CHAPTER 3

RESOURCE BASE

3.1 Agro Ecological Zones

The natural environment of the coastal region is highly diverse. The region has different land types, soils, agro-ecological systems and is also rich in biodiversity comprising different bio-ecological zones. Bangladesh has thirty agro-ecological zones (AEZ) based on different land forms and soils, inundation regimes and hydrology and ago-climatic resources of which the AEZ 13 constitutes major portion of the coast (Figure 3.1). The southern region also includes smaller portions of ten other zones (Table 3.1).

Table 3.1: Distribution of AEZs in the southern region

Agro-ecological Zone (AEZ) with Number	Districts	Area (ha) cover in study	% cover in study Area
Active Ganges Floodplain (AEZ 10)	Barisal	1,725	0.07
Chittagong Coast al Plain (AEZ 23)	Chittagong, Cox's Bazaar, Feni	325,547	12.78
Ganges Tidal Floodplain (AEZ 13)	Bagerhat, Barguna, Barisal, Bhola, Jhalokati, Khulna, Patuakhali, Pirojpur, Satkhira	1,209,185	47.47
Gopalganj -Khulna Beels (AEZ 14)	Bagerhat, Barisal, Khulna, Pirojpur	38,360	1.51
High Ganges River Floodplain (AEZ 11)	Bagerhat, Khulna, Satkhira	96,312	3.78
Low Ganges River Floodplain (AEZ 12)	Bagerhat, Barisal, Khulna, Pirojpur	22,722	0.89
Lower Meghna River Floodplain (AEZ 17)	Lakshmipur, Noakhali	28,566	1.12
Northern and Eastern Hills (AEZ 29)	Chittagong, Cox's Bazar, Feni	341,758	13.42
Northern and Eastern Piedmont (AEZ 22)	Feni	131	0.01
Old Meghna Estuarine Floodplain (AEZ 19)	Barisal, Feni, Lakshmipur, Noakhali	83,970	3.30
St. Martin's Coral Island(AEZ 24)	Cox's Bazar	280	0.01
Young Meghna Estuarine Floodplain (AEZ 18)	Barisal, Bhola, Chittagong, Feni, Lakshmipur, Noakhali, Patuakhali	398,477	15.64
Total		2,547,033	100.00

Source: Compiled from BARC and SRDI

The Ganges Tidal Floodplain (AEZ 13) constitutes about half of the southern region (48%). The other major agro-ecological zones are Young Meghna Estuarine Floodplain (16%) and Chittagong Coastal Plain (13%).

The Ganges Tidal Floodplain is low-lying compared to the Ganges River Floodplain. The area is crises-crossed by innumerable tidal rivers and creeks whose banks generally stand less than a meter above the adjoining basins. The area consists of three sub-units namely, non-saline, saline and the Sundarbans. The area covers mostly Satkhira, Khulna, Bagerhat, Pirojpur, Jhalokati, Barisal, Patuakhali and Barguna districts.

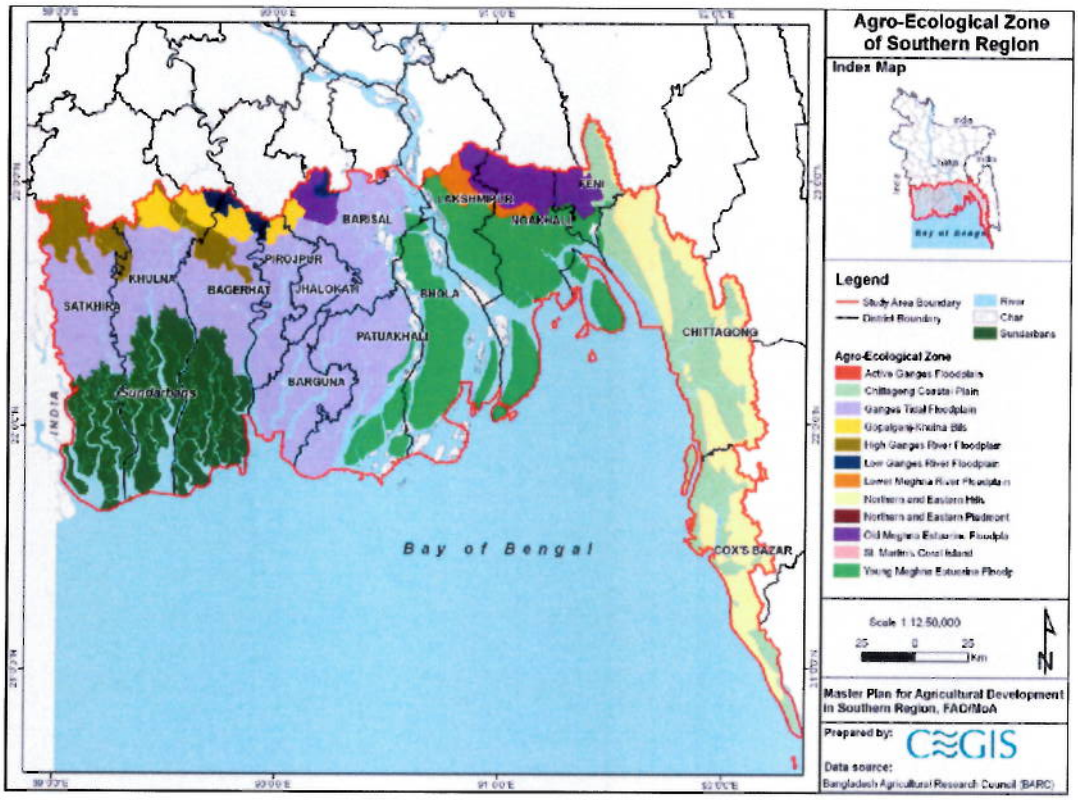

Figure 3.1: Agro-ecological zones in the southern region

3.2 Land

With respect to seasonal flooding, land resources of the region are classified into five different types. These are Highland, Medium Highland, Medium Lowland, Lowland and Very Lowland. Highland and Medium Highland are dominant in the southern region (Table 3.2, Figure 3.2).

Table 3.2: Seasonal flooding regimes

Land type	Inundation regime	Area (ha)	% of NCA
Highland	Above normal flood level	364,472	16
Medium Highland	Inundated up to 90 cm	1,692,007	76
Medium Lowland	Inundated up to 90 -180 cm	149,918	7
Lowland	Inundated up to 180 -300 cm	32,370	1
Total		2,238,767	100

Source: SRDI and BARC AEZ database

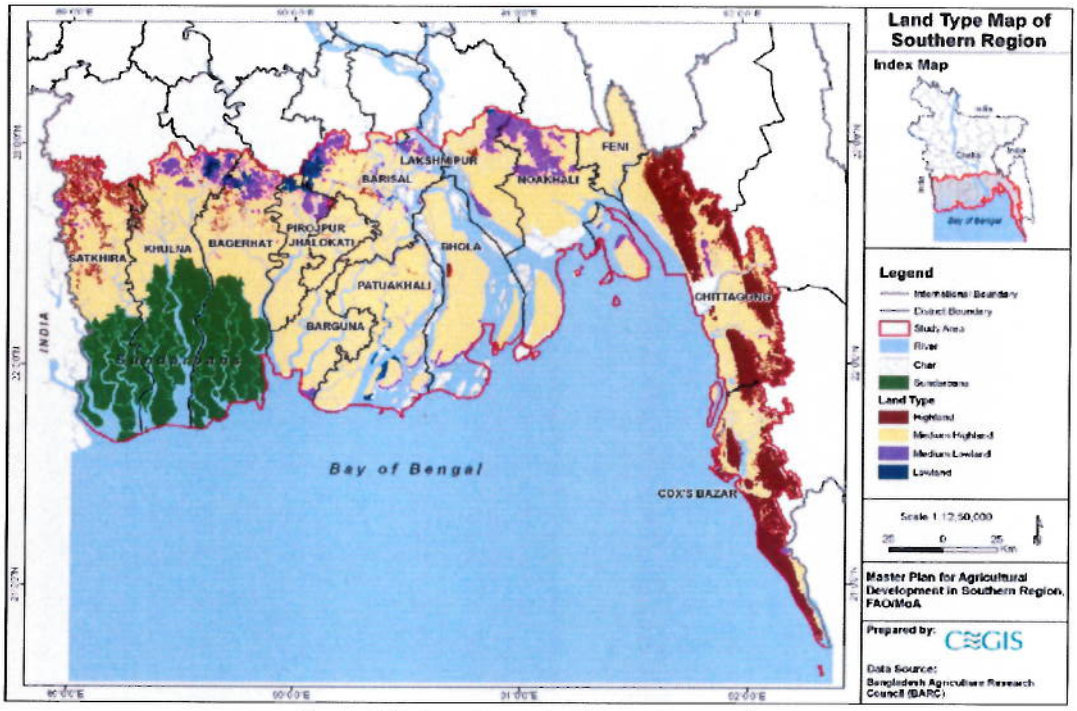

Figure 3.2: Land types in the southern region

Highland may be suitable for Kharif or perennial dry land crops if soils are permeable. Impermeable soils or soils which can be made impermeable by puddling may be suitable for transplanted Aus and/or Aman if *bundhs* are made to retain rainwater on fields.

Medium Highland is suitable for crops which can tolerate shallow flooding, such as broadcast or transplanted Aus, jute and transplanted Aman, Early Kharif dry land crops which mature before flooding starts can be grown on permeable soils, and late Kharif and early Rabi dry land crops on soils which drain in September-October.

Medium Lowland is flooded too deeply for transplanted Aus or transplanted Aman. Mixed broadcast Aus and deepwater Aman is a common practice; or long Aman seedlings may be transplanted as the floodwater recedes, if it does so early enough. Dryland Rabi crops are widely grown on soils which drain in October or November.

Lowland is flooded too deeply for broadcast Aus or transplanted Aman to be grown. Deepwater Aman is typically grown on such land (although the cultivation of irrigated Boro on such land in the dry season now precludes the cultivation of deepwater Aman over considerable areas of Lowland). Dry land Rabi crops can only be grown if floodwater recedes before December.

3.2.1 Floodplain

The average elevation of coastal tidal lands is only about one meter above the mean sea level. Bangladesh has extensive floodplains. As much as 34% of the country's land area goes under water for about 5-7 months in a year. More than 25% of the areas are faced with drainage problem (Figure 3.3).

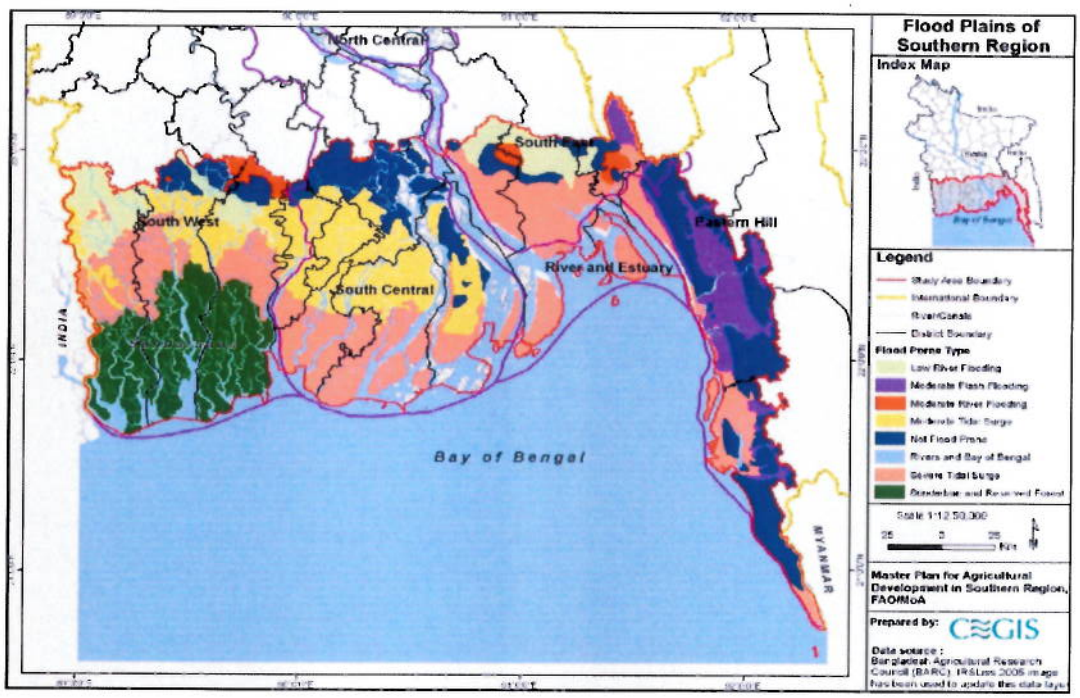

Figure 3.3: Floodplains of the study area

The major part of the southern region is the active delta of the three largest rivers of Bangladesh namely the Ganges, the Brahmaputra and the Meghna. These rivers carry huge amount of sediments to the Bay of Bengal in the south, leading to coastal erosion, accretion and other phenomena. The region includes four distinct zones. These are: the Ganges Tidal Plain West, the Ganges Tidal Plain East, the Meghna Deltaic Plain and the Chittagong Coastal Plain.

Tidal ranges are high along the coast of Bangladesh. They vary between 0-2m in the upstream part of the coastal zone (Tetulia River) and 2-4m in the western and middle part along the coast to more than 4m in the northeastern part of the Bay between Hatiya and the Chittagong coast.

Intertidal areas are found almost all along the coastline. They consist of fine materials, have low slopes and are inundated during high tides while falling dry at low tides. On many of these intertidal areas, new alluvial land is formed continuously. The importance of these intertidal areas is twofold. Firstly, these areas are biologically active and play a crucial role in the food and reproduction cycles of many marine species. Secondly, these areas form potentially new cultivable land.

3.2.2 Wetland

Wetlands (ponds, *beels* and *baors*) are common features in the landscape Southern Region are used as water reservoirs. Ponds are man-made for various purposes and use and of different sizes, shapes and depths. They are used for fish culture and other household uses. Total area of ponds in the southern region is 93,383 ha, of which nine percent area is unused.

Beels are natural depressions in floodplains and are not embanked. *Beels* are inter-connected with

the open river system and, in terms of habitat for aquatic species, form an integral part of the floodplain system. Another part of the floodplain river system is oxbow lake (*baor*), which consists of river sections.

3.2.3 Land drainage and surface water recession

Two-thirds of the net cropped area in the Southern Region is poorly drained. The dominance of poorly drained soil indicates that the removal of salinity from soil is a major constraint for land reclamation.

The Rabi season starts from November and continues up to February. Cultivation of Rabi crops mainly depends on the recession of surface water from the field. The recession of surface water is related to the connectivity with rivers which flows toward the sea. Surface rain/floodwater recession at the end of the monsoon season depends on soils and topography. As a result, cultivation of Rabi crops starts in different times.

Recession of surface water starts from the first week of October to the middle of October (very early) and amount to roughly a quarter of the net cultivable areas. Further cultivable areas become free of floodwater from the middle of October to the middle of November (early recession). The bulk of the cultivable land becomes free of flood water from the middle of November to the middle of December (Normal recession); 17 percent of the net cultivable area become free of water by the end of December (late recession); and the remaining four percent area is free from flood water after the month of December to January (very late recession).

3.3 Soil

3.3.1 Soil property

There is a pattern of grey, slightly calcareous, heavy soils on river banks and grey to dark grey, non-calcareous, heavy silty clays in the extensive basins. Non-calcareous grey floodplain soil is the major component of general soil types. Acid Sulphate soil also occupies some patches of the area where it is extensively acidic in the dry season. In general, most of the top soils are acidic and sub-soils are neutral to mildly alkaline. Soils of the Sundarban area are strongly alkaline. The fertility level is generally high with medium to high organic matter content.

Soil texture corresponds to relative proportions of sand, silt and clay. It is very important for crop production. The dominant soil textures are clay loam which is followed by clay. The southwestern areas are mostly clay to clay loam and the southeastern areas are mostly clay loam to loamy in texture. The clayey soil is not favourable for preparing land for dry land crops in the Rabi/dry season.

3.3.2 Soil moisture

The available soil moisture is very important for the cultivation of Rabi crops. Most of the area of the southern region is under low level of available soil moisture (40%), closely followed by area covered by medium level of available soil moisture (38%). About one-fifth of the area (22%) has high level of soil moisture.

3.3.3 Soil salinity

Soil salinity is a main constraint for crop production in the southern region. Salinity is very high in parts of Satkhira, Khulna, Patuakhali, Noakhali and Cox's Bazar districts (Figure 3.4).

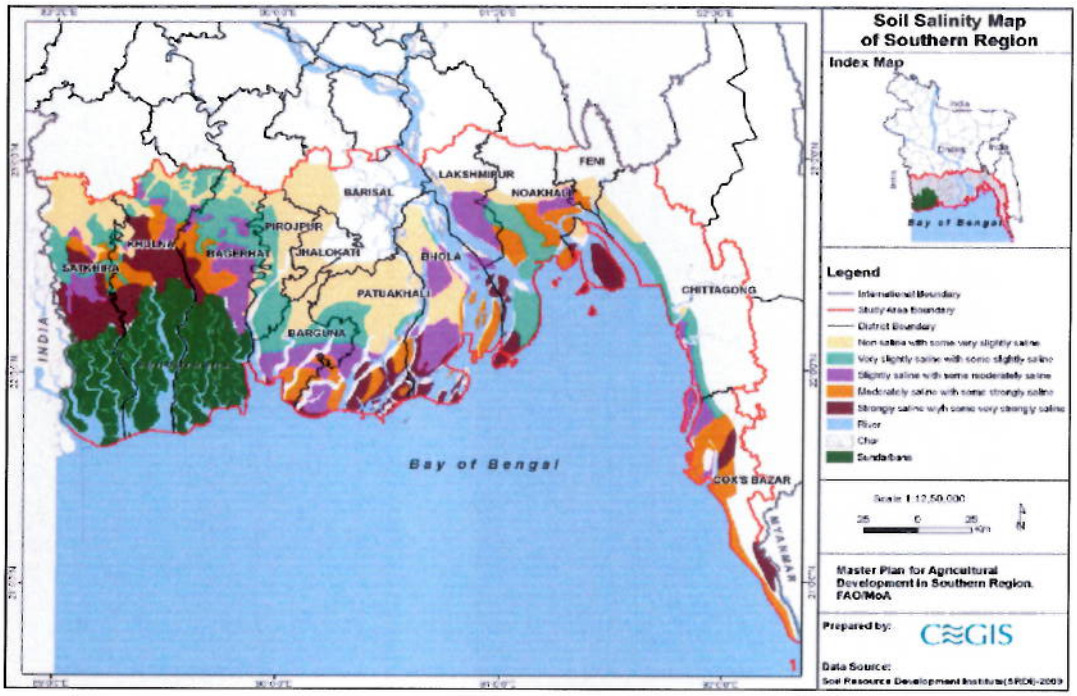

Figure 3.4: Soil salinity

3.4 Climate

In the southwest region, the maximum and minimum temperatures are 43^{0}C, and 3.6^{0}C respectively. The maximum, mean and minimum rainfalls are 257 mm, 149 mm and 0 mm respectively. The maximum, mean and minimum evaporations are 7.4 mm/day, 2.09 mm/day and 0 mm/day respectively.

In the south central region, the maximum and minimum temperatures are 43.8^{0}C and 3.6^{0}C respectively. The maximum, mean and minimum rainfalls are 373mm, 215mm and 0mm respectively. The maximum, mean and minimum evaporation rates are 9.80mm/day, 0mm/month and 1.83 mm/month respectively.

In the southeast region, the maximum and minimum temperatures are 43.4^{0}C and 4.9^{0}C respectively. The maximum, mean and minimum rainfalls are 420 mm, 233 mm and 0 mm respectively. The maximum, mean and minimum evaporation rates are 9.80 mm/day, 1.83 mm/day and 0 mm/day respectively.

3.5 Water

The water resources system of the region is shaped by its linkage at the upstream side with the Ganges-Brahmaputra-Meghna (GBM) basin and at the downstream side with the Bay of Bengal (Figure 3.5). The coastal zone has extensive areas of water bodies, among which the following sub-systems can be differentiated:

- The interlinked system of rivers and channels;
- The riverine flood plains, including wetlands;
- The intertidal lands along the coast and estuary branches;

- Lakes and man-made ponds; and
- Groundwater.

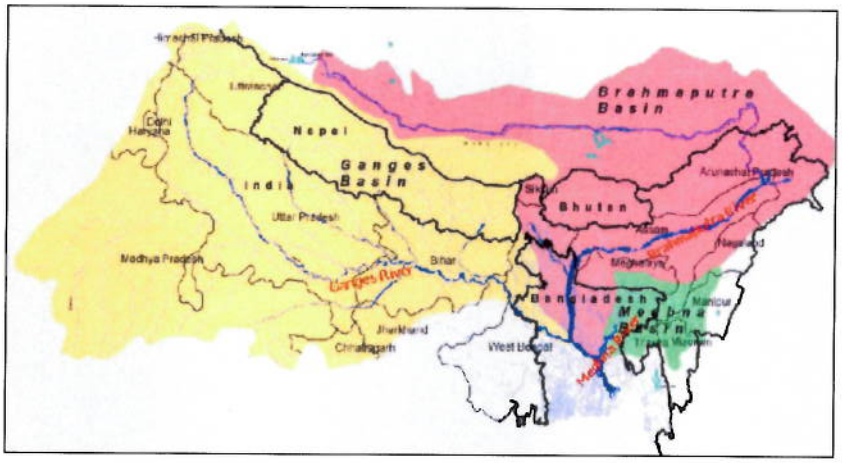

Figure 3.5: River basins

3.5.1 Rivers, channels and sedimentation

The southern region has a network of rivers and channels, most of which are under a seasonal-dependent tidal regime with twice daily variations of water levels and salinities. (Figure 3.6).

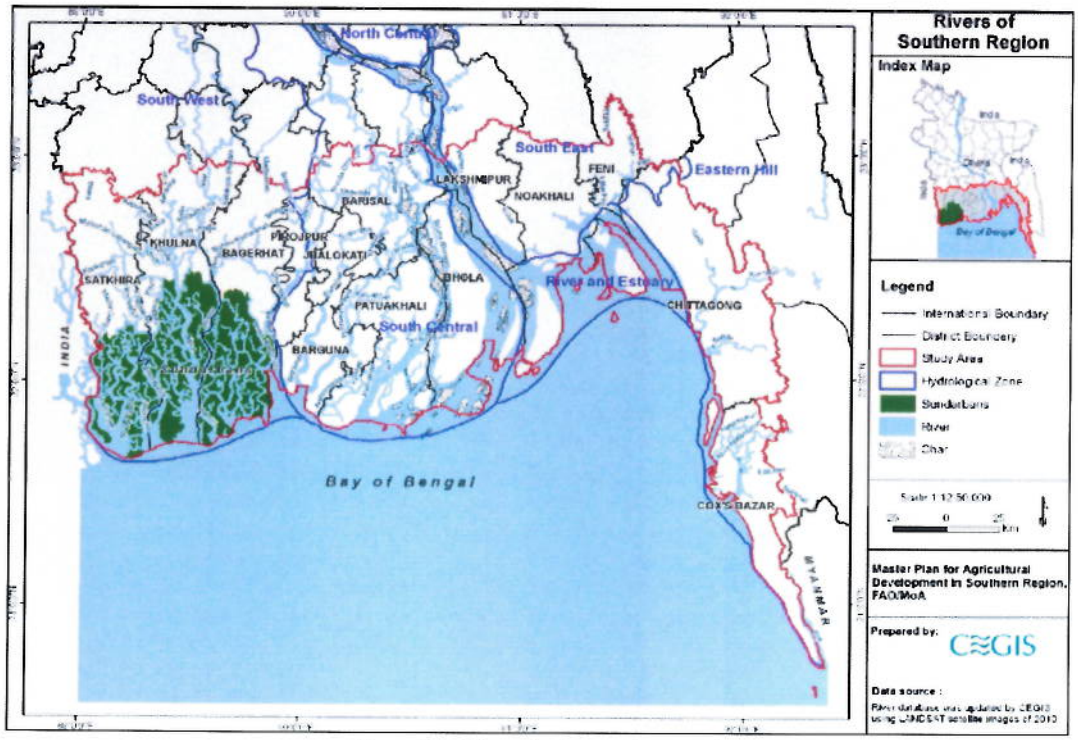

Figure 3.6: Rivers in the southern region

The western and the central coastal zones of Bangladesh are very dynamic. On average, around 1.1 billion tonnes of sediment is carried down by the Ganges, the Brahmaputra and the Meghna rivers, the largest sediment load in any river system in the world. The zone is characterized by numerous morphologically active tidal rivers and creeks. The tidal river systems are in equilibrium in terms of sediment inflow and outflow.

In the Southwestern part, the rivers in the *Ganges* dependent area take off from the *Ganges* River, flowing in south-eastern direction towards the Bay of Bengal. Other main rivers in the region are the *Madhumati, Atrai, Chitra, Kobadak, Kumar, Nabaganga, Bhairab, Ghasiakhali, Mongla, Baleswar, Raimangal, Malancha, Arpangasia, Passur, Kholpetua*, and *Sibsha.*

Apart from the *Meghna*, there are eight large rivers of the south central region. Although these rivers all flow north to south, only one of the eight, the *Baleswar*, which leaves the *Padma* far to the north, flows through the entire region.

Besides the *Meghna*, the *Dakatia*, the *Bhulua*, and the *Little Feni* are major rivers in the southeast hydrological region.

Four important zones of the region are described below.

Ganges Tidal Plain West (GTPW), extending from the Indian border to the center of the Baleswar and Gorai Rivers. The area is mainly distinguished by the presence of the Sundarbans. It is intersected by distributaries derived from the Ganges, mostly via the Gorai, and is essentially a moribund delta formation; most of the inland rivers now bring little or no water in the dry season. The coastline has not changed significantly in the last two centuries.

Ganges Tidal Plain East (GTPE), from the centre of the Baleswar and Gorai Rivers to the centre of the Tetulia River (the Tetulia River is the westernmost major channel carrying water from the Meghna River). This area comprises polders separated by rivers deriving from the Meghna Estuary. Although the river system is subject to continuous change, the coastline has not shifted much in the last two centuries.

The Meghna Deltaic Plain (MDP) lies between the Tetulia River on the west and the Feni River and Swandip Channel on the east. This is currently the active estuary of the Meghna (carrying water from the Ganges and the Brahmaputra). Much of the area is characterised by extensive erosion and deposition (accretion) of sediment by river and tidal actions. The MDP includes several large islands formed in geologically recent times by accretion of sediment, and these are particularly subject to continuing erosion and accretion, while new islands are continually emerging. Much of the land that is now part of the mainland started as such islands, the channels between them having been closed and silted up by a combination of natural processes and human interventions. So the shape and position of the coastline have changed extensively in the last two centuries.

Chittagong Coastal Plain (CCP), from the middle of the Feni River and Sandwip Channel to the Teknaf peninsula and the Myanmar border. This is a narrow coastal plain between the Bay of Bengal and a range of hills. Hydrologically independent of the Meghna estuary, the plain is intersected by a number of small and medium-sized rivers, prone to flash floods, that drains the

hills. A few islands located close to the shorelines are included in this area. The coastline in the south of Chittagong is not changing much, but some accretion is happening in the northern shoreline.

3.5.2 Water quality

Groundwater

Groundwater salinity in the coastal areas and offshore islands is a limiting factor in parts of the Southwest (SW), South Central (SC) and Southeast (SE) hydrological regions, although the water is generally fresh enough at greater depth (300m for domestic use). Groundwater availability in the upper aquifers is further limited due to the presence of silty clay in the upper soil strata. For this reason, groundwater irrigation in Barisal and Patuakhali region is not practiced. A declining trend is observed in Noakhali, which can be attributed to the increased detection of arsenic contamination in that area. In the entire coast, detailed exploration for availability and quality of groundwater is needed.

Surface water

Surface water salinity is a normal hazard in many parts of the study area. In the SW region surface water salinity has been accentuated by the reduction in dry season flows entering the Gorai distributaries, following the diversion of the Ganges flow upstream of the border. Salinity now reaches as far as Khulna, creating problems to normal agricultural practices (Figure 3.7).

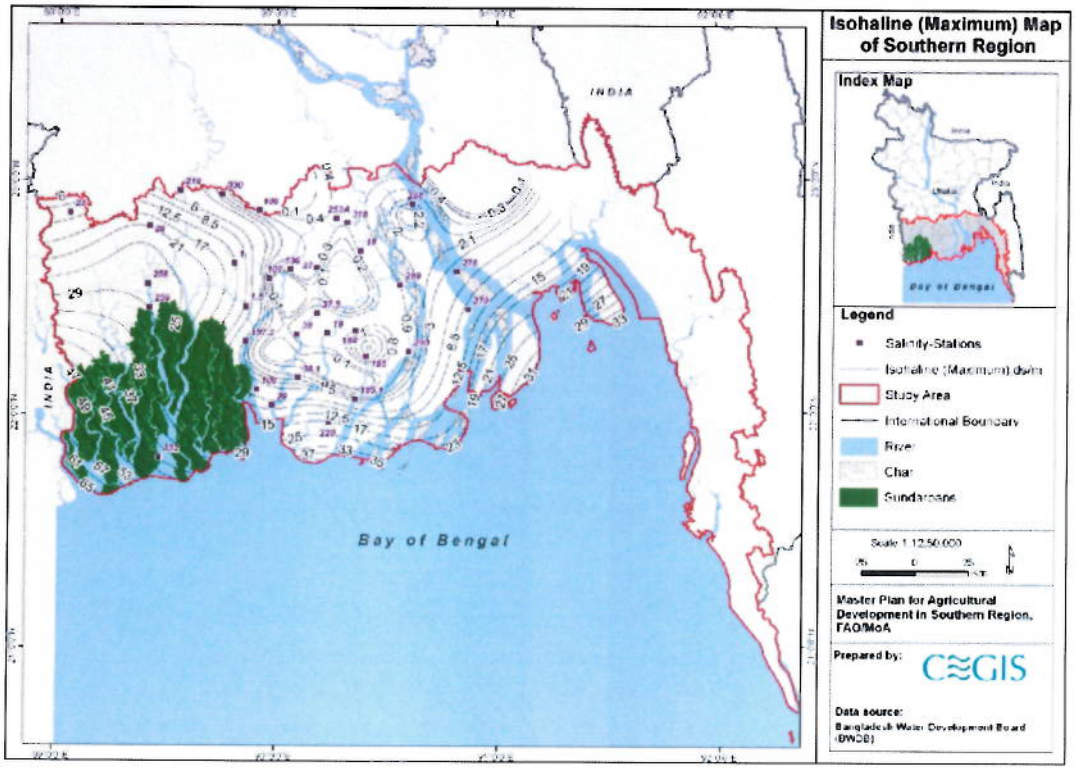

Figure 3.7: Isohaline (maximum) of the southern region

3.6 Flora and Fauna

The southern region has 11 different bio-ecological zones namely, the Ganges floodplain, saline tidal floodplain, offshore islands, coastal and marine waters, the Meghna estuarine floodplains, sandy beaches/sand dunes, the Gopalganj-Khulna peat land, major rivers, Chakaria Sundarbans, Narikel Jinjira and the coastal plains.

This floodplain is characterized by mixed vegetation. The presence of many stagnant water bodies and channels, rivers and tributaries in this zone support a habitat of rich biodiversity. In the *beels* and other water bodies, free-floating aquatic vegetation is prominent. Nearly all the major groups of oriental birds are represented in this region by one or more species. In addition, a large number of migratory birds are found here in the winter.

Innumerable indigenous weeds grow in *beel* areas. Several types of palms and bamboo clumps grow in almost all the villages. Mango *(Mangifera indica)* and jackfruit (*Artocarpus heterophyllus*) trees supply the most common timber.

Among the rich vegetation observed in offshore islands are man-made plantations of mangroves. The islands are very important staging and wintering areas for wide variety of waterfowl, particularly the migratory shorebirds. *Uri ghash* (*Portaresia coarctata*) is the pioneer plant species in these new lands.

All the accreted inter-tidal lands are important wintering grounds for migratory waterfowls. Globally threatened shorebirds, like the Eurasian spoonbill (*Platalea leucorodia*), Common sandpiper (*Actitis hypopeucos*), spotted redshak (*Tringa erythropus*) and Indian skimmer (*Rynchops albicollis*) use this zone as their wintering habitat. Common mammalian species of these zones include the Ganges river dolphin (*Platanista gangetica*), jackals (*Canis aureus*), Small Indian Mongoose (*Herpestes auropunctatus*), Clawless Otter (*Aonyx cinerea*), Greater Bandicoot Rat (*Bandicota indica*) *etc.*