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Bangladesh Housing Land and Property (HLP) Rights Initiative

Study Report on

Land Availability for Climate Displaced Communities of Bangladesh

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Study on Land Availability for Climate Displaced Communities of Bangladesh

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Chapter 1: Study Background, Objectives and Methodology

1.1 Study background

The UN Framework Convention on Climate Change (UNFCCC) recognizes that Small Island Developing States (SIDS), low-lying and coastal countries, Africa, and the Least Developed Countries (LDCs) are particularly vulnerable to the impacts of climate change (UNFCCC 2007). Millions of people in the coastal areas of Bangladesh are under threat of climate change and climate variability issues. Modelling studies indicate that if sea level rise occurs at a rate higher than predicted and coastal polders are not strengthened then six to eight million people will be at risk of being displaced by 2050 (Practical Action 2008). According to a recent report, over 35 million people will be displaced from 19 coastal districts of Bangladesh in the event of a 1-meter sea level rise this century (Rabbani 2009).

In Bangladesh, climate change can affect population movement in many ways. Both sudden environmental events and gradual environment change influences population movement in different ways. Sudden onset events such as floods, cyclones and riverbank erosion may cause the affected population to leave their homes at least temporarily. These movements are usually large scale. In most cases people return to their place of origin in the long term. Slow onset process such as coastal erosion, sea-level rise, salt water intrusion, changing rainfall patterns and drought can produce irreversible results, leading to more permanent forms of migration (Siddiqui 2011).

Floods are a fact of life for many communities in Bangladesh. A quarter of the country is inundated in a normal year. In the last 25 years the frequency of severe floods has intensified. 1988 and 1998 floods displaced as many as 45 and 30 million people respectively. Protracted water-logging after floods has increased. Owing to such events, a large group of people are displaced temporarily. River bank erosion is a major concern of people who live alongside major rivers and on *chars*. Each year around 1 million people are affected by river bank erosion (Siddiqui 2011).

In the context of increasing climate change, sea level rise poses an existential threat to Bangladesh by potentially inundating 18 percent of its total land-mass, directly impacting 11 percent of the country's population. Rising sea levels will affect Bangladesh through saline water intrusion, drainage congestion, a higher frequency and intensity of extreme events (including tropical cyclones and storm surges) as well as changes to the coastal morphology (MOEF 2005). Sea-level rise is cited as the biggest cause of mass displacement with estimates of 30 million to 40 million people being displaced this century.

It is interesting to note that none of the policies of the Government of Bangladesh deal with the issue of migration. While the Bangladesh Climate Change Strategy and Action Plan BCCSAP) mention climate migration – and recommends that the Government take action to monitor migration as well as develop a protocol to provide for adequate resettlement and rehabilitation, migration as an adaptive option has not been thought of by policy makers and development practitioners. The National Adaptation Programme of Action (NAPA) and the BCCSAP are concerned about building capacity and resilience against climate change

effects through considering site-specific vulnerabilities of the impacts of climate change. It is found that the migration of family members in times of distress provides much-needed economic support to ensure the survival of their households (Siddiqui 2011).

To face the challenge of mass displacement (both internal and external) as a result of climate change, Bangladesh must be adequately prepared so that the vast majority of those displaced will be supported with adequate resettlement and rehabilitation schemes, whilst also ensuring that their basic human rights are respected. One of the major concerns associated with resettling climate displaced people will be to increase the availability of affordable, safe and well-located land that can be effectively utilized by climate displaced persons requiring new land resources.

Given this context, the Study Report will categorize land availability in Bangladesh that could ostensibly be used to resettle climate displaced communities as well as indicating ten key land parcels that could be sought for donation/purchase for contributing to the resolution of climate displacement.

1.2 Study objectives

The specific objective of the study is to identify viable land parcels in Bangladesh that could be used for resettlement of climate displaced persons.

The objectives of the study are:

- Categorization of each of the various land categories in Bangladesh, including both public and private land;

- Analysis of land categories suitable for the resettlement of climate displaced persons in Bangladesh;

- Estimate of the land resources required to resettle the entire climate displaced population in Bangladesh;

- Identification of specific land parcels in the Chittagong region which could be acquired and accessed by civil society groups and climate displaced communities an utilized as possible resettlement sites.

1.3 Study methodology

The study employed appropriate tools of Geographic Information Systems (GIS), including:

(i) Digital interpretation of satellite imagery;
(ii) Ground truthing in selected locations of Bangladesh to analyse different land use categories and to identify suitable land parcels;
(iii) Landsat satellite images and other sources were also analysed.

1.3.1 Landsat satellite image: NASA-based Landsat satellite imagery was used to identify suitable land availability in Bangladesh. Considering the geographical aspects, a number of locations with different characteristics were selected for data collection on human, physical, financial, natural and social assets of the local community following a semi-structured interview, focus group discussion and key informant interview. Participatory workshops were organized at the local level with a wide range of stakeholder groups, including, farmers, fishers, day labourers, traders, local administrators, policy makers, extension managers, local elites, politicians, NGO representatives, media personnel and researchers to identify and rank the attributes/criteria with significant weight. Land use patterns and the locations of roads, electricity supply lines, markets, schools and health centers were taken from land use and administrative maps and then updated with Landsat satellite images, field surveys and participatory interviews with local communities.

A total of 14 Landsat images from paths 135-139 and rows 42-46 covered the entirety of Bangladesh have been analyzed digitally in Figure 1:

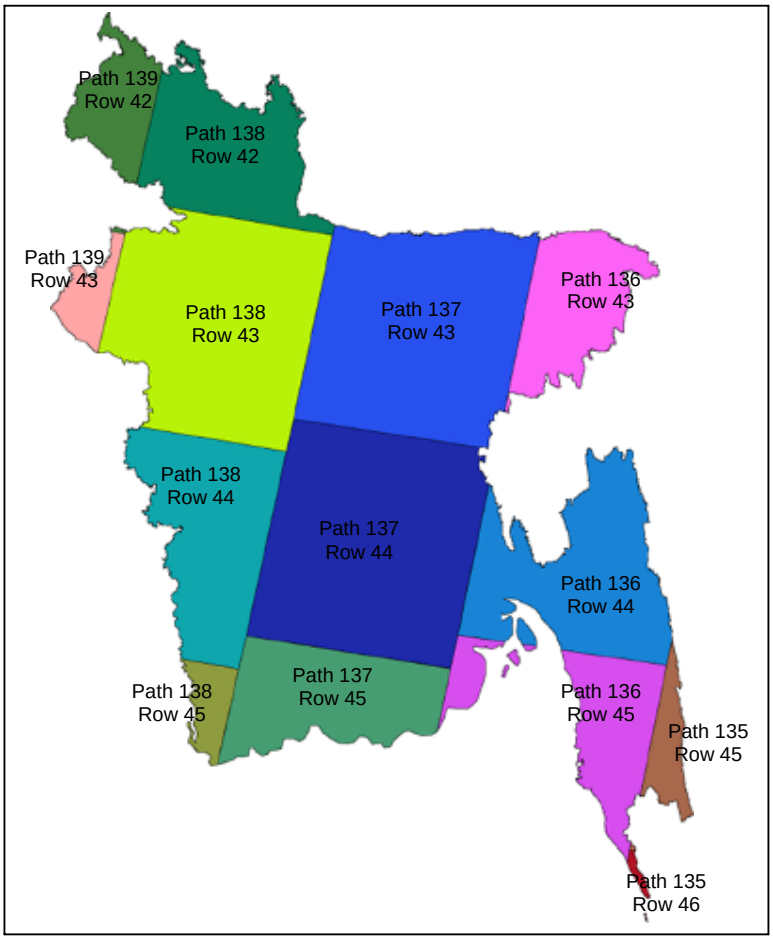

Figure 1. Landsat satellite path and row map of Bangladesh with 14 scans by NASA, USA

1.3.2 Multicriteria Analysis: The multicriteria analysis as a spatial decision support tool focused on specifying and creating a comprehensive set of evaluation criteria that reflected all the concerns relevant to the decision problem. A scoring system of 1 to 3 was chosen, 3 being the most suitable and 1 the least suitable for climate displaced communities in Bangladesh. The decision maker's preferences with respect to the evaluation criteria were incorporated into the decision model. These were assessed in terms of the relative importance (weights) assigned to the evaluation under consideration that expressed the importance of each criteria relative to other criteria. Eventually, the criteria layers and their weights were integrated to provide an overall assessment of the alternatives. This step is known as multicriteria evaluation (MCE) and accomplished by appropriate decision rules, which are formal mathematical expressions that combine the weights and scores of each of the layers used.

1.3.3 GIS analysis of data: ArcGIS software (version 9.3) developed by Environmental Systems Research Institute Inc, USA was used to develop land availability modeling. The spatial extension module was used for surface interpolation in ArcGIS. The values of the collected and analysed data were expanded to the sites where no samples were available using interpolation methods. The interpolation provided the values in such points where no measurements were available. Universal Transverse Mercator (UTM) projection was used to transform the maps and satellite images. ENVI software (version 4.5) developed by Research Systems Inc, USA was used for the digital interpretation of satellite images.

1.3.4 Ground truthing: The suitable land availability database created from the digital interpretation of satellite imagery and GIS analysis was verified through a ground survey in the selected sites using hand held GPS (Global Positioning System). The relevant secondary data collected from various sources was used for triangulation of the satellite image classification and GIS analysis.

This detail study methodology is presented in Figure 2:

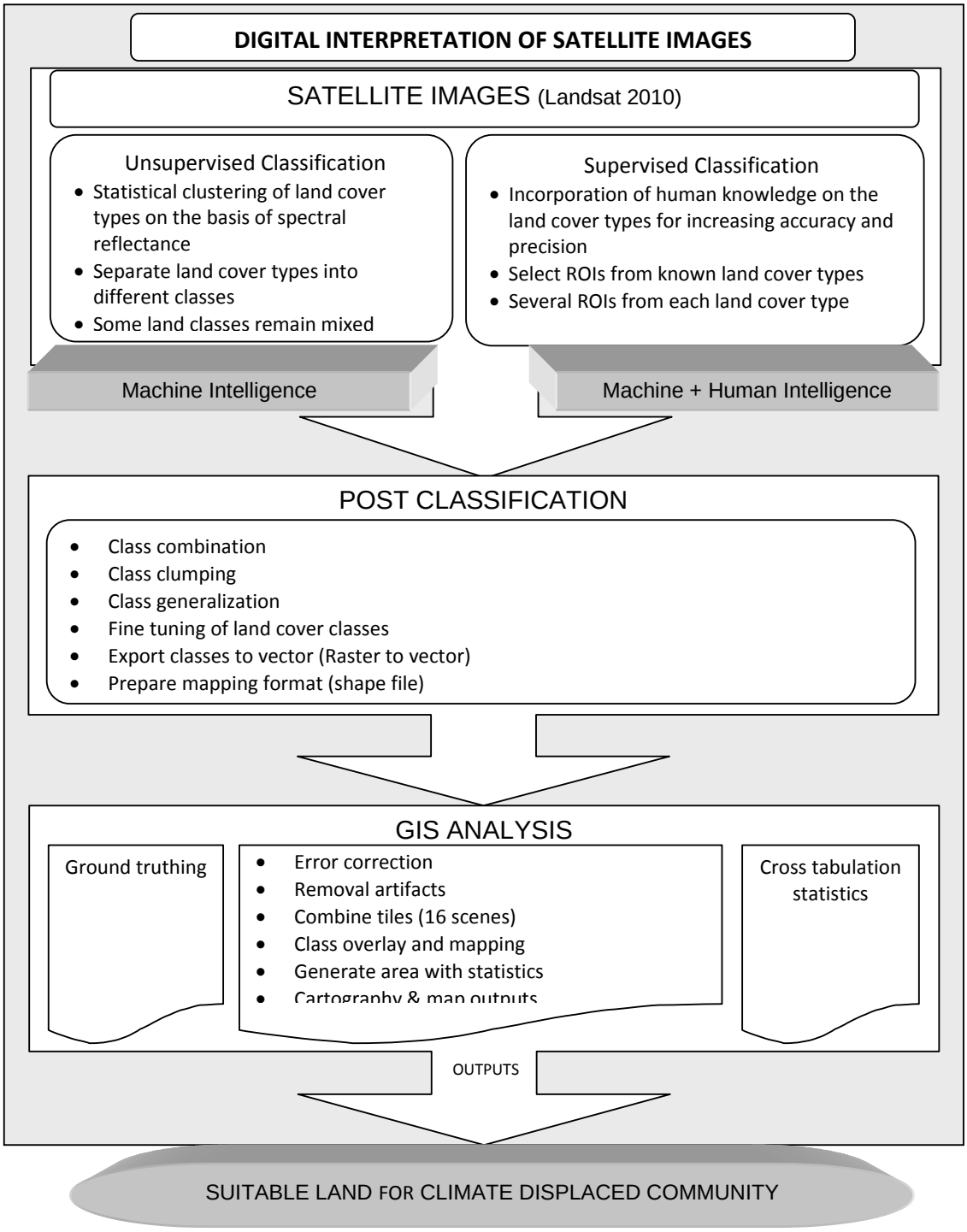

Figure 2: **Digital interpretation of satellite image for land suitability modeling**

Chapter 2: Categorization and explanation of various land categories in Bangladesh

In Bangladesh, agricultural land dominates the land cover of the country of which arable land occupies about 59%, forests (including mangroves) about 19%, urban and rural settlements about 11%, and rivers and water bodies about 9% of the total area (Climate Change Cell, 2009). The distribution of land under different land use category is illustrated in Table 1.

Table 1: The distribution of various land categories in Bangladesh

Classification	Area (sq.km)	Proportion	Summary classification	Area (sq.km)	Proportion
River	4626	3.3%	River and water bodies	12210	8.7%
Water bodies	7584	5.4%			
Mangrove	4957	3.5%	Forest and mangrove	26015	18.6%
Forest	21058	15.1%			
Urban	8697	6.2%	Urban and rural	15431	11.0%
Rural	6734	4.8%			
Agriculture	82784	59.2%	Agriculture	82784	59.2%
Other	3373	2.4%	Other	3373	2.4%
Total	139,813	100		139,813	100%

Note: The above figures are provisional estimates; WARPO is in the process of updating the land use with more refined databases; the land area excludes estuarine rivers. Source: WARPO, 2001b

2.1 Agricultural land

Bangladesh has a varying climate of warm wet summer and cool dry winter that favours growing a wide range of annual and perennial tropical crops (for example, rice and jute) in summer; temperate crops (including wheat and potato) in winter and subtropical crops (including sugarcane and banana) throughout the year.

On the other hand, the forests of Bangladesh are tropical in nature and are classified as tropical semi-evergreen, tropical wet evergreen, tropical littoral and tropical moist deciduous and swamp forests. They are located in the greater districts of Dhaka, Chittagong Hill Tracts, Khulna, Sylhet, Mymensingh and Tangail. The majority of the forests of Bangladesh are found in the coastal zone. In the coastal region, most of the forests are tropical evergreen, tropical semi-evergreen and tropical littoral (mangroves) which comprise around 43% of the total forest cover of the country (PDO-ICZMP, 2004a). Mainly tropical evergreen and tropical semi-evergreen forests are located in the coastal areas of Chittagong and Cox's Bazaar. Figures 3, 4 and 5 below shows agricultural land use, forest coverage area and urban land use in Bangladesh.

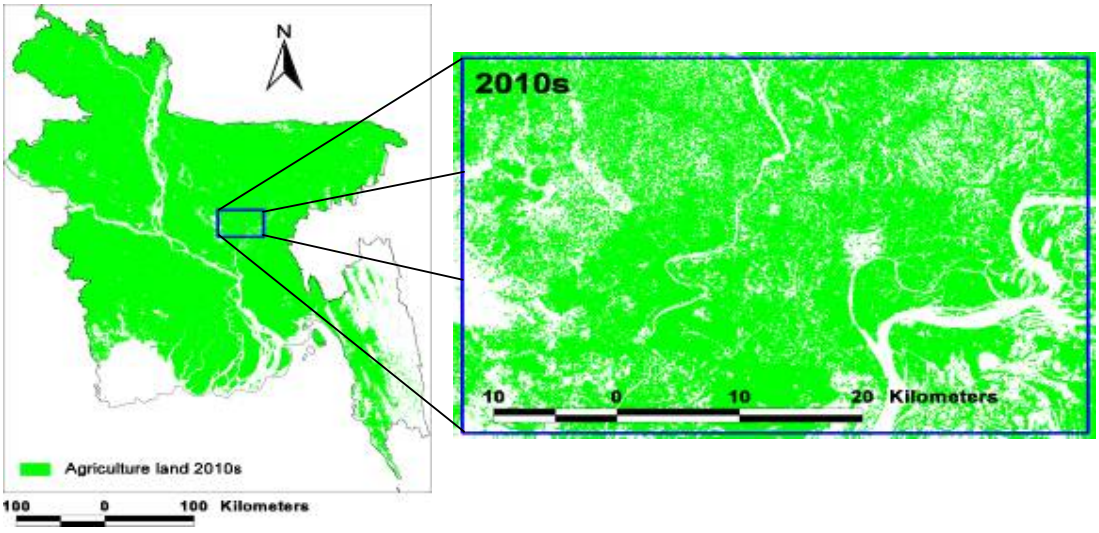

Figure 3: Agriculture land in Bangladesh, based on digital interpretation of Landsat satellite imagery from NASA

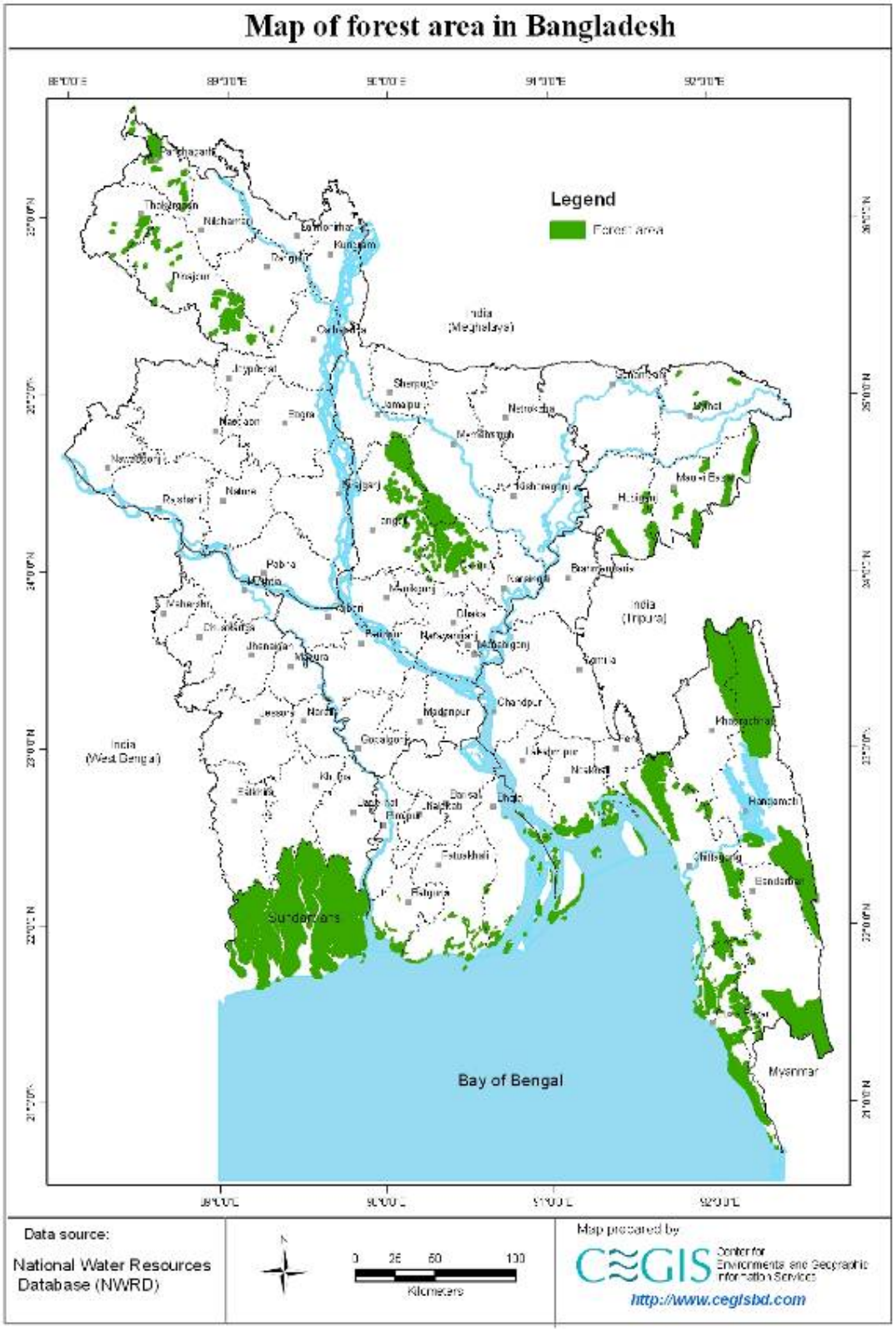

Figure 4: **Forest coverage area of Bangladesh, based on digital interpretation of Landsat satellite imagery from NASA**

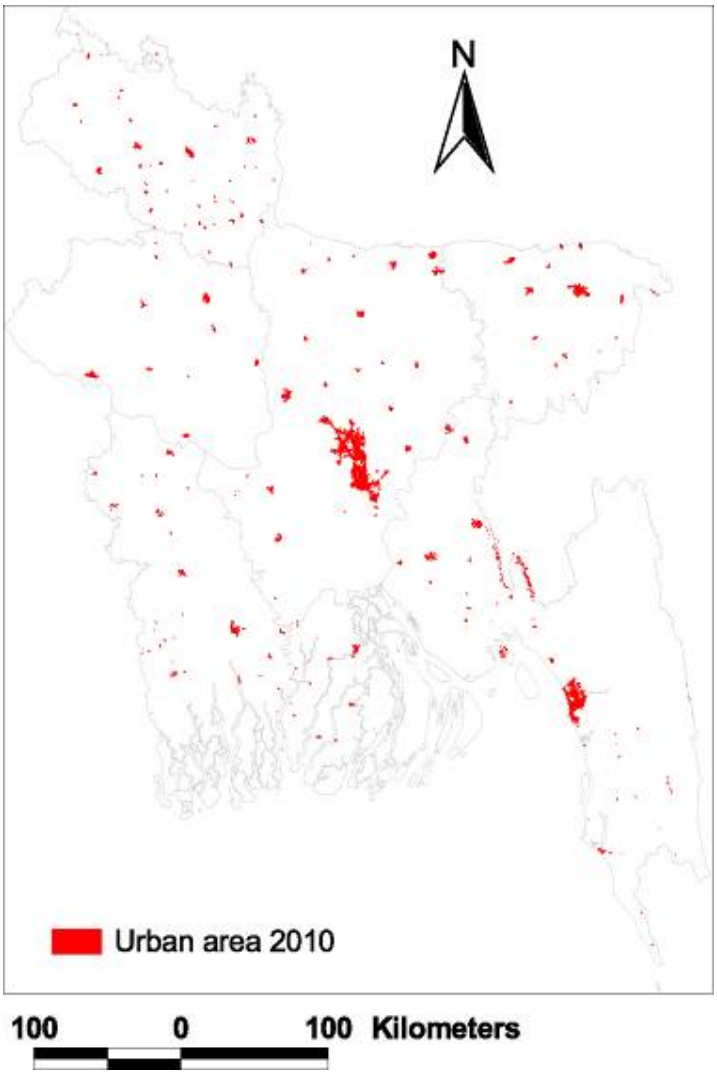

Figure 5: **Urban zones of Bangladesh, based on digital interpretation of Landsat satellite imagery from NASA**

2.2 Waterbodies

Bangladesh is called the land of rivers. It is rich in water bodies that include rivers, estuaries, lakes, ponds, haors, baors and beels. Most of the floodplain depressions are concentrated in the northeast region and in the southern part of the northwest region. Most of the haors are situated in the northeast region and the beels in the northwest region. Oxbow lakes in the floodplain (known as baors in the south west and south central regions) are the abandoned reaches of meandering rivers. In rural areas, ponds varying from 0.1 to 0.5 acres in size are dug and used as important sources of domestic water supply as well as for fish culture. These ponds have also been very successful in alleviating drought impacts on rain-fed rice lands (Saleh et al., 1996). Figure 6 shows the perennial waterbodies of Bangladesh.

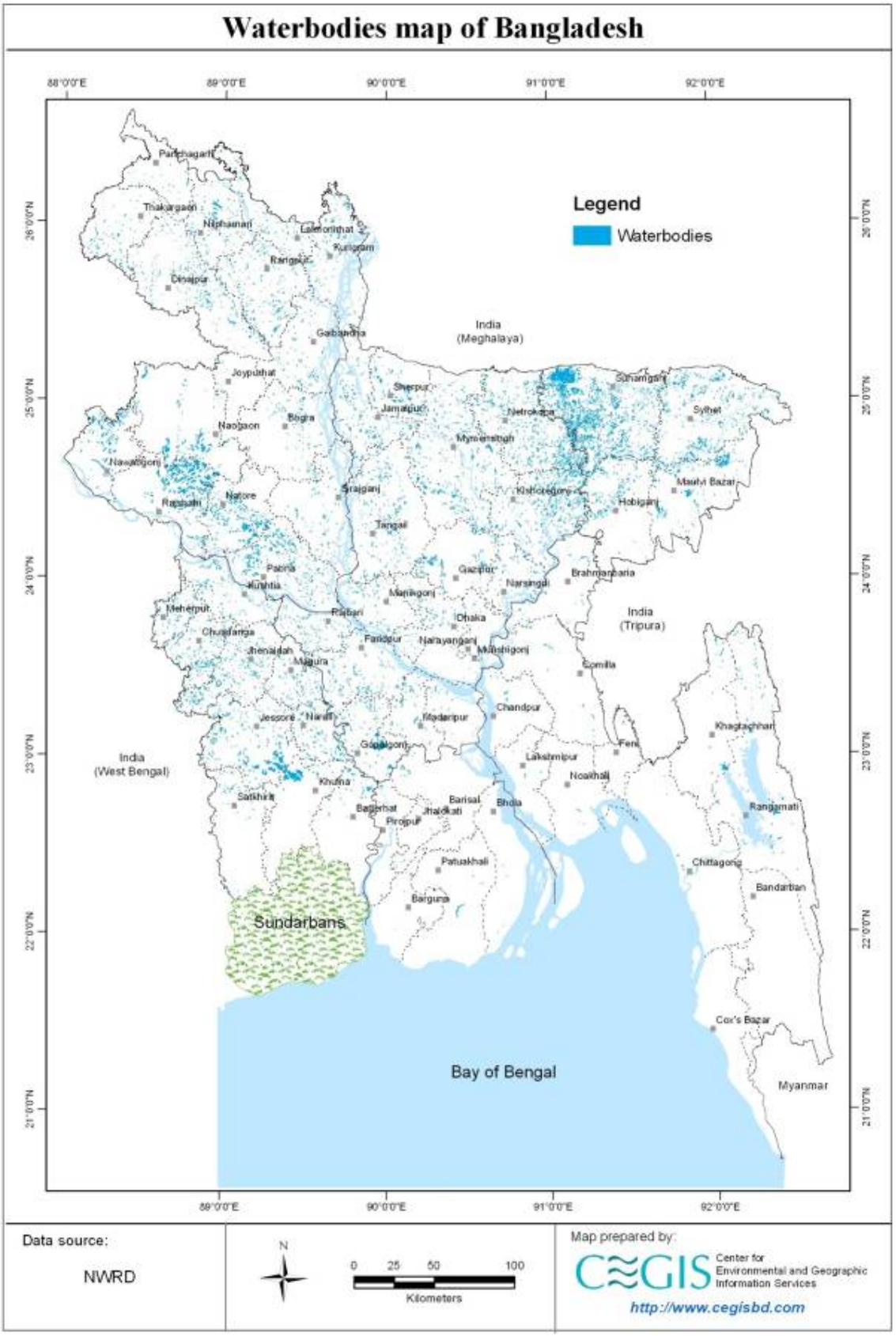

Figure 6: Waterbodies of Bangladesh

2.3 Floodplains

The floodplains of Bangladesh cover a significant part of the country and are formed by different rivers. A meandering river eroding sideways as it travels downstream makes floodplains. When a river breaks its banks and floods over, it leaves behind layers of rock and mud which gradually builds up to create the floor of the floodplain. Floodplains are basically accumulations of sand, gravel, loam, silt, and/or clay which are considered very important types of landscape in the context of agriculture.

The floodplains of Bangladesh are divided into 19 sub-units:

(i) The Teesta Floodplain;
(ii) The Old Himalayan Piedmont Plain;
(iii) The Old Brahmaputra Floodplain;
(iv) The Meghna Floodplain;
(v) The Haor Basin;
(vi) The Surma-Kushiyara Floodplain;
(vii) The Jamuna (Young Brahmaputra) Floodplain;
(viii) the Young Meghna Estuarine Floodplain,
(ix) the Lower Meghna Floodplain,
(x) the Old Meghna Estuarine Floodplain,
(xi) the Middle Meghna Floodplain;
(xii) The Ganges River Floodplain;
(xiii) The Ganges Tidal Floodplain;
(xiv) The Sundarbans;
(xv) The Lower Atrai Basin;
(xvi) The Arial Beel;
(xvii) The Gopalganj-Khulna Peat Basin;
(xviii) The Chittagong Coastal Plain; and
(xix) The Northern and Eastern Piedmont Plain. (Banglapedia, 2006)

2.4 Wetlands and Marshland

Wetland or marshes are known as haors, baors and beels and are generally formed on the topographically depressed areas of Bangladesh with very insignificant water flow. The total area under wetlands in Bangladesh has been estimated at 7 to 8 million hectares, which is about 50% of the total land surface.

Table 2 provides an overview of the different categories of wetlands and their area:

Table 2: Types of wetlands and their area (in sq km)

Rivers	7,497
Estuaries and mangrove swamps	6,102
Beels and haors	1,142
Inundable floodplains	54,866
Kaptai Lake	688

Closed water	
Ponds	1,469
Baors (Oxbow Lakes)	55
Brackish-water farms	1,080
Total	72,899

Source: Akonda 1989 and Khan 1994

These areas are formed by marsh clay and peat known as 'paludal deposits'. Fan- type local deposits are also found in the wetlands near to sediment sources.

2.5 Charlands

All the major river systems in Bangladesh have 'braiding features' (i.e they have multiple channels separated by semimetal islands) including the Brahmaputra-Jamuna and parts of the Ganges-Padma and the Lower Meghna. *Char* is the common name of islands and accreted lands on the bank. The shifting of the main riverbank results in erosion and accretion of the main land. The continuous erosion of river banks and islands influences to deposit new materials on existing islands or on other banks to form point bars or new islands within the channels. Thus, *chars* in Bangladesh can be considered to be a 'by-product' of the hydro-morphological dynamics of its rivers. The total population in the *chars* during 1993 was about 631,000 representing a 47% increase over the population of 1984. The national population growth in the same period is estimated to be 26% (Banglapedia, 2006). Thus, there is a growing importance of *chars* in providing land for human habitation in Bangladesh. Two types of *chars* - island chars and attached chars - are found in Bangladesh. Island chars are always inaccessible without crossing the river arm whereas attached chars are reachable from the mainland during dry season with the exception of the flood season (ISPAN 1993).

According to ISPAN 1993, during the period 1992-1993, 4% of the country's total, i.e. 4.3 million people dwelled in active floodplains of which 22% lived in chars mostly concentrated in the Meghna and the Jamuna. Due to river erosion almost 64,000 thousand people were displaced from their settlements during 1981-1993. During the period of 1984 to 1993, *char* areas increased in all rivers, except in the Upper Meghna. The net increase of chars during this period amounted to 36,000 hectares. The effects of riverbank erosion and widening of the river channel on people living in *chars* have been significant. More than half of the displacement during this period was along the Jamuna river. Island chars are found to be flooded more extensively than attached chars. Among the chars within different river reaches, those within the Ganges are found to be the most extensively flooded.

Chars are extremely vulnerable to both erosion and flood hazards. Recent analysis of time series satellite images indicates that over 99% of the area within the riverbanks of the Jamuna had been *char* at one time or another during the 27-year period of 1973 to 2000. The same analysis shows that about 75% of the *chars* persisted between one and nine years, while only about 10% lasted for 18 years or more. In certain areas, however, the *chars* can

be quite stable (for example, in the Upper Meghna area). Island chars so far occupy 40% of active river floodplain, which is about 6% of the total land in Bangladesh.

The ISPAN study also indicates that *chars* that are not eroded in the first four years of their emergence could be used for either cultivation or settlement by the end of those four years. The BBS report in 1999 suggests that in the relatively lower reaches where land is more fertile, cropping intensity in the *chars* appears to be between 150 and 185, which is quite similar to the average intensity of 165 for the entire country.

2.6 Coastal Islands

The islands in Bangladesh are scattered either in the Bay of Bengal or at the river mouth of the Padma (Figure 6). There are a numbers of coastal islands in the western, south middle and eastern part of the Bay of Bengal. Table 3 and figure 6 shows the coastal islands of Bangladesh.

Island in the western part of the Bay of Bengal are: Ashar Char, Andar Char, Char Hare, Char Lakhsmi, Char Manika, Nijhum Dwip, Chhera island, Ramnabad Island, Char Mantaz, Rangabali, Dublar Char, Burir Char, Pakhkhir Char, Dimer Char and Char Bagala,

Islands in the middle part of the Bay of Bengal are: Bhola Island (the largest island in Bangladesh), Sandwip, Hatiya, Manpura Island, Char Sakuchia, Char Nizam, Char Kukri Mukri, Dal Char, Char Gazi and Char Faizuddin.

Islands in the eastern Bay of Bengal are: Martin's Island, Kutubdia, Maheshkhali, Sonadia and Urichar.

The submerged islands that existed before but have now disappeared include Bholar Dweep, situated between Teknaf and St Martin, which disappeared under water by 1861 and the South Talpatti Island (a disputed island between India and Bangladesh) which was reported to have submerged by March 2010.

(Source: http://en.wikipedia.org/wiki/List_of_islands_of_Bangladesh).

Table 3: The char islands of Bangladesh

District	No of Chars	District	No of Chars	District	No of Chars
Bagerhat	8	Bhola	28	Cox's Bazar	6
Barguna	3	Chandpur	12	Feni	4
Barisal	35	Chittagong	7	Khulna	12
Lakshmipur	15	Noakhali	18	Patuakhali	28
Pirojpur	7	Satkhira	4	Shariatpur	7

Source: http://en.wikipedia.org/wiki/List_of_islands_of_Bangladesh

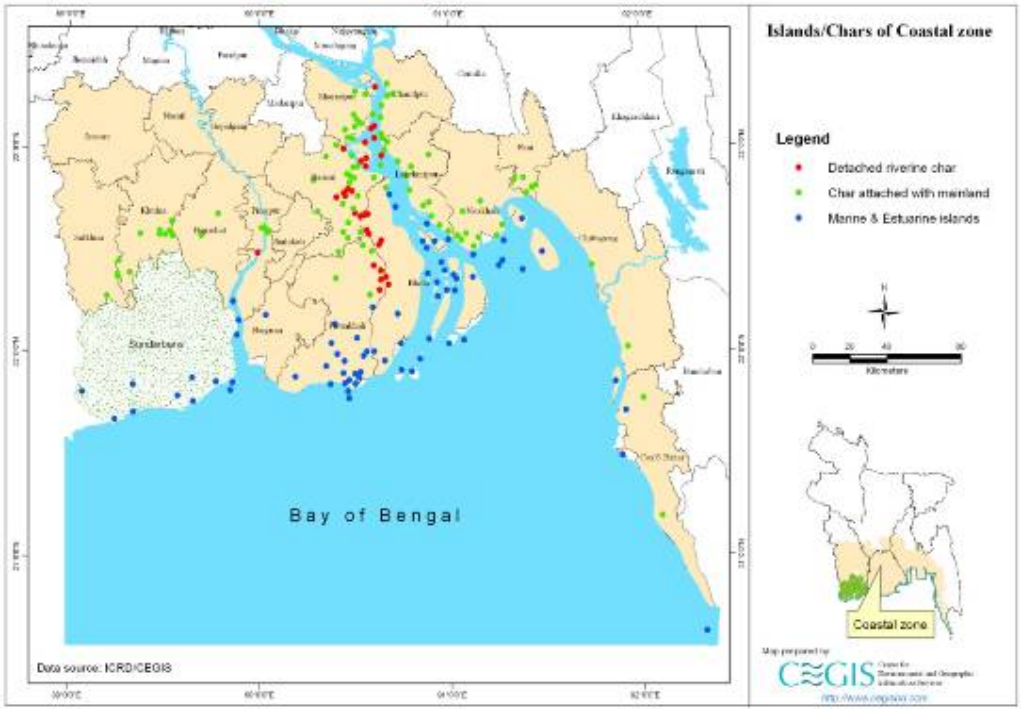

Figure 6: Coastal islands of Bangladesh

The coastal islands of Bangladesh are also considered to be a 'by-product' of the hydro-morphological dynamics of the Ganges Brahamputra Meghna (GBM) river system at the upstream that drains out 6 million cusecs of water with 2179 million metric tons of sediments into the Bay of Bengal. The gradual deposition of huge volume of silts results formation of new land mass, also called Mudflats. At the initiation stage the newly emerged land masses are brought under mangrove plantation for increasing their stability and then for allocation for human settlement.

Figure 7 shows inland accreted areas (*Char* land) and coastal accreted areas (Mudflats) and figure 8 shows the coverage of mangrove forests in the coastal Mudflats

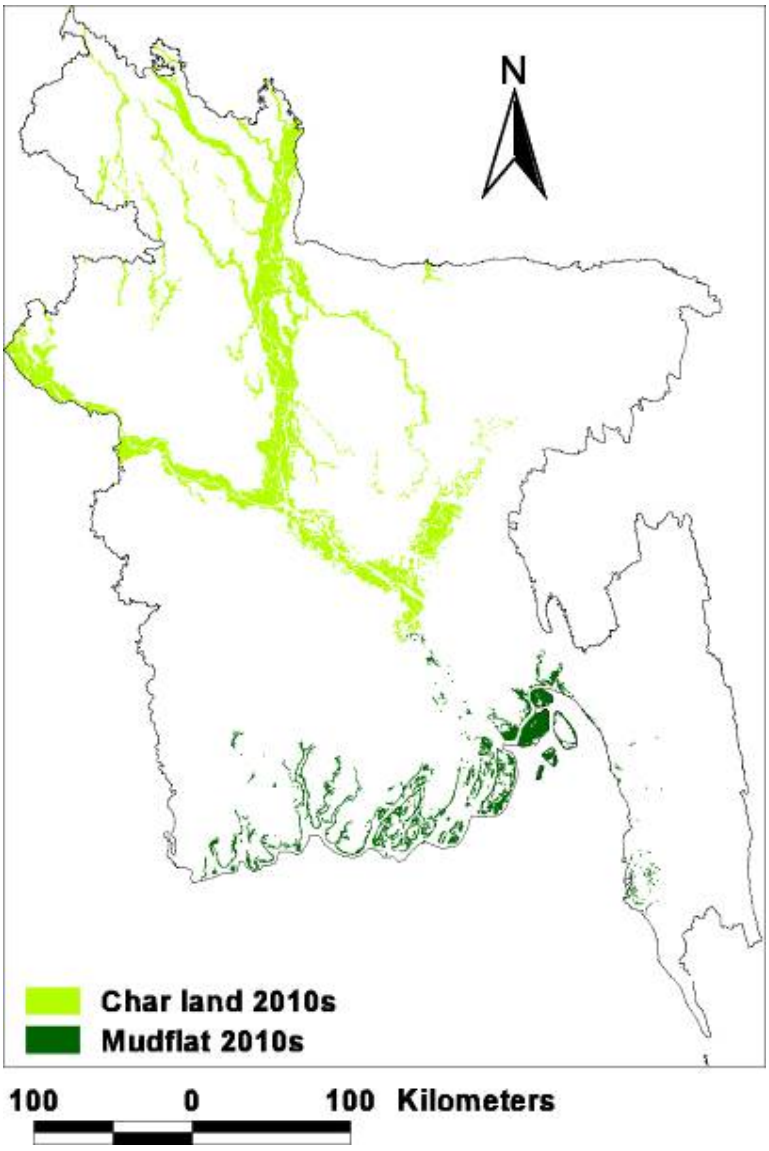

Figure 7: **Inland accreted areas (Char land) and coastal accreted areas (Mudflat) of Bangladesh, based on digital interpretation of Landsat satellite imagery from NASA**

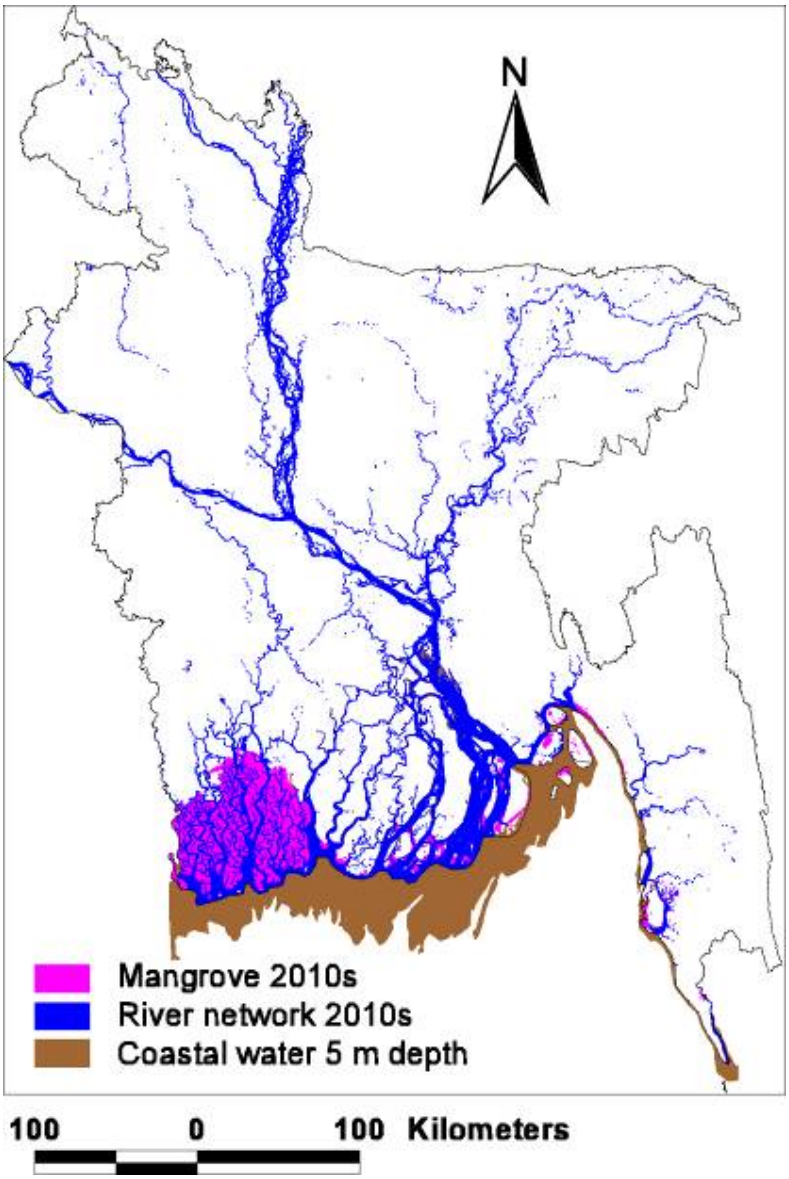

Figure 8:Mangrove forest with river networks of Bangladesh, based on digital interpretation of Landsat satellite imagery from NASA

2.7 Hills

The hilly areas cover about 17,342 km² (12 percent) of Bangladesh and are mostly in the Chittagong Hill Tracts and Chittagong, Habigonj and Moulavibazaar regions. The Chittagong Hill Tracts alone covers 13,184 km² of hilly areas, which is around 9 percent of the country's total.

The Chittagong Hill Tracts constitute the only significant hill system in the country and, in effect, are the western fringe of the north-south mountain range of Burma and eastern India. The hills rise steeply to narrow ridge-lines, and are generally no wider than 36 meters,

with an altitude of 600 to 900 meters above sea level. The highest elevation in Bangladesh is found at 1,052 meters altitude in Mowdok Mua (Banglapedia 2006), in the south-eastern part of the hills. Fertile valleys lay between the hill lines, which generally run north-south.

A large part of hilly areas are under the state forest and some are under tea and rubber plantation. In the remaining area *jhum* (shifting cultivation following the slash and burn method) is practiced by tribal people, especially in the Chittagong Hill Tracts and locally in other areas. *Jhum* involves the clearing of forest land that has remained fallow for several years. This exposure of land has increased the chance of soil erosion and further degradation of land. For example, on May 9, 2009, a massive landslide blocked the flow of the river Sango and on 29 July, ten people were killed due to a landslide in the Bandarban Hill District.

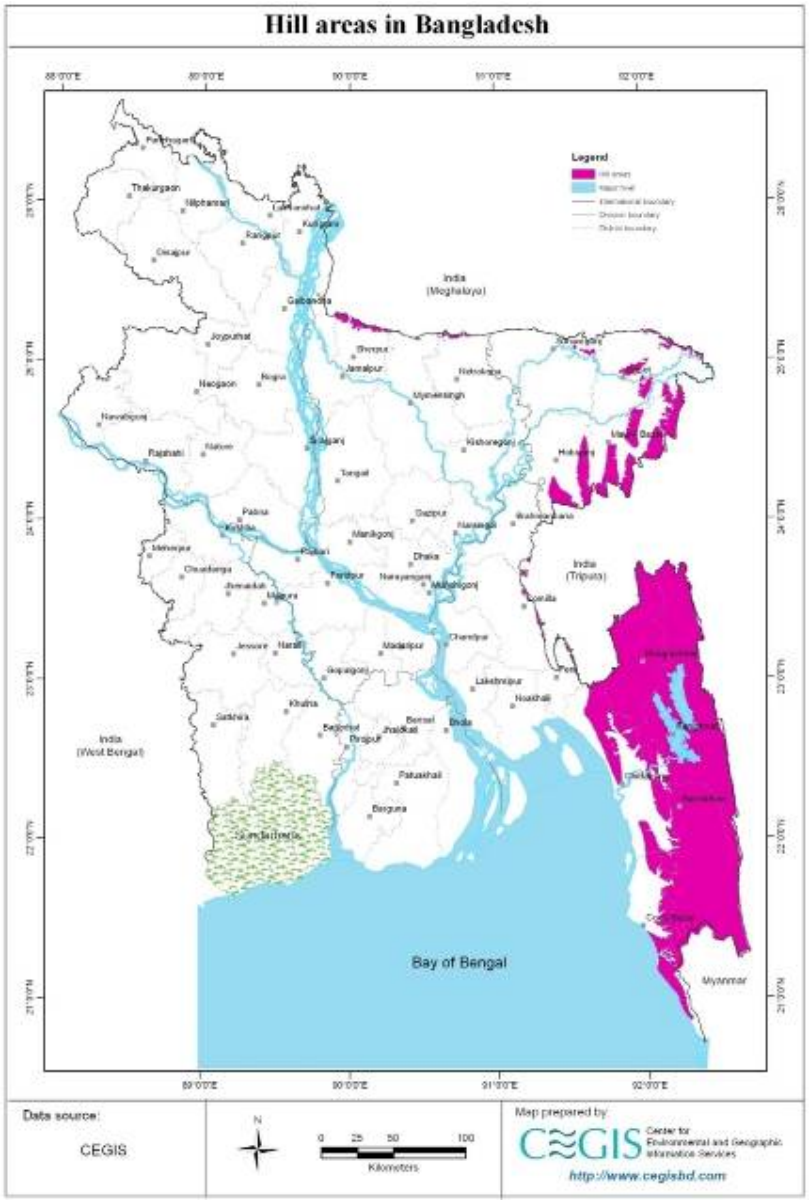

Figure 9:Hill areas in Bangladesh

Based on geology and landform, the hills of Bangladesh may broadly be subdivided into high hill ranges (about 70%) and low hill areas (about 30%). The high hill ranges, about 200-1,000m above the Mean Sea Level (MSL), are steep to very steep hills and usually have a rather youthful soil mantle ranging from a few centimetres to several metres in thickness over bedrocks. In contrast, the low hill areas, about 15-200m above the MSL are nearly flat or round-topped and usually have old and deep soil. The whole hilly region receives more than 2000 mm of precipitation annually about 80% of which is received in 4 months (June-September). The region used to be covered by tropical climax forests with diversified flora and fauna just a century back.

Figure 10 shows the land use of Chittagong Hill Tract (CHT):

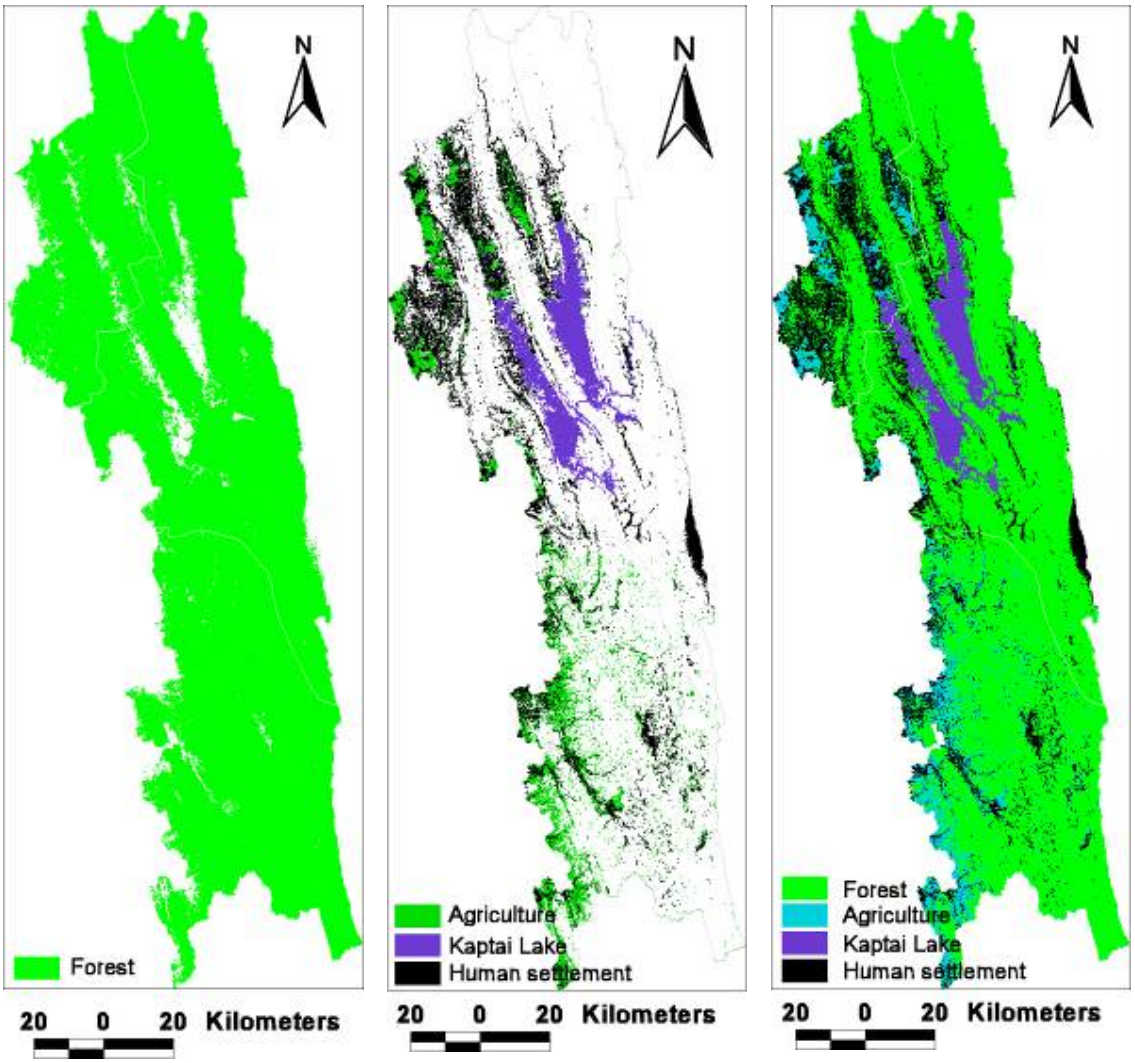

Figure 10: **Chittagong Hill Tracts (CHT) with forest, agriculture, human settlement and Kaptai Lake, based on digital interpretation of Landsat satellite imagery from NASA**

2.8 Elevated lands

The elevated land is characterized as 'Pleistocene uplands' that cover an area of about 10% of Bangladesh (Figure 11) with an average elevation of more than 15m above the Mean Sea Level (MSL). The Barind Tract (the largest one of the three Pleistocene uplands) comprises the mid and lower western parts of Rajshahi division between the Ganges and the Brahmaputra. The Barind Tract is spread over an area of about 7,770 sq km, which is also shown in Figure 11.

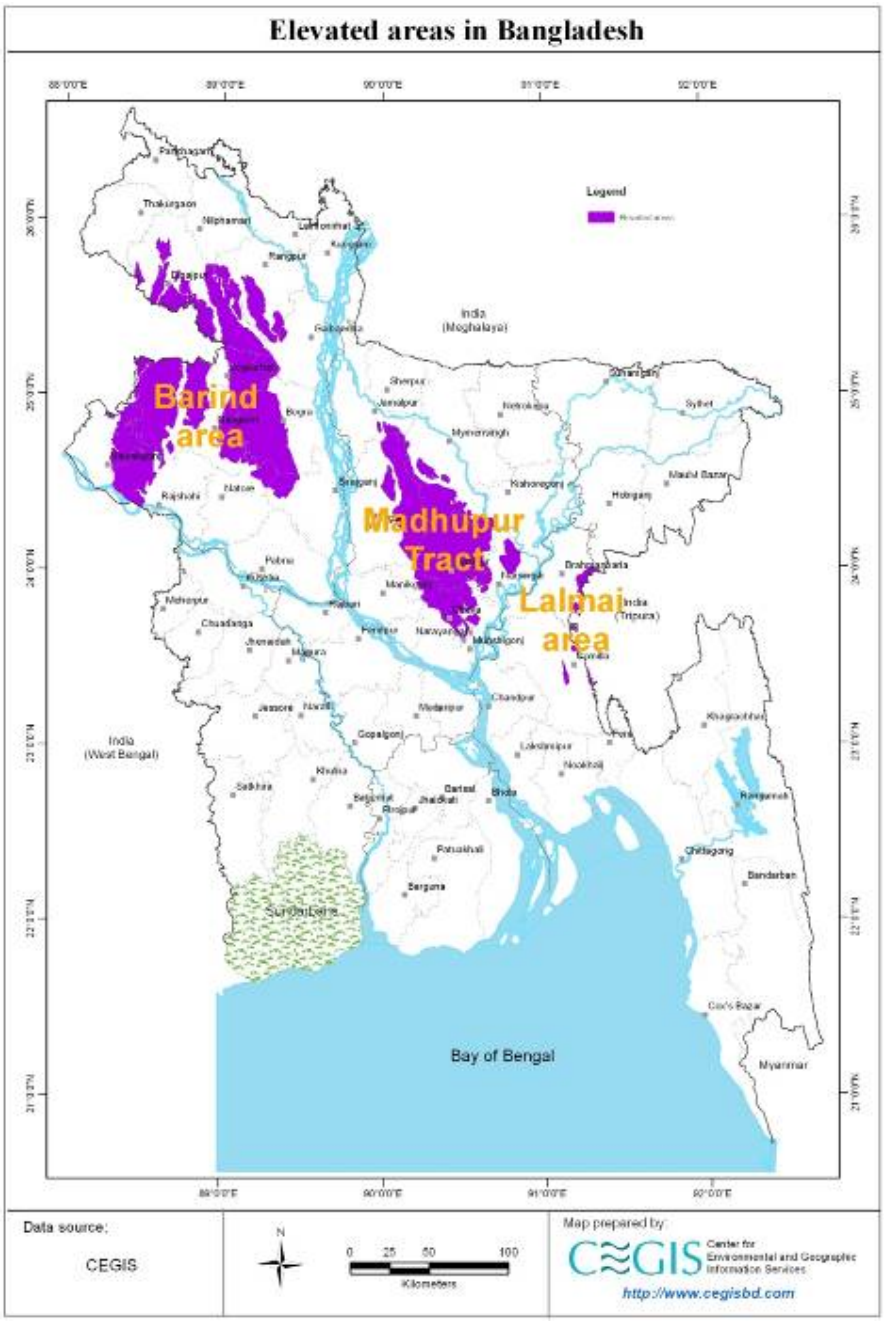

Figure 11: Elevated land areas of Bangladesh

Chapter 3: Categories of land that would be most suitable for the resettlement of climate displaced persons

Most of Bangladesh consists of extremely low and flat land. The floodplains occupy about 80% of the country. The land elevation increases towards the north-west and reaches an elevation of about 90 meters above the Mean Sea Level (MSL). Only in the extreme northwest are elevations greater than 30 meters above the MSL. Mean elevation ranges from less than one meter on tidal floodplains, 1 to 3 meters on the main river and estuarine floodplains, and up to 6 meters in the Sylhet basin in the north-east (Rashid 1991).

On the other hand, about 12% of the country is occupied by hilly areas which include the northern and eastern hills. Terraces occupy about 8% of the country. The remaining 80% of the country is occupied by floodplain areas that include alluvial floodplain and estuarine areas. They are composed of predominantly recent alluvial deposits transported from the hills by rivers. There are numerous natural depressions some of which are abandoned channels formed as a result of change in river courses, and some have been formed in the process of delta building and as a result of tectonic movements of the earth. In Bangladesh five main kinds of landscape can be recognized in the floodplain areas (Brammer, 2002), which are briefly described below:

1. **Active river floodplains:** These are the youngest alluvial lands within and alongside the main rivers which are subject to alternate deposition of new sediments and erosion by shifting channels within the main river course. The temporary alluvial formations (known as *chars* in Bangladesh) have an irregular relief with stratified sandy and silt deposits.

2. **Piedmont plains:** They include the Old Himalayan Piedmont Plain at the foot of the Himalayas and active alluvial fans at the foot of the Northern and Eastern Hills (including parts of the Chittagong Coastal Plain). These are characterised by gently sloping land at the foot of the hills composed of colluvial and alluvial sediments (deposited by rivers and streams subject to flash floods) and a drainage pattern of a braided river.

3. **Meander floodplains:** Meander floodplains formed by big meandering rivers; cover the relatively older parts of the Teesta, Atrai, Brahmaputra-Jamuna, Karatoa-Bangali, Ganges and Surma-Kushiyara river floodplains. They have relatively stable landscapes with complex patterns of curved ridges (former riverbanks), back swamps and cut-off channels, crossed by a few active river channels (tributary and distributary channels of the main rivers). Some young floodplain lands near to active channels (especially on the Jamuna floodplain) receive new deposits during high floods but most of the older floodplain lands receive regular additions of new alluvium from the rivers.

4. **Estuarine floodplains:** They are characterized by smooth, almost horizontal levels underlain by silts deposited uniformly both in the lateral and vertical directions

under estuarine conditions. These floodplains are divided into the stable and old part, which no longer receives new alluvial sediments and is no longer flooded by the tide and the young part adjoining the Meghna estuary, which is still subject to tidal flooding and to new accretion and erosion by shifting estuarine channels.

5. **Tidal floodplains:** These are characterised by a distinctive, almost-level landscape crossed by innumerable, interconnecting tidal rivers and creeks following a zigzag pattern and flood levels lower than on meander plains. Under natural conditions, the land is subject to flooding with saline water at high tide during at least a part of the year; but many areas have been protected by embankment and are thus cut off from tidal flooding and sedimentation. On the Ganges tidal floodplain, tidal water is saline throughout the year in the south-west and fresh throughout the year in the north-east; in between there is a zone where floodwater is fresh in the monsoon season and saline for part or all of the dry season.

Although floodplains are comparatively more exposed to disaster events, especially annual flooding, than hilly areas and terraces, human habitation is mostly concentrated in the floodplains as they are more productive and endowed with natural resources. However, impending and future impacts of climate change will increase the risk factor especially in the active river floodplains, tidal floodplains and estuarine floodplains areas. For example, both the tidal and active river floodplain areas will face an increased level of erosion, while intrusion in the estuarine floodplain areas will cause scarcity in drinking water as well as crop loss and loss of productive eco-system services.

Considering the impending and future impacts of climate change, the meander floodplains, the piedmont plains and the stable parts of tidal floodplains may be considered suitable for re-settlement of climate displaced persons.

Chapter 4: Estimate of available land – for the potential use of relocating climate displaced persons

Bangladesh is one of the most densely populated countries in the world with a population of about 149.8 million (Census 2011). The population of Bangladesh is growing at the rate of about 1.39 % per annum, and is expected to reach 200 million by 2030 (BBS, 2008). Therefore, Bangladesh faces formidable challenges related to housing, food security, access to clean water and energy and other services for a population of around 150 million living in a land area of 147,570 square km.

In fact, ensuring food security through extension and intensification of crop agriculture is one the major policy priorities of the Government of Bangladesh. However, the country is losing on average close to 1% of agricultural land per annum to other uses (GOB, 2012). More agricultural land will be lost in the future due to increased salinity ingress and river erosion as a consequence of climate change. This is a serious concern relating to food security in the future.

On the other hand, resettlement and housing for the increasing population is another major priority. Ownership of land in Bangladesh is vested in either private individuals or entities of the State. While private lands are mostly covered under housing and agricultural activities, public lands are used either for government infrastructure, forest coverage or sometimes are illegally occupied by vested interest groups for economic purposes. Further, unplanned land use in setting-up development projects, horizontal expansion of human settlements, grabbing of wetlands and other common resources by unscrupulous, and unplanned rapid urbanization leaves no specific land that could be provided to climate displaced persons for their resettlement and rehabilitation.

In this context, the Bangladesh Land Use Policy emphasizes the distribution of *khas* lands among landless people in Bangladesh. *Khas* land is Government owned land and applies to agricultural land, non-agricultural land and water bodies. In Bangladesh, the state owns 3.5 million acres of *Khas* land of which 25% is agricultural, 50% non-agricultural and 25% is covered by water bodies (Barkat, A. and K.P. Roy. 2004). *Khas* land covered by water bodies is not feasible for human settlement *while khas* land that are covered by agricultural activities will have less comparative advantage if they are converted to human settlement.

Being one of the most densely populated countries of the world, Bangladesh has put its prime effort into agricultural production. This is not only for ensuring food self sufficiency but also to foster subsistence economy and rural employment in this sector where still more than 70 percent people are employed. Land is a critical resource for agriculture and the Agriculture Policy of the Government of Bangladesh put a high emphasis on protecting agricultural land from other uses (e.g. housing and urbanization). In this context the non-agricultural *khas* land could be considered for the settlement of climate change displaced persons. Therefore the 1.75 million acres of non-agricultural *khas* Land (50 percent of the total 3.5 millions acres of *khas* Land) could be estimated as available for rehabilitation of climate displaced people.

Chapter 5: Required land resources to support the resettlement of climate displaced persons in Bangladesh

Migration or displacement is not a new issue for Bangladesh. People have been displaced and have migrated for various social, political, economical and disaster-related reasons. However, recent evidence suggests that Bangladesh will face the challenge of mass displacement, mostly internal, due to the risks associated with the impacts of climate change. Furthermore, it is clear that the country is not yet adequately prepared to face this challenge.

Climate change induced extreme weather events, particularly hydro-metrological events, are already leading to significant displacement in three distinct ways: first, the effects of warming and drying in the northern parts of the country are leading to a reduction in agriculture potentials through decreasing soil moisture content and fertility. Second, heavy precipitation and resulting flash or river floods in the hilly areas and Ganges Brahamputra Meghna (GBM) river basins in the middle part of the country. Thirdly, sea level rise is leading to the permanent destruction of extensive highly productive low-lying coastal areas that are home to millions of people who will have to be permanently relocated.

In the last 25 years alone, Bangladesh has experienced six severe floods, with the 1988 and 1998 floods alone causing 2000-6,500 and 1,100 deaths respectively and displacing as many as 45 and 30 million people. (NAPA 2005). Floods in 1987 led to the temporary displacement of 45 million people and to longer-term permanent migration within Bangladesh (Saadi, 2003, IMO 2010). There is significant evidence that in the near past natural disasters have forced people to migrate from their ancestral homes (Findlay and Geddes 2011; IMO 2010; World Bank 2010; Warner et.al. 2009).

Cyclone Aila in May 2009 led to an estimated 100,000 people forced to live on nearby embankments until the early months of 2010, (IOM and other agencies, 2010; IRIN 2010). As of March 2010 an estimated 42,250 HH/211,255 individuals remain severely affected. Severely affected means families that are still displaced and living on the embankment, families living outside of the ring embankment with their land inundated with salt water and families that have just returned to their homes recently, but do not have sufficient income opportunity to feed their family members (Oxfam 2012).

In recent years, the incidence of slow and sudden onset disasters is leading to increased migration flows through the permanent loss of homestead and households assets as well as through degrading productive ecosystems and means of production, for example, land and water. Cyclone SIDR in 2007, for instance, caused damage to approximately 2.3 million households as well as approximately 1 million people being seriously affected in their livelihoods. Many of the affected households had complex livelihoods, combining several overlapping activities and thus some were simultaneously affected by losses in crops, livelihoods, fisheries, commerce, small trading and wage employment. While sudden onset

disasters are the most reported and referred to driver of displacement and migration, it is important to note that slow onset disasters and their resulting persistent and differential vulnerability are also causing migration and displacement. In the context of climate change, slow onset hazards are affecting new areas and sudden onset hazards are becoming both more frequent and more intense. The occurrence of sudden onset hazards, including tropical cyclones, tidal water incursion and river erosion are reported in the low-lying coastal districts; whereas slow onset hazards including saline intrusion and soil salinity ingression associated with sea-level rise are also observed in the coastal areas (Shamsuddoha et.al 2011). The occurrence of river bank erosion constantly forces people to migrate (Haque and Zaman 1989, Poncolet 2009) with more than 16, 000 people living on the banks of Jamuna, Ganges and Padma allegedly displaced by river bank erosion in 2010 alone (IOM 2010).

It has been estimated that climate change will lead to the displacement of more than 20 million people across Bangladesh in the near future. The resettlement and rehabilitation of these climate displaced persons will pose a serious challenge for the densely populated Bangladesh (BCCCSAP 2009). Though climate change displacement is considered a future threat, this challenge should be addressed now as climate change displacement is already a reality for the country.

To support the rehabilitation of landless people ,the Government has implemented programs to relocate and rehabilitate landless people through the distribution of *khas* land as well as through the construction of new houses under the *Gucchgarm* (cluster village) and *Abashan/Asrayan* projects. The Land Reform Action Programme (LRAP) recommends that under the concept of a cluster village "a *homestead area of 0.08 acre could be allocated for the rehabilitation of a family"* (Barkat, A., Zaman, S., Raihan, S., 2001). Though these projects were not designed with the context of climate displacement in mind, learning and experience from these projects could be utilized in undertaking any projects for the rehabilitation of climate displaced people.

On the basis of the LRAP that recommends 0.08 acre of land for rehabilitation of each household, the country will require 320, 000 acres of land to rehabilitate 20 million people (4 million households) who are under threat of displacement as the BCCSAP has projected.

Chapter 6: Land parcels identified for the potential relocation and rehabilitation of climate displaced persons in Bangladesh

To facilitate the planned relocation and rehabilitation of climate displaced persons, several land parcels (predominately *khas* land) have been identified in the Chittagong region. All of these land parcels could be accessed and acquired by civil society groups and climate displaced communities, with the collaboration of the Government, for use as possible resettlement sites. These land parcels have been identified following 'multicriteria analyses' as a spatial decision support tool.

The criteria considered for land selection included:
- road connectivity;
- proximity to growth center and social service facilities;
- elevation and suitability for housing;
- unlikelihood of erosion.

The land parcels were also physically verified to assess their availability, the current status of occupancy and suitability of human settlement.

In total, 104.28 acres of land have been identified in the Chittagong region, including:

- 13.32 acres in Sitakunda Upazilla;
- 18.59 acres in Mirsarai Upazilla;
- 67.71 acres in Rangunia Upazilla; and
- 4.66 acres in Chandanaish Upazilla.

The location of these land parcels is shown in Figures 12, 13, 14 and 15 and the area of land of each parcel is shown in tables 4, 5, 6 and 7.

6.1 Potential land parcels at Sitakunda Upazila

On the basis of 'Multi-crieria' analysis, 4 land parcels, totaling 13.32 acres, have been identified in Sitakunda Upazilla. The land parcels are located close to the growth centers and are suitable for human settlement. Figure 12 and Table 4 respectively show the physical locations and areas of identified land parcels in Sitakunda Upazilla.

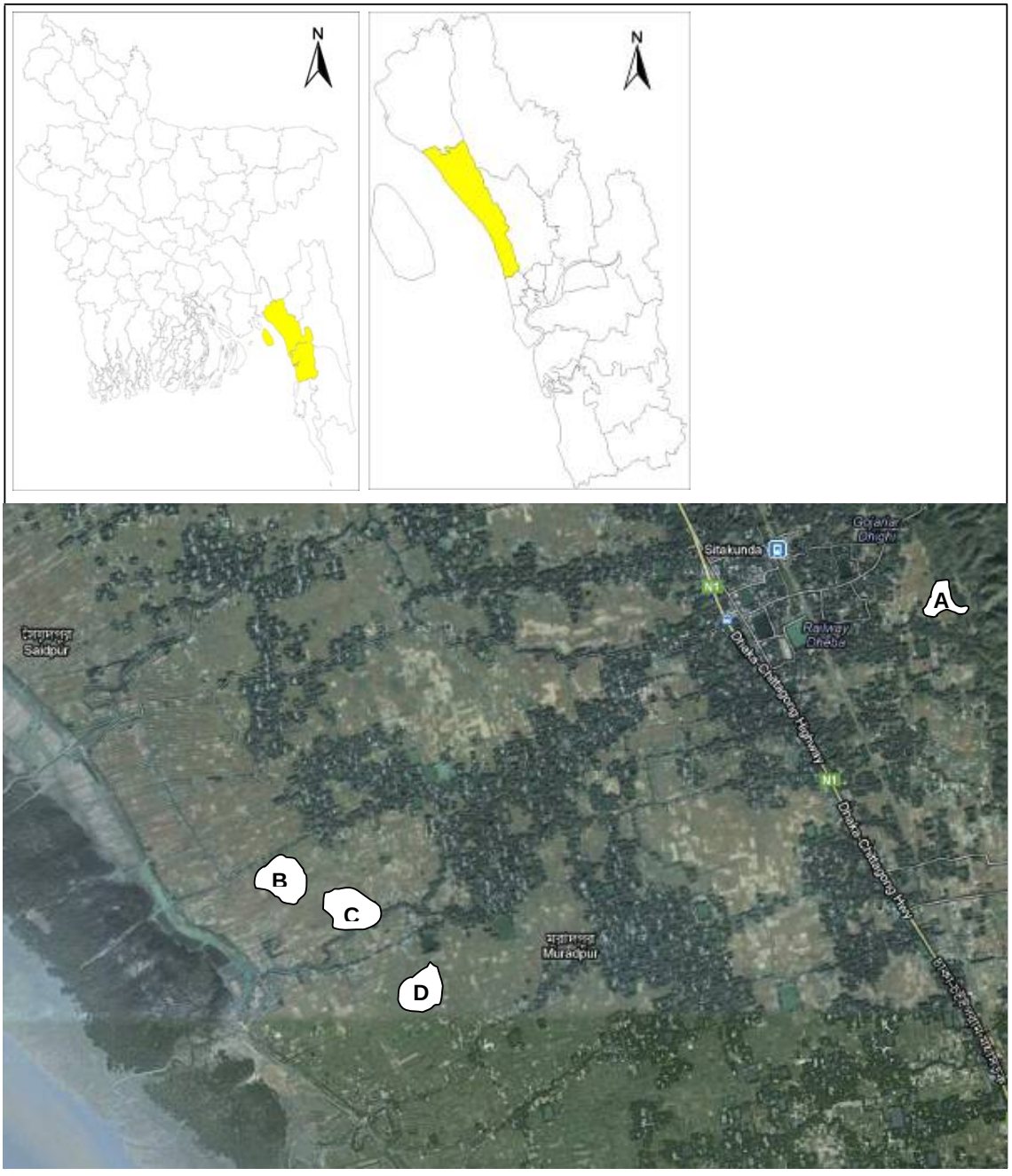

Figure 12: **Potential land parcels at Sitakunda Upazila of Chittagong district (source: SPOT image from Digital Globe, accessed 02 December 2012)**

Table 4: Potential land parcels for climate displaced community at Sitakunda Upazila

ID	Union name	*Mouza* name	BS Plot No.	Land type	Land area (Acre)	Control over land
A	Mohadebpur	Jangal Mohadebpur	113	Hillock	0.87	Illegal control by local people
B	Muradpur	Vaterkhil	6006, 6007, 6008 & 6014	Plain land	4.82	Illegal control by local people
C	Muradpur	Vaterkhil	6031, 6034, & 6042	Plain land	4.26	Illegal control by local people
D	Muradpur	Vaterkhil	6066, 6067, & 6075	Plain land	3.37	Illegal control by local people

6.2 Potential land parcels at Mirsarai Upazila

On the basis of 'Multi-crieria' analysis 6 land parcels, totaling 18.59 acres, have been identified in Mirsarai Upazilla. The land parcels and characterized as plain land and is suitable for human settlement. Figure 13 and Table 5 respectively shows the physical location and areas of identified land parcels in Mirsarai Upazilla.

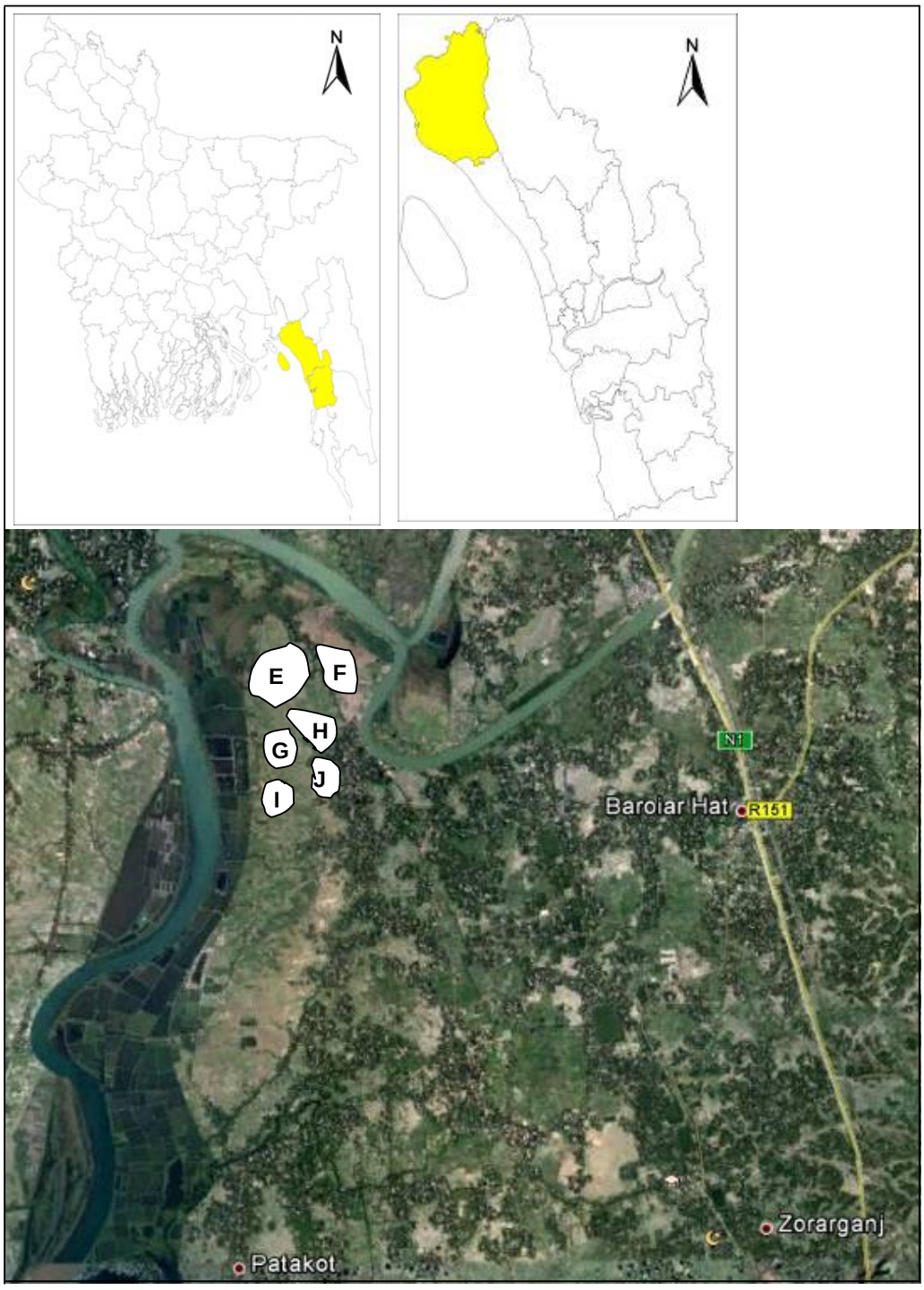

Figure 13: **Potential land parcels at Mirsarai Upazila of Chittagong district (source: SPOT image from Digital Globe, accessed 02 December 2012)**

Table 5: Potential land parcels for climate displaced community at Mirsarai Upazila

ID	Union name	*Mouza* name	BS Plot No.	Land type	Land area (Acre)	Control over land
E	Dhum	Mobarak Ghona	1 & 2	Plain Land	8.00	Illegal control by local people
F	Dhum	Mobarak Ghona	13	Plain Land	4.14	Illegal control by local people
G	Dhum	Mobarak Ghona	19	Plain Land	1.23	Illegal control by local people
H	Dhum	Mobarak Ghona	30	Plain Land	2.01	Illegal control by local people
I	Dhum	Mobarak Ghona	45	Plain Land	1.21	Illegal control by local people
J	Dhum	Mobarak Ghona	50	Plain Land	2.00	Illegal control by local people

6.3. Potential land parcels at Rangunia Upazila

On the basis of 'Multi-crieria' analysis 7 land parcels, totaling 67.71 acres, have been identified in Rangunia Upazilla. The land parcels and characterized as plain and hillock land are suitable for human settlement. Figure 14 and Table 6 respectively show the physical location and areas of identified land parcels in Rangunia Upazilla.

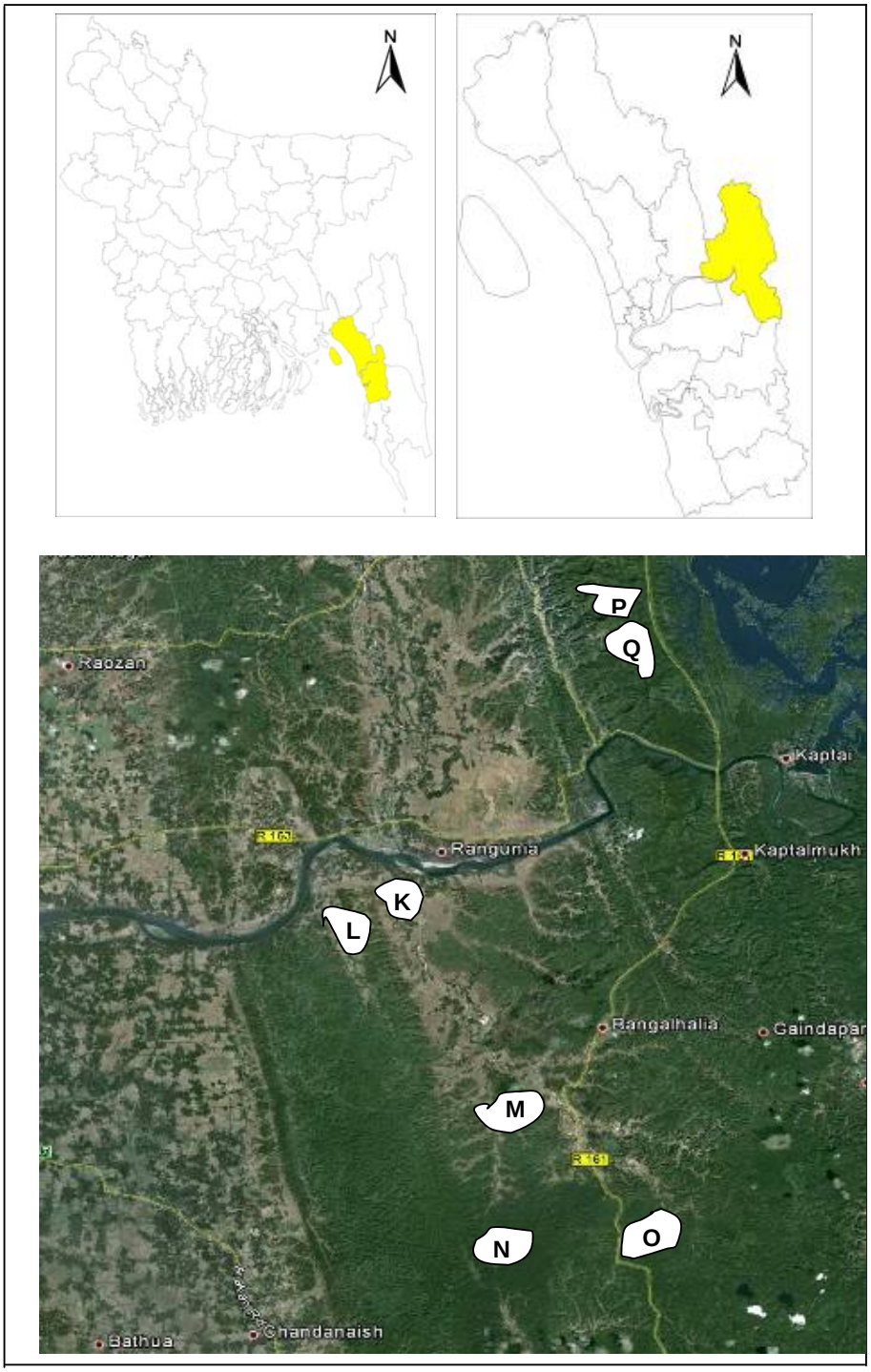

Figure 14: **Potential land parcels at Rangunia Upazila of Chittagong district (source: SPOT image from Digital Globe, accessed 02 December 2012)**

Table 6: Potential land parcels for climate displaced community at Rangunia Upazila

ID	Union name	*Mouza* name	BS Plot No.	Land type	Land area (Acre)	Control over land
K	Shilak	Shilak	8950	Plain Land & hillock	6.60	Illegal control by local people
L	Shilak	Shilak	8953	Plain Land & hillock	5.00	Illegal control by local people
M	Padua	Tripura Sundari	1906	Plain Land & hillock	14.43	Illegal control by local people
N	Padua	Sukbilash	1819	Plain Land & hillock	4.68	Illegal control by local people
O	Padua	Sukbilash	4538	Plain Land & hillock	8.00	Illegal control by local people
P	Lalanagor	East Nishcintapur	7118	Plain Land & hillock	14.00	Illegal control by local people
Q	Lalanagor	East Nishcintapur	7291	Plain Land & hillock	15.00	Illegal control by local people

6.4 Potential land parcels at Chandanaish Upazila

On the basis of 'Multi-crieria' analysis, 3 land parcels, totaling 4.66 acres, have been identified in Chandanaish Upazilla of Chittagong district. The land parcels and characterized as plain land are suitable for human settlement. Figure 15 and Table 7 respectively show the physical location and areas of identified land parcels in Chandanaish Upazilla.

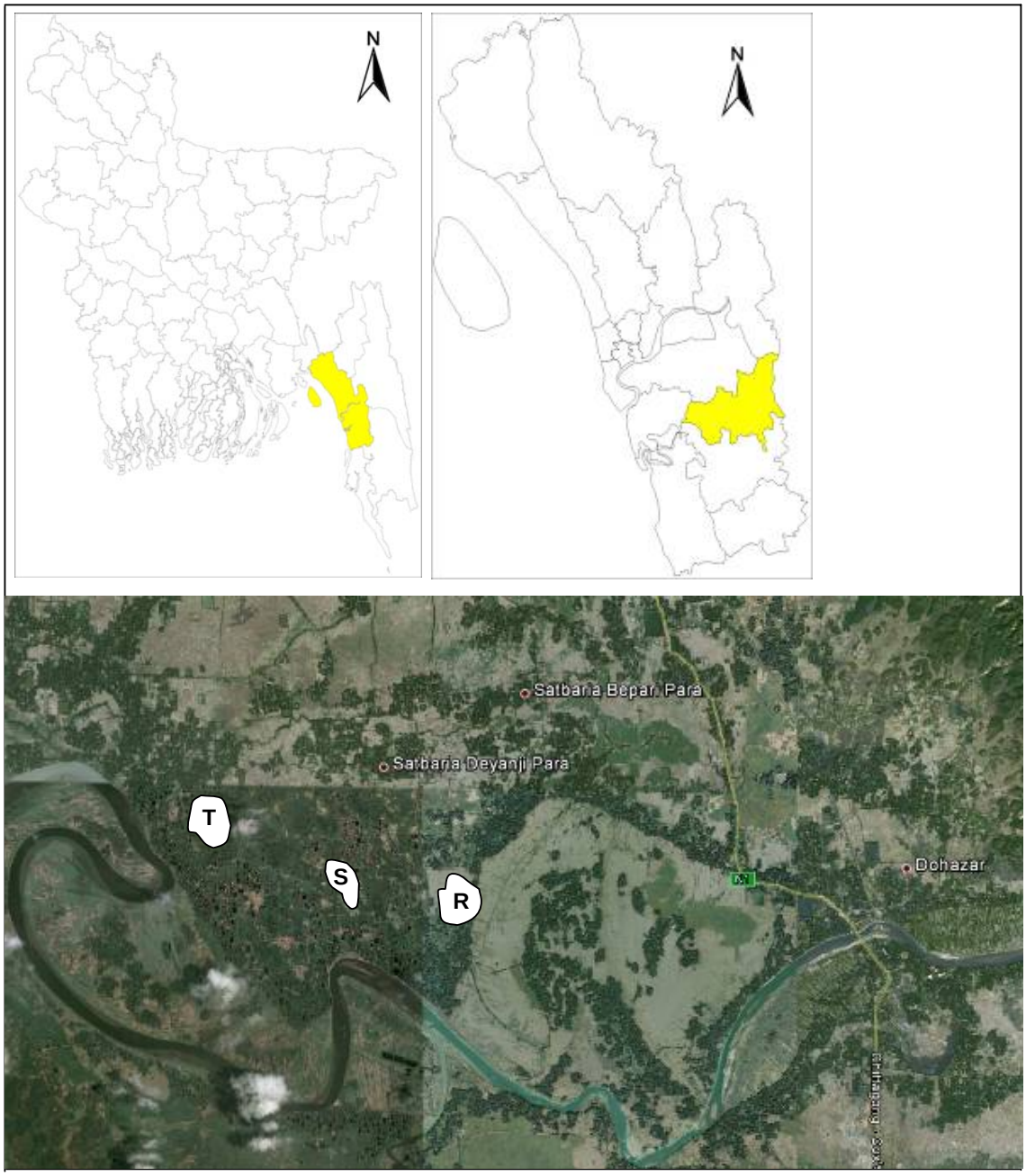

Figure 15: Potential land parcels at Chandanaish Upazila of Chittagong district (source: SPOT image from Digital Globe, accessed 02 December 2012)

Table 7: Potential land parcels for climate displaced community at Chandanaish Upazila

ID	Union name	*Mouza* name	BS Plot No.	Land type	Land area (Acre)	Control over land
R	Satbaria	Satbaria	10702	Plain Land	1.87	Illegal control by local people
S	Satbaria	Satbaria	484	Plain Land	1.00	Illegal control by local people
T	Barama	Migata	2527	Plain Land	1.79	Illegal control by local people

7. Conclusion:

To ensure the successful planned rehabilitation and resettlement of climate displaced people, Bangladesh must be adequately prepared so that the vast majority of those displaced will be supported with adequate resettlement and rehabilitation schemes.

This study recommends non-agricultural *khas* land for the resettlement of climate displaced people across Bangladesh. A number of well located land parcels have been identified through applying a multi- criteria selection procedure. These land parcels, totaling 104.28 acares, can be effectively utilized for the resettlement of more than 6500 climate displaced persons.

The main challenge of undertaking such a resettlement scheme for climate displaced persons is ensuring that suitable *khas* land is free from illegal occupancy. Long term policy advocacy and campaign strategies will be required to free illegally occupied *khas* land and facilitate access of climate displaced people to those lands.

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