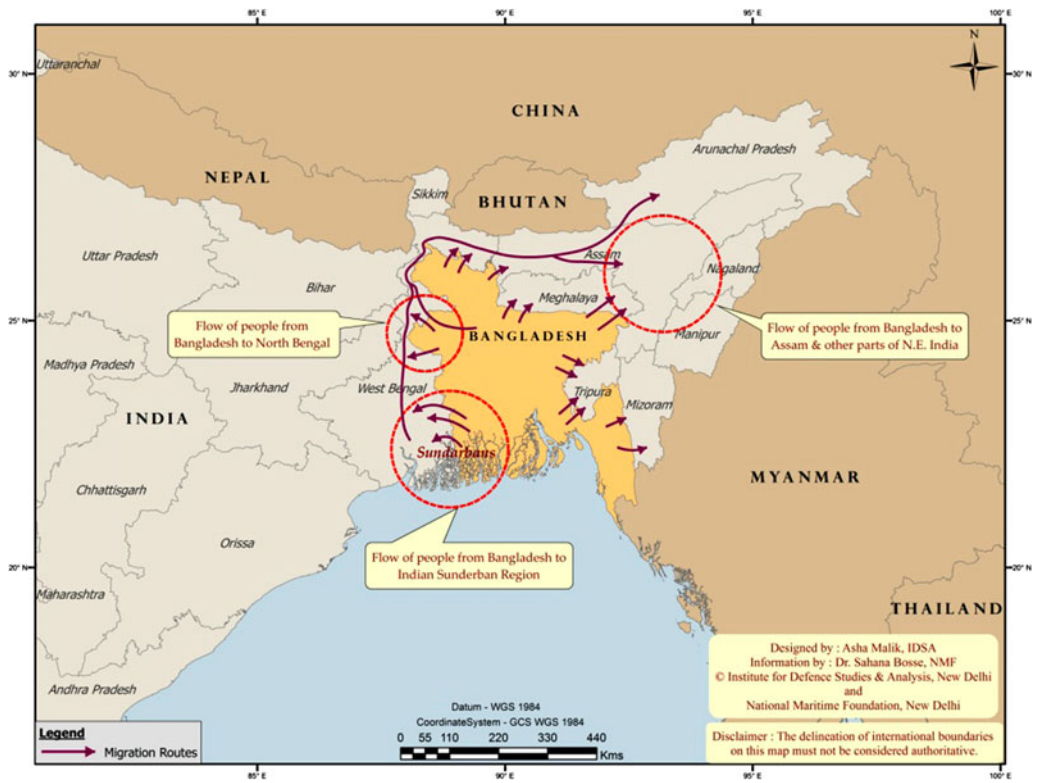

Fig. 2. Bangladeshi Migrants in Three Different Areas of India.

Farakka has caused various environmental problems in the south-western part of Bangladesh, which have subsequently led to the displacement of a large number of populations in that area and their eventual migration to India.[32] The water diversion has given a serious blow to the fishing and navigation sectors, affected the agricultural productivity and changed the fluvial geomorphology of the delta.

This has eventually created disputes between India and Bangladesh over the sharing of Ganga waters. Bangladesh has objected on the grounds that the diversion of water has affected the river navigation capabilities of the country; furthermore, it has lowered the groundwater level in the river basin area, which has a direct effect on agricultural productivity and riverine fisheries. It blamed India for its incapability in handling floods upstream of the river. India disagreed and is of the opinion that Bangladesh has magnified its problem and overstated its water needs without any logical basis. Moreover the bilateral talks between India and Bangladesh on water sharing issues could not finalized to protect the interests of the concerned state government. It is a long-term conflict between Bangladesh and India, regarding the distribution of water in the Ganges river.[33]

The barrage has obstructed the natural oscillation of the river within its meandering belts and this has choked the riverbed and reduced its cross-sectional area. Every year, more than 10,000 are evicted from their lands by erosion, losing everything into the river. When India gained independence in 1947, the course of the Ganga was accepted as the international boundary between Rajshahi District of East Pakistan (now Bangladesh) and Murshidabad District of West Bengal (India). According to the award of the Bagge Tribunal (1948), the Indo-Bangladesh border has been declared fixed irrespective of any change in the course of Ganga, and the international boundary should not be oscillate with the changes in the deep water channel. The Ganga, due to its meandering nature, has started to swing; in some portions it has encroached upon the territory of Bangladesh and in others it encroached towards Indian Territory. Due to the nature of this meandering, it has eroded some portion of land and at the same time deposited sediments at the other end. These deposition features are called Charlands; they are attached along the borderline of Malda and Murshidabad, are well accessed by Bangaldeshi population and are difficult to approach from India at the same time. Erosion has wiped away the boundary posts at many places, created boundary demarcation problems.

The meandering nature of the Ganga has also posed a serious threat to the Farakka Barrage. The uninterrupted encroachment of the river towards the left bank

may outflank the barrage and open a new course through the present Kalindri–Mahananda route. This may create more geopolitical tension between India and Bangladesh regarding water sharing agreements in the near future. A large number of people live in chars all over the world, especially in the flat plains of developing countries of Asia such as in Eastern India and Bangladesh.[34] In recent years, possession of some Charlands have become an issue of controversy in the Indo-Bangladesh relationship.[35] The infiltration and illegal occupation on Charlands by Bangladeshi nationals is very often experienced. The noted geomorphologist, Professor Kalyan Rudra of North Bengal University points out, "at a very modest estimate it is no less than 50,000 and the number is increasing every year". There is hardly any official record regarding the number of people living on the Charlands at present. The erosion victims live in subhuman conditions with their improvised strategies. This has caused considerable increase in disguised unemployment in the agricultural sectors and declined the agricultural productivity.

The bank protection is so expensive that it often involves US$10,000 to protect a 1-m stretch of land but it offers no assurance against erosion. It has already jeopardized the main objectives behind the construction of the Farakka Barrage Project. There is need for an efficient river basin management plan. To date, the problem of siltation in the Hugli estuary remains unsolved and the port of Kolkata is not yet accessible to large ships.

Bangladeshi Illegal Migration in the Indian Sunderbans Region

The Sunderbans islands, the world's largest mangrove estuaries shared by India and Bangladesh, is one of the most geographically challenged regions of the world, where loss of lands and habitats are the two major issues due to SLR in recent years. The Indian Sunderbans Region (ISR) has a population of 4.1 million with a density of more than 1100 persons per square kilometre. Estimates are that 70,000 people out of the 4.1 million living in these islands would be rendered homeless by 2020.[36] There is a constant influx of illegal Bangladeshi migrants into this region, which has created social marginalization among rural population, disguised unemployment, scarcity of land for agriculture, decrease in agricultural yield and food insecurity. How can this densely populated region alone battle this increasing loss of land and habitat due to SLR? The formation of new islands is constantly going on, where land waters shallow from one end, spit out as sandbanks and form new islands at another. This has caused

huge displacement of people within the islands. Two types of environmentally induced migrants are found belonging to same social groups in terms of economic status and class: 1) rural illegal Bangladeshi migrants, and 2) village dwellers living near the coast, continuously migrating from one island to another.

Rural poverty is hidden here and a lack of data makes it difficult to estimate the extent of unauthorized migration between the two countries. There exists no rehabilitation programme for them. There is extremely poor participation of the majority of the people in decisions that affect their lives. At present, migration issues are not effectively mainstreamed with environmental, disaster management or climate change policies. Forced displacement or migration here symbolizes the failure of adaptation to climate change. There are ample opportunities for adaptation techniques but the availability of funds is the main obstacle for this region's development. These climate refugees are the world's poorest people, and do not even earn US$10 per month. Sunderbans mangroves represents South Asia's largest carbon sink, which mops up CO_2 and must survive to help prevent global warming. It has a seemingly unlimited capacity to absorb pollutants from air and water. The cutting of trees for fuel woods has made this region more prone to coastal disasters. A lack of data on climate refugees makes research work difficult; moreover, illegal migrants from Bangladesh are diminishing the carrying capacity of the land.

There have been significant failures in development planning and strategies on the part of local and national governments, compromising the capacity of locals to adapt effectively. In the absence of planning and institutional support, people have little choice but to adapt on their own. Intrusion of saline water into agricultural land results in a loss of fertile land, making them migrate in search of new lands. Farmers have shifted their cultivation period in anticipation of a shifting of the monsoon season and are growing different weather resistant crops, but due to lack of fund and proper market linkage it remains a distant dream for them to cope up with the problem of food scarcity. Sundarbans needs new embankment engineering and resources should be channelled towards in-depth research on what kind of embankment in which areas would last without causing collateral damages. This can prevent shrinkage of land areas. The big challenge lies ahead with the government, non-governmental organizations and other stakeholders, who can still save this region if the illegal infiltration from Bangladesh could be checked to reduce the burden of the lands. There should be more options available for the climate refugees to discover an alternate source of livelihoods. Strengthening the role of panchayats or local government and more involvement in civil

society are a must for this region. The establishment of fodder and fuel wood plantations in the villages as a livelihoods option is expected to lead to a decrease in the pressure on mangroves. Agro-forestry methods include plantations of mangroves along freshwater canals and ponds have recently been done by the village communities, and brought significant results.

Sea Level Rise and Submergence of New Moore Islands

India and Bangladesh co-occupy approximately 180 km of maritime borderline. However, because of constantly changing river courses due to soil erosion and frequent floods, both nations have claimed overlapping maritime boundaries. The Bay of Bengal Island, which India called New Moore Island and Bangladesh referred to as South Talpatti (situated midway between India and Bangladesh) became a catalyst for military threats in the 1980s, and has been submerged under the rising sea since 2010. This is the third island that was submerged under water in Bay of Bengal, after Lohachara and Goramara. As Professor Saugata Hazra, School of Oceanographic studies, Jadavpur University, Kolkata points out "What these two countries could not achieve from years of talking … has been resolved by global warming". His studies revealed that sea levels in this part of the Bay of Bengal have risen much faster over the past decade than they had done in the previous 15 years.

Figure 3 shows the maritime boundary demarcation between India, Bangladesh and Myanmar, as well as the location of New Moore Island. The emergence of the island was discovered by an American satellite in 1974 that showed the island to have an area of 2500 m^2. In the 1990s, it was just only 2 m above sea level, part of a low-lying delta extremely vulnerable to the rising sea. The island was totally uninhabited and there were no permanent settlements, but India and Bangladesh claimed sovereignty over it because of speculation over the existence of oil and natural gas in the region.

According to the Radcliffe Award, the "mid-channel flow" principle or Thalweg Doctrine is generally used in the maritime boundary demarcation between India and Bangladesh. The Thalweg Doctrine says, "when a river separates two nations, the middle of the deepest channel serves as the borderline". Based on this doctrine, the middle line of the mid-channel flow (thalweg) of the Hariabhanga River established the original boundary between India and Bangladesh and became a source of maritime dispute over the years. Had the New Moore Island not disappeared, the eventual determination of the island's sovereignty might have had a major impact over the location of the states'

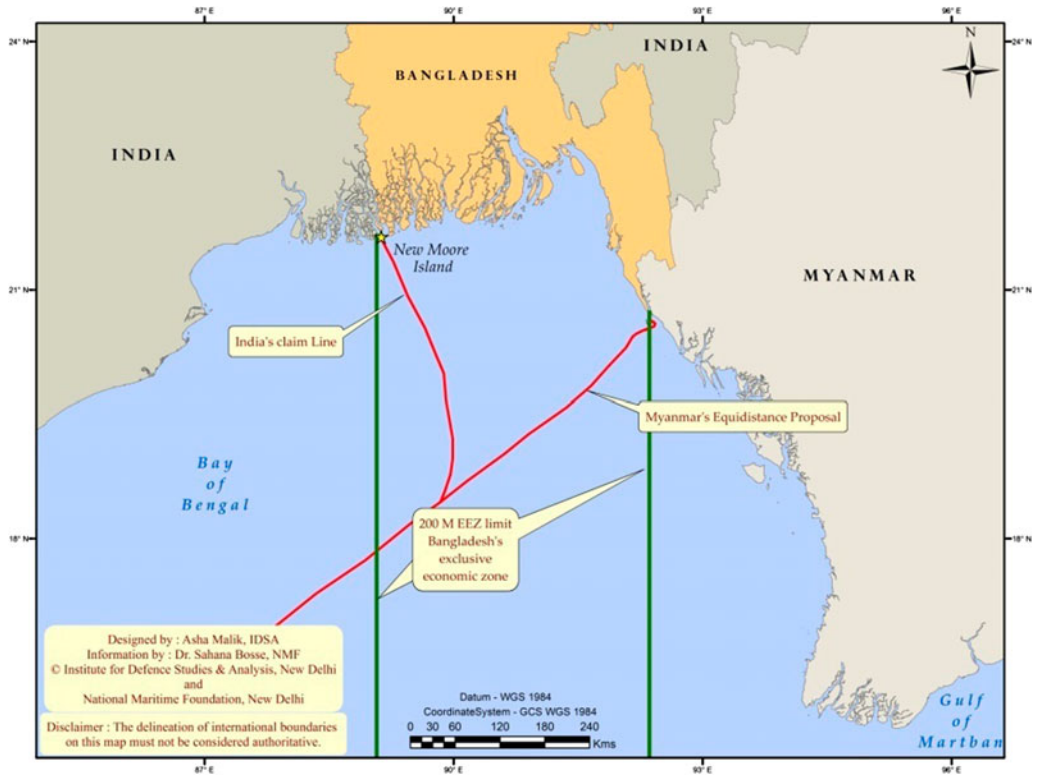

Fig. 3. Indo-Bangladesh Maritime Boundary Demarcation and Location of New Moore Island.

maritime boundary further offshore, if the negotiation had taken place between these two neighbours. India's bid over the maritime boundary demarcation still remains important even though the island has disappeared under water.

Illegal Bangladeshi Migrants in North East India

The illegal migration from Bangladesh has seriously affected the security scenario in the North-East[37] and created a hub of booming illegal trade and services. These immigrants have settled in various North East Indian states, including West Bengal, Assam, Bihar (in the northeastern districts of Katihar, Sahebganj, Kishanganj and Purnia) and Tripura. They have gone into large numbers in Nagaland, a tribal state protected by inner line permit,[38] which is also sometimes restricted for the Indians. The illegal migrants have transfigured the demographic composition of the entire North East, which further created social tensions among the state's original population.

India shares 4096 km of border with Bangladesh.[39] Of which about 1000 km of the border is riverine and thickly populated on both sides. In some parts, the borders are not clearly demarcated, which makes illegal penetration easier. India's border management on the Indo-Bangladesh border has been weak.[40] It is alleged that smuggling, cattle trading, human trafficking, illegal movement and other displeasing occurrences often disturb the border forces. Bangladesh's military camps that are located near to the porous border are mainly responsible for carrying out disruptive activities threatening the peace and security of India's North-East Region. India's attempt to fence the 4090-km border in 2002 could not succeed in preventing the illegal migrants and suspected militants. Some political parties in the bordering provinces of West Bengal, Assam and Tripura do not oppose migration from Bangladesh, because the migrant population acts as vote banks for them.[41] There is a deeply entrenched network on both sides of the border that manufactures illegal documents for the migrants and facilitates the entry of (as well as provision of residential access to) these undocumented migrants in India.[42] In fact, it has been found that fake documents are often prepared in advance while the person is still in Bangladesh.[43]

The migration to Assam from East Bengal has been taking place since pre-independence days[44] and much of the insurgency in the Northeast region, especially in Assam, revolves around the issue of Bangladeshi migrants.[45] After the 1991 census the changing demographic patterns in Assam became more visible. Bangladeshis found in Assam no longer stick to manual work. They have shifted to business activities and own lands in some places. Bangladeshi illegal migrants have been moving to Kerala owing to the high wages for unskilled and semi-skilled labourers in the state. The Kerala Police are reportedly finding it difficult to check the influx of these Bangladeshi illegal migrants. Kerala State Intelligence officials said they found that a large section of migrant labourers in the state claiming to be from West Bengal were actually from Bangladesh. Bangladesh ignores the magnitude of the problem of illegal migration, which always remains a daunting task for India to tackle the issue.

Enclaves

India and Bangladesh has about 6.5 km of undemarcated border where the enclaves are clustered on either side of the country. These enclaves are lands of Indian and Bangladeshi territory completely surrounded by the other country's land. There are 111 Indian enclaves (covering 17,149 acres of land) in Bangladesh and 51 Bangladeshi

enclaves are found on Indian soil (spread over 7110 acres of land). It is estimated that about 150,000 people live in these enclaves and are virtually stateless. They live in abysmal conditions and are deprived of the basic amenities of life. Residents of the enclaves can travel to their own countries only on the production of an identity card, and after taking permission from the border guards, which often causes much resentment. As Anand Kumar in his article "Impact of West Bengal Politics on India–Bangladesh Relation" points out, "the problems have to be resolved in such a way that it becomes win–win situation for both countries. This is only possible if the treaties are signed after due diligence, taking into account all stakeholders and if they are implemented sincerely".[46]

Recently the countries have moved towards an agreement to absorb the enclaves, but the resulting nationality of the current residents remains an impediment, as it could have implications for border disputes in other parts of the region. Bangladesh foreign minister Dipu Moni's July visit to India has rather rekindled the discussion regarding the bilateral talks between the two countries in respect of exchange of enclaves. There is a need to build up a strong political consensus on the Constitution (One Hundred and Nineteenth) Amendment Bill, 2013, which seeks to ratify the agreement. The bill is likely to be introduced in the ongoing monsoon session of Parliament. The Bill has met with opposition on the grounds that the proposed exchange of enclaves will result in a national loss of 10,000 acres of land and it may develop secessionist tendencies in other parts of India as well. The ratification of the Indo-Bangladesh land boundary agreement will definitely reduce the difficulties in administering border enclaves, and improve the conditions of those living there.

Adaptation Measures

Although Bangladesh is an insignificant or virtually zero contributor to the greenhouse gas emissions that causes global warming, it is ironic that it has to suffer so disastrously from the effects of climate change. It must therefore adapt itself to the changing circumstances. Adaptation requires assessment of vulnerability from the viewpoint of different disciplines, which then requires an integrated approach. Climate change and SLR have various significant impacts on economy, environment and security of Bangladesh and, if these impacts are not integrated in the development plans, it will fail to attain sustainability. The Coastal Zone Policy (2005) of Bangladesh was adopted with the overall goal to create conditions in which the reduction of poverty,

development of sustainable livelihoods and the integration of the coastal zone into national processes can take place. One of the objectives of the Policy is the preservation and enhancement of critical ecosystems and ecological processes. It was a significant step towards implementing Integrated Coastal Zone Management as well.

The damage from cyclones and coastal flooding can be minimized with proper remedial measures like embankment construction or repairing the older ones, coastal afforestation, polder establishment, cultivation of salt-tolerant species and construction of elevated houses. Some of the adaptive measures in full swing in Bangladesh are the practice of floating vegetable cultivation along the riverside deltas and fish culture in cages. Floods are controllable through river dredging and the construction of dams and barrages. The priority has to be determined by society itself, whether it needs flood control programmes more urgently, or it needs to expand its shrimp farming or to build industries along the coastal waters.

One of the best ways to adapt to climate change is to involve people at the grassroots level through the implementation of decentralized planning. The people of Bangladesh are very enterprising and innovative. They have been living with disasters for a long, long time. Adapting to changing situations is a familiar, traditional practice in Bangladesh.[47] Bangladesh's early cyclone warning and evacuation system is vital to saving lives. The overall quality of cyclone and storm surge forecasting has improved in recent years but further improvements are needed. These include the need for greater precision in forecasting, especially with regard to landfall location and location-specific inundation depth, broadcasting of warnings in local dialects and raising awareness to promote timely and appropriate evacuation.[48] Embankments must be strengthened beyond their current protective capacity as the added risk of inundation becomes more certain. Bangladesh also achieved success in building shelters on coastal areas that can house more than 2000 people at one go. More research is needed to arrive at a more reliable assessment so that a better response mechanism can be developed. The present lack of financial and technical capacities adds to the existing problems, though Bangladesh has intensified its efforts in cooperation with international donors.

Conclusion

SLR might be a threat to national security for both India and Bangladesh, as the growth of environmental refugees may trigger conflicts between these two countries. There should be development of various adaptation policies in different sectors of

Bangladesh to face the crucial hazards of SLR and to retain the coastal population. Cross-border migration between India and Bangladesh needs clear understanding, recognition and sharing of more information on the magnitude and operation of the undocumented flow of people. The local political parties should resist the urge to use the migrants as vote banks and to ensure that the border control mechanisms are effective. The opening of a legal channel of migration may be considered the most appropriate one to allow the entry of Bangladeshi migrants into Indian territory. They should be given a free pass and designated daily commuters for work in the Indian Border States. A memorandum of understanding (MOU) can also be drawn between Bangladesh and India that would enable the Bangladeshi migrants not only to work but also to receive equal wages and benefits like the other Indian workers of the same group. This will prove a win–win situation for both the countries. The existing MOU between Thailand with Myanmar, Cambodia and Laos is an example that supports the above case.

There are several occasions where India stood by Bangladesh. It provided aid worth US$37 million to help Bangladesh cope with natural disasters and floods in 2007–08 and is co-operating with it to rehabilitate cyclone-affected villages in the southern part of its territory.[49] During 2008 when the food prices rose drastically, India exported near about 5 lac tons of rice at a reduced price to Bangladeshis to cope up with the problem of food insecurity. If India and Bangladesh, through bilateral negotiation, arrive at certain acceptable solutions to check the illegal infiltration, this would help both the countries to have stable political systems. For this, Bangladesh needs to accept that illegal migration is taking place and its intensity has increased due to climate change in the first place.

Today Bangladesh faces a seemingly endless number of social and economic problems, which have an indirect effect on the domestic politics of India. The issue of illegal migration has embittered Indo-Bangladesh relations over and time again. Therefore, Bangladesh and India must reconcile the conflict between a rapidly growing population and a struggling economy. If this illegal infiltration from Bangladesh to India continues, it will generate a range of destabilizing socio-political, economic and environmental impacts in future; therefore, a multi-pronged approach is needed to resolve it comprehensively. There are other issues as well where India and Bangladesh are still struggling to resolve, like the trans-boundary Ganga water management, illegal smuggling, cattle trading and establishment of a transit route for trade. Bangladesh's climate crisis has made human security the most important element among

Indo-Bangladesh relations in the coming years. The country may face extraordinary policy challenges due to relentless population pressure and deforestation. From a wider angel, illegal migration should not be seen as a permanent strategy to cope up with the habitat loss by Bangladesh. The global community needs to extend support to climate refugees and assist them in obtaining refugee status under international law.

Notes

1. UNDP, *Human Development Report* (2007/08).
2. J. A. Church, J. M. Gregory and P. Huybrechts, "Changes in Sea Level", in *Climate Change 2001: The Scientific Basis*, ed. J. T. Houghton, Y. Ding, D. J. Griggs et al. (Cambridge: University of Cambridge Press, 2004), pp. 639–693.
3. R. F. Mclean, A. Tsyban and V. Burkett, "Coastal Zones and Marine Ecosystems", in *Climate Change 2001: Impacts, Adaptation, and Vulnerability*, ed. J. J. McCarthy, O. F. Canziani and N. A. Leary, et al. (Cambridge: Cambridge University Press, 2001), pp. 343–379.
4. J. G. Titus, R. A. Park, S. Leatherman, R. Weggel, M. S. Greene and M. Treehan, "Greenhouse Effect and Sea Level Rise: The Cost of Holding Back the Sea", *Coastal Management*, 19(3) (1991): 171–204.
5. N. Islam, "Environmental Issues in Bangladesh: An overview", *Journal of Peace and Social Science* 3(2005): 671–79.
6. M. G. Sarwar, "*Impacts of Sea Level Rise on Coastal Zone of Bangladesh"* (Master's thesis of Environmental Science Programme, Lund University, Sweden, 2005).
7. M. R. Islam, *Where Land Meets the Sea: A Profile of the Coastal Zone of Bangladesh* (Dhaka: The University Press Limited, 2004).
8. B. J. Wallace and Michael Harris, "Anthropology and Development In Bangladesh", *Urban Anthropology and Studies of Cultural Systems and World Economic Development*, 18(3) (1989): 241–264.
9. Charles David Keeling, a geochemist developed an accurate method of CO_2 measurement in the atmosphere. From 1958, he started recording the global atmospheric CO_2 concentration at Mauna Loa Observatory in Hawaii. The famous "Keeling Curve", which shows the steady rise of atmospheric CO_2 is named after him.
10. H. Brammer, M. Asaduzzaman and P. Sultana, "Effects of Climate and Sea level Changes on the Natural Resources of Bangladesh", Briefing Document No. 3 (Dhaka: Bangladesh Unnayan Parishad, 1993).

11. World Bank, *Bangladesh: Climate Change & Sustainable Development*, Report No. 21104 BD (Dhaka: 2000), pp. 23–49.
12. NAPA is a type of reporting prepared by the least developed countries under aegis of United Nations Framework Convention on Climate Change to describe the country's perception of its most urgent and immediate needs to adapt to climate change.
13. A. Ali, *Vulnerability of Bangladesh Coastal Region to Climate Change with Adaptation Option* (Dhaka: Bangladesh Space Research and Remote Sensing Organization [SPARRSO], 2000).
14. D. Hutton and C. E. Haque, "Patterns of Coping and Adaptation among Erosion-Induced Displacees in Bangladesh: Implications for Hazard Analysis and Mitigation", *Natural Hazards* 29(2003): 405–421.
15. O. E. Frihy, "The Nile Delta-Alexandria Coast: Vulnerability to Sea-Level Rise; Consequences and Adaptation, Mitigation and Adaptation Strategies", *Global Change* (2003): 115–138.
16. J. Barnett, Security and climate change, *Global Environmental Change* 13(2003): 7–17.
17. H. Brammer et al., ibid.
18. World Bank, ibid.
19. O. P. Singh, "Spatial Variation of Sea Level Trend along the Bangladesh Coast", *Marine Geodesy* 25 (2002): 205–212.
20. Z. Karim, S. G. Hussain and M. Ahmed, *Salinity Problems and Crop Intensification in the Coastal Regions of Bangladesh*, Soils Publication No.33, Soils and Irrigation Division, BARC, FarmGate (Dhaka, 1990), pp. 1–20.
21. I. M. Faisal and S. Parveen, "Food Security in the Face of Climate Change, Population Growth and Resource Constraints: Implications for Bangladesh", *Environmental Management*, 34(4) (2004): 487–498.
22. M. S. Iftekhar and M. R. Islam, "Managing Mangroves in Bangladesh: A Strategy Analysis", *Journal of Coastal Conservation* 10 (2004): 139–146.
23. M. S. Iftekhar, "Conservation and Management of the Bangladesh Coastal Ecosystem: Overview of an Integrated Approach", *Natural Resources Forum* (2006): 230–237.
24. M. S. Rahman, "Ecology and Management of Sundarban: A Rich Biodiversity of the World's Largest Mangrove Ecosystem", 2009, http://docs.google.com/viewer (accessed on August 13, 2013).
25. J. E. Ong, "The Ecology of Mangrove Conservation and Management", *Hydrobiologia* 295 (1995): 343–351.
26. M. Ali, M. A. Kabir and A. T. Hoque, "People, Policy, and Perpetuity: Sustainability Indicators of Bangladesh Forestry", *Electronic Green Journal*, 2006, http://escholarship.org/uc/item/2c34v67q (accessed on August 5, 2013).

27. M. S. Islam and M. Haque, "The Mangrove-based Coastal and Near Shore Fisheries of Bangladesh: Ecology, Exploitation and Management", *Reviews in Fish Biology and Fisheries*, 14 (2004): 153–180.
28. K. L. Elahi, K. S. Ahmed and M. Mafizuddin, eds., "River Bank Erosion, Flood and Population Displacement in Bangladesh", River Bank Erosion Study (Dhaka: Jahangir Nagar University, Savar, 1991).
29. Sonja Butzengeiger and Britta Horstmann, "Sea-Level Rise in Bangladesh and the Netherlands: One Phenomenon, Many Consequences", German watch, p. 7, 2004, http://germanwatch.org/download/klak/fb-ms-e.pdf (accessed on August 20, 2013).
30. Sanjoy Hazarika, "Illegal Migration from Bangladesh: Problem and Long term perspective", in *Illegal Migration from Bangladesh*, ed. B. B. Kumar (New Delhi: Concept Publishers, 2004).
31. Sreeradha Datta, "Illegal Migration and Challenges for India", in *India's Neighbourhood: Challenges in the Next Two Decades*, ed. Rumel Dahya and Ashok K. Behuria (New Delhi: Pentagon Publishers, 2012).
32. Ashok Swain, "The Environmental Trap: The Ganges River Diversion, Bangladeshi Migration and Conflicts in India", Report No.41, Department of peace and Conflict Research, Uppsala University, Sweden (1996).
33. A. Nishat and I. M. Faisal, "An Assessment of the Institutional Mechanisms for Water Negotiations in the Ganges–Brahmaputra–Meghna System", *International Negotiation* 5 (2000): 289–310.
34. Maminul Haque Sarkera, Iffat Huquea, Mustafa Alama and Rob Koudstaalb, "Rivers, Chars and Char Dwellers of Bangladesh", *Journal of Geomorphology*, 5 (2003): 89–102.
35. K. Rudra, "Living On the Edge: The Experience along the Bank of the Ganga in Malda District, West Bengal", *Indian Journal of Geography & Environment*, 5 (2000): 57–67.
36. "Climate Refugees", *Economic and Political Weekly*, 44(23) (June 6–12, 2009): 7.
37. J. N. Roy, "Illegal Migration from Bangladesh and Security Scenario in the North-East", in *Illegal Migration from Bangladesh*, ed. B. B. Kumar (New Delhi: Concept Publishing House, 2006).
38. Anand Kumar, "Illegal Migration into India:Problem and Prospects", in *Asia 2030 The Unfolding Future*, ed. Ajey Lele, Namrata Goswami and Rumel Dahiya (New Delhi: Lancer Publications, 2011).
39. Anand Kumar, ibid.
40. K. Rudra, ibid.
41. M. S. Islam and M. Haque, ibid.

42. Shutapa Paul, "Illegal immigration: East Bengal in West Bengal", *India Today*, January 14, 2011, http://indiatoday.intoday.in/site/Story/126587/The%20Big%20Story/east+bengal+in+west+bengal.html (accessed November 18, 2011).
43. Anand Kumar, ibid.
44. K. Rudra, ibid.
45. M. S. Islam and M. Haque, ibid.
46. Anand Kumar, "Impact of West Bengal Politics on India–Bangladesh Relations", *Strategic Analysis*, 37(3) (2013): 338–352.
47. Anwar Ali, "Climate Change Impacts and Adaptation Assessment in Bangladesh", *Climate Research* (12) (1999): 109–116, http://www.int-res.com/articles/cr/12_2/c012p109.pdf (accessed July 30, 2013).
48. Susmita Dasgupta, Mainul Huq, Zahirul Huq Khan, Manjur Murshed Zahid Ahmed, Nandan Mukherjee, Malik Fida Khan and Kiran Pandey, "Cyclones in a changing Climate: The case of Bangladesh", 2011, http://www.gwu.edu/~iiep/adaptation/docs/Dasgupta,%20Cyclones%20in%20a%20Changing%20ClimateThe%20Case%20of%20Bangladesh%20(updated).pdf (accessed on August 1, 2013).
49. Khan Rabb M. Shamsur, op. cit., www.idsa.in, Publication, IDSA Comment (accessed July 27, 2010).