Review on Coastal Erosion, Displacement and Resettlement Strategies of South Asian Countries

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Abstract: Coastal areas are subjected to unwelcome circumstances in the shape of sea-level rise and its adverse outcomes like storm surge, flooding and erosion with continuous climate change. In this manuscript, the authors presented the two case studies of erosion, displacement pattern and resettlement examples of climate displaced people of Bangladesh and India. Climate displaced people of Bangladesh and India have been an influx from coastal areas to a disaster-free safe area and also urban slum areas. In these circumstances, displaced people didn't enjoy their cultural harmony, social status, family bondage in new living places. Resettled climate displaced people in the new habitat of Bangladesh and India are trying to adopting their new living conditions. Facilities of rehabilitation facilities have been evaluated to be insufficient and tiny for their sustenance in the long run. An appropriate development strategy is required by the Government so as to avoid the socio-economic backwardness of the resettlement areas of the South-Eastern coast of Bangladesh and Indian Sundarban inhabitants. The island inhabitants wait with great anxiety for help from the Government and Non-Government authorities to come frontward and support them to pull through their losses.

Keywords: Disaster, Climate change, Coastal erosion, Displacement, Resettlement, South-Eastern coast of Bangladesh, Indian Sundarban.

1. INTRODUCTION

Coastal Erosion is the spoil of the lands due to net elimination of sediments from the coastal shoreline. There are two types of coastal erosion happening in the world at present, including rapid-onset hazards occurring very quickly and slow-onset hazards occurring over the long years, or decades to centuries. Significant affairs of coastal erosion are habitually related to thrilling weather events like a cyclone with storm surges and flooding, both because the waves and currents incline to have greater intensity and due to associated storm surges inundation can consent currents and bout landforms which are normally out of their reach. In accumulation, heavy rainfall can upsurge the saturation of soils, with high saturation foremost to a decrease in the soil's shear strength, and a steady increase in the spontaneity of slope failure. The erosion becomes a hazard when coastal communities not able to adapt to its impact on people, housing, rights and property, the built environment and infrastructure.

However, worldwide it is projected that about 60% of the inhabitants are living in coastal environments. Although the coastal environment can recall some degree of natural charm, increased human modification decreases the "naturalness". Coastal erosion and displacement of the coastal communities are the inter-linkages. Coastal Erosion can negatively impact the cultural links people have to the special parts of the landscape which plays a major role in socio-economic changes too. According to the Report on Internal Displacement Monitoring Center, 5.1 million people in 95 countries are displaced because of disasters like erosion, flood and cyclone in the year 2019 which is higher comparatively statistics from 2012 [1].

Records maintained by the Centre for Research on the Epidemiology of Disasters (CRED) show that disaster frequency appears to be increasing, from about 100 events per decade in 1900-1940 to 650 per decade during the time of 1960s, to 2000 per decade in the 1980s. Within the year of 1990s, this number had attained almost 2800 events per decade. The increase in reported disasters can be partly explained by a higher number of small and medium-level events that are related to natural and human-induced or socio-natural phenomena. While the number of geophysical disasters has remained fairly steady, the number of hydrometeorological disasters has increased signifi-cantly over the decades. An increase in global costs of weather-related disasters alone has increased from an annual average of USD 8.9 billion in 1977-1986 to USD 45.1 billion in the 1997-2006 period [2].

Recent estimates by CRED (2018) show that between 1998 and 2017 climate-related and geophysical disasters killed 1.3 million people and left a further 4.4

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E-ISSN: 2410-3624/20

billion injured, homeless, displaced or in need of emergency assistance. During the year 1998-2017, disaster-affected countries also reported that direct economic losses valued at US$ 2,908 billion, of which climate-related disasters caused US$ 2,245 billion or 77% of the total. This is increased to 68% (US$ 895 billion) of losses (US$ 1,313 billion) reported between the year 1978 and 1997 [2].

In complete monetary conditions, over the last 20-year, the USA estimated the greatest losses (US$ 945 billion), sparkly high asset standards and frequent events. China, by comparison, suffered a significantly higher number of disasters than the USA (577 against 482), but lower total losses (US$ 492 billion). As economic data for such losses are hard to get, the World Bank has calculated that the real cost to the global economy is a staggering US$ 520 billion per year, with climate change-induced disasters approaching 26 million people to become poverty every year. Inequality is even superior to available realities data recommended due to systematic under-reporting by the low-income countries.

Georeferencing an analytical technique is being employed by CRED, to have an in-depth understanding of EM-DAT data to reveal the relative vulnerabilities of rich and poor, and quantify how the human cost of disasters increases in cases where national income levels decline. This has helped reveal the high proportion of loss in low-income countries (130 people per million) to only 18 in high-income countries. This proves that people exposed to natural hazards in the poorest nations were more than seven times more likely to die than equivalent populations in the richest nations [3,4].

The matter of displacement, as well as resettlement, frequently come to opinion at the point of any natural disasters induced events that might likely disconnect people either temporarily or permanently from their original settlements, that can negatively or positively impact the welfare of the inhabitants of the coastal area. The approach of Disaster risk reduction highlights the preventive actions to decline people's and infrastructure's revelation to the natural hazards by reducing their susceptibility and intensification organizations for active risk management. During the time of risk assessment of disaster-affected populations are experiencing to mitigated by other measures, resettlement considers the only option. There is a brawny association between climate change-induced disaster and development in the world. Unplanned development activities could increase the levels of disaster risk vulnerability and disasters unenthusiastically impact the development of poor countries. In adding up to climate change, the major drivers of the risk are the feebly planned and managed urbanization, degradation of the environment, poverty and absence of good governance and child and gender inequality [4].

The major drivers to disaster risk have been the substantial growth of population and assets in at-risk areas. Migration to the coastal areas and the growth of urban cities in flood plains, attached with the inapt building standards, are among the major causes for the increase. As reported climate-related disasters accounted for 74% (US$2.6 trillion) of total reported losses, 87% (18,200) of total disasters, and 61% (1.4 million) of total lives lost [5-7].

Over the last decade, about 1.5 billion population people have been impacted due to climate change-induced disasters which have cost at least US$ 1.3 trillion. Climate change, lack of good governance, and a growing attentiveness of the people and values in the areas that exposed to natural hazards are pouring disaster risk upwards, particularly in poor and fragile nations [8-10].

Resettlement is not only a housing solution but a compound, multidimensional progression with hypothetically very high negative effects if not appropriately planned and implemented. However, resettlement interrupts the original livelihoods of the resettled peoples and may increase their risk of destitution, although resettlement programs are expected to reinstate their livelihoods and generate opportunities for development. Consequently, resettlement that takes place on the salvage point after a disaster is crucial for mitigation and preparedness for the next disaster by applying structural and non-structural measures [11, 12].

South Asia, nearly about 2 billion people living in this region which is an area of 5.2 million Sq. km. Bangladesh, India, Pakistan, Afghanistan, Bhutan, Maldives, Nepal, and Sri Lanka are the countries of South Asia, where about a third of whom are still living in the condition of poverty, faces a major challenge in achieving rapid economic growth to reduce poverty and attaining other Sustainable Development Goals in an era of emphasized risks posed by global climate change.

South Asia recognized as a universal climate change-induced disaster hotspot in the present

moment and during the year 2019, 9.5 million people forced to displaced due to different natural hazards as the highest record of statistics since 2012. Floods triggered by the monsoon in India and Bangladesh and Cyclones *Amphan*, *Fani,* and *Bulbul* were among the events to force most people to flee their homes last year. Approximately, 6.5 million people were forced to displaced due to climate change-induced disasters in this region over the past decades on an average statistics which found most affected region worldwide. The statistics of climate displacement indicated that during the year 2019, 5 million people were forced to displaced in India which is the highest in the world. In 2019, there were five million new disaster displacements in India, the highest in the world. During *Amphan* which outbreak May 31, 2020, there were 3,50,000 people were displaced in Bangladesh and India.

The limiting factor to identify the appropriate numbers of displaced people after a natural disaster that sometimes they lived the places permanently for lacking basic amenities in the disaster affected areas and few numbers of displaced people return to their past living places for living again. So, a displacement tracking matrix necessary to implement in the displacement recorded places of the South Asian countries. Resettlement strategies are different approach according to the program aim and objectives. So, limiting factors in the resettlement approach observed during the selection of appropriate climate victims and the poverty scale of the communities. The authors face the limitation for real statistics of resettled people in the study areas for the availability of proper data and information from the respective department and website of the relevant resettlement program. The authors also observed the limitation of preparation of 2 case studies of 2 countries about the displacement and relocation program status. The comparative scenario of the resettlement program becomes difficult for the authors due to the absence of relevant information. Further, the authors believe that proper documentation, strong management of resettlement program and clear authenticity of real climate displaced people will key point for successful and effective implementation of the climate displaced people's relocation for South Asian Countries. The effects of climate change are likely to consequence in enormous economic, social, and environmental degradation to South Asian countries, compromising their growth potential and poverty reduction efforts.

This review study has been prepared to following objectives:

1) To look out the coastal erosion, adaptation practices, the crisis of displacement and resettlement strategies of South Asian countries.

2) To explore the pattern of coastal erosion, displacement and resettlement condition of the most disaster-prone locations of Bangladesh and India through the case study presentation.

2. COASTAL EROSION PATTERN

The coastal environment of the worldwide nations is repeatedly changing as a result of the interactions among the ocean, winds, currents, waves and anthropocentric variables. Sustainability of coastal ecosystems contingent on the degree of use of the coast by the stakeholders and the external impacts that occur such as natural disasters. However, the extent of coastal use and external impacts may underwrite the impact of global warming and increasing it significantly. The Effects of climate change and extreme exploitation of coastal areas have an enormous influence on coastal erosion [13-18].

The coastal zone is the furthermost dynamic and effortlessly affected by any disaster event. The dynamics of the coastal zone lies in the attendance of land physical features comprising rocks, shorelines and other forms containing unsensitized materials, swamps, estuaries and coral reefs and physical factors of the ocean that fundamentally comprise the beach coastal lines and other acting mediators on the physical setting of the coastal zone like currents, waves, tides and winds. In fact, every change will influence the next consequences and usually, the authorities can reinstate natural circumstances if a disturbance causes only minor variations [19, 20] (Figure **1**).

India is rich in marine and coastal habitats, like mangroves, coral reefs, and sand dunes. The coastal area of the country of nearly 8,000 km^2 faces the Indian Ocean, Arabian Sea, and the Bay of Bengal. Indian coastal area includes 9 states and 2 union territories having 66 coastal districts and includes sandy beach 43%, rocky coast 11%, muddy flats 36%, marshy coast 10%, 97 large estuaries and 34 small and big lagoons. Increasing sea levels will accelerate coastal erosion which consequences in saltwater contamination of groundwater supplies, threatening the quality and quantity of freshwater access for a big percentage of the population. Coastal erosion is a lingering crisis along with the numbers of seashores of the coastal area of India. According to the report of the National

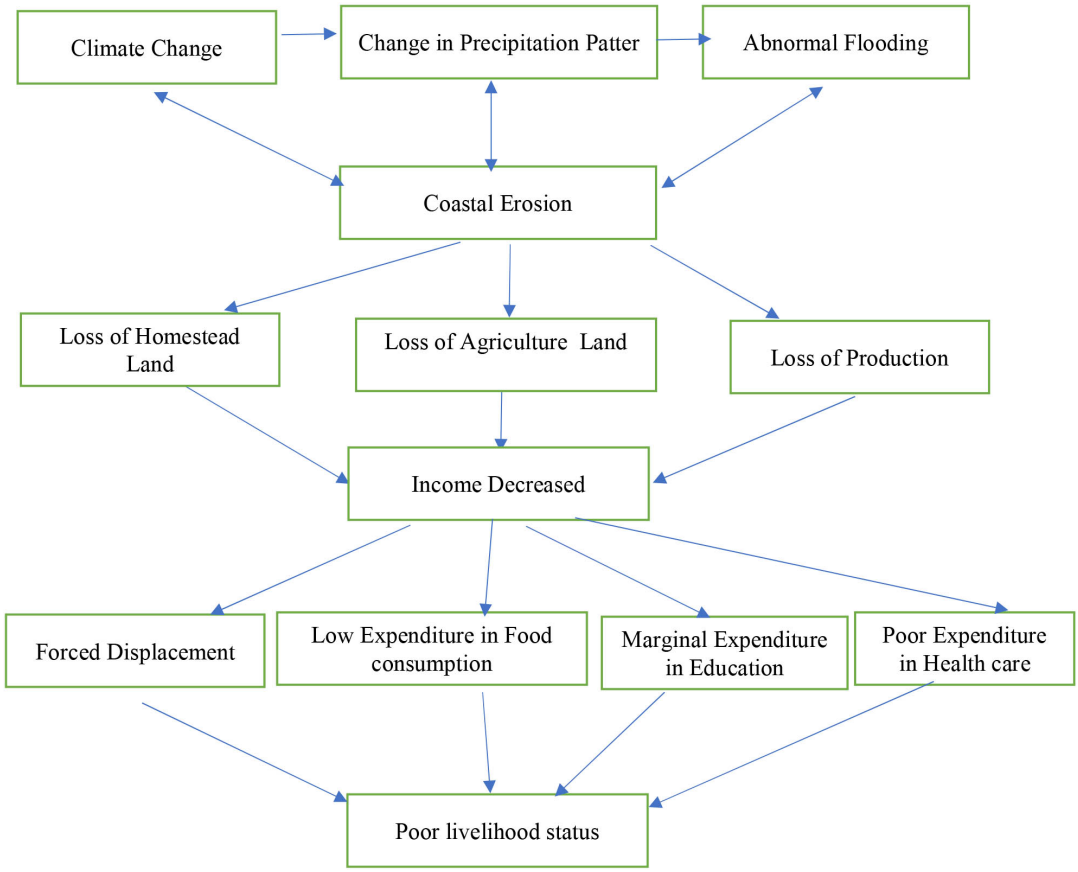

Figure 1: Coastal erosion and relation of livelihood for coastal communities.

Centre for Coastal Research, from 1990 to 2016, 6,632 km^2 coastal area of India was submerged into the sea and the finding stated that the most susceptible coastal area of India in the West Bengal coast The Eastern part of Indian coastal area undergo increased erosion because of recurrent cyclonic storm surges outbreak from the Bay of Bengal in the last 3 decades rather than western coast that remains mostly stable. On the other hand, 33% of the coastal area experiences increasing erosion and nearly 50% of the coastal area that do not recuperate their innovative form over the yearly cycle, endure net erosion. Currently, 23% of the seashore of the Indian mainland are impacted by coastal erosion, which is increasing significantly in recent years [21-26].

Bangladesh is recognized worldwide as one of the most vulnerable countries to natural disasters and to the impacts of global warming and climate change. Coastal areas of Bangladesh is not static, nor is it uniform. There is 32% land area of Bangladesh are covered as coastal zones which total area is 47,201 km^2. Among the 54 districts of the country, 19 districts are declared as coastal districts of Bangladesh. Approximately 40 million people living in the coastal area which representing 30% of the total population in the country [27, 28].

The coastal area of Bangladesh comprises 3 regions according to the geographical locations and these are - (a) The eastern zone, (b) The central zone, (c) the western zone. The western part of the country recognized ass Ganges tidal plain, consists of semi-active delta and is crisscrossed by plentiful river channels, creeks and small water body. The central part of the nation is the most dynamic and active an incessant process of erosion as well accretion activities both are going on in the region. On the other hand, the eastern region is sheltered by the hilly region which is further stable. The coastal area of Bangladesh is nearly 710 km long that is comprises the boundary of the different economic and ecological environment such as wetland, mangrove forest, tidal flat and aquatic biodiversity. A GIS-based research work explored that nearly 1183 km^2 of coastal land has submerged from 1995 to 2005 at the rate 118.3 km^2 /year and the rate increased significantly in the central part to 1194 km^2 /year from 2005 to 2015. The finding also explored that

between 1989 to 2016, approximately 76959.7 ha land submerged into the sea and 216742 ha land area have been accelerated which indicated that approximately 139782.3 ha land area become deposited along the Bangladesh territory [29-31].

The Average erosion rate in coastal Bangladesh is 100 meters per year in locations, the result is so hares, both economically and socially, especially for people who are already challenged economically With the reference of disaster vulnerability index of Bangladesh about 57 km of the whole coastal area now existing under very high venerable and more than 75 km is under high vulnerable and nearly 67 km shoreline is at moderate risk and 63 km shoreline is at low risk [31-35].

Sri Lanka is an island country having 2,825 kilometres of coastline and 500,750 Sq. Km of surrounding waters in its Exclusive Economic Zone. The coastal area of this country consists of diverse shorelines and near-shore locales and a significant resource pedestal in the coastal environment adjacent to the island. The coastal area of Sri Lanka comprising 24% of the land area, contributes about 40% to the nation's Gross Domestic Product (GDP). About 45-50 % of Sri Lanka's coastline, mainly in the south, is uncovered by coastal erosion. On average, this nations coast recedes about 0.3 meters every year [36-38].

Maldive is a nation that comprises over 1,000 low-lying islands, and land below mean sea level totals 80%. The Maldives population are extremely anxious about coastal erosion and flooding. All the islands of the country are continuously exposed to processes of accretion and erosion. Maldive is composed of a sequence of low-lying islands, where any area of landmass constitutes a coastal area. The total exclusive economic zone (EEZ) of the Maldive is 959,100 sq km. There are around 530,000 people extremely vulnerable to storm surges, sea swells and severe weather. During the year 2014, nearly 100 of the islands were already experienced erosion and 30 islands are recognized as harshly eroded. The nations expense approximately $10 million yearly for the protection of the country from erosion but the budget should expense up to $8.8 billion for the necessary solution of the embankment development for the protection of the living island of Maldive. Structural defence systems of coastal erosion and flood are considered as major responses to coastal erosion and flood hazards and protection for coastal communities. The coastal embankment program of Bangladesh and other countries of South Asia had a thoughtful effect on the geomorphology of the coastal zone and contributing to a transformation in human settlement patterns [38-41].

3. DISPLACEMENT OF COASTAL COMMUNITIES

Coastal communities of South Asian countries displacing from their living home and land in at least four ways: (i) the escalation of natural disasters both rapid and slow-onset leading to increased displacement as well as migration; (ii) the adverse effect of augmented warming, variability of climate and additional influences of climate change on living and livelihoods, health, food insecurity and availability of ground and surface water ; (iii) rising sea levels that consequences of the coastal areas dilapidated; and (iv) antagonism over the inadequate natural resources potentially consequences for increasing tensions and even conflict and, in turn, displacement [42-46]. Rahman *et al*., stated that people in an excellent financial condition and with useful resources migrate in a planned way, while those who are very poor, particularly women, children, old aged and person with disabilities, have fewer options for moreover intended or obligatory displacement leading migration. Total displacement leading migration process has direct social, financial and cultural effects on the society together in the new destination and origin of the climate displaced communities [41, 42] (Figure **2**).

A continuous circle of accessibility of land, poverty and food safekeeping, land loss because of the cyclone and storm surges, tidal surges and coastal erosion considered as long term problem that ultimate impacts on are loss of agricultural land and opportunities of the development activities. Livelihood circumstances of the climate displaced families of the south-eastern coast of Bangladesh be inclined to pursue a continuous cycle from the lower livelihood condition of the disaster victim communities around their living circumstances [43, 44] (Figure **3**).

Climate displaced households settled in the new locations in an unplanned mode near the embankment, hilly areas, and roadside. They are suffering from various social, economic, cultural and political problems. Accordingly, climate displaced people consolidated in the specific location are also suffering different problems such as social stratification; the crisis of identity; oppression by local political and muscle men; isolation of mainstreaming society; paying illegal money; loss of social, cultural harmony; lacking their basic amenities,

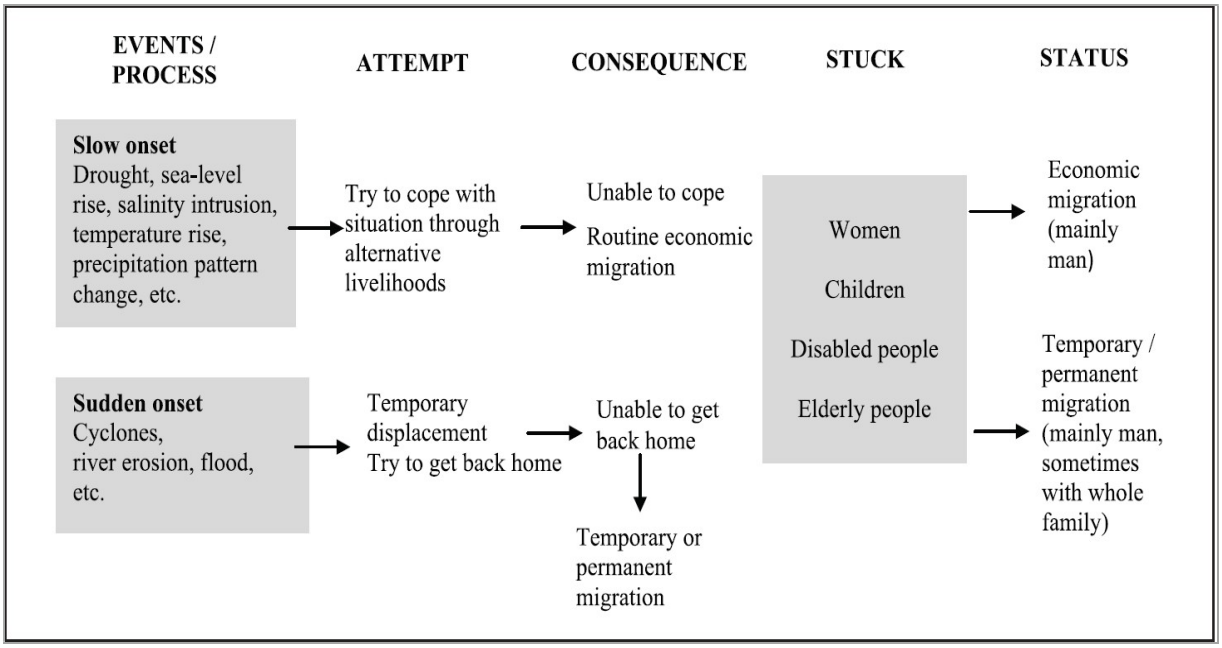

Figure 2: Consequences of climate displacement due to natural disasters [42, 43].

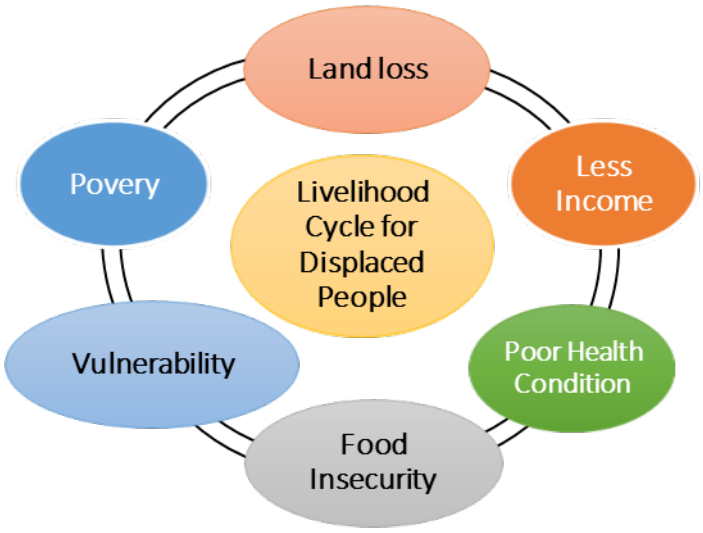

Figure 3: Livelihood cycle for climate displaced people.

dignity and rights and so on. This community-based relocation process can guard them against stigmatization and isolation and which could avail the other essential benefit from Government and NGOs as they stay in conventional society [44, 45]. Among the 64 districts, 26 coastal and mainland districts of Bangladesh are already producing climate displacement. It also found that almost 6 million peoples have been experienced displacement from their ancestral land and living homes because of climate change impact in Bangladesh. Nearly 46% of communities have experienced temporal displacement and 12% of the communities have experienced eternally displacement because of different climate change-induced natural hazards in 4 most climate hotspots of Bangladesh [46-48].

There are 1.4 billion coastal inhabitants are living in India among the total 170 million people of the nation who are living on the front lines of a changing climate, affected by sea-level rise, coastal erosion and different natural disasters like tropical storms and cyclones. The most recent confirmation of this susceptibility outbreak in May 2020, like the devastating cyclonic storm recorded in recent years in the Bay of Bengal—Cyclone *Amphan*—hit, damaging several million coastal popula-

tions to evacuate. From 1990 to 2016, India lost 235 km^2 of the due to coastal erosion, insertion the livelihoods and homes of the large numbers of coastal communities become in danger, with the voyage to disaster safer places happening voluntarily or, as a preceding alternative, through the intervention of Indian Government. Approximately, 3.6 million people of India have displaced from 2008 to 2018, maximum as a consequence of seasonal monsoon flood that occurring the strongly in South Asian region in utter terms. Sea levels increased by 8.5 centimetres within the last 50 years and scientific forecasts suggest that 36 million people are expected to be living in such location where experiencing severe flooding as well as displacement within the year 2100. Economic Survey of India which conducted during the year 2017, degree of throughway migration because of climate displacement was nearly 9 million communities between 2011 and 2016, while the census of 2011 found that the total number of inside migrants at an astounding 139 million—or nearly 10% of the inhabitants that impacted by different natural disasters. Climate change responsible for a supplementary stressor to inside migration flow in India [49-52].

Wherever climate change-induced displaced populations living or end up? different studies and evidence found that most of the climate displaced people migrate to Dhaka, Chattogram and other urban cities of Bangladesh and living in the high density and ever-growing slums. The second outlook is that some absolutely do migrate to urban cities, perchance around 10 % of the displaced communities including those who forced to migrate for enhanced opportunities of the livelihood conditions or economic perspective migrants. consequently, rural-urban migration is not unavoidably ambitious by the impact of climate change. Third, an enormous majority of climate displaced people stay within their nearby areas, as recorded in some current research studies and cooping to the changing circumstances with assistance from extended households and relatives lastly, migration of cross-border among the neighboring nations has also been documented in some research studies.

In the South Asian countries, a solid national adaptation plan is under implementation, which involves strategies of adaptation as a central element to climate change. Since displacements linked to climatic forces are already happening in Bangladesh, India and other south Asian countries mobility, migration and resettlement should also constitute key responses to climate disasters, particularly planned preventive resettlement of populations at risk of disasters. Otherwise, the concern of climate change-induced displacement will linger hidden among the lines of present national adaptation policies and strategies.

4. RESETTLEMENT STRATEGIES FOR CLIMATE DISPLACED HOUSEHOLDS

There are 3 enter principles of the successful resettlement program as climate change adaptation are recognized, drawn from a different research-based literature review on climate change adaptation and relocation program of climate displaced communities. The 3 principles mentioned below were considered highly noteworthy across all of the worlds for successful resettlement program among the world (Figure **4**).

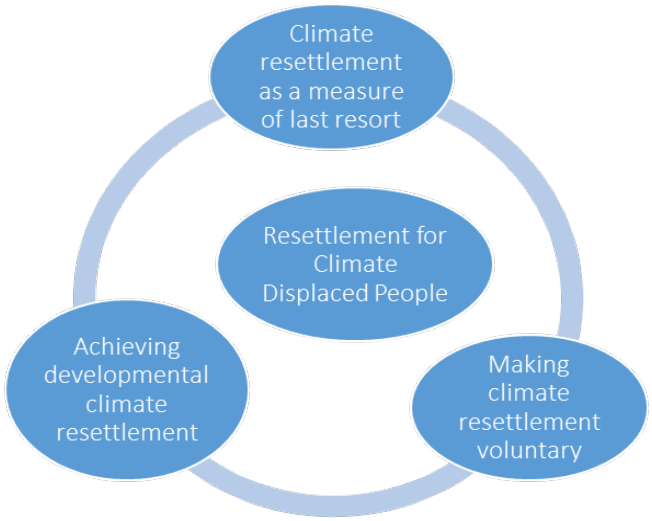

Figure 4: Principles of resettlement strategies for climate displaced people.

- The first principle considered that resettlement options as a climate change adaptation practices that should become a preceding resort and during the time of complete necessary moment. Although climate change becomes the consequences of significant livelihood challenges for mass communities for low-lying nations at inundation risk, there is constant indecision over how the impacts of climate change will be hindered for different community groups in various locations and that its effects may not be appreciably felt for the last decades. Thus, depending on the relocation and resettlement strategies as a climate change vulnerability responses that assess for the foreclose other, few severe options for climate adaptation, development of early disaster warning systems could attempt for reducing the climate change vulnerability and effects on the coastal communities [43-45].

- The second principle is that relocation and resettlement strategies should be a voluntary role as climate change adaptation practices in nature. The voluntary approach of resettlement defines as 'allows the disaster-affected communities to settle on whether they required to stay at the back or involved in the approach of resettlement strategies that might proffer them new opportunities for permanent living and livelihood'. This process permitted the latent resettles to work out the alternative in whether displaced communities leave the relocated places or not. This is due to obtaining the gratis and well-versed approval of the disaster-affected populations in relation to 'decision of communities to relocate or not, whether they wanted to migrate and the circumstances under that displaced people are acknowledged for choice of integration into the new living community places' [46-48].

- Resettlement as the adaptation options that should be the developmental process which considered as the last and third principle. This principle considered as a complete minimum criterion that resettlers could be no inferior off as a consequence of resettlement and that, preferably, their long term well-being in their new settlements should be improved. The process for improvement of the resettlement approach is considered as the Impoverishment Risks and Reconstruction (IRR) model for relocating climate displaced communities [49, 50].

- There are three principles that should follow the implementing the resettlement strategies for climate displaced people as adaptation options which are: Firstly, Government penchant for nation-led relocation strategies over the period and across the different political approaches. Secondly, the challenges implicated in distinctive among the resettlement of voluntary and involuntary approaching practice; and last principle is the further impediments that the enlistment of the legitimizing illustration for the present the achievement of developmental resettlements. However, intended resettlement repeatedly engages many multifaceted political, ecological and psychological questions that crop up during and after the time of the resettlement approach, in adding up to the subsidy decisions.

5. CASE STUDIES

In this manuscript, two case studies are presented to exemplify the trend of coastal erosion, displacement, and resettlement approach by the Government of Bangladesh and India. One case study is in Kutubdia, Bangladesh and the other is in Sagar and Ghoramara Island of Indian Sundarban, West Bengal, India.

5.1. Displacement and Resettlement Approach of Kutubdia

Kutubdia Upazila situated on the south-eastern part of Bangladesh coast that lies between latitude 21°44'23" to 21° 55'24" N and line of longitude 91° 50'40" to 91°54'04" E, placed within the south-eastern part of Bangladesh having a part of 215.8 km² and separated from the most land by Kutubdia channel (Figure **5**).

The population of Kutubdia is 1,25,279 according to census 2011. People living on Kutubdia Island are mostly involved in farming and fishing as their primary occupation. The fishermen of this island facing numerous challenges in their livelihoods that are environmentally induced. Incessant erosion of the Kutubdia forced to displaced the fishermen families frequently from their inherited living homes. Besides, recurrent tropical cyclones induced storm surges insert the most vulnerable life and livelihood for them. The irresistible majority of the inhabitants are living in extreme poverty who are staying in the house which is made of bamboo and straw. There are nearly 5% of the total home structure of the island are thought to adopted as straighten of the power of cyclone and storm surges. Comparison of the income generative activities than other areas of the country, inhabitants of the islands are relatively very poor condition. Besides, illiteracy rates and landless people rates are significantly higher on this island compared to the rest of the nation [50-54]. Communities of Kutubdia were harshly affected by the cyclone in 1991. During these disasters, every person was temporarily displaced and a significant portion went to other places permanently. However, there are 2 categories of destination that have been identified, such as own as well as another district (Figure **6**).

Most of the displaced people responded that they were involved numbers of professional activities as alternative livelihood before the displacement but due to forced to displaced from their homeland, their income-generating activities become very limited. The living cost is significantly increased, livelihood becomes insurance, poor social bonding and harmony as well as higher physiological stress on their mind in new living places after displacement [54, 55]. There are 4 cate-

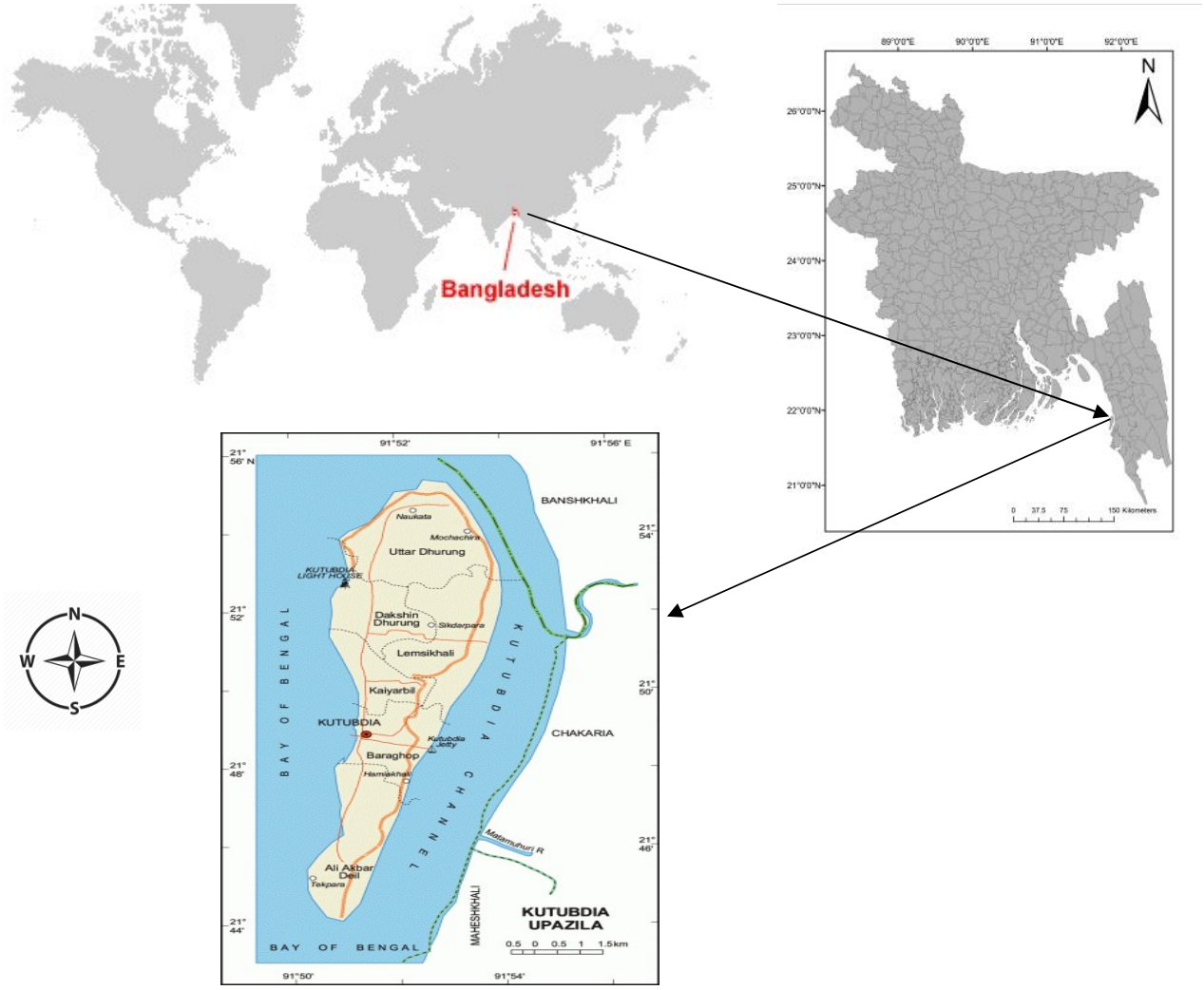

Figure 5: Geographical Location of Kutubdia.

gories of profession available for climate displaced people during the time before and after displacement in Kutubdia which found significantly impacted. Inhabitants of Kuttubdia stated that they involved their livelihood through day labour, fishing, small trades, salt production, vessel driving from their childhood before the displacement. But after displacement, they were living in new areas and limited income-generating activities forced to living with low financial capacity and they faced hardcore poverty, eventually getting engaged in different informal activities [56, 57].

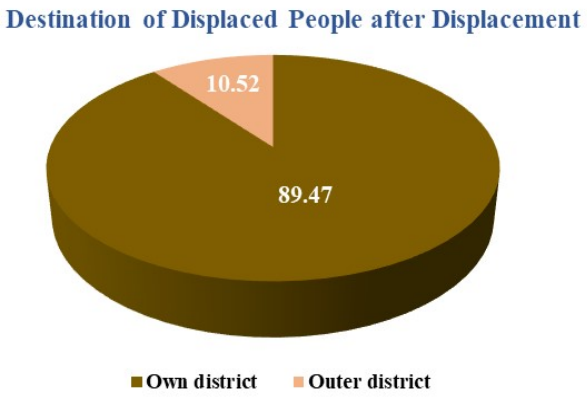

Figure 6: Destinations of climate-induced displaced people.

The data on on coastal erosion of Kutubdia from 1972 to 2013 found that within this year, Kutuddia lost 9 $km^{2\ of}$ land from 1972 to 2013 that express that coastal erosion rate higher than the accretion rate. However, because of the negligence of proper management and absence of proper monitoring process, defective infrastructure and absence of re-engineering process, favouritism for tender construction and lastly corruption responsible for not properly developing of the coastal embankments of Kutubdia Island have experienced embankment vanishing [56]. Because of the damaging

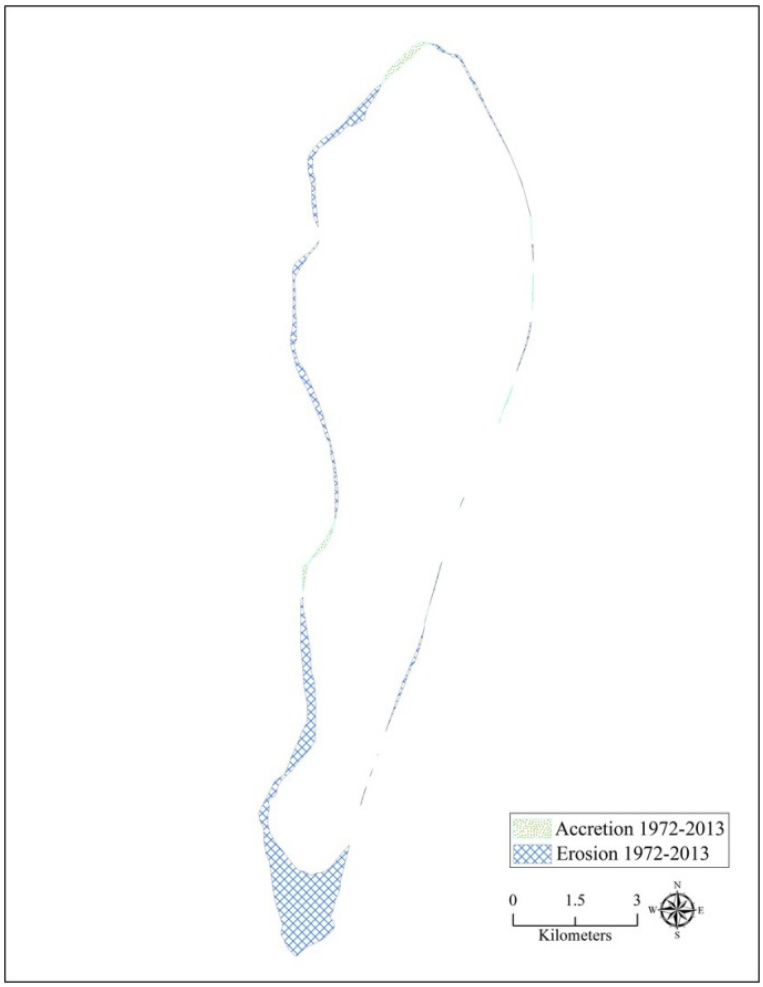

Figure 7: Land erosion and accretion [57].

of the coastal embankment, agricultural croplands always flooded with tidal water and inhabitants stated that crop production in Kutubdia always been affected severely. Because of regularly flooding by tidal water, salinity intrusion damages the agriculture production of Kutudbia which ultimately make the sediments less productive in this area. Besides, the agriculture and forest land of Kutubdia changes significantly over the year and submerged into the sea. The three different land cover classes from 1972 to 2013 are shown in Figures **7** and **8**.

Inhabitants of the island stated that salt production now becomes a more lucrative and profitable business rather than crop production which frequently damaged by different natural hazards like cyclone, tidal flood and storm surges. local crop and vegetable production have decreased due to the increasing trend of salt farming on former cropland [58]. Significant land cover changes from 1972 to 1978 were the conversion of land (6.6 km^2) from agriculture to forest and agriculture to water. The authors found the major changes of conversion of forest to agriculture (5.1 km^2) since the year 1978 to 1989 and from 1989 to 2009 the major change of land cover was in the conversion of agriculture to water (5.2 km^2) and from 2009 to 2013 the major changes of land cover were the alteration from the agriculture activities land to a water body (7. 1 km^2). The finding of the study indicates the land loss of approximately 9 km^2 of Kutubdia Island since 1972 and 2013 [59, 60].

Many former residents of Kutubdia Island left their ancestral homes for a variety of climate-related reasons, and about 50,000 displaced peoples have been living in the Cox's Bazar city located 75 km south of Kutubdia to escape land erosion, floods, cyclones, storm surges, and a rise in sea level [60,61]. This is found that unwilling migration takes place as a last resort to cope with the impacts of disasters. In the study, it was found that 370,000 people of Kutubdia, Maheskhali and Sandwip islands have been experienced displacement from their living places within 36 years (1980-2016) due

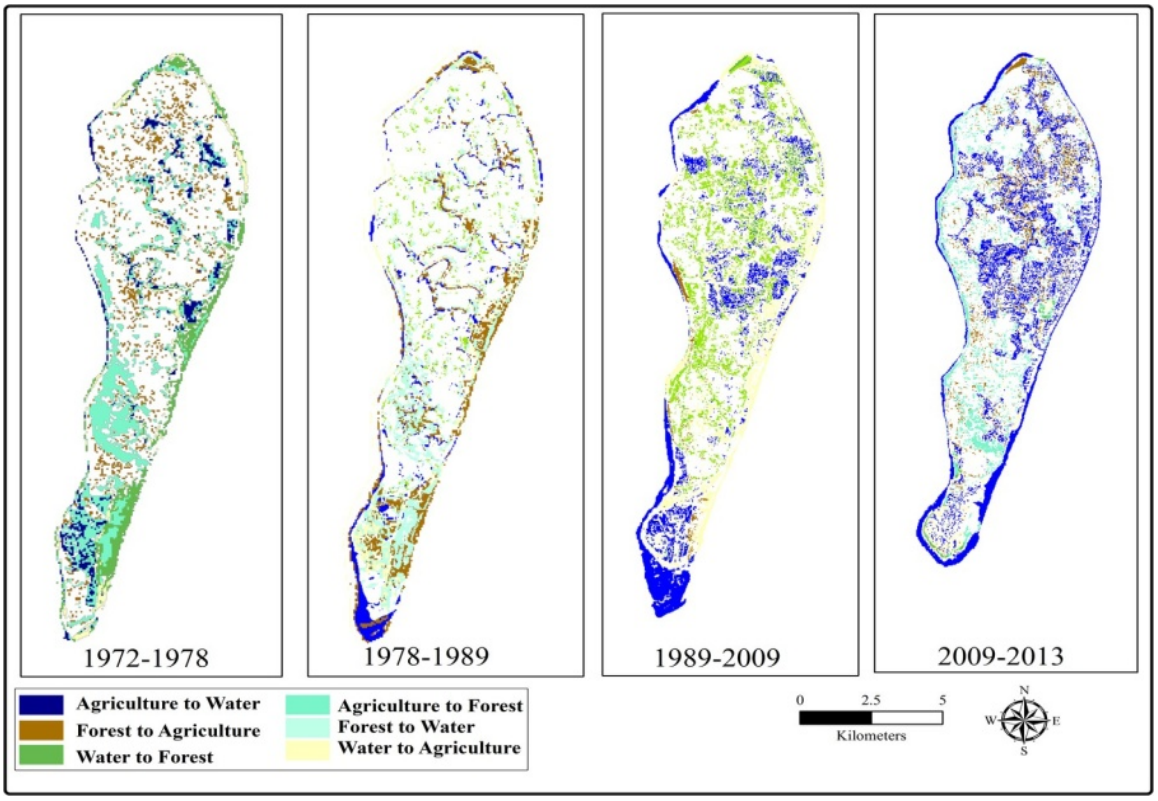

Figure 8: Change detection of land cover (1972 to 2013) of Kutubdia [57].

Table 1: Numbers of Climate Displaced Peoples of the Study Areas from 1980 to 2018 [64]

District	Upazila	Reason for Displacement	Displaced Peoples No	Destination
Chittagong	Sandwip	Cyclone, Erosion, Tidal Inundation and Water Logging.	1,50,000	Chittagong and Cox's Bazar
Cox's Bazar	Maheskhali	Cyclone, Erosion, Tidal Inundation and Sudden Flood.	100,000	Cox's Bazar
	Kutubdia	Cyclone, Erosion, Tidal Inundation, Sudden Flood and Water Logging.	2,00,000	Cox's Bazar
Total			**450,000**	

to the disaster of the cyclone, coastal erosion, tidal flood and waterlogging [62, 63] (Table **1**).

Inhabitants of Kutubdia planted important commercial trees around the homestead. They also construct their living houses as low height and enlarged the ground level of the houses. These adaptation options by the island dwellers ranked as high categories due to environmentally, economically, and social perspective these practices become a sustainable and successful adaptation for the respondents. These adaptation practices are trying to reduce the displacement risk of damage due to storm surges and coastal erosion for the households. The Government of Bangladesh rehabilitated climate displaced people in these islands through the distribution of agriculture *khas* land and housing in *Ashrayan* and *Abasan* project. However, the numbers of rehabilitated peoples in Kutubdia found so nominal compared to several displaced people from the study areas. The *Ashrayan* and *Abasan* project is the housing-related rehabilitation program by the Government, where displaced people living there free of cost. Due to lack of monitoring by the respective department and the *Ashrayan* and *Abasan* project of Kutubdia becoming abandoned as both of the *Katcha, Pucca* houses found cracks and damaged which currently unsuitable of people living there. There is6 Government *Ashrayan* projects in Kutubdia where 1300 inhabitants were living with the threat of coastal erosion. Respondents demanded more *Ashrayan* and *Abasan* project in

Table 2: Rehabilitation of Climate Displaced People in the Study Areas

Islands	Khas Land	Ashrayan/ Abasan project	Cyclone Shelter/ Shelter home	Rehabilitated People Permanently
Maheskhali	1302 acre (1170 acre distribute)	04	95	1100
Kutubdia	2345 acre (1200 acre distribute)	06	76	1300
Sandwip	10543 acre (3450 acre distribute)	03	20	2000

Kutubdia for the rehabilitation of climate displaced people as they become landless and homeless frequently (Table **2**).

There is 06 Govt. rehabilitation program in Kutubdia where one *Ashrayn* project located at South Dhurang union of Kutubdia where 40 displaced families living and established 2012**.** All the families were living in the embankment of South Dhurang and they are depending on fishing. They got the information from Union Parishad about the rehabilitation program by the Government then they applied to the housing according to the prescribed form. They have to face so much harassment to get the all necessary documents from the respective department and pay the bride in different stages. 1 year later of the application they got the house in the *Ashrayan*. The authors visited the rehabilitation program of Kutbubdia in January 2017. During the visit, inhabitants said that during the rainy season, the area of the *Ashrayan* project, totally flooded and sometimes rehabilitated families has to leave the project for survival. This condition happened last 2 years. During the visit to the *Ashrayan*, there are 5 houses were found locked. The inhabitants said that these families were living in other places with a good situation. There are 2 tubewells set up in the *Ashrayan* project for the inhabitants. But within a short period of time, we found both the tubewells surrounded area are now damaged. Users of the tubewells have to work hard for water collection. Both the tubewells also required long times for collection by the families. This *Ashrayan* project established under the *Ashrayan* phase-2 and for that reason all the houses are *Pacca* structures, but during observation all the houses inside and outside area observed big cracks and floors become down due to the corruption of housing construction. The sewerage system of garbage from latrine found damaged and it is creating an unhygienic situation for the families. The families of the *Ashrayan* project also complained that local villagers creating obstacles to free movement. The girls who are going to school always suffered Eve Teasing by the youth peoples. They protest several times to the local members and administration, but nothing happened. They also fear security problems inside and outside of the *Ashrayan* project. Another *Ashrayan* project located in Kaiarbill union of Kutubdia was established during the first phase of *Ashrayan* project in 1996 where 25 families rehabilitated in the tin shade houses. Most of the families of this *Abasan* affected by a cyclone in 1991 and they became homeless at that time. They were living in the Kaialbill embankment with enormous suffering of havoc. Inhabitants of the Abasan project said that most of the families earning members are day labourer. During the rainy seasons, the communication road was submerged under the flood water and at that time earning members not able to go outside of work. They return the full amount of the loan to the respective department before the deadline. But now they need financial assistance from the respective department for various purposes due to the crisis. But the loan assistance of the social welfare department stopped as authority said to us. The families of this Abasan project demanded the Govt. financial support and reconstruction of all housing in this Abasan project immediately for their existence in the rehabilitated housing area.

5.2. Relocation of Inhabitants of Sagar and Ghoramara Island, West Bengal, India

A great widen of the Indian coastal area is at risk because of the sea-level rise, along with intensifying cyclone and larger storm surges. As India possesses the second-largest population (1.353 billion), 7,500 km coastline, almost 70 % percent of communities inhabiting in the low lying coastal zone and seventh in terms of area (82,000 sq km). Climate change often affects freshwater quality and geomorphological changes that might make some small island developing countries uninhabited forcing migration. Indian Sundarban consisted of 102 islands but now 98 islands are in existence as 4I islands have been submerged and nearly 6000 families turned into climate displaced peoples [65]. Approximately 1.4 million people inhabiting 53 Islands are facing serious threats of becoming

homeless due to the accelerating rate of sea-level rise, coastal erosion and embankment breaching. Some of the islands are rapid disappearance from the Indian geographical map because of people displacement from their original habitat due to climate change-induced disasters [66].

Ghoramara Island and Sagar island located in South 24-Pargana district of West Bengal, India. Both the islands are situated in the face of Indian Sundarban is part of a tidally active delta formed by the alluvium of Ganga and Brahmaputra and their tributaries (Figure **9**).

Resettlement and rehabilitation of climate displaced communities from the Lohachara island and the Ghoramara village to nearby place Sagar island that has been considered for the case study of this book chapter. Time series analysis reveals that in 1975, the island of Ghoramara had a total area of 8.51 km^2, which reduced to 4.43 km^2in 2012. Within the year 1975 to 1990, the erosion rate recorded as the highest and also led to the vanishing area of these Lohachara, Suparibhanga and Bedford Islands, along with the Khasimara, Khasimara Char, Lakshmi Narayanpur, Bagpara, Baishnabpara villages of Ghoramara island [67-70] (Figure **10**).

Some coastal and marine researchers have forecasted that the coastal erosion frequency and flooding of the islands, particularly in the southern area of a deltic region because of increasing mean sea level (3.14 mm per annum that is higher than the global sea level rising rate of 2 mm per annum), quite than the dearth of sediments or human interventions [71, 72]. Ghoramara was once a fraction of Sagar island but was detached from 1901-1905. Administratively, it is still a fraction of the Sagar Community Development Block [73, 74]. Ghoramara now has a population of 5236 in 899 households. The total figure of the displaced communities varies from 4000 and 6000-7000 [75. 76]. On the other hand, the total land area of Sagar Island is 41.27 km^2. According to the national population census of India during 2011, the total number of houses of this island is 2030 and the total population around 10,500 and the poverty ratio is 44.46%. Maximum communities make out a precarious living on this flood and cyclone-prone land by farming, fishing, collecting prawn seeds. Marginal workers depend on seasonal tourism during the annual fair at

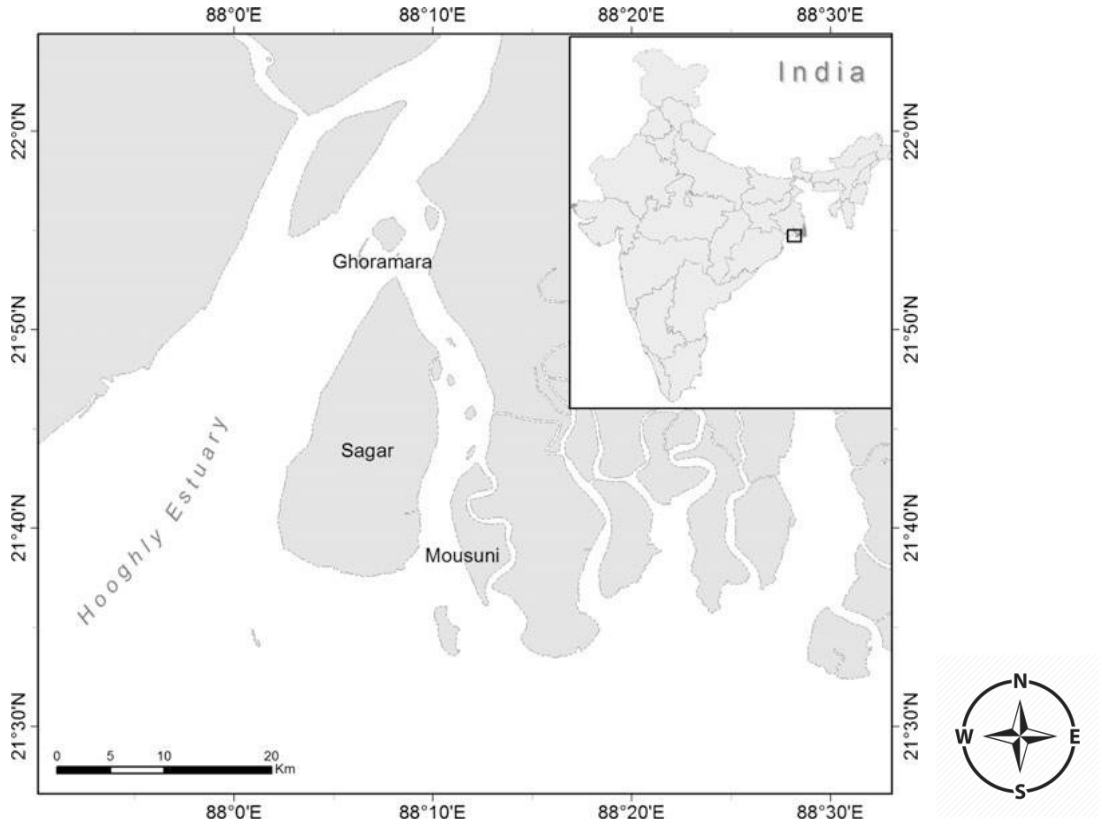

Figure 9: Geographical Location of Ghoramara and Sagar Island.

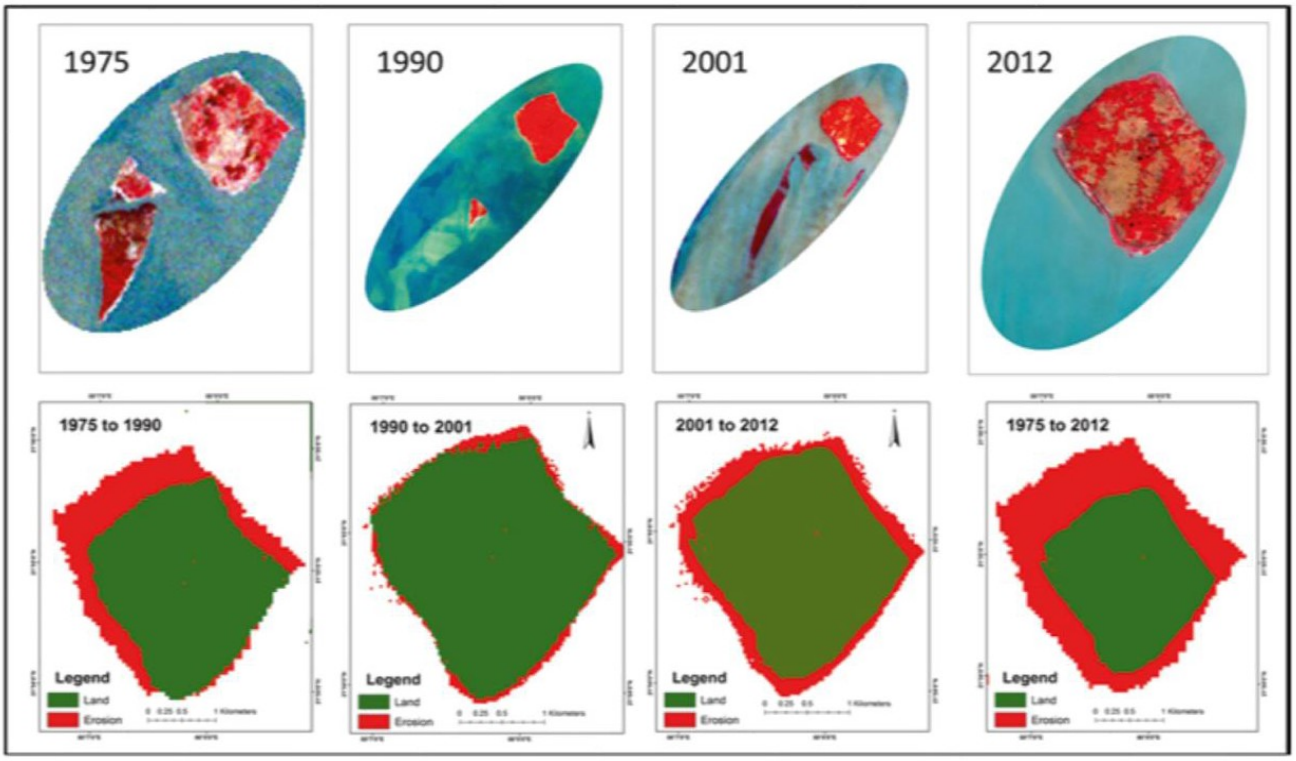

Figure 10: Time series analysis show the extent of erosion in Ghoramara Island during the period of 1975–2012 [70].

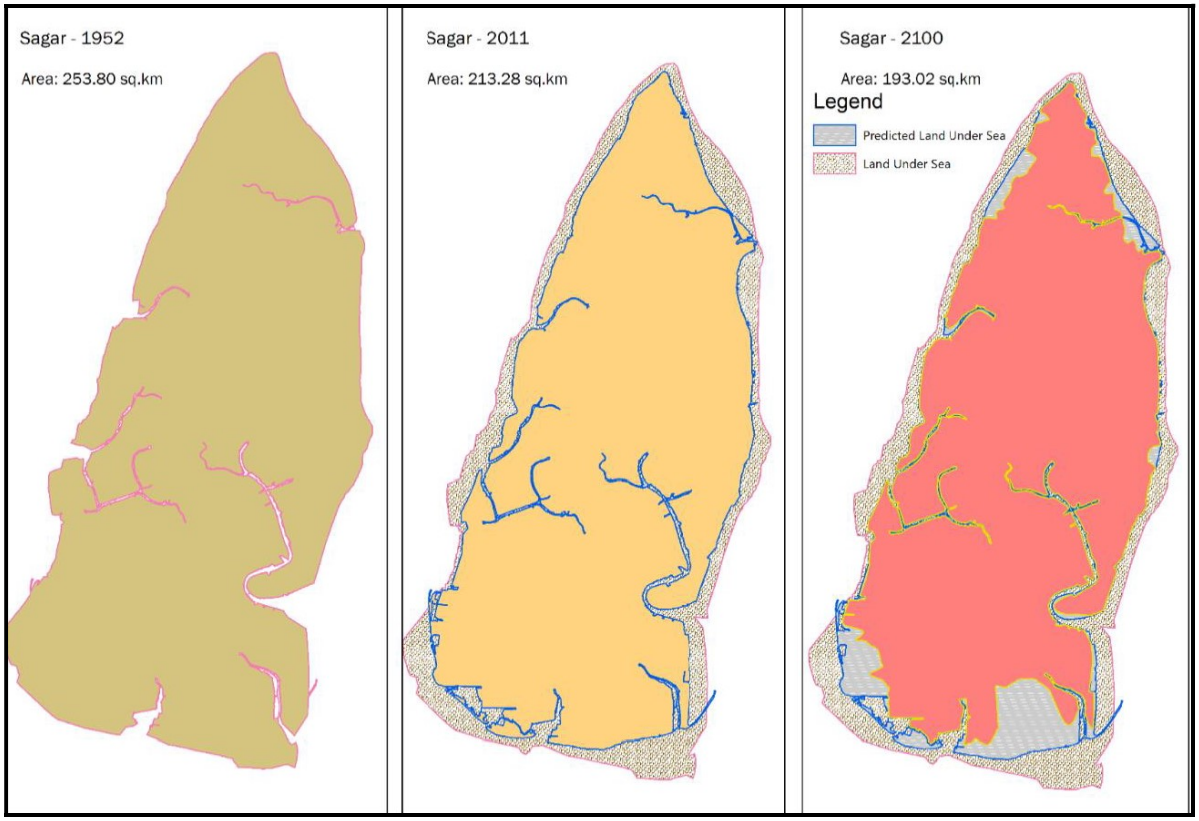

Figure 11: GIS mapping of Sagar island through changing the area from 1952 to 2011 and future prediction [76].

Gangasagar and for the remaining year, they become daily labourers. After the 2009 cyclone *Aila,* agricultural lands became barren and converted into aquaculture ponds because of saline water intrusion [76] (Figure **11**).

Total area of Sagar island has changed dynamic changes from 1990 to 2015. During 1990-95, the land area increases from 235 to 252 km^2 but after 1995-2000 and 2000-2005, this island recorded the highest land loss within 25 years. Conversely, Ghoramara island has experienced considerable loss over the 25 years and erosion rate found 0.02 km^2 per year which is 36% of the land from 1990 to 2015 [77] (Table **3**).

During the year 1980, the Indian government launched a longer period of strategy to relocate the climate displaced communities of Ghoramara and Lohachara to Sagar Island. The Island was chosen for relocation because there was a more suitable place of land for living and infrastructure development and erosion free places. [78, 79]. But relocation approach found not so smooth and easy for climate displaced people from the island of Ghoramara. Although the Indian Government selected Sagar Island for resettlement but during that period, there was no construction of coastal embankment around the Sagar island. Island inhabitants forced to elevated the level of living houses as the tidal water submerged the living places. This is also the story that local inhabitants of Sagar Island forcefully captured the land of resettlement location of Ghoramara inhabitants. They also create obstacles to taking drinking water from tubewells and other resources useful for migrant people. Regardless of these obstacles and different troubles, climate displaced people of Ghoramara involving their livelihood with few alternatives during the time of displacement by coastal erosion and were thankful for all kinds of rehabilitation assistance from the West Bengal Government. . During the discussion with resettled displaced people of Ghorama to the integrated process of resettlement facilities of Sagar island that they never agreed to return to Ghoramara even if it were possible. Climate Displaced people from Ghoramara, Sagar and other islands are resettled in Sagar island by the government authority. The main concentrations are found in Bankimnagar, Gangasagar and Jibantala-Kamalpur colony areas (Figure **12**).

Phuldubi colony: This was 1st resettlement colony in Sagar island during the year 1964. People from Ghoramara island were relocated here. There were 11 households with a population of 50 settled here. Every household was granted 0.533 ha of land from the government.

South Haradhanpur colony: This colony established during the year 1965 and all the people are climate displaced from Ghoramara island. There were 11 households that benefited for resettled here and they got the same amount of land as Phuldubi colony.

Bankimnagar colony: The 2nd big resettlement project of Indian Sundarbans initiated during the year 1972 at the Bankimnagar colony where every family obtains 0.833 ha of land as funding by the West Bengal Government. They have constructed earthen embankments surrounding their colony to prevent saltwater intrusion in the agricultural fields and water bodies. Cultivation is the main occupation that is greatly dependent on the monsoons and pond water, a universal trend noticeable in most parts of Sagar. There are 151 households are living in the colony. There is one primary school and the literacy rate is admirably high 92% and inhabitants have participated in afforestation and social forestry programs.

Gangasagar Colony: This colony was established in 1981 in the Gangasagar area. People from Ghoramara were resettled here and each family got 0.267 ha of land and the house of one-room mud house as a grant from the government. There are 150 families are living in the colony with a population of 1,050. The main source of income of the inhabitants is agriculture followed by prawn seed collection. There are 74% of inhabitants are literacy rate is high.

Jibantala-Kamalpur Colony: This colony established in 1983 and there are 2 parts in the colony —Jibantala and Kamalpur areas. Together, there are 135 households are living in the resettlement places and each family got one pucca (brick-built) house with

Table 3: Total Land Area and Land Loss of Sagar and Ghoramara Island from 1990-2015 [77]

Island	Time Window	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015
Sagar	Erosion in sq. km	0.43	9.35	3.8	0.55	5.79
	Accretion in sq. km	17.13	1.59	0.86	7.56	0.39
Ghoramara	Erosion in sq. km	0.11	0.61	0.61	0.09	0.46
	Accretion in sq. km	0.35	0.00	0.02	0.29	0.05

a tin shade and 0.2 ha of land as a grant from the government. The land is not suitable for cultivation and a change in livelihoods is common.

It was revealed that there exists a socio-economic difference leading to conflict amongst the early settlers and the new settlers. Colony numbers 1 and 2 which consists mainly of older settlers of Jibantala have the facility of tube wells but colony number 3 consists of newer migrants who have no safe drinking water facility. The new settlers forced to go the far distance to fetch drinking water daily; for which they are required to make a payment. There is one primary school available in the colony where the education rate is 45%.

Inhabitants of the resettled colonies mainly engaged in various informal occupations. In the Phuldubi colony and South Haradhanpur colony, most of the resettled displaced people are working as daily labourers, cultivators and followed rickshaw van pullers. , On the other hand, Bankimnagar resettled the colony, maximum communities are living their lives as agriculture cultivators followed by small traders and rickshaw van pullers. Lastly, a colony of Gangasagar where resettled displaced communities are involved as crop farmers followed by day labour, small traders and rickshaw van pullers while maximum people are involved as day labours in the colony of Jibantala-Kamalpur [80, 81] (Figure **12**).

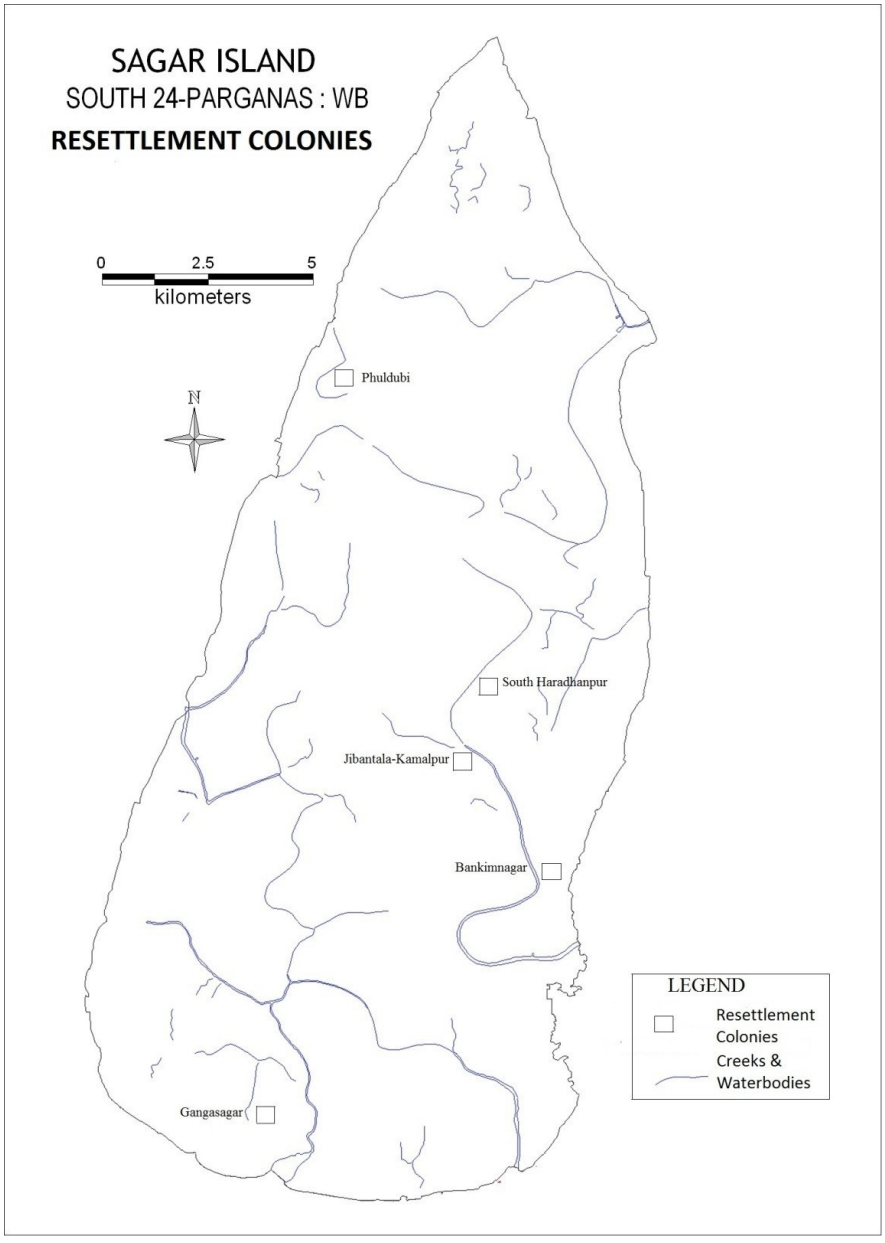

Figure 12: Map of a Resettlement colony of Sagar Island [82].

Evaluation of the resettlement program by the resettled population disclose dissatisfaction among the relocated people, with people facing common problems like retreating land allotment, unemployment, high rate of illiteracy, professional change leading to income reduction, absence of primary health facilities, education, hygiene sanitation, electrification, drinking water, road communication as well as the occurrence of conflict among the residents and the settlers have also been evidence earlier in different media. In addition, these tribulations, the resettled inhabitants are also fighting with different natural hazard like high salinization, waterlogging, erosion, flood, etc. [83-85]. The satire of the circumstances, however, lies in the truth that Sagar island itself is sighted as vulnerable for submerged and is facing the harsh rate of coastal erosion [86, 87].

6. COMPARATIVE SCENARIO OF RESETTLEMENT PROGRAM

Climate displaced communities of Bangladesh and India have been an influx from coastal areas of the disaster-free safe area and also urban slum areas. In these circumstances, displaced people didn't enjoy their cultural harmony, social status, family bondage in new living places. The authors stated that the massive erosion process occurred in the Kutubdia island of Bangladesh and Ghoramara as well as Sagar Island. Furthermore, the displaced people were left out of ongoing social safety net programs and fell in inaccessible situations to get their children into school, children education programs, community- based health care facilities and were not easily getting the authorization of the local competent administrative body. Moreover, there are some misconceptions among local people such as that the displaced people are involved in many anti-social activities, particularly local violence, robbery and ransoming drug business activities and so on. Consequently, local people were unwilling to create many kinds of social bondage like marriage, community-based get-together, social and cultural events with displaced people.

Resettled climate displaced people in the new habitat of Bangladesh and India are trying to adopting their new living conditions. They adjusted differently in the new habitat on the basis of their approach to the problem, the frame of mind, and abilities of adjustment. Facilities of rehabilitation facilities have been evaluated to be insufficient and tiny for their sustenance in the long run. An appropriate development strategy is required by the Government so as to avoid the socio-economic backwardness of the resettlement areas of the South-Eastern coast of Bangladesh and Indian Sundarban inhabitants. The islanders' retort can be categorized into 2 types of strategies: structural adjustments and non-structural adjustments. Structural adjustments include damage reduction of dwellings and embankments.

Most of the island inhabitants of Bangladesh and India want to leave the island because of insecurity and frustration of living, surveillance and waiting as they see every day how their living land is being eroded away by coastal erosion and they are experiencing displacement from their origin. The island inhabitants wait with great anxiety for the help of the Government and Non-Government authorities to come frontward and support them to pull through their losses.

7. SUMMARY AND CONCLUSIONS

Climate change influence is a reason for mass human displacements all over the earth over the last few decades and climate displaced person are putting major challenges to the geophysical biological and social arrangement. In this chapter, the authors briefly discussed the coastal erosion, displacement of the coastal communities and the resettlement scenario of South Asian countries. The authors also presented the two case studies of erosion, displacement pattern and resettlement of displaced communities of Bangladesh and India. A review of the literature exposed that South Asian nations such as Bangladesh, India and Sri Lanka are the prime victim of climate change-induced coastal erosion and displacement problem.

The authors recommended always the need to required four management stages such as a survey of climate displaced people, selection of appropriate beneficiaries, survey and finalization of land and legal processing of housing and land separately those are going to proper rehabilitation of climate change-induced displaced people. In this situation, the research study prescribed the advancement of the sustainable management of climate change-induced displaced people by good governance through ensuring strong and continuous coordination among the relevant stakeholders, ensuring civilian rights for displaced people, ensuring safe and risk-free relocation and rehabilitation places, strengthening climate change adaptation and disaster management related laws, rules and policies, ensuring community- based resettlement program and ensure the accountability, transparency& equity during the Government-owned land distribution for displaced people (Figure **13**).

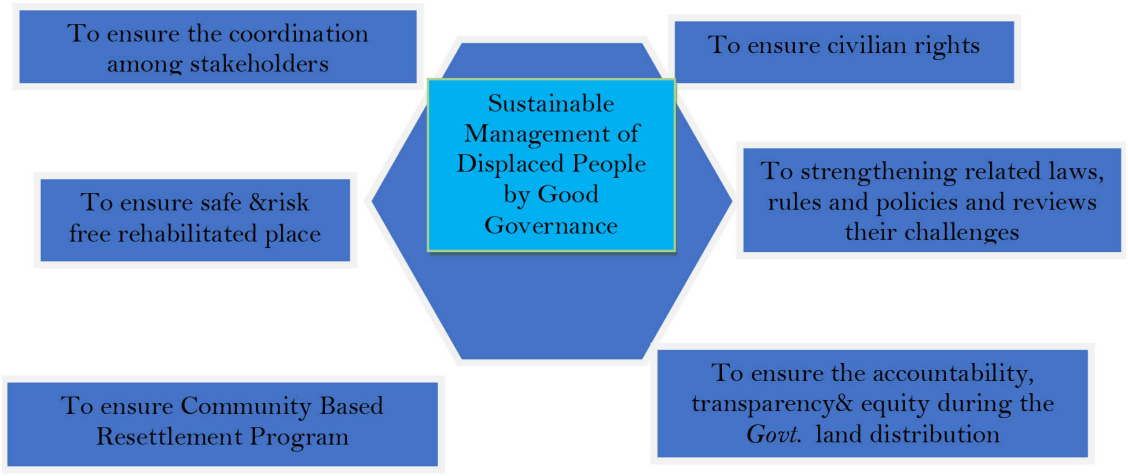

Figure 13: Sustainable management of solution of climate displacement problem.

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Received on 20-10-2020 Accepted on 18-11-2020 Published on 20-12-2020

DOI: https://doi.org/10.15377/2410-3624.2020.07.4